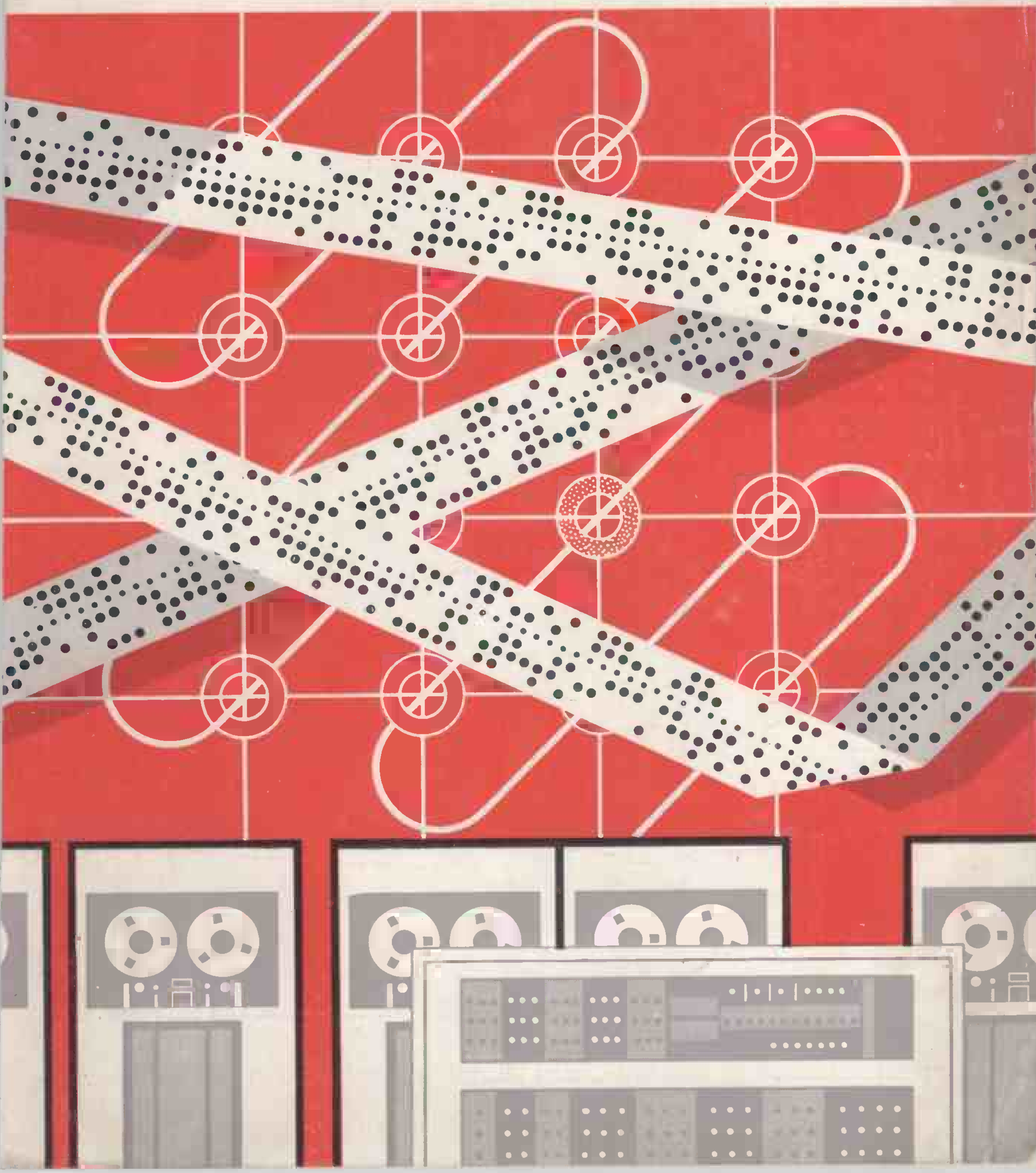
12 Lakewood

Wireless World

ELECTRONICS
RADIO
TELEVISION

NOVEMBER 1961 Price Two Shillings and Sixpence



Wireless World

ELECTRONICS, RADIO, TELEVISION

NOVEMBER 1961

Managing Editor:

HUGH S. POCOCK, M.I.E.E.

Editor:

F. L. DEVEREUX, B.Sc.

Assistant Editor:

H. W. BARNARD

VOLUME 67 No. 11.

PRICE: 2s. 6d.

FIFTY-FIRST YEAR OF PUBLICATION

Iliffe Electrical Publications Ltd. *Managing Director:* H. S. Pocock, M.I.E.E.
Dorset House, Stamford Street, London, S.E.1

Please address to Editor, Advertisement Manager, or Publisher as appropriate

PUBLISHED MONTHLY (4th Monday of preceding month). *Telephone:* Waterloo 3333 (65 lines). *Telegrams:* "Ethaworld, London-SE1." *Annual Subscriptions: Home and Overseas,* £2 0s. 0d. *Canada and U.S.A.,* $5.50. Second-class mail privileges authorized at New York, N.Y. BRANCH OFFICES: *BIRMINGHAM:* King Edward House, New Street, 2. *Telephone:* Midland 7191. *COVENTRY:* 8-10, Corporation Street. *Telephone:* Coventry 25210. *GLASGOW:* 62, Buchanan Street, C.1. *Telephone:* Central 1265-6. *MANCHESTER:* 260, Deansgate, 3. *Telephone:* Blackfriars 4412. NEW YORK OFFICE: *U.S.A.:* 111, Broadway, 6. *Telephone:* Digby 9-1197.

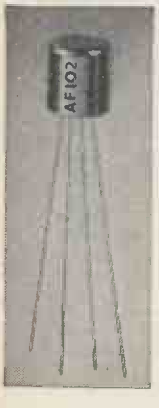
and so Mullard brings you interesting details of What's New in the New Sets—new devices, new developments and the latest production techniques in Mullard's unceasing contribution to better radio, television and sound reproduction.

New Miniature Potentiometers

Small components are in great demand for the controls of transistor portables and car radios, and the new Mullard miniature potentiometers—the E088 range—are playing an important part in fulfilling this demand.

These components are available for both wired and printed-circuit applications. The range of resistance is 1 to 500kΩ, and the diameter 16 mm. These small potentiometers are outstanding among miniature components for their robust construction, reliability of operation and length of service life.

MULLARD TRANSISTOR FOR TV TUNERS



The AF102 is the first Mullard transistor designed specifically for use in television tuners. It is made by the alloy-diffusion technique, which has enabled a very low base impedance and an extremely low feedback capacitance to be achieved. Operation up to frequencies of 260Mc/s is thus possible.

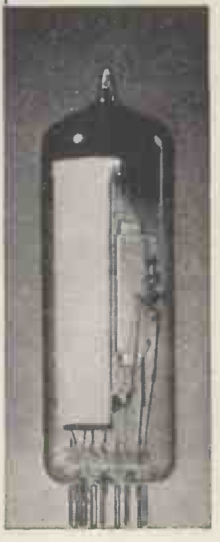
The outstanding features of this transistor are the high gain and low noise figure at very high frequencies, which readily explains why the AF102 is to be found in the r.f. amplifier, mixer and oscillator stages of the first transistor television receivers.

Longer Valve Life

Stranded Heater Spirals

Conventional valve heaters have to fit within the cathode and must therefore be as compact as possible. However, the heater wire must be thick enough to carry the current to heat the cathode adequately, and thick wire is subject to large stresses when wound in a tight spiral. In those types where the dimensions are such that the heater is likely to be a potential source of trouble during the life of the valve, Mullard is now able to replace the single strand of wire by two or three wires wound together without reducing the rating of the heater. The emissive property of the valves is thus unaffected, but a marked improvement in heater reliability during life is ensured.

EM87 *sensitive voltage-level indicator*



In many present-day tape recorders, the recording output voltage available for driving the voltage-level indicator is about 10V, which is often insufficient to close the display of existing types of indicator. For this reason, Mullard has introduced a new indicator—the EM87—which has a grid base of only 10V.

An additional feature of the EM87 is that signals greater than 10V cause the luminous areas of the display to overlap. This gives a brighter central section of the display which indicates that the signal modulation is excessive.

MVE 4018

Wireless World

VOL 67 NO. 11 NOVEMBER 1961

Television Anniversaries

THIS month the British Broadcasting Corporation celebrates the 25th anniversary of the start of its "high-definition" television service, which was inaugurated by Lord Selsdon on 2nd November 1936. We offer our sincere congratulations to the Corporation on its fine record, and on the technical quality of its transmissions which, in spite of the handicap of what is now called a low standard of definition, are admitted by our friends on the Continent to be among the best if not *the* best in Europe. Picture quality is not determined by the number of lines alone, but is a product of good studio lighting and camera work, and the work of the B.B.C. in these sectors is second to none, as indeed it is in the technical development of the means of transmission.

Looking back through the pages of this journal of 25 years ago we are reminded of the activity in the Baird and Marconi-E.M.I. camps as the day drew near when regular 2-hour daily transmissions were decreed to start, with Baird on 240 lines, 25 pictures per second, sequential scanning and E.M.I. on 405 lines, interlaced 50 fields, 25 pictures per second taking turns on alternate weeks. Baird used an intermediate film technique for scanning the scene, but E.M.I. were able to start from scratch with "direct" pick-up using the Emitron electronic camera on which work had been proceeding for some time before under the leadership of Isaac Shoenberg.

One feature of this period which is often forgotten is that the few receivers which were in service were more often than not dual-standard types, but these were never produced in any large quantities. In February 1937 the P.M.G. decided in favour of the 405 line system.

As in other countries interest in this latest wonder of science was first stimulated by public demonstrations, and weekly lists were published in this journal of the places where people could go to see the demonstrations. After a slow start the growth of viewing became exponential. The industry quickly met the demand for privately-owned receivers and in September 1939 when, with the outbreak of hostilities, the service closed down, there were at least 20,000 sets in operation.

This, rather than the actual date of commencement of a regular service should be Britain's claim to fame in the history of television. Other highly-developed countries were carrying out development work and appreciated the vast future possibilities of television, but we—that is the authorities, the industry *and the public* were quicker off the mark than any nation in the world, including America, in *expanding* our service.

We have no wish to put a damper on the festivities currently organized by the B.B.C. in celebration of its Silver Jubilee, but when it is said that "twenty-five years ago Britain alone in the world started a television service" the good feelings of our overseas admirers are apt to become tempered by a certain, and in our view a justifiable, irritation. Even if, as a correspondent in this issue suggests, the words "high definition" are interpolated—as indeed they are by the B.B.C. when it remembers to do so—this does not entirely dispose of the matter. It all depends on what one means by "regular," "public" and "high definition." The last of these is purely relative. Taking a world view in 1934 it meant "not 30 lines"; in 1935 it was applied to the German 180-line service which started in March and to the French 180-line service which began in December. A year later the B.B.C. were still using the positive and not the comparative form of the adjective to describe the 240- and 405-line systems with which their service started. In 1948 France established the superlative with 819 lines. (If we must continue to split hairs, may we suggest a nomenclature for the degrees of "high definition": Mark I=180, Mark I*=240, Mark II=405 (and 441), Mark II*=525, Mark II**=625 and Mark III =819 lines?)

More hair splitting is possible when argument shifts to the ground of what constitutes a "service" as distinct from a public demonstration of television. In the Unesco report (1953) "Television, a World Survey" it is stated for example (pages 57 and 58) that in America prior to 1939 . . . "public demonstrations of television were undertaken by a number of companies" but that "Television broadcasts for the general public began on 30 April, 1939, the day the World's Fair opened in New York." But these were on 441 lines and the Federal Communications Commission felt "that the public had to be warned against investment in receivers which, by reason of technical advances, when ultimately introduced, may become obsolete in a relatively short time." The decision to raise the American standard to the present 525 lines was in fact made on 3rd May, 1941, and in the latter part of that year there were, according to the Unesco report, an estimated 5,000 receivers in use. The highest estimate of the number of television receivers in use in Germany before the war was 500†.

If a service means the regular emission of programmes which may or may not reach a viewing public, then the B.B.C.'s claim to priority is open to question, but if it is argued that a service is not established until it is widely accepted, then there is no question that in 1939 Great Britain, with more than 20,000 receivers, led the world.

†"Das Fernsehen in Deutschland bis zum Jahre 1945" by Gerhart Goebel. *Archiv für das Post-und Fernmeldewesen,* Vol. 5, No 5, August 1953.

Subscription Television

By L. S. WHITE*

BASIC REQUIREMENTS AND THEIR TECHNICAL FULFILMENT BY THE TELEMETER SYSTEM

A SUBSCRIPTION television service provides entertainment in the home and uses the subscriber's television receiver to display it. It differs from the familiar television services in that a price is set for each programme offered and this demand must be met, one way or another, before the selected programme can be seen. The service can be distributed throughout a community by means of a cable network, or it can be broadcast over an area by a transmitter.

Whichever method of distribution is used, the nature of the service creates a number of basic requirements that must be met and places squarely before the designers of a Pay TV system a number of problems that must be solved if technical and commercial success is to be realized. In the discussion that follows some of these problems are stated and the method by which the "Telemeter" system solves them is described in some detail.

FLEXIBILITY. The system must be engineered in such a manner that it can be used in conjunction with most established and acceptable transmission media without placing too many or too restrictive conditions upon the means of distribution. It must be capable of shouldering responsibilities that good commercial practice places upon it and provide facilities that satisfy the needs of both the system operator and the subscriber to the service.

The Telemeter system is a multi-channel system that is basically capable of handling any number of programmes in monochrome or colour. The broadcast system transmits coded signals at frequencies in the spectrum assigned to the service by an authority. The cable system either "stacks" the programme channels in the conventional way, using a band of frequencies not normally acceptable to a television receiver (h.f. coaxial network), or uses cable circuits that are available and which are peculiar to a particular design of network (l.f. multi-pair networks).

In all three cases, the subscriber is provided with a unit which is inserted in series with the input terminals of a receiver and the aerial or cable lead; in no instance does the installation of the unit involve interference with the receiver or its circuitry. The facilities provided by the unit ensure that there can be no doubt in the subscriber's mind as to the transaction he is entering into. The price of the programme is clearly displayed and on payment of the demand the programme is seen in its entirety. The fundamental principle behind the Telemeter system establishes a relationship between the system operator and the subscriber that is the common experience of everyone who has purchased entertainment, whether it be films, the theatre, a football match or a boxing match. In this manner, the interests of the system operator, the programme supplier and the subscriber are adequately protected.

PRICE. The system must be able to set a particular price on a programme, to vary this price easily from programme to programme from a central station and to inform the viewer of this price. As the times at which subscribers may select a programme are random the pricing information and control must always be accessible during the course of a programme; in like measure the pricing principle should not exclude the possibility of running "continuous shows" of two or more "houses" to enable those who entered late to see a complete performance.

On turning the selector switch to a particular channel, the Telemeter pricing system automatically enables the subscriber to see the price asked

* British Telemeter Home Viewing Ltd.

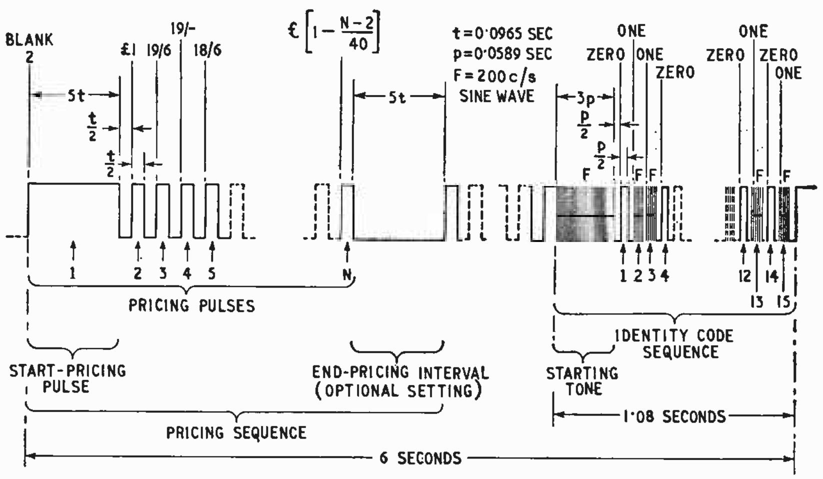


Fig. 1. Pulse code modulation of control channel for pricing and recording transactions.

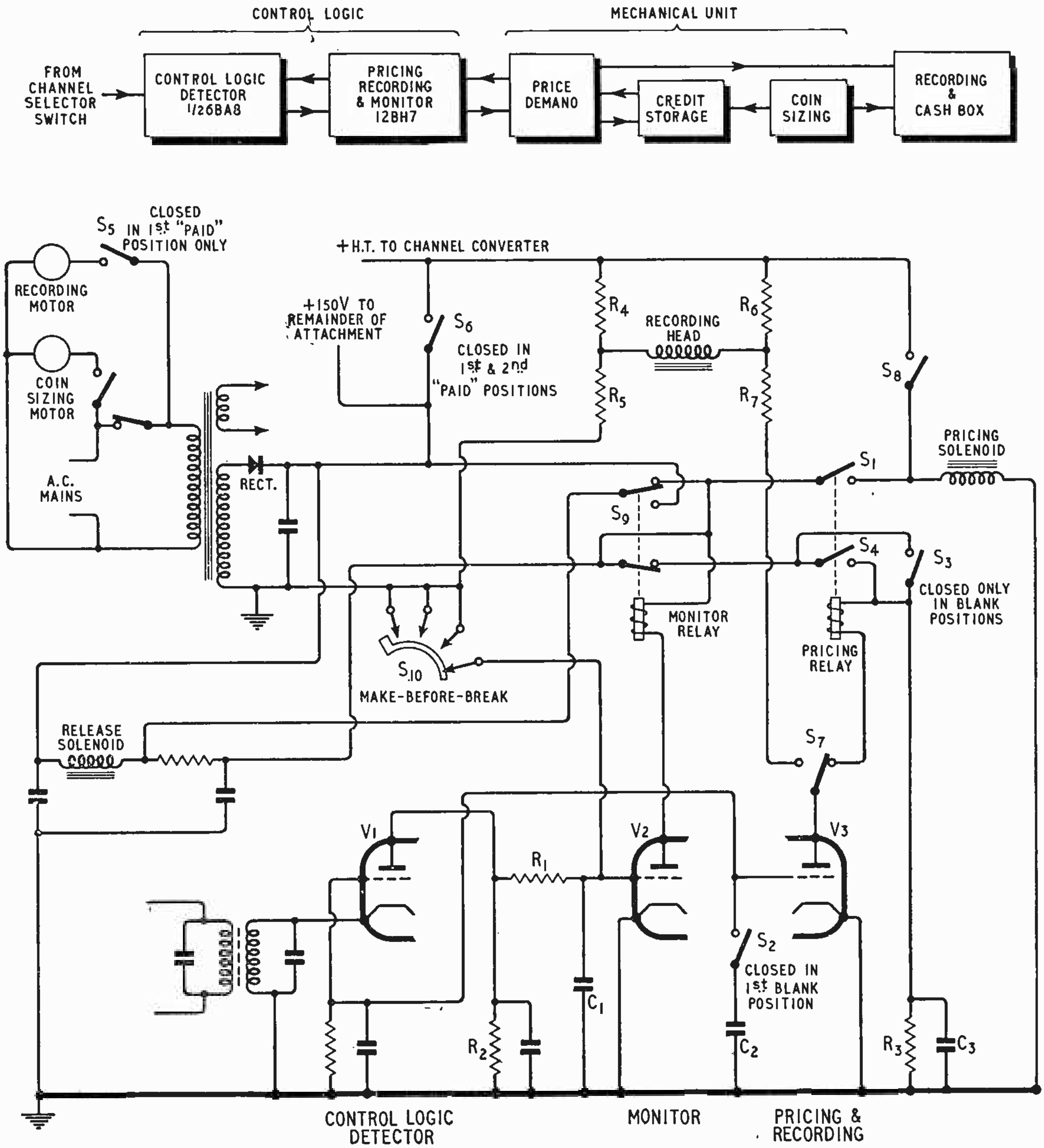


Fig. 2. Control logic circuit of subscriber's unit.

for the programme. Associated with each programme channel is a control channel which contains the pricing information. This information consists of a pulse train, each pulse representing a value of sixpence. The logic which controls the pricing mechanism recognizes the start and end of a price sequence by arranging for the price pulses to be preceded and followed by pulse intervals which are ten times as long as the price pulses themselves. The position of the end-price interval is variable with respect to the entire sequence and by varying this position the programme price is set. The waveform, shown on the left of Fig. 1, is generated by a rotating perforated disc. The disc has two perforated tracks which extend into a gap in a "lighthouse" which contains two semiconductor photo-diodes with their source of illumination. The disc rotates at 10 r.p.m. and the output pulses so produced form the substance of the price information contained in the control channel. The price pulse repetition rate is approximately 10 per second with a 50% duty cycle.

At the input to the subscriber's unit the programme selection is made and the appropriate control channel is demodulated by the control logic detector, V1 (Fig. 2). The pulse output from the detector is direct-coupled to the grid of the pricing and recording valve, V3, and has sufficient ampli-

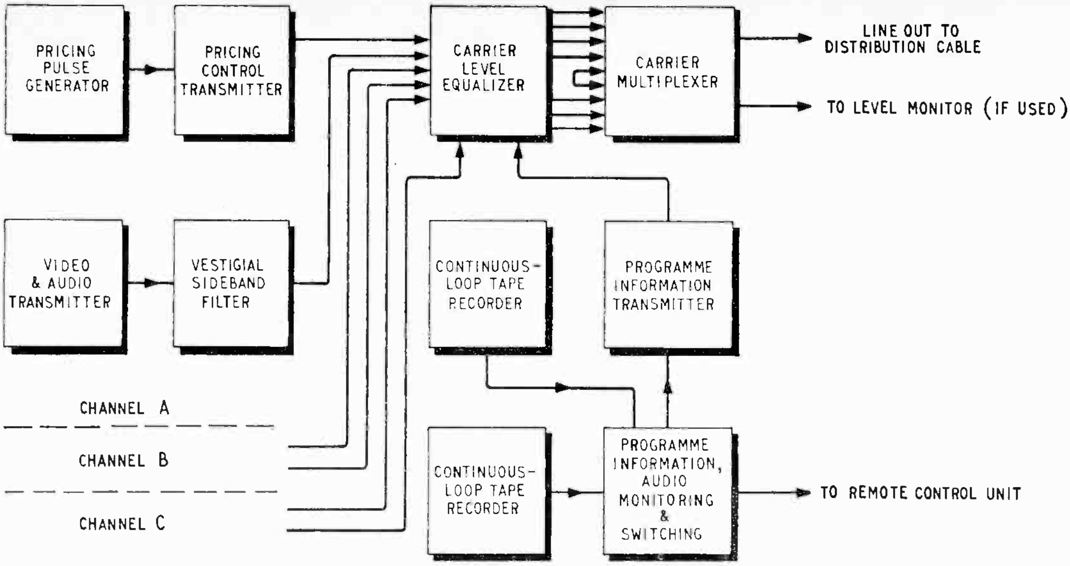


Fig. 3. Block diagram of transmitter for a cable distribution system.

tude to drive this valve from cut-off to full conduction at each pulse. The pricing relay is thus operated, and in turn energizes the pricing solenoid. This solenoid steps a price indicator drum in decrements of sixpence to a position where the price asked is displayed behind a window on the front of the unit. The beginning of the pricing pulse train is recognized by the time-constant of C_2R_2, and only during the 0.5 sec start-price pulse will the grid voltage of V3 reach such a value that this valve will conduct, advancing the price drum from the 1st to the 2nd "blank" position which, in turn, opens S2. This removes C_2 from being in parallel with the load R_2 and allows the subsequent short price pulses to be resolved by the detector. The end-price pulse is recognized by the time-constant C_3R_3.

PAYMENT. The system must provide means for receiving payment of the price demand, or, in the case of a billing system, indicate the acceptance of the charge by the subscriber. Where cash payment is required, a multi-coin acceptance mechanism is highly desirable and a credit storage facility should be provided to register and hold against future payment any money inserted in excess of the programme price. The latter facility should be accessible at all times (whether the unit is switched on or off) to enable it to be used as a savings bank for the payment of future entertainment.

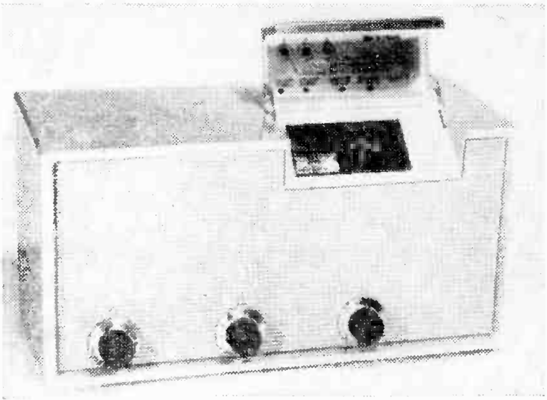
The Telemeter unit contains a coin mechanism that accepts any silver coin from a sixpence to half-a-crown. On inserting a coin an evaluating and credit-accumulating cycle is initiated and for each coin deposited the evaluating disc makes one complete revolution. This disc determines the value of the coin by measuring its diameter and it is coupled to the credit drum for a period of time during each revolution which is proportional to the coin value. On the periphery of the credit drum is printed in increments of sixpence the value of credit represented by a given angular displacement.

After the insertion of each coin the drum takes up a position which is proportional to the value of the coin, and as each successive coin is deposited this angle is increased so that the total angular displacement represents the total sum inserted; this sum is displayed behind the credit window in front of the unit and adjacent to the price window.

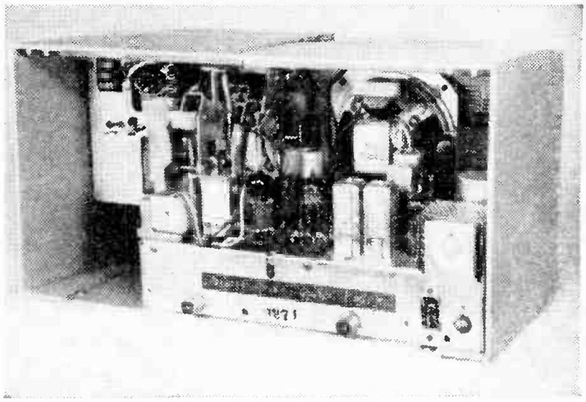
If a programme is selected before coins are inserted, a price demand will be displayed behind the price window. On depositing coins the mechanism operates in the manner described above except that at a certain point in each revolution of the evaluating disc the credit drum is released and by spring tension drives the pricing drum towards the "paid" position by an amount equal to the value of the coin deposited. As this happens quite quickly, it appears that the coins inserted pay directly for the programme, as their value is deducted from the price shown. This is not the case, but the method of operation does enable the subscriber to see at any moment the balance still required to pay for the programme, and the mechanism does store and register any excess sum paid if exact change is not available. If the credit store registers a sum of money, this credit can be used to pay partly or wholly for a selected programme by pressing a button which initiates the cycle of operations just described.

The "billing" unit is the same as the "cash" unit except that the coin acceptance mechanism is not provided. If a subscriber selects a programme a price demand is set up in the same manner as described above whereupon a button is pressed, the programme appears on the receiver screen, and the recording cycle, which is described in the next section, is initiated. At regular intervals the record is read and the information it contains is used to make up the subscriber's bill.

RECORDING. An accurate record must be made of each transaction entered into by each subscriber. This record enables disputes between subscriber and system operator to be resolved and provides information



Telemeter Unit with lid lifted to show coin slot, price and credit windows.



Rear view of Telemeter with coin box removed showing (left) coin mechanism.

whereby the accounts of the various parties engaged in the enterprise may be prepared. As very large numbers of subscribers to the service are envisaged, the record should be of such a form as to be readily handled by data processing equipment.

In the interests of simplicity, accuracy and reliability, magnetic tape recording is used in the Telemeter systems. The information to be recorded consists of a programme identification number and a price; no further data is needed to satisfy all the necessary requirements.

The information is coded in binary form and is transmitted over the control channel on a time-sharing basis along with the price-control information. A code sequence of 15 binary bits is used in which zeros are transmitted as pulses and ones as 200 c/s tones. The sequence is preceded by a long starting-tone burst of 200 c/s to enable the data processing equipment to recognize the start of the identity code sequence. Fig. 1 shows on the right the waveform which is produced by the perforated disc described in the section on pricing. As stated, the disc has two perforated tracks, the outer one generating the start-pricing pulse, the price pulses and the zeros of the programme identity code, and the inner track generating the starting tone and the ones of the identity sequence. Fifteen adjustable tabs expose openings either in the outer or inner track to create the binary code. When a subscriber purchases a programme, the pricing drum closes switches S_5 and S_6 (Fig. 2). The closing of S_6 enables the subscriber to view the programme and switch S_5 furnishes power to the tape recorder drive motor. This, in turn, after 4 seconds, moves S_7 to the "recording" position and V3 now serves to drive the recording head with the composite waveform generated by the perforated disc. After 8 seconds, enough time for one complete identity code sequence to be recorded, S_5 opens and the recording cycle is completed.

The recording head and tape are contained in the cash box which, on collection, is taken intact to the central office. There, while the tape record is being read by the data processing equipment, the money is machine counted. The total provided by the tape record is compared with the cash in the

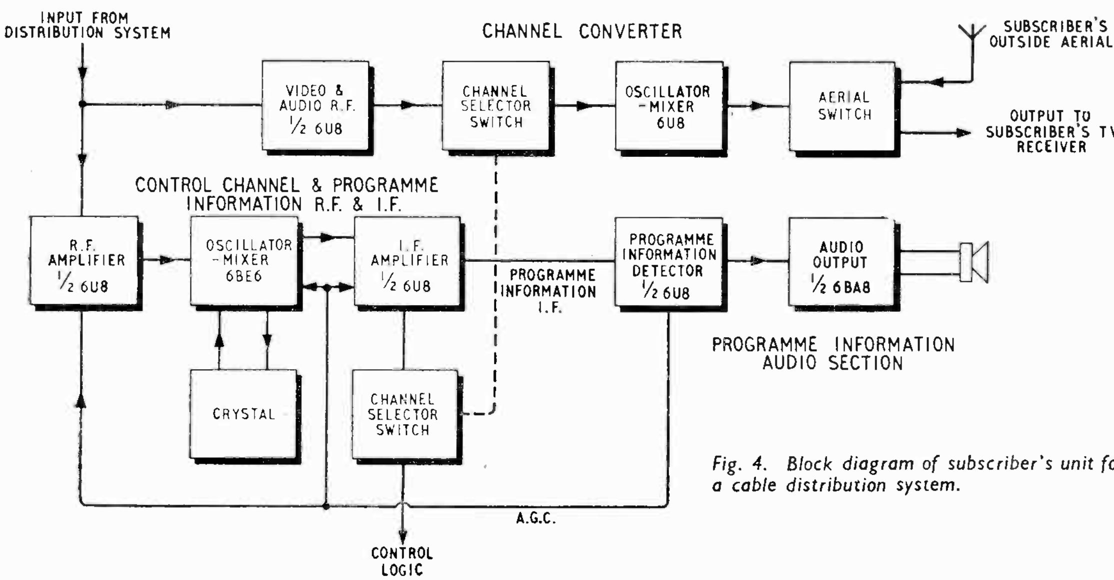


Fig. 4. Block diagram of subscriber's unit for a cable distribution system.

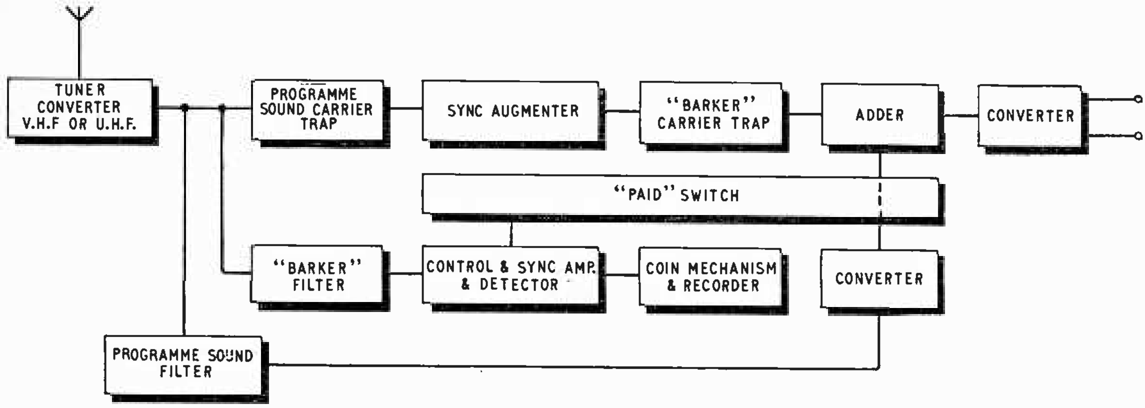


Fig. 5. Block diagram of subscriber's unit for broadcast transmission of Pay TV.

box and a note made in the subscriber's file of any adjustments that may be necessary. Also, at the time the data processing equipment is reading the tape, it records on a tally board the programmes viewed by the subscriber. This tally board displays the identity numbers of all the programmes offered within the accounting period and so the cumulative totals of viewers who have purchased a particular programme may be read-off at any time.

PROGRAMME INFORMATION. Information on current and future programmes should be readily available to subscribers.

The Telemeter system provides an audio programme information channel the substance of which is recorded on a magnetic tape loop and is transmitted continuously from the central station. This channel, together with the control channel, forms a group which is handled collectively by the distribution system. Three control and one programme information channels occupy a band of frequencies some 200 kc/s wide. The programme information carrier furnishes a.g.c. to the input stages of the subscriber's unit and the delay is set to provide 20 volts each of detected audio and control signals. This enables a wide range of input voltages to be accommodated. The power output to the loudspeaker contained in the unit is 0.6watts.

SECRECY. The security of the system must be such that unauthorized persons cannot receive the Pay TV programmes.

In the case of the cable system Telemeter rely on the inherent security of a "closed circuit" network together with the use of bands of frequencies for transmitting the programmes which are not normally acceptable to a television receiver. Fig. 3 shows in block diagram the transmitting station arrangement of a three-programme system and Fig. 4, in similar fashion, the programme and programme information circuits of a subscriber's unit.

The broadcast system has quite a different set of problems to solve as the frequencies on which these programmes are transmitted are readily acceptable to a normal television receiver. If a subscriber (or any TV receiver owner) were to tune his receiver to a Pay TV channel the programme of which was being transmitted by means of the Telemeter system, he would hear, on the sound channel normally associated with the programme, the programme information (on what is aptly described in America as the "Barker" channel) being transmitted through his loudspeaker; the picture would be so "scrambled" as to be unintelligible; and a price demand would be set up automatically on his unit in the manner previously described. This state of affairs would have come about at the transmitting station as a result of the normal sound content of the programme being translated to a new carrier frequency not receivable by the set, the programme information and the control and recording information being transmitted on the frequency normally occupied by the television sound signal, and by the line-synchronizing pulse being reduced. After payment of the price demand, the subscriber's unit operates to restore the programme sound to its correct position in relationship to the video signal and to amplify the line-synchronizing pulses to their full amplitude so that the picture "locks." A block diagram of the subscriber's unit is given in Fig. 5.

Radio Hobbies Show

THIS year's International Radio Hobbies Exhibition, sponsored by the Radio Society of Great Britain, will be opened on November 22nd at the Royal Horticultural Society's Old Hall, London, S.W.1, by Henry Loomis, director of Voice of America, which, incidentally, transmits a monthly programme for radio amateurs. The exhibition will be open for four days from 11.0 to 9.0. Admission is 2s. At the time of going to press the following had booked space.

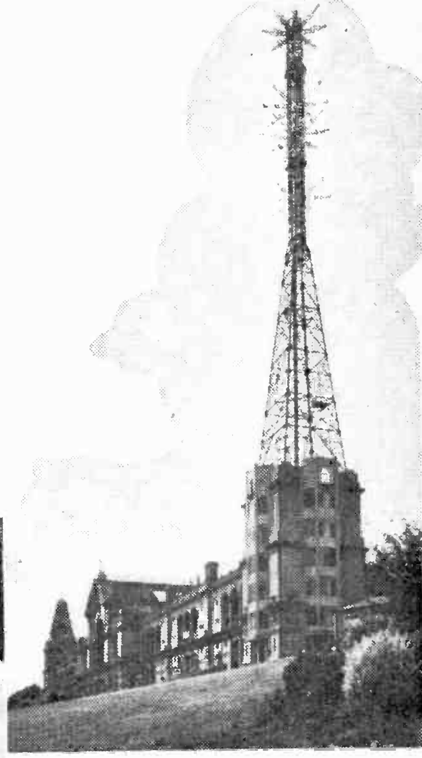
Avo	Post Office
Bernards Publications	R.A.F.
British Amateur TV Club	R.S.G.B.
Copp Communications	Radar & Electronics Assoc.
Daystrom	Royal Naval Reserve
Diatronic	Selray Book Co.
Electroniques (Felixstowe)	*Short Wave Magazine*
Enthoven Solders	Sound Vision Services
K. W. Electronics	Territorial Army
Labgear	V.H.F. Group,
Minimitter Co.	Webbs Radio
Newnes, George	*Wireless World*
Philpott's Metalworks	Withers (Electronics)

It is understood the British Amateur Television Club is putting on a colour TV demonstration during the Show. There will be a competition for home-constructed equipment for a trophy and also a competition to win a Hammarlund HQ170 communications receiver.

B.B.C. TELEVISION

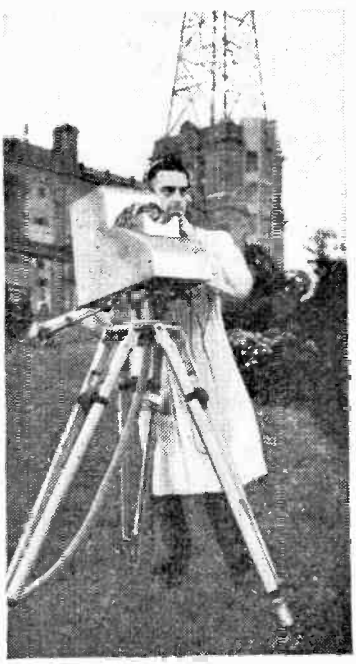
25TH ANNIVERSARY OF "HIGH-DEFINITION" SERVICE

THIS page of illustrations records the start of regular television by the B.B.C. in 1936. Experimental transmissions had been radiated during the run of the National Radio Show of that year but it was not until November 2nd that a regular programme service began. Even then the transmitting techniques were still to some extent experimental as two systems (Baird 240-line sequential scanning and Marconi-E.M.I. 405-line interlaced scanning) were use on alternate weeks. From February 8th, 1937, the television service used only the Marconi-E.M.I. system.

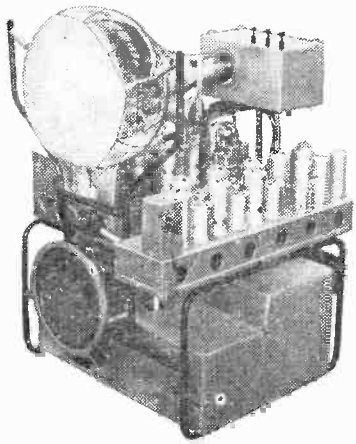


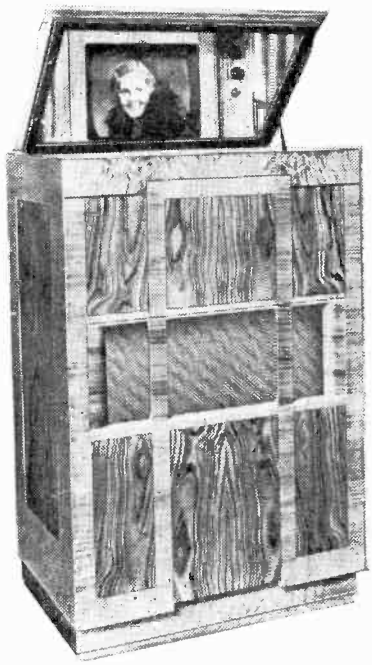
The original London transmitting aerial and tower at Alexandra Palace.

Control desk for the Marconi-E.M.I. transmitter.



(Left) Marconi-E.M.I. "instantaneous" camera, so-called because the Baird system employed intermediate film scanning. The cameraman is D. C. Birkinshaw, now Superintendent Engineer, Television.





Two examples of 1936 television receivers Left, the chassis of a Pye direct-viewing receiver and, above, Marconiphone model 702 indirect-viewing receiver, both for 240- and 405-line pictures.

Electronic Computer Exhibition

NEW TECHNIQUES AND EQUIPMENT

THE advent of the "second generation"—as it was often referred to—seems to have brought a greatly increased air of respectability to computers, the emphasis at this exhibition being very much on practical, immediate use. The possibility of building up an installation piece by piece (even by the addition of internal (storage) units) together with flexibility of connection to different types of input and output (peripheral) equipment were both also emphasized. Transistorization seems complete—if any of the computers shown did use valves to any great extent, their manufacturers were too ashamed to inform us of the fact.

Logic.—Simple programming in a sort of pidgin or basic English is often possible now. Several "languages" are in use—most of them said to be compatible with each other.

The bottleneck often set up by the relatively slow speed of the input and output readers and printers is being increasingly obviated by the provision of "time sharing" facilities, by which several (usually up to three or four) programmes can be run at once on a computer. Thus, for example, several data transcription programmes (which use mainly the relatively slow peripheral equipment) might be run simultaneously with one data processing or scientific programme (which uses mainly the much faster arithmetic unit). Time sharing thus increases computer flexibility by allowing several input and output units to be used in parallel, and also obviates the necessity for very fast "off-line" printers to make full use of the computer calculation speed. Individual programmes also need not be optimized to make best use of the computer facilities and speeds of calculation, storage, input and output. Each programme can be independently written as well as read in and read out.

The time-shared programmes are arranged by the operator in a priority order. For example, as in the Ferranti "Orion", first might come those programmes using peripheral equipment which it is difficult to interrupt, secondly those programmes needing much slower mechanical peripheral equipment, and finally those needing tape peripheral equipment or the arithmetic unit. In the Ferranti "Atlas", this programme priority order may even be partly modified by the computer itself—depending on the requirements for peripheral equipment. In the A.E.I. 1010 an interrupt switch is provided to allow additional urgent work to be given overriding priority.

Whenever a programme is interrupted and the arithmetic unit no longer employed (for example, while information is being transferred, or by non-availability of peripheral equipment or working storage) the next programme in the priority order which is not interrupted is proceeded with, until the original programme can continue, or until a further interruption occurs.

The time sharing supervisory system usually automatically allocates and reserves to the individual programmes storage space and peripheral devices (the latter are not usually individually shared); this naturally being done in such a way as to prevent any mutual interference between the programmes. Should any attempt at interference occur, the programme causing it is interrupted and an alarm given. The possibility of such interference is further reduced in the Leo III and Ferranti "Atlas" computers by "tagging" each stored block of information by the number of the programme to which it refers.

When automatic storage allocation is provided, the task of the programmer is simplified since he need not consider absolute addresses nor arrange and optimize storage transfer.

An unusual feature of the English Electric KDF9 are its "nesting" core stores. Each of these can store up to sixteen items of information in a fixed serial order in such a way that transfer in or out of the store occurs only at the beginning of the series and automatically causes the remaining items to shift down or up a place respectively. This automatic shifting motion allows arithmetic and certain other simple operations to be carried out without reference to the main store, thus increasing the speed of computation. Such stores can also be used to facilitate the ordering of sub-routines.

Data transfer between the main store and peripheral equipment is carried out in the A.E.I. 1010 via buffer stores whose capacity has been reduced to only one word per peripheral unit. This reduction has been made possible by transferring data one word at a time and at such a rate that all the thirty-two buffer stores provided can be sequentially scanned in less than the time taken to store one word.

By addressing each character individually and by the use of end-of-word symbols, fully variable word length is provided in the English Electric KDP10. This naturally economizes the capacity required for data storage.

Storage.—Fast but relatively small ferrite core stores backed up by larger but slower magnetic drums (or sometimes tape systems) are now almost invariably used. The possibility of extending their drum stores by mechanically coupling up to three additional units is a feature of the Sperry Type C and E series. A different type of store which consists of a set of vertically stacked rotating magnetic discs with an interlinking "comb" of read/write heads was used by De La Rue Bull Machines in their Gamma 30 and by I.B.M. (1301).

The normally somewhat contradictory requirements of size and speed of store can be better satisfied by providing random access. One popular system has similarities to the rotatable "ring" of records often used in juke boxes; such a (magnetic disc) storage system being used in the De La Rue Bull Machines "Gamma 30". What might be described as a juke box magnetic tape storage system is used in the Facit ECM 64 (of Swedish origin) shown by A.E.I. Here the information is stored in 64 separate 30-ft long reels of magnetic tape spaced along the circumference of a rotatable circle. To address a particular reel, the circle is rotated until this reel is at the bottom. A weight on the free end of the tape then falls through guides so as to lead the tape past the read/write head and pinch roller. When reading or writing has been completed, the reel is rewound and the store then ready for further use.

In a Card Random Access Memory (CRAM) shown by the National Cash Register Company, information is stored in the form of seven magnetic strips on each card. The cards are individually identified and selected from the stack by means of eight notches through which pass eight independently rotatable rods: each notch can have one of two shapes (corresponding to 0 and 1) and quadrangular cross-section rods are used so that, depending on their angular position, each rod engages with either only 0 or 1 notches. Thus, by rotating the rods individually to correspond to the set of notches in the card required, this card only may be freed from the pack. (A similar system of selection by means of cylindrical rods and holes/notches is used in the Anson

Visipoint edge punched card system shown at the neighbouring Business Efficiency Exhibition.) In CRAM, when a card is released, it is pneumatically drawn on to a rotating drum against which bears the read/write head. On release from the drum, it is seized by pinch rollers and passed at a fixed speed to one side of the pack, against which it is pushed by a synchronized vibrating plate.

Fast semi-permanent stores are being increasingly used for fixed sub-routines. In the Ferranti "Atlas" computer, these stores consist of ferrite rods inserted to provide magnetic coupling at the desired junctions of the (orthogonal) input and output wires. Mullard showed two semi-permanent single-plane ferrite core stores. In one of these stores two layers of cores separated by copper foil are used, the cores being coupled together at the desired points through holes in the copper foil: in the other, the fixed storage is provided by permanent magnets plugged in above the desired cores.

Data Recording.—An increasing trend—seen in equipment shown mainly at the adjacent Business Efficiency Exhibition—is towards recording information straight away in a format (such as punched cards or paper tape) which is immediately acceptable by a computer—a written record being often simultaneously also produced. This avoids errors arising from the normal double process of first recording the information in written form and then later re-recording it for use by the computer. In simultaneous recording systems for accounting shown by Burroughs and the National Cash Register Company, the information is simultaneously typed and recorded on magnetic strips on the back of the ledger. A recording which is both legible and acceptable to a computer is provided by the Cummins Perf-O-Data punched hole system shown by Original Documents Processing. In this the normal punched in-line five-hole code patterns are spread out to three columns, and extra redundant holes added to produce legible figures.

Input Readers.—An alternative to recording input data in a form which, though not legible, is acceptable to the computer is to provide equipment in the computer for reading legible letters and figures. Although a number of such systems have already been described and were discussed in a paper by M. B. Clowes and J. R. Parks given at the Electronic Data Processing Symposium held concurrently with the Exhibition, only one such system was shown at the Exhibition. This was the I.B.M. 1412 which follows the popular general idea of using a suitably modified type face which is scanned so as to subdivide it into a number of sensing areas. The presence or absence of ink in each area is recorded and compared by logic circuits with the corresponding data for permissible variations of the symbols so as to determine the actual symbol being read. In the I.B.M. 1412 magnetic ink is used and the pre-aligned characters are scanned seven times by a ten-track magnetic head to break them up into seventy rectangular sensing areas.

Normal punched tape readers generally use phototransistors and lamps to detect the presence or absence of holes. However, in the Facit ETR 500 shown by A.E.I., the holes are detected rather by the changes in capacity they produce between a set of metal pins and a plate on opposite sides of the tape. This system has the advantages that it is not affected by light, and much less affected by dust, dirt and ageing.

Data Transmission by Telephone.—A considerable amount of development is going on in this field and a number of different systems were shown at the exhibition. Except for the I.B.M. 1001 all these were for binary data.

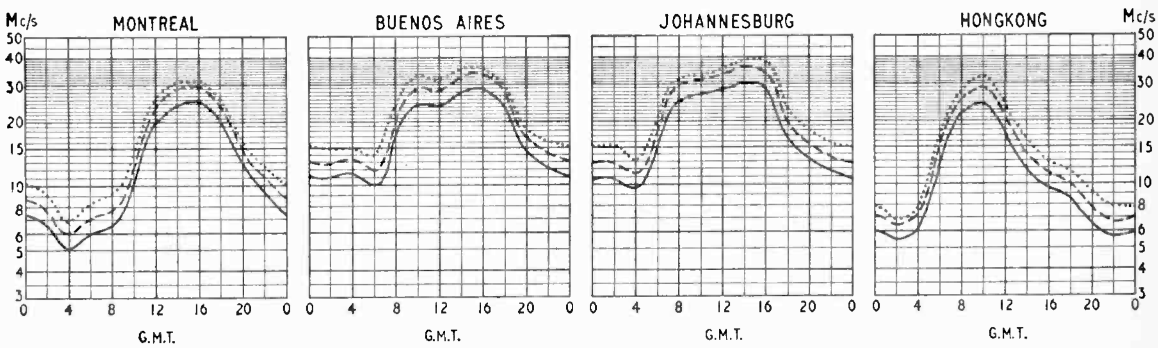
As regards the choice of modulation system for binary data, manufacturers seemed to be almost equally divided between (180°) phase modulation and (≈500c/s) frequency shift keying. Although the latter system is theoretically somewhat slower and more susceptible to interference, it does avoid the necessity for carrier synchronization.

Even more varied provisions were made for error detection or correction. This is reasonable since the complexity and cost of the equipment required depends greatly both on the degree of protection desired (and in particular on whether correction or only detection is required) as well as on the type of telephone link used (since this latter determines the number and type of errors to be expected). Most manufacturers used the standard method of adding one or more redundant "parity" bits and checking the known redundant information after transmission. Nearly complete detection was provided by Ferranti and Plessey—the latter by retransmitting the received signal back for direct comparison with the original, and the former by transmitting with each character its binary inverse.

The I.B.M. 1001 system transmits fifteen different characters in the form of pairs of frequencies. In this system any errors are unlikely to produce a valid digit.

SHORT-WAVE CONDITIONS

Prediction for November



•••••••••• FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE FOR 25% OF THE TOTAL TIME

— — — PREDICTED MEDIAN STANDARD MAXIMUM USABLE FREQUENCY

———— FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE ON ALL UNDISTURBED DAYS

THE full-line curves indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during November.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.

French Radio Show

LA DEUXIÈME CHAINE

IN general the changes this year in the French Radio Show were similar to those in our own. There was less high-quality sound reproducing equipment, decreased emphasis on stereo, little essential change in sound receivers and, finally, the most striking resemblance, a preoccupation with provision for receiving a new television programme, although major details of this have not yet been settled.

Television

So far as we could tell, all manufacturers felt it necessary to make some provision for receiving the alternative programme (deuxième chaine), although the date for its commencement has not yet been definitely settled and is at least a year away.

The French are, however, better off than us in that the major technical details of this second chain have been decided. It will be in the u.h.f. Band IV using 625 lines with positive vision modulation and a.m. sound.

The use of 625 rather than 819 lines for the second programme has two advantages. First, if and when colour television comes into use throughout Europe, conversion between the various standards will be easier, and secondly, the bandwidth occupied is halved so that more transmitters can be provided in the band.

A variety of arrangements were made for receiving the second programme. Most sets were already modified to receive both standards, but provision only was made for the addition of a u.h.f. tuner. A few receivers were, however, already fitted with such a tuner and capable of receiving a second programme: no such programme was, however, laid on at the show, even for demonstration purposes.

Switched tuning in the u.h.f. band is difficult, so that continously variable tuners will almost invariably be used.

Standards switching was in some cases provided by a special position on the normal turret tuner and in others by a separate control—this latter produced alarming results on 819-line pictures!

As might be expected, these provisions for the second programme have encouraged the production of multi-standard sets and these were more in evidence, though often only for the various 819-line standards. In the Philips and Radiola multi-standard 819-line receivers the switch for standards conversion is motor driven and set in operation by the channel selector switch.

Most, though not all, receivers now use 110° tubes, often of the "square"-faced variety. Although introduced some years back, 27-in screens do not seem to have caught on, in fact we did not notice any.

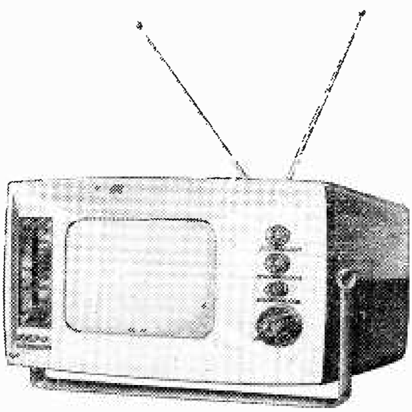
Popular are the 114° square American Twin-Panel 19 and 23-inch tubes. In the Twin-Panel construction the protective glass cover is already attached to the c.r.t. (and usually protrudes somewhat more from the front of the set) in an arrangement which is claimed to reduce light reflected from the screen. The slightly dark tint of the cover also reduces image "flicker".

We have previously noted a greater attention in France to the sound side of television receivers shown, for example, by frequent provision of a tone control, a "tweeter", or one speaker on each side of the receiver. This year we noted two ways of diffusing forwards the sound from such side-facing speakers. One way, seen on the Pathé-Marconi (La Voix de Son Maitre) T1049MD, is simply to use two reflecting side doors. Another, seen on the Titan "Dauphin" receiver, is to use a specially shaped (elliptical) speaker cone with the voice coil mounted asymmetrically towards one (long) side.

An unusual facility we noticed in some Oceanic, Radio-Celard and Titan receivers was the provision of a "magic-eye" indicator for the fine tuner. (Indicators that are unusual either in themselves or in the circumstances in which they are utilized were, in fact, noted occasionally in all types of French equipment and examples will be found in most of the sections of this review.)

Although, in general, the emphasis on remote control facilities seemed to have largely disappeared, we did note the first (in France) "wire-less" remote control. This was for Oceanic receivers and used a battery, transistorized, three-frequency (10, 11 and 12 kc/s) ½-watt oscillator (and mains receiver) to separately control the sound, contrast and on/off switch from up to 15 feet away. Pressing the contrast or sound remote control button alternately continually increases and decreases the contrast or sound (as the case may be) so that the desired position may be reached by successive approximations.

Another unusual facility noted in some Point-Bleu (Blaupunkt in Deutschland, Blue Spot in U.K.) and Schneider receivers was arrangements for locking the controls against tampering by children—and, dare we say, adults also?



Combined transistor TV and a.m. radio—the Télécapte—shown by Radio-Celard.

A transistorized battery combined radio and television receiver—the Télécapte—(even this could be adapted for the alternative programme) was shown by Radio-Celard. This can operate from batteries or mains, has an 8-in tube and uses 27 transistors.

Transistor Receivers and Record Reproducers

These are very popular in France and seem to come in all sizes without much evidence of the English trends towards either miniature or table models. Push-buttons are much in evidence, and are used to provide on/off and aerial as well as wave-change switching. Two push-button long-wave stations are provided in the Martial "Vancances".

Tone controls (push-button or continuous) are much more common in France than here. We even noted the provision of continuous bass as well as the normal treble controls in the L.M.T. Super T420 a.m./f.m. receiver.

As regards external connections, sockets for car aerials are very common in France as in this country. Much more common than in this country is the provision of an external speaker socket (usually intended alternatively for use with an earphone). Much less common is the provision of a socket for tape recording (we could only find one example, in the L.M.T. Super T420). This may be a reflection of the general lack of interest in tape recording at this Show. Pick-up sockets were noted in the Martial "Europe"—one of the table models—and the Pygmy "Varitron".

As in this country, manufacturers are increasingly using drift transistors in the h.f. stages. Unlike the case here, however, in France at least one manufacturer is using them to allow the number of transistors required to be reduced rather than to increase the receiver sensitivity.

A circuit feature seldom found necessary in this country but very often used in France is the provision of a thermistor or other temperature-sensitive resistive element to prevent thermal runaway in the output stage.

Although still rather unusual, transistor receivers combined with clocks are more common than in this country.

Although short-wave bands are very frequently provided, f.m. is much less so. Where we were able to obtain sufficient details (and people with such knowledge seemed, if anything, to be even rarer than at our own show) the combined a.m./f.m. sets seemed to follow the same basic circuitry as is used here, with a separate r.f. stage and combined mixer/oscillator two-transistor f.m. front end followed by three i.f. stages (or a mixer/oscillator and two i.f. stages on a.m.).

Unusual features of the Pygmy "Varitron" are —besides the pickup socket already mentioned— the provision of a filament bulb for use either as a dial light or as a signal level and direction indicator and a local/distance combined selectivity/sensitivity control.

Several record reproducers with unusual features were shown by Dentzer-Eden. For example, their S200 and S250 operate from the mains and have class-A output stages giving a power as high as 2 watts. Their S270 can be operated from mains or, if this supply is not available for any reason, automatically from batteries (and thus continues operating when unplugged from the mains). But most unusual is their 600—a battery model which combines a record reproducer, a.m. radio and tape recorder. The latter is simply driven from the 3-in take-up spool by placing this spool on the record spindle: a separate motor is used for fast rewind. A permanent magnet provides erase facilities.

Combined transistor record reproducer, tape recorder and a.m. radio shown by Dentzer-Eden.

Aerials

Band IV arrays were, as might be expected, much in evidence.

A broadband (41-54 Mc/s) folded "dipole" shown by Ara Sefara used one closed and two open rods to reduce the s.w.r. in much the same way as would the use of two dipole elements with different diameters.

Two reflectors were used in a Portenseigne aerial to secure a high front-to-back ratio and smaller side lobes. The same company also showed a bent dipole omnidirectional f.m. aerial.

A three-element indoor aerial mounted (partially concealed) under a television table was shown by Telescopictv.

Amplifiers

Filament light bulbs were used as level indicators in models shown by Teppaz and Claude.

In two Claude stereo amplifiers two such bulbs can be switched in instead of the two speakers: at the same time a signal at 100c/s and its harmonics (derived from the mains) is fed to the two amplifier inputs. The two amplifiers can then be balanced by adjusting the two lamps for equal brightness.

In the high-power (80W) Teppaz 780S amplifier such an indicator is used to show overload. This amplifier is also protected by electromagnetic and thermal "fuses".

Tape Recorders

Unlike the case with this country, these do not appear to be popular since they were shown by only about five of the eighty or so radio and television exhibitors.

A fully transistorized recorder which operates however not from batteries but from the mains was shown by Radiola (RA 9546). This uses six transistors and has high-frequency erase as well as the other usual facilities.

In conclusion, we are glad that we can at last find space in a review of this show to commend the catalogue, which for only 2.50 Nouveaux Francs (slightly under 4 shillings) provides a considerable amount of technical detail on all the models exhibited.

WORLD OF WIRELESS

Pay TV

THE question of the possible introduction of subscription television both in this country and on the Continent is currently being discussed and an article on the subject will be found elsewhere in this issue. This deals with the Telemeter equipment which is now being used in a pilot scheme in Toronto. A demonstration of another system was given in London on October 16 by Choiceview Ltd., a company in which the Rank Organisation and Rediffusion are partners.

Choiceview has not only developed a system but is also planning to provide a programme service to relay or broadcasting organizations. Two methods of payment have been developed—both applicable to either "over the air" or wire services, although only the wire system was demonstrated. One employs a coin box on a "deferred payment" system; the user being unable to see a second programme until the first is paid for. The other employs a credit meter which will be read and an account submitted.

1962 Audio Festival

NEWLY elected chairman of the exhibitors' committee for the 1962 International Audio Festival, to be held at the Hotel Russell, London, from April 26-29, is R. Merrick of British Ferrograph.

The 1962 Audio Festival is expected to be the most comprehensive exhibition of sound reproduction equipment yet staged by the organizers, by virtue of the increased interest shown by overseas firms. Already 56 companies have applied for entry.

It is expected that one of the attractions to enhance the festival aspect of the exhibition is that Gilbert Briggs (Wharfedale) will give a live demonstration of immediate recordings.

It has been decided to exclude the public from the first day of the show, devoting it almost exclusively to a preview for trade visitors.

Do You Know?

WHICH countries operate on the 625-line television standard and which on 525 lines?

What are the frequency limits of the X-band?

Which country uses call signs beginning VE?

What spacing is required between the dipole and radiator for a Band II aerial?

Is there a colour code for fuses?

What is the address of the National Council for Technological Awards?

The answers to these and very many other questions will be readily found in the 80-page reference section of the 1962 "Wireless World" Diary. Features introduced or re-introduced in the Diary, which is in its 44th year of publication, include transistor types and connections; the world's television standards; some historic radio dates; and international call sign prefixes. The Diary costs 5s 9d, plus 1s 1d purchase tax, in leather, or 4s (plus 10d) in rexine.

B.B.C. Annual Report

ALMOST a third of the year's cost of £18M for running the B.B.C. television service was for engineering services (including £760,000 paid to the Post Office for line rentals) and of the £12.6M for the home sound broadcasting services a quarter was devoted to engineering (including £260,000 for Post Office lines). These and the following facts are culled from the 1960/61 Report of the B.B.C.*

The Corporation's income from licences increased by £2.25M to £33.5 compared with the 1959/60 figure. The number of v.h.f. receivers in use (estimated at 4M) has not increased "as rapidly as had been hoped."

On the question of stereophonic broadcasting, using one v.h.f. station for both channels, the Report says "much research has been done, but no satisfactory system has yet emerged that would not reduce the area covered by the v.h.f. transmitter." It also points to the difficulty presented by the fact that the Post Office lines used for linking studios, etc., for normal broadcasting "are not suitable as they stand" for stereo signals.

*Cmnd. 1503. H.M.S.O. 10s 6d.

An exhibition coinciding with the 25th anniversary of the introduction of this country's television service is being staged by the B.B.C. at the headquarters of the National Book League, 7 Albemarle Street, Piccadilly, London, W.1. It opens on October 31 for four weeks and will be devoted to both sound radio and television broadcasting. It will include books, scripts, models and historic items from the archives of the B.B.C. Admission is free and the exhibition will be open on weekdays from 11.0 to 8.0 (closing at 5.0 on Saturdays).

Universal Programmes Corporation are holding their third "At Home" on November 24, 25 and 26 at 35 Portland Place, London, W.1. A unique feature will be the recording of a live group on 3-track equipment and then allowing selected members of the audience to follow the processes through to editing, dubbing, reduction to 2-track and mono, and finally to master cutting both stereo and mono. Admittance is by ticket only on application to the company at the above address.

The Technique of Sound Recording is the title of a series of six lectures to be delivered by Peter Ford, hon. historian, B.S.R.A., on consecutive Fridays, commencing November 10 next, at 7.0 at the British Institute of Recorded Sound, 38 Russell Square, London, W.C.1. Fee for the course is 10s, or 2s 6d per lecture.

I.T.A. Headquarters Move.—New headquarters for the Independent Television Authority are located at 70 Brompton Road, London, S.W.3 (Tel.: Knightsbridge 7011). E.M.I. Electronics Ltd. have installed a wired TV and sound system at the new H.Q.

Television licences in the U.K. have now passed the 11.5M mark. Sound only licences total 3.8M including 0.49M for sets fitted in cars.

"Stratovision" was developed by the Westinghouse Electric Corp. not Western Electric as stated in error in the note on "Flying TV Classroom" in the September issue.

A sub-committee for stereophonic broadcasting has been set up by the technical committee of the west German industry and broadcasting organizations. The sub-committee will study stereophonic broadcasting problems in close co-operation with the Institut für Rundfunktechnik, a research institute working for all German broadcasting organizations on a participation basis. First part of the studies will cover aspects of an eventual introduction of stereophonic standards now in use in the U.S.A. for west Germany. The problem is expected to be discussed throughout the year of 1962, and stereophonic broadcasting in west Germany may start by 1964.

Radio Show Attendances.—Highest attendance since the National Radio Exhibition moved to Earls Court from Olympia in 1951 was recorded at this year's Radio Show when the grand total was 385,925—an increase of 39,855 over the 1960 figure. Also attracting more visitors was the recent Italian National Radio Show with a total attendance of 220,000, up by 10,000 on last year. Understandably, in view of the political situation in Berlin at the time, the west German Radio Show registered a smaller number of admissions (387,500) than originally expected.

Two new v.h.f. sound broadcasting stations have been brought into service recently by the B.B.C. That for the Channel Islands is located at Les Platons, Jersey, and transmits on 91.1, 94.45 and 97.1 Mc/s. The other new station, at Sherriffs Mountain, Londonderry, Northern Ireland, transmits on 88.3, 90.55 and 92.7 Mc/s.

An improved microphone network has been installed in the Chamber of the House of Commons by Tannoy who provided the original installation introduced in 1950. This involved replacing the fifteen existing microphones with twenty-three of an improved pattern. They are laid out in four lines of five microphones down the length of the Chamber, one over the Speaker's chair, and two over the despatch boxes.

The Junior Institution of Engineers have awarded their Vickers Prize and Medal to John Heywood for his paper on "Radio Investigation of the Solar Atmosphere." Mr. Heywood is a lecturer at the Birmingham College of Advanced Technology.

S.E.E. Programme.—The Society of Environmental Engineers, Suite 7, 167 Victoria Street, London, S.W.1, have issued their programme of technical papers and factory visits for the 1961-1962 session. Now in its third year, the Society has a membership approaching the 250 mark.

"Philips Awards," each consisting of a Philips Electrical Ltd. service kit, are to be presented to the three candidates judged to be the most meritorious in the City and Guilds of London Institute's final examinations in radio and television servicing.

Polarad Microwave Tuning Unit: The marketing rights for the Polarad Microwave Tuning Unit type RE-T, were inadvertently attributed to Brüel & Kjaer in the October issue. In fact, the equipment is marketed in the U.K. by B & K Laboratories Ltd., 4 Tilney Street, Park Lane, London, W.1.

Blaupunkt Printed Circuits.—In connection with the report on the Berlin Exhibition (1st column, p. 533, October issue) Blaupunkt ask us to point out that they have used printed boards in their television receivers for several years, but this year a single panel is used instead of three separate units.

"Parametric Amplification with Transistors."—In the circuit diagram on p. 498 of our October issue the 20μH inductance should have been labelled 20$\mu\mu$H.

A Ferranti Atlas Computer is to be installed at the University of London towards the end of 1963 at a cost of approximately £2M. The machine is claimed to be in speed and capacity the most powerful computer in the world and should accelerate Britain's scientific research. Orders worth about £1M from the Universities of Birmingham, Glasgow, Leeds and Liverpool, for their KDF9 high speed data processing system have been received by the English Electric Company.

Colour Television Refresher Courses organized by The Television Society recently have proved so popular that arrangements have been made to repeat the series of lectures in London in January, 1962. Lecturers will again be S. N. Watson, B.B.C. Designs Dept., and G. B. Townsend and P. Carnt of the G.E.C. Hirst Research Centre. Early application for enrolment forms from the Society at 166 Shaftesbury Avenue, London, W.C.2, is advised.

International Short Wave Club, 100 Adams Gardens Estate, London, S.E.16, are conducting an official vote to determine the favourite stations of all listeners, whether members of the Club or not. Postcards, listing listeners' five most popular s.w. stations in order of merit and a few words about their No. 1 choice, are requested before January 1 next.

Personalities

Sir Willis Jackson, F.R.S., has relinquished his appointment as Director of Research and Education of A.E.I. (Manchester), formerly Metropolitan-Vickers Electrical Co., to return to academic life as Professor of Electrical Engineering at Imperial College, University of London. He is continuing as an A.E.I. research consultant. Sir Willis' long association with the company began with a vacation apprenticeship in 1928. Ten years later he left the organization on being appointed Professor of Electrotechnics at Manchester University, and in 1946 became Professor of Electrical Engineering at Imperial College. He returned to the company in 1953.

J. M. Dodds, O.B.E., Dr.Ing., M.A., B.Sc., who is appointed director of the A.E.I. Research Laboratory, Manchester, was awarded the degree of Dr.Ing. from Aachen University, where he went with a travelling scholarship on completion of a graduate apprenticeship with Metro-Vick in 1931. Dr. Dodds was appointed physicist in the radio section of the Research Laboratory in 1933, and became responsible in 1937 for the development of the C.H. radar transmitters. In 1956 he was appointed assistant manager of the Research Laboratory and became manager the following year.

A. F. Gibson, Ph.D., A.Inst.P., leader of the semiconductor physics research division of R.R.E., which he joined in 1944, has been promoted to Deputy Chief Scientific Officer in the Scientific Civil Service. He is among several officers who have been given special promotion in recognition of research work of exceptional quality. Dr. Gibson has made a special study of the microwave properties of germanium and the effect of carrier injection and extraction on the absorption. His most recent work has been concerned with "hot" electrons in germanium.

J. F. Gittins, B.Sc., A.R.C.S., of the Services Electronics Research Laboratory at Harlow, Essex, is among several scientific civil servants promoted to Senior Principal Scientific Officer. He has undertaken research in the field of high-power microwave valves and particularly travelling-wave tubes. He is chairman of the Services Power Valve Research Advisory Panel.

Major General Eric S. Cole, C.B., C.B.E., Director of Telecommunications at the War Office from 1958 until last April when he retired, has joined Ultra Electronics as operational manager of its new Telecommunications Division. General Cole, who was deputy chief signals officer, Allied Command Europe, prior to his War Office appointment, was at one time chairman of the British Joint Communications Electronics Board. Well-known in amateur radio circles—he has operated his own transmitter in many parts of the world—General Cole has been president of the Radio Society of Great Britain for the past year.

Maj. Gen. E. S. Cole

N. Hughes

Nathan Hughes, B.Sc., A.M.I.E.E., A.M.Brit.I.R.E., at present chief engineer and deputy manager at the studios of Television Wales and the West, at Pontcanna, Cardiff, has been appointed general manager of Wales Television, the programme contractor for the I.T.A. stations to be built in Pembrokeshire and on the Lleyn Peninsula. Mr. Hughes, who is 37, graduated at University College, Swansea, and served with the Royal Navy and Royal Signals from 1942 to 1947. He then went to Marconi's W/T Company as an installation engineer and in 1955 joined Associated Rediffusion. He has been with T.W.W., the I.T.A. programme company serving South Wales and the West of England, since 1957.

Leslie H. Bedford, C.B.E., M.A., B.Sc., F.C.G.I., M.I.E.E., M.Brit.I.R.E., for the past two years director of engineering, Guided Weapons Division of English Electric Aviation Ltd., is one of five new members appointed to the Council for Scientific and Industrial Research. Mr. Bedford, who is 61, was director of research at A. C. Cossor Ltd. from 1931 to 1947. He then joined the English Electric Group as chief television engineer of Marconi's W/T Co., and subsequently became chief engineer of the English Electric Guided Weapons Division. The present constitution of the Research Council is: Sir Harold Roxbee Cox (chairman), L. H. Bedford, Professor B. Bleaney, Professor C. F. Carter, Dr. J. W. Cook, Frank Cousins, Sir Walter Drummond, G. B. R. Feilden, Professor E. R. H. Jones, Vice-Admiral Sir Frank Mason, Professor O. A. Saunders, Dr. C. J. Smithells, H. C. Tett, and Lewis T. Wright. Sir Harry Melville is secretary.

George E. Partington, B.Sc., A.M.I.E.E., chief engineer of Marconi's Broadcasting Division, was the only British contributor at the 90th Semi-annual Convention of the American Society of Motion Picture and Television Engineers held in New York at the beginning of October. He read a paper on operationally simplified camera channels at the session covering television equipment and techniques. Mr. Partington has been with Marconi's since 1938 and was appointed to his present position two years ago.

Rear-Admiral Sir Philip Clarke, K.B.E., C.B., D.S.O., has, on his doctor's orders, retired from the board of Ether Langham Thompson Ltd. He joined the Langham Thompson organization after retiring from the directorship of the Naval Electrical Department in 1955. Sir Philip was president of the Brit. I.R.E. from 1954 to 1956.

Air Vice-Marshal G. P. Chamberlain, who retired from the R.A.F. a year ago after 37 years' service, has joined Collins Radio Company of England as managing director. A.V.-M. Chamberlain was deputy controller of electronics in the Ministry of Aviation from 1957 until his retirement.

L. G F. Shuttleworth

L. G. F. Shuttleworth, assistant engineer - in - charge of the B.B.C. Tatsfield Receiving and Measurement Station since 1940, has been appointed engineer-in-charge in succession to the late **H. V. Griffiths.** He has been on the staff of the station since it was built in 1929—starting as a maintenance engineer — having previously been for four years at the Keston Receiving Station which was the forerunner of the one at Tatsfield.

J. W. L. Johnson has joined Fidelity Radio as assistant general manager. For the past 11 years he has been with Amplion where he was at one time chief engineer and latterly general manager. After war service in the R.A.F. signals, Mr. Johnson, who is 48, went to Multitone where he was for three years production manager.

OUR AUTHORS

R. A. Tobey, M.A., Grad.I.E.E., and **Jack Dinsdale,** B.A., who are working on instrumentation magnetic recording systems at Elliott Brothers, contribute an article in this issue on their spare-time interest—sound reproduction. They describe a transistor audio amplifier. Mr. Tobey, who graduated at Magdalene College, Cambridge, in 1955, has been with Elliotts since 1957 working mainly on transistor circuitry. Mr. Dinsdale, who is 23 and graduated at Trinity College, Cambridge, in 1959, joined the Weapons Division of Elliotts the same year. He recently completed one year of post-graduate study at the College of Aeronautics, Cranfield, where he worked mainly on magnetic tape recording.

W. McMillan, author of the article on page 570, has been with Standard Telephones & Cables since 1956. Educated at Ayr Academy and Glasgow University, he joined S.T.C. as a technical writer dealing with microwave transmission systems and submarine cables, but for the past two years has been on the headquarters staff for liaison work with the technical press.

OBITUARY

Thomas Brown Watkins, Ph.D., M.Sc., A.M.I.E.E., who died on September 19th at the age of 40, had been with the Mullard Research Laboratories since 1952. Dr. Watkins graduated at Edinburgh with 1st class honours in electrical engineering in 1941, and obtained his M.Sc. in mathematics in 1950. He served in the R.A.F. as a Technical Officer from 1941 to 1947. Dr. Watkins, who obtained his Ph.D. degree at London University on a thesis entitled "Modulation noise as a surface property in germanium junction diodes" in 1958, held a leading position in semiconductor research.

TRANSFORMERLESS TECHNIQUE RESULTS IN GOOD PERFORMANCE, ALLIED WITH SIMPLICITY AND COMPACTNESS

Transistor Audio Power Amplifier

By R. TOBEY, M.A. and J. DINSDALE, B.A.

THE object of this design is to produce a transistor amplifier comparable in performance with good modern practice using thermionic valves, but with all the advantages of transistorized equipment.

This object is best achieved by the elimination of all transformers from the design, when the following advantages are obtained:—

(i) Smaller size and weight, since transformers account for a large portion of the bulk and weight of a conventional power amplifier.

(ii) Better frequency response.

(iii) Greater efficiency.

(iv) Less distortion without feedback.

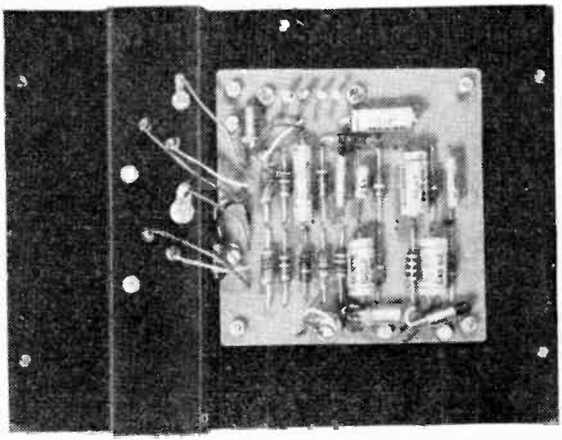
(v) More feedback may be used to reduce this distortion still further, without causing instability.

(vi) One expensive component less required.

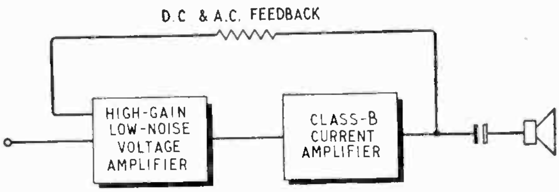
The basic circuit is shown in block diagram form in Fig. 1. It consists of a high-gain, low-noise, voltage amplifier, directly coupled to a current amplifier, with overall d.c. negative feedback to stabilize the working points of the transistors, and a.c. feedback to reduce distortion to a sufficiently low level.

Current Amplifier.—This matches the low impedance of the loudspeaker to the output of the voltage amplifier. Two stages are needed to give the required current gain of about 1,000.

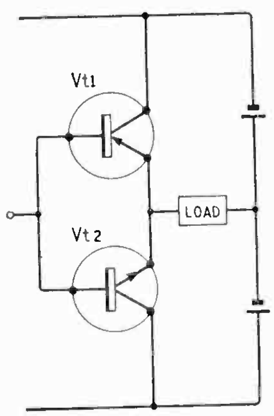
There are various ways of matching a Class-B push-pull output stage to a loudspeaker load without incorporating transformers. These all hinge round the use of complementary symmetry, i.e. a p-n-p/n-p-n pair of transistors.



Power amplifier showing components mounted on a printed circuit plate.



Above: Fig. 1. Block diagram of amplifier.



Left: Fig. 2. Push-pull Class-B emitter follower.

Fig. 2 shows a single stage of what may be considered as a Class-B emitter follower. Vt1, a p-n-p transistor, acts as an emitter follower for the negative half cycles of the input, while Vt2 is cut off. Similarly, Vt2, an n-p-n transistor, emitter follows the positive half cycles.

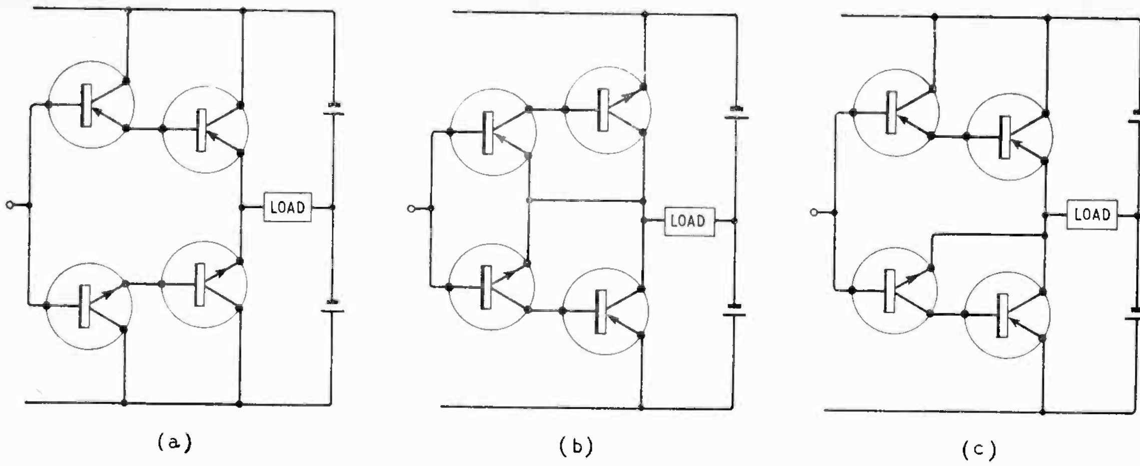
Fig. 3a shows a two-stage Class-B emitter follower having a total current gain equal to the product of the current gains of the individual stages. The voltage gain is slightly less than unity, as would be the case with the analogous cathode-follower circuit, each stage having 100 per cent voltage feedback.

A different arrangement of the same transistors giving the same result is shown in Fig. 3b. This consists of two grounded-emitter stages with 100 per cent voltage feedback over the two stages together (as opposed to over each stage separately as in Fig. 3a). The voltages, currents and dissipations of the various transistors are the same at any point of the waveform in both arrangements.

From Figs. 3a and 3b is derived the arrangement of Fig. 3c which has the advantage that both output power transistors may be of the p-n-p type.

All three arrangements will give equally satisfactory results, however, with suitable transistors.

The voltage amplifier (see Fig. 4) consists of two directly-coupled grounded-emitter stages in cascade. Vt1 works with a low value of collector-



ig. 3 (a) Two-stage push-pull Class-B emitter follower. (b) Two-stage push-pull Class-B grounded-emitter amplifier with 100 per cent voltage feedback. (c) Hybrid circuit derived from (a) and (b).

emitter potential and with a small collector current, thus ensuring a low noise factor.

Complete Amplifier (Fig. 4).—The voltage and current amplifiers are d.c. coupled, and the complete amplifier has d.c. feedback around it via R_{16}, which stabilizes the working points of all the transistors. The quiescent current in the output stage Vt5, Vt6, is set by R_9, in series with the diode D1, about 10-20 mA being suitable. The d.c. working point of the output of the amplifier (Vt6 collector) should be half the supply voltage with respect to earth, and should be set up if necessary by varying R_1.

The diode D1, is biased in the conducting direction on a portion of its characteristic giving a high degree of voltage stabilization across it, with change of current through it (Fig. 5). This stabilizes the output stage quiescent current against supply voltage variations, and also reduces the effects of temperature on the output stage quiescent current, provided that the diode is attached to the same heat sink. R_{14}, R_{15} are included to give good thermal stability under adverse conditions.

Values of components are given for two typical versions of the amplifier (see Table 1). Version 1 is designed to give 10 watts into a 15-ohm speaker from a 40-volt supply. Version 2 is designed to give 10 watts into a 4-ohm speaker (or 3½ watts into a 15-ohm speaker) from 24 volts. The design is extremely flexible and easily adapted for other needs. Maximum theoretical power output is $V^2_{batt}/8R_L$ but in practice is only about $V^2_{batt}/10R_L$.

It might be thought that the use of a Class-B output stage in an amplifier for high fidelity applications is undesirable, and would lead to considerable distortion, especially high order harmonics. The distortion introduced at the cross-over point of the output stage characteristic may, however, be kept low by a suitable choice of quiescent current, and the total amplifier distortion may be reduced to any desired level by negative feedback. The application of the high values of

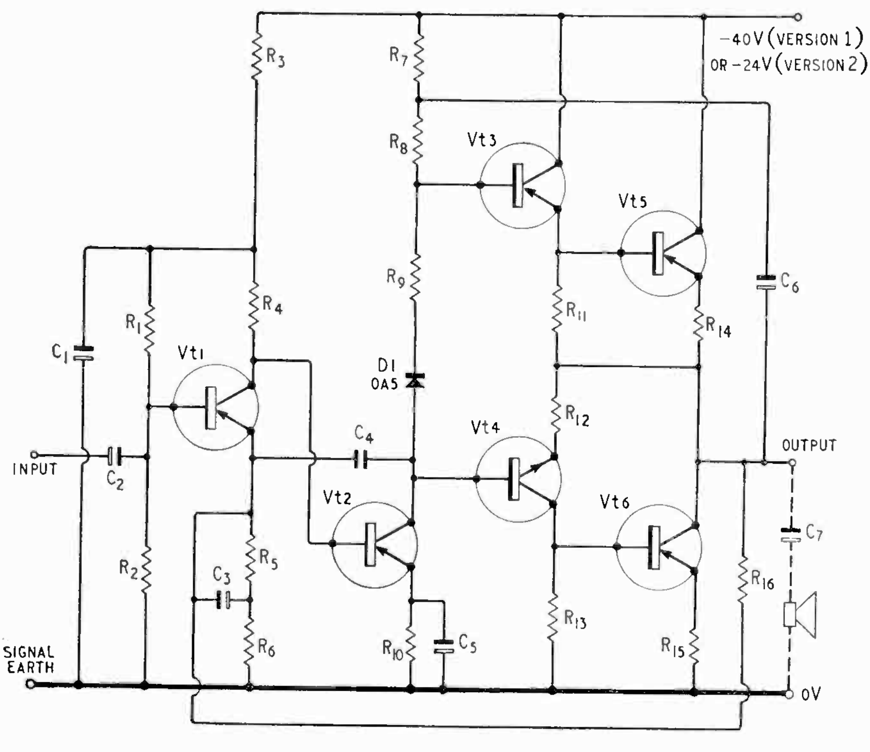


Fig. 4. Power amplifier circuit.

TABLE 1
Component Values for Power Amplifier

Component	*Version* 1: 40 volts 15 ohms		*Version* 2: 24 volts 4 ohms	
Resistor	*Value*	*Remarks*	*Value*	*Remarks*
R1	270kΩ	See Text	330kΩ	See Text
R2	56kΩ		56kΩ	
R3	68kΩ		22kΩ	
R4	22kΩ		22kΩ	
R5	220Ω		150Ω	
R6	33Ω	H.S.	33Ω	H.S.
R7	1kΩ		470Ω	
R8	4.7kΩ		1.5kΩ	
R9	22Ω	See Text	10Ω	See Text
R10	560Ω		270Ω	
R11	150Ω		150Ω	
R12	10Ω		3.3Ω	W.W.
R13	150Ω		150Ω	
R14	1Ω	W.W.	0.5Ω	W.W.
R15	1Ω	W.W.	0.5Ω	W.W.
R16	3.9kΩ	H.S.	2.2kΩ	H.S.

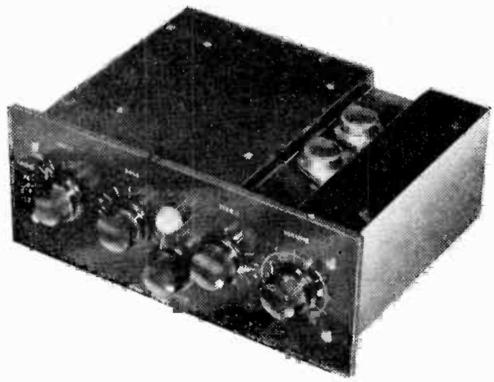
Capacitor	*Value*	*Remarks*	*Value*	*Remarks*
C1	1μF	25V wkg	1μF	25V wkg
C2	50μF	25V wkg	50μF	25V wkg
C3	100μF	6V wkg	100μF	6V wkg
C4	1000 pF		2200 pF	
C5	100μF	6V wkg	100μF	6V wkg
C6	25μF	50V wkg	50μF	25V wkg
C7	1500μF	25V wkg	2500μF	25V wkg
C8 (power supply)	1500μF	50V wkg	2500μF	25V wkg

feedback needed to produce low distortion is facilitated by the transformerless technique, and the absence of transformers removes one source of particularly objectionable cross-over distortion in Class-B amplifiers, which is produced by imperfect coupling between the two halves of the primary of the output transformer.

This amplifier has feedback totalling over 60 dB (34 dB via the main loop, 26 dB locally in the output stage), and the distortion is satisfactorily low (see Table 3) being predominantly third harmonic, as would be expected in a normal well-balanced push-pull amplifier.

Advantages of Class-B Output Stage Operation. —By operating the output stage under conditions which approximate to Class B, important economies are possible in several directions, namely, in the design of the heat-sink and power supplies.

When used to amplify a speech or music input, the average dissipation in the output transistors is very small; they would, in fact, remain cool even without a heat-sink. However, with sine-wave drive (which is used for example in routine testing), a heat-sink of about 50 square inches of 16 s.w.g. aluminium bent to any convenient shape is required. A 10-watt amplifier with a Class-A output stage would require a heat-sink to dissipate at least 20 watts continuously, which would result in a large and cumbersome design. The prototype amplifier



Stereo power amplifier and pre-amplifier showing one pair of output transistors.

was built into an aluminium box which itself served as the heat-sink.

The amplifier is suitable for operation from a wide variety of power supplies. For permanent use a mains power unit may be used, which can, however, be quite rough and ready. Provided a large reservoir capacitor is used, further smoothing and

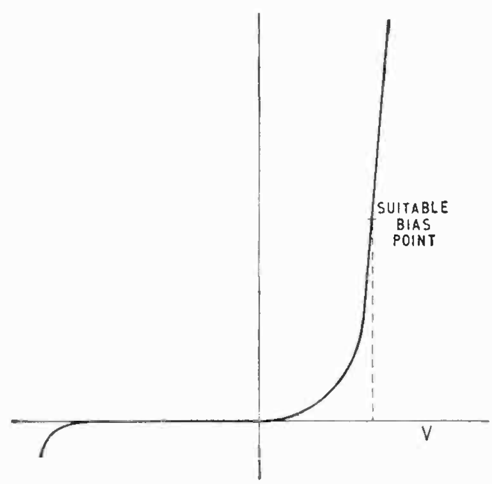


Fig. 5. Diode current/voltage characteristic.

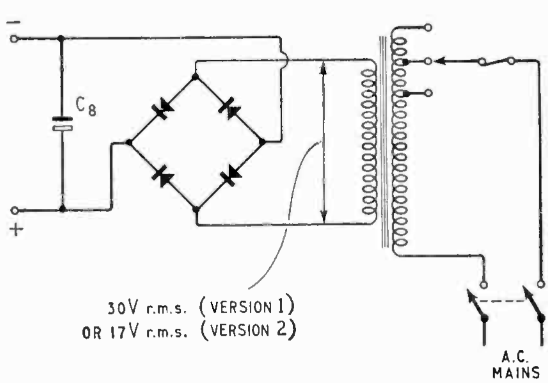


Fig. 6. Simple mains power supply circuit.

TABLE 2
Guide to suitable types of transistor for power amplifier

Transistor Number	*Type*	*Gain (Typical)*	*Version 1*		*Version 2*	
			Voltage wkg	*Typical Types*	*Voltage wkg*	*Typical Types*
Vt 1	p-n-p Small signal high frequency	High (100)	6	GET874 OC44 XA102	6	GET874 OC44 XA102
Vt 2	p-n-p	Medium (50)	40	GET111 XB121	24	GET102 OC71 XB103
Vt 3	p-n-p	Medium (30 at 100mA)	40	GET111 XB121	24	GET102 OC72 XC121
Vt 4	n-p-n	Medium (30 at 100mA)	40	2N385A 2N388A SYL1750	24	XA702 2N385 SYL1750
Vt 5, Vt 6	p-n-p Power	Medium (30 at 3A)	40	OC35 GET573 2N257 2N457 XC141	24	OC35 GET572 2N257 2N457 XC141

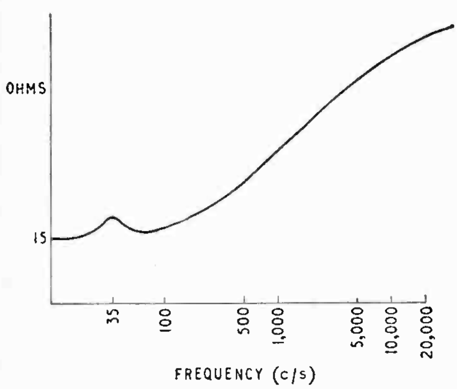
a high degree of regulation are not necessary (see Fig. 6), since under zero or low signal input, when hum is most noticeable, the quiescent current drawn by the amplifier is small, and hence the hum producing ripple on the reservoir capacitor is low.

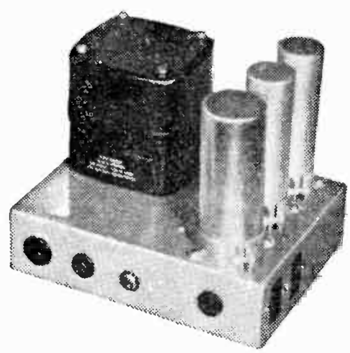
Battery supplies may also be utilized, and a surprisingly long life can be obtained from ordinary dry batteries (e.g. grid-bias batteries), especially if the quiescent current of the amplifier is reduced, at the expense of a slight increase in distortion, by shorting out R_{10}. The amplifier will operate satisfactorily down to less than half nominal voltage without component alterations, but with a reduction in power output, which is proportional to V^2_{batt}.

Transistor Characteristics Required.—The choice of transistors used in the amplifier is not critical, but the basic requirements of each part of the circuit must be satisfied.

It will be seen from Table 2 that ordinary p-n-p power transistors are used in the output stage, whose current gain falls appreciably at the high end of the audio-frequency band. However, this does not cause a corresponding reduction in performance because the impedance of a typical moving-coil speaker increases with frequency, see Fig. 7, (and hence the current it draws falls) at a rate which, in fact, more than offsets the decrease in current gain of the output transistors. The amplifier is designed to work into an inductive lead, as given by a normal speaker or speaker combination.

Fig. 7. Impedance characteristic of typical moving-coil loudspeaker.





Power supply for stereo power amplifier and pre-amplifier.

If, however, an amplifier is required to work into a resistive or capacitative load (e.g. an electrostatic speaker) the use of power transistors having a high α cut-off frequency, such as the Mullard OC23, would be worth-while.

Transistors Vt2 to 6 must be able to stand the full supply voltage in the cut-off condition.

Stability.—Even though the feedback loop does not contain a transformer, care is needed if the

(*Continued on page 569*)

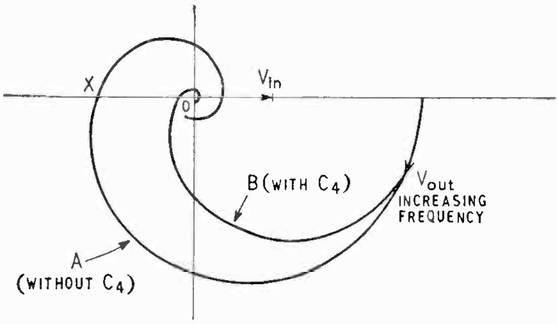


Fig. 8. Open-loop Nyquist diagrams of amplifier with (curve B) and without (curve A) the stabilizing capacitor C_4.

amplifier is to have an adequate margin of stability under all conditions, since the transistors give appreciable phase shift at frequencies where high loop gain is needed for good performance.

The amplifier contains two subsidiary feedback loops within the main feedback loop, both of which contribute to maintaining stability. One loop consists of the output stage and driver stage, which have 100 per cent voltage feedback, thus reducing the phase shift at high frequencies due to these two stages. The voltage amplifier stages Vt1, Vt2, have feedback around them at high frequencies, via C_4, so that the voltage amplifier approximates to a single active dominant lag.

In Fig. 8 Curve A shows the open-loop Nyquist diagram of the amplifier without the stabilizing capacitor, C_4. From the length of the intercept OX, on the X axis it will be seen that very little overall loop gain is required to make the amplifier unstable. The addition of C_4 gives Curve B, which is much more satisfactory.

Earthing.—The correct connection of earths (see Fig. 9) is essential if distortion is to be avoided, since the earth wire to the output stage carries large asymmetric earth currents, from the Class-B output stage, which can produce appreciable voltages across quite short pieces of wire. If these voltages are coupled into the input of the amplifier even harmonic distortion will be produced.

Noise.—The performance of the amplifier with regard to noise, and, when used with a mains unit, hum, is extremely good, being better than 85 dB down on full output.

A word of warning however: the noise depends almost entirely on Vt1, and, although the conditions of operation are chosen to minimize noise, the occasional specimen may be found unsatisfactory in this respect, when it should be changed. In fact, transistors are extremely variable in this parameter—the author has found variations of 50 dB in noise factor between transistors of the same type from the same packet. Transistors with a doubtful past history of use (or abuse) are particularly to be avoided on this account.

TABLE 3

Performance of Power Amplifier

Power output	10 watts at 400 c/s
Total harmonic distortion ..	0.25 per cent
Second harmonic distortion ..	0.1 per cent
Third harmonic distortion ..	0.2 per cent
Fourth harmonic distortion ..	0.05 per cent
Fifth harmonic distortion ..	0.04 per cent
Sixth harmonic distortion ..	0.02 per cent
Distortion for harmonics higher than the sixth	Less than 0.01 per cent
Output impedance	Less than 0.25 ohm
Input impedance	33 kilohms
Input voltage for 10 watts output	100mV
Voltage gain constancy	Within ± 1dB from 40 c/s to 20 kc/s. (The bass response can be extended if desired by increasing C_3)

Layout.—The layout of the power amplifier is not at all critical, and with suitable screening they may be mounted in close proximity to the pre-amplifiers. Thus, for the prototype, two of the 40-volt, 10-watt amplifiers were made up on printed circuit boards, and used in conjunction with a four-transistor stereophonic pre-amplifier. The complete unit has a front panel 8½in × 3½in and is 6in deep. (Power supplies were kept separate, as the unit is very suitable for operation from batteries.)

The power amplifiers are mounted on the top and base plates of the unit, and a channel in each of these housed the output transistors (see photographs). This heat-sink is quite adequate for the output dissipation, even on short-term sine-wave testing at full output power.

As with all transistor apparatus, a little care when first switching on the newly-built equipment will often save an expensive catastrophe. The voltage should be applied slowly, preferably from a dry battery, so that the presence of any fault current is discovered before damage is done.

Associated Equipment.—While the amplifier is sensitive enough to work directly from a crystal

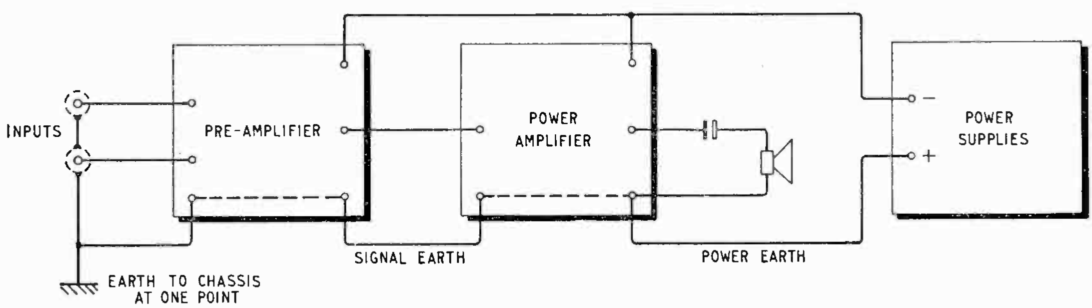


Fig. 9. Earthing diagram for power amplifier and associated equipment.

pick-up, it must be driven from a low impedance source (i.e. less than 10 kilohms) if the full value of feedback is to be operative.

The design of a suitable pre-amplifier, incorporating all the usual refinements, will be the subject of a future article.

Performance.—The performance of the amplifier has proved very satisfactory, and subjective listening tests have confirmed the results obtained in the laboratory (see Table 3). It is possible to apply more feedback to the amplifier and reduce the distortion still further, but it is doubtful if any worthwhile benefit would result, and the lower sensitivity would complicate the design of the pre-amplifier.

High frequency tests on the amplifier should be carried out using a dummy load simulating the impedance of a loudspeaker, i.e.: for a 15 ohms loudspeaker: 15 ohms + 1 mH; and for a 4 ohms loudspeaker: 4 ohms + 0.25 mH.

Putting the Computer to Work

SEQUENCE OF OPERATIONS ILLUSTRATED BY A SIMPLE ELECTRICAL CALCULATION

By WILLIAM McMILLAN*

Although readers of this journal have been kept up to date on the electronic elements of digital computers, they may be less clear about what people do with the complete machine when it is assembled and ready for use. This article describes a computer installation and illustrates its use by a familiar example.

THE upsurge of interest in computers, accelerated to some extent by the recent Electronic Computer Exhibition, has caused many electronic engineers and businessmen to take a fresh look at the subject. Unfamiliar terms used by logical designers and programmers have perhaps tended to make computer operation appear more difficult than it is. This article is intended to help dispel this illusion.

The various units which make up a typical computer installation are shown in Fig. 1. The particular installation shown here consists (reading from left to right) of:—

1:—The computer cubicle, which contains the electrical circuits and storage medium. The computer draws its special power supplies from a separate cubicle which is not shown in this picture. The power cubicle is about half the size of the computer cubicle.

2:—Two high-speed tape readers.

3:—The computer input control panel.

4:—The "on-line" teleprinter.

5:—Two "on-line" high-speed tape punches.

6:—The "off-line" tape reader.

7:—The "off-line" teleprinter.

8:—The keyboard tape perforator (for the preparation of the "programme" and "data" tapes).

From this it will be obvious that although the computer is the heart of the installation, a great deal of other equipment is needed to make full use of its capabilities.

These "Input" and "Output" devices are necessary to put information into a form which is usable by the computer and to reconvert the computer output signals—electrical pulses—into printed form.

The Computer — What's Inside?—The most important feature of an electronic computer is its ability to store numbers. In many computers a magnetic drum is used for this purpose, there being many

* Standard Telephones and Cables Ltd

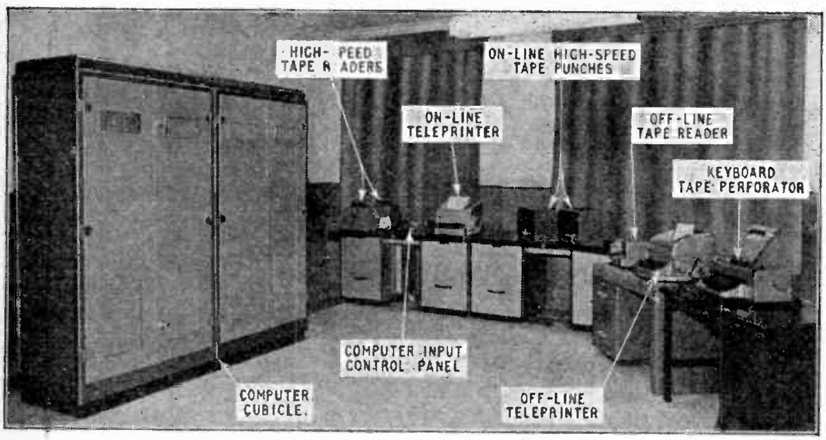


Fig. 1. Typical Stantec Zebra installation showing the computer and peripheral equipment.

different "locations" on the drum to which numbers can be directed for storage. Each location consists of a narrow strip of the magnetic coating on the surface of the drum; each strip will accommodate a number of discrete, magnetized, "spots" which make up a "word".

The convenience of using binary (two-state) techniques in the electronic circuits of computers becomes evident when the magnetic drum is considered; it means that only two magnetic conditions are needed—magnetized and un-magnetized.

The drum store has a large number of read/write (record/reproduce) heads placed around it, each a little further down the drum than its neighbour. Some idea of the compactness of this type of store is given from Fig. 2. This drum, which revolves at 6,000 r.p.m., is only 6 inches in diameter and 15 inches long, yet it can hold 8,192 computer words, each of 33 digits. This is a density of nearly 1,000 magnetic spots every square inch of drum surface. It is not surprising, therefore, that storage drums have to be made to a very tight specification.

Whenever something mechanical is introduced into electronic circuitry, an appreciable delay is also introduced. The mechanical element here is the rotating drum. When a word has been written into a location on the drum, the drum has to complete one revolution before the word can be read again. Even at 6,000 r.p.m. this takes time!

Some computer calculations require the reading of particular words every revolution of the drum and this mechanical delay—it is called "access time"—can accumulate into many minutes. The maximum access time on a store of the type described is 10 msec. Much of this time can be saved, however, by the well-trained programmer, who writes the instructions for the machine.

The whole operation can be speeded up immensely by the use of "immediate access registers". These are a number of tracks on the drum with several read/write heads connected together. No sooner has a word been written than it is available for reading.

But why not do this to the whole store to give higher overall speed? The answer is simply that this technique is wasteful of drum space. A compromise solution is to provide a small number of immediate access registers which are used for storing those numbers which are most frequently required in calculations. This increases considerably the overall speed of the computer.

For really high speeds, this mechanical link in the computer chain is gradually being replaced by the ferrite store. This consists of a grid of tiny ferrite rings each of which can have one or other of two magnetic states and thus can store one binary digit signal. Because there are no moving parts, ferrite stores give fast access and make for a faster computer. For the same storage capacity, however, ferrite stores take up more room than a drum and, at present, cost more. Nevertheless, more and more computers in the future will have ferrite or other rapid access stores. For example, thin films of magnetic material can also be used for storage; discrete, small areas of the film each forming a one-digit store.

Where a great deal of information has to be stored for use in calculations in a computer, it is necessary to have "backing" stores which back up the relatively small, main store. Backing stores are usually reels of magnetic tape, driven by fast electric motors. Naturally, as it takes the computer some time to run through a reel to look for a number, the numbers stored there are those not often required. Magnetic tape stores can be speeded up by using more tape mechanisms, with a correspondingly shorter length of tape in each.

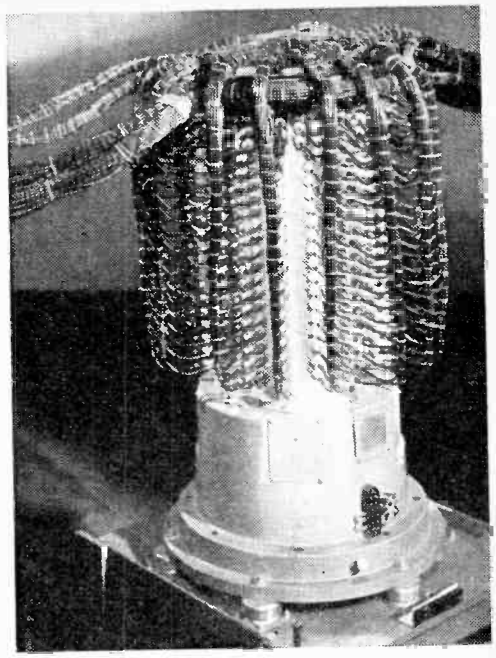


Fig. 2. Magnetic storage drum used in the computer of Fig. 1.

The recent introduction of several types of "random access" store will overcome some of the delays inherent in large magnetic-tape stores. Random access stores may use magnetic cards or punched cards which can be picked out quickly from a stack, have their information read, and be put back again without the necessity for reading all the cards, one after the other. Using a random access store is akin to using the index of a book: it saves you reading every page to find a particular reference.

Inputs.—There are several ways of feeding information into a computer: by the use of punched paper tape, a telephone dial, a prepared magnetic tape, or punched cards. At present the most widely used medium is punched paper tape. A typical machine uses a 5-hole punched tape. The 32 combinations of "hole" and "no hole" in these five positions make it possible to use this number of characters in any code used for operating the machine.

To feed instructions into the computer one must begin by producing a punched tape on the keyboard perforator (Fig. 3). Operated like a typewriter, the perforator punches patterns of holes in a paper tape according to which keys are pressed. The perforator has several differences from a typewriter, however, but very little practice is needed for perfection.

The operator must first "run-out" enough blank tape to allow for threading it later into a tape reader. To run-out blank, the O key is pressed once, followed by the "run-out" key; this results in a machine-gun-like issuing forth of tape as long as the run-out key is held down. This done—about

12in of blank is enough—the programme of instruction may be punched on the tape. The make-up of a typical programme is described later.

At the end of the programme, more blank tape should be obtained by the O key, followed by a short burst of # and run-out. The final # pattern distinguishes the end from the beginning of the tape. It is essential that this tape is now marked for identification, to avoid confusion later.

Depending on the importance of the work, the complexity of the computor instructions and the competance of the operator, this tape may be used as it stands or, more usually, it is checked using a tape verifier. The verifier has a keyboard upon which the instructions are again keyed. As keying proceeds, the tape is passed through the verifier and, in the event of a difference between the first and second keying of the programme, an alarm lamp indicates a possible error in the original tape or in the second keying.

When a "clean", verified tape is produced, it can then be "read" and its instructions fed into the computer, via a tape reader.

There are several types of tape reader. One type which is widely used is the high-speed photoelectric tape reader (Fig. 4). This illuminates the tape from one side, the pattern of holes producing voltages in five tiny photo-transistors. These voltages are fed into the computer.

The tape is loaded into the reader and the guide clamp is pressed to hold it in position. A button on the reader is pressed "to set" it ready for action. The computer control panel (Fig. 4) has a key marked CLEAR, which is held down for a second or two; it sets the computer circuits so that when the new tape information is read into the instruction store, it automatically over-writes, erasing all previous information held in this store. Our typical computer is of the "stored-programme" type, which takes in its instructions and stores them for execution when required.

The tape reader is set. The clear key has been pressed. All that remains is the START key on the control panel which, when pressed, starts the reading operation on the tape. With a short programme this will take only a few seconds, with long programmes, it can take many minutes to read the whole tape into the store.

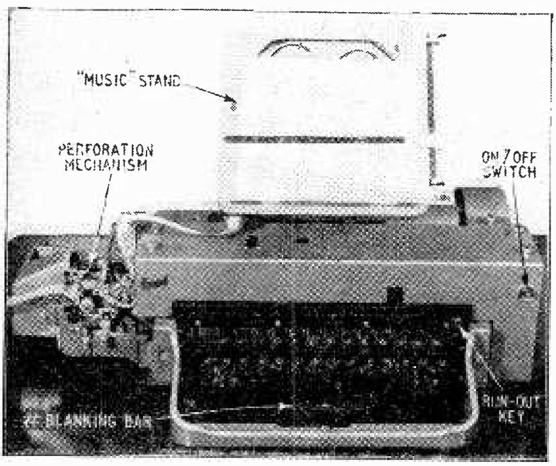


Fig. 3. Keyboard tape perforator.

When the tape has been read, it may be removed from the tape reader and stored for future use.

Some computer programmes are arranged so that numbers can be dialled into the computer, using an ordinary telephone dial on the control panel; usually, the various digits have to be dialled in fairly quick succession in case the computer accepts a part as the whole number. There is a small loudspeaker on the computer control panel which "squeaks" when the computer reaches a dynamic stop, or when dialling has been completed. This gives a check on the response of the computer to the dialling process.

Outputs.—Computers work so quickly that it is difficult to feed information into them and print out results fast enough to use their capabilities to the full. But high-speed tape readers have been developed and there have been important advances in print-out machines. One recently announced printer prints 2,880 lines per minute.

However, a very fast printer may cost almost as much as the computer itself, or even a lot more. Its cost would be justified only on highly repetitive data processing work such as invoicing, stock control and payrolls.

For solving straightforward scientific or engineering problems on a computer where time is not too severely rationed, a teleprinter may be coupled "on line", that is, directly to the computer.

As with tape readers, perforators, verifiers, punches and the rest, one must not forget to switch on the teleprinter before expecting it to print results! Other than this, and checking that there is sufficient paper to feed the teleprinter, there is nothing more to be done about printing out. In the latest Creed teleprinter the paper does not move laterally as a typewriter roller does; instead, the type mechanism moves across the roller. This makes for easier reading of the message while it is still being printed; it also means a more compact design of teleprinter.

An alternative to the fast printer which is connected directly to the computer is the technique of using an on-line high-speed paper tape punch or a magnetic tape unit to store the output data for printing out at leisure on relatively much slower teleprinters. Many computers for research work use this "off-line" printing technique, which keeps the cost of the computer installation low.

The choice of on-line teleprinter or tape punch is normally made when the computer programme is written, the appropriate instruction being punched into the input tape, although the decision can be deferred until the computer is being set up for a run.

The on-line punch has a RUN OUT button on top which is held pressed for a few seconds before computation begins. This gives a length of blank tape upon which its identity is written. The operation of the punch is automatic, the tape being poured out into a bin. When the computation is complete, the tape is torn off the punch and rewound to form a spool, ready for printing out on the off-line teleprinter.

The equipment for off-line printing usually consists of one or more sets of tape readers (medium speed) and teleprinters, the number of sets depending upon the amount of work and the time available.

The tape from the on-line punch is threaded into

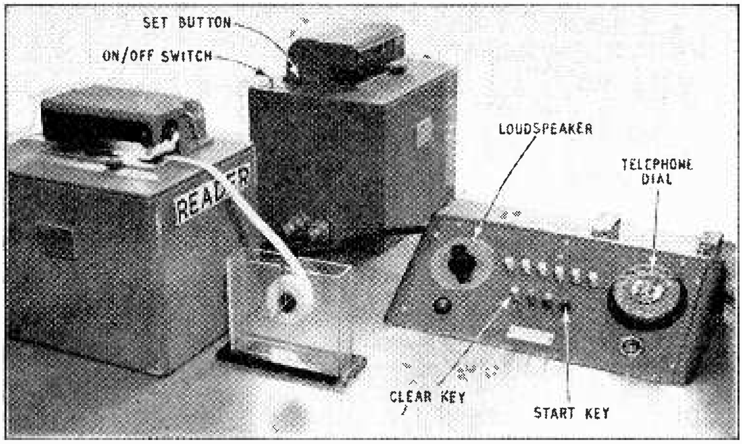


Fig. 4. Two tape readers (left) and computer control panel (right).

a tape reader. The teleprinter, suitably loaded with paper, can be left to print out results without attention. Any fault in the tape which jams the reader will stop the operation and an audible or visual alarm can be given.

When the computer is used for regular data processing, such as invoicing, stock control or payroll, the teleprinter paper is pre-printed with standard details and column ruling on the top and carbon copies. After the initial lining up on the teleprinter, this stationery emerges with the teleprinter information in the appropriate places.

Programming.—A programme is a set of instructions to enable the computer—a rather dumb creature in itself—to carry out a particular kind of calculation.

Programmes for early machines were written by skilled mathematicians who often found it difficult to explain the operation to less mathematically minded people. But most manufacturers soon realized that if they were to sell computers on sufficiently large a scale, new, simplified methods of programming would be needed, which would enable the intelligent layman to use a computer. Thus, gradually, more and more manufacturers announced facilities for automatic coding of programmes. One of these simplified procedures is described here.

Almost without exception, the use of such an "auto-code" means a sacrifice in operating speed and computer storage capacity. But this is offset by the fact that more and more people can operate the machine, with the minimum of training.

The normal codes for individual machines are complicated enough to require a training course lasting many weeks. The simplified codes reduce the training period to a few days, or even hours, according to the intelligence of the student and the extent to which he wishes to know the machine.

High computational speeds are wasted on the majority of laboratory and industrial concerns who use the computer for a variety of different jobs. On such tasks the preparation of a complicated programme in ordinary "machine code" may be out of proportion to the importance of the overall task.

It is nearly always quicker and better for a scientist or engineer to write his own computer programme than to have to explain the nature of the problem to a professional programmer before the programme is obtained. In these circumstances, the use of an auto-code is well justified.

The auto-code makes use of various "sub-routines" which are built into the computer to produce computers within a computer. Auto-code instructions are fed into the computer which operates on them to produce an internal equivalent programme in basic machine code before carrying them out.

All this takes up computer time and storage space. Sometimes a calculation takes four or five times as long when written in the easy, auto-code, compared with normal machine code. This difference is usually minimized by the programmer when he writes the programme.

In the computer described here, the usable store,

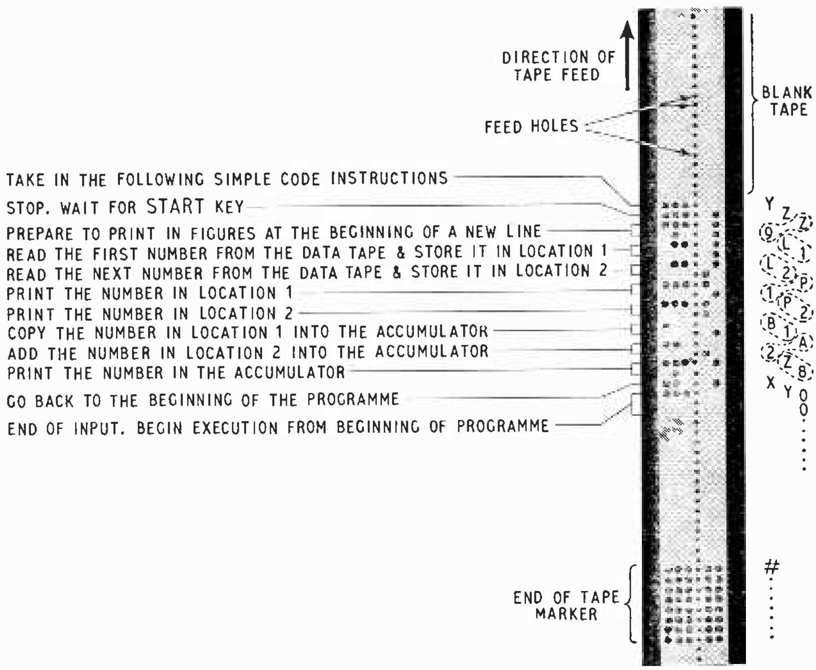


Fig. 5. Programme tape for the addition of two numbers.

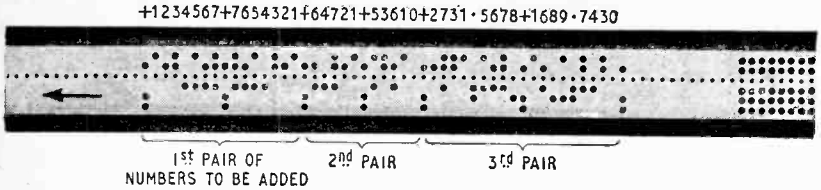


Fig. 6. Data tape for the addition of three pairs of numbers.

normally 8,192 words, is reduced to about 3,000 words by the storage of auto-code routines.

To illustrate the Zebra Simple Code, which is a typical auto-code, the following problem is set out and solved:—

Programme: Read and print two numbers, add them together and print the answer.

Data:		
	1234567	+ 7654321
	64721	+ 53610
	2741.5678	+ 1689.743

Once the programme has been fed into the computer, an unlimited number of pairs of numbers can be fed in, the answers being printed out within a few milliseconds of the second number of each pair being read by the tape reader.

The programme for adding two numbers is shown in relation to the punched programme tape, in Fig. 5. It is derived as follows:—

The first symbol, the letter Y, is pressed on the tape perforator. Y always comes first in a Simple Code programme and it tells the computer that the programme and data to follow are written in Simple Code and to set the internal switching circuits accordingly. The Y symbol then, introduces the subroutines which convert the instructions which follow into basic machine code.

The next instruction, Z, is inserted at this point so that when the programme is later executed by the computer, the computer will stop and wait for the operator to press the start key. It introduces a pause to enable the operator to remove the programme tape from the reader and to insert the tape containing the numbers required for the calculation (the "data tape").

The instruction which follows is a composite one, Z9, which sets the circuitry so that the output teleprinter prints in figures at the beginning of a new line.

Most Simple Code instructions begin with a letter, which may be followed by a one- or two-digit number.

The machine autmatically knows when a particular instruction is completely read when it reads another letter, i.e., the first part of the next instruction.

Having warned the computer that we are about to instruct it in Simple Code language, and prepared it to print out figures, we then ask it to read the first number of the first pair to be added (1234567) and to store this number in location No. 1 of the store. The instruction for this is L1.

The next instruction, L2, means "read the next number from the data tape and store it in drum location No. 2".

So that there is a complete printed record of each calculation, we next tell the computer to print out these two numbers which are to be added together. The instructions are P1 and P2, meaning "print the numbers in locations Nos. 1 and 2". These numbers will be printed on the same line, since we have not instructed the teleprinter to excute a "carriage return". Care has to be taken that the number of digits (and spaces) likely to be printed out on the teleprinted page does not exceed 68; if this is likely, a Z9 instruction has to be inserted in the programme in the appropriate place.

As all calculations are carried out in the computer's "arithmetic unit", or "accumulator" as it is also called, these numbers must be brought from their respective drum locations into the accumulator. The instruction B1 means "copy the number in location No. 1 into the accumulator".

The copying of a number from its location does not remove it from the location; the number remains, in the same way as the music on a tape recording remains in spite of being read over and over again by the reproducer.

The next instruction is A2, which is the key instruction in this particular programme, namely, "add the number in location No. 2 into the accumulator". If we wanted a programme to multiply these two numbers, all other instructions would have been the same as in the programme, except that A2 would become V2. Similarly, to subtract these two numbers, A2 would read S2. To divide the first number by the second, the instruction would be D2.

Having done what we set out to do, namely, to add two numbers, we print out the answer. The instruction is Z8, which means "print what is in the accumulator".

The X instruction means "go back to the beginning of the programme". It is followed by Y and at least two zeros; this Y00 instruction means that we have reached the end of the programme. It tells the computer to start carrying out the programme which it has now stored away.

To finish off the programme tape, a succession of # codes is punched. By this means one can tell the end of the tape from the beginning. The tape is then torn off from the perforator and an identification message written on it such as "programme tape for the addition of two numbers".

This tape is now ready for verification and for feeding into the computer tape reader. The method of feeding the programme tape into the computer has already been described: the clear key and the start key are used.

When the computer stops, as signified by a whistle in the loudspeaker, the operator knows that it has taken in the programme, started executing the instructions and has reached the Z stopping point. He then removes the programme tape from the reader and inserts the data tape on which the various pairs of numbers have been punched, ready for summing.

The data tape is punched with a + sign between each number and the next. The sign has the added

(*Continued on page* 575)

significance of separating the numbers. Tapes using + signs can equally well be used on a programme for subtracting, dividing or multiplying two numbers, the + meaning a positive number.

Unless the start key is locked on, the computer will deal with only one pair of numbers at a time, stopping each time to wait for the start key.

The time taken to feed in the programme is only a second or two, and this does not need repetition for each pair of numbers. The time taken up on operation consists almost wholly of teleprinter time; the computation time being negligible, In fact, the answer is queuing up waiting for the teleprinter to print it out!

To make more efficient use of the computer, it is possible to insert an instruction into the programme to have the teleprinted message recorded on another paper tape at a high speed. Instead of the on line teleprinter giving the numbers and their sum, these figures are punched out on the Teletype punch for processing on the off-line reproducer equipment at the slower, teleprinter speed. Meanwhile, the computer is free to go on with other work.

The programme given above would be modified as follows:—

Y Z Z23 L1 L2 P01 P02 B1 A2 Z22 X Y00.

the instructions which are underlined are those concerned specifically with producing an output from the on-line tape punch.

The data tape for all of these programmes of addition, subtraction, multiplication, division for on-line or off-line printing would be punched as shown in Fig. 6. This shows the figures separated by plus signs and the tape finished off in the usual way.

Printing The Answers.—One of the advantages of this Simple Code is that it has "floating point" decimal notation. In this notation all numbers are expressed as decimal fractions followed by a digit which indicates the number of places by which the decimal point must be moved to give the true number.

Thus 0.1674932+4 means 1674.932 (move point four places to the right), and 0.65012437−7 means 0.000000065012437.

Although the computer can print out only nine significant figures, the floating point technique enables it to handle very small and very large numbers. This is because the conversion to floating point form occurs only after the calculation has been completed and before printing out.

Quite often it is difficult to forecast the order of magnitude of the answer to a problem and it may well be outside the handling range of the normal machine code. In these circumstances the Simple Code should be used.

The print-out in Fig. 7 shows how the floating point technique appears.

More Complex Programmes.—Using the Simple Code "dictionary" and some common sense it is possible to write programmes for more complicated problems. Obviously, there is little point in using up time and effort in writing a programme for a problem which arises just once. In research work, however, there is often a complicated formula which occurs, involving a set pattern of variables and constants. For this type of problem the time spent writing a programme becomes worthwhile.

It would defeat the object of this article to go into the working of complex problems but the following example should be sufficient to show how Simple Code is applied. It forms *part* of a longer calculation in electrical network design. The purpose of this little part of the programme is to evaluate $R_1 R_2$ (R_1+R_2) and put the answer in location No. 12 for use later. The formula is the well-known one for obtaining the equivalent resistance of two resistors in parallel. (The values of R_1 and R_2 are already stored in locations 10 and 11.)

1st. NUMBER OF EACH PAIR			2nd. NUMBER OF EACH PAIR			SUM		
+0.123456700	+	7	+0.765432100	+	7	+0.888888800	+	7
+0.647210000	+	5	+0.536100000	+	5	+0.118331000	+	6
+0.273156780	+	4	+0.168974300	+	4	+0.442131080	+	4

FLOATING POINT DECIMAL NOTATION

Fig. 7. Print-out answer to the problem of adding three pairs of numbers, illustrating the "floating point" decimal notation.

The programme is:—

B10:—Copy R_1 value in location No. 10 into accumulator.

A11:—Add R_2 value to the accumulator.

T13:—Transfer the number in the accumulator (R_1+R_2) into location No. 13.

B10:—As before.

V11:—Multiply the contents of the accumulator by the number in location No. 11.

D13:—Divide the contents of the accumulator by the number in location No. 13 (R_1+R_2).

T12:—Transfer the contents of the accumulator into location No. 12 for future use.

To take the above calculations as typical of all computer work would be misleading. Nevertheless they are typical of the use of the auto-codes which are enabling an increasing number of people to use computers directly, without the need for skilled programming services. Auto-codes also serve as a useful introduction to more advanced programming techniques.

Club News

Basingstoke.—Readers in the Basingstoke area interested in the formation of a local amateur radio group are invited by P. J. Sterry, of "Ashley," Orchard Road, Basingstoke, Hants., to get in touch with him.

Birmingham.—A demonstration of stereo equipment will be given to members of the Slade Radio Society by F. B. Griffin on November 3rd. The Club meets on alternate Fridays at 7.45 at Church House, High Street, Erdington.

Bradford.—"Modern methods of communication" is the title of the talk to be given by E. M. Price at the November 15th meeting of the Bradford Radio Society. Meetings are held at 7.30 at Cambridge House, 66 Little Horton Lane.

Cardiff Group of the R.S.G.B. meets at 7.30 on the second Monday of each month at the Territorial Army H.Q., Park Street.

Derby & District Amateur Radio Society has sent us a copy of its golden jubilee booklet giving a brief history of the Society, which incorporates the Derby Wireless Club started in 1911. This interesting 32-page booklet includes a list of Derbyshire amateur transmitters.

Halifax.—The November meetings of the Northern Heights Amateur Radio Society, which meets at 7.45 at the Sportsman Inn, Ogden, include a demonstrated talk on "hi-fi" by A. E. Falkus (1st) and a talk on convertors for 2 and 4 metres by D. Millard, G3OGV (29th).

Spen Valley Amateur Radio Society now meets on alternate Wednesdays in the Infants' School, Hill Top, Gomersal, at 7.30. On November 22nd J. C. Belcher, of the G.P.O., will be discussing interference problems.

Measurement of Harmonic Distortion

SENSITIVE DETECTOR-AMPLIFIER METHOD USING TRANSISTORS

By C. BAYLEY

HARMONIC-DISTORTION measurement is a most necessary part of the test procedure for apparatus which is supposed to exhibit a " linear " relationship between output and input. Although in itself a relatively simple test to make, the apparatus employed sometimes uses complicated filter networks which often limit the range over which measurement can be made. Described here is one of the methods which avoids the use of high-performance filters which are difficult to design and make.

Conventional Methods

There are two methods generally used in practice for measurement of harmonic distortion. One is a direct method (Fig. 1(a)) where the fundamental frequency is suppressed by the rejector network "A" and remaining harmonic frequencies are passed through the selective amplifier " B ", being finally recorded by the output meter " C ". The second approach (Fig. 1(b)) is indirect in that intermodulation products are measured: for this the basic fundamental frequency f_1 and an additional frequency f_2 are passed through the nonlinear network (" X ") under test. As a result of distortion the output from the network has, apart from the original frequencies f_1 and f_2, intermodulation products $f_2 \pm f_1$, $f_2 \pm 2f_1$, etc. The former have to be suppressed by the rejecting network "A" and the latter, being functions of the harmonics, are passed through the selective amplifier and recorded by " C ".

It is worth mentioning that the required total discrimination in the intermodulation method is approximately 12dB less than that needed in the direct system. This means that the loss for intermodulation components while passing through "A" is smaller than the similar loss of harmonic components when using the direct method.

Consequently the intermodulation method is more sensitive and also more flexible because free choice of f_2 can be made: thus this method is usually preferred for h.f. distortion measurements. Even so, while attempting to measure low distortion at a low fundamental level, very considerable gains are required in the selective amplifier " B ". If, for instance, the fundamental level is 100mV and harmonic margin say -100dB, the absolute value of harmonic voltage before entering the filter "A" is only 1μV and could be as low as 0.1—0.2μV at the input of the selective amplifier " B ". The problem of measurement of such low magnitudes is difficult and by no means is a subject only of academic interest. For instance, in multichannel carrier-telephony networks, repeater circuits etc., the presence of even very low harmonic distortion can cause cross-talk as a result of intermodulation between carrier frequencies.

It can thus be seen that the measurement of

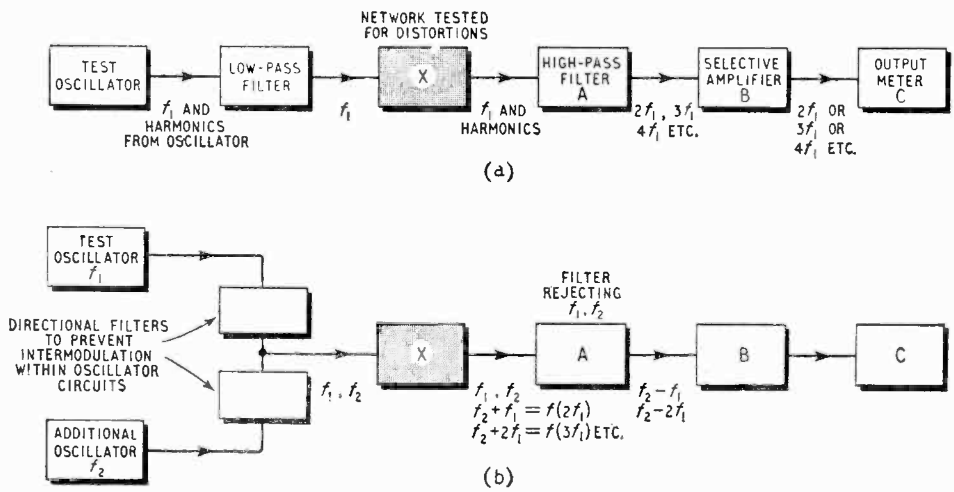


Fig. 1. (a) One conventional method for measurement of harmonic distortion: here filter " A " and selective amplifier " B " must reduce fundamental to less than experimental error allowable on smallest harmonic component. (b) Intermodulation-distortion method is less severe in demands on filter-amplifier combination.

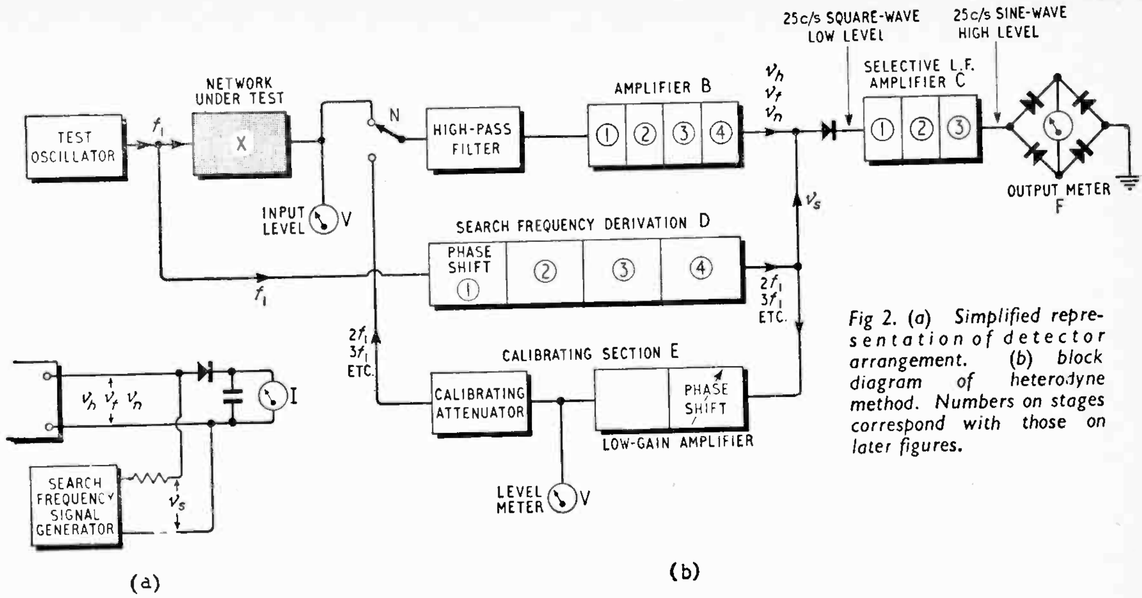


Fig 2. (a) Simplified representation of detector arrangement. (b) block diagram of heterodyne method. Numbers on stages correspond with those on later figures.

harmonic signals of the magnitude of 0.05—1μV is of importance and a method for carrying out such measurements without the use of conventional selective networks such as sharply tuned circuits or crystal filters is described here.

Selective Detection without Tuned Circuits

Application of the well-known heterodyne search method to harmonic measurements makes it possible to set up a circuit (block diagram Fig. 2(b)) which has very high selectivity. The simplified basic circuit (Fig. 2(a)) helps to illustrate how, in a heterodyne search detector, all noise plus the remains of the fundamental frequencies are suppressed and only the wanted harmonic signal is selected. We assume that linear detector " D " replaces the output meter from section " C " of Fig. 1(a). Under such conditions four signals will be applied to the detector: these are various harmonic frequencies v_h, remains of fundamental v_f, noise v_n and voltage from the search-frequency generator v_s. Assuming that if v_s is substantially larger than the other voltages and that the instantaneous value of $v_h+v_f+v_n+v_s$ would never go below the linear portion of detector characteristic during, say, 90% of the positive half cycle, the rectified current I will depend entirely upon v_s.

However, if the search frequency approaches very closely the frequency of v_h, the slow beat between these two frequencies would cause variation of I (I$\pm i$) which could be registered on a d.c. meter and the output harmonic signal v_h can be calculated from the simple relation:—

$$v_s/\mathrm{I}=v_h/i$$

It is significant that the presence of the unwanted voltages v_f and v_n up to even 10dB higher than v_h do not interfere with this measurement. Hence the required discrimination between v_h and the unwanted signals (within stages "A" and " B ") can be about 30dB smaller in comparison with a conventional detector-amplifier system (Fig. 1 (a)(b)). The arrangement shown in Fig. 2(b) employs the heterodyne principle of detection, modifying it to the specific conditions of harmonic-distortion measurements.

This circuit has four additional features which are:— 1. The search-frequency generator is replaced by the amplifier " D " whose purpose is to produce an output voltage v_s of frequency identical with the desired harmonic frequency f_h ($2f_1$ $3f_1$ etc.). The amplifier " D " is driven by a fundamental frequency f_1 which is derived from the same signal generator which is used for the main harmonic-measurement chain.

In such a case the beat frequency applied to the detector " C " will be zero and, assuming that the relative phase of v_s and v_h is $\pm180°$, the detector current I will be smaller or bigger by an amount i (there is no " swing " of I).

2. The harmonic-signal amplifier " B " has an additional stage " B_3 " which reverses the phase of the output voltage v_h by 180° at a rate of, say, 25 c/s (in other words v_h is 100% phase-modulated).

3. As a result of 1 and 2, in the detector output circuit, apart from current I, there will be also present a square-wave current of amplitude i and frequency 25c/s. This current which is proportional to the harmonic signal v_h is amplified in the selective low-frequency amplifier " C " (tuned to 25c/s) and finally registered by the output meter " F ".

4. To calibrate harmonic meter, a known calibrating voltage of the frequency of f_h should be injected at the point " N " (after disconnecting the fundamental input) to obtain exactly the same output meter indication. The calibrating voltage is derived from block " E " which consists of an attenuator and a low-gain amplifier which is fed by v_s. The low-gain amplifier is provided with a continuous phase-shift control whose function will be explained later in the text.

Operating Conditions

Before giving more details about each stage " A " to " F " it will perhaps help the clarification of the system to outline the test procedure using its principal controls. It is assumed that distortion measurements have to be made on 100mV output of network

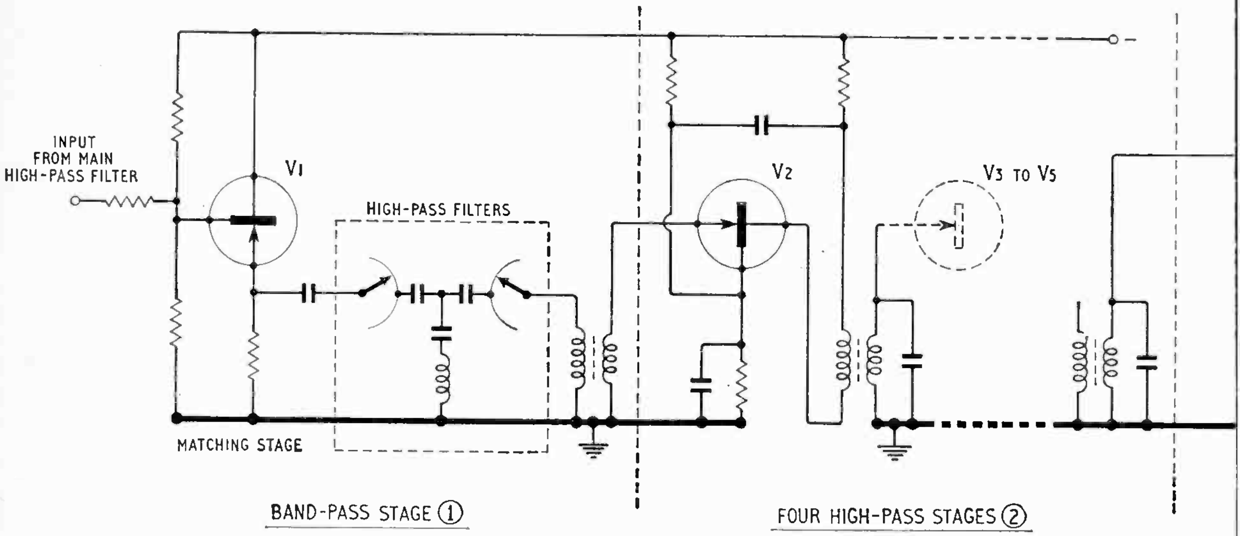


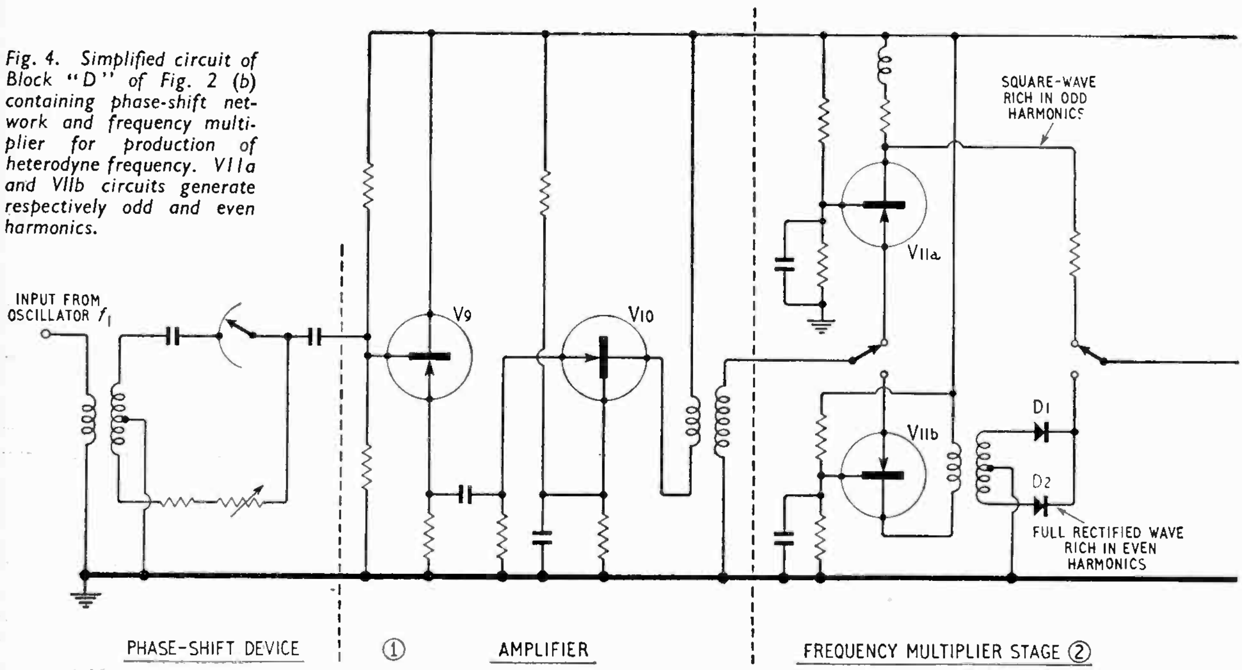
Fig. 3. Amplifier and modulator of heterodyne harmonic test-set. Circuit has been simplified by omission of detail. (Corresponds to Block B and high-pass filter of Fig. 2 (b).)

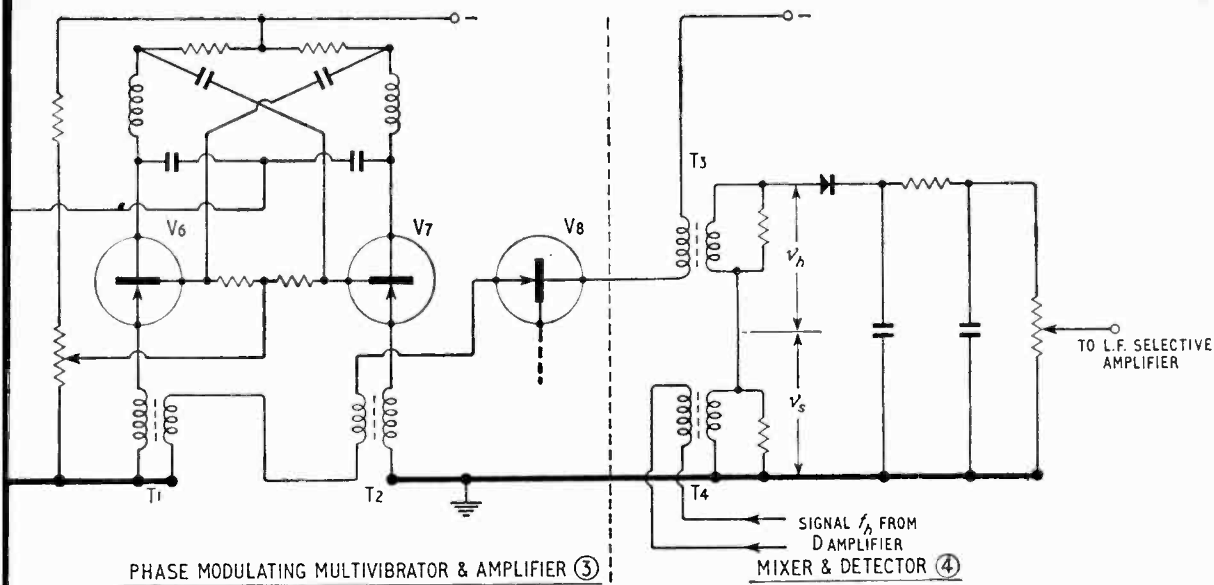
" X ". The fundamental frequency is, say, 300kc/s.

Measurement of Harmonic Signal v_h.— 1. The test-oscillator frequency and the output of the network " X " are set.
2. The high-pass filter is set to a suitable range (cut-off frequency in this case is about 450kc/s).
3. Amplifiers " B " and " D " are " tuned " to the desired harmonic frequency.
4. Sensitivity of amplifier " B " is set to the estimated range of v_h.
5. By variation of phase shift of the search frequency v_s (in block " D ") a maximum indication on the output meter should be obtained (condition for 0 or 180° phase shift between v_h and v_s). This deflection should be recorded as v_{h1} (output meter " F ").

Calibration of v_h.— 6. Input to " B " should be switched over to the output of calibrating attenuator.
7. By operation of the calibrating attenuator and phase-shift control (in block " E ") maximum indication of the output meter identical with v_{h1} should be obtained.

Fig. 4. Simplified circuit of Block "D" of Fig. 2 (b) containing phase-shift network and frequency multiplier for production of heterodyne frequency. VIIa and VIIb circuits generate respectively odd and even harmonics.





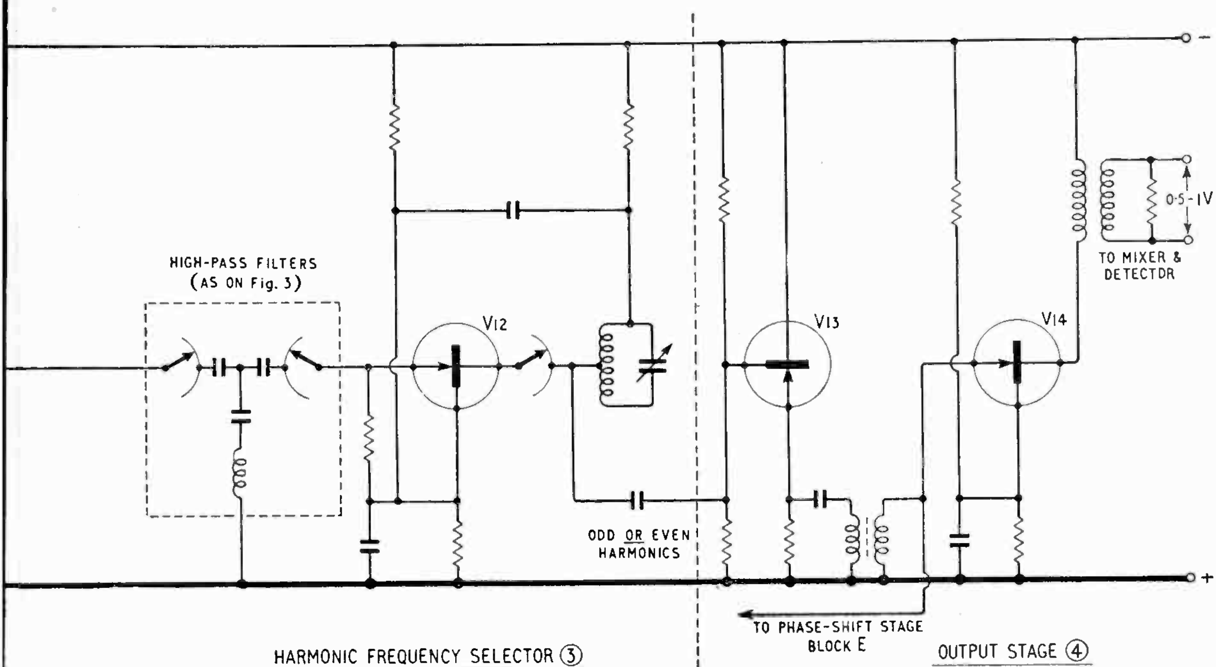
8. Absolute value of v_{h1} is read then from calibrating attenuator (say 2μV).
9. Finally, the harmonic component may be computed as, say, $2\mu v/100mV=0.0002$ (i.e. -86dB).

Analysis of System

As can be seen from the above operating procedure the measurement of harmonic content is relatively simple with this apparatus. This simplicity extends to the demands made by the circuit details themselves.

Amplifier-Modulator.—(Fig. 3). Wide-pass-band filters with step-selection of cut-off are employed in the first section of amplifier "B" (their purpose is to reduce noise and remnants of the fundamental) and these filters are the only frequency-discriminating networks in the whole of block "B". The second part of "B" consists of multistage h.f. untuned transistor amplifier (only one stage is shown).

This is followed by the modulator which works on the principle of an electronic switch (employing an l.f. multivibrator). The h.f. signal is applied to both collectors of the multivibrator and is alternately directed to the primary windings of the h.f. transformers T_1 and T_2. The secondary windings of these transformers are connected in series and by the proper connection and by balancing of the



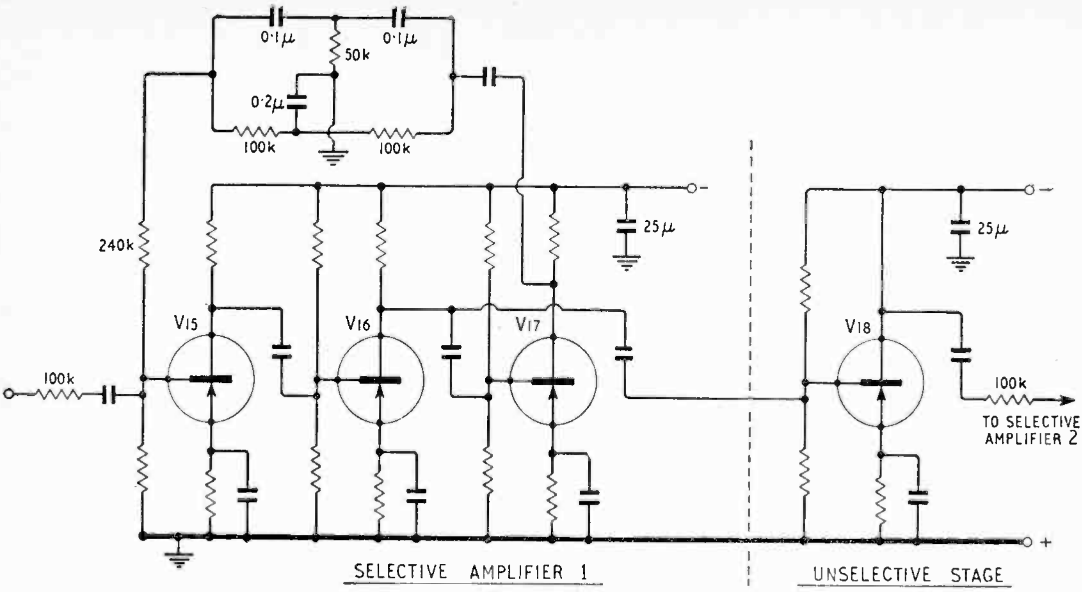
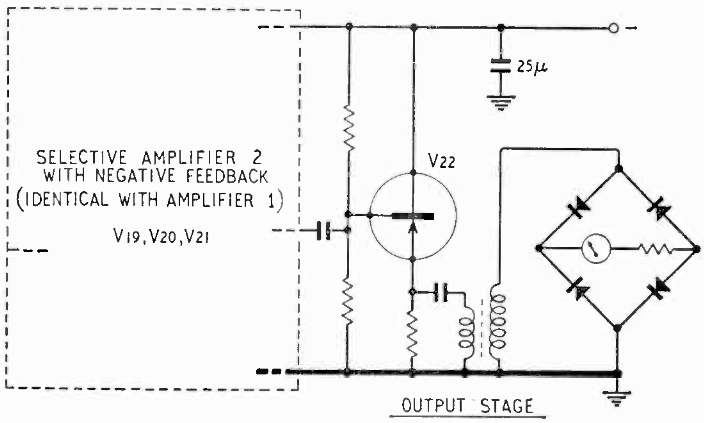


Fig. 5. Selective amplifier corresponding to Block "C" of Fig. 2 (b). V15-V16 and V19-V20 are isolated from each other by V18. V17 and V21 drive twin-T feedback networks.



transformer inductances, a 180°-phase-modulated output is obtained which feeds the common-base amplifier stage (V8).

The output from V8 collector, via a matching transformer, is applied to the detector which also receives the strong signal v_s (of identical frequency with v_h), derived from the output of amplifier "D".

Amplifier "D".—The special amplifier "D"—as has been explained already—is fed by the fundamental frequency f_1 from the test oscillator and has four principal stages shown on the simplified circuit of Fig. 4. The first stage consists of a conventional phase-shift control giving a range 0-100° followed by an untuned amplifier (transistors V9 and V10).

The output from V10 should be large enough to obtain frequency multiplication in the next stage (V11b and diodes D_1 and D_2 or overloaded transistor V11a). The frequency-multiplication circuit works on the principle of producing a square wave or an asymmetrical waveform (half- or full-wave rectification of the fundamental)—so that the requirement for odd or even harmonics, respectively, can be met. The third stage is a high-pass filter combined with a selective amplifier (transistor V12). The filter is tuned in steps and the amplifier continuously to obtain from its output the desired harmonic frequency. The conversion gain of this stage (including the loss of the high-pass filter) is only 1 or so for the 2nd or 3rd harmonics. For higher harmonics however, two or even three tuned stages should be employed as the percentage of harmonic components in the distorted fundamental (input to this stage) usually decreases rapidly with increase of harmonic order. The last stage of block "D" is an untuned amplifier (V13, V14) whose purpose is to deliver sufficient output (0.5-1V) to the detector.

Variations of this output (depending on frequency, etc.) do not affect seriously the performance of the whole system provided only that the level should not drop below say 0.5V. It is worth mentioning that the phase-shift device in the first stage of circuit "D" works very effectively for harmonic frequencies as the shift is applied to the fundamental. By shifting fundamental up to 100°, angles $n \times 100°$ for harmonic frequencies are obtainable (where n is the order of the harmonic), hence the required 0—180° is easily obtained for every desired frequency.

Mixing of v_h and v_f Detection.—As a result of superimposition of v_h (100% square-wave phase-modulated) on v_s by the mixing transformers T_3 and

T_4 a large a.m. carrier is produced at the input to the detector. The depth of modulation is usually very low (it should be set to the maximum by manipulating the phase-shift control—as explained previously) and the l.f. square-wave components should be tuned to the multivibrator frequency.

L.f. Selective Amplifier.—The l.f. signal proportional to the investigated harmonic signal is usually at very low level (see Fig. 5). In spite of the good gain obtained in the untuned h.f. amplifier in block "B" (of the order of 60dB) a loss of signal of approximately 26dB is unavoidable in the modulator stage (including the buffer amplifier preceding the detector)—if a wide band of harmonic frequencies (30kc/s up to 1,500kc/s) has to be received with a flat response and without employing tuning arrangements. Consequently having on top of this additional loss, a loss of about 10dB in the detector stage, the net conversion gain between h.f. input and the input to the l.f. amplifier is only 24dB. If, for instance, the input harmonic signal is of the 1μV order, the gain in the l.f. amplifier should be at least 110dB to obtain sufficient a.c. output on the bridge of the output meter (a few volts). Such a high gain could be achieved by two selective amplifiers connected in cascade with one unselective stage (V18) separating them. Each amplifier has two transistor RC-coupled stages (V15, V16, V19, V20) with negative feedback applied through a selective twin-T network between the output of transistor V17 (V21) and input of V15 (V19). Transistor V17 (V21) serves as buffer feedback stage (to prevent instability).

The second selective amplifier is similar to the first with an additional common-collector output stage (V22) which employs a step-up l.f. output transformer. The secondary winding of this transformer feeds a conventional bridge circuit with a moving-coil meter (1mA f.s.d.) as the output meter.

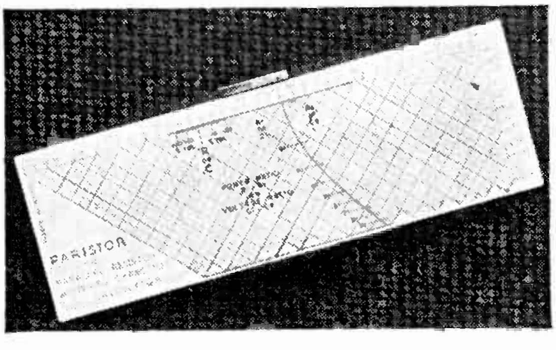
Design Conditions

To prevent instability in the amplifier certain conditions should be fulfilled by the designer:—

1. Separate and adequately decoupled power supplies for each amplifier should be used.
2. The input of each selective amplifier should be fed from a high impedance (100kΩ or so).
3. The selective feedback network must be terminated by a high impedance on the input of the amplifier side (0.25MΩ).

RESISTANCE AND CAPACITANCE CALCULATOR

THE eternal problem of how to obtain an exotic resistance of something like 4.1kΩ from two standard values is rendered rather less wearisome by the "Paristor" Parallel Resistor and Series Capacitor Calculator, which takes the form of a slide rule with a combined slide and cursor. A tolerance scale is provided and an indication of relative power dissipations in the two resistors is given by the cursor. Referring to the photograph, the procedure is as follows. Suppose a resistance of 4.1kΩ is required; set the cursor line marked "R or C" to 4.1 and scan the hyperbola inscribed on the cursor to find a position where it cuts an intersection of two bold diagonal lines. Each of the lines cuts the top scale at a preferred value of resistor, these being the two values which, when in parallel, give the combined value of 4.1kΩ. In the case illustrated, the two values are 15 and 5.6. If the hyperbola does not cut an intersection exactly, it may be moved on until it does so, when the departure from the required combined value can be read on the tolerance scale marked either side of the "R or C" line on the cursor. The ratio of power dissipations in the two resistors is given by the series of horizontal lines marked on the hyperbola. The process of calculation is, of course, identical for two capacitors in series. The calculator is available at 44s 6d from Paristor, Ltd., 96, Park Lane, Croydon, Surrey.



The Paristor calculator indicating the two valves 5.6 and 15, which give the required value of 4.1 when paralleled.

Commercial Literature

Ultrasonic control gear working at 45kc/s is added to the range of PERRAM equipment. Consisting of transmitter, receiver and control unit, the transistorized equipment can be used in level control, counting and intruder alarm applications and, as the wavelength is long, is not affected by fog or smoke. Details from Tyer and Co., Ltd., Perram Works, Merrow Siding, Guildford, Surrey.

Low-Frequency signal generator Type 252 covering the range 30c/s to 300kc/s is announced by Airmec. A thermistor-stabilized Wien-bridge oscillator is followed by a push-pull amplifier providing 100mW into 600 ohms. Leaflet 187A gives full details and can be obtained from Airmec Ltd., High Wycombe, Bucks.

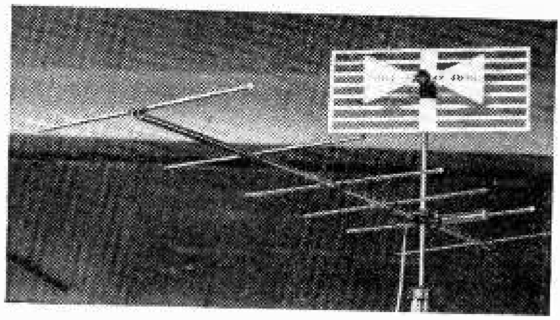
Measuring Instruments by the Canadian firm of Bach-Simpson are described in a leaflet from Aveley Electric Ltd. The instruments are for use in education and scientific laboratories. Details from Aveley Electric Ltd., Ayron Road, Aveley Industries Estate, South Ockenden, Essex.

Encapsulated Mica capacitors by Johnson Matthey are available in values between 5pF and 0.033μF at working voltages of 200V and 350V d.c. Lead spacing is to a 0.1-in module. Information on type C22 E and C33 E is obtainable from Johnson Matthey and Co. Ltd., 73-83 Hatton Garden, London, E.C.1.

Microsecond Triggered Relay by Ericsson will operate on the application of a pulse about 4μsec wide and at a p.r.f. of up to 100c/s. Two sets of changeover contacts are provided. Details from Ericsson Telephones, Ltd., 22, Lincoln's Inn Fields. London, W.C.2.

Soldering Irons with element ratings from 10 to 55W, weighing between ½oz and 7oz respectively, irons with bits resistant to erosion by high-tin solders (Permabit), solder pots, bench stands, a bench cable stripper, transformers and guards to reduce risk of damage when soldering complicated close-packed assemblies, are listed in a catalogue from Light Soldering Developments Ltd., 28 Sydenham Road, Croydon, Surrey.

TRENDS AND TECHNIQUES
SEEN AT
THE MILAN EXHIBITION



Offel Band III/IV combined aerial.

Italian National Radio Show

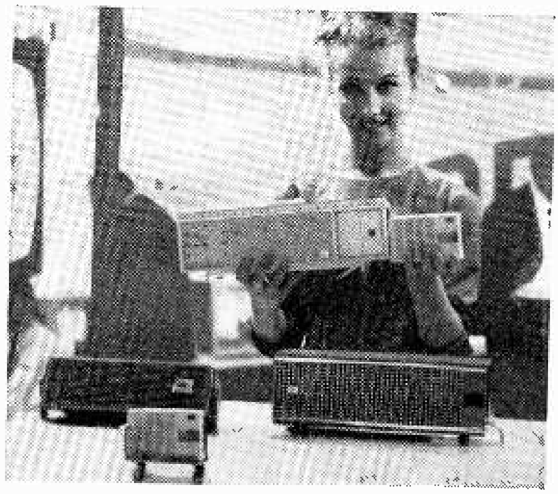
THE starting of the second television programme on 4th November was the major topic of interest and a display by the R.A.I. (Radiotelevisione Italiana) gave viewers a foretaste of what they might expect. The second programme is to be run by the R.A.I. on the same basis as the existing network, i.e. financed by both licence fees and advertising revenue, and the examples given of a typical week's programme showed that true alternatives are to be offered; a variety show on one channel, for example, with a documentary and news programme on the other.

The second service will, of course, use u.h.f. and R.A.I. are to be congratulated on the amount and quality of both technical and general information that they were giving out at the show. Booklets illustrated the ways in which receivers might be converted and aerial installations set up, gave a summary of the factors affecting propagation and the difficulties that might be experienced, even going so far as to suggest suitable channels in Bands I and III for down-conversion for communal-aerial networks and old sets without internal u.h.f. tuners.

At the start a potential 50% coverage will be achieved from 14 transmitters serving the more densely populated areas. Then over the next thirteen months the opening of an additional 28 transmitters will raise the coverage to 70%. Channels 21 to 34 (Band IV) each 8 Mc/s wide, are being used but, as Italy has 7-Mc/s channelling in Bands I and III (i.e. the Gerber system is used), the existing signal characteristics are preserved.

Naturally, sets with u.h.f. tuners were practically universal at the exhibition; but receiver design, apart from minor improvements to the *de luxe* models, such as remote control and the fitting of automatic brightness or contrast controls, seems to have stabilized over the last year. This is probably a very wise move on the part of the manufacturers as the advent of the second programme is expected to help precipitate a television boom which might be halted by teething troubles of new designs. Even the diversity of u.h.f. tuner design seen last year had almost disappeared: most manufacturers were using the two-valve r.f. stage and self-oscillating frequency changer type. In many cases changeover between the two tuners is effected by push-buttons on the front of the set although a few manufacturers have models which use one position of the v.h.f. tuner to select the u.h.f. band. Naturally, the use of separate switching provides a push-button "tuning" facility and some sets have the controls for both tuners tucked away at the side or even the back ("Nuclear"). Pye Electronics have, as in their English dual-standards set, an extra i.f. amplifier stage for u.h.f. and another feature is the use of two loudspeakers, one facing forward, the other to the side.

Even extremes of presentation were less noticeable than at last year's show, but a few examples were seen.



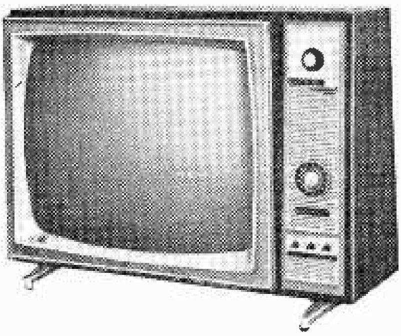
"Cucciolo" by Radio Allocchio Bacchini is a multi-purpose transistor pocket portable.

Firte had on show a very futuristic set with an eight-pointed mask round the tube. Brion-Vega's "Yades" luxury 23-in table model has its bonded-face-plate tube mounted outside the housing and retained by four small chromium-plated U-bolts, instead of, as is more usual, being "pushed through". This set is mounted on a small pedestal which has piano-sized piano-key controls on it, automatic u.h.f./v.h.f. tuning and ultrasonic remote control facilities.

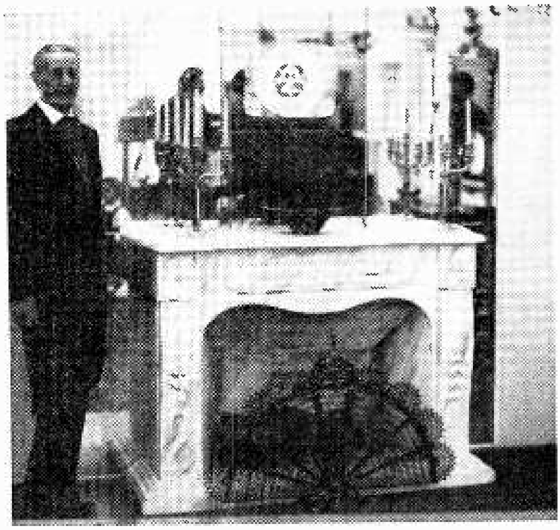
Dark filters on television sets are very popular—the majority are greyish; but a few khaki and brown ones were seen—and the Firte set mentioned above had a polarizing filter.

A novel idea in this field was shown by Atlantic as *lo specchio magico* (the magic mirror) in which the dark filter was replaced by a half-silvered mirror. Thus the receiver, when not in use, appears to be a mirror with a rather deep frame; but on dimming room lighting and turning on the set the picture appears. Although shown built into various items of furniture (even a fireplace and overmantel), there are two main versions of this set, one self-contained, the other with the main chassis in a shallow flat box with the c.r.t. unit available for separate mounting.

Aerials for Band IV television are, in the main, small narrow-band Yagi arrays but a few bow-ties (Offel, for instance) were noted. The Yagi-type arrays can, for

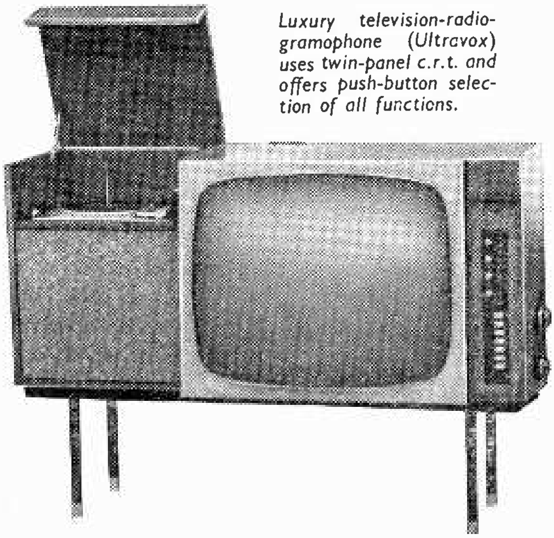


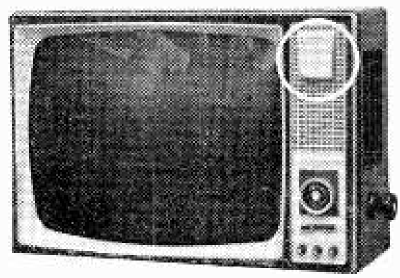
Pye Type T235 television receiver. One of the models made by Pye in Italy.



"Magic Mirror" television receiver by Atlantic shown, for demonstration, built into a mantelpiece. Chassis is inside mantelshelf with controls at left.

Luxury television-radio-gramophone (Ultravox) uses twin-panel c.r.t. and offers push-button selection of all functions.





"Roma" television receiver by Televideon incorporates plug-in transistor pocket portable radio (ringed).

long-range reception, run to fantastic complexity—a Fracardo model had no fewer than 80 elements, consisting of eight ten-element arrays stacked—but some models exhibited some novel ideas. Napoli, for instance, use very small section elements and dip seal the whole aerial with p.v.c. whilst Fracardo were using a folded dipole stamped from a flat sheet and bent to adjust the impedance and provide mechanical rigidity.

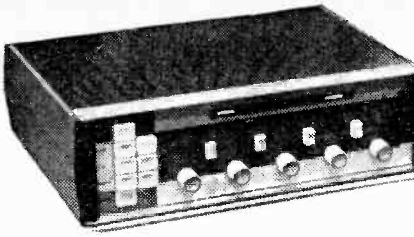
No pattern of using either coaxial cable or twin feeder has yet emerged and impedance-changing devices are common, as are v.h.f./u.h.f. diplexers.

Radio Receivers, particularly transistor types, have undergone great development during the last year and some very ingenious equipment was on show. There is, with the national love for music *everywhere*, a very large market for transistor portables in Italy, particularly the pocket-sized sets. Consequently the manufacturers have exerted their ingenuity to offer something that is different: for instance, a great selling feature is the idea that one need not be limited to using the transistor set solely as a pocket portable. Radio Allocchio Bacchini were showing their "Cucciolo"—a combination set for living room, bedroom, car and pocket—having at its heart a seven-transistor pocket portable (using two drift transistors) with a power output of 70mW. For use in the living room this plugs into a larger wooden cabinet containing extra batteries, a larger loudspeaker and amplifier. A plastics case contains in addition a clock-cum-time-switch for use as a radio-alarm for the bedroom whilst for use in the car the set clips into a bracket on the dashboard and is so used as a driver for the bigger amplifer-loudspeaker system mounted in the car. In spite of the meaning of *cucciolo* we don't think that purchase of this set could be described as "buying a pup"!

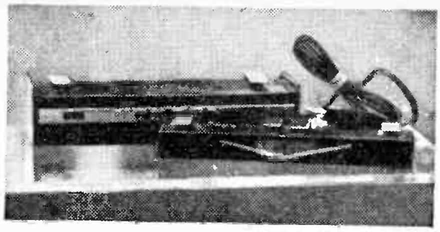
Another approach was illustrated by Televideon in their "Roma" television receiver. On the loudspeaker grille is a small pocket into which a transistor receiver can be plugged. Used separately it plays through its own small loudspeaker, using its ferrite aerial; but when attached to the TV set the larger loudspeaker is brought into circuit and the television aerial is coupled up to improve radio reception.

The Autovox "'Transmobil" 2 is a transistor portable of the larger type, with a top-mounted scale and edge controls. Fitted in the car is a rack for the receiver which is complete with a spring-loaded "letterbox" flap so that a neat appearance is preserved when the set is not in place. Pushing in the receiver connects it up to an extra power amplifier and loudspeaker, various models being available for 6- or 12- V supplies with either negative or positive earth. Equally versatile over its power requirements is the Autovox RA 141 car radio tuning over long and medium waves and f.m. This is a hybrid set; but it uses ordinary high-voltage valves in the f.m. and a.m. "front-end" stages, deriving the h.t. by an internal transistor converter. The use of valves for the "critical" stages side-steps the drift and sensitivity-loss problems that might beset transistors if overheated.

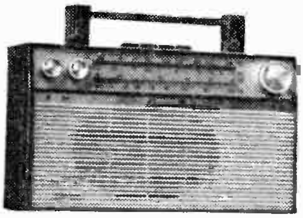
A.m./f.m. transistor sets, in marked contrast to last year, were fairly widespread. Parkanal's "Caravelle"



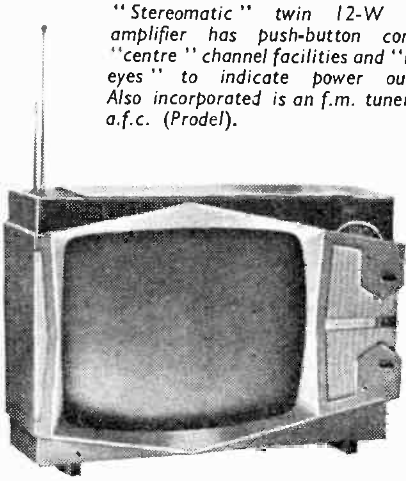
"Stereomatic" twin 12-W stereo amplifier has push-button controls, "centre" channel facilities and "magic eyes" to indicate power outputs. Also incorporated is an f.m. tuner with a.f.c. (Prodel).



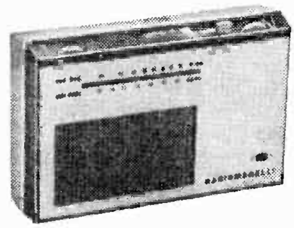
Mains power units for Voxson portables. Set clips onto top of unit.



Twelve-transistor "Caravelle" by Parkanal tunes over long-, medium-, short- and f.m.-wavebands.



Left: Firte 19E44 19in TV receiver in moulded-plastics case.



Radio Marelli a.m./f.m. transistor portable.

is a luxury-class set: it uses twelve transistors, has a 700-mW output and covers long and short wavebands as well as medium and f.m. Automatic frequency control is provided on f.m. and the telescopic f.m. and s.w. aerials fold into the handle when not in use. Nine-transistor sets were shown by C.G.E. (Compagnia Generale d'Elettricità) and Radio Marelli, this latter being notable for its clean-lined styling. The G.C.E. "Cottage 2" receiver, like many of the mains sets, also tunes to the v.h.f. television-sound frequencies.

The prize for disguise must go to Krundall, who have mounted transistor receivers in pictures roughly 50 cm square, the controls being hidden under the edge of the frame. The picture itself is on permeable material and forms the loudspeaker grille. Voxson offer small mains power units which clip onto their pocket size transistor receivers, and also serve as stands.

An unusual arrangement of loudspeakers is employed in a La Voce della Radio small stereo-radio-gram (one of the models, incidentally, with wire-distribution facilities). One loudspeaker is at one end of the front whilst the other is on the underside of the remote end of the lid over the turntable and is exposed when the lid is opened. Compared with another model with the two loudspeakers at either end of the four-foot long cabinet the lid arrangement provided better separation. The television sound reception facility continues on many f.m. models, but this year most incorporated tuning for both Bands I and III.

Wire Broadcasting in Italy is carried out in the long-wave band over the telephone system and is available free to telephone subscribers who have a wireless licence. Six channels are provided, the first three carrying the four radio programmes (which follow roughly the basis of our own). Channel 4 provides a "classical" music service and 5 "popular" material, whilst 6 is used for special purposes such as stereophonic diffusion. This latter group of three is available only from the network, which was extended to cover another eight cities on October 1st. A subscriber's terminal apparatus can consist of a push-button or switch-tuned receiver and amplifier or an ordinary radio receiver tuning over the long-wave band can be employed. To this end many of the newer sets incorporate long-wave coils, which also makes them suitable for export to countries where l.w. broadcasting is employed.

High-fidelity reproduction tends to be provided by the luxury radio-gram rather than by assemblies of separate units, as is more common in England. Particular examples of this were noted on the C.G.E. stand, where we saw a range of apparatus culminating in a very large cabinet containing a.m./f.m. radio-reception and disc-playing facilities and a well into which a new four-track three-speed stereo tape recorder can be dropped and connected up to sockets provided. The companion loudspeakers are full range bass-reflex types. However, the "unit" trend in "hi-fi" is starting: Radio Marelli, for instance, were showing their "Belform" series which contains turntable and amplifier combinations giving a range of systems from 3.5W/channel upwards, and Prodel also offer a wide selection of units. A feature of several of their amplifiers is the use of a pair of strip-type tuning indicators to give an approximate indication of power output, whilst a twin twelve-watt transistor amplifier (Selene) has transformerless output stages that can be adjusted for 4-to 16-Ω loudspeakers. Two of Prodel's professional combined stereo pre-amplifier-amplifier units (SR2040 and SR2051) are fitted with difference-channel gain controls, allowing variation of the apparent separation of stereo signals, and a combined amplifier and tuner (SR1040) has a sum-channel output for a centre loudspeaker.

Radio Communication without the need for a transmitting licence has been allowed in Italy since the 8th June, 1960. A frequency of 29·5Mc/s is reserved for this and the maximum power ouput allowed is 5mW. Radio Mazza were showing a two-transistor "walkie-talkie" (the Babyphone) for use under these conditions. Although intended primarily as a toy, the set, which is switched on by pulling out the telescopic aerial and uses a super-regenerative detector (whose wide bandwidth avoids the need for tuning) should be of more general use.

There need be no doubt that this has "caught on": your reporter spent an hour waiting for the return flight. Several sets were in use by children who were, needless to say, within shouting distance of each other!

LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

Television in 1936

I WRITE on the occasion of the 25th anniversary of television in Great Britain, first to offer my congratulations. The B.B.C. and the British radio industry did good work during this period, both technically and in the production of programmes, and British television must be included among the leading institutions of its kind in the world.

My second object in writing is to comment on statements made in two recent books* to the effect that the first public television service anywhere in the world began with the B.B.C.'s regular television broadcasts in November 1936. There is here a small but important omission, namely the words *high definition* between "public" and "television."

In fact the first regular public television service in the world was opened in Germany on 22nd March, 1935 in Berlin. The service began with a two-hour programme every second day in the week. In August 1935 the transmitter was destroyed by fire, but the public service was reopened in 15th January 1936 with a *daily* programme of two hours between 8 p.m. and 10 p.m. During the Olympic Games in 1936 the service was extended with live transmissions from the Olympic Stadium, the Swimming Stadium, etc., during the periods 10 a.m.-12 noon and 3 p.m. to 7 p.m.

Hamburg-Meiendorf KARL TETZNER.

* Page 4 of "Television by Design," by Richard Levin (*Bodley Head*), and page 9 of foreword by H. Carleton Greene, O.B.E., to "Television Jubilee," by Gordon Ross (*W. H. Allen*).

Hearing High Frequencies

I HOPE that "Free Grid" will not be too disappointed when he finds his "senescence adjuster" or "presbyotic tone control" (October issue) unused by senescient presbyotic listeners to receivers equipped with this device: and not only because of difficulty in reading the wording on the knob (or the small print of the dictionary)!

A person affected to a noticeable degree of progressive insensitivity to the higher audio frequencies (senile nerve deafness) is compelled to seek less, rather than more "bite," and he would not choose to expose himself to the effects of treble boost.

Hearing loss due to the nerve cannot be made up by amplification if the sounds heard as a result of that amplification are to have any dynamic range. Within the affected frequency range a sound level 10 dB above the threshold of hearing can be as unpleasant as toothache.

The most acceptable type of radio receiver for the elderly is that which many of them have, with plenty of built-in top-cut.

K. W. MAWSON,
Royal Eye and Ear Hospital, Bradford.

625 Lines are Quieter

MUCH is being currently written and said about the possible conversion of our TV line standard, but I have yet to see a reference to what, to my mind, would be the greatest advantage of the change to 625 lines—an improvement to television's Cinderella, the sound channel. Anything which would get rid of that inescapable 10 kc/s whistle would be a great improvement. Not only is the whistle generated within our receivers, it is an all pervading scream in any TV studio or control room, transmitted by direct acoustic pick-up on microphones and insidious induction on every line and cableform associated with TV sound circuits.

Of course, it is well known that audio engineers engaged on 405-line TV work develop a notch in their ossicles, and so far as 10 kc/s is concerned they are completely deaf (and I suppose by a process of evolution the viewing public is developing the same self-defence); but I for one would like 10 kc/s to return to the human audio spectrum. Push up the line time base frequency and our TV system will not have to whistle while it works. (Later, of course, you will be in correspondence with the Canine Defence League, but every action must have a reaction).

Uxbridge. J. LONGDEN.

Impedance-Magnitude Measurement

MR. R. C. WHITEHEAD, in his article on "Impedance-Magnitude Measurement" in the September issue, gives two conditions in which the error due to voltmeter loading is zero, first when the unknown and standard impedances have phase angles identical in magnitude and sign, and secondly, when the phase angles are equal in magnitude and opposite in sign and the voltmeter impedance is resistive. He did not mention that in the latter case the generator impedance must also be resistive. If, however, it was intended that the generator impedance be assumed zero, then the error due to voltmeter loading is always zero, whatever the unknown, standard, and voltmeter impedances, since the impedance of the circuit to which the voltmeter is connected is the same for either position, being that of the unknown and standard impedances in parallel, as can be seen by the application of Thévenin's theorem. The effect of a generator of zero impedance can of course be obtained by using a second voltmeter to measure the generator voltage, and adjusting it to equality for the two measurements.

London, E.C.1. K. S. HALL.
Northampton College of Advanced Technology.

Voltage or Current Operated?

IT is most kind of "Cathode Ray" (September issue) to give us qualified permission to call our transistors what we will. Some of us, however, consider that the idea of a Third Force is more healthy than the Uncommitted Nation and that the transistor user should always use the word "and" in place of "or".

The case for the current operator is, essentially, the constancy of the current gain. We have in our minds an ideal transistor in which all the current injected at the emitter junction is balanced by current at the collector junction. In terms of the OC45 this may seem a little academic. When we turn to non-linear applications, especially with power transistors, there seems little alternative. The transistor is required to be held well into saturation by a voltage which is usually a good deal more than the normal range of V_{be}. We have, let us say, a minimum large signal current gain of 20 and our load line shows we should get a current of 10 amps. The transistor base is then fed with 0.5 amps and the characteristics look after the rest.

In linear amplifiers the voltage operators have a stronger case than "C.R." makes for them. The transconductance, g_m, shown in the table of "C.R.'s" article is not constant, but taking at random the E80F pentode, the transconductance at −0.6V bias is 2,500 μA/V and at −6.0V is 25μA/V, a ratio, max/min. of 100 compared with the 20.6 which so alarms "C.R." We still use g_m for pentode circuit design, though. The first result is to warn us that increasing the load resistance may not give us more gain because we may lose more on the fall in g_m than we gain by the increase in R. The second result, which I am exploring in detail in an article half-written, is to warn us that a voltage-operated amplifier, that is, one fed from a low impedance, will give us a good deal of distortion. Even if you think about the nice constant current gain you cannot exercise the variations of transconductance.

When we look at some of our circuits we come much more positively to voltage control. With 1,000 ohms in the emitter lead we have, quite definitely, a g_m of 1mA/V and an input impedance which is relatively high. What is more, we can think of bias in voltage terms, too.

Do we use transistors to economize in current? Not, I think, to the extent that "C.R." suggests. Once you make the great advance from the 150mW, or whatever it is the smallest battery valve consumes, to the 6 volts ½-2mA of a transistor it is carrying economy too far to pinch fractions of a milliamp at the cost of gain. Many of us use transistors because we want the added reliability both of devices and of associated components.

Must we say that negative resistances are voltage or current controlled? Surely all we mean is short- or open-circuit stable?

THOMAS RODDAM.

Norwegian V.H.F. Reception

AFTER trying for five days of this period of DX reception on the v.h.f./f.m. band, I was able to pick up for a short time on 4th Sept. a Norwegian station which I believe to be Bjørkreim on 90.6 Mc/s. 9 p.m. B.S.T.

This was giving the weather reports from the three districts, North, West and Oslo and was 100% readable, but began to fade out after the news. A Danish station on a slightly higher frequency was still strong later, and in fact several Danish stations were heard during the evening, but the German and Dutch which came in strongly two days earlier were absent.

I should be interested to hear if Norwegian v.h.f. stations have been heard by any other readers at any time, as I have tried unsuccessfully several times before.

There are two other 60 kW stations listed, Voss 93.3 Mc/s, and Stord 91.8 Mc/s which is on the West Coast south of Bergen which might also be receivable if clear of interference.

Burniston, Yorks. L. TRANMER.

CONFERENCES AND EXHIBITIONS

Further details are obtainable from the addresses in parentheses.

LONDON

Nov. 8-10 — Savoy Place
Non-Destructive Testing in Electrical Engineering
(I.E.E., Savoy Place, W.C.2.)

Nov. 22-25 — Horticultural Hall
Radio Hobbies Exhibition
(R.S.G.B., Little Russell Street, W.C.1.)

Savoy Place
Nov. 30-Dec. 1
Nuclear Electronics Symposium
(I.E.E., Savoy Place, W.C.2.)

1962

Jan. 15-19 — R.H.S. Halls
Physical Society Exhibition
(Institute of Physics & Phys. Soc. 47 Belgrave Square, S.W.1.)

Feb. 26-28 — *
The Importance of Electricity in the Control of Aircraft
(I.E.E., Savoy Place, W.C.2).

April 26-29 — Hotel Russell
Audio Festival & Fair
(C. Rex-Hassan 42 Manchester Street, W.1.)

May 8-18 — Earls Court
Mechanical Handling Exhibition
(*Mechanical Handling*, Dorset House, Stamford Street, S.E.1).

May 28-June 2 — Olympia
Instruments, Electronics & Automation Exhibition
(Industrial Exhibitions, 9 Argyll Street, W.1).

May 31-June 7 — Savoy Place
International Television Conference
(I.E.E., Savoy Place, W.C.2).

July 2-6 — *
The Ionosphere
(Institute of Physics & Phy. Soc. 47 Belgrave Square, S.W.1).

Aug. 22-Sept. 1 — Earls Court
National Radio & Television Show
(Radio Industry Exhibitions, 59 Russell Square, W.C.1).

CRANFIELD

April 16-18 — College of Aeronautics
International Flight Test Instrumentation Symposium
(College of Aeronautics, Cranfield, Bucks.)

EXETER

July 16-20 — The University
Physics of Semiconductors
(Institute of Physics and Phy. Soc., 47 Belgrave Square, S.W.1).

* Venue not yet announced.

FARNBOROUGH

Sept. 3-9 — R.A.E.
Farnborough Air Show
(S.B.A.C., 29 King Street, London, S.W.1).

OVERSEAS

Jan. 9-11 — Washington
Reliability & Quality Control
(R. Brewer, Hirst Research Centre, Wembley, Middx.).

Feb. 6-7 — Washington
Redundancy Techniques for Computing Systems
(Miss J. Leno, Office of Naval Research, Washington).

Feb. 14-16 — Philadelphia
International Solid-State Circuits Conference
(E. G. Nielsen, General Electric Co., Syracuse, N.Y.).

Feb. 16-20 — Paris
International Components Exhibition
(Fédération Nationale des Industries Electroniques Françaises, 23 rue de Lübeck, Paris 16).

April 10-14 — Paris
International Conference on Stress Analysis
(Joint British Committee for Stress Analysis, 1 Birdcage Walk, London, S.W.1).

May 8-10 — Washington
Electronic Components Conference
(I.R.E., 1 East 79 Street, New York 21).

May 22-24 — Boulder
Microwave Theory and Techniques
(I.R.E., 1 East 79 Street, New York 21).

June 25-30 — Copenhagen
Electromagnetic Theory & Antennas
(J. Brown, Department of Electrical Engineering, University College, London).

June 27-29 — New York
Automatic Control Conference
(I.R.E., 1 East 79 Street, New York 21).

Aug. 14-16 — Boulder
Standards and Electronic Measurements
(Dr. J. M. Richardson, N.B.S., Boulder, Col.).

Aug. 21-28 — Copenhagen
International Congress on Acoustics
(Professor S. Ingerslev, Royal Technical University, Ostervoldgade 10, Copenhagen)

Aug. 27-Sept. 1 — Munich
Information Processing & Digital Computers
(International Federation of Information Processing Societies, c/o British Computer Society, Finsbury Court, London, E.C.2).

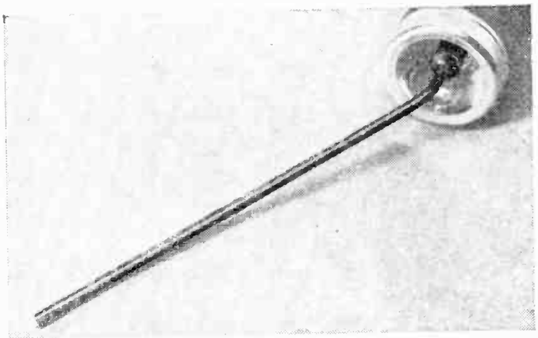
Sept. 3-7 — Brussels
International Symposium on Information Theory
(Dr. F. L. Stumpers, Philips Research Laboratories, Eindhoven, Netherlands)

MANUFACTURERS' PRODUCTS

NEW ELECTRONIC EQUIPMENT AND ACCESSORIES

Miniature Inspection Lamp

CLINTON Laboratory's "Prodlite" consists of a miniature lamp incorporating a lens set into a ⅛-in diameter "stalk" fitted with a standard "torch bulb" screw at the other end. Current rating of the lamp is about 0.25A at 2.5V (two-cell torch) and an intense spot of light is produced up to several inches from the lamp. The stalk, even when fitted with an insulating sleeve, is easily inserted into a tightly-packed assembly: thus the "Prodlite" should prove most useful to service engineers, inspectors and amateurs for work on electronic equipment.



"Prodlite" miniature inspection lamp for illumination of "inaccessible" corners.

The "Prodlite" costs 15s 6d and a switched handle and flex lead is available (12s 6d) for use with, say, a step-down transformer or an accumulator.

The Clinton Laboratory, 43 Broomhall Place, Sheffield, 10.

Wire Stripper

DESIGNED to strip insulation from wires used in electronic equipment and telephone systems without nicking the wire or crushing the remaining insulation, the H35 series weighs 14 ounces. The standard model is intended for commercial use, while the de-luxe version is for use in aircraft and guided-weapon wiring. An automatic device holds the jaws open without crushing. Details can be obtained from Hellermann, Ltd., Gatwick Road, Crawley, Sussex.

Range of Car Radio Aerials

SIX different car-radio aerials are manufactured by Antiference for differing requirements and utilizing various mounting position methods. "Top of the range" is the extensible 45½-in "Autex" designed for universal mounting and particularly suitable for wing use where there is no weather-shield between wheel and aerial. It requires only one hole and can be fitted without the necessity for access to the underside of the mounting surface. Lead length is 5ft (the plug is already fitted) and the price is £2 5s. Next down the price scale is another telescopic type 39-in long, the "Silverstone." This has a spring and swivel base, is fitted with an 80-in lead and plug and can be fixed (again one hole only) in any position which affords a weather-proof underside for the lead termination. Price is 2gns.

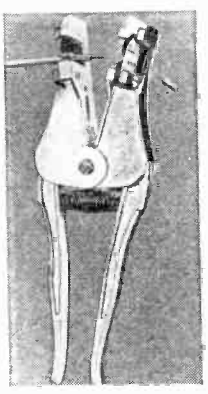
At £1 19s 6d comes the "Continental de Luxe"—a 36-in stainless-steel whip—especially designed for use with transistor receivers. This aerial clips on to the gutter and the feeder enters via a flat plastics ribbon which fits round the top of the door frame. 6ft 6in of lead and a 180° swivel for the whip complete the specification. £1 17s 6d will buy a simpler version of the "Silverstone" without the spring mount, whilst the "Continental," a 30-in long model of the "Continental de Luxe" costs £1 12s 6d.

Cheapest aerial of the range is the "Monte Carlo," which employs the same mounting principle as the "Silverstone," but has its 31-in flexible whip spring mounted at an angle of 45° to the base. Price of this is £1 9s 6d.

Antiference Ltd., Bicester Road, Aylesbury, Bucks.

Pure Water Supply

THE Permutit Company's Mark 7 portable "Deminrolit" water purifier can produce up to 12 gal/hr of water pure to the B.P. standard. Conductivity is given as the order of 1/℧ cm and dissolved matter less than 1 part in 10^6. The Mark 7 employs two processes taking place simultaneously in a resin bed through which the water flows: the first replaces the metallic ions by hydrogen, so forming the acid corresponding to the salt of the original impurity, then the acid so produced is absorbed. A feature of the device is the incorporation of a transistor "purity" meter which indicates in arbitrary units the conductivity of the outflowing water.



Above: The Hellermann Wire Stripper Model H35.

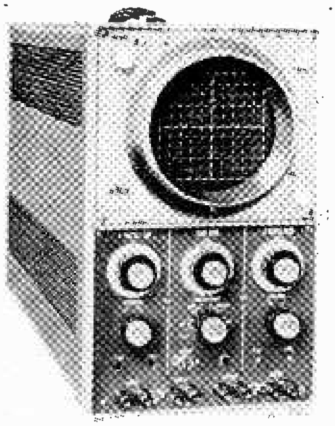
Right: Permutit Co's "Deminrolit" Mark 7 portable water purifier.

The cartridge of de-ionizing material is replaceable and will purify about 16 gal of London's water before requiring replacement, which costs £5 6s for five. The Mark 7 "Deminrolit" costs £35 and should prove useful in laboratories working on printed circuits and semiconductors and on the factory floor for a final on-the-spot "clean up" of already purified water.

The Permutit Company Ltd., Permutit House, Gunnersbury Avenue, London, W.4.

Microvolt Oscilloscope

A Y-SENSITIVITY of 50µV/cm enables the Du Mont Type 403-B oscilloscope to display signals produced by strain gauges, biological transducers, etc., without the need for further amplification. The Y-amplifier is direct-coupled and, at its most sensitive, has a −3dB bandwidth of 0-150kc/s, increasing to 0-1Mc/s at a sensitivity of 5mV/cm. The input to the

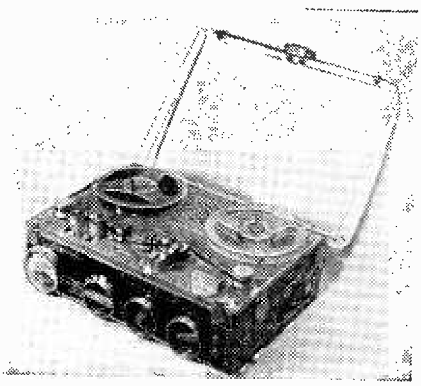


Du Mont 403-B sensitive oscilloscope.

amplifier is differential, with a common-mode rejection of more than −40dB; drift is nominally 500µV/hr. Sweep times are continuously variable from 1µsec/cm to 25sec/cm and single-sweep operation is possible, with resetting from an external switch, such as a camera shutter, if required. External X-sensitivity is 10mV/cm. Full details are available from Aveley Electric, Ltd., Ayron Road, Aveley Industrial Estate, South Ockendon, Essex.

Professional Transistor Recorder

THE Nagra III professional battery portable transistor tape recorder is provided with separate record and replay heads and amplifiers. Even at 3¾in/sec, the slowest of its three alternative speeds, the signal-to-noise ratio is 50dB (for 3% distortion at 1kc/s), the frequency response within ±3dB from 50c/s to 7kc/s and the wow and flutter 0.35% (peak to peak). At 7½in/sec these figures become respectively 51dB (for 2.5%), ±1.5dB from 30c/s to 12kc/s and 0.2%, and at 15in/sec 52dB (for 2%), ±1dB from 30c/s to 15kc/s and 0.15%. The speed difference between the beginning and end of a 5-in reel is 0.1%, between new and nearly discharged batteries 0.05%, and between horizontal and vertical recorder positions 0.03%. The speed is electronically stabilized using a transistorized f.m. tachometer. Battery voltage and line output can be indicated on the recording level meter. Automatic adjustment of the recording level (at the cost of some distortion) may be obtained by means of a volume compressor. A 50 to 200-Ω microphone impedance change only alters the input sensitivity from 100µV to 200µV. The output is

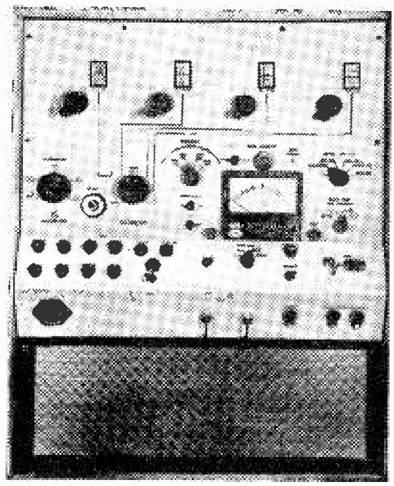


Nagra III professional battery portable tape recorder.

1.55V at 100-Ω and a built-in monitor speaker is provided. The current consumptions on record and replay are 180 and 120mA respectively. Twelve 1.5-V torch batteries are used as the power supply. The dimensions of this recorder are 12½ by 8¾ by 4¼in and up to 7-in reels can be used with the lid open (5in when closed). Its weight is 16½lb. This recorder costs £340 (approximately) and is distributed in this country by Livingston Laboratories of 31, Camden Road, London, N.W.1.

Field Intensity Meter

ESSENTIALLY a frequency-selective microvoltmeter, the Stoddart Type NM-62A covers the band 1-10Gc/s, in four bands. Automatic frequency-scanning is provided, and outputs are available to allow an X-Y plotter to trace the spectrum analysis of the input signal. The maximum sensitivity is 5.5µV at 1Mc/s bandwidth and an internal calibration-pulse generator is included. When used as a voltmeter, the range is 6µV-10V, and field intensity measurements may be made from 78µV/m to 130V/m. Rejection of



Aveley Electric Stoddart type NM-62A field intensity meter.

signals outside the selected pass-band is better than −80dB. The NM-62A is marketed in the U.K. by Aveley Electric, Ltd., Ayron Road, Aveley Industrial Estate, South Ockendon, Essex.

Radio-Frequency Measurements

1.—WAVEMETERS AND HETERODYNE TECHNIQUES

By R. BROWN

FREQUENCY measurement can be carried out with greater accuracy than probably any other type of measurement in the electronic field, and this high measurement accuracy was achieved quite early. By 1938, for example, it was possible to measure frequency with an accuracy of about 0.0001%, and improvements in technique since then have resulted in considerable improvement even on this accuracy.

The top-grade frequency measuring systems are, however, usually rather difficult to operate; certainly considerable practice is necessary before their full accuracy can be made use of and before measurements can be made with any speed. The result is that while the accuracy of measurement is still being improved upon, and top-grade measuring systems find many applications, there is a tendency, strange in the electronics field where the demand is always for greater and greater accuracy, to use measuring techniques which, while they have a useful accuracy, are less accurate than the best, but which are much easier to use.

There have been as many different methods of frequency measurement suggested, tried out, and put into use as there have been of other types of measurement. Many of these different techniques have not, however, stood the test of time. Yet anybody faced with the problem of choosing a frequency measuring system still has an almost bewilderingly wide range to choose from.

Measurement by Lecher-Wire System

Probably the cheapest and simplest means of frequency measurement is by the Lecher line system[2, 5]. To carry out measurements by this system two wires,

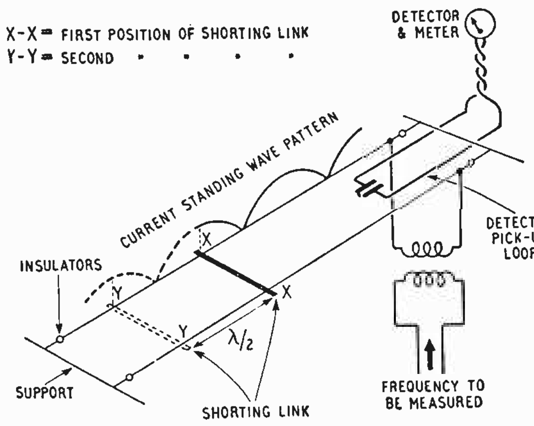


Fig. 1. The lecher line method of measurement.

insulated at each end, are stretched out parallel to each other, to form a transmission line. The signal to be measured is injected into one end of the line, and the other end of the line is left open-circuited. If a shorting link is now placed across the line at some point a standing wave pattern will be set up along the line, maximum and minimum values of current occurring at half-wavelength intervals along the line.

To make a measurement a detector and milliammeter are coupled to the end of the line at which the signal is injected, and the position of the shorting link adjusted until the meter indicates a maximum. This is shown in Fig. 1. In this condition there are a whole number of half wavelengths in the standing wave pattern. The position of the shorting link is then moved along the line until the meter again shows a maximum. There are, as before, a whole number of half wavelengths in the standing wave pattern, and the distance the shorting link has been moved is equal to one half wavelength of the signal in the line.

The true wavelength, λ_1, in free space differs slightly from the measured wavelength, the error usually being less than 0.5%. If greater accuracy is required the true wavelength can, however, be found with the help of a correction term, Δ[1, 3]. This term depends upon the frequency, the inductance and the resistance of the line. It is given by:—

$$\Delta = \frac{\sqrt{r_0}}{8 \log_e B\sqrt{\{\omega[1-(d/a)^2]\}}} \quad .. \quad .. \quad (1)$$

where d is the diameter of each conductor
a is the distance between the conductors

$$B \text{ is equal to } \frac{1 + \sqrt{[1-(d/a)^2]}}{d/a}$$

and r_0 is the d.c. resistance per cm. length of the double line in the c.g.s. system.

Once the correction factor, Δ, has been found the true wavelength can be found from the expression

$$\lambda_1 = 2\lambda(1+\Delta)$$

where λ is the measured half-wavelength.

Provided that λ is in metres the corresponding frequency f is given by:—

$$f = \frac{1.499 \times 10^5}{\lambda(1+\Delta)} \text{ kc/s} \quad .. \quad .. \quad .. \quad (2)$$

This is a useful method of frequency measurement; practical considerations prevent its use below about 15 Mc/s, however, and even long before this frequency is reached the line becomes excessively long. A capacitor can be connected across the input end of the line, so as to keep the length of the line down to a minimum. There is little to be gained, however, by simply measuring the length of the first half wavelength, and restricting the line to slightly greater than this, for the distance between the end of the line and the first current maximum is not an accurate half wavelength because of the influence of the signal and detector coupling circuits. The length of the free end of the line, that beyond the short circuit, should be kept small compared with a quarter wavelength, or a multiple of a quarter wavelength to prevent interaction between the two sections of the line.[4]

Absorption Wavemeters

This is a very robust and portable class of instrument with which frequency can be measured with an accuracy which varies from about $\pm 3\%$ to about 1 part in 10^5. It consists essentially of a simple variable frequency resonant circuit which can be coupled to the signal to be measured, plus some indicating device to show when the circuit is in resonance. The chief advantage of this type of wavemeter is its simplicity, and an additional advantage is that if the indicator consists of a crystal detector and a meter no power supplies are required.

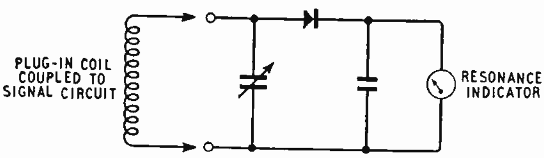


Fig. 2. A simple absorption wavemeter.

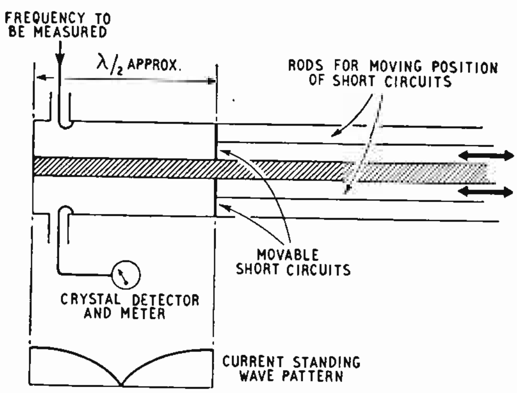


Fig. 3. A coaxial line wavemeter.

A simple type of wavemeter suitable for use up to about 300 Mc/s is shown in Fig. 2[6]. The variable capacitor has a calibrated dial, and in use it is tuned for a peak reading on the indicator. The frequency can then be read directly off the dial.[7]

The tuned circuit of a wavemeter of this type should have as high a " Q " as possible so as to give a sharp indication of resonance, thus giving good frequency discrimination. Loose coupling is essential if a high " Q " is to be obtained, but this reduces the sensitivity of the instrument, and a compromise is usually made between these two conflicting requirements. Special instruments have, however, been described in which loose coupling and high sensitivity are achieved together.[8] Another important requirement is that the instrument should be free of spurious responses or resonance in an unwanted mode. If this requirement is not met considerable ambiguity of reading can result.

Up to about 300 Mc/s conventional lumped LC circuits are used, a wide operating range being obtained by changing coils. The accuracy is, however, usually low because of the inherent poor stability of the components.

The relationship between capacitor setting and frequency usually follows one of two laws; either a straight-line frequency law, where one division of the capacitor scale always represents the same alteration of frequency, or a logarithmic law where equal alterations of capacitor setting produce equal percentage frequency changes.

The straight-line frequency law capacitors are almost the ideal for some wavemeters. Here the relationship between capacitor setting θ, frequency f, and capacitance C is:—

$$\theta \propto f \propto \frac{1}{\sqrt{C}}$$

At the low frequency end, however, the accuracy becomes rather poor, for as the frequency is decreased each division of the capacitor dial will correspond to a larger percentage frequency change.

If, however, instead of the capacitor being made so that $\theta \propto f$, it is made in such a way that the rate of change of capacitance is always proportional to capacitance, then equal alterations of the capacitor setting ($\delta\theta$) will produce equal percentage frequency alterations. This will result in a wavemeter which has constant percentage frequency error over the whole scale.

Coaxial Line Wavemeters

At frequencies above about 600 Mc/s the coaxial line wavemeter becomes practicable. This type of wavemeter makes use of the fact that a half-wavelength length of coaxial line is equivalent to a resonant circuit. This is shown in Fig. 3. The movable short circuits are usually operated by push rods, which in turn are linked to a calibrated dial.

The distance between the front of the short-circuit and the end of the coaxial line is not an exact half wavelength owing to end effects. This instrument has, therefore, to be calibrated against a standard. The sharpness of resonance is usually very high, and provided an accurate mechanical drive system for the push rods is achieved, a drive system in which back lash is eliminated, the accuracy can be as high as 0.05%.

Resonant Cavity Wavemeters

At microwave frequencies resonant cavities are widely used. These cavities are the microwave equivalent of parallel tuned circuits. They are always in the form of a cylinder, and tuning is accomplished either by using a piston to vary the length of the cavity, or by means of a plunger projecting into the cavity.

Many field configurations are possible in such a cavity for any given setting of the piston, and as a result many resonant frequencies are possible. The choice of the mode to be employed in any given wavemeter will depend upon the function of the wavemeter[6 9 10].

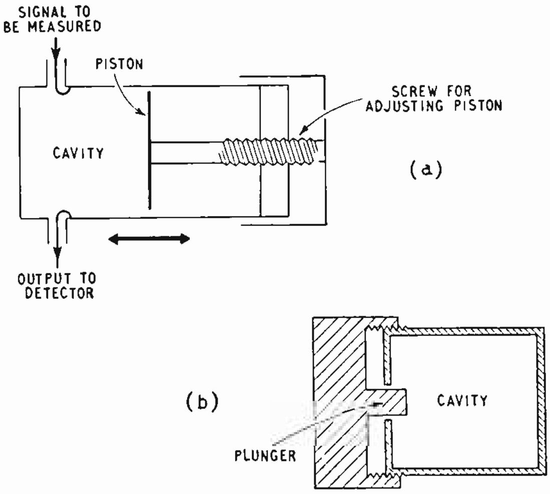


Fig. 4(a) A simple cylindrical wavemeter with piston tuning; (b) Plunger tuning.

The H_{111} mode is frequently preferred for simple cylindrical wavemeters of the type shown in Fig. 4, since it has the lowest resonant frequency, thus reducing mode troubles to a minimum. The H_{011} mode is, however, often used, since although mode troubles are increased, the 'Q' obtained is about twice that obtained with the H_{111} mode.

Wide frequency coverage consistent with freedom from unwanted modes is the most important quality required in general purpose wavemeters. It has been shown that this can best be achieved by the use of a hybrid mode, the E_{010}-EH hybrid mode. The length of the cylinder in a wavemeter using this mode is made much larger than its diameter, and the plunger can be inserted into the cylinder to almost its complete length. Fig. 5 shows the constructional details of a wavemeter of this type. In the region X-X the field configuration is like that of the E_{010} mode, while in the region Y-Y the field configuration is similar to that in a coaxial line.

Comparison Method

In this method of measurement the frequency to be measured is compared with the frequency of an accurately known standard frequency. The source of this standard frequency is usually a crystal controlled oscillator, a caesium atomic standard or a standard radio signal controlled by one of these two standards.

An instrument having only one output frequency would have only a few applications. A number of comparison frequency measuring techniques have, therefore, been devised in which the system provides a large number of comparison frequencies from a single standard frequency.

The simplest example of such a system is the crystal calibrator.[11] In such an instrument there is usually a single crystal controlled oscillator working at, say 1 Mc/s, or possibly 100 kc/s, while some instruments have a 1 Mc/s crystal and a 10 to 1 divider circuit, which allows either a 1 Mc/s or 100 kc/s output to be obtained. This output is fed into a harmonic generator, and by suitable design a large number of harmonics of the selected frequency can be obtained. There are, therefore, a series of crystal controlled frequencies available, the spacing between frequencies being either 1 Mc/s or 100 kc/s.

A series of frequency markers of this sort is particularly useful when checking the calibration of a receiver, say, or of a variable frequency transmitter, a variable test oscillator or a signal generator. The instrument is usually completed by a mixer, a detector, and a pair of headphones, and in use the output from the equipment being checked is mixed with the output from the crystal calibrator. The frequency of the equipment under test is varied, and as the frequency approaches one of the crystal harmonics an audio frequency beat note will be heard. The equipment can then be tuned to give a zero beat note, and once it is found which crystal harmonic is actually being used the frequency to which the equipment is tuned can be accurately determined.

The question of deciding just which harmonic of the crystal oscillator is being used, is very easily solved when using low order harmonics, but it can become very troublesome when using high order harmonics. A further disadvantage of this simple instrument is that it is impossible to measure frequencies which lie between crystal harmonic frequencies.

Heterodyne Frequency Meters

A more versatile instrument is the heterodyne wavemeter, which, in addition to a crystal oscillator, a 10 : 1 divider, detector, and 'phones, has a calibrated variable frequency oscillator. This oscillator covers a large section of the desired working range

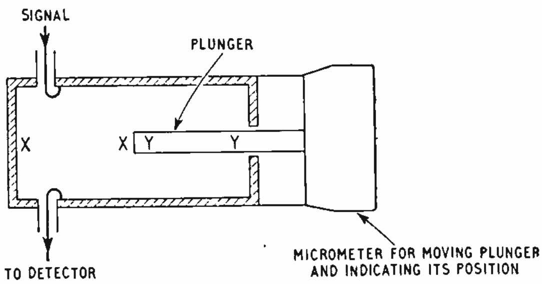


Fig. 5. Hybrid cavity.

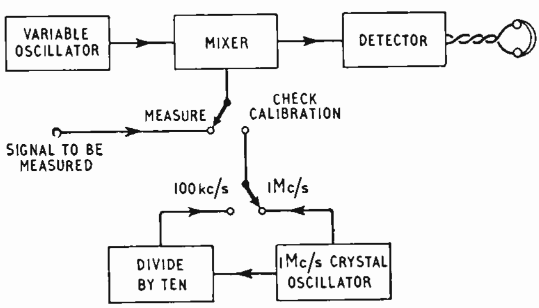


Fig 6. Heterodyne frequency meter block diagram.

of the instrument, and immediately before use its calibration is standardized against the nearest harmonic of the crystal oscillator. The oscillator is then tuned to zero beat with the frequency to be measured, and the frequency determined from the setting of the oscillator tuning dial. Fig. 6 shows a typical arrangement.

The variable oscillator calibration must be reasonably accurate over the range between crystal harmonics. This can be achieved by calibrating the main tuning dial in degrees, and then checking and plotting the oscillator frequency against the dial reading—a lengthy business which results in a complicated and bulky calibration chart. An instrument has, however, been produced in which the manufacturing tolerances in the variable capacitor are allowed for by a cam driven by the main tuning control[12]. A true straight-line frequency law is obtained, and the oscillator dial is direct-reading in frequency.

To obtain the maximum use of a heterodyne wavemeter the harmonics of the variable oscillator are used to extend the frequency coverage. When doing this the problem of the identification of the high order harmonics can be solved using the following method[13].

The oscillator frequency is adjusted until its nth harmonic is brought into zero beat with the higher frequency signal being measured. This oscillator frequency is noted and the oscillator retuned so that its (n-1)th harmonic is brought into zero beat with the frequency being measured. This second oscillator frequency is noted, and the value of the frequency being measured can be found in the following way.

Let f_0 = the unknown high frequency.

f_1 = the first (lower) oscillator frequency.

f_2 = the second (higher) oscillator frequency.

n = the order of the harmonic of f_1, causing the first beat.

Then (n-1) will equal the order of the harmonic of f_2 causing the second beat.

$$\text{Thus } f_1 n = f_0 \qquad (3)$$

$$\text{and } f_2 (n-1) = f_0 \qquad (4)$$

$$\text{hence } f_1 n = f_2 (n-1)$$

$$\text{or } f_1 n = f_2 n - f_2$$

$$\therefore n (f_2 - f_1) = f_2$$

$$\text{and } n = \frac{f_2}{f_2 - f_1} \qquad (5)$$

But from (3) $f_1 n = f_0$

$$\text{so } f_0 = \frac{f_1 f_2}{f_2 - f_1} \qquad (6)$$

Analogue Frequency Meters

This technique, frequently used for very low frequency measurements, has recently been adapted for use at radio frequencies.[14] The idea is to convert each cycle of the frequency to be measured into a narrow pulse. This pulse is then used to trigger a monostable multivibrator which produces a pulse of accurately determined height and width (that is, area) for each pulse. These pulses are then integrated to produce a voltage which is proportional to the number of pulses per second. A voltage is thus produced which is proportional to frequency and a voltmeter can then be calibrated directly in frequency and used to measure this voltage. Accuracy is about 0.2%.

High Accuracy System

The accuracy obtainable with a simple heterodyne wavemeter is limited, usually to about 1 part in 10^4 for simple systems. A variable frequency interpolating oscillator can only be accurate at the crystal check points, and the limited accuracy attainable between check points only holds for a short period after the calibration has been checked.

A number of alternative methods for filling the gap between the crystal harmonics are in use. They all rely on the production of sub-harmonics of the crystal frequency by frequency division,[15] and obtaining a series of closely spaced harmonics from these sub-harmonics. As an example of the production of these sub-harmonics a one megacycle crystal oscillator could be used as the primary standard, and a series of 10 : 1 dividers can then be used to provide 100 kc/s, 10 kc/s, 1 kc/s and 0.1 kc/s sub-harmonics. These sub-harmonics can then be converted to pulses which are rich in harmonics, and the desired harmonic selected by means of a tuned amplifier, the tuning of this amplifier being adjusted by a switch to the required harmonic frequency.

The technique of measurement by successive reduction is an example of the use of a series of sub-harmonics. This is shown in Fig. 7. The seventh harmonic of the 1 Mc/s standard is mixed with the frequency to be measured. The fifth harmonic of the 100 kc/s is then mixed with the 546.255 kc/s resultant,

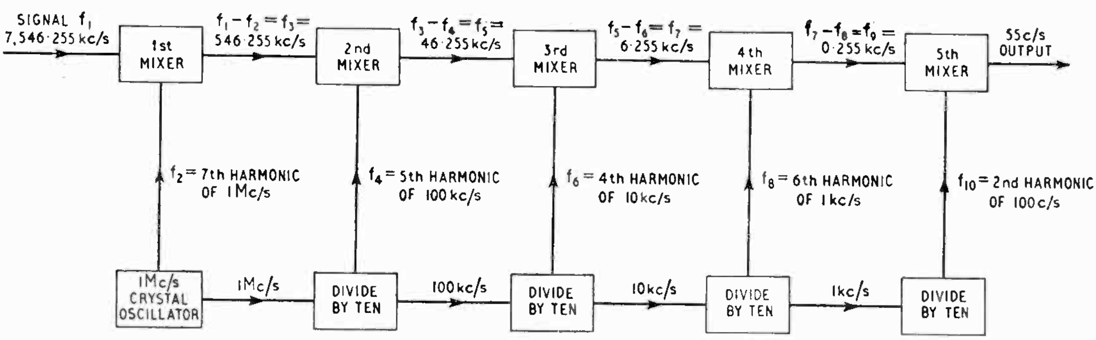


Fig. 7. Frequency measurement by successive reduction using harmonics from divider chain.

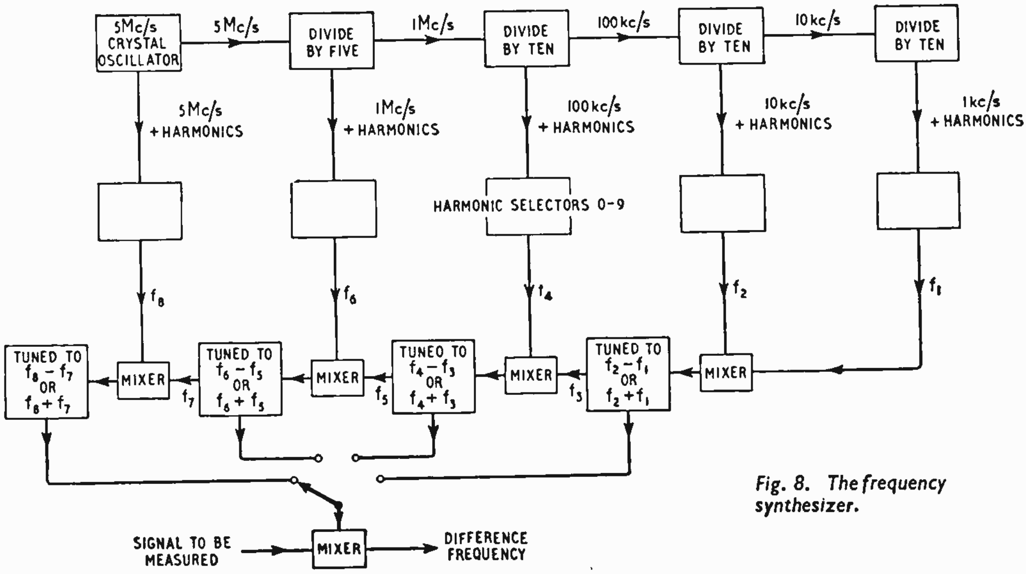


Fig. 8. The frequency synthesizer.

and the fourth harmonic of the 10 kc/s sub-harmonic is mixed with the 46.255 kc/s difference frequency. The result, 6.255 kc/s, is mixed with the sixth harmonic of the 1 kc/s sub-harmonic giving 0.255 kc/s. This is mixed with the second harmonic of the 0.1 kc/s sub-harmonic giving an output of 55 c/s. This latter frequency is low enough to be measured by comparing it with a stable, accurate, low frequency oscillator, using Lissajous figures.

An alternative approach is to use the sub-harmonics to lock a variable oscillator. An arrangement on these lines which will produce a standard frequency which is within 100 c/s of the frequency to be measured is shown in Fig. 6. A variable oscillator which covers the frequency range 1 Mc/s to 2 Mc/s can be locked anywhere in this range to one of the harmonics of the 0.1 kc/s. The output from this oscillator is then mixed with one of the harmonics of the 1 Mc/s. The difference frequency can then be easily checked (see later). By suitably combining different harmonics of the 1 Mc/s, the frequency coverage can be extended up to at least 30 Mc/s.

The Frequency Synthesizer

With this device it is possible to produce a very great number of marker frequencies, only one of which is present in the output at any one time.[16,17] Each marker is locked to the standard crystal oscillator, and is a pure tone, so that there can be no possible difficulty in identifying the frequency marker in use. Equipment can easily be designed to produce markers in steps of 1 kc/s or of 100 c/s and individual frequencies at 100 c/s intervals up to 30 Mc/s can be produced. Thus no matter what the frequency of a signal in this range, the equipment can produce an accurate frequency marker which is within 100 c/s of it. The two frequencies, the signal to be measured, and the standard frequency, can then be combined and their difference frequency accurately measured by one of the l.f. comparison methods.

How this is done can best be seen with the aid of the block diagram of the basic arrangement as shown in Fig. 8. The standard crystal oscillator usually operates at 5 Mc/s, and one of the standard harmonic divider chains is used to produce harmonically rich frequencies of 1 Mc/s, 100 kc/s, 10 kc/s and 1 kc/s. Any individual harmonic, up to the 9th, of the 1 kc/s, 10 kc/s, 100 kc/s and 1 Mc/s frequencies, and of the standard frequency can be selected by tuned amplifiers. The harmonic, or harmonics selected can then be combined in a series of balanced modulators to produce the desired output.

Any two selected harmonics, say the n_1th harmonic of the standard frequency f, and the n_2th harmonic of the output of the first divider f/5 are fed to a balanced modulator system. The output from this modulator will contain a number of products, the most important two being $n_1f + n_2f/5$ and $n_1f - n_2 f/5$. These modulation products are fed to a continuously variable calibrated tuned amplifier which is tuned to the wanted product, and is sufficiently selective to reduce the level of the other products to a negligible figure. If the required output frequency is simply $n_1f + n_2f/5$ this can now be fed to the output of the equipment where it can be mixed with the signal.

To produce other frequencies which are multiples of f/50, f/500 and f/5000, a similar process occurs. For example, suppose the frequency to be measured is say, 76.5 kc/s. A frequency output of 76 kc/s from the equipment will produce a difference frequency of 500 c/s when it is mixed with the frequency to be measured, and 500 c/s is a suitable frequency for measurement by one of the low frequency comparison methods. This 76 Kc/s signal is produced in the following way. The sixth harmonic of the 1 kc/s frequency is selected by its harmonic selector, and combined in the balanced modulator with the seventh harmonic of the 10 kc/s frequency which has been selected by its harmonic selector. The output from the modulator will consist of 70 kc/s + 6 kc/s and 70 kc/s − 6 kc/s. The product at 76 kc/s is selected by the tuned amplifier and passed on to be compared with the frequency to be measured.

The output must be reasonably pure if the synthesizer is to exhibit its chief attractions—ease of operation, and no ambiguity. This can be easily achieved in the case of the example just considered, for the main unwanted modulation product is at 70 kc/s-6 kc/s i.e., at 64 kc/s, 12 kc/s away from the wanted product at 76 kc/s. Trouble arises when the second digit of the wanted product, instead of being 5, 6, 7, 8 or 9, is 1, 2, 3 or 4. In the worst possible case, which in the example considered would be 71 kc/s, the unwanted product, at 69 kc/s would be only 2 kc/s away, and it would be difficult and expensive to adequately suppress it. This difficulty can be overcome, and relatively simple tuned circuits retained, by always selecting a harmonic which is the complement of these low value digits. If a frequency of say 72 kc/s is required, the 8th, instead of the second harmonic of the 1 kc/s is selected, and this is mixed with the eighth, instead of the seventh harmonic of the 10 kc/s signal. The modulation product will now be 80 kc/s $\pm$ 8 kc/s., i.e. 72 kc/s and 88 kc/s. The wanted product of 72 kc/s is selected quite easily for it is separated by 16 kc/s from the unwanted product at 88 kc/s.

As a further example of the operation of the synthesizer consider the production of a frequency of say 15.678 Mc/s.

The eighth harmonic of the 1 kc/s frequency is selected and mixed with the seventh harmonic of the 10 kc/s frequency. Their sum, 78 kc/s, is selected and mixed with the sixth harmonic of the 100 kc/s signal. The product, 678 kc/s, is then selected and mixed with the fifth harmonic of the 1 Mc/s frequency to produce 5,678 kc/s, and this is combined with the second harmonic of the 5 Mc/s crystal standard. Their sum, 15.678 Mc/s, is the wanted signal.

If it should be necessary to produce marker frequencies at intervals which are smaller than 1 kc/s either one of two methods can be used. A further 10 : 1 divider chain can be used to produce a frequency of 100 c/s from the 1 kc/s frequency. Individual harmonics of this 100 c/s frequency can then be selected and mixed with a selected harmonic of the 1 kc/s frequency, and so on, to produce marker frequencies at intervals of 100 c/s. Alternatively a variable 500 c/s to 1000 c/s oscillator can be used. The output from this oscillator is combined with the selected harmonic of the 1 kc/s frequency, thus providing a variable frequency signal in between the fixed frequency markers spaced at 1 kc/s intervals. The oscillator need only cover the frequency range 500 c/s to 1000 c/s because frequencies between 0 and 500 c/s are produced by mixing the 500 to 1000 c/s frequency with a harmonic of the 1 kc/s frequency, which is one higher than the required harmonic, the difference being selected. The harmonics of a 100 c/s frequency obtained by dividing down from the 1 kc/s frequency, can be used to provide 100 c/s calibration check points on the oscillator, and the calibration of the oscillator need then only hold over the 100 c/s spacing between these calibration check points.

References

1. J. E. Thwaites, and F. J. M. Laver. *The Technique of Frequency Measurement and its Application to Telecommunications, J.I.E.E.*, Vol. 89 part III, p. 139, September, 1942.

2. F. W. Dunmore, and F. H. Engels, *A Method of Measuring Very Short Radio Wavelengths and their Use in Frequency Standardisation, Proc. I.R.E.*, Vol. II, p. 467, October, 1923.

3. August Hund, *Correction Factor for the Parallel Wire System used in Absolute Radio Frequency Standardisation, Proc. I.R.E.*, Vol. 12, p. 817, December 1924.

4. Eijiro Takagishi, on a *Double Hump Phenomenon of Current through a Bridge Across Parallel Lines, Proc. I.R.E.*, Vol. 18, p. 513, March 1930.

5. H. B. Dent, *Measuring Decimetric Wavelengths, Wireless World*, Vol. 64, p. 319, July 1958.

6. P. M. Ratcliffe, *Marconi Absorption Wavemeters, Marconi Instrumentation*, Vol. 6, p. 73, September 1957.

7. W. H. F. Griffiths, *Direct Reading of the Frequency of Resonant Circuits, Wireless Eng.*, Vol. 20, p. 254, November 1943.

8. G. W. Short, *Transistorised Absorption Wavemeter, Wireless World*, Vol. 65, p. 193, April 1959.

9. Technique of Microwave Measurement (Vol II Radiation Laboratory Series), p. 286, 1947.

10. L. Essen, *The Design, Calibration and Performance of Resonance Wavemeters for Frequencies between* 1000 *and* 25000 *Mc/s, J.I.E.E.*, 1946. Part IIIa, p. 1413.

11. G. de Visme, *Crystal Calibrator, Wireless World*, December 1959.

12. L. G. White, *Heterodyne Frequency Meters, Marconi Instrumentation*, Vol. 7, No. 7, p. 215, 1960.

13. L. H. Moore, *The Identification of Harmonically Related Frequencies, Electrical Engineering*, Vol. 19, p. 134, April 1947.

14. *An Analog Frequency Meter for Modern Measurements, The General Radio Experimenter*, Vol. 35, Nos. 1 and 2, p. 3. Jan./Feb. 1961.

15. J. E. Attew, *Decade Multivibrator Design, Wireless World*, Vol. 58, No. 3. p. 114, March 1952.

16. H. J. Finden, *The Frequency Synthesiser, J.I.E.E.* 1943, Vol. 90, Part III, p. 165.

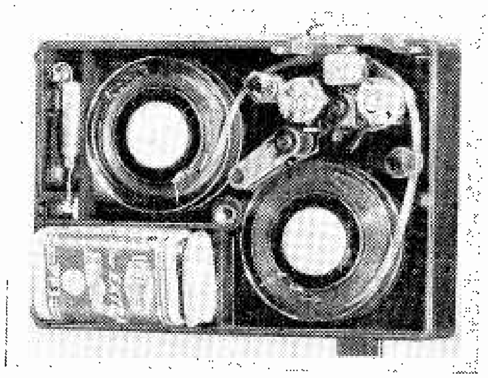
17. H. J. Finden, *Developments in Frequency Synthesis, Electronic Engineering*, Vol. 25, p. 178, May 1953.

(To be continued)

Miniature Tape Recorder

AN hour's playing time is provided by the Stuzzi "Memo-Cord" which measures only $4\frac{1}{2}$in $\times$ $3\frac{1}{8}$in $\times$ $1\frac{1}{2}$ in and weighs 11oz. Standard $\frac{1}{4}$-in tape is used and there are four tracks, selected by shifting the record/playback head with a miniature gate-change mechanism. Alternate tracks are played in opposite directions and there are therefore two erase heads, using d.c. to saturate the tape. Separate batteries are used for the 3-transistor amplifier and for the motor which drives the spool rims. Fast rewind can be effected manually, and a numbered backing ensures accurate tape location.

The price of the "Memo-Cord," which as the name implies is primarily a pocket dictating machine, is £26 5s and it is supplied in the U.K. by Recording Devices Ltd., 44 Southern Row, London, W.10.



Interior view of the Stuzzi "Memo-Cord." The carrying case is in the form of a book.

VIRTUAL EARTH

By "CATHODE RAY"

THIS is a term that appears from time to time in *Wireless World** and other technical literature, but perhaps not often enough to be familiar to all. In fact, although it was invented something like 20 years ago (I believe by Prof. F. C. Williams) a substantial radio encyclopedia published in 1950 contains no mention of it. So when it does occur it is liable to interrupt the flow of comprehension, unless explained, and if it is explained the explanation interrupts the main stream of the argument. Although it can be quite quickly explained, it is worth some less hurried consideration, because it ties in rather interestingly with other ideas.

Fig. 1 shows the essentials for producing a virtual earth. It comprises an amplifier, with two impedances (in this simplest case, two resistances, R_1 and R_2) connected so as to apply negative feedback in a particular way. Provided the amplifier has a large voltage gain and reverses the sign, the potential of the point P stays relatively constant, almost as if it were earthed.

So what? Couldn't one do even better, without any amplifier, simply by connecting P to earth directly or (if constant p.d. had to be maintained) through a battery, Zener diode, electrolytic capacitor or whatever? But to be effective these would all have to be paths of very low impedance compared with R_1 and R_2. The special feature about the virtual earth is that there is no need to connect it to earth at all, let alone through a low impedance. It need only

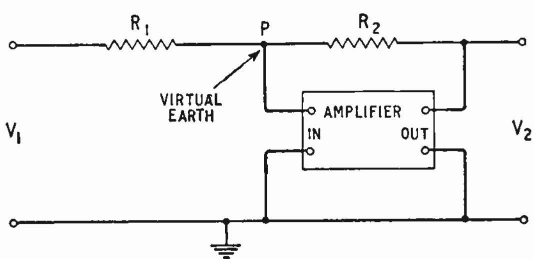


Fig. 1. Basic virtual-earth circuit, comprising an amplifier and two resistors (or other impedances). The higher the gain of the amplifier the better.

go to a negatively biased grid. In which case no current passes out of the circuit there; all that goes through R_1 must go through R_2 as well.

That again, by itself, is nothing remarkable; the same is true of any impedances in series. It is the near-earthing of the junction without any appreciable current-carrying path to earth that is special and yields interesting results.

One notable result (with resistances, as shown) is that V_2 is a copy of V_1, but reversed in sign and enlarged or reduced to any desired extent, the ratio

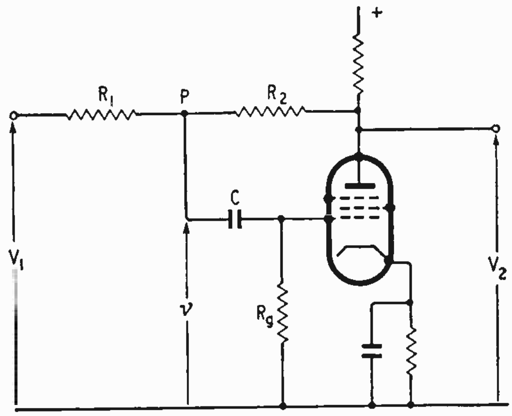


Fig. 2. How Fig. 1 is directly utilized in the see-saw phase inverter circuit. Here $V_2 = -V_1$.

being R_2/R_1. This is true whatever the waveform of V_1, so long as the amplifier covers the requisite range of frequency. With other kinds of impedance other phase relationships can be obtained, as we shall see later.

The best known application, using equal resistances to get an opposite and nearly equal V_2, is what is appropriately called the see-saw circuit. It is identical with Fig. 1, the amplifier normally being a single high-gain stage. Fig. 2 is a practical version. Its usual purpose is as a so-called phase splitter or phase inverter, to drive the balancing half of a push-pull amplifier. V_1 is the alternating voltage output of an amplifying valve—often, but not necessarily, of the same type as the valve shown—and V_2 is the resulting equal and opposite voltage.

The voltage gain of the amplifier is V_2/v, so the greater it is the smaller v is, and the closer P is to earth potential.

Perfect equality of V_1 and V_2 can be represented as in Fig. 3; as one potential goes up the other goes down, and so on alternately—hence the name "see-saw." The diagonal lines represent the peak potentials all along the path R_1R_2. If these resistances were equal, P would be exactly at earth potential, but then there would be no signal to drive the amplifier, so the thing wouldn't work. Fig. 3 shows that in order to get the necessary v and still keep $V_2 = -V_1$, R_2 has to be slightly greater than R_1. Applying a little elementary geometry to the diagram gives the correct value of R_2 as $R_1(A+1)/(A-1)$, where A is the gain, V_2/v.† So, for example, if $A = 100$, R_2 would have to be about 2% more than R_1. If however $R_1 = R_2$, V_2 would be about 2% less than V_1, which in practice would often be near enough.

These calculations assume that the same current passes through R_1 and R_2, but according to Fig. 2

*E.g., March 1961 issue, p. 121.

†Strictly, A is negative, but its sign is disregarded here.

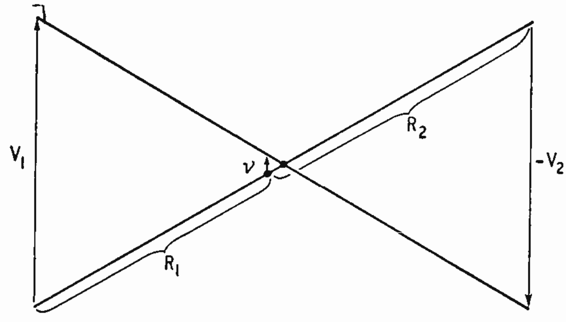


Fig. 3. Peak potential diagram showing how, because V_1 and V_2 are in opposite phase, there is an earth-potential point somewhere on R_2. The drive for the amplifier (v) is taken off quite close to this, at the junction P, which is the virtual earth.

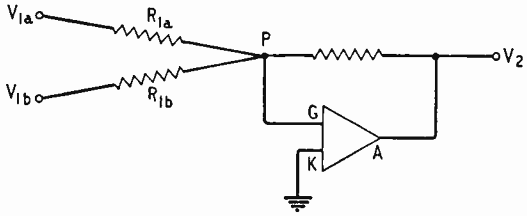


Fig. 4. Basis of electronic adding and subtracting machine. Here (because it is the fashion) the conventional triangular sign for an amplifier is used instead of the block in Fig. 1. Oddly enough, the big signal comes out of the small end.

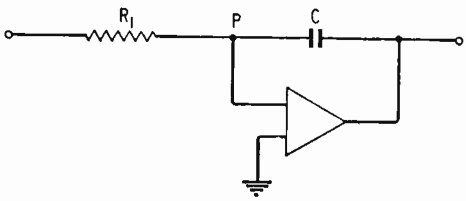


Fig. 5. This slightly modified version can be used for mathematical integration, or as a time base, or for tone control. The first two of these uses are explained by Fig. 6.

some current must branch off to earth via C and R_g. C is chosen so as to have negligible impedance at any working frequency, so only R_g need be considered. And that needn't be considered long, because its resistance is likely to be at least as great as R_1 and R_2, but the voltage across it is only 1/A as much, so with A of the order of 100—or even 50—the effect of R_g is usually negligible. There is therefore no need to go to the trouble—as some do—of avoiding the use of R_g by various circuit modifications. These are more likely to introduce complications than R_g, which is located at almost the lowest-potential part of the circuit.

It may help you to get a still more complete picture of the action of the basic circuit if you discard R_1 and apply the input voltage V_1 direct to P. The only current path (assuming a high-impedance amplifier input) is through R_2. If the far end of R_2 were earthed, it would appear as a resistance of exactly R_2 and the current would be V_1/R_2. But for every volt applied at P, the far end of R_2 has $-A$ volts applied to it by the amplifier. So the total voltage across R_2 is $V_1(A + 1)$ volts, and the current through it is $V_1 (A + 1)/R_2$, and so R_2 looks to V_1 (which can't see what the amplifier is up to at the far end of it) like resistance $R_2/(A+1)$. This is normally quite low—almost a short-circuit to earth; hence the "virtual earth." The amplifier turns R_2 into a sort of transformer, stepping down the impedance between P and earth.

Going back to the see-saw circuit, one of its several advantages is that the ratio of V_2 to V_1 depends almost entirely on the ratio of R_2 to R_1 and hardly at all on the actual amplification, so long as that is reasonably large. And V_2 is an almost perfect upside-down copy of the V_1 input; in other words, hardly any distortion is introduced. These features, of course, are typical of negative feedback, which is here used to a maximum extent.

Because another single-valve circuit with maximum negative feedback, but on the cathode side, is called the cathode follower, some people call the see-saw circuit the anode follower. But that is typical of the muddled thinking that informs our terminology. The point of the name "cathode follower" is that the potential of the cathode closely follows that of the grid. But precisely the opposite is the case with the so-called anode follower. One might just as well call a mouse a cat follower.

Another name is "paraphase circuit." But it too is liable to confuse, because the name has been used for another circuit that looks very similar, the only difference being that the point P is directly earthed and the valve is driven from a tapping on R_1; this entirely alters the way the thing works, and prevents it from being self-balancing.

The virtual-earth principle in what is basically the same circuit is even more in evidence when it is used in analogue computers. These (for any who are not familiar with the term) are computers in which the numbers in the problem are represented by the magnitudes of potential differences or currents. The most elementary operation in arithmetic is addition, and if two or more voltages, V_{1a}, V_{1b}, etc. are applied through equal resistances, as in Fig. 4, the current flowing in them will be very nearly proportional to the applied voltages. This is because P is virtually earthed, so that no appreciable voltages are applied at that end. And because both or all of these currents have to flow through R_2 the total current therein (and therefore V_2) is proportional to $V_{1a} + V_{1b} + \ldots$. Subtraction is automatically included, because a negative voltage causes a corresponding reduction in voltage output.

It is a simple matter to introduce coefficients, by making R_{1a}, R_{1b}, etc. different. For instance, the sum

$$x + 2y$$

can be done by making V_{1a} proportional to x, V_{1b} proportional to y, and R_{1b} 1/2 times R_{1a} so that V_{1b} causes twice as much current per volt as V_{1a}.

The scheme can be designed for a.c. or d.c. With a.c. there are greater possibilities, because instead of simple positive and negative there is a continuous range of phase difference. If a capacitor is substituted for R_2, as in Fig. 5, the equal-current rule still holds, but because of the nature of capacitance the voltage across C is equal to the *time integral* of the current. For instance, if a constant voltage V_1 is applied it will cause a constant current, which will charge the capacitor at a constant rate, making the voltage across it increase likewise, as in Fig. 6. Mathematically V_2 is the time integral of V_1, so the device can be used to solve differential equations.

This is also in principle the so-called Miller integrator, developed by Blumlein, which is the basis for many time-base and delay circuits as well as computer circuits. The fault of the ordinary time-base circuits that charge a capacitor through a simple resistor is that the rise in voltage across the capacitor is at the expense of the voltage available for charging it, so that the rate of charge falls off exponentially. In Fig. 5, by contrast, the virtual earth keeps point P at constant potential and the amplifier provides the rising voltage across C, up to the limit of its output.

Substituting C for R_1 instead of R_2 does the opposite thing—differentiation. V_2 is then a measure of the rate at which V_1 is changing.

The now famous Baxandall tone control circuit‡ was designed around the virtual earth, which allows continuously variable bass and treble lift and cut to be applied independently up to a maximum of about ± 20 dB. In the treble control a capacitor feeds to P a controllable proportion of V_1 (for lift) or V_2 (for cut), varying the impedance ratio and hence the ratio V_2/V_1 progressively at high frequencies. With Fig. 6 still in mind, one might for a moment fear distortion as a result of the integrating and differentiating effects of using the capacitor. But although it is true that the waveform is altered by such a tone control, that has no effect on hearing, which is interested only in the sine-wave components present.§ And it happens that the sine wave has the unique property that its form is not altered by integrating and differentiating; only its magnitude and phase are affected.

Bass control is provided by making P a slider tapping on a middle section of $R_1 + R_2$, thus varying the ratio R_2/R_1 and thereby V_2/V_1. This effect is confined to low frequencies by shorting out this middle section to high frequencies by means of two equal and relatively large capacitances.

Fig. 7 shows the essentials of the complete tone control system. It is worth noting that negative feedback of the same basic type is adopted in many radio receiver output stages (see my contribution in last July issue), sometimes with fixed tone-adjusting intent.

Ability to bring part of a circuit to earth potential or thereabouts without actually earthing it (i.e., without providing a route for current to escape) is particularly interesting to designers of a.c. measuring bridges. Their problem is that the bridge arrangement (Fig. 8(a)), which is an outstandingly versatile and precise scheme for measuring impedances of all kinds, allows either the signal source or the signal detector to be earthed, but not both. In Fig. 8(a) the detector is earthed, and in the normal operation of the bridge it is adjusted so that the detector has nothing to detect. In other words, there is no p.d. across it, and both terminals are at earth potential. There are inevitably some stray capacitances from the source to earth, shown dotted. These shunt Z_3 and Z_4, altering their effective values to an unknown extent and so introducing errors.

If the link joining the bridge to earth were removed, stray capacitances to earth would be disconnected from the detector and so would not cause misleading currents to flow through it, provided they did not enter via stray capacitance C_3 between detector and earth as in Fig. 8(b). Such entry can be prevented by bringing the detector to earth potential so that no p.d. exists across C and therefore no current can flow that way.

What is called the Wagner earth (totally uncon-

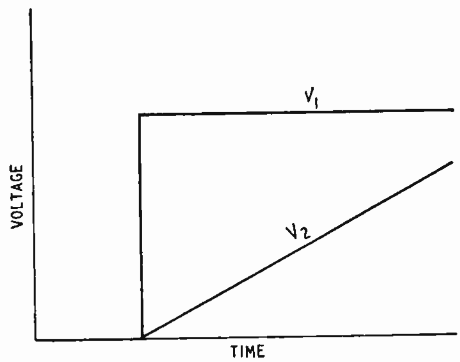


Fig. 6. If V_1 takes the form of a step, as shown here, V_2 comes out as a steady slope.

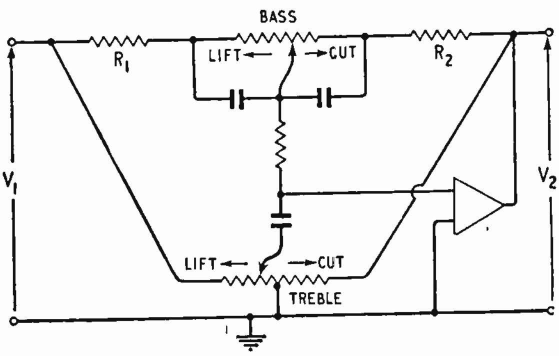


Fig. 7. Essentials of the Baxandall tone control system, which is an elaboration of the same basic circuit.

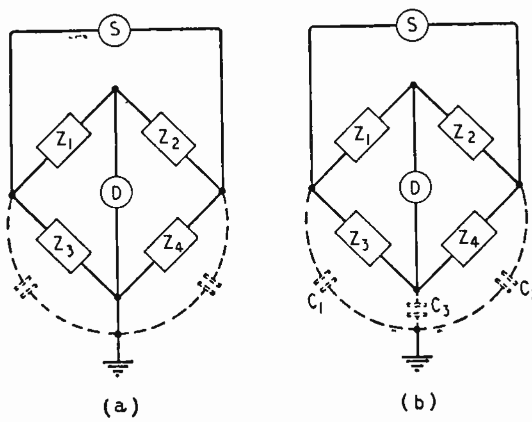


Fig. 8. (a) General a.c. bridge circuit, with the detector directly earthed, in which stray capacitances cause errors. If the detector can be brought to earth potential without direct connection (b) this is avoided.

‡"Negative-feedback Tone Control," by P. J. Baxandall. *Wireless World*, October 1952, pp. 402-5.

§*High Quality Sound Reproduction*, by J. Moir; p. 52 (Chapman & Hall).

nected with the composer of *Tannhäuser*) does this by shunting C_1 and C_2 with variable impedances, which are adjusted to bring the detector to earth potential. To ensure that all the stray capacitances are connected to earth and none to the detector (other than C_3), the bridge arms are enclosed in earthed screens.

The snag about this is the adjusting of the Wagner impedances. To avoid it, C. G. Mayo|| made use of the virtual-earth principle as in Fig. 9. As before, the amplifier input is connected between earth and the point P which is to be made a virtual earth. The output is connected to one side of the source, at Q. The part of R_2 is played by the bridge network between P and Q. Remember, at any one frequency—in this case the frequency of the source—*any* network, however complicated, is equivalent to one resistance and one reactance, either in series or parallel as desired. And the part of R_1 is played by the bridge network between X and P. A slight departure from the arrangement we have been considering is that the signal source is connected between X and Q instead of between X and earth,

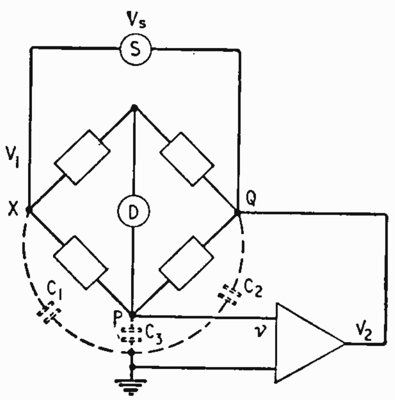


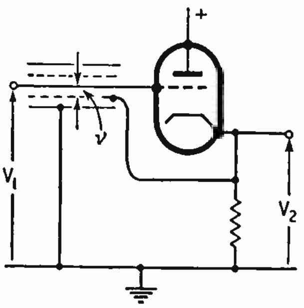
Fig. 9. Mayo-Muirhead-Wagner system for accomplishing (b) in Fig. 8.

but this makes no difference in principle; it just means that V_1 is $V_s - V_2$.

At balance, there is no p.d. across D, and the source voltage V_s divides itself according to the ratio of the bridge, with D at virtual earth potential. For instance, with a 1 : 1 bridge ratio, points X and Q would be at opposite and very nearly equal signal potentials, just as in the see-saw circuit. The stray capacitances C_1 and C_2 from the source to earth occur across the amplifier output and the source, so can be regarded as parts of them, perhaps very slightly altering the signal voltage but not affecting the bridge impedances or its accuracy. All stray capacitance to earth from the detector (and from any bridge-arm screens connected thereto) are rendered insignificant by the relative smallness of the p.d. across it.

Sometimes it may be desirable to minimize potential to some point other than earth. That is where the cathode follower comes in. Fig. 10 shows how. V_2 now has the *same* sign as V_1, and v is the difference between the two—and is relatively small if the internal gain (A) of the valve is large. When a single valve doesn't give enough, there are more elaborate cathode followers.¶ In Fig. 10 the device

Fig. 10. By making use of the cathode following action in a cathode follower, the effective capacitance between the input lead and its screen can be reduced to a small fraction of its directly earthed value.



is being used to reduce the p.d. between the input lead and its screen. This greatly reduces its effective capacitance. But, as I emphasized in the May issue, one has to be careful that the cathode follower isn't put out of action by large-amplitude negative-going steep-fronted signals.

Incidentally, the cathode follower is the extreme case of the other main form of negative feedback. That form can be derived from the first one in Fig. 1 simply by changing over the earth connection from one input terminal to the other. But as it looks rather unfamiliar to have the earthed input terminals on top, I have redrawn it in more conventional form as Fig. 11. Just as R_1 and R_2 in Fig. 1 can be regarded as a potential divider controlling the overall gain V_2/V_1, which is nearly R_2/R_1 if A is large, so in Fig. 11 R_1 and R_3 is a potential divider straight across the amplifier output, controlling the amount of feedback and hence the overall gain, which is approximately $(R_1 + R_2)/R_1$. To apply this form it is necessary, as we have seen, for the amplifier output to be in phase with the input, instead of opposite as in Fig. 1. P is still the junction between R_1 and R_2, and now follows the potential of the "live" input terminal instead of the earthed one.

The cathode follower is distinguished by the fact that (1) *all* the output voltage is fed back, by making $R_2 = 0$, so that the overall gain is approximately 1 (again, assuming A is large), and (2) the output is taken from cathode instead of anode, so that it is in phase with the input instead of inverted. So we see there is a very close relationship between our virtual-earth circuit and the cathode follower. In fact, the

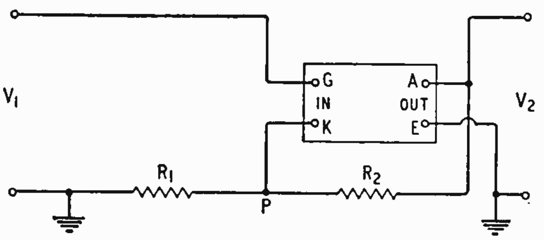


Fig. 11. This, for comparison with Fig. 1, is an alternative main type of negative feedback connection. If $R_2 = 0$ and the anode is transferred to earth, it is a cathode follower.

amplifier in the Mayo circuit can be seen as a cathode follower if point Q is earthed, instead of the cathode as in Fig. 9. (The source S then has one terminal earthed.) The cathode-follower action makes the potential of the bridge screening (which is in effect its local "earth") follow that of the grid, in the usual manner.

||"An Electronic Wagner Earthing Device." *Muirhead Technique*, January 1957, pp. 6-7.

¶"Multi-valve Cathode Follower Circuits," by J. G. Thomason. *Wireless World*, July and August 1957, pp. 310-3 and 373-7.

News from Industry

British Relay Wireless & Television Ltd.—A 40% increase in trading profit is reported for the year to April 30 last. At £3,516,985, trading profit shows an increase over last year of £1,042,379. Chairman, Sir Robert Renwick, Bart., K.B.E., states that more subscribers were gained to their rental and relay services than in any single previous year. B.R.W. opened seven main stations and 24 substations during 1960-61 bringing the network coverage to over 3M people.

Electric & Musical Industries Ltd. report a group profit before taxation of £5,448,000 for the year to June 30, 1961. This compares with £5,348,000 for 1959-60. Group net profit, after all charges including taxation, was virtually the same at £2,443,000.

Pye and Ekco Profits Drop.—Both Pye Ltd. and E. K. Cole Ltd. experienced set-backs in the financial year to March 31 last. E. K. Cole incurred a group loss of £665,429 as against a previous profit of £675,031 and Pye's group profits contracted from £2.4M to £1.4M. British Electronic Industries Ltd., the company formed just a year ago for the merger between Pye and Ekco, is paying a 15% dividend out of Pye's profits.

Telefunken Annual Report for the year to March 31 last reveals that sales rose in all divisions of the business. Domestic sales increased by 22% and export business by 18%. Including companies wholly owned by Telefunken, the sales amounted to approximately DM740 million.

The **Antiference Group Ltd.**—Trading profit of £440,375 shows a reduction of some 6% on the previous year, but the company's policy of diversification is starting to bear fruit, states chairman N. M. Best.

British Aircraft Corporation Ltd. announce the following new appointments: Sir George Edwards, C.B.E., (Executive Director, Aircraft), is appointed managing director of British Aircraft Corporation Ltd. He will cease to be managing director of Vickers-Armstrongs (Aircraft) Ltd. and will become deputy chairman of that company. The Rt. Hon. Viscount Caldecote (Executive Director, Guided Weapons), is appointed deputy managing director and chief executive (guided weapons) of British Aircraft Corporation Ltd. Marshal of the Royal Air Force Sir Dermot Boyle, G.C.B., K.C.V.O., K.B.E., A.F.C., has been appointed to undertake special responsibility for co-ordinating the administration of personnel and training and education within the Group. A. W. E. Houghton is to be managing director of Vickers-Armstrongs (Aircraft) Ltd.

Graetz K.G. and Standard Electrik Lorenz A.G. have merged as far as financial control is concerned. S.E.L. already have an interest in domestic radio through the Schaub-Lorenz firm, but the identities of Graetz and Schaub-Lorenz are to be kept separate as far as development, production and sales are concerned. There will, however, be an exchange of know-how.

Nigerian Telecommunications Corporation is the title of a company newly formed in Nigeria by Marconi's Wireless Telegraph Co. Ltd. and L. M. Ericsson Company of Sweden. The purpose of the new Corporation is threefold; to provide an "on-the-spot" organization which can deal rapidly and efficiently with all aspects of telecommunication requirements; to promote the expansion of technical education in Nigeria, and to introduce local assembly of some types of telecommunication units rather than import them already assembled.

Garrard Engineering Board.—Following the recent announcement that the Garrard Engineering Manufacturing Co. Ltd., of Swindon, had become a wholly owned subsidiary of the Plessey Co. Ltd., the formation of a reconstituted board of directors is announced by Plessey. New directors of the company are A. E. Underwood (chairman); Hector V. Slade (managing director); K. J. Slade; J. Tyldesley; John A. Clark; and Michael W. Clark. Plessey also announce that Sir William Stanier has resigned from the Garrard board, and has accepted an appointment as a director of Machine Products Ltd. Donald F. Brown has also resigned from the Garrard board and has joined the board of Hawley Products Ltd.

Pye have signed a long-term technical agreement with the French company, Schneider Radio-Television, covering the manufacture of specified electronic products but excluding sound radio and TV receivers. Under the agreement Schneider will manufacture Pye products in France and market them throughout the franc area through a joint sales subsidiary which the two companies have agreed to establish.

C.E.C. (U.K.) Ltd. Formed.—The American electronic instrument makers Consolidated Electrodynamics Corporation, Inc., of Pasadena, California, has formed a U.K. subsidiary to manufacture in Britain for both home and export markets. The headquarters of the new Consolidated Electrodynamics Corporation (U.K.) Ltd., is at 14 Commercial Road, Woking, Surrey (Tel.: Woking 5633).

Veroboard Marketing Company.—Expansion of the Electronics Division of Vero Precision Engineering Ltd. has resulted in the formation of that division into a new self-supporting company named Vero Electronics Ltd., to produce and market Veroboard and its accessories. Trading continues from the same address at 7 South Mill Road, Southampton (Tel.: Southampton 71061), and it is pointed out that the new company's formation in no way affects the present or future trading operations of the parent company.

Aveley Electric Ltd., of South Ockendon, Essex, have introduced into the U.K. a number of tubes newly developed by Allen B. DuMont Laboratories for whom they are agents. Among these is the new scan convertor Type K.2070. This is a double ended, electrical input—electrical output, non-destructive readout storage tube capable of resolution in excess of 1,000 lines at 50% modulation.

Plessey Co. Ltd, of Ilford, Essex, have granted an exclusive licence to the Centralab Division of Globe Union Inc., of U.S.A., to manufacture, sell and use in the U.S.A. moulded track potentiometers made to Plessey designs.

British Telemeter Home Viewing Ltd. announce that they have appointed Marconi's Wireless Telegraph Company Ltd. as technical consultants in the field of broadcast subscription television and associated matters. British Telemeter have moved recently to 1 Albemarle Street, London, W.1 (Tel.: Hyde Park 5494).

Winter Trading Co. Ltd., of Ladbroke Grove, London, W.10, have acquired all the branches of L.P.F. Ltd., the old-established national radio and electrical wholesalers. The four branches involved, in Manchester, Sheffield, Leicester and Ipswich, will be integrated into the existing Winter Trading organization.

Tannoy Equipment for Border TV.—Comprehensive studio intercommunication equipment and monitoring equipment is being installed by Tannoy Ltd. for the new Border Television Studios. This follows the pattern of similar equipment for radio and TV studios throughout the country. In this instance multi-channel transistorized selective intercommunication equipment is used, together with the new Tannoy 3LZ monitor loudspeaker units mounted in Tannoy "infinite baffle" enclosures.

Lufthansa German Airlines are to equip their entire jet airliner fleet with a new radar-navigation set supplied by Collins Radio Company. Called the DN-101/NC-103 Doppler Radar Navigation System, the unit continuously measures and displays ground speed and displays present aircraft position.

Ship-board Television.—Two special broadband aerial arrays designed by Belling-Lee are being used on board the liner *Canberra* owned by P. & O. Orient Lines. During the preliminary trials of the liner *Oriana* which plies the same route as the *Canberra* and is equipped with a similar system, the aerials were subjected to a force 9 gale which they withstood without any damage. TV programmes continued to be received up to 120 miles from the transmitter. The complete system was installed by the Marconi International Marine Communication Co. It provides for the reception of TV broadcasts employing the 405-line system used in Britain, the 625-line system used in Australia, and the greater part of Europe, and the 525-line system used in the Western Hemisphere and Japan.

New A.M.P. Factory.—Aircraft-Marine Products (Great Britain) Ltd. have opened a 60,000 sq ft plant at the Industrial Estate, Port Glasgow, Scotland. A wide diversity of A.M.P. terminals are used in the electronics industry and in commercial applications the most common use is for loudspeaker connections. Headquarters of the American parent company are located at Harrisburg, Pennsylvania.

Ultra Radio & TV Service Department, under service manager J. S. Lawson, has moved to Eley's Estate, Angel Road, Edmonton, London, N.18 (Tel.: Edmonton 3060).

Perdio Factory at Sunderland.—Perdio Ltd., the London manufacturers of transistor radios and TV sets, components and other related products, are to build a new 115,000 sq ft factory, which will provide, initially, jobs for 700 women and 300 men, on a six-acre site at the Pallion Industrial Estate, Sunderland, Co. Durham.

Brimar Move.—All orders and enquiries, other than those concerned with export and publicity, should now be addressed to Brimar Commercial Division, Thorn-A.E.I. Radio Valves & Tubes Ltd., Rochester, Kent (Tel: Chatham 44411). London area telephone enquiries can still be made to Footscray 3333. Commercial manager is G. P. Thwaites.

Racal Change Name.—The broadening of their activities in the radio communications field has prompted Racal Engineering, of Western Road, Bracknell, Berks., to change their name to Racal Electronics Ltd. A 24,000 sq ft addition to their Bracknell Works is scheduled for completion next spring. Racal (Australia) Pty. Ltd., Baulkham Hills, Sydney, has been formed to market Racal and other products in Australia.

OVERSEAS TRADE

Indian Industries Fair.—A representative selection of Ekco nucleonic counting and gauging equipment will be featured at the Indian Industries Fair, New Delhi (November 14, 1961-January 1, 1962). The Ekco display will be on the stand of Greaves Cotton & Co. Ltd., Ekco Electronics distributors in India. The Board of Trade is providing an official U.K. exhibit and organizing a large commercial display of British products.

Dexion Radio Mast.—A 60ft radio transmitting mast built entirely in Dexion Slotted Angle is being supplied to Emmisores do Norte Reunidos, a commercial broadcasting station in Portugal.

Marconi Marine equipment has been chosen for six fishing vessels being built in British yards for the Ghana Supply Commission. They will be fitted with Marconi Marine radio equipment and electronic navigation and fishing aids.

NOVEMBER MEETINGS

Tickets are required for some meetings; readers are advised, therefore, to communicate with the secretary of the society concerned.

LONDON

1st. I.E.E.—"Generation of power in satellites" by H. J. H. Sketch at 6.0 at Savoy Place, W.C.2. (Joint meeting with Royal Aeronautical Society.)

1st. Brit.I.R.E.—"The teaching of the theory of transistors and other semiconductor devices" by Professor M. R. Gavin at 6.0 at London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

2nd. I.E.E.—"Acoustics and the electrical engineer" by T. Somerville at 6.0 at Savoy Place, W.C.2.

3rd. I.E.E.—Discussion on "Information theory in relation to biology" opened by Professor D. M. Mackay at 6.0 at Savoy Place, W.C.2.

6th. I.E.E.—"The general problems of f.m. multi-channel communications" by R. G. Medhurst at 5.30 at Savoy Place, W.C.2.

6th. Society of Instrument Technology.—"Semiconductor diodes and rectifiers in control engineering" by P. R. Wyman and "The transistor in control engineering" by Dr. G. D. Bergman at 7.0 at Manson House, 26 Portland Place, W.1.

8th. Brit.I.R.E.—"Electronics in chromatography" by E. L. Gregory and E. A. Piper at 6.0 at London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

9th. Radar & Electronics Association.—"Space communications" Part II by Dr. W. F. Hilton (Hawker Siddeley Aviation) at 7.0 at Royal Society of Arts, John Adam Street, W.1.

9th. Television Society.—"The colourimetric requirements of monochrome television phosphors: when is your white screen white?" by C. G. A. Hill (Levy West Laboratories) at 7.0 at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, W.C.2.

13th. I.E.E. Graduate & Student Section.—"The Work of the B.B.C., with particular reference to transistors" by R. W. Leslie at 6.45 at Savoy Place, W.C.2.

15th. Brit.I.R.E.—"Infra-red applications in navigation" by C. M. Cade at 6.0 at London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

17th. Institute of Navigation.—"The navigation and guidance of supersonic aircraft" by Capt. W. L. Polhemus, at 5.30 at The Royal Geographical Society, 1 Kensington Gore, S.W.7.

22nd. Brit.I.R.E.—Computer Group Symposium on "Adaptive optimizing control" at 6.0 at London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

24th. Television Society.—"Television distribution by wire: factors influencing the choice of system" by A. Cormack (Hirst Research Centre), G. J. Hunt (General Piped Television), R. P. Gabriel (Rediffusion) and R. E. Billham (Rediffusion) at 7.0 at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, W.C.2.

29th. I.E.E.—"Recent developments in semiconductor devices and their applications" by E. Wolfendale at 5.30 at Savoy Place, W.C.2.

29th. British Kinematograph Society.—"Radar recording" by Dr. R. E. Eastwood and N. R. Phelp (Marconi's) at 7.30 at Central Office of Information, Hercules Road, Westminster Bridge Road, S.E.1.

29th. Brit.I.R.E.—"An experimental assessment of loudspeaker performance" by R. York at 6.0 at London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1.

ABERDEEN

10th. I.E.E.—"Thermistors—their theory, manufacture and application" by Dr. R. W. A. Scarr and R. A. Setterington at 6.0 at Robert Gordon's Technical College.

ABORFIELD

20th. I.E.E. Graduate & Student Section—"History of modern television" by A. D. G. Wheatley at 7.0 in the Unit Cinema, 3 (Tels.) Training Bn., R.E.M.E.

BATH

8th. I.E.E.—"Silicon power rectifiers" by A. J. Blundell, A. E. Garside, R. G. Hibberd and I. Williams at 6.0 at the S.W.E.B. Demonstration Theatre.

BEDFORD

20th. I.E.E.—"Some recent advances in semiconductor circuits" by Dr. G. B. B. Chaplin at 7.0 at the Swan Hotel.

BELFAST

14th. I.E.E.—"The potentialities of artificial earth satellites for radiocommunication" by W. J. Bray at 6.30 in Lecture Theatre LG25, David Keir Building, Queen's University.

BIRMINGHAM

15th. Television Society.—"The S.E.C.A.M. French colour television system" by Pierre Cassagne (Compagnie Française de Television) at 7.0 at the Physics Lecture Theatre, The University.

22nd. I.E.E.—"Experimental investigation of space" by J. A. Ratcliffe, C.B.E., at 6.30 at the Midland Institute.

23rd. Brit.I.R.E.—"Tunnel diodes" by Dr. K. Hulme at 6.15 at the Electrical Engineering Dept., The University.

27th. I.E.E.—Third Hunter Memorial Lecture on "The Application of electronics to the electricity supply industry" by Dr. J. S. Forrest at 6.0 at the James Watt Memorial Institute.

BRISTOL

15th. Brit.I.R.E.—"Introduction to analogue computers" by P. G. Davies at 7.0 at the College of Science and Technology, Ashley Down.

21st. I.E.E.—Faraday Lecture on "Expanding horizons in communications" by D. A. Barron at 6.30 at the Colston Hall.

CARDIFF

8th. Brit.I.R.E.—"High-frequency induction heating and dielectric heating" by W. D. Wilkinson at 6.30 at the Welsh College of Advanced Technology.

23rd. I.E.E.—Faraday Lecture on "Expanding horizons in communications" by D. A. Barron at 6.45 at the Sophia Gardens Pavilion.

CHATHAM

29th. I.E.E. Graduate & Student Section—"Some aspects of the control and guidance of guided weapons" by J. A. Miller at 7.0 at the Medway College of Technology, Maidstone Road.

CHESTER

20th. I.E.E.—"Transistors" by P. Godfrey at 6.30 at the Town Hall.

23rd. Society of Instrument Technology.—"Transistors applied to modern instrumentation" by J. E. Fielden at 7.0 at Stanley Palace, Watergate Street.

DUNDEE

9th. I.E.E.—"Thermistors—their theory, manufacture and application" by Dr. R. W. A. Scarr and R. A. Setterington at 6.0 at the Electrical Engineering Department, Queen's College.

EDINBURGH

7th. I.E.E.—"Brushless variable-speed induction motors using phase-shift control" by Professor F. C. Williams, C.B.E., Dr. E. R. Laithwaite, J. F. Eastham and W. Farrer at 7.0 at the Carlton Hotel, North Bridge.

FARNBOROUGH

28th. I.E.E.—"Brushless variable-speed induction motors using phase-shift control" by Prof. F. C. Williams, C.B.E., Dr. E. R. Laithwaite, J. F. Eastham and L. S. Piggott at 6.15 at the Technical College, Boundary Road.

28th. Brit.I.R.E.—"Data acquisition systems" by K. L. Smith at 7.0 at the Technical College.

GLASGOW

8th. I.E.E.—"Education: why bother?" by Dr. K. R. Sturley at 6.0 at the Institution of Engineers and Shipbuilders, 39 Elmbank Crescent, C.2.

29th. I.E.E.—"The banana-tube display system—a new approach to the display of colour-television pictures" by Dr. P. Schagen at 6.0 at the Institution of Engineers and Shipbuilders, 39 Elmbank Crescent, C.2.

IPSWICH

15th. I.E.E.—Third Hunter Memorial Lecture on "The application of electronics to the electricity supply industry" by Dr. J. S. Forrest at 6.30 at Electric House.

LIVERPOOL

15th. Brit.I.R.E.—"The guidance of bats and men by echo-location" by L. Kay at 7.30 at the Walker Art Gallery.

MALVERN

2nd. Brit.I.R.E.—"Transistor portables" by R. A. Lampitt at 7.0 at the Winter Gardens.

MANCHESTER

2nd. Brit.I.R.E.—"V.H.F. communications receivers and transmitters using transistors" by A. J. Rees and D. C. Carey at 7.0 at Reynolds Hall, College of Technology.

7th. I.E.E.—"Some recent developments in oscillating electrical machines" by Prof. F. C. Williams, C.B.E., at 6.15 at the Electrical Engineering (Dover Street) Laboratories, The University.

8th. I.E.E.—"Data transmission" by R. H. Franklin and J. Rhodes, M.B.E., at 6.15 at the Engineers' Club, Albert Square.

21st. I.E.E.—"Transistor instrumentation in rockets" by G. G. Haigh at 6.15 at the Engineers' Club.

21st. Incorporated Practitioners in Radio & Electronics.—"Operational use of radio by the police" by a member of Manchester City Police Radio Dept., at 7.30 at the Central Hall, Oldham Street.

MIDDLESBROUGH

1st. I.E.E. — "Thermistors—their theory, manufacture and application" by Dr. R. W. A. Scarr and R. A. Setterington at 6.30 at the Cleveland Scientific and Technical Institution.

NEWCASTLE-UPON-TYNE

1st. I.E.E.—"The potentialities of artificial earth satellites for radio-communication" by W. J. Bray at 7.0 at the Conservative Club, Pilgrim Street.

6th. I.E.E.—"Microminiaturization" by L. J. Ward at 6.15 at the Rutherford College of Technology, Northumberland Road.

8th. Brit.I.R.E.—"A pulse time multiplex system for stereophonic broadcasting" by G. D. Browne at 6.0 at the Institute of Mining and Mechanical Engineers, Neville Hall, Westgate Road.

20th. I.E.E.—"Simulation of intelligence" by Professor D. M. Mackay at 6.15 at Rutherford College of Technology, Northumberland Road.

NEWPORT

10th. Institute of Physics and Physical Society.—"Colour television: principles and practice" by K. Hacking (B.B.C.) at 6.0 at the College of Technology.

NOTTINGHAM

28th. I.E.E.—Third Hunter Memorial Lecture on "The application of electronics to the electricity supply industry." by Dr. J. S. Forrest at 6.30 at Nottingham University.

PORTSMOUTH

10th. Brit.I.R.E.—"Recent Advances in low noise microwave valves" by Dr. D. G. Kiely at 7.0 at the College of Technology.

SOUTHAMPTON

1st. I.E.E.—"Brushless variable-speed induction motors using phase-shift control" by Professor F. C. Williams, C.B.E., Dr. E. R. Laithwaite, J. F. Eastham and L. S. Piggott at 7.0 at The University.

14th. I.E.E.—"High speed ferrite core stores" by P. Cooke at 6.30 at The University.

STONE

13th. I.E.E.—"Data transmission" by R. H. Franklin and J. Rhodes, M.B.E., at 7.0 at Duncan Hall.

TAUNTON

9th. I.E.E.—Third Hunter Memorial Lecture on "The application of electronics to the electricity supply industry" by Dr. J. S. Forrest at 3.0 at the Lecture Theatre, S.W.E.B., Electric House, The Parade.

WOLVERHAMPTON

1st. Brit.I.R.E.—"Electronics in biological engineering" by W. J. Perkins at 7.0 at the College of Technology.

WORKINGTON

7th. I.E.E.—"Silicon power rectifiers" by A. J. Blundell, A. E. Garside, R. G. Hibberd and I. Williams at 7.0 at the College of Further Education.

RANDOM RADIATIONS

By "DIALLIST"

One Year Old

I HEAR that the members of the Pilkington Committee recently held a small informal party to celebrate its first birthday. I wonder how old it will be before it speaks! The P.M.G. has certainly made it clear in his reply to the recent appeal from the Radio & Television Retailers' Association for an early decision on line standards that there will not be an interim report from the Committee. I understand that during the year there have been 56 full-day meetings. In addition a sub-committee of four spent 10 days in N. America. The 11 members of the Committee (there were originally 13) are certainly putting in a tremendous amount of time one way and another. They have already had almost as many meetings as its immediate predecessor—the Beveridge Committee of 1949—which held 62 meetings and produced its 900-page report (including appendices) in 19 months.

Simply a Question Of . . .

DUE, undoubtedly, to the disproportionate amount of publicity given in the lay press to the questions of TV line standards and colour, there is in the mind of the man in the street the idea that these are the Committee's only problems. This is, of course, far from the truth but I can't, myself, be sure of the scope of the terms of reference. I wonder if the Editor would refresh our memories by reprinting them.* Can you remember, by the way, the "familiar" titles of the earlier committees of enquiry into broadcasting set up by the Government? The first was the Sykes Committee of 1923; the second, the Crawford Committee of 1925; the third, the Ullswater Committee of 1935 and the fourth, the Beveridge Committee of 1949. What a simple task the first committee must have had by comparison with the major problems facing the present members. In those far off days it was simply (*sic!*) a question of sound broadcasting.

Colour TV

DID you see what Jules Thorn had to say about colour television in his statement at the recent annual general meeting of Thorn Electrical Industries, which, as you know, markets domestic sound and television sets under a number of trade names, including Ferguson, Philco, Pilot and Ultra. He said: "As to colour, I am appalled at the irresponsible statements that have been appearing in the Press. It is certainly possible to give colour demonstrations under carefully controlled closed circuit conditions, but I believe it is wrong to mislead the public into thinking that we can have it as a satisfactory broadcast service." He then went on to quote a few facts from the American scene where colour TV was introduced as far back as 1954. In the seven years since then only 590,000 colour sets have been sold to the trade. During the same period over 50M monochrome receivers were sold. Mr. Thorn added: "Although we (Thorns) have developed a system which we think has many advantages over the U.S.A. system we do not believe it to be at the stage when we can put colour on the market."

A Worthwhile Job

THE Editor has passed to me a letter from the Nuffield Talking Book Library for the Blind appealing for help for the servicing of talking book machines. In his letter, D. Finlay-Maxwell, the honorary organizer of servicing volunteers—of which there are already some 1,500—says that volunteers would be called upon to install machines (some disc and some tape) for the blind and also to service these should faults develop. This valuable and worth-while activity involves no financial obligation as all spare parts, etc., are provided by the Library. Circuit diagrams and technical data are also provided. From the information given in the letter it would appear that, if you volunteered, you would not be called upon very frequently. My present state of health prevents me from offering my services, but I do hope that this note will stir some of my readers to volunteer. Your offers should be addressed to D. Finlay-Maxwell, A.M.I.E.E., Hon. Or-

---

* Yes, certainly, here are the terms of reference and, for full measure, the names of the members of the Committee.—Ed.

"To consider the future of the broadcasting services in the United Kingdom, the dissemination by wire of broadcasting and other programmes and the possibility of television for public showing; to advise on the services which should in future be provided in the United Kingdom by the B.B.C. and the I.T.A.; to recommend whether additional services should be provided by any other organization; and to propose what financial and other conditions should apply to the conduct of all these services."

Members:—H. Collison, Elwyn Davies, Miss Joyce Grenfell, R. Hoggart, E. P. Hudson, Prof. F. H. Newark, J. S. Shields, Dr. R. L. Smith-Rose, Mrs. Elizabeth Whitley, W. A. Wright and D. G. C. Lawrence (secretary).

ganizer of Servicing Volunteers, c/o John Gladstone & Co., Ltd., Galashiels, Scotland. It would help the organizer if you would state the approximate area you would be prepared to cover.

A Retrograde Step?

SO France has taken the retrogressive step of introducing the 625-line standard for its second television programme which, when started next year, will operate in Bands IV and V. Although there is no indication that the present 819-line standard is to be abandoned for existing services, I am more than surprised that our French cousins have weakened in their stand to foster the world's highest definition TV. The official announcement from the Ministry of Information states that an 8-Mc/s channel will be employed, and that the spacing between vision and sound carriers will be 6.5Mc/s. The vision carrier will employ positive modulation and sound will be a.m., as in their present 819-line transmissions. One wonders if the introduction of a second service will give an impetus to the growth of TV in France which, as I said a few months ago, has not been very spectacular.

U.H.F./V.H.F. Co-Siting

TALKING of a second programme: I was interested to see the note in last month's "World of Wireless" on the introduction of Italy's second chain of stations. I was particularly interested in the decision to install the u.h.f. stations at the same sites as the existing v.h.f. transmitters. At first sight (sorry!) this seemed odd as, of course, the service area of stations in Bands IV and V is considerably less than those in the lower bands. However, when one reflects that the majority of Italy's 550 or more v.h.f. television stations each cover only a very limited area—almost every valley has its own station—the decision on co-siting is logical. As you know, the Italian TV channels in Bands I and III are lettered A-H, but I see that they will be using numerals for the channels in Bands IV and V. Incidentally, be very cautious when referring to the numbering of channels in the u.h.f. bands. They are no longer continuous from those of Bands I and III. It was agreed at the recent Stockholm Conference to start numbering the 61 channels in Bands IV and V at 21—an advance of seven on the old temporary numbering.

UNBIASED

By "FREE GRID"

"Steam" P.A. Link

ONE day last summer, when paying a brief visit to one of our more popular seaside resorts, I went to the show being given by the concert party on the pier. The building itself was modern and its p.a. system was first-class in all respects but one.

I noticed it first during a performance by a ventriloquist who, as he walked about the stage with his dummy, was using a microphone and a trailing cable connected to the p.a. system to enable his voice to carry to all parts of the theatre. His performance as a ventriloquist was very good indeed, but the out-of-date technique of the trailing cable struck a jarring note.

This cable was obviously a nuisance and a snare to the feet of the ventriloquist, more especially when he came down among the audience, as he did. In addition to this disadvantage, the very presence of the cable drew unkind remarks from some of the "know-alls" in the audience to the effect that the mike was really a loudspeaker and that the dummy's "voice" came along the cable from a backstage confederate.

Surely in these days it should not be necessary to employ a "steam" p.a. link, such as a trailing cable, to couple a portable mike to the amplifier. It should be the simplest thing in the world to have a tiny microwave and microwatt transmitter inside the dummy, linking to a backstage receiver feeding into the p.a. system. The absence of the trailing cable would make the performance much more realistic.

In fact I would go even further and put the tiny transmitter on the person of the ventriloquist and have a receiver in the dummy as well as backstage. By this means the ventriloquist would be able to leave the dummy on one side of the stage, while he took up his stance on the other, or just walked about. It would naturally be a simple matter of telearchic technique to control also the movements of the dummy's lips and eyes from the "micromitter" on the ventriloquist's person, the controls being in his trousers' pocket. He could then call himself by the Graeco-Latin hashup of "teleloquist".

If my suggestion was adopted, a performance of greatly enhanced entertainment value could be given. There should be no difficulty about getting a transmitting licence from the P.M.G. as the apparatus would, I think, come into the same category as that used for controlling model boats and aircraft.*

* It is not quite so simple as "F.G." imagines. The risk of interference with the receiver associated with the radio microphone raises difficulties in finding a suitable frequency. However, we understand the Post Office has drawn up a proposed specification for equipment to operate in the 174.6-175 Mc/s band.—Ed.

"F.G." will be interested in this radio microphone designed by Associated Television.—Ed.

Hospital Sales Resistance

IN the August issue, I complained of the heavy and old-fashioned type of headphones used in hospital wireless installations, and put forward a plea for lightweight headphones of the stethoscope type. In October I amended my plea and suggested a system whereby there was one earpiece in the control box on the wall to feed the sound by an ordinary type of stethoscope, to the patient's ears.

I am pleasantly surprised to learn that both these systems are already available, the first being marketed by Hadley Telephone & Sound Systems Ltd., of Smethwick, Staffs., and the second, under the name of Stethophone, by Goring Kerr Ltd., of Gerrards Cross, Bucks. Although the latter is at present not well known in this country it is in widespread use in Scandinavia and Holland.

Judging from details sent to me, I think both these systems are worthy of the highest praise and are "just what the doctor ordered" except that the doctors—or at any rate the hospitals—seem very reluctant to order them, despite the fact that they have been supplied with full details.

This does not altogether surprise me as hospital authorities are very conservative in these matters, as was shown in the 'twenties when they showed no great enthusiasm toward the introduction of hospital radio itself, in spite of the fact that it acts as a psychological anæsthetic to those spending long, weary hours in bed.

Perhaps indeed it was just because broadcast listening did act as an anæsthetic that the hospitals were suspicious of it, as was the greater part of the medical profession in 1847 when Sir James Simpson began the extensive use of *physical* anæsthetics. His fellow medicos continued their opposition even when Simpson pointed out to them that an anæsthetic was used at the very earliest recorded physical operation when, prior to the removal of his rib, a deep sleep was caused to fall upon Adam (Gen. II 21).

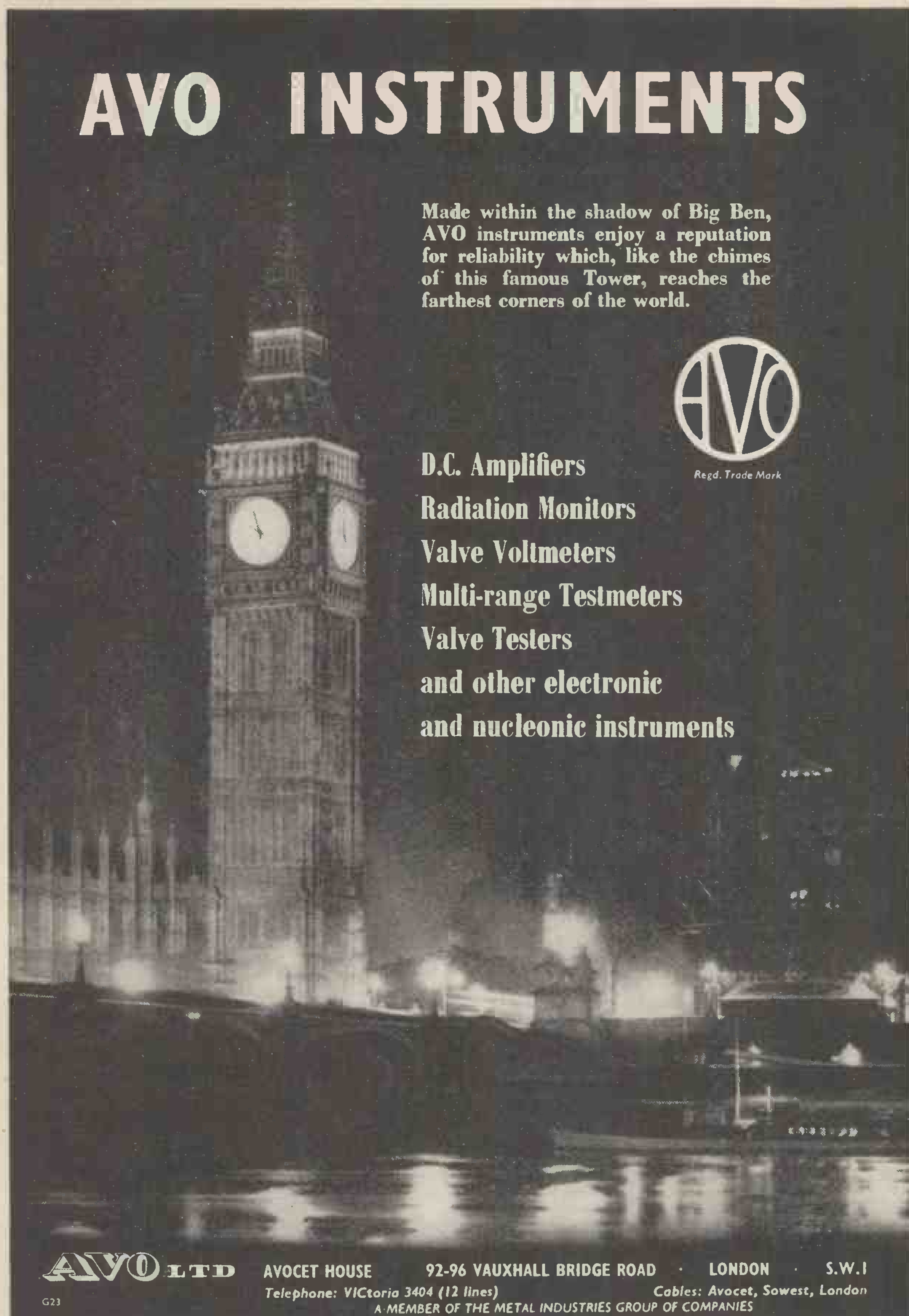
Etymological Exactitudes

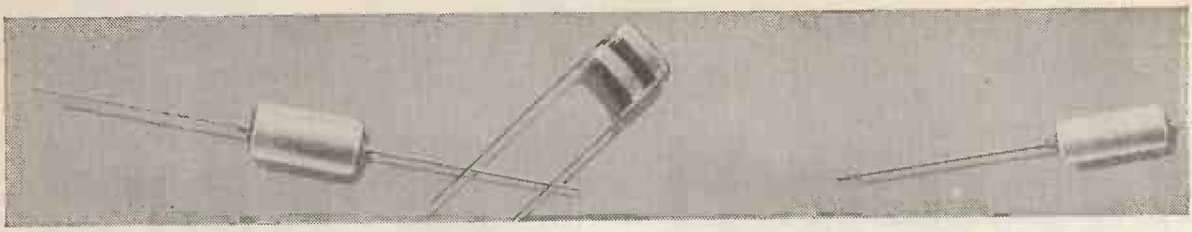
THE expression "in vacuo" is to be found quite a lot in electronics literature when, for instance, discussing the phenomenon recurring in a valve or c.r.t., and is, of course, commonplace in other branches of physics. The use of the word "vacuo" although an etymological exactitude is, in my opinion, irritatingly pedantic.

In my vulgar and ignorant way, I usually write "in a vacuum," since I regard the word "vacuum" as having become as completely a part of the English tongue as, for instance, the Latin word "inertia." What physicist, for instance, speaks of overcoming "inertiam" (note the final M) as he rightly but pedantically should.

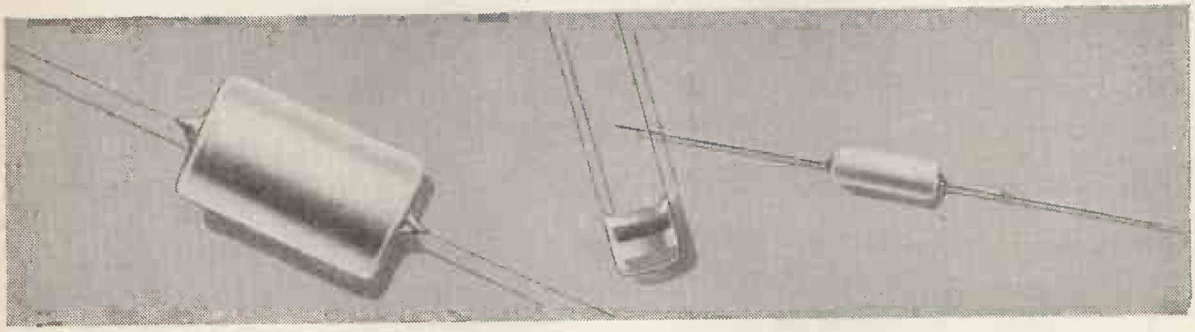
I raise this question here because some months ago, I was shocked to read in a learned journal an article in which occurred the truly dreadful expression "Loss of Vacuum," which only a vulgar person like myself would use. Matters were made much worse in that hard on the heels of this philological philistinism came the pedantically correct "in vacuo."

I am quite aware that the English preposition "of" is embodied in the Latin genetive "vacui" but that is all to the good; after all, the English indefinite article "a" is embodied in the Latin ablative "vacuo." Maybe you don't agree with my argument, but I don't think you can deny that it is logical; or can you?

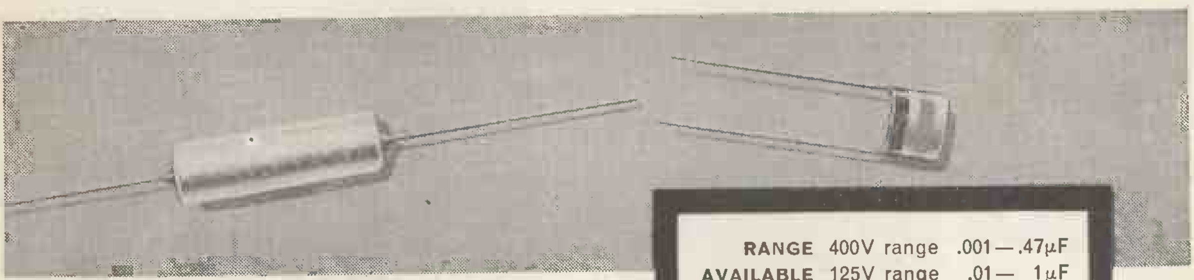

AVO INSTRUMENTS
Made within the shadow of Big Ben, AVO instruments enjoy a reputation for reliability which, like the chimes of this famous Tower, reaches the farthest corners of the world.
AVO
Regd. Trade Mark
D.C. Amplifiers
Radiation Monitors
Valve Voltmeters
Multi-range Testmeters
Valve Testers
and other electronic
and nucleonic instruments
AVO LTD
AVOCET HOUSE · 92-96 VAUXHALL BRIDGE ROAD · LONDON · S.W.1
Telephone: VICtoria 3404 (12 lines)
Cables: Avocet, Sowest, London
A MEMBER OF THE METAL INDUSTRIES GROUP OF COMPANIES
G23



Mullard POLYESTER CAPACITORS...



designed for peak performance with economy...



RANGE	400V range	.001—.47μF
AVAILABLE	125V range	.01— 1μF
	30V range	.01— .1μF

Write to Mullard House for leaflets giving full technical details

SMALL PHYSICAL SIZE

HIGH WORKING TEMPERATURES

CLOSE CAPACITANCE TOLERANCE

HIGH INSULATION RESISTANCE

FULLY TROPICALISED

COST SAVING

MULLARD LTD · COMPONENT DIVISION · MULLARD HOUSE · TORRINGTON PLACE · LONDON W.C.1

MC4214

an absolute practical minimum of

wow

and flutter

That has been one of our main objectives since we started making tape decks and recorders and we feel that we have achieved this (along with many other notable features) in our present range of recorders. By the use of high quality components and fastidious precision assembly these "wow and flutter" figures are maintained:—

Below .05% at 15 ips
Below .1% at $7\frac{1}{2}$ ips
Below .15% at $3\frac{3}{4}$ ips
Below .25% at $1\frac{7}{8}$ ips

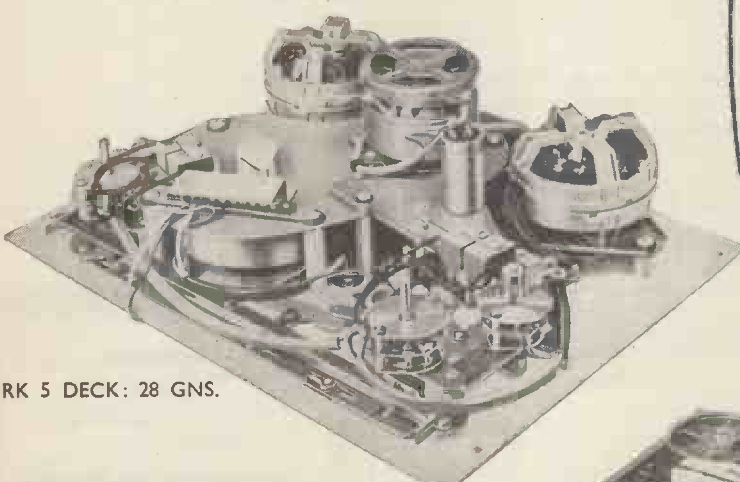
The Brenell Mark 5 deck at 28 gns. has greater precision and dependability than you are ever likely to find elsewhere at anywhere near the price.

IT'S A HEART THAT IS AS SOUND AS SOUND CAN BE.

Abridged Specification:

3 INDEPENDENT MOTORS (Capstan motor-hysteresis synchronous)
4 RECORDING AND PLAYBACK SPEEDS, $1\frac{7}{8}$, $3\frac{3}{4}$, $7\frac{1}{2}$ and 15 ips.
FAST REWIND (1,200ft. rewound in either direction in 45 secs)
ACCEPTS $8\frac{1}{4}$in. reels. **INTERLOCKED CONTROLS**
PAUSE CONTROL. DIGITAL REV. COUNTER.
PROVISION FOR EXTRA HEADS (Mono or Stereo)

TAPE RECORDERS: MARK 5 STEREO: £99.12.0.
3 STAR: 58 GNS.
3 STAR STEREO: 89 GNS.



MARK 5 DECK: 28 GNS.

MARK 5 TYPE M: 88 GNS.

MARK 5: 64 GNS.

Brenell

Full details and the address of your nearest stockist from the sole manufacturers:— **BRENELL ENGINEERING CO. LTD.**
1A DOUGHTY STREET, LONDON, W.C.1. CHA 5809 and HOL 7358

GD821

ELEMENTARY...

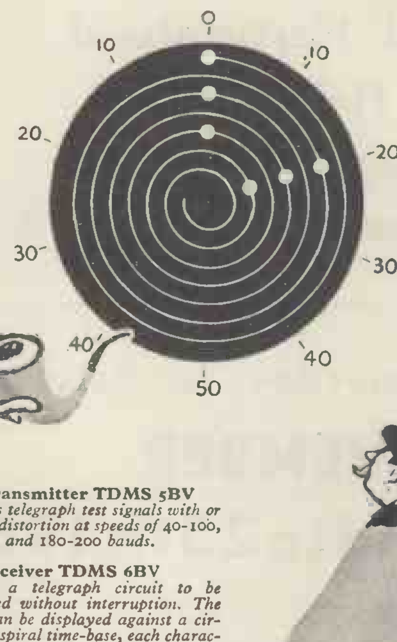
1 BIAS DISTORTION

The uniform lengthening or shortening of the mark or space elements, one at the expense of the other. The total time interval for one mark and one space remains the same. If the mark element is lengthened, then the space element will be shortened by the amount the mark is lengthened.

By examining a suspected transmission using the spiral time-base of a TDMS 6B, distortion becomes immediately apparent from the displacement from the vertical of the 'bright ups' representing the characteristic instants of modulation.

In the example shown, at 50 bauds, the space to mark transitions are all occurring 20% late, this means that the MARK element is being shortened by 4 mS consequently the SPACE element is being lengthened by 4 mS — note that the total allocated for one Mark and one Space (40 mS) remains the same.

Bias distortion may be due to a badly adjusted relay, mistuning of a radio receiver or even to a badly adjusted transmitter.



The Transmitter TDMS 5BV
Provides telegraph test signals with or without distortion at speeds of 40-100, 160-180 and 180-200 bauds.

The Receiver TDMS 6BV
Enables a telegraph circuit to be monitored without interruption. The signal can be displayed against a circular or spiral time-base, each characteristic instant of modulation being shown as a bright dot on the screen. Speeds of 40-100, 160-180 and 180-200 bauds.

The Telegraph Signal Display Unit TDU2
A specialized oscilloscope, having a linear time-base of good short term stability and long term accuracy, for examination of the d.c. telegraph wave form against a continuous start stop time-base. Valuable features of the instrument are an X shift calibrated in terms of code element transitions and an X expansion control. Speed ranges 40-100, 160-180 and 180-200 bauds.

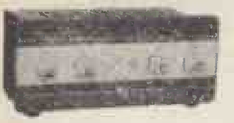
Write for the full descriptive brochure to:—

AUTOMATIC TELEPHONE & ELECTRIC CO. LTD.,
STROWGER HOUSE, ARUNDEL STREET, LONDON, W.C.2.

AT14011

So easy to build — Heathkit DAYSTROM — **so easy to use**

6 W STEREO AMPLIFIER KIT



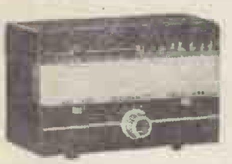
Model S-33

A versatile high-quality self-contained STEREO/MONAURAL Amplifier with adequate output for a living room. Can be used to convert a favourite (monaural) radiogram into a stereo-radiogram. 3 watts per channel; 0.3% distortion at 2.5 w/chnl.; 20 dB N.F.B., inputs for Radio (or Tape) and Gram., Stereo or Monaural; Ganged controls. Sensitivity 200 mV. **£12.8.6**

HI-FI SINGLE CHANNEL AMPLIFIER KIT Model MA-12

A compact high fidelity power amplifier (including auxiliary power supply). 12 watts output. Wide frequency range and low distortion. A variable sensitivity control is fitted enabling it to be used with an existing amplifier in a stereophonic system. Other applications include sound reinforcing systems, transmitter modulators, for use with tape recorders, also as a general purpose laboratory amplifier. **£10.19.6**

STEREO-HEAD BOOSTER KIT



Model USP-1

Hi-Fi Stereo Pre-Amplifier for low-output Hi-Fi P.U.s. Input 2 mV. to 20 mV. Output adjustable from 20 mV. to 2 V. 40–20,000 c/s. Also suitable as low-noise R.C.-Coupled high-gain monaural amplifier. **£6.17.6**

STEREO CONTROL UNIT KIT

Model USC-1

Incorporates all worthwhile features for high fidelity stereo and mono. Push-button selection, accurately matched ganged controls to ±1 dB. Negative feedback rumble and variable low-pass filters. Printed circuit boards. Accepts inputs from most tape heads and any stereo or mono-pick-up. **£8.18.6**

TAPE DECKS

Are available as "packaged deals" with other equipment. Customers purchasing much of their audio equipment at the same time will find our PACKAGED DEAL scheme more economical. Details on request.

'MALVERN' HI-FI EQUIPMENT CABINET KIT

A NEW AND ATTRACTIVE CABINET in modern style designed to house all your Hi-Fi equipment (including tape deck and full-sized transcription record player). The cabinet parts are veneered and pre-drilled, with edging in Panoplex plastic strip, for ease of finishing. Complete with everything you need for assembly, including screws, hinges and even a padsaw! Left "in the white" for finishing to choice.
Size 39⅛ x 32 x 21⅜in. **£17.10.0**

TAPE AMPLIFIER UNITS Models TA-1M and TA-1S

This Combined Tape-Record/Replay Amplifier is available in both monophonic and stereophonic models. Model TA-1M can be modified to the stereo version with modification kit TA-1C.

TA-1M, £18.2.6; TA-1S, £23.6.0; TA-1C, £6.10.0

'GLOUCESTER' STEREO CABINET KIT

OPEN

Specially developed to meet the varying needs of different homes, it will house Tape Deck and/or Record Player, F.M. Tuner and Stereo Amplifier. In addition, for the convenience of those to whom space is an overriding consideration, it is possible to house speaker systems at each end. For this purpose a loudspeaker kit, comprising two 4in. plus 8in. speaker systems, balance unit, speaker grille, cutting template, padsaw and mounting details are also available. Neutral hardwoods have carefully been selected so that the finished product can be stained and polished to individual choice. There is storage space for records, etc., also for power amplifiers. Dimensions: length 46½in., height 30in., depth 21in.

Mk. I for Tape Deck or Record Player **£16 13 6**

Mk. II for both T/D and R/P **£17 18 6**

'CHEPSTOW' EQUIPMENT CABINET KIT

Specially designed for those whose floor space is at a premium. Will house Record Player, FM Tuner, Stereo Amplifier and additional power amplifiers where needed. An upper deck is available for the self-power stereo amplifiers to ensure maximum heat dissipation. Veneered and left in white for finishing to personal taste. Overall dimensions are 35in. x 18in. x 33in. high. **£11.5.6**

HI-FI STEREO AMPLIFIER KIT Model S-88

Gives 16 w. output (8 per channel with 0.1 per cent. distortion at 6 w. per channel). It has ganged controls. STEREO/MONAURAL gram, radio and tape recorder inputs and push-button selection as well as many other first-class features well above its price range. In two-tone grey metal cabinet with a golden surround and fittings. Also ultra-linear push-pull output. **£26.12.6**
Basic sensitivity 20 mV. (4 mV. available 7/6 extra).

HI-FI SPEAKER SYSTEM KIT Model SSU-1

Ducted-port bass reflex cabinet, "in the white." Frequency response to 40–16,000 c/s. Power rating 25 watts. Matched speaker units 8in. high flux (12,000 lines) with hyperbolic cone and 4in. wide angle dispersion type for higher frequencies.
With legs £11/18/6.............. **£10.17.6**

COTSWOLD SPEAKER SYSTEM KIT

This acoustically designed enclosure measures 26 x 23 x 15½in. and houses a special 12in. bass speaker with 2in. speech coil, elliptical middle speaker together with a pressure unit to cover the full frequency range of 30–20,000 c/s. Its polar distribution makes it ideal for really Hi-Fi Stereo. Delivered complete, with speakers, cross-over unit, level control, Tygan grille cloth, etc. Left "in the white" for finish to personal taste, all parts are precut and drilled for ease of assembly. **£21.19.0**

● See our KITS at the R.S.G.B. RADIO HOBBIES EXHIBITION Royal Horticultural Hall, London NOV. 22—25 ●

DAYSTROM LTD.

DEPT. W.W.11, GLOUCESTER, ENGLAND

A member of the Daystrom Group. *MANUFACTURERS OF THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS*

Technically **Heathkit** DAYSTROM **excellent**

5in. OSCILLOSCOPE KIT
Model O-12U

Laboratory quality at utility oscilloscope price and ease of assembly make this kit of outstanding value. Vertical frequency response 3 c/s to 5 Mc/s., + 1.5 dB. −5 dB., sensitivity 10 mV. per cm. at 1 kc. Horizontal frequency 1 c/s. to over 400 kc/s. (± 1 dB. up to 200 kc/s.). The Heath patented sweep circuit functions from 10 c/s to 500 kc/s. in five ranges giving five times the usual sweep of other 'scopes. In addition it has exceedingly short re-trace and rise times and electronically stabilised power supply. Included is a 48-page instructional Manual. **£36.10.0**

ELECTRONIC SWITCH KIT Model S-3U (Oscilloscope Trace Doubler)

This extremely useful, low priced device will extend the use of your single-beam oscilloscope for duties otherwise only in the province of the double-beam tube. In short, at a nominal cost, the Heathkit model S-3U will give you the advantages of a double (or other multiple) beam 'scope, while retaining all the advantages of your present single-beam instrument.

Hitherto an electronic switch of this nature, permitting the simultaneous observation of two signals on the screen of a single-beam C.R.T. oscilloscope, has cost nearly as much as the 'scope itself **£10.15.6**

RESISTANCE-CAPACITANCE BRIDGE KIT Model C-3U

Measures capacity 10pF to 1,000μF, resistance 100Ω to 5 megohms and power factor. 5-450 v. test voltages. Safety switch provided. **£8.6.6**

MULTIMETER KIT
Model MM-1U

Provides wide voltage, current, resistance and dB ranges to cover hundreds of applications. Sensitivity 20,000 ohms/volt D.C. and 5,000 ohms/volt A.C. Ranges: 0-1.5 v. to 1,500 v. A.C. and D.C.; 150μA to 15A D.C.; 0.2Ω to 20MΩ. 4½in. 50 μA meter. **£11.18.6**

AUDIO SIGNAL GENERATOR KIT
Model AG-9U

10 c/s. to 100 kc/s., switch selected. Distortion less than 0.1%. 10 v. sine wave output metered in volts and dB's. **£19.19.6**

AUDIO VALVE MILLIVOLTMETER KIT Model AV-3U

Very sensitive. High stability. 1 mV. to 300 V. A.C. 10 c/s. to 400 kc/s. **£13.18.6**

AUDIO WATTMETER KIT
Model AW-1U

This popular meter is used in many recording studios and broadcasting stations as a monitor as well as for servicing purposes. Dissipation rating up to 25 w. continuous, 50 w. intermittent. **£14.14.0**

HI-FI F.M. TUNER

Tuning range 88-108 Mc/s. Flywheel tuning. Attractive Plastic Front Panel in two-tone grey with golden trim surround and motif. Thermometer type visual tuning indicator. Pre-aligned I.F. transformers (eliminates adjustment). Three I.F. Stages. Wide-band low distortion Ratio Detector. Complete R.F. Unit, wired, tested and pre-aligned (ready for mounting to chassis). Printed circuit for I.F. Amplifiers and Ratio Detector, for ease of assembly. No alignment necessary after assembling. Built-in power supply. Output sockets for stereophonic adaptor (for stereo transmission when available).

TUNER UNIT Model FMT 4U (incl. P.T.) with 10.7 Mc/s I.F. output	£3 5 0
I.F. AMPLIFIER and Power Supply Model FMA-4U complete with case and valves......	£11 11 0
Sold separately ......Total ...	£14 16 0

TRANSISTOR PORTABLE RADIO KIT Model UXR-1

Presented in elegant real hide case with tasteful gold relief. Can be assembled in 4 to 6 hours, and you have a set in the top flight of transistor portables. Pre-aligned I.F. transformers, printed circuit and a 7in. x 4in. high-flux speaker. **£14.18.6**

4-wave TRANSISTORISED PORTABLE RADIO KIT
Model RSW-1

Using 7 latest type transistors and three diodes this highly sensitive set is specially designed for Short and Medium wavebands (200-550, 90-200, 18-50 and 11-18 m.). In solid leather case fitted with retractable whip aerial. **£22.10.0**

PERSONAL TRANSISTOR RADIO KIT Model UJR-1

Operated by a 4.5v. torch battery, this sensitive dual-wave headphone set is a fine introduction to electronics for young and old. In Polystyrene moulded plastic case which accommodates battery (and amplifier if added) **£2.16.6**

Additional Amplifier Stage Model UJR-1S will enable the UJR-1 to work a loudspeaker under favourable conditions, 16/6 extra.

● Deferred Terms ●
available on all orders above £10

VALVE VOLTMETER KIT
Model V-7A

The world's most popular valve voltmeter, with printed circuit and 1 per cent. precision resistors to ensure consistent laboratory performance. It has 7 voltage ranges measuring respectively d.c. volts to 1,500 and a.c. to 1,500 r.m.s. and 4,000 peak to peak. Resistance measurements from 0.1 ohm to 1,000 M ohms with internal battery. D.C. input impedance is 11 megohms and dB measurement has a centre-zero scale. Complete with test prods, leads and standardising battery. **£13.0.0**

R.F. PROBE KIT Model 309-CU

This complete probe kit will extend the frequency range of the V-7A Valve Voltmeter to 100 Mc/s. and will enable useful voltage indication to be obtained up to 300 Mc/s. **£1.9.6**

POWER SUPPLY UNIT KIT
Model MGP-1

Compact, general purpose unit suitable for FM Tuners, Tape Recording Amplifiers and general Laboratory use. Input 100/120 v., 200/250 v., 40-60 c/s. Output 6.3 v. 2.5 A. A.C.; 200, 250, 270 v. 120 mA. max. D.C. **£4.16.6**

DECADE CAPACITOR KIT
Model DC-1

Capacity values 100μμF to 0.111μF in 100μμF steps. Precision silver-mica capacitors and minimum loss ceramic wafer switches ensure high accuracy. **£6.5.6**

R.F. SIGNAL GENERATOR
Model RF-1U

Provides extended frequency coverage on six bands from 100 kc/s.-100 Mc/s. on fundamentals and up to 200 Mc/s. on calibrated harmonics. **£11.18.0**

2¾in. SERVICE OSCILLOSCOPE KIT Model OS-1

Light, compact, portable, for service engineers. Printed circuit board for easy construction. Wt. 10½ lb. Size 5in. x 8in. x 14½in. long. **£19.10.0**

CAPACITANCE METER KIT
Model CM-1U

This Direct-Reading Capacitance Meter is a very low priced, time-saving instrument which is so useful that it should be part of the general equipment of every electronic laboratory and production line. Easily built in a few hours. 0-100μμF, 0-1,000μμF, 0-0.01μF, 0-0.1μF. The meter has 4½in. scale and can be used by an unskilled operator after a few minutes' instruction. **£14.15.0**

DAYSTROM LTD.

DEPT. W.W.11, GLOUCESTER, ENGLAND

A MEMBER OF THE DAYSTROM GROUP, MANUFACTURERS OF

thoroughly **Heathkit** DAYSTROM ***dependable***

AMATEUR TRANSMITTER KIT
Model DX-40U

Covers all amateur bands from 80 to 10 metres, crystal controlled. Power input 75 watts C.W. 60 watts peak controlled carrier phone. Output 40 watts to aerial. Provision for V.F.O. Filters minimise T.V. interference. **£32.10.0**

AUDIO SINE-SQUARE WAVE GENERATOR KIT Model AO-IU

An inexpensive generator which covers 20 c/s to 150 kc/s in four ranges with choice of sine or square waves. The latter up to 50 kc/s. Output voltage 10 v. max. and distortion less than 1%. An ideal instrument for audio testing. Size 9½in. x 6½in. x 5in. **£12.18.6**

HIGH VOLTAGE PROBE KIT
Model HV-336

Measures voltages up to 30,000 v. D.C. with negligible circuit loading. A special High Stability 1,090 megohm resistor gives a multiplication factor of 100X when used with a valve voltmeter of 11 megohms input impedance such as the V-7A. **£2.15.6**

BALUN COIL UNIT KIT
Model B-IU

Useful transmitter accessory. Will match unbalanced co-axial lines, used on most modern transmitters, to balanced lines of either 75 or 300Ω impedance. Can be used with transmitters and receivers without adjustment over the frequency range of 80 through 10 metres, and will handle power inputs up to 200 watts. **£4.9.6**

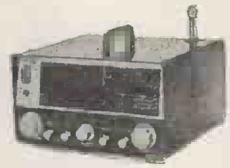
Now Released
STABILISED POWER PACK
Models MSP-IM and MSP-IW

Specially recommended for industrial and laboratory use, meeting the need for a reliable and versatile stabilised power pack capable of a very high performance. Input 200-250 v., 40-60 c/s., A.C., fully fused. Outputs: H.T. 200–410 v. D.C. at 20–225 mA. in 3 switched ranges. Unstabilised A.C. 6.3 v. at 4.5 A. centre-tapped. Two 3in. "easy-to-read" meters for reading voltage and current simultaneously. Separate L.T. and H.T. supply transformers. All output circuits are isolated. Size 13in. x 8½in. x 9½in.

MSP-IM (with meters) £34 12 6

MSP-IW (without meters) £27 17 6

THE "MOHICAN" GENERAL COVERAGE RECEIVER KIT
Model GC-IU



This fully transistorised receiver, which includes 4 piezo-electric transfilters, is in the forefront of receiver design. It is an excellent portable or fixed station receiver for both the Ham and the short-wave listener. To overcome the problems of alignment, etc., the R.F. "front-end" is supplied as a pre-assembled and pre-aligned unit. Designed for outstanding performance, its many features include a 10 transistor circuit, printed circuit board, telescopic whip antenna, tuning meter, and a large slide-rule dial giving a total length of approximately 70 inches.

Housed in a strong steel cabinet in stove-enamelled green and powered by two 6 volt dry batteries (not supplied) mounted internally, it gives continuous frequency coverage from 550 Kc/s to 30 Mc/s in five bands; thus enabling world-wide reception. Electrical bandspread on five additional bands covers the amateur frequencies from 80 to 10 metres—each band having a scale length of approximately 8 inches. B.F.O. tuning and Zener diode stabiliser. Size 6⅞in. x 12in. x 10in. **£38.15.0**

GRID-DIP METER KIT
Model GD-IU

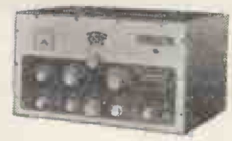
Functions as oscillator or absorption wave meter. With plug-in coils for continuous frequency coverage from 1.8 Mc/s to 250 Mc/s. **£10.9.6**

Additional Plug-in Coils Model 341-U extend coverage down to 350 kc/s. With dial correlation curves, 15/-.

TRANSISTORISED GRID-DIP METER KIT
Model XGD-I

Similar to GD-IU. Fully transistorised with a frequency range of 1.75 to 45 Mc/s. **£10.8.6**

AMATEUR TRANSMITTER KIT
Model DX-100U



The world's most popular Amateur T.X. Kit

- Completely self-contained compact Amateur Transmitter. 150 W. D.C. input.
- Built-in high stable VFO and all Power Supplies.
- TVI: Careful design has reduced TVI to a minimum by use of effectively screened frequency-generating stages and pi-tuned circuits at the input and output of the PA stage, and by 11 chokes and pi network filters to all outlets from the cabinet. No fewer than 35 disc-ceramic by-pass capacitors help to achieve the exceptional stability and high-performance for which this Transmitter is noted.
- The KT88 high-level anode and screen modulator stage gives over 100 watts of audio from less than 1.5 mV. input.
- Adjustable drive and clamp control ensure that valves are only driven sufficiently to maintain the required output.
- Keying on CW is via the VFO and buffer amplifier cathodes; the other RF valves are biased beyond cut-off. When zero-beating the TX with incoming signals, the exciter stages only may be run without the final amplifier being switched on.
- Provision has been made for remote control operation.
- VFO slow-motion drive is very smooth and backlash free. ● VFO or Crystal control.
- Covers all Amateur bands up to 30 Mc/s phone or CW. **£81.10.0**

VARIABLE FREQUENCY OSCILLATOR KIT Model VF-IU

Specially designed to meet the demand for the maximum possible flexibility from an amateur Transmitter which would otherwise be subject to certain limitations imposed by crystal control. Calibrated for all Amateur Bands 160-10 metres, fundamentals on 160 and 40m. Ideal for Heathkit DX-40U and similar transmitters. **£11.2.0**

● Deferred Terms ●

Available on all orders above £10

All prices include free delivery in U.K.

Please send me FREE CATALOGUE (Yes/No)......

Full details of Model(s)..................................

NAME ....
(Block Capitals)

ADDRESS ....

.... WW11

DAYSTROM LTD.

DEPT. W.W.11, GLOUCESTER, ENGLAND

THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS

the experts' choice *Stentorian*

F. C. JUDD
Technical Editor
'Amateur Tape Recording' and 'Hi-Fi Magazine'

PERCY WILSON
Technical Editor
'The Gramophone'

MILES HENSLOW
Editor
'Hi-Fi News' and 'Record News'

JOHN GILBERT
Technical Editor
'Music Trades Review'

DONALD ALDOUS
Technical Editor
'Audio and Record Review'

MODEL H.F. 1016

10in. P.M. Unit, 16,000 gauss magnet. Die-cast chassis and universal impedance speech coil providing instantaneous matching at 3, 7.5 and 15 ohms. Handling capacity, 10 watts, Frequency response, 30 c.p.s. to 15,000 c.p.s.
Bass resonance, 35 c.p.s.

Price £8.4.0 (inc. P.T.)

Other Stentorian Speakers ▶

Type	Flux Density	Price	Type	Flux Density	Price
10″ H.F.1012*	16,000 gauss	£5 2 6	T359 tweeter	9,000 gauss	£1 15 10
8″ H.F.816*	16,000 gauss	£7 0 9	T816	16,000 gauss	£6 13 3
8″ H.F.812*	12,000 gauss	£4 5 6	T12 tweeter	16,000 gauss	£13 4 6
8″ H.F.810	10,000 gauss	£3 3 6	T10 tweeter	14,000 gauss	£4 8 3

CROSSOVER NETWORKS:
CX3,000 £1.11.6
CX1,500 £2.0.0
CX500 £1.7.3

** These three speakers incorporate a universal impedance speech coil.*

WB

WHITELEY ELECTRICAL RADIO CO. LTD.
MANSFIELD · NOTTS · ENGLAND · Telephone: MANSFIELD 1762-5
London Office: 109 Kingsway, London W.C.2.

FERRANTI CAPACITY DIVIDER

TYPE PD30

* Measures accurately high voltage pulses up to 30 kV.
* Incorporates differentiation circuits for measuring rate of rise.
* Suitable for laboratory use or for permanent installation.

Specification and Ratings:

Top Capacitance:	3·4 ± 0.2 pf
Total Load Capacitance:	6 pf. max.
Applied Voltage:	30 kV. max.

Ratios:

Position 1:	250:1
Position 2:	500:1
Position 3:	7·5kV/µs/V.
Position 4:	5·0kV/µs/V.

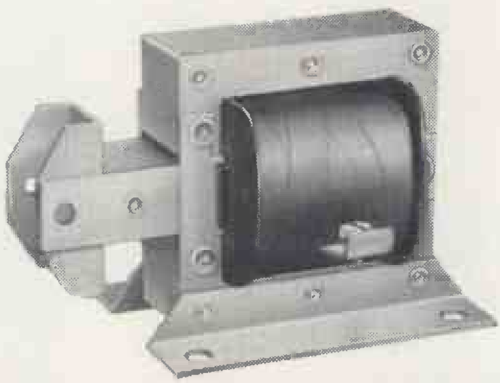
FERRANTI

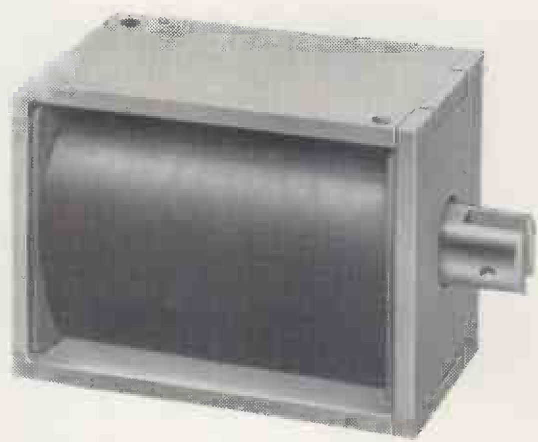
First into the Future

FERRANTI LTD · KINGS CROSS ROAD · DUNDEE · *Tel: DUNDEE 87141*

DS/T76/2

ELECTRO METHODS LTD





A FULL RANGE OF A.C. & D.C.

SOLENOIDS

PROMPT DELIVERY

Illustrated technical data sent on request :

ELECTRO METHODS LTD., General Products Division, **CAXTON WAY, STEVENAGE, HERTS**

Telephone : Stevenage 2110-7

NEW

300µV to 3V up to 900 Mc/s and D.C.

MILLIVOLTMETER TYPE 301

The Airmec Millivoltmeter Type 301 is a compact, lightweight instrument employing advanced circuitry to achieve a low noise level and a high degree of stability. It measures alternating voltages from 300 microvolts to 3 volts in the frequency range 100 c/s to 900 Mc/s, and direct voltages from 100 microvolts to 10 volts. A.C. inputs are rectified in a probe containing semiconductor diodes; for low frequency measurements the probe is plugged into a holder on the front panel, and alternative positions on the holder provide input impedances of 75 or 52 ohms. The advantage of this arrangement is that the attenuator handles only D.C., and is therefore free from frequency errors. The probe lead retracts into the case when not in use, stowage is provided at the back of the instrument for prods and mains cable, and the fuses and mains voltage adjustment are accessible without dismantling

•

FREQUENCY RANGE:
100 c/s to 900 Mc/s and D.C.

AC RANGE:
300µV to 3V in 8 ranges (also calibrated in dB relative to 1 volt).

DC RANGE:
100µV to 10V in 10 ranges.

ACCURACY:
AC: ± 5% fsd 1 mV to 3V up to 200 Mc/s ± 10% up to 900 Mc/s.
DC: ± 5% fsd 300µV to 10V.

INPUT IMPEDANCE:
AC: 120 kohms and 2pF at 100 kc/s; alternatives of 75 ohms and 52 ohms available at plug-in unit on front panel.
DC: 5 Mohms.

Airmec

AIRMEC LIMITED, HIGH WYCOMBE, BUCKS. Tel.: High Wycombe 2501.

+ REVERSED POLARITY –

Reversed polarity versions of Mullard 20 amp Silicon Power Rectifiers bring new economies

To give designers a choice of either cathode or anode mounting, Mullard have added two new, reversed polarity, Silicon Power Rectifiers to their range. These new rectifiers, the BYZ15 and the BYY16 complement the BYZ14 and BYY15—the well known, rugged, 20A, 200 and 400V industrial silicon rectifiers.

The addition of these two new types to the Mullard range of rectifiers not only offers designers more freedom in mechanical design, but also the advantage of reducing the number of heat-sinks required consequently reducing costs and saving space.

ABRIDGED DATA

	BYZ14	BYZ15	BYY15	BYY16
Max. recurrent P.I.V. voltage (V)	200	200	400	400
Max. transient peak voltage (V)	400	400	800	800
Max. average current (A)	20	20	20	20
Max. recurrent peak current (A)	100	100	100	100
Max. junction temperature °C	150	150	150	150
Mounting base	Cathode	Anode	Cathode	Anode

Mullard
semiconductors
for industry

Except for mounting polarity, information on the BYZ15 and the BYY16 reverse polarity rectifiers is exactly the same as that shown on the BYZ14 and BYY15 data sheets. For these or other information, please write quoting reference M4011 to:

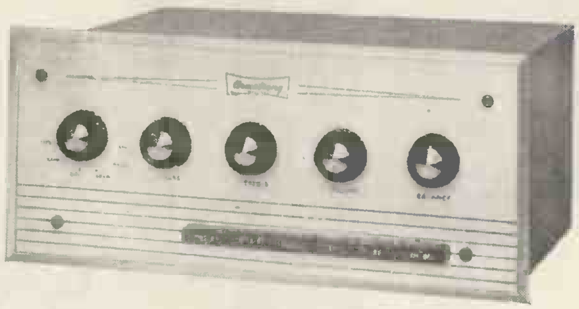
MULLARD LIMITED Semiconductor Division, Mullard House, Torrington Place, London, WC1 Tel: LANgham 6633

Mullard

MIS 40a

Armstrong

A New Hi-Fi Stereo Amplifier



A20 STEREO POWER AMPLIFIER

12 watts push-pull ultralinear output from each channel. Distortion less than 0.1%. Hum and noise 85 dB below full output. Frequency response 15-22,000 c.p.s. within 1 dB. Power response 20-18,000 c.p.s. within 1 dB. Negative feedback 29 dB. Stability factor 20 dB. Valves: GZ34, 3 x ECC83, 4 x EL84. High specification output transformers with grain-orientated laminations and multi-sectional winding. Dimensions 14in. x 7in. x 7in.

PCU25 STEREO PRE-AMPLIFIER

Six inputs providing for all possible signal sources including the lowest output pick-ups and tape heads. Push button function switching. Bass and treble tone controls. Balance control. Treble filter. Rumble Filter. Tape recording outputs. Distortion less than 0.1%. Hum and noise (high sensitivity pick-up input) 60 dB below full output. Valves, 2 x EF86, 3 x ECC83. Dimensions 10½in. x 4½in. x 7½in.

Matching VHF Tuner T4B £23.0.0.

AVAILABLE FROM LEADING HIGH FIDELITY DEALERS THROUGHOUT THE COUNTRY

A new hi-fi system which meets all the needs of the music-lover in his own home. The compact amplifier has more than adequate power for any domestic use but will operate with equal quality of performance at any volume setting whilst the self-powered VHF tuner is so simple to operate with the broad easy tuning which automatic frequency control provides. The T4B tuner and the PCU25 pre-amplifier are each fitted into an attractive maroon vinyl-hide covered case and are completely matched in size and styling. Although primarily designed for cabinet mounting, provision has been made for both to be used free-standing on a shelf. For those who require coverage of the AM wavebands the ST.3 Mk. 2 AM/FM Tuner can be used instead of the FM Tuner.

Complete Amplifier (PCU25 & A20) £52.10.0

Complete System with VHF Tuner (T4B) £75.10.0

Where the ST.3 Mk. 2 AM/FM Tuner is used instead of the T4B FM tuner add £5/10/- to the total price.

Write for free descriptive literature (quoting Dept. WNA) to

ARMSTRONG WIRELESS & TELEVISION CO. LTD., WARLTERS RD., LONDON N.7. NORth 3213

D 33 is more than a new oscilloscope . . . it is a new oscilloscope system.

D 33 is built to the familiar high standards of all Serviscope equipment. A special feature is the $3\frac{1}{2}''$ double-beam PDA tube of advanced design, operating at 3.5 KV to give an exceptionally clear trace.

PDA TUBE

HIGH GAIN

INTERCHANGEABLE AMPLIFIERS

A3 GENERAL PURPOSE AMPLIFIER

A standard form of amplifier with a wide frequency response, and the additional facility of x10 sensitivity when needed over a limited bandwidth.

A4 DIFFERENTIAL AMPLIFIER

This unit gives high gain; maximum sensitivity is 1mV/cm DC, frequency response 200 Kc/s.

A5 ULTRA HIGH GAIN AMPLIFIER

Maximum sensitivity is as high as 100 uV/cm AC, frequency response 5 c/s to 150 Kc/s.

D 33

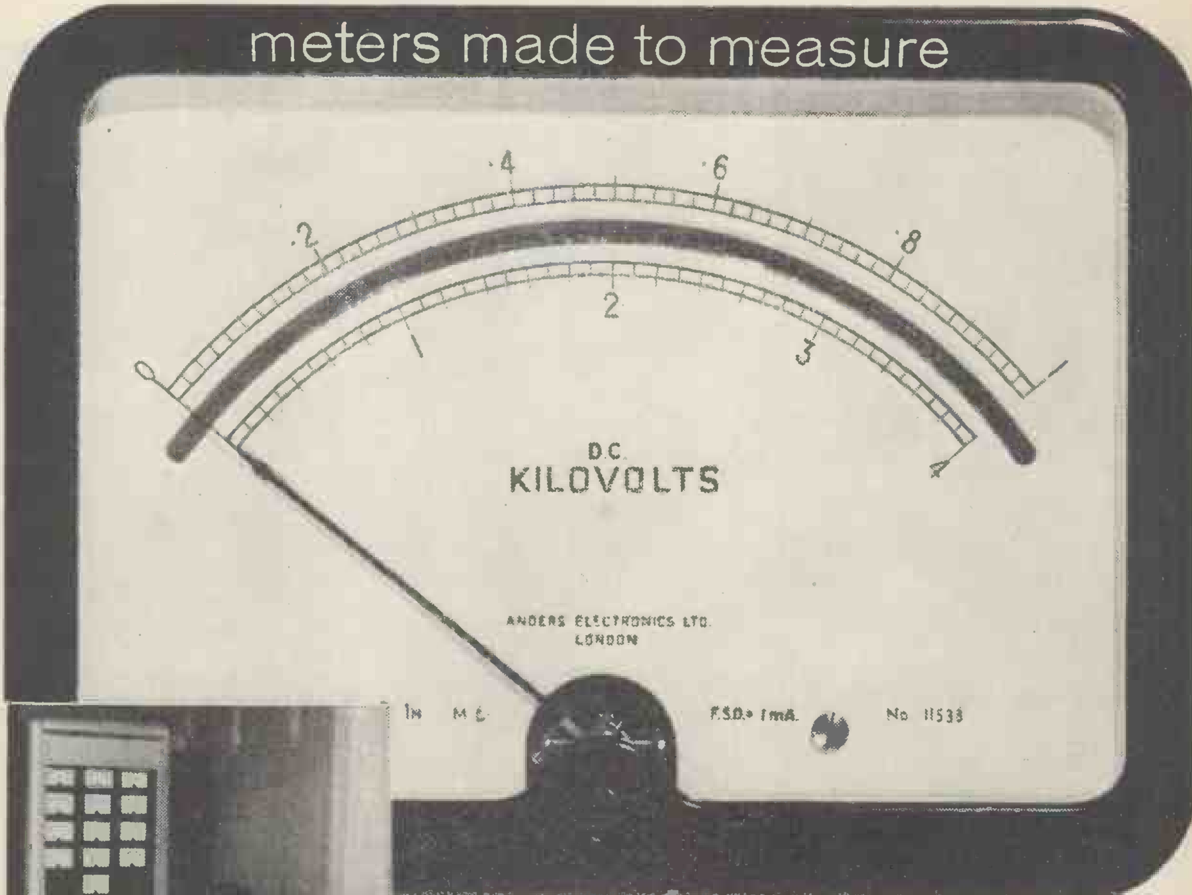
double beam SERVISCOPE*
with plug-in amplifiers

* *'Serviscope' is the registered trade mark of Telequipment Ltd.*

Interchangeable plug-in Y amplifiers allow one instrument to be adapted to a wide range of applications, and still to remain compact, portable . . . and inexpensive. All connections are made internally as the unit slides home. All or any of the basic range of amplifiers can be supplied, or special units can be built to requirements.

TELEQUIPMENT

Telequipment Limited, 313 Chase Road, Southgate, London, N.14. Tel: Fox Lane 1166



special EHT meter rushed through for MO Valve Company

This Multi-range E.H.T. Series 705 meter is one of a number of instruments supplied to the M.O. Valve Company Ltd. by Anders Electronics at very short notice. These meters are used in the M.O. Valve Company Production Test Equipment for Travelling Wave Tubes shown here. Just the kind of work Anders excel in: special meters for very special equipment. Anders are indebted to the M.O. Valve Company for their kind permission to illustrate this test gear.

The Anders Instrument Centre is in a unique position to meet the most urgent, and the most unusual, meter requirements from production, development and research. Many standard meter ranges are available immediately from stock. Non-standard meters are calibrated, tested and normally ready within 10-14 days. All shapes; sizes from $1\frac{1}{2}''$ to the largest switchboard meters. All well-known makes and all types including moving coil, moving iron, thermocouples, electrostatic, dynamometers and full range of meter accessories. Anders would like to demonstrate the kind of service they can give you and look forward to your enquiries, by letter or by telephone.

ANDERS ELECTRONICS LIMITED

103 Hampstead Road, London NW1. Tel: EUSton 1639

Contractors to GPO and Government Departments.
Ministry of Aviation approved.

METERS, ELECTRONIC AND TEST EQUIPMENT TO INDIVIDUAL SPECIFICATIONS

there's an ENTHOVEN solder . . .

. . . for every job

1 *Superspeed solder to all specifications*

2 *Washers and preforms for every application*

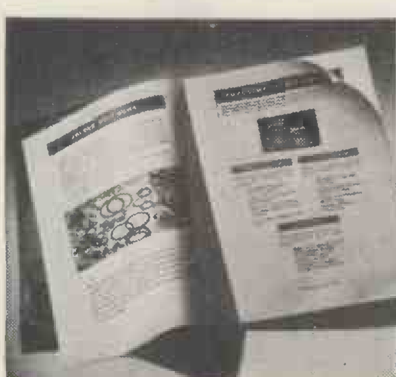
3 *Lacquer, flux, and thinners for printed circuits*

4 *Preservative, metal, and Tricence de-oxidant for printed circuits*

5 *Superspeed six-second heat soldering iron*

If you're faced with any soldering problem, get in touch with Enthoven. Our advice is free, and our range of solder products is comprehensive. Enthoven have 150 years experience of smelting and refining non-ferrous metals; you can rely on us for the fine quality materials essential to all precision soldering.

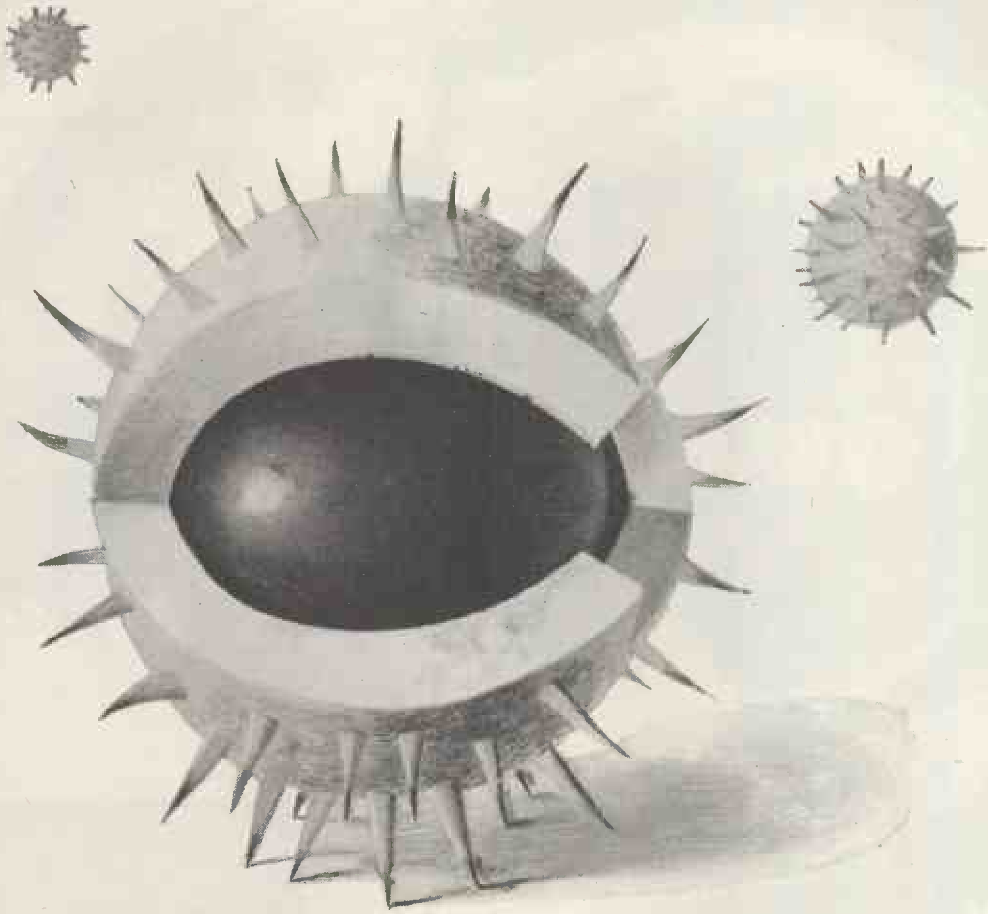
All these Enthoven solder products, and many more, are fully described in the redesigned Enthoven Solder Products booklet, sent free on request



ENTHOVEN SOLDERS LIMITED

Sales Office & Works:
Upper Ordnance Wharf,
Rotherhithe Street, London,
S.E.16 BERmondsey 2014

Head Office:
Dominion Buildings,
South Place, London, E.C.2
MONarch 0391



State of readiness

There's no waste space in a chestnut;
it's functional through and through. Armour, padding,
insulation, packed full with potential promise.
Many instruments need this same compactness,
this same ability to endure heat and cold, sudden shock,
vibration, changes of speed and pressure,
and still function readily when the looked-for stimulus is felt.
Venner reserve type batteries enable designers to
achieve this; compact, robust, hermetically sealed, these
lightweight units provide abundant, enduring, power
under extreme operating conditions.

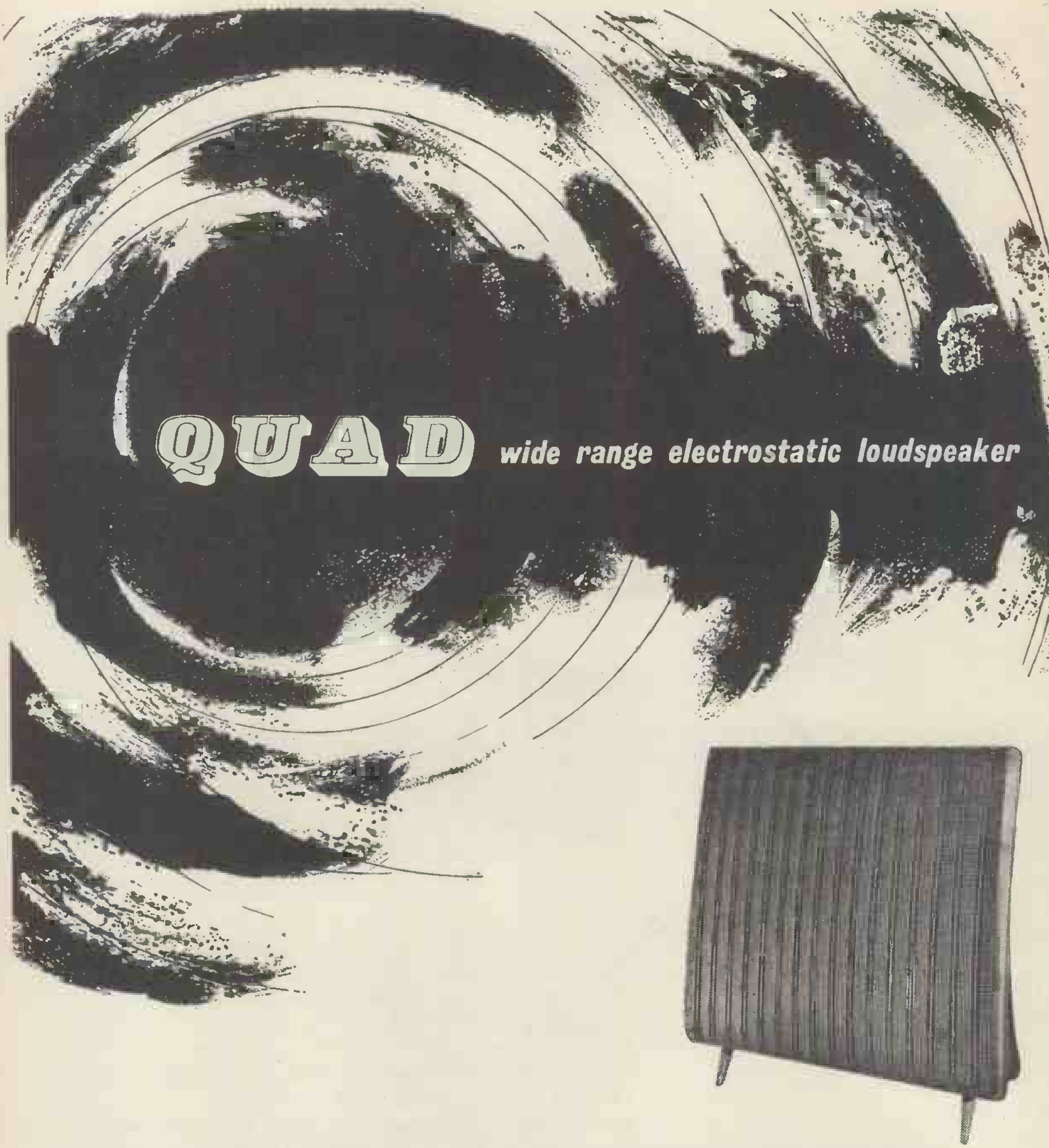
VENNER *RESERVE TYPE* BATTERIES

FOR PACKAGED POWER

Send for full technical details

Venner Accumulators Limited, ***A member of the Venner Group of Companies***

KINGSTON BY-PASS · NEW MALDEN · SURREY · MALDEN 2442



The QUAD speaker uses closely coupled moving elements some two hundred times lighter than diaphragms of moving coil loudspeakers, thus enabling the air to follow the electrical impulses with far greater precision. It is extremely analytical and much of the recent improvement in gramophone records can be directly attributed to the use of these loudspeakers for studio monitoring and quality control.

For the listener in the home "it represents, by a wide margin, the closest approach to truly natural reproduction of sound in the home that we have yet heard". (American High Fidelity H.H. Lab. report, November 1960). *Send for illustrated brochure to Dept. W.W.*

QUAD for the closest approach to the original sound

ACOUSTICAL MANUFACTURING CO LTD • HUNTINGDON • HUNTS

RADIO TUBES
EXPORT ONLY

3000 types of both receiving and transmitting tubes ***IN STOCK.*** In addition, a comprehensive range of crystals and some types of transistors and trustworthy tubes are available.

Over the years our business with Government Departments and their contractors has increased tenfold and is still going forward. This has been achieved by competitive prices coupled with outstanding SERVICE. We would like to offer you our fullest co-operation for your requirements.

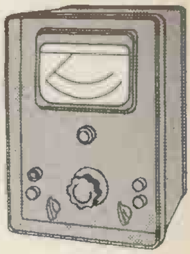
Your specific enquiries for special types to CV. JAN and MIL specifications are invited.

Our organisation is Air Registration Board Approved.

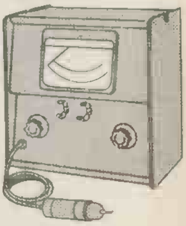
HALL ELECTRIC LTD
HALTRON HOUSE, ANGLERS LANE, LONDON N.W.5.

Tel.: Gulliver 8531 (10 lines) Telex 2-2573 Cables: "Hallectric London"

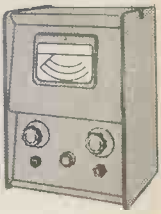
Voltage Measurement



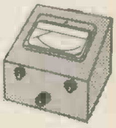
SENSITIVE VALVE VOLTMETER TYPE TF 1100



WIDE-BAND MILLIVOLTMETER TYPE TF 1371



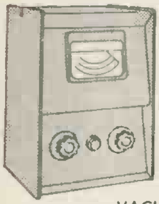
VALVE MILLIVOLTMETER TYPE 899A



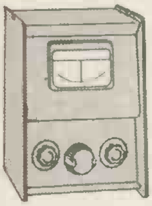
U.H.F. MILLIVOLTMETER TYPE TF 1262

VACUUM TUBE VOLTMETER TYPE TF 1041B

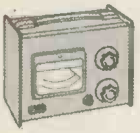
Measures:
A.C.: 25 mV to 300V, 20 c/s to 1,500 Mc/s.
D.C.: 10 mV to 1,000V.
R: 0.02Ω to 500 MΩ.
Multipliers for up to 2 kV a.c. and 30 kV d.c.



VACUUM TUBE VOLTMETER TYPE TF 1300



SUPPRESSED ZERO VOLTMETER TYPE TF 1377



A.C. MICRO-VOLTMETER TYPE TF 1375

Marconi Instruments provide a balanced range of precision voltage-measuring equipment. Full technical particulars are available on request.

MARCONI INSTRUMENTS

A good name for good measure

AM & FM SIGNAL GENERATORS · AUDIO & VIDEO OSCILLATORS · FREQUENCY METERS · VOLTMETERS · POWER METERS · DISTORTION METERS TRANSMISSION MONITORS · DEVIATION METERS · OSCILLOSCOPES SPECTRUM AND RESPONSE ANALYSERS · Q-METERS AND BRIDGES

Please address your enquiries to:
MARCONI INSTRUMENTS LTD.,
at your nearest office

London and the South:
English Electric House,
Strand, London, W.C.2.
Tel: COVent Garden 1234

Midlands:
Marconi House,
24 The Parade,
Leamington Spa. Tel: 1403

North:
23-25 Station Square,
Harrogate.
Tel: 67455

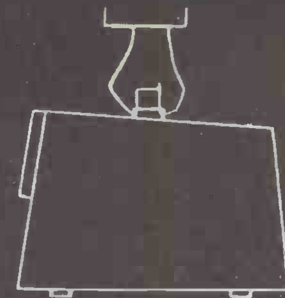
EXPORT DEPT: Marconi Instruments Ltd., St. Albans, Herts., England. Tel: St. Albans 59292

TC198

ARIEL PRESSINGS
Anti Corona Tags, Battery Plugs and Sockets, Cavity Cap Connectors, Co-Axial Plugs and Sockets, Contacts, Fuseholders, Group Boards, Lampholders, Metal Stampings, Phono Plugs and Sockets, Plugs, Printed Circuit Connectors, Sockets, Solder Tags, Speaker Connectors, Switched Phono Sockets, Tag Strips, Terminal Assemblies, Transformer Panels, Valve Pins, Valveholders and Cathode Ray Tubeholders, Vibrator Sockets and Retainers, Voltage Selectors.
ARIEL PRESSINGS LTD.,
WOLLATON ROAD,
BEESTON, NOTTINGHAM
ARIEL, BEESTON NOTTS

1 Mc/s Counter with In-line Readout for less than £350

COMPACT STYLING—EASILY PORTABLE

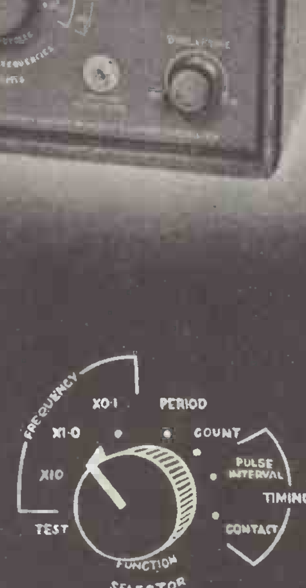


New techniques enable Venner to offer a transistorized frequency and time measuring equipment with in-line readout at a lower cost than ever before.

The treble-3-six is proof that Venner gives a high technical performance AND versatility at low cost.

TYPE T.S.A 3336

- Frequency measurement to 1 Mc/s.
- Multi-period measurement over 1 to 10^7 cycles.
- Oven-controlled crystal.
- Six digit display.
- Sampling times 0.1, 1.0 and 10 sec.
- Gated random pulse counting.
- Mains or battery operation.
- Light, compact and portable.
- Venner proved performance packaged circuits throughout.



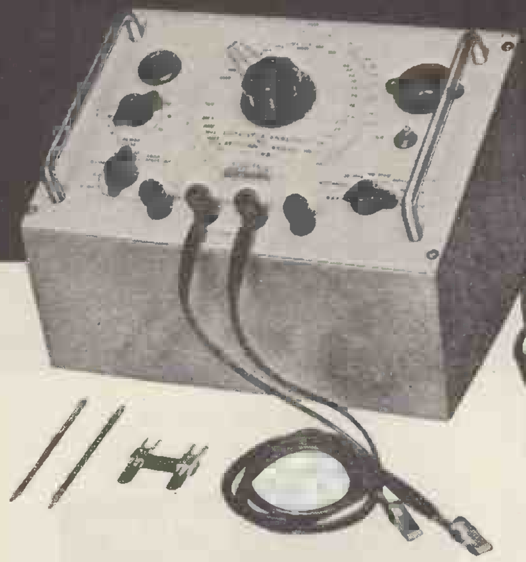
CLEAR READING MODERN STYLED KNOBS

VENNER

VENNER ELECTRONICS LIMITED

Kingston By-Pass, New Malden, Surrey. MALden 2442

RIGHT ARMS 2



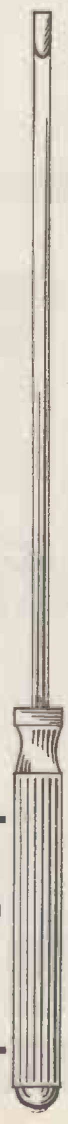
FOR EVERY ELECTRONIC ENGINEER

Hunts Capacitor Analyser and Resistance Bridge

This accurate and dependable bridge measures capacitance from 0·00002 μF to 500 μF in three ranges: resistance from 5 to 100 MΩ on three large scales: power factor of Electrolytics from zero to 50%; and tests insulation resistance at voltages from 25 to 500 volts using a flashing neon indicator. All measurements are read directly on an effective scale length of over 6 ft.; and controls are arranged on a sloping panel for maximum convenience and readability.

Complete, compact and portable, housed in an attractive metal cabinet with strong carrying handles, Hunts CRB3 Capacitance Analyser is the ideal instrument for engineers.

The CRB3 operates from 210-250 volts 50-cycle AC mains (110 volts AC model available). No external meters, standards, headphones or similar accessories are required.



Hunts Picofarad Meter

Hunts Picofarad Meter is designed to measure low capacitance in two ranges: 0-55 pF (calibrated in 1 pF divisions) and 0-550 pF (calibrated in 10 pF divisions). The circuit is completely transistorised. One internal 4½ volt dry battery provides all power supplies. Capacitance values are read directly on a clearly calibrated scale to an accuracy of ±3%, and no calculations are necessary.

This accurate and fully portable meter is complementary to Hunts CRB3 Capacitance Analyser. Both instruments are ideally suited to the work of radio and television service engineers, manufacturers inspection and test departments, circuit laboratories and educational establishments.

Manufactured & distributed by

F.C. ROBINSON & PARTNERS LTD

COUNCILLOR LANE, CHEADLE, CHESHIRE

Telephone: GATLEY 2469

HUNTS CAPACITORS

'ENGLISH ELECTRIC' announce the first

HIGH VACUUM VARIABLE CAPACITORS

developed and manufactured in Britain

The range comprises five types for operation in high voltage r.f. circuits and all are tunable over an approximately linear capacitance range. High vacuum variable capacitors offer outstanding advantages over conventional air dielectric counterparts :—

* **Compactness relative to high capacitance and operating voltage.**
* **Low self inductance and stray capacitance.**
* **No electrostatic dust precipitation on plates.**
* **Easily demountable.**

Full information on the present range is available from the address below:

Further types will be added to meet future requirements.

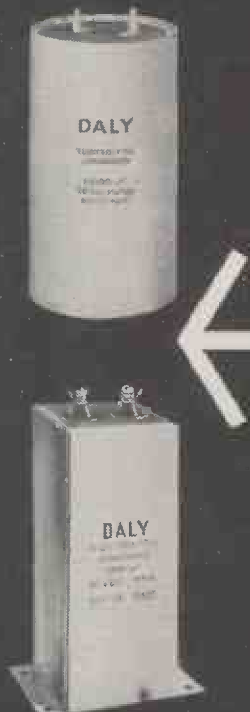
'ENGLISH ELECTRIC'

E.E.V. type	Approx linear capacitance range (pF)	Shaft turns in linear capacitance range	Max peak r.f. voltage (kV)	Max r.f. current (r.m.s.) (A)	Max length (in)	Max dia. (in)
U30/15	5—30	10.4	15	10*	6.5	2.13
U50/15	8—50	10.4	15	15*	6.5	2.75
U80/15	16—80	10.4	15	20*	6.5	3.30
U200/8	5.5—206	17	8	20†	9.5	2.49
U200/10	5.5—206	17	10	20†	9.5	3.50

* Up to 30 Mc/s † Up to 20 Mc/s

ENGLISH ELECTRIC VALVE COMPANY LIMITED

AGENTS THROUGHOUT THE WORLD | *Chelmsford, England. Telephone: Chelmsford 3491*



DALY

ELECTROLYTIC CAPACITORS

Daly have specialised in the manufacture of electrolytics for over 20 years. Recent developments in the lower working voltages associated with transistors have greatly increased the capacitance obtainable in a given physical size—over 30,000 microfarads are possible in a single unit. Daly are always ready to design for special requirements; they make aluminium electrolytics of all types.

DALY electrolytics for transistorised equipment ● for telecommunications ● for radio and television receivers ● for miniaturised equipment ● for pulse and storage circuits ● for capacitor start motors, etc.

Send for descriptive leaflets!

DALY *(Condensers)* **LTD.**

WEST LODGE WORKS, THE GREEN, EALING, LONDON, W.5.

Phone: Ealing 3127-8-9 Cables: Dalycon, London

Connoisseur

FOR STEREO OR MONAURAL

Please write for LEAFLETS

Variable 3-speed motor. For 33⅓, 45 and 78 r.p.m. Stroboscope fitted with internal light source. Synchronous motor dynamically balanced and resiliently mounted. Mechanical speed change giving 4% variation on all speeds. £28/10/8 incl. tax.

Stereo Pickup Type CS1. Pick-up arm fitted with integral lifting device. The pick-up head employs miniature ceramic units. Frequency range 20-16,000 c.p.s., output 20mV with channel separation of 20-25 dBs. Downward pressure 3½-4 grams. Diamond stylus. Will accept Mark II monaural heads. Pick-up (complete as illustrated) £13/6/4 incl. tax. Pick-up Head £8/3/11 incl. tax. Pick-up Arm £5/2/5 incl. tax.

★ **ALL PRICES INCLUDE 10% P.T. SURCHARGE.**

ALSO AVAILABLE
THE "*CRAFTSMAN*" 2 SPEED MOTOR, STEREO AMPLIFIER AND PRE-AMPLIFIER, SPEAKER ENCLOSURE MARK III PICKUP.

A R SUGDEN & CO(ENGINEERS) LTD.

MARKET STREET, BRIGHOUSE

Working at full stretch ... to bring you a better tape!

There's *extra* toughness, *extra* resistance to stretch and breakages, in the new GEVASONOR Tensilized Polyester Tapes—because they are pre-stressed to bring you even greater strength than ever. GEVASONOR Tapes are made by GEVAERT, makers of world-famous films for so many years. You can't choose better than GEVASONOR—for so many sound reasons.

GEVASONOR

POLYESTER TAPES

Long Play and Double Play

TYPE LRP LONG PLAY TENSILIZED POLYESTER

3″	225′	9/-	LRP/68
4″	450′	16/-	LRP/137
5″	900′	28/-	LRP/275
5¾″	1150′	35/-	LRP/350
7″	1800′	50/-	LRP/550

TYPE DP DOUBLE PLAY TENSILIZED POLYESTER

3″	300′	14/-	DP/90
4″	600′	25/-	DP/183
5″	1200′	45/-	DP/365
5¾″	1650′	55/-	DP/500
7″	2400′	80/-	DP/730

GEVASONOR

GEVAERT FROM YOUR USUAL DEALER

ensure CONSISTENT magnetic characteristics

with STC

permalloys & permendur

PERMALLOY 'C'
for highest initial permeability, useful for wide-band frequency transformers, current transformers, chokes, relays and magnetic shielding.

PERMALLOY 'B'
has lower initial permeability than Permalloy 'C' but has a higher value of flux density. It is suitable for use where high permeability to an alternating field superimposed upon a steady polarising field is required.

PERMALLOY 'D'
for very high resistivity withouc undue lowering of the maximum flux density. Variation of permeability with frequency is small. Ideal for H.F. applications.

PERMALLOY 'F'
very rectangular hysteresis loop with a rententivity of at least 95% of its saturation value; high flux density and low coercive force. Ideal for saturable reactors, magnetic amplifiers, digital computers, memory devices, etc.

V-PERMENDUR
for high permeability with a very high value of maximum flux density. Finds special application for use as high quality receiver diaphrams, also motor generators and servo-mechanisms in aircraft where weight and volume are important factors.

PHYSICAL PROPERTIES AND GENERAL MAGNETIC CHARACTERISTICS

	Permalloy 'B'	Permalloy 'C'	Permalloy 'D'	Permalloy 'F'	V-Permendur
Specific Gravity	8.3	8.8	8.15	8.4	8.2
Electrical resistivity—microhms per cm cube	55	60	90	26	26
Initial permeability μ_0	2 000 to 4 000	15 000 to 40 000	1 800 to 3 000	400 to 1 000	700 to 1 000
Maximum permeability μ_{max}	15 000 to 40 000	50 000 to 150 000	12 000 to 20 000	200 000 to 400 000	3 000 to 6 000
Magnetising force for μ_{max}-oersteds	0.20 to 0.40	0.025 to 0.04	0.2 to 0.5	0.03 to 0.10	2.0 to 6.0
Maximum flux density-gauss	16 000	8 000	13 000	14 000	24 000
Coercive force in oersteds for B_{max}=5 000 gauss	0.15	0.03	0·15	0.05*	2.3†
Remanence in gauss for B_{max}=5 000 gauss	4 000	3 500	3 500	13 000*	16 000†
Hysteresis loss in ergs/cc/cycle for B_{max}=5 000 gauss	160	40	200	220*	12 500†
Total loss in watts/lb for B_{max}=5 000 gauss 50 c/s 0.015 in. sheet	0.11	0.04	0.2	0.3*	4†

* for B_{max}=14 000 gauss † for B_{max}=20 000 gauss

Write for Technical Data Sheets :—

STC COMPONENTS GROUP

Standard Telephones and Cables Limited

MAGNETIC MATERIALS SALES DEPT: EDINBURGH WAY · HARLOW · ESSEX

60/1MM

Model 1200B.
For A.F. and low R.F. applications. Sensitivity 100mV/cm. B/W D.C. to 100Kc/s. C.R. Tube 2¾in. diam.
£35 10 0

Model 2300.
Light-weight Portable. B/W D.C. to 2.5Mc/s Sensitivity 50mV/cm. C.R. Tube 2¾in. diam.
Dims.: 7¼x4¾x 7¾ins.
£39 10 0

write for full details of

OSCILLOSCOPES

SONTRANIC LIMITED

FORUM WAY · EDGWARE · MIDDLESEX · *TELEPHONE EDGWARE 6020 — 3736*

Here are the tools for increased production

WRITE FOR PUBLICATION No. 439 T.E.

PISTOL MODEL

LEVER MODEL

These specially designed lightweight tools incorporate the latest refinements. They meet the requirements of the modern workshop and assembly lines for all light duties.

- ★ **Both models weigh less than 1½ lb.**
- ★ **Best power/weight - power/air ratio.**
- ★ **Positive speed control. Easy to handle.**

"BROOMWADE"

Air Compressors and Pneumatic Tools · YOUR BEST INVESTMENT

Broom & Wade Ltd., P.O. Box No. 7, High Wycombe, Bucks.
Telephone : High Wycombe 1630 (10 lines) Telex : 83-127.

841 SAS

STC

HIGH SLOPE FRAME GRID VALVES

FOR WIDE BAND,
LOW NOISE
LOW DISTORTION AMPLIFIERS

Type	g_m (mA/V)	Figure of Merit	Typical I_a (mA)	Max P_a (W)	Classification
3A/167M	47	370	40	6·5	Triode
5A/170K	16·5	185	13	3·3	Beam Tetrode
5A/180M	32	180	26	6	Beam Tetrode

COMPONENTS GROUP

61/4MS

Standard Telephones and Cables Limited

VALVE DIVISION: FOOTSCRAY · SIDCUP · KENT

WIDE BAND, 4" TUBE

MODEL

33A

NEW

High sensitivity STABILISED Oscilloscope

"Y" AMPLIFIER. Sensitivity 12.5 V R.M.S. per inch. Input resistance 5 megohms (approx.). Push-pull output, sensitivity 80 mV per inch, frequency response 10 c/s to over 6 Mc/s. Input impedance 1 megohm. Maximum input 250 V peak. Wide shift range.

"X" AMPLIFIER. Push-pull output, sensitivity 0.45 V R.M.S. per inch maximum. Wide shift range. Frequency range 5 c/s to 500 Kc/s.

TIME BASE. Hard valve covering 2 c/s to 100 Kc/s in five ranges free running or recurrent trigger.

SYNCHRONIZATION. Exceptional synchronization characteristics, switchable internal/external. External synchronization impedance 1 megohm 20 p.f. Flyback suppression incorporated. Facility for observing Flyback available.

LIST PRICE: **£80.0.0** CREDIT TERMS AVAILABLE

Taylor

Write for fully illustrated literature to:

TAYLOR ELECTRICAL INSTRUMENTS LIMITED

Montrose Avenue, Slough, Bucks. Tel.: Slough 21381. Cables: Taylins, Slough

METAL INDUSTRIES GROUP

WE SEND THE BEST OF BRITAIN'S HI-FI EVERYWHERE

NOW AT LARGER PREMISES

PLEASE NOTE Prices quoted subject to alteration in accordance with those advertised by manufacturers at time of receipt of order.

● RECORDERS

Vortexion W.V.A. ...	£93	13	0	$268
Vortexion W.V.B.	£110	3	0	$315
Vortexion W.V.C. Stereo	£148	10	0	$425
Brennell Mk. V	64 gns.			$192
Brennell 3 Star Stereo...	89 gns.			$267
Brenell M	88 gns.			$264
Cossor 1601 4 Tr.........	37 gns.			$111
Cossor 1602 4 Tr. 3 spd.	59 gns.			$127
Ferrograph 4AN	81 gns.			$243
Ferrograph 4AH	86 gns.			$258
Ferrograph 808 Stereo	105 gns.			$315
Grundig TK1	26 gns.			$68
Grundig TK55 Stereo ...	92 gns.			$276
Grundig TK20 with Mic.	42 gns.			$126
Grundig TK24	55 gns.			$165
Grundig TK30	65 gns.			$195
Philips 4 Track EL 3542	59 gns.			$117
Philips 4 Track Stereo	92 gns.			$276
Philips 4 Track	34 gns.			$102
Reflectograph "A" ½ Tr.	105 gns.			$315
Reflectograph "B" 4 Tr.	115 gns.			$345
Stuzzi Magnette	59 gns.			$177
Stuzzi Tri-corder	63 gns.			$189

● DECKS

Wearite 4A mono	£36	10	0	$105
Wearite 4B	£41	10	0	$119
Brenell Mk. V	28 gns.			$84
Brenell Stereo Deck ...	£33	16	0	$101

Microphones by Lustraphone, Reslo, Acos, Simon, etc.

AKG. C12, Condenser...	£185	0	0	$535
AKG, D.19. Dynamic ...	£19	10	0	$56

● TAPES BY ALL LEADING MAKERS

● SPEAKER SYSTEMS

Quad Electrostatic	£52	0	0	$149
Wharfedale W.15RS ...	£17	10	0	$50
Wharfedale Super 12 RS	£17	10	0	$50
Wharfedale W.12 RS ...	£10	10	0	$30
Wharfedale Coaxial 12	£25	0	0	$72
Wharfedale Golden 10	£8	14	11	$20
Tannoy 12in. Monitor ...	£30	15	0	
Tannoy 15in. Monitor ...	£37	10	0	
WB. 1016	£7	12	3	$16
Goodmans AL.120	£29	10	0	$84
Goodmans AL.100	£23	10	0	$67
Goodmans Triaxiom ...	£25	0	0	$72
Goodmans 300	£11	5	9	$32
Goodmans 400	£16	1	0	$41
Kelly Ribbon Mk. II ...	£10	10	0	$30

● MOTORS AND PICK-UPS

Decca Stereo P.U. complete	£21	0	0	$45
Lenco GL60 Trans. Unit	£27	12	6	$60
Garrard 301	£22	7	3	$49
Garrard 4HF/Stereo P.U.	£19	4	8	$45
Connoisseur Motor "B"	£27	16	1	$59
Connoisseur, 2 sp. Motor	£16	13	1	$36
Goldring 700	£9	14	9	$21

● AMPLIFIERS & TUNERS

Quad 22-Control Unit...	£25	0	0	$73
Quad II Amplifier	£22	10	0	$65
Leak Stereo 20 Amp. ...	£30	9	0	$87
Leak Point One Pre-Amp.	£21	0	0	$60
Rogers Junior Stereo ...	£28	10	0	$82

ARMSTRONG TUNERS AND AMPLIFIERS

Quad FM Tuner	£28	17	6	$60
Chapman AM/FM	£29	8	0	$60

Enquiries for all items by firms mentioned in this advertisement invited.

BINSON "ECHOREC" UNITS

BINSON STANDARD ECHOREC pre-amplifier unit enables echoes to be imposed on signals between microphone (or other source) and amplifier or recorder. 3 channels available, and timing of echoes is controllable. Details on request. 140 gns. $420. **Binson "Baby Echorec,"** similar to above, but for single-channel working. 100 gns. $300

PROFESSIONAL AND TRADE DISCOUNTS.

- **LARGE AND UP-TO-DATE STOCKS.**
- **FULL OFFICIAL RATES OF EXCHANGE FOR PAYMENT IN ANY CURRENCY.**
- **MANY ITEMS FOR 110 VOLTS A.C.**
- **TRANSISTOR RADIOS.**
- **ACCESSORIES**
- **PROMPT REPLIES TO ENQUIRIES**

Carriage charged at cost.

Export prices in U.S. dollars

MODERN ELECTRICS (RETAIL) LTD.

120 SHAFTESBURY AVENUE LONDON W.1

(3 mins. from Piccadilly Circus and opposite Columbia Cinema)

Tel: TEM 7587 & COV 1703 Cabels: MODCHAREX, LONDON

the finest
mobile speaker
ever to be produced
by Wharfedale

Airedale

free standing speaker assembly

The AIREDALE

SIZE: $39 \times 28\frac{1}{2} \times 14$ in. WEIGHT: 91 lb. complete. IMPEDANCE: 12/15 ohms only. MAX. INPUT: 20 watts Individual controls for middle and treble response are located in the rear panel. Available in whitewood or fully finished with a choice of walnut, oak or mahogany veneers. Tropical model also available at extra cost.
Fully descriptive literature free on request.

Price £65. 0. 0.

For many years the Wharfedale omni-directional 3-speaker Corner System has been recognised as a superbly natural reproducer and has frequently stood the difficult test of comparison with live musical performances. The AIREDALE is the latest version of this famous speaker presented for the first time in a one-piece free-standing assembly suitable for corner or along the wall location. Cabinet resonance is avoided by a sand filling the front panel and fitting ceramic tiles to rear side panels. Some idea of the solid construction is given by the fact that the total weight exceeds $\frac{3}{4}$ cwt. Fitted with castors for ease of movement.

In the Airedale L.F. output is produced by a 15in. unit type W15/RS fitted with heavy cone and impregnated cloth roll surround for minimum distortion.

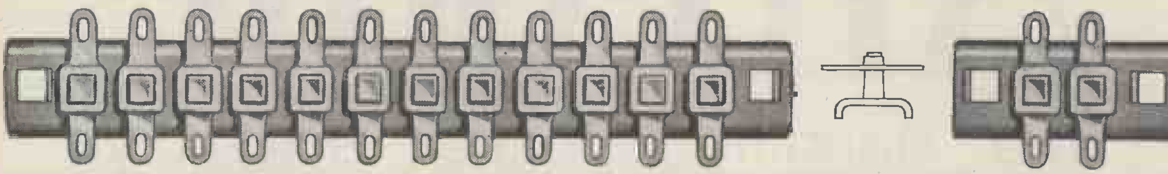
Wharfedale
WIRELESS WORKS LTD

IDLE BRADFORD Yorkshire

Tel: Idle 1235/6
Grams: Wharfdel, Idle, Bradford

JACKSON the big name in PRECISION components

Jackson Brothers' Stand Off Insulators and Terminal Strips are used in large quantities by all the services and in every branch of Electronics, Neucleonics and Communications. Write now for fully illustrated list of complete range of Stand Off Insulators comprising some 40 different types.

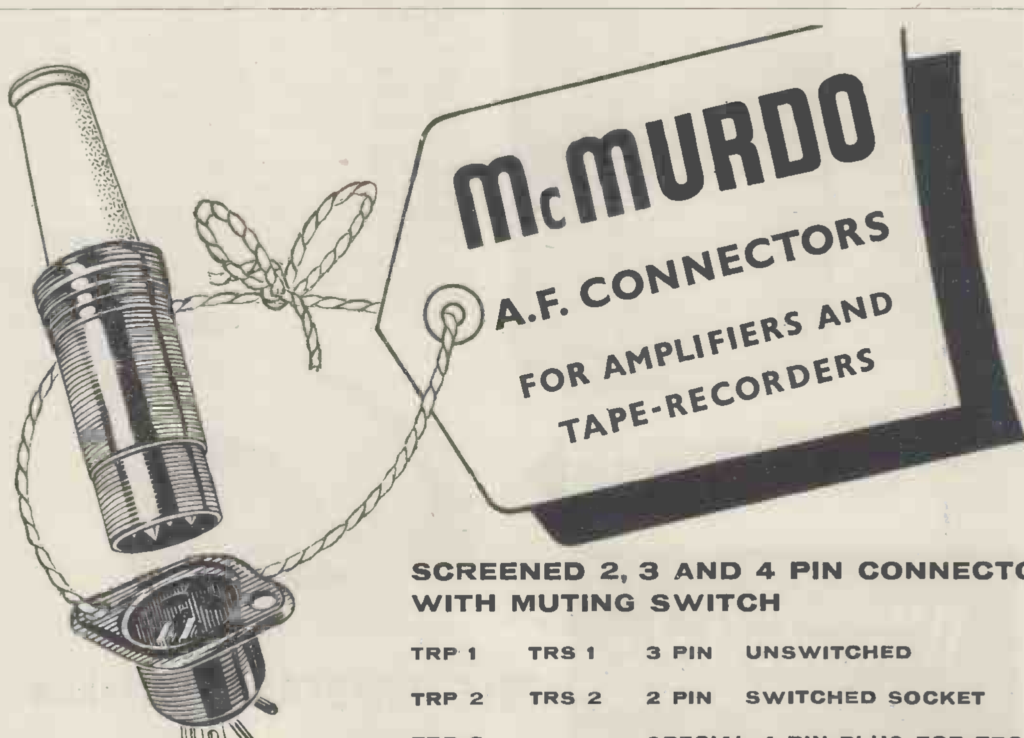


JACKSON BROS. (LONDON) LTD., KINGSWAY-WADDON, SURREY

Telephone : Croydon 2754-5 Telegrams : Walfico, Souphone, London

Canadian Distributors:- Messrs. R. Mack & Co. Ltd., 1485. South West Marine Drive, Vancouver 14, B.C., Canada

American Distributors:- Messrs. M. Swedgal Electronics, 258, Broadway, New York 7, U.S.A.



SCREENED 2, 3 AND 4 PIN CONNECTORS WITH MUTING SWITCH

TRP 1	TRS 1	3 PIN	UNSWITCHED
TRP 2	TRS 2	2 PIN	SWITCHED SOCKET
TRP 3		SPECIAL 4 PIN PLUG FOR TRS 2 SOCKET PROVIDING EXTERNAL CONNECTION TO MUTING SWITCH	

Send for technical information to:—

McMURDO INSTRUMENT CO LTD · ASHTEAD · SURREY · TEL: ASHTEAD 3401

61 JHS 6181

The L.F. SIGNAL GENERATOR . . .

Typ SG81A

Five features of this outstanding instrument

1 *Wide frequency range*
15 c/s to 200 kc/s

2 *Output impedance*
600 *ohms* **balanced**
600 *ohms unbalanced*
300 *ohms unbalanced*

3 *Attenuator* **balanced or unbalanced**
range 65dB in 1dB steps

4 *Maximum output*
1 *watt into* 600 *ohms*

5 *Output calibrated in volts and dB*

—in brief Audio Signal Generation at its best!

by

Advance
– to be sure!

NETT PRICE IN U.K
£85

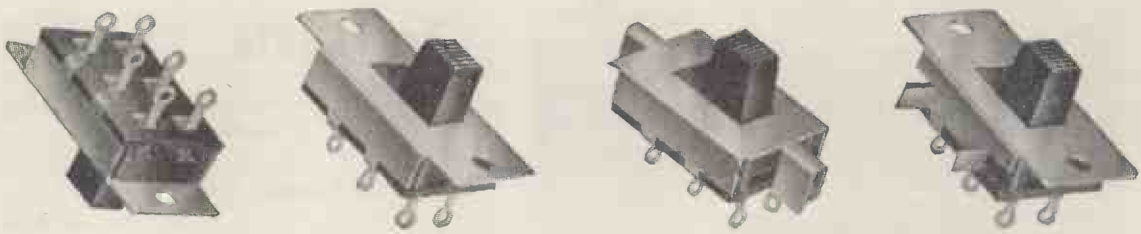
The "Advance" type SG81A is a wide range, low frequency, Signal Generator incorporating an excellent attenuator that can be used in the balanced or unbalanced condition and provides outstanding facilities for the audio engineer.

We should be pleased to send you a copy of our Leaflet R.102, or arrange a personal demonstration, at your request.

Advance COMPONENTS LIMITED
INSTRUMENTS DIVISION
ROEBUCK ROAD • HAINAULT • ILFORD • ESSEX • TELEPHONE: HAINAULT 4444

IT/GD 76

Arcolectric *SLIDE SWITCHES*



Cat. No. T.225 *Alternative fixing methods*

A new range of switches designed to provide convenient low cost switching for radios and instruments. Single and double pole change-over.

- Current carrying parts silver plated.
- Rating 1-amp., 250 volt AC, ·25-amp. DC.
- Resists 2,500 volt AC flash test.
- Self-cleaning contacts.
- Positive snap feel.

Write for samples for design purposes quoting Cat. No. T.225.

CENTRAL AVENUE, WEST MOLESEY, SURREY.
Tel: MOLESEY 3232

ARCOLECTRIC SWITCHES · LTD

163 Mains transformers for valve and contact-cooled rectifiers, audio output transformers and chokes are fully described in Gardner's new " S/M " Catalogue available on request.

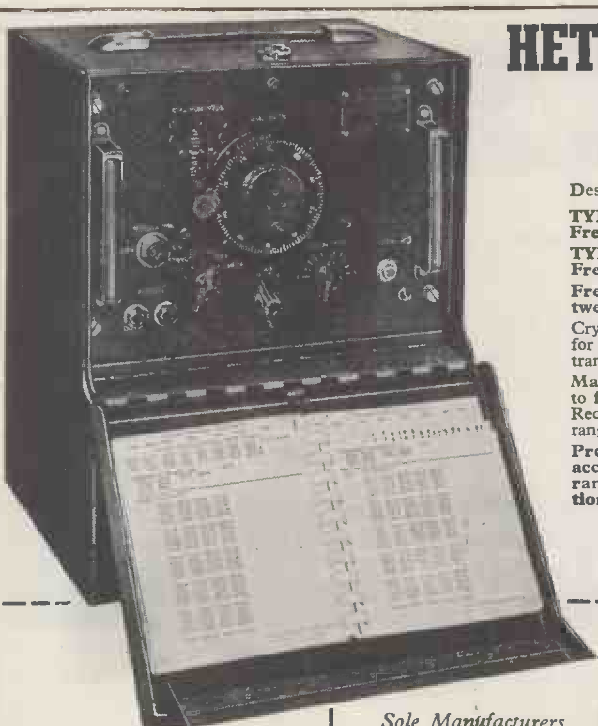
Electrical characteristics, dimensions, weights, fixing centres and prices are fully described in this new publication which includes the latest additions to the Solent range (to BSS 2214 group 10/55) and the high performance but inexpensive " Miniford " range. Typical frequency response characteristics are also given.

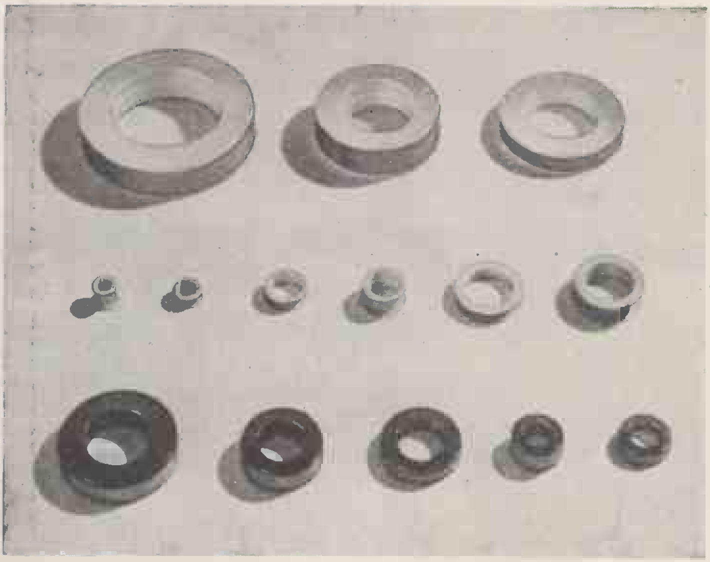
Your copy of Gardners "S/M" Catalogue can be obtained now by writing to

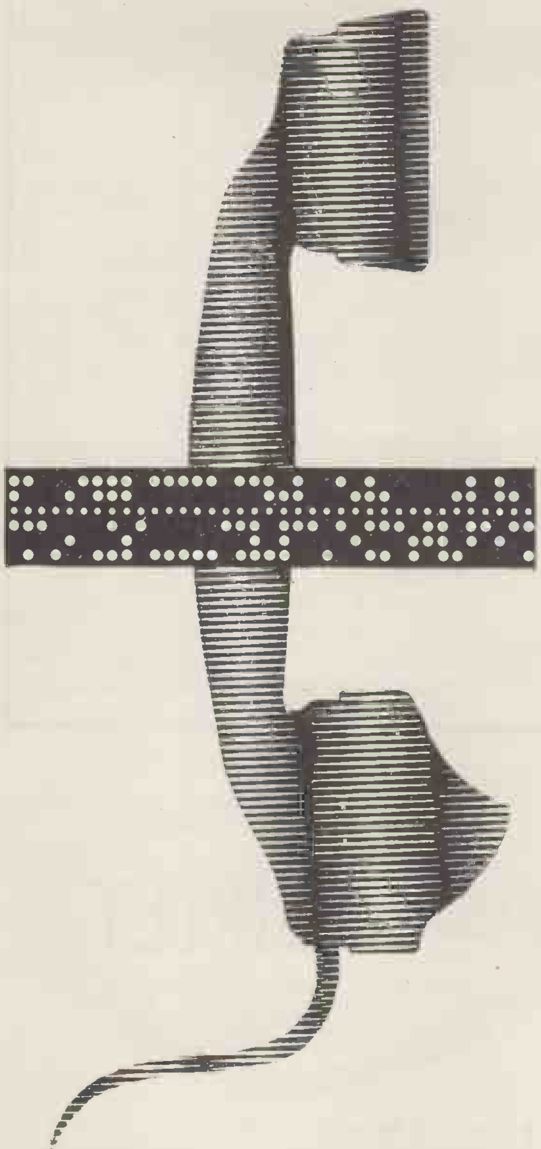
GARDNERS RADIO LTD., SOMERFORD, CHRISTCHURCH, Hants.

Gardners

telephone Christchurch 1734







FIRST PRIVATE MICROWAVE RADIO TELEPHONE SYSTEM IN BRITAIN

British Railways have ordered a Marconi microwave system to link Newcastle with York via Darlington.
This 300 channel capacity system, operating at 7500 mc/s, allows for channels to be dropped off at intermediate points and is designed for both data transmission and telephone operation.

MARCONI

COMPLETE COMMUNICATION SYSTEMS

SURVEYED · PLANNED · INSTALLED · MAINTAINED

COMMUNICATIONS DIVISION, MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND.

H3A

DON'T FORGET YOUR MS4

The Service Engineer who leaves his tube of MS4 behind is without one of his most useful tools—a non-melting, water-repellent grease with excellent dielectric properties. Used to lubricate turret tuners and variable condensers, and prevent "leakage" around the caps of CRT's (and for 101 other jobs)—

MS4 is extraordinarily useful

* it's stable from —50°C to +200°C and doesn't melt * it's a super water-repellent grease * it seals disconnectable plugs and sockets, terminal and junction boxes * stops corrosion of terminals and keeps contacts clean * prevents flashover and "leakage" due to moisture

and helps the busy service engineer.

Write for the new ILLUSTRATED LEAFLET on MS4—or ask one of these MS4 distributors:

British Central Electrical Co. Ltd., 6 & 8 Rosebery Avenue, London, EC1. Tel: Terminus 3666. Also at Briticent House, Addlewell Lane, Yeovil.

Caselco Ltd., Midland Works, Canal Road, Leeds 12. Tel: Leeds 630551.

Direct TV Replacements Ltd., 138 Lewisham Way, New Cross, London, SE14. Tel: Tideway 6666.

Electrical Trades Supply Ltd., Loveday Street, Birmingham 4. Tel: Aston Cross 5671.

T. J. Grainger & Co. Ltd., 9-13 St. James Street, Newcastle-upon-Tyne 1. Tel: Newcastle 24552.

Holiday & Hemmerdinger Ltd., 71 Ardwick Green North, Manchester 12. Tel: Ardwick 6366.

R. D. Taylor & Co. Ltd., 9 Lynedoch Street, Glasgow C3. Tel: Douglas 1202-3-4.

(MS) **MIDLAND SILICONES LTD**

(Associated with Albright & Wilson Ltd and Dow Corning Corporation)

first *in British Silicones*

68 KNIGHTSBRIDGE · LONDON · SW1 · TELEPHONE: KNIGHTSBRIDGE 7801

Area Sales Offices: Birmingham, Glasgow, Leeds, London, Manchester. Agents in many countries.

MSE13

YOU'LL HEAR NOTHING BUT GOOD OF ZONATAPE

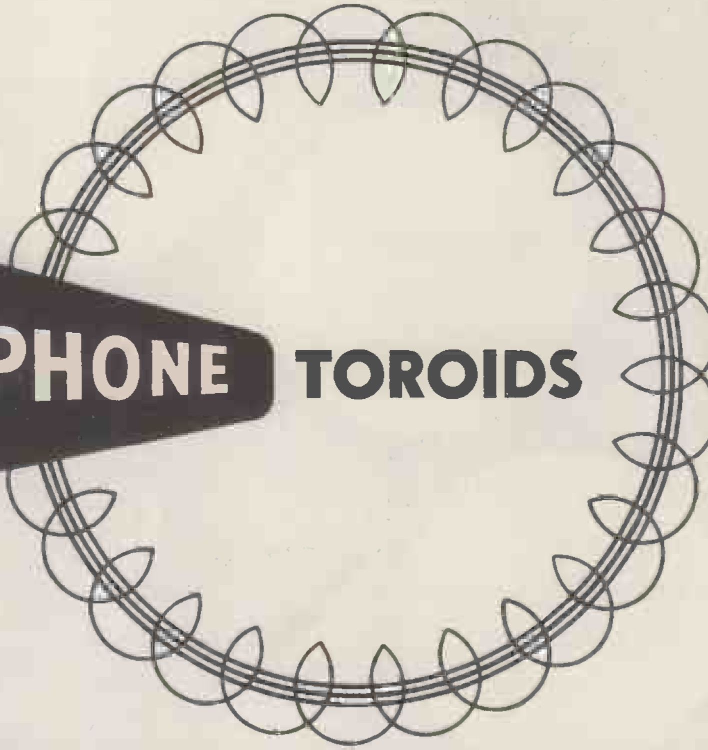
Zonal Magnetic Coatings are those most commonly used in film, broadcasting and television studios. It is against this professional background of experience and exacting standards that we present ZONATAPE as the new standard in ¼in quality tape for home recorders.

If you would like to hear more about ZONATAPE write to us for leaflet " The Basis of Every Good Magnetic Recording " and the name of your nearest ZONATAPE dealer.

ZONAL FILM (MAGNETIC COATINGS) LTD., THE TOWER, HAMMERSMITH BROADWAY, LONDON, W.6. *RIVerside 8741*

A COMPLETELY NEW ADDITION TO OUR WIDE RANGE OF TRANSFORMERS

FORTIPHONE TOROIDS



Why not send us details of your requirements.

FORTIPHONE LTD. (Dept. T.5), TRANSFORMER DIVISION, 126 DENMARK HILL, LONDON, S.E.5

Chapman 1KW AUDIO FREQUENCY AMPLIFIER

SPECIFICATION

Maximum Power Output: 1,000 watts

Frequency Range: 40-12,000 c/s. (LF version available: 5-3,500 c/s.)

Output Voltage: 25, 50 or 100v.

Output Impedance: 0.625 ohms, 2.5 ohms, or 10 ohms.

Total Harmonic Distortion at 1 Kw and 1,000 c.p.s.: 1%.

Sensitivity: 100 m/v into 600 ohms for 1Kw output.

Mains Supply: 200/250v. at 50/60 c.p.s.

Dimensions: A fully enclosed 5ft. high metal cabinet with hinged side and rear doors measuring 24½in. x 20in. deep.

Finish: Silver Black Hammertone.

Valves Used: ECC83, 2 x EL84, 4 x EL34, 2 x TY3-250, 2 x GZ34, 4 x RRS-250.

CHAPMAN ULTRASONICS LTD.

A MEMBER OF THE D DEBRITRON GROUP

MINIATURE RIBBON MICROPHONE

Type RB Microphones come in three forms:—

RB/T	RB/W	RB/WS
"T" Base	"W" Base	"W" Base and Switch

EACH in Five Impedances.

Type RBL
White Dot 30/50 ohms.

Type RBM
Green Dot 250 and Blue Dot 600 ohms

Type RBS
White Dot 30/50 and Orange Dot 1000 ohms.

Type RBY
White Dot 30/50 and Yellow Dot 10000 ohms.

Type RBH
White Dot 30/50 and Red Dot Hi-Z

Cables are colour coded at Plug Centre as shown. Cable Length 18ft. Attachments Thread ½in. x 26 or ⅝in. x 27. Finish—All Satin Chrome.

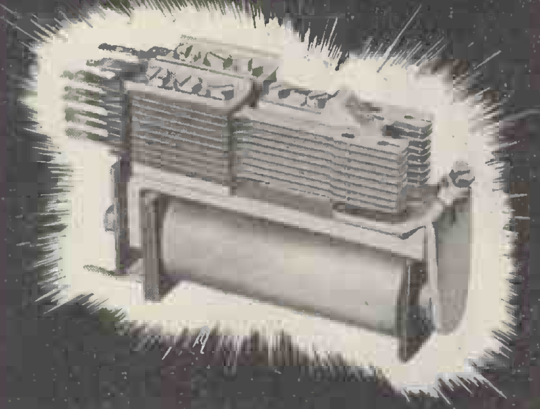
RESLOSOUND LIMITED

Sales enquiries all Companies: **24 UPPER BROOK STREET, MAYFAIR, LONDON, W.1 Telephone HYDE PARK 2291**

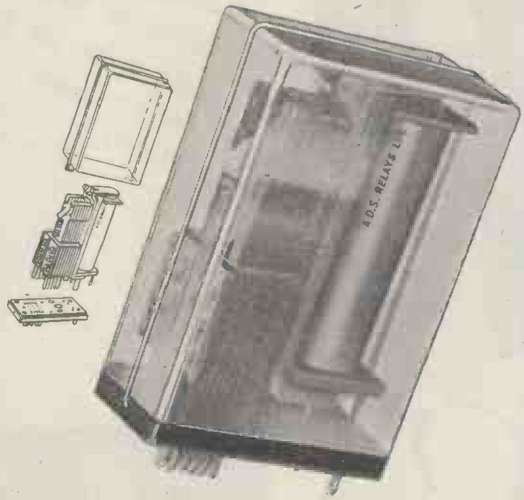
Da1161WW

FULLY TYPE APPROVED
TO A.I.D., A.R.B., & ADMIRALTY

Still THE MOST RELIABLE K 3,000 type RELAY



"PLUG-IN" 3,000 type RELAY
with TRANSPARENT DUST COVER and PLUG-IN BASE
as used exclusively in
BERKELEY POWER STATION



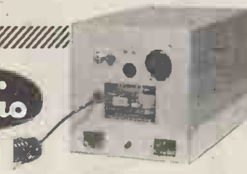
NOW SUPPLIED AS FOLLOWS:—

- 6 CHANGE-OVERS LIGHT DUTY
- 6 MAKES OR 6 BREAKS HEAVY DUTY
- 2 CHANGE-OVERS HEAVY DUTY AND 2 CHANGE-OVERS LIGHT DUTY
- TRANSISTORISED TO OPERATE AS LOW AS 3 MICRO-AMPS
- A.C. OPERATION FOR: 6 V. 12 V. 50 V. 110 V. AND 250 V. A.C.
- DOUBLE WOUND COILS
- P.T.F.E. INSULATION
- OPERATE AND DELAY UP TO 5 SECONDS

A.D.S. RELAYS LTD
89-97, ST. JOHN STREET, CLERKENWELL, E.C.I.
Telephone: CLErkenwell 3393/4/5

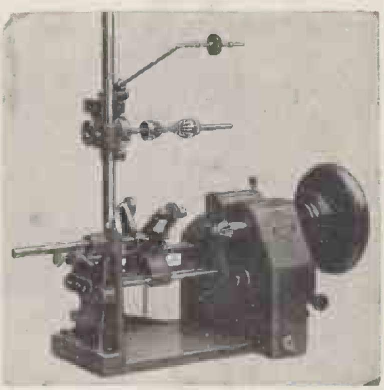
Valradio TRANSISTORISED DC CONVERTERS

HIGH EFFICIENCY—over 80%.
Up to 400 watts—800 watts intermittent.
MANUALLY CONTROLLED FREQUENCY 50 c/s-60 c/s-400 c/s.
REED TYPE 50 c/s FREQUENCY METER fitted to some models.
MARINE-AIRCRAFT-MOBILE use.
POLARITY REVERSAL PROTECTION.
PROVISION FOR REMOTE CONTROL.
SQUARE WAVE AND SINUSOIDAL.
Standard range available ex-stock for T.V., Fluorescent lighting, OSCILLOSCOPES, etc.
FROM 12V, 24V, 32V, 50V.



Valradio D.C. CONVERSION SPECIALISTS

VALRADIO LIMITED
DEPT. W.W./C. BROWELLS LANE, FELTHAM, MIDDLESEX
Telephone: Feltham 4242.
Valradio and Stereosonoscope are the registered trade marks of Valradio Ltd.



Sole Agents Abroad

K. G. Khosla & Co., (Private Limited) 1, Deshbandhu Gupta Road, New Delhi-1, India.

Etablts Octave Houart, 14, Quai Timmermans, Sclessin-lez-Liege, Belgium.

R. H. Cunningham P.T.W. Ltd., 2-6 Bromham Place, Richmond E.1, Australia.

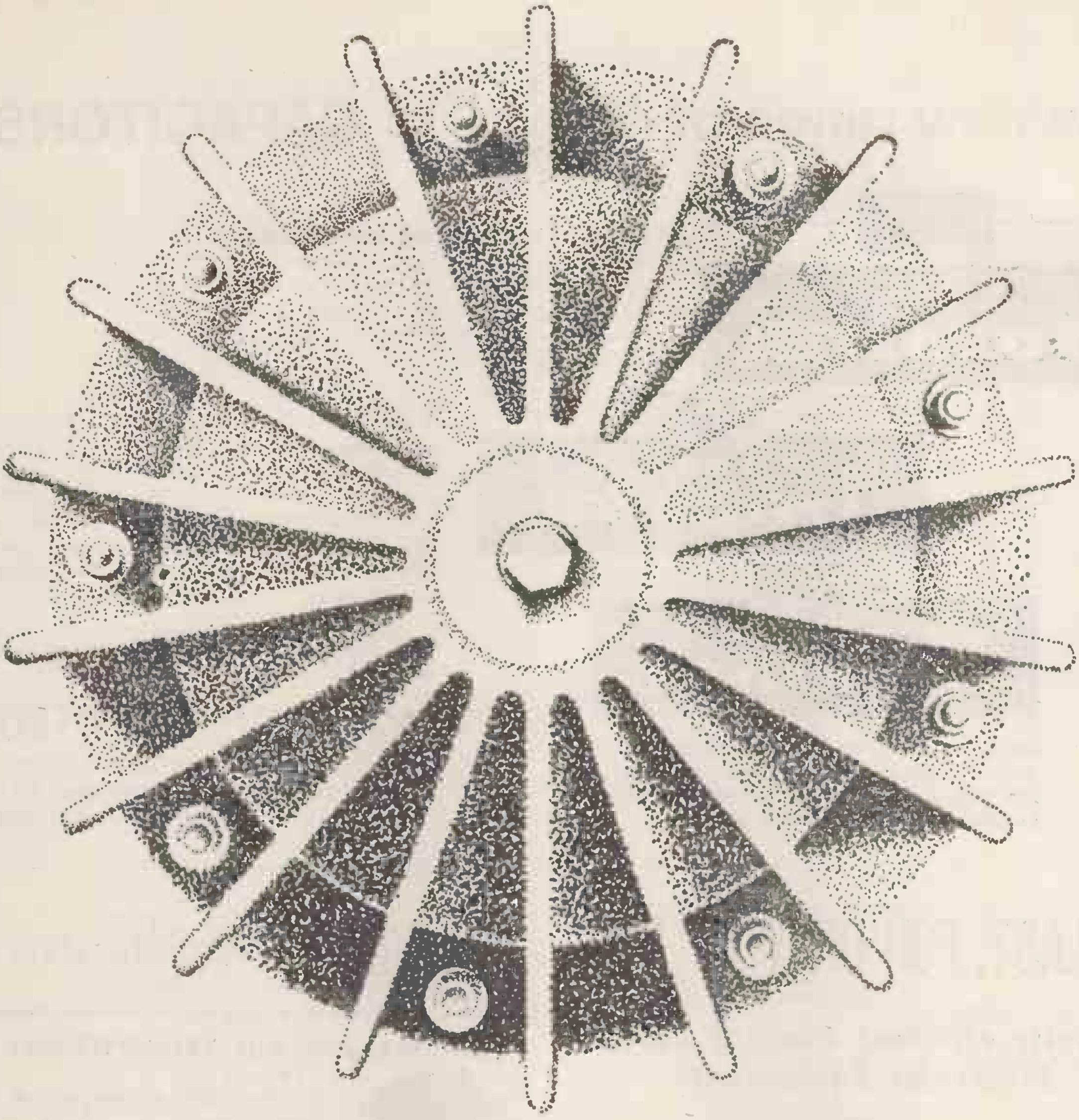
MODEL "Q"

AUTOMATIC COIL WINDING MACHINES
AND HAND WINDING MACHINES

For Layer Wound Coils. Wave Wound Coils.
Strip Winding Machines.
For Wire Gauges from 10 to 50 S.W.G.

Machines supplied complete with Motor, Clutch, and Cabinet Stand or to Customer's Specifications.
Manufacturers of High Class Winding Machines for Thirty Years.

ETA TOOL CO. LTD.
29a WELFORD ROAD, LEICESTER.
Phone: Leicester 56386 *Grams: Leicester 56386.*



5 kW Type L.382 in cast aluminium.
Frequency range 1.5—30 M/cs,
with VSWR better than 1.5


Keeping —
key personnel in touch

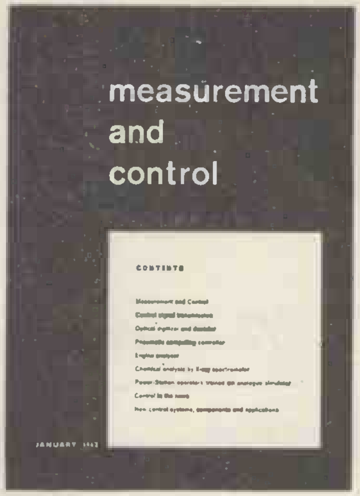
ANNOUNCING A

NEW INTERNATIONAL

JOURNAL FROM

THE ILIFFE GROUP

To be published monthly beginning January 1962



measurement and control

Instruments, systems, methods . . . of industrial control

MEASUREMENT AND CONTROL—first issue January 1962—is designed for those responsible for the choice, installation, operation and maintenance of automatic control equipment in all branches of industry.

Each month, MEASUREMENT AND CONTROL will report, analyse, and interpret in a practical down-to-earth manner the world's latest installations, instruments, equipment, systems—every facet of this new major science.

Produced by highly qualified engineers, writers and Iliffe's unique team of illustrators, MEASUREMENT AND CONTROL is a progressive journal for progressive people. In a world of fiercely growing competition it will be a major influence in the progress of large and small organizations to higher peaks of more efficient production.

a new journal from ILIFFE - world leaders in technical and specialist publishing

SECURE THIS NEW SERVICE FROM THE BEGINNING - POST TODAY

To ILIFFE Production Publications Ltd.
Dorset House, Stamford Street, London, SE1

Please enter my subscription as indicated (tick appropriate box on right).

I enclose remittance for ____________________

Name ____________________

Company ____________________

Address ____________________

____________________ Date ____________________

One year

- ☐ 12 issues including postage £3
- ☐ U.S. and Canada $9.50
- ☐ Special student rate (for registered students and apprentices only) £1 10s 0d

Three years (overseas only)

saving the cost of 12 issues

- ☐ 36 issues including postage £6
- ☐ U.S. and Canada $19.0

Multiple orders from the same Company enjoy a bulk discount rate:
i.e. 3-10 subscriptions, 10%;
over 10 subscriptions, 20%.

TRUVOX

SERIES 80

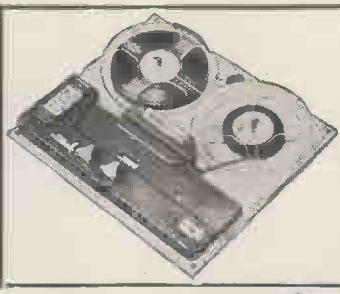
TAPE DECKS and PRE-AMPS

"Technically Luxurious"

Model PD 82. Tape Deck and Pre-amp. Two track mono.

Model PD 84. Tape Deck and Pre-amp. Four track mono-stereo.

Complete in attractive cabinet. Full technical specification freely available.



Model D 82
Twin Track Tape Deck.

Model D 84. 4-track Deck with mono-stereo switch fitted. Two speeds 7½ and 3¾ i.p.s. Pushbutton controls with perfect interlock. Pause control. 7in. spools. Digital counter.

Instant mechanical brakes. Independent speed change wheels automatically disengaged in "off" position. Three motors, heavy balanced flywheel, silent running fast re-wind.

Technically luxurious, the precise construction and finish of these new Truvox Decks, Hi-Fi Units,* and complete recorders, ensure an outstanding performance. Note that wow and flutter is better than .15% at 7½ and .2% at 3¾ i.p.s. Brilliantly designed new heads provide a response from 30-20,000 c.p.s. Decks are tropicalised and available in all voltage ranges. Auto stop and "trick" switch available as optional extras.

**Comprises: Deck, Record Amplifier, Play-back pre-amplifier, mounted in attractive plinth for easy connection to your equipment.*

Full technical specification and details from:

TRUVOX LIMITED

Neasden Lane, London, N.W.10.

Telephone: Dollis Hill 8011

If you want to record

come to us for Strip Recorders

Elliott Multitrack Strip Chart Recorders give you all these advantages:

Available with up to 6 tracks · Each track 3" wide Curved ordinates · Record on strip charts by ink · 500 microamps upwards. AC/DC · Adjustable high and low level contacts can be fitted · Dynamometer movements or Event Pens can be fitted.

Full details from -

ELLIOTT

Electrical Measurement Division
ELLIOTT BROTHERS (LONDON) LTD
Century Works London SE13 *Tel: TIDeway 1271*

EA *A member of the Elliott-Automation Group*

EMD10

"SEE THE POINT"

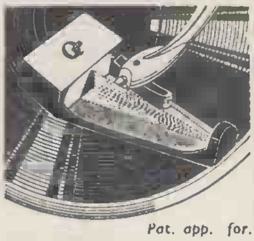
of your Stylus with the "Q-MAX"

"STYLOVUE"

The "Stylovue" is a device for projecting a magnified shadow of your stylus on to a screen, enabling you to see whether your stylus is worn and needs replacing, which cannot be detected by the naked eye.

28/3

Batteries 9d. extra.



Pat. app. for.

GARRARD AUTO-TURNTABLE

TYPE "A"

Transcription Auto-Changer

A transcription Record Player with provision for automatic use, if desired. Perfect playing from both Stereo and Mono records.

£23 . 1 . 0 (with G.C.8 cartridge)

(Base £2.16.9 extra.)

"Q-MAX"
SHEET METAL PUNCHES
TWO NEW SIZES

$1\frac{1}{16}$" 16/6 | $1\frac{5}{16}$" 18/6

(Keys: 1/6 each.)

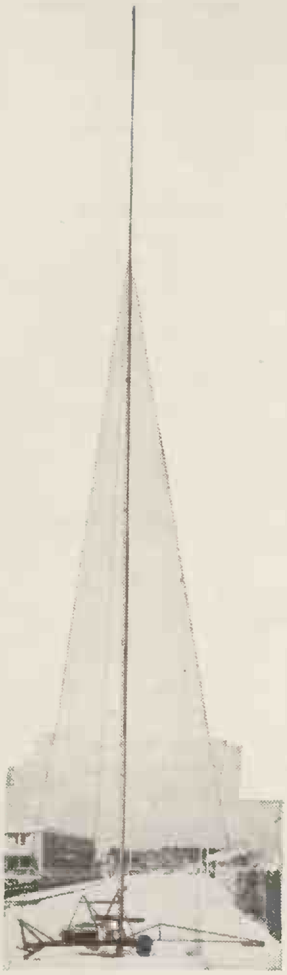
List of all sizes and prices on application.

Fully illustrated CATALOGUE of all HI-FI products 6d. Post Free.

BERRY'S RADIO

25 HIGH HOLBORN, LONDON, W.C.1.
Tel.: HOLborn 6231/2

PNEUMATIC TELESCOPIC MASTS FOR EVERY MOBILE AERIAL PROBLEM



Type PT.6 mast 70′ high mounted on Light Clark Trailer.

CLARK

AIR OPERATED MASTS

FROM 25′ to 80′ HIGH AVAILABLE AS STANDARD

A full range of equipment and accessories makes the Clark telescopic mast the easiest solution to aerial raising problems where mobility is an important factor.

Mast equipped Land-Rover (reproduced by kind permission of Marconi's Wireless Telegraph Co. Ltd.)

Type 61/70 mobile mast. Reaches 70ft. from this position in under 5 minutes—with only one man!

Special Clark trailers are available. They cover the entire height range and whilst retaining mobility, avoid tying up a vehicle.

CLARK MASTS ARE IN USE WITH GOVERNMENT DEPARTMENTS, FOREIGN GOVERNMENTS, CIVIL AUTHORITIES AND LEADING FIRMS IN MANY PARTS OF THE WORLD

CLARK

A. N. CLARK (ENGINEERS) LTD
PHIPPS BRIDGE ROAD, MERTON
LONDON, S.W.19 Tel: MITCHAM 7190

High reaching, fast in operation, compact when retracted, light to handle —that's a CLARK MAST

Just published — A NEW BBC ENGINEERING TRAINING MANUAL

SOUND AND TELEVISION BROADCASTING

General Principles

K. R. Sturley, Ph.D., B.Sc., M.I.E.E.

This manual, primarily written for recruits to the BBC Engineering Division, explains the basic principles of sound and television broadcast engineering and operations. The introductory chapter deals with basic physical principles and their applications to broadcasting. Chapters follow on sound and television studios; telecine and telerecording; amplitude and V.H.F. modulated transmitters; the problems of conveying the sound and television programme frequencies; and communicating between the various studio centres and transmitting centres. This book will be invaluable to anyone engaged in broadcasting and other forms of radio communication, and to those responsible for training in these fields.

45s net. by post 46s 4d. 378 pp illustrated.

Other BBC Engineering Training Manuals in this series

STUDIO ENGINEERING FOR SOUND BROADCASTING
General editor: J. W. Godfrey
25s net, by post 26s. 208 pp.

TELEVISION ENGINEERING
Principles and Practice
by S. W. Amos, B.Sc.(Hons.), A.M.I.E.E. and D. C. Birkinshaw, M.B.E., M.A., M.I.E.E.

Vol. I. Fundamentals, camera tubes, television optics, electron optics.
35s net, by post 36s 2d. 302 pp.

Vol. II. Video-frequency amplification.
35s net, by post 36s 2d. 270 pp.

Vol. III. Waveform generation.
30s net, by post 31s. 224 pp.

Vol. IV. General circuit techniques.
35s net, by post 36s 2d. 268 pp.

from leading booksellers

published for "Wireless World" by

ILIFFE Books Ltd. DORSET HOUSE · STAMFORD STREET · LONDON S.E.1

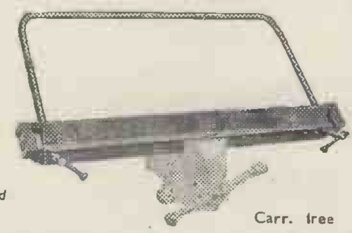
MINIATURE ELECTRIC BULBS
FROM 1V to 50V
IN SIZES FROM 4.5mm to 18mm DIAMETER

After nearly 30 years of specialising solely in the production of Miniature Electric Lamps, we have accumulated a store of information that is freely available to the Electronics Industry. You are invited to write or phone us for any information you may require about Miniature or Sub Miniature Filament Lamps for use in existing or new projects.

VITALITY BULBS LTD.

Neville Place, Wood Green, London, N.22 **Phone: BOWes Park 0016**

PARKERS SHEET METAL FOLDING MACHINE HEAVY VICE MODELS *With Bevelled Former Bars*



Carr. free

No. 1.	Capacity 18 gauge mild steel x 36in. wide	£8 10 0
No. 2.	Capacity 18 gauge mild steel x 24in. wide	£5 5 6
No. 3.	Capacity 16 gauge mild steel x 18in. wide	£5 5 6

Also new Bench Model, capacity 36 in. wide x 18 gauge mild steel. Weight approx. 2 cwt. £17.15.0—Carr. Free.

End folding attachments for Radio Chassis, Tray and Box Making for 36in. model, 3/6 per ft. Other models 2/-. The two smaller models will form flanges. As supplied to Government Departments, Universities, Hospitals. One year's guarantee. Money refunded if not satisfied. Send for details.

A. B. PARKER, Wheatcroft Works, Wellington Street, Batley, Yorks. Tel. 426.

For Safety's Sake use AVO Prodclips

Patent No. 748811

Safety first every time with these patented spring-oaded AVO prodclips.

Cleverly designed for use as insulated prods, they are invaluable for reaching and holding test points which are difficult of access.

Suitable for use with AvoMeter, Multiminor and Avo Electronic Test Meter Leads.

Post Free **15/-** per pair

AVO LTD **AVOCET HOUSE . 92-96 VAUXHALL BRIDGE ROAD, LONDON, S.W.1**

VICtoria 3404 (12 lines)

A MEMBER OF THE MEMBER INDUSTRIES GROUP OF COMPANIES

A GOOD 'SCOPE *from every point of view!*

MODEL 381. Vertical amplifier bandwidth DC—9 mc/s (–3dB) with rise time of .04 μSec., and overshoot of less than 1%. Calibrated nine stage frequency compensated input attenuator. In addition all the facilities of a high class 3″ general purpose oscilloscope. Unique mechanical construction with all panels removable for ease of maintenance. Convection cooled.

ELECTRONIC EQUIPMENT MANUFACTURERS

SEND FOR FULL TECHNICAL DETAILS

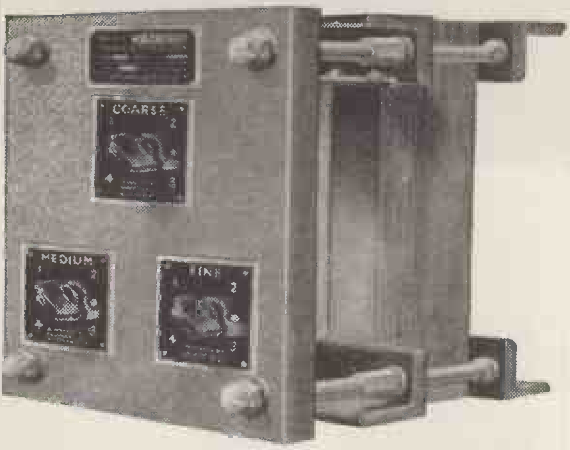
At its price the best value obtainable in this country—perhaps in the world.

£36

Dartronic LIMITED

3-7, WINDMILL LANE, LONDON, E.15

Telephone: MARyland 6247



VOLTMOBILE VOLTAGE SELECTOR

AUTO-TRANSFORMERS

Range from 1.6% to 100% of supply volts in 64 steps.

ON LOAD SWITCHING.

VOLTMOBILES can be used by themselves or in the primary of another transformer to give very fine changes of output.

25% OVER-VOLTS AVAILABLE AS EXTRA.
Output 30A 60A 100A.

1 PHASE 220/250V.

3 PHASE 380/440V.

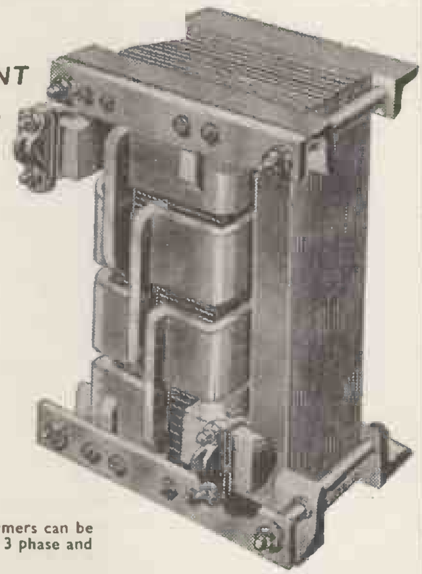
TRANSFORMERS

2 V	200 A
5 V	80 A
4 V	100 A
8 V	125 A
10 V	150 A
10 V	200 A
12 V	15 A
60 V	40 A
110 V	4 A
18 V	30 A
6 V	100 A
24 V	30 A
30 V	5 A
30 V	25 A
30 V	40 A
55 V	15 A
5 V	150 A
110 V	10 A
40 V	25 A
5 V	300 A
6-12 V	50 A
12 V	60 A
12 V	100 A
50 V	60 A
10-20-30 V	100 A

HEAVY CURRENT TRANSFORMERS

2 V	2,000 A
3 V	4,000 A
4 V	6,000 A
5 V	500 A
5 V	7,000 A
6 V	300 A
8 V	3,000 A
10 V	300 A
10 V	500 A
10 V	700 A
10 V	1,000 A
20 V	3,000 A
20 V	4,000 A
27 V	8,000 A
50 V	600 A
100 V	7,000 A

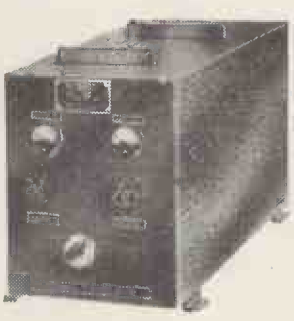
These and other transformers can be supplied for 1 phase and 3 phase and for use with rectifiers.



D-C MOBILE RECTIFIER SETS

For 1 or 3 phase supply.
Full load Volts and Amps are stated.

6 V	15 A	24 V	60 A
6 V	50 A	24 V	105 A
6 V	100 A	24 V	200 A
12 V	10 A	36 V	60 A
24 V	750 A	110 V	5 A
36 V	10 A	110 V	10 A
36 V	20 A	110 V	15 A
36 V	40 A	110 V	20 A
12 V	20 A	110 V	25 A
12 V	30 A	110 V	600 A
12 V	60 A	220 V	130 mA
12 V	105 A	250 V	6 A
12 V	210 A	250 V	10 A
12 V	1,000 A	250 V	15 A
24 V	12 A	250 V	20 A
24 V	20 A	250 V	200 A
24 V	30 A	1,200 V	225 mA



Ammeters—Voltmeters—Rheostats—Stabilising Circuits—Control Devices—all built to order.

With the exception of Voltmobiles, all ratings are indicative only. Any rating of TRANSFORMER, SATURABLE REACTOR AND RECTIFIER SET MADE TO ORDER

CARRIAGE EXTRA on all units.
SPECIFIC ENQUIRIES are invited for Transformers and Rectifiers. We specialize in HEAVY CURRENT EQUIPMENT.

HARMSWORTH, TOWNLEY & CO.
2 JORDAN STREET MANCHESTER 15 CENTRAL 5069

SONIC MASTER

4-TRACK TAPE RECORDER BARGAIN!!!

Complete Tape Amplifier (pre-amplifier, output stage 3 watts, oscillator and power pack).

9 x 5in. high flux density loudspeaker. Superimposing facilities, 4-track change-over switch, recording level indicator. Separate independent mic. and radio/gram inputs with mixing facilities.

Separate bass and treble controls . . 8 gns.

Extra speaker if required (9 x 5in. high flux density) . . . . 1½ gns.

De luxe Cabinet

(to take two 9 x 5in. loudspeakers) 8 gns.

Standard Cabinet

(takes one 9 x 5in. loudspeaker) . . 4 gns.

Latest Collaro Studio 4-track 3-speed transcriptor with pause and digital counter . . . . 13 gns.

Microphone, recording leads, 1,200ft. 7in. spool and spare 7in. spool . . 3 gns.

Complete kit, de luxe cabinet with two 9 x 5in. speakers . . . . 29 gns.

Or deposit of £10 and 12 monthly payments of £1/15/6.

Complete kit, standard cabinet with one 9 x 5in. speaker . . . . 25 gns.

Post and packing extra.

TRANSISTOR TRAVELLING SUPERHET " TRABANT 6 "

Transistor Travelling Superhet " Trabant T 6 " Technical Data: Power supply 2 flat batteries 4.5 volts—Working voltage 9 volts max. Power consumption ca. 12.5 mA at 8 volts without modulation—Semi-conductor equipment 7 transistors, 2 germanium diodes —Receiving ranges short, medium, long wave—Station tuning planetary drive with dial scale—Circuits 7, 2 of them variable—Intermediate frequency 460 kilocycles—AVC acting on the first intermediate frequency transistor, additional attenuating diode in parallel with the first intermediate frequency circuit—LF final stage ≥ 300 mW—Loudspeaker permanent dynamic oval speaker 1 VA—Aerials ferrite aerial for medium and long wave, telescopic aerial for short wave—Housing unbreakable wooden housing coated with coloured material—Dimensions 10⅜in. × 7¼in. × 3⅜in. Weight with batteries approx. 5 lb.

£25 only—limited quantity.

GENERAL SONIC RADIOS

92 CALEDONIAN ROAD, LONDON, N.1.

TELEPHONE: TERMINUS 0322

---

for the radio man

Wireless World Diary 1962

All the everyday information that is needed plus a week-to-an-opening diary.

Abacs—Abbreviations—Addresses of Radio Organizations—Aerial-Sharing Circuits—Aerials—Amateur Transmission—Attenuators—B.A. Screws and Drill Sizes—Binary Code—Circuit Diagrams—Coil Winding Data—Component Coding—Conversion Table—Decibel Equivalents—Electrical and Magnetic Units—Frequency Allocations—Greek Alphabet—Interference Suppression—Licence Regulations—M.K.S. and C.G.S. Units—Mathematical Signs—Modulation Classification—Morse Code—Radar Bands—Resistance of Metals—Resistor and Capacitor Markings—Resistor Ratings—Standard Frequencies—Symbols, Graphical and Letter—Television Stations (U.K.)—Television Standards—Time Constants—Unit Abbreviations—V.H.F. Broadcasting—Valve Base Connections—Waveband Classification—Weights and Measures—Wire Tables—Wood Screws.

6s 10d leather (Overseas 5s 9d) Postage 4d
4s 10d rexine (Overseas 4s) Postage 4d

from booksellers, newsagents and stationers

Published by T. J. & J. Smith Ltd., in conjunction with WIRELESS WORLD, Dorset House, Stamford St., London, S.E.1.

TRANSFORMERS
COILS *LARGE OR SMALL QUANTITIES*
CHOKES *TRADE ENQUIRIES WELCOMED*

SPECIALISTS IN

FINE WIRE WINDINGS

MINIATURE TRANSFORMERS, PICK-UP, CLOCK AND INSTRUMENT COILS, ETC.
VACUUM IMPREGNATION TO APPROVED STANDARDS

ELECTRO-WINDS LTD.

CONTRACTORS TO G.P.O., M.O.S., L.E.B., ETC.
123-5-7 PARCHMORE ROAD, THORNTON HEATH, SURREY
LIVINGSTONE 2261 EST. 1933

A. C. SOLENOID type SAM/T

Now fitted with stainless steel guides—six times the life.

Continuous 14 ozs at ¾in. Instantaneous to 5½lbs.

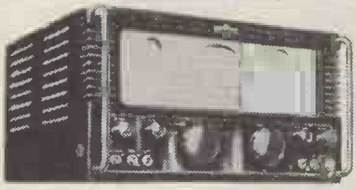
Larger and smaller sizes available.

Also Transformers to 7 kVA 3 phase.

R. A. WEBBER LTD.

KNAPPS LANE, CLAY HILL, BRISTOL 5. Phone: 65-7228/9

This advertisement invites YOU to contact H·P RADIO for EDDYSTONE RADIO RECEIVERS



EDDYSTONE 680X

A 15 valve communication receiver with many refinements, including crystal filter, variable selectivity "S" meter, push-pull output and stabilized supply to oscillator stages. 1110 kc/s to 480 kc/s and 2.5 to 30 Mc/s in 5 switched bands. Electrical performance, sensitivity for 50 milliwatts, 15 db signal/noise ratio, 4 microvolts on all ranges. £140.0.0

EDDYSTONE 840C

Communication receiver at a moderate price. 8 B8A valves in a straightforward superheterodyne circuit. 5 wave bands 30.6-10.5 Mc/s, 10.6-3.7 Mc/s, 30.6-10.5 Mc/s, 10.6-3.7 Mc/s, 3.8 Mc/s, 1.4 Mc/s, 205-620 Metres. Sensitivity better than 10 microvolts. Selectivity 30 db down to 10 kc/s off resonance, AC/DC, Internal speaker. £58.0.0.

EDDYSTONE 880

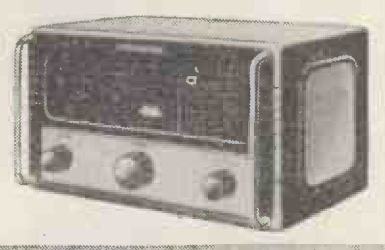
The Eddystone 880 high stability communications receiver has been designed expressly for use in professional communications systems. Tuning range is from 500 kc/s to 30.5 Mc/s. Please write for technical specification. £380.0.0

EDDYSTONE 888A

A 12 valve receiver designed for the amateur bands, giving full bandspread. Double superheterodyne with high selectivity and excellent signal to noise characteristics. Crystal calibrator audio filter, separate gain controls, oscillator trimmer. Frequency 1,800-2,000 kc/s, 3.500-4,000 kc/s, 7,000-7,300 kc/s, 14,000-14,350 kc/s, 21,000-21,500 kc/s, 28,000-30,000 kc/s. £110.0.0.

EDDYSTONE 870A

A compact, precision built receiver for the home, giving news and entertainment from the whole world. 5 wavebands, vernier device. AC/DC operation, built-in mains filter and loudspeaker. Two tone metal cabinet £33.0.0



HP RADIO SERVICES LTD
51, COUNTY ROAD LIVERPOOL, 4

HIRE PURCHASE TERMS OVER 1 YEAR

Model No.	Cash Price	Deposit	12 Monthly of
870A	£33	£6 12 0	£2 6 8
840C	£58	£12 0 0	£4 2 6
888A	£110	£22 0 0	£7 17 8
680X	£140	£28 0 0	£10 0 8

HIRE PURCHASE TERMS OVER 2 YEARS

Model No.	Cash Price	Deposit	24 Monthly of
870A	£33	£6 12 0	£1 5 4
840C	£58	£12 0 0	£2 4 0
888A	£110	£22 0 0	£4 4 4
680X	£140	£28 0 0	£5 7 4
880	£380	Cash Only	

Carriage Paid per Passenger Train.

Most carefully packed to ensure safe delivery.

If payments are completed in 6 months
ONLY CASH PRICE WILL BE CHARGED.

Wireless World

ELECTRONICS, RADIO, TELEVISION

NOVEMBER 1961

VOLUME 67 No. 11.

PRICE: 2s. 6d.

FIFTY-FIRST YEAR OF PUBLICATION

Iliffe Electrical Publications Ltd. *Managing Director:* H. S. Pocock, M.I.E.E.
Dorset House, Stamford Street, London, S.E.1

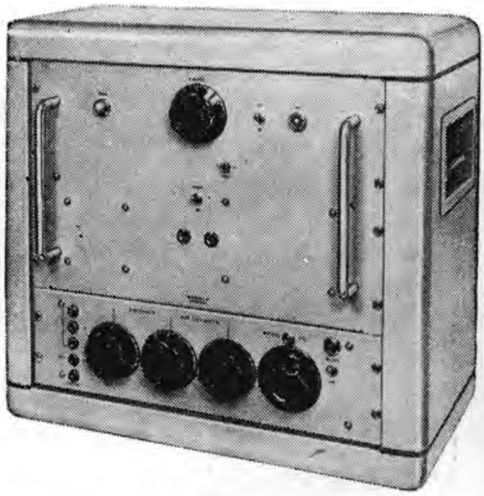
Please address to Editor, Advertisement Manager, or Publisher as appropriate

PUBLISHED MONTHLY (4th Monday of preceding month). *Telephone:* Waterloo 3333 (65 lines). *Telegrams:* " Ethaworld. London-SE1." *Annual Subscriptions: Home and Overseas,* £2 0s. 0d. *Canada and U.S.A.,* $5.50. Second-class mail privileges authorized at New York, N.Y. BRANCH OFFICES: *BIRMINGHAM:* King Edward House, New Street, 2. *Telephone:* Midland 7191. *COVENTRY:* 8-10, Corporation Street. *Telephone:* Coventry 25210. *GLASGOW:* 62, Buchanan Street, C.1. *Telephone:* Central 1265-6. *MANCHESTER:* 260, Deansgate, 3. *Telephone:* Blackfriars 4412. NEW YORK OFFICE: *U.S.A.:* 111, Broadway, 6. *Telephone:* Digby 9-1197.

Vortexion

quality equipment

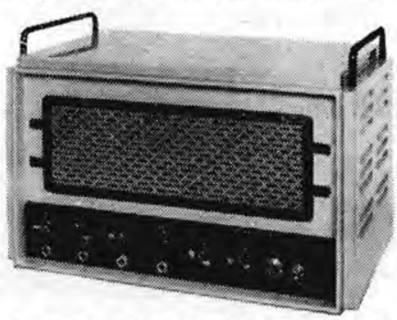
120/200 WATT AMPLIFIER



Will deliver 120 watts continuous signal and over 200 watts peak Audio. It is completely stable with any type of load and may be used to drive motors or other devices to over 120 watts at frequencies from 20,000 down to 30 cps in standard form or other frequencies to order. The distortion is less than 0.2% and the noise level —95 dB. A floating series parallel output is provided for 100-120 V. or 200-250 V. and this cool running amplifier occupies 12¼ inches of standard rack space by 11 inches deep. Weight 60lb.

30/50 WATT AMPLIFIER

Gives 30 watts continuous signal and 50 watts peak Audio. With voice coil feedback distortion is under 0.1% and when arranged for tertiary feedback and 100 volt line it is under 0.15%. The hum and noise is better than —85 dB referred to 30 watt.



It is available in our standard steel case with Baxendale tone controls and up to 4 mixed inputs, which may be balanced line 30 ohm microphones or equalised P.U.s to choice.

ELECTRONIC MIXER/AMPLIFIER

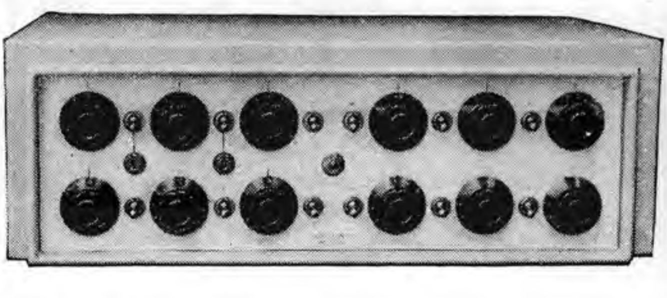
This high fidelity 10/15 watt Ultra Linear Amplifier has a built-in mixer and Baxendale tone controls. The standard model has 4 inputs, two for balanced 30 ohm microphones, one for pick-up C.C.I.R. compensated and one for tape or radio input. Alternative or additional inputs are available to special order. A feed direct out from the mixer is standard and output impedances of 4-8-16 ohms or 100 volt line are to choice. All inputs and outputs are at the rear and it has been designed for cool continuous operation either on 19 x 7in. rack panel form or in standard ventilated steel case.

Size 18 x 7½ x 9½in. deep.

Price of standard model **£49.**

12-WAY ELECTRONIC MIXER

The 12-way electronic mixer has facilities for mixing 12 balanced line microphones. Each of the 12 lines has its own potted mumetal shielded microphone transformer and input valve, each control is hermetically sealed. Muting switches are normally fitted on each channel and the unit is fed from its own mumetal shielded mains transformer and metal rectifier.



Also 3-way mixers and Peak Programme Meters. 4-way mixers and 2 x 5-way stereo mixers with outputs for echo chambers, etc. Details on request.

Full details and prices of the above on request

VORTEXION LIMITED, 257-263 The Broadway, Wimbledon, London, S.W.19

Telephones : LIBerty 2814 and 6242-3 **Telegrams : "Vortexion, Wimble, London."**

STOP SCRATCHING

Don't attack your records with a blunt instrument. Don't grind away the grooves. Give your discs the care they deserve by fitting replacement styli at the right time, of the right type, of the best quality. Acos make many of the most successful cartridges and pick-ups in the world. As you would expect, therefore, Acos replacement styli, also, are unsurpassed for precision and good value—part of the Acos contribution towards faithful sound reproduction at reasonable cost.

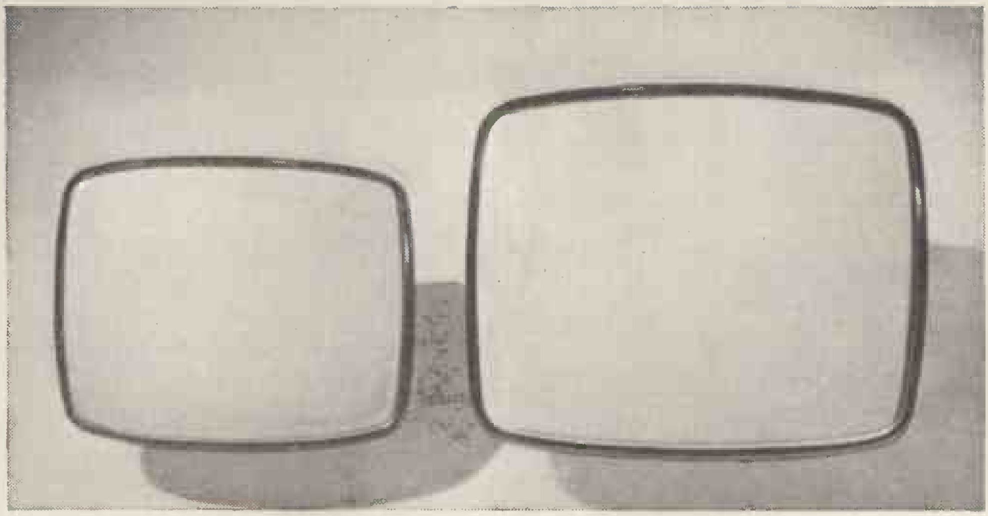
USE ACOS x500 STYLI

Every Acos stylus is individually tested at 500 times magnification for perfect shape and polish. Acos Sapphire and Diamond replacement styli are available for all current Acos and ACOStereo pick-ups and cartridges, and an extensive range of other cartridges. U.K. Retail price Sapphire from 6/1 Diamond 35/8 including P.T. The Acos Changer Dust Bug clips easily over most changer arms and wipes the record before and after the stylus, giving up to five times longer stylus life.

acos ARE DOING THINGS IN STYLI

COSMOCORD LTD WALTHAM CROSS HERTS · TEL: WALTHAM CROSS 27331.

NEW 19" AND 23" TELEVISION CATHODE RAY TUBES



EDISWAN MAZDA TYPES CME1901 AND CME2301

The CME1901 and CME2301 are, respectively, 19in. and 23in cathode ray tubes using magnetic deflection and electrostatic focus. The diagonal deflection angle of CME1901 is 114° and that of CME2301 is 110°. The shape of these tubes differs from the shape of conventional 110° tubes in that the face plates are more nearly rectangular. In addition the radii of curvature of the faces of the 19in. and 23in. tubes are greater than those of the 17in. and 21in. tubes. These changes result in a more pleasing presentation of the picture.

The external shape of the glass in the deflection region of these tubes is identical to that of conventional 110° tubes, enabling coils with conventional 110° internal mechanical contours to be used.

With equal values of final anode voltage, beam deflection in the CME1901 and CME2301 can be carried out with no more power consumption than in the CME1703 and CME2101.

GENERAL DETAILS

Rectangular face	Aluminised screen
Electrostatic focus	Silver activated phosphor
Magnetic deflection	Grey glass
Straight gun—non ion trap	External conductive coating
Heater for use in series chain	

Heater Current (amps)	I_h	0.3
Heater Voltage (volts)	V_h	12.6

TENTATIVE RATINGS AND DATA

Design Centre Ratings		CME1901	CME2301
Maximum Second and Fourth Anode Voltage (kV)	$V_{a2,a4(max)}$	17	17
Minimum Second and Fourth Anode Voltage (kV)	$V_{a2,a4(min)}$	14	15
Maximum Third Anode Voltage (volts)	$V_{a3(max)}$	±700	±700
Maximum First Anode Voltage (volts)	$V_{a1(max)}$	500	500
Maximum Heater to Cathode Voltage—Heater Negative d.c. (volts)	$V_{h-k(max)}$	180	180

Inter-electrode Capacitances (pF)		CME1901	CME2301
Cathode to All*	$c_{k\ all}$	5	5
Grid to All*	c_{g-all}	8	8
Final Anode to External Conductive Coating (approx.)	$c_{a2,a4-M}$	1500	2000

*Inter-electrode capacitances including AEI "Clix" B8H holder VH68/81 (8 pin).

TYPICAL OPERATION

		CME1901	CME2301
Second and Fourth Anode Voltage (kV)	$V_{a2,a4}$	16	16–17
First Anode Voltage (volts)	V_{a1}	450	450
Third Anode Voltage for Focus-Mean (volts)	$V_{a3(av)}$	180	180
Grid Bias for cut-off of Raster (volts)		38 to 72	38 to 72
Average Peak to Peak Modulating Voltage for Modulation up to 350μA (volts)		34.5	34.5

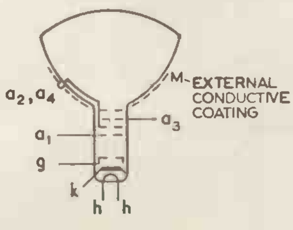
Note: All voltages given with respect to the cathode.

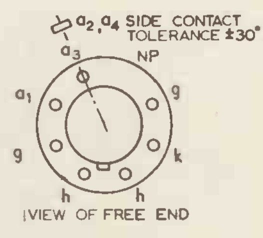
Maximum Dimensions (mm)	CME1901	CME2301
Overall Length	322	386
Face Diagonal	476†	598†
Face Width	420†	524†
Face Height	342†	422†
Neck Diameter	29.4	29.4

†The maximum dimension at the face seal may be 3.5 mm larger than this dimension but at any point around the seal the bulge will not protrude more than 2 mm.

Tube Weight (lb.)	CME1901	CME2301
Nett (approx)	13.5	27

Side Contact: CT8 (Cavity) **Base:** B8H





Thorn-A.E.I. Radio Valves & Tubes Ltd
155 Charing Cross Road, London, W.C.2.
Tel: GERrard 9797. Grams: Sieswan, Westcent, London

MAZDA

TRIODE TETRODE FOR VIDEO OUTPUT APPLICATIONS

MAZDA 30FL12

The 30FL12 consists of a high slope tetrode with frame grid construction for use in a video output stage, and a general purpose triode.

Higher peak current with an appreciably higher slope is available from the tetrode, as compared with the 30FL1, so enabling adequate video drive to be provided for the cathode ray tube, with anode loads down to 4,700 ohms. This low value of load eases the problems of HF video compensation.

The triode has identical characteristics to the 6/30L2.

Heater current (amps)	I_h	0.3
Heater voltage (volts)	V_h	9.8

TENTATIVE RATINGS AND DATA

Maximum Design Centre Ratings

		Triode	Tetrode
Anode Dissipation (watts) ..	$p_{a(max)}$	1.5	2.5
Screen Dissipation (watts) ..	$p_{g2(max)}$	—	0.8
Anode Voltage (volts) ..	$V_{a(max)}$	250	250
Screen Grid Voltage (volts) ..	$V_{g2(max)}$	—	250
Heater to Cathode Voltage (volts rms)	$V_{h-k(max)rms}$	—	150*

*Measured with respect to the higher potential heater pin.

Inter-Electrode Capacitances† (pF)

		Triode	Tetrode
Input	c_{in}	2.3	8
Output	c_{out}	2.0	2.6
Control Grid to Anode	c_{g-a}	2.4	0.04
Grid Triode to Grid 1 Tetrode	c_{gt-g1}	0.003	
Anode Triode to Anode Tetrode	c_{at-aq}	0.012	
Grid Triode to Anode Tetrode	c_{gt-aq}	0.004	
Anode Triode to Grid 1 Tetrode	c_{at-g1}	0.008	

†Measured in fully shielded socket without can.

CHARACTERISTICS

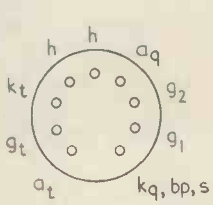
		Triode	Tetrode
Anode Voltage (volts)	V_a	200	180
Screen Grid Voltage (volts) ..	V_{g2}	—	180
Anode Current (mA)	I_a	10	10
Mutual Conductance (mA/V) ..	gm	3.4	12.5
Amplification Factor	μ	18	—

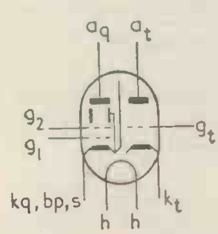
TETRODE OPERATION AS VIDEO AMPLIFIER

Allowance must be made in circuit design, not only for component variation, but also for valve spread and deterioration during life. Values of tetrode peak anode current, for an average valve when new and at the assumed end-of-life point for any valve, are as follows:—

	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)
Average New Valve	70	180	—1	40
Assumed End of Life Condition	60	180	—1	25

Mounting position: Unrestricted.
Base: B9A (Noval).

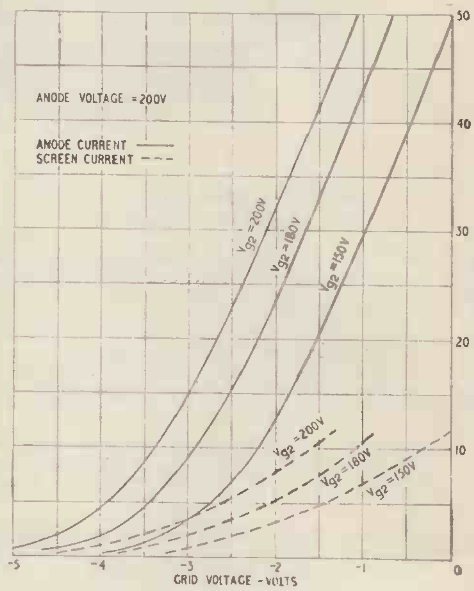


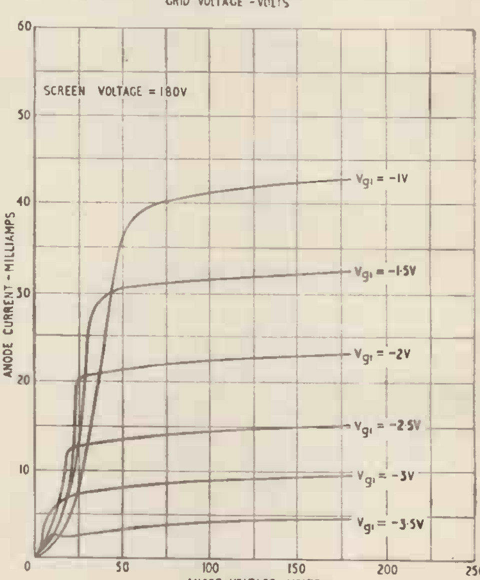


Maximum Dimensions (mm)

Overall Length	56
Seated Height	49
Diameter	22.2

Tentative Characteristic Curves of Mazda Valve Type 30FL12



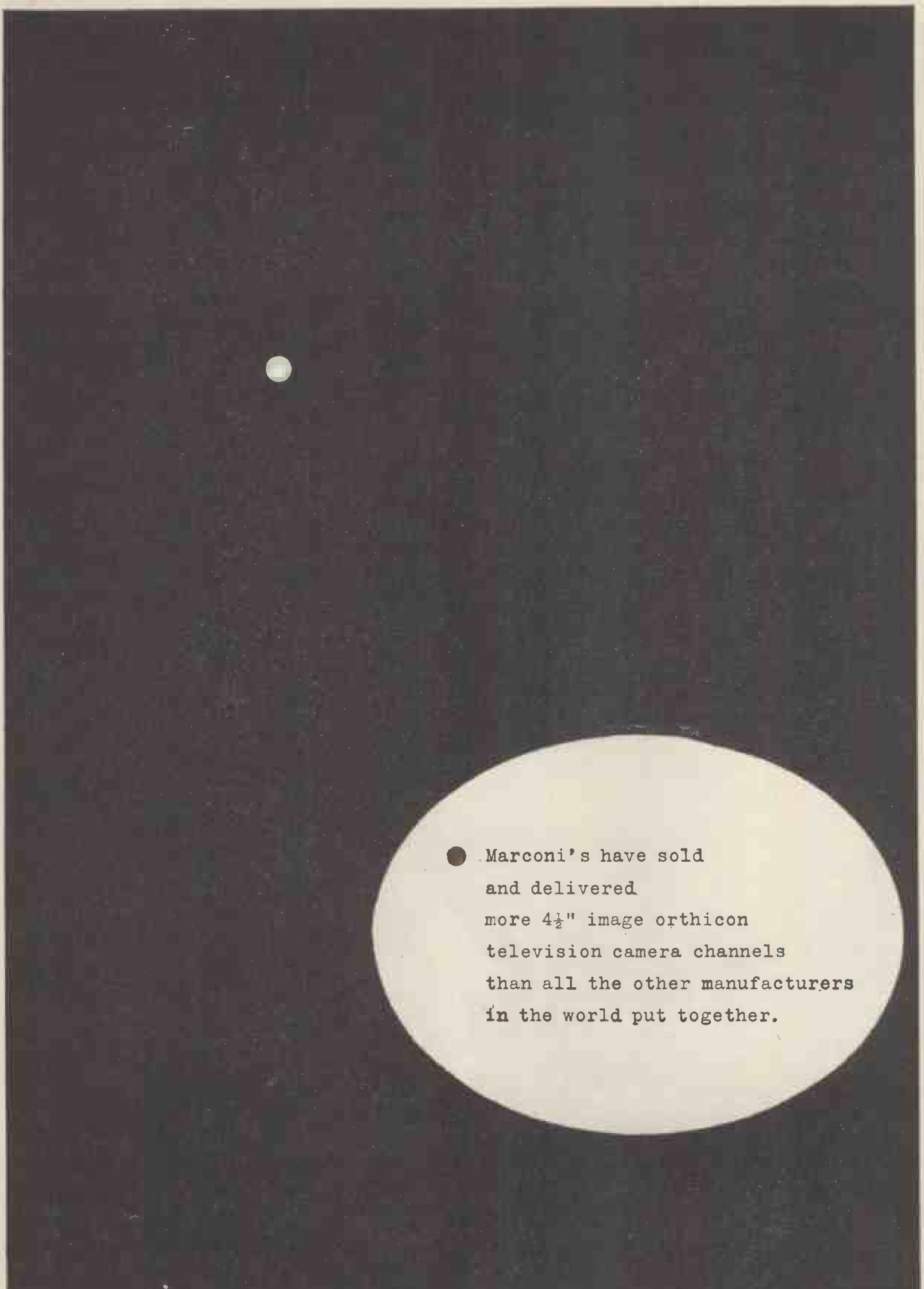


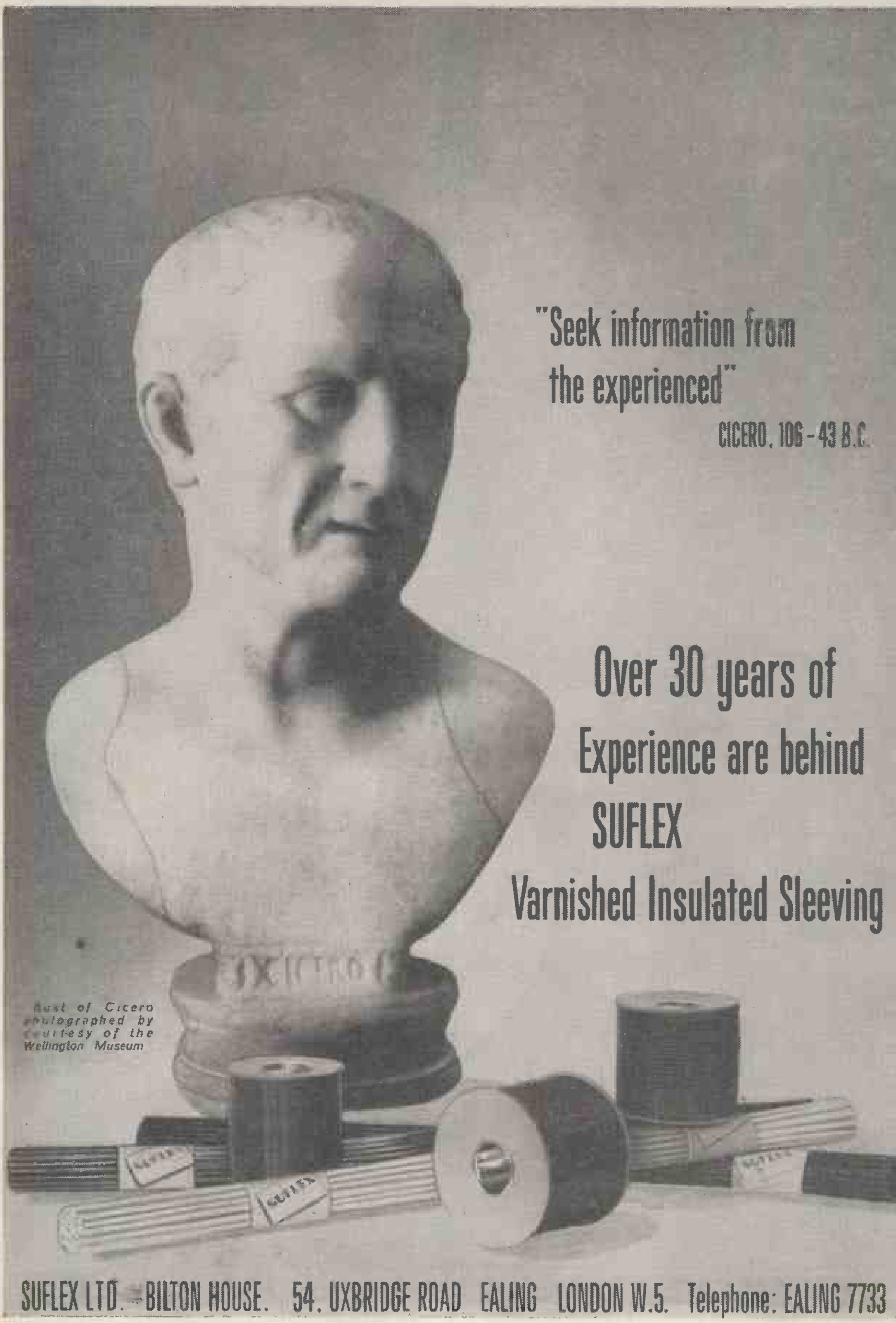
Thorn-AEI Radio Valves & Tubes Ltd

155 Charing Cross Road, London, W.C.2
Telephone: GERrard 9797
Telegrams: Sieswan Westcent London

MAZDA

TA 18/10


Marconi's have sold
and delivered
more 4½" image orthicon
television camera channels
than all the other manufacturers
in the world put together.


"Seek information from the experienced"
CICERO, 106 - 43 B.C.
Over 30 years of Experience are behind SUFLEX Varnished Insulated Sleeving
Bust of Cicero photographed by courtesy of the Wellington Museum
SUFLEX LTD. - BILTON HOUSE. 54, UXBRIDGE ROAD EALING LONDON W.5. Telephone: EALING 7733

Plessey

Aerial Exchange feeds 80 receivers from one aerial

- 2 Mc/s to 30 Mc/s overall coverage; uses four basic units.
- Optional additional units link any receiver to any of several arrays.
- Standard unit range speeds maintenance, simplifies installation.
- Complete system gives ultimate capacity of 80 receivers working to 12 aerial arrays.
- Electronic switching minimises noise, heightens long-term reliability.
- Zero overall insertion loss; high-gain, low-noise wideband amplification.
- Easily arranged for dual-diversity working.

Comprehensive details of this flexible range of equipment are available on request.

Plessey

Telecommunications Division · Electronic and Equipment Group
THE PLESSEY COMPANY LIMITED · Ilford · Essex · Tel: Ilford 3040
Overseas Sales Organisation: Plessey International Limited

CONTROLLED
POWER

Generally known for sternly withstanding fierce charges are G.E.C.'s silicon controlled rectifiers, ideal for power control and power switching applications at voltages up to 400 V and currents up to 70 A.

Write for details to G.E.C. **SEMICONDUCTORS**

THE GENERAL ELECTRIC COMPANY LIMITED · SEMICONDUCTOR DIVISION · SCHOOL STREET
HAZEL GROVE · STOCKPORT · CHESHIRE · OR, IN THE LONDON AREA, RING: TEMPLE BAR 8000 EXT. 10

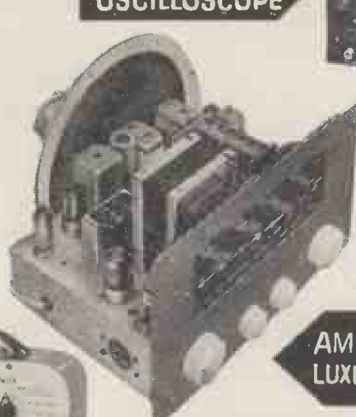
NOW YOU can MASTER ELECTRONICS!

BRITAIN'S MOST COMPREHENSIVE PRACTICAL COURSE in RADIO · ELECTRONICS · TELEVISION!

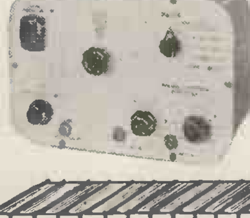
THESE SPECIAL TRAINING KITS — YOURS TO KEEP

Multi-Range TEST METER

CATHODE RAY OSCILLOSCOPE



AM and VHF/FM LUXURY RECEIVER



SIGNAL GENERATOR

Complete set of Picture Way books and Experimental Manuals

LEARN BY BUILDING NOW for your CAREER • HOBBY • OWN BUSINESS

YOU RECEIVE

- Complete kits of equipment as illustrated.
- Complete set of experimental manuals.
- Complete set of 'picture way' theory books.
- Modern test-yourself examination sheets.
- Study programme.
- Unlimited consultation with Tutors.

FREE BROCHURE

POST NOW

RADIOSTRUCTOR

TO: RADIOSTRUCTOR (DEPT. M.66)
READING, BERKS.

NAME ....

ADDRESS ....

....

(BLOCK CAPITALS, PLEASE)

Date..............

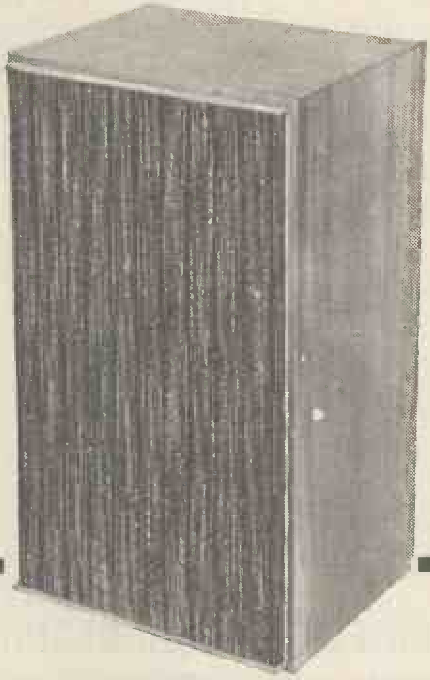
(We do not employ Representatives.)

11/61

AN ASTONISHINGLY IMPROVED LOUDSPEAKER SYSTEM

invented by LEAK

the first name in High Fidelity



Leak speakers won the day

"This occasion proved a most stringent test as we were listening to a stereo recording of a very recent orchestral and operatic performance we had enjoyed either as audience or performer. By way of experiment other pairs of speakers were switched in, but the very smooth response of the Leak speakers won the day."

Quoted from the Test Report by Ralph West, B.Sc., M.Brit.I.R.E. The full report appeared in "Hi-Fi News," August, 1961.

Selecting the equipment

"Suggestions? The *Leak* line comes highly recommended on two continents, the pre-amp isn't cursed with superfluous knobs, and it looks good. The mono amp would thus be the *TL/12 Plus* and the stereo version would be the *Point One Stereo 20 Amplifier.* Both run about 10-12 watts per speaker, and frankly I think this is plenty. Even with that you can rattle the windows, and the reason is that this 10W is at *minimum distortion,* 10W sinewave power (which means that it'll put out a lot more on peaks) The price* of the *Leak* is also quite reasonable for uncompromised sound quality."

Quoted from the article "Frankly Speaking," by John Berridge, "Hi-Fi News," August, 1961.

The new LEAK "SANDWICH" LOUDSPEAKER SYSTEM is the product of many years of research and development work

The cabinet is of unique construction which damps panel resonances and permits the loudspeaker motor to reproduce full clean bass without the "boxy" coloration of conventional cabinets. A 3in. and a 13in. moving-coil loudspeaker motor of novel design and a half-section cross-over network complete the system which gives the highest quality of reproduction over the whole frequency range of the input signal from records, radio, tape or microphone. THE GREATEST ADVANCE IN THE DESIGN OF MOVING-COIL LOUDSPEAKERS SINCE RICE-KELLOGG INVENTED THE FIRST UNIT IN 1925 HAS NOW BEEN MADE BY LEAK WITH A NEW INVENTION WHICH ELIMINATES BREAK-UP DISTORTION IN THE WORKING RANGE. The 13in. unit employs a new cone whose stiffness to weight ratio is 200 times better than the best cones which are currently available. The low stiffness of conventional cones results in the flexing of the cone at large amplitudes and break-up resonances. The new LEAK cone, which has immense stiffness for no greater weight than a conventional cone, has, for the first time, given us a loudspeaker which behaves as the theoretical ideal of a rigid piston; thus there is no flexing of the cone at large amplitudes and there is no break-up distortion within the frequency range handled by the loudspeaker. It is this freedom from coloration, produced in conventional systems by break-up distortion of the cone and cabinet resonances, which distinguishes the superior quality of reproduction of the LEAK "SANDWICH" LOUDSPEAKER SYSTEM from that of the best currently available loudspeaker systems. The cabinet measures only 26in. × 15in. × 12in.; it can be used in the vertical or horizontal position to suit the convenience of the user.

Price £39 : 18s.

Please tick your requirements below:

☐ **New Loudspeaker System.**

☐ **Hi-Fi Equipment.**

Name ....

Address ....

....

WW/11/61

**The price of Leak studio quality Hi-Fi Equipment is as low as it is because we are kept fully and efficiently employed by the world-wide demand.*

See your LEAK dealer or POST THE COUPON now for full details of this superb new EQUIPMENT.

H. J. LEAK & CO. LTD · BRUNEL ROAD · WESTWAY FACTORY ESTATE

LONDON, W.3

Telephone: SHEpherds Bush 1173

Telegrams: SINUSOIDAL, EALUX LONDON.

THIS MONTH'S SNIP

A fully-built, tested and ready to work pocket radio using six semi-conductors and tuning over the long and medium wave bands. An excellent performer and a real bargain at **£5/15/-** post free.

Seven days approval. Send for one today. If you are not 100% pleased then return it within seven days and your money will be refunded.

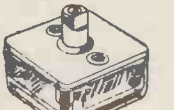
Charging Switchboards

Type A. 550 w. 18 v.—contains three reverse current relays, one voltmeter rated 25 v. f.s.d., one main ammeter rated 40 amps. f.s.d., one secondary ammeter rated 15 amps. f.s.d. and two secondary meters rated 20 amps f.s.d., one 2 ohm variable resistor, one 11 ohm variable resistor and two 1.2 ohm variable resistors. Complete in metal case 2ft. 6in. × 2ft. 8in. approx. Price **£2/15/-**, carriage and ins. 15/-.

Type B. 1260 w. 50 v., .12 amps.—contains one 14 ohm variable resistor and four 1 ohm variable resistors, one main ammeter rated at 40 amps. f.s.d., four secondary meters rated at 20 amps f.s.d. and one voltmeter rated at 50 volts, and two reverse current relays. Complete in metal case—size approx-. imately 2ft. 6in. × 2ft. 8in. Price **£4/15/-**. carriage 15/-.

Connecting Leads for these switchboards with Nifam plugs **30/-** each.

Smallest Possible 2-gang



With built-in trimmers, polystyrene cased, size only 1 × 1 × 7/16in., price **17/6**. Smallest IF and oscillator to match, **21/-**. P.P. input and P.P. output transformers. **12/6**. Circuit diagram free with any of above.

Miniature Earphones

For Transistor Circuits or Deaf Aids. Very light weight and easy to wear, cord almost invisible, good quality production of music and voice, complete with miniature plug and socket, ready to use—correct impedance OK for red spot and similar transistors. Crystal and Magnetic, **9/-**. Post and Insurance 1/-.

NOW THE MARK IV

Pocket Transistor Radio

Read these Testimonials

D. A. Hilton, Leigh, Lancs.
"I received Pocket 4 on Christmas Day. I made it up on Boxing Day and I am very pleased with the results. It brings in local stations and many foreign stations including Luxembourg at good strength. I am 13 years old."

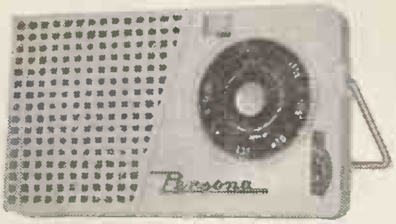
Mr. J. Bell, Wolverhampton.
"I am writing to express my satisfaction at the standard of your kit for your Pocket 4 Transistor set and also to state that it has come up to my expectations in regard to performance."

Mr. R. Belt, Newcastle-on-Tyne.
"I have built your Pocket 5 Transistor set. I am very pleased with it."

Mr. F. Jackson, Ickenham, Middx.
"I have built the Pocket 4 and am more than pleased with the results."

Mr. G. Bamford, Ramsgate.
"I find this set even better than you claim it to be and most certainly up to your usual standard of quality. I feel that nobody could fail to build it and get results. Even the first-time-ever novice, as your circuit diagrams and instructions are so clear and precise."

Mr. A. J. Simmonds, Welling, Kent.
"I purchased from you a week ago the Pocket 4 Transistor Kit. I put it together last night in 1½ hours, on switching on the set I was right on Radio Luxembourg. I must say thank you because not only has the set a very attractive appearance, it also behaves fantastically."



Our famous Pocket "4" which is doing yeoman service all over the country has been modified and improved to make it an even better receiver. The new features include:—

- New elegant dial graduated for Long and Medium Waves.
- Switched Long and Medium Waves.
- Slide switch on/off control.
- Printed circuit.
- Ferrite Rod Aerial.
- Improved reaction circuit.
- Positive spindle coupling to tuner.
- Battery containers.

The Pocket "5" of course retains its original r.f. circuit which means still no aerial or earth needed.

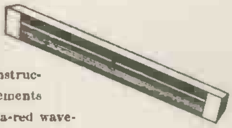
The Pocket "5" Mark IV uses 4 transistors, crystal diode, miniature loud speaker and has all the above refinements, complete in case as illustrated (less motif) **52/6**, battery 10d., post and insurance 2/6. Motif **2/-**.

Pocket "6" as Pocket "5," but with Moving Coil Speaker and Q.P.P. output stage **95/-**.

Seven days approval
Order in confidence. We allow you seven days to decide whether or not to make the set, you may return the parcel as received within this time and your money will be refunded in full.

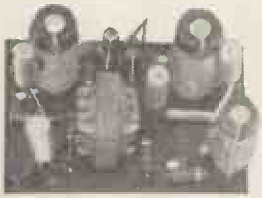
Read some of the testimonials over 1,000 of which have been received about our Pocket Receivers.

INFRA-RED HEATERS



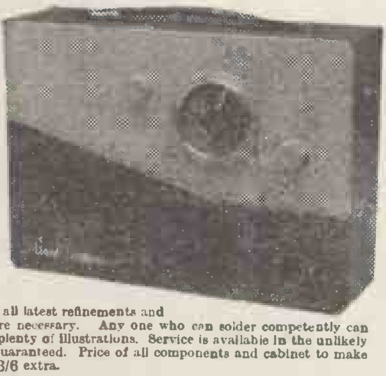
These latest type heaters are ideal for bathroom, kitchen, bedroom. etc. They are simple to make from our easy to follow instructions—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750-watt element and instructions. **15/6** plus 2/6 post and insurance. Or made up heater, **52/6**, plus 3/6 post and insurance —fully tested and guaranteed.

750mW TRANSISTOR AMPLIFIER



4 transistors including two in push-pull—input for crystal or magnetic microphone for pick-up—feed back loops—sensitivity 5 m/v—output 1 watt peak into 35 ohm speaker. Speakers available. Price **52/6**. Postage and insurance 2/6.

THE GOOD COMPANION



Largely due to the helpful criticisms and suggestions received from purchasers of our previous set "The Real Companion" we have improved and now supersede this with a new set which we call "The Good Companion." We feel confident that this new set is one of the finest of its kind available. The design is the combined efforts of our own technicians and of those of several of the leading manufacturers in the country, and the resulting set has a performance as good as if not superior to those selling at £20 and more. It has the eight transistor set performance.

Features include American Philco R.F. transistors and Mullard A.F. transistors—Q.P.P. output giving 750 mW—full coverage on Medium and Long—very fine tuning arrangement—excellent reception of difficult stations like 208—variable feed-back control—full tonal qualities —really superior looking cabinet size 11 × 8 × 3in. approximately—car aerial attachment—several months operation from battery costing only **3/6**.

Circuit employs six transistors and two diodes, it incorporates all latest refinements and oscillator I.F. Transformer is pre-aligned so no instruments are necessary. Any one who can solder competently can make this set. The instructions are fully comprehensive with plenty of illustrations. Service is available in the unlikely event of your getting into difficulties. All components fully guaranteed. Price of all components and cabinet to make set as illustrated **£9/19/6**. Post and insurance 5/-. Battery **3/6** extra.

ELECTRONIC PRECISION EQUIPMENT, LTD.

post orders are dealt with from Eastbourne, so for prompt attention please post your orders to 66 Grove Road, Eastbourne, marked Department 2. Callers may use any one of the Companies below.

226 London Road, Croydon.	29 Stroud Green Road, Finsbury Park, N.4.	520 High Street North, Manor Park, E.12.	42-46 Windmill Hill, Ruislip, Middx.	246 High St. Harlesden, N.W.10.
Phone: CRO 6558.	Phone: ARChway 1049.	Phone: ILFord 1011.	Phone: Ruislip 5780.	Phone: ELGar 4444.
Half-day, Wednesday.	Half-day, Thursday.	Half-day, Thursday.	Half-day, Wednesday.	Half-day, Thursday.

ILIFFE books
for radio and electronic engineers and students

INTRODUCTION TO LAPLACE TRANSFORMS

for radio and electronic engineers

W. D. Day, Graduate I.E.E., A.M.Brit.I.R.E.

This book, written specially for radio and electronic engineers, presents the Laplace transformation theory in a language that they will readily understand, dealing with electrical circuits from the very first paragraph and building up to the stage when transforms are used to investigate transient conditions.

32s 6d net BY POST 33s 6d 183 pp

NUMERICAL METHODS FOR HIGH-SPEED COMPUTERS

G. N. Lance, M.Sc., Ph.D., M.I.A.S., A.R.F.Ae.S.

Collects those methods of solving complicated problems which have been developed by research mathamaticians to make the fullest use of all types of modern automatic high speed computing machines. All the methods described have been tested and found useful in practice, while important considerations are discussed. The book is invaluable to programmers, mathematicians, engineers, physicists, chemists, and scientists generally who are interested in the application of electronic computers to the solution of their own particular problems.

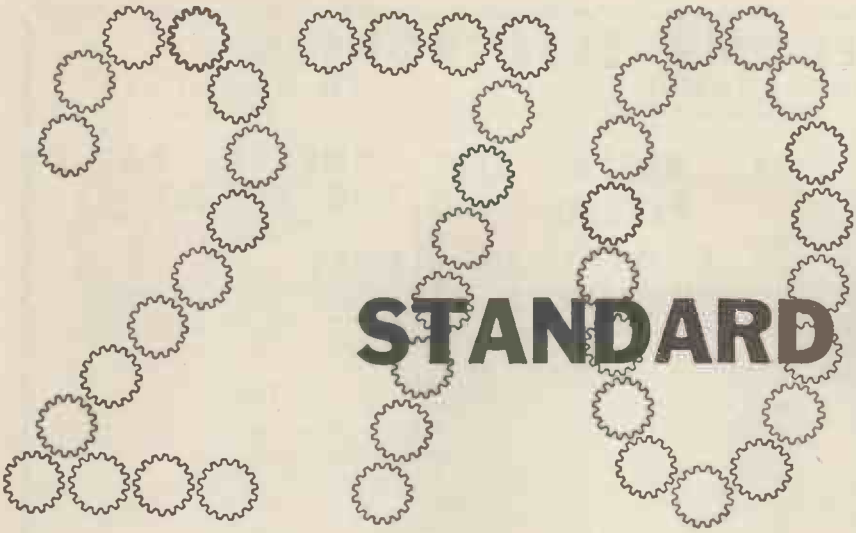
42s net BY POST 42s 11d 166 pp

from leading booksellers

published by

ILIFFE Books Ltd.

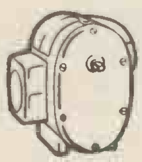
DORSET HOUSE, STAMFORD ST., LONDON, S.E.1



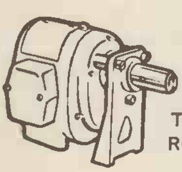
STANDARD SPEEDS

from 57 mins. per rev. to 2,700 revs. per min.

Type RQR

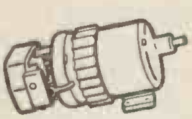


No other motors offer the wide range of speeds, torques and programme switching of the versatile Drayton RQ. Conforming to BSS 170/1939, it is suitable for continuous or intermittent running; reversing; and can also be supplied with or without internal limit and programme switches. Motors giving a shaft rotation of more than one revolution before switching operates, or with multi-position switching, are also available. Write now for your copy of Data Sheet No. 302.

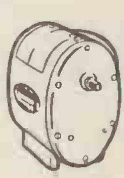


Type RQ 53

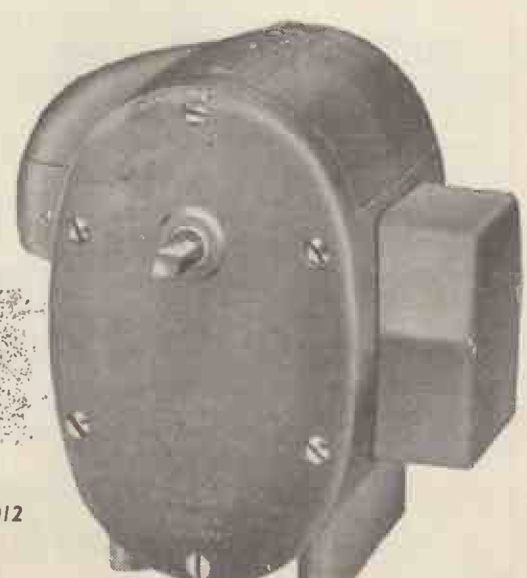
Type RQH



Type RQU



Type RQG



DRAYTON 'RQ' MOTORS

DRAYTON CONTROLS LIMITED
Bridge Works, West Drayton, Middx. *Phone: West Drayton 4012*

DR. 9A

WIRECOMP ELECTRONICS

378 HARROW ROAD, LONDON, W.9. TEL.: CUNNINGHAM 9530

Hours of business: 9 a.m. to 6 p.m. Open all day Saturday. Opposite Paddington General Hospital. Buses 18B & 36 pass the door.

TAPE RECORDERS

THE WALTER
BATTERY/MAINS
TAPE RECORDER

ORIGINAL PRICE 55 gns.
OUR PRICE
27 GNS.
Carr. & Ins. £1.

Transistorised, records anywhere—indoors or outdoors. Quality features include: Hi-Fi reproduction; 2 watts output; rev. counter; WALTER master control; mixing and superimposing facilities; 3 hours' recording on 5¾in. reels. Works off 200/250 A.C. or three Ever Ready PP9 batteries.

THE VERDIK
MODEL S44 4 TRACK

First class Tape Recorders using the famous Collaro transcription deck. 3-speed 1⅞-3¾-7½ IPS. Mic. and Radio inputs. 7 × 3¾in. internal speaker. Valve line-up ECC83, ECL82, EM84. Wow and Flutter 0.15% total at 7½ins./sec. Size width 15½in., depth 6½in., height 6½in., weight 26 lbs.

39 GNS. LIMITED STOCK ONLY Carr. & Ins. 21/-.

MODEL RA-11
FULLY TRANSISTORISED/PORTABLE

OUR PRICE **£13.10.0** P. & P. 3/6.

A fully transistorised precision built miniature tape recorder. Size 6 × 8½ × 2¾in., weight only 2½lb. Records and plays for over one hour on standard 3in. reel. (Twin track recording, 35 minutes per track at 3¾ I.P.S.). Simple operation. Attractive two-tone plastic and metal case. Complete with batteries, tape and accessories.

RECORDING TAPE
FAMOUS MAKE PVC BASE ON PLASTIC SPOOL

1,800ft. on 7in. spool 32/6. 1,200ft. on 7in. spool 21/-. 1,200ft. on 5¾in. spool 22/6. 850ft. on 5¾in. spool 16/6. P. & P. 1/6.

ENTHUSIASTS' BARGAINS!
KAPURA Mdl. U1 MULTI-METER

59/6 P. & P. 2/6.
Complete with test leads.

A must for the home constructor. Sensitivity: 1,000 ohms per volt A.C. and D.C. Ranges: (A.C./D.C.) 0 10-50-250-500-1,000 v. D.C. current 0-100 -500 m/a. fused at 0-10 v. range). Resistance 1-2,000 ohms (centre 24 ohms), 100-200,000 ohms (centre 2.4 k.). Size 5×3×2½in.

EP. 10K MULTI-METER
Complete with test leads, battery and instructions

£5.19.6 P. & P. 3/6.

10,000 O.P.V. on A.C. and D.C.
D.C. Volts: 0-6; 0-30; 0-120; 0-600: 0-1200.
A.C. Volts: 0-6; 0-30; 0-120; 0-600; 0-1200.
D.C. Current: 0-120A; 0-12M; 0-300M.
Resistance: 0-20K: 0-3 meg.
Decibels: —20 to —63 in five scales.
Capacity: 50 F to .01 F and .001 F to .15 F.
Output Ranges: 0-6; 0-30; 0-120; 0-600; 0-1200.
Size: 4½ × 3¼ × 1in.

THIS MONTH'S SPOT BARGAIN!

THE WIRECOMP 'JUNIOR 5'
TRANSISTOR POCKET RADIO KIT

An easy "first step" set for the young constructor. This miniature marvel with the BIG performance covers medium and long wavebands—has an internal Ferrite rod aerial—5 transistors and 1 diode — 200 milliwatt push pull output — 2½in. speaker. Supplied in 4¾ × 3½ × 1½in. unbreakable plastic case with carrying handle. Complete with full instructions. All parts sold separately.

THIS MONTH'S PRICE **£2.19.6** P. & P. 1/6

THE LATEST TRANSISTOR RADIO KITS
THE "SONIC SIXTY"

6 Mullard transistors, 1 diode, internal ferrite rod aerial, 7 × 4 high quality speaker, printed circuit, 500 MW, push pull output. MW and LW calibrated direct drive assembly. Highly polished handsome walnut cabinet.

£9.15.0 Complete kit P. & P. 4/6.
All parts sold separately. Inst. Book 2/6.

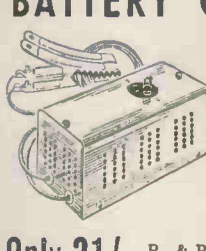
3 TRANSISTOR POCKET RADIO

May be built in one evening. Uses miniature speaker, ferrite rod aerial and 2 germanium diodes. Covers medium and long wavebands. Complete with instructions and al components ONLY **28/6** All parts sold separately. (batteries 1/3 extra). P. & P. 2/-.

IDEAL FOR THE TRANSISTOR RADIO HOME CONSTRUCTOR
PORTABLE MAINS SOLDERING IRON

30 watt. Designed for lightweight applications. High stable heat characteristics assure long life and safety in use. Complete with vinyl bag, Mains lead and plug. **18/9** P. & P. 1/3.

NOW! WIRECOMP'S SUPER VALUE BATTERY CHARGER



OVERNIGHT CHARGING ENSURES INSTANT WINTER STARTING

6 and 12 volts charging at 2 amps. A.C. mains 200-250 v. with mains fuse, in sturdy metal case 6in. × 3in. × 3in. with silver/grey hammered finish. Complete with leads and battery clips.

Only 21/- P. & P. 3/-.

COMPLETE RADIO

THE LEECO
6 TRANSISTOR POCKET PORTABLE

£9.19.6 P. & P. 2/-

Beautifully designed and precision built. Uses six high grade transistors and one diode. Frequency range 535 kc/s.-1605 kc/s. Built-in 2½in. P.M. speaker. Dimensions 1⅛ × 2⅞ × 4½in. Weight 7 oz. Complete in presentation box with carrying case and earphone.

V.H.F./A.M. RADIO

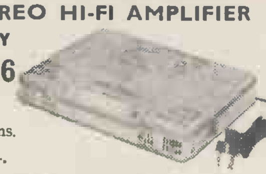
FOR ONLY **£12.12.0** P. & P. 5/-.

Brand new, in superb walnut cabinet (size 19 × 8½ × 14in.). Covering 80-100 Mc/s. 16-49 M., 200-500 M. and 1,200-2,000 M. Mains trans. 200-250 v with 3 tappings. Ferrite rod aerials for A.N. Gram and ext. speaker positions. Fully guaranteed.

AMPLIFIERS

THE TELEFUNKEN
STEREO HI-FI AMPLIFIER

NOW ONLY
£9.19.6



Original Price 16 gns.
P. & P. 5/-.

The perfect Stereo amplifier designed to unequalled specifications:
Power output 5 watts (2½ watts per channel).
Frequency response 30 c/s to 40 kc/s. 2dB., 45 c/s to 30 kc/s. ½dB.
Suitable for all normal inputs from tape recorders, pickups, microphones, radio.
Power requirements 110, 125, 150, 220, 240 volts A.C.
Piano key selecting. Preselected tone control.
Size 12 × 9 × 2in. Finished in grey/green hammered enamel.

THE ONLY REMAINING STOCKIST!
AVANTIC AMPLIFIERS
SPA11 STEREO AMPLIFIER AND PRE-AMPLIFIER

Twin 10 watts output, 3-dimensional Monaural reproduction by combining both channels, 3 inputs for each channel. Size 14½in. wide, 4in. high, 8⅞in. deep. LIST PRICE £29/8/-.

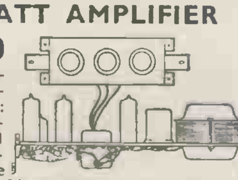
19 GNS. CARR. & INS. 7/6.

PL6/21 10 WATTS MONAURAL AMPLIFIER AND COMBINED PRE-AMPLIFIER CONTROL UNIT. 5 inputs. Size 14½in. wide, 9in. deep, 4in. high.

19 GNS. LIST PRICE £29/8/-. CARR. & INS. 7/6.

8 WATT AMPLIFIER

£4.15.0



Made by well-known manufacturer. Spec.: 2 EL84, 12-AX7 and EZ81 Push-pull output. Separate Bass and Treble controls on panel with extended lead. P. & P. 3/6.

3/4 WATT AMPLIFIER
SUITABLE FOR STEREO ADAPTOR

Spec.: 2 valves EF80 and EL84. Switch control for Stereo and Mono. Suitable for use with Acos GC/71, GP/73 and Garrard GC/10. Complete with wiring diagram.

£2.19.6 P. & P. 2/6.

TRANSISTORS

EDISWAN
XC121, 8/9. XB113, 8/9.

G.E.C.
114, 6/9. 874, 9/9. 2—873, 8/9.

MULLARD
OC81D, 6/9. OC44, 9/9. 2—OC81, 6/9. 2—OC45, 8/9. Diode, 1/9.

Complete set, 47/6. Post FREE.

DE-LUXE TAPE RECORDER CABINET

only **29/9**

Beautifully made Tape Recorder Cabinet. Size: approx. 13½ x 10½ x 7½in. Covered in two-tone coloured rexine cloth. Stylish design. Easily adapted to Record Player Cabinet. P. & P. 4/6.

Salvage VALVES Guaranteed

9d Each — 7/6 Dozen
4D1, 6AL5, 6D1, 6D2, 9D2, 12Y4, 15D2, 73, 210VPT, 7193, C2C, CV66, D1, P61, D152, EA50, EB91, E.50, HL42DD, T41, PM202, SP61, VR35, VR51, VR107.

2/9 Each — 30/- Dozen
6L18, 6SN7, 6U4GT, 10D1, 10F1, 874, 10P13, 12AT7, 12AU7, 20D1, 20P3, B36, DH76, ECC31, ECC34, ECC81, ECC82, EF80, EF92, EL32, EY51, KT36, KTW61, L63, N18, N37, PL33, TH233, U22, U31, U35, U151, U281, UAF42, UB41, UCH42, UF41, UF42, W77, Z152.

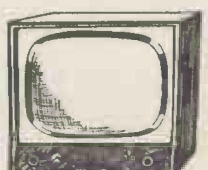
1/9 Each — 17/6 Dozen
6AM6, 6AT6, 6F1, 6F12, 6F13, 6F14, 6F15, 6K7, 6P25, 6P28, 7C5, 7Y4, 8D3, 12SJ7, 12SK7, D77, DH77, EB41, EF91, N142, PEN 46, W148, Z77.

5/9 Each — 60/- Dozen
6AB8, 6F6, 6Q7, 6V6, 7AN7, 9BW6, 12AX7, 12K7, 12Q7, 15A6, 20F2, 20F5, 20L1, 20P1, 21A6, 30C1, 30FL1, 30L1, 30L2, 30PL1, 30PL13, 1625, EBC33, ECC83, ECF80, EL33, EL38, EL41, EL42, EY85, KT33c, KT63, LN152, LZ319, N152, N309, N339, PL81, PL82, PL83, PY80, PY81, PY82, UBF80, U152.

POST ON 1—7d. POST ON 6—1/6d. POST ON 12—2/6d.

17 in. COMPLETE TELEVISIONS 14 in.
£11.10.0 Ex-RENTAL SETS £7.10.0

Excellent table models. ITA/BBC. Famous manufacturer. 12 months' guarantee. Terms available. Personal collection advised or delivery rate by arrangement up to 50 miles, or despatched in 3 parcels for easy assembly, 25/-.

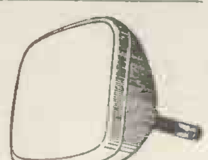


ITA/BBC. As 17". Ideal for caravans, chalets, weekend bungalows, etc. Personal collection advised. Special delivery rate by arrangement up to 50 miles, or despatched in 3 parcels for easy assembly 20/-.

REPLACEMENT REBUILT

21 in. 99/6
17 in. 90/-
15, 14, 12 in. 70/-

Ins. & Carr. 15/6. 12 months' guarantee.



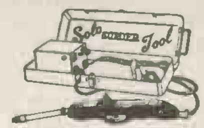
£1 extra without old bowl, refundable if same received within 14 days.

14KP4 14 in. T.V. TUBES 35/- 36/24

Due to purchase of Rental replacement stocks. Carr. 5/-.

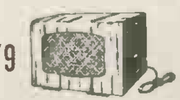
SOLO SOLDERING TOOL

only **12/6**



110 v., 6 v. or 12 v. (special) adaptor for 200/250 v., 10/- (extra). Automatic solder feed including reel solder and spare parts. It is a tool for electronic soldering or car wiring. Revolutionary in design. Cannot burn. In light metal case with full instructions for use. Post 3/6.

EXTENSION SPEAKERS 19/9



8in. P.M. Speakers fitted into polished cabinets. Complete with switch and flex. P. & P. 3/9.

DUKE & CO.
(LONDON) LTD.,
621/3 Romford Road,
Manor Park, E.12.
ILF 6001/3

Send for a FREE CATALOGUE

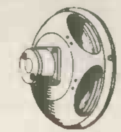
DE LUXE RECORDER CABINET 79/6

Beautifully styled rexine covered cabinet in Red or Beige. Size 14½ x 13 x 9½in. Storage comp. in lid for tapes and mike. Easily adapted to Record Player Cabinet. Ins., Carr. 4/6.

SCOTCH BOY TAPES
5¾in. 19/9

Limited quantity of these 5¾in. tapes. Post Free.

SPEAKERS
8/9 EACH



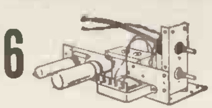
5, 6, 8 and 7 x 4in. Ex-manufacturer's salvage. Money back guarantee. P. & P. 2/9.

ELLIPTICAL SPEAKERS. New, slot type. 8 x 3 and 7 x 4in. P. & P. 2/9. **15/9**

MINIATURE SPEAKERS. 2½ and 3in. P. & P. 1/-. **16/9**

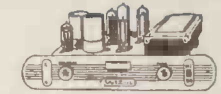
RECORD PLAYER AMPLIFIER

79/6



12 months' guarantee. MK. D.2
Latest design incorporating negative feedback, giving 4 watts undistorted output. Valves: ECL82, and metal rectifier. Tone and volume control panel on flying leads. P. & P. 3/6.

TAPE RECORDER AMPLIFIER £7.19.6



Compact, well designed 5 valve amplifier. Output 3.5 W. Input for Microphone, Radio and Gram. Size 8½ x 3 x 4¾in. Ins., carr. 4/6. 12 months' guarantee. Terms available. Extras: Dial plate, including sockets and superimpose switch, 3/6. Knobs 2/6.

TAPE RECORDER AMPLIFIER £9.15.6

By famous manufacturer. Superb 4-valve amplifier. Two controls and superimpose switch. Sockets for Mike and Gram. Size 11 x 4 x 6in. Ins., Carr. 4/6. Drawings FREE with Order.

RECORD PLAYER CABINET
"PETITE"
29/9

P.L.5 Portable cabinet in smart two-tone colours. Size:— 12 x 10½ x 6in. Light and easy to carry. Insurance and carriage 4/6.

RECORD PLAYER CABINET 99/6

Portable Show Model in two-tone colours. Suitable for Stereo with Extension Speaker secured in lid. Size: 18 x 14 x 8½in. Ins. & Carr. 5/6.

TESTMETERS FOR EVERY POCKET AND PURPOSE

1,000 OHMS PER VOLT

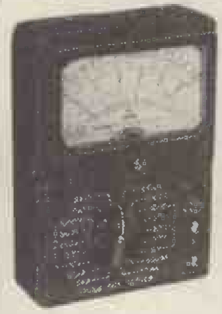
MODEL U.1. Reads A.C. and D.C. volts up to 1,000; D.C. current to 500 mA; Resistance to 200 K. Basic movement 300 μA. Easily read open scale. Size 5½ × 3½ × 2¼in.

£2/19/6.

2,000 OHMS PER VOLT

MODEL TP-10. Reads A.C. and D.C. volts up to 1,000; D.C. current to 500 mA. Resistance to 1 Meg.; Capacitance to 1 μF; Decibels from −20 to +36; Output jack for Audio measurements. Size 3½ × 5 × 1¾in.

£3/19/6.



20,000 OHMS PER VOLT

MODEL TP-5S. Reads voltages up to 1,000, D.C. at 20,000 ohms per volt, and A.C. at 10,000 o.p.v.; D.C. current to 500 mA; Resistance to 10 Megs; Capacitance to 0.1 μF; Decibels from −20 to +36. Size 3½ × 5½ × 1¾in.

£5/19/6.

30,000 OHMS PER VOLT

MODEL 500. Reads voltages up to 1,000, D.C. at 30,000 ohms per volt, and A.C. at 15,000 o.p.v.; D.C. current to 12 amps; Resistance to 60 Megs; Decibels from −20 to +56; Incorporates internal buzzer for audible warning of direct shorts and blocking condenser for AF output measurements. Size 3 7/8 × 6 3/8 × 2¼in. **£8/19/6.**

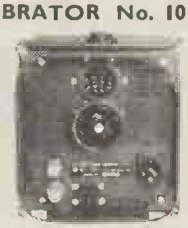
20,000 OHMS PER VOLT

MODEL 8 AVOMETER. Ex-Air Ministry but thoroughly overhauled and in perfect order. Too well known to repeat specification which will be sent on request. Model 7 AVOMETERS also available, appearance as above.

Model 8 .... £17 10 0
Model 7 .... £12 10 0

All instruments supplied with test leads and prods, instructions, and internal batteries, and are fully guaranteed. Further details sent on request.

CRYSTAL CALIBRATOR No. 10



A superb Crystal Controlled Wavemeter. Has directly calibrated dial for nominal coverage of 1.5-10.0 Mc/s. but may actually be used from 500 kc/s up to 30 Mc/s. Complete with 500 kc/s. Crystal, 2 valves type 1T4, 1 of 1R5 and 1 of CV286 (Neon Stabiliser), and Instruction Book. Size 7in. × 7½in. × 4in., weight 5 lbs. Used but in first-class condition. ONLY **£2/19/6.** Carr. 3/6.

PCR COMMUNICATIONS RECEIVERS

Manufactured by Pye & Philips. One of the Army's most versatile and sensitive sets. RF Stage and 2 of I.F., using 6 British I.O. valves. Large 180 Degrees Illuminated and Calibrated Dial, Flywheel Tuning with locking device, Aerial Trimmer, Tone and Volume controls, Band Switch, front panel jacks for speaker or phones. In black metal case. Size 17in. L. × 8in. H. × 10in. D. Model PCR covers 6-18 Mc/s., 200-550 metres and 850-2,000 metres, and has internal 5in. speaker. REME reconditioned AS NEW **£9/19/6**, OR used, but very good condition, **£7/19/6.**

Model PCR 2 has similar Long and Medium Waveband coverage, Short wave 6-18 Mc/s, but no speaker. Used good condition sets only available, **£6/19/6.**

Every receiver aerial tested before despatch. Add 10/6 carriage all models.

Designed to operate from bulky EXTERNAL power supply, but any set can be fitted with BRAND NEW COMPONENTS INTERNAL PACK for 200/250 v. A.C. at an extra cost of £2.

W 1191A WAVEMETER. Crystal controlled heterodyne frequency meter covering 100 kc/s. to 20 Mc/s. in 8 switched bands and is virtually the British BC221. Power requirements 2 v. L.T. and 40-60 volts H.T. Complete with Calibration Book, Crystal, Operating Valves and full set of spares. Used but in perfect order. ONLY £5 (carriage 15/-).

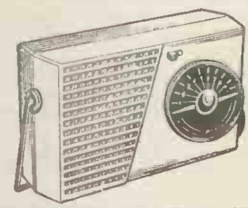
PANEL METERS

F.S.D.	SIZE AND TYPE			PRICE
25 microamps	D.C.	2½in. Proj.	circular	59/6
50 microamps	D.C.	2½in. Flush	circular	59/6
50 microamps	D.C.	3½in. Flush	circular	80/-
1 milliamp	D.C.	2½in. Flush	circular	30/-
200 milliamps	D.C.	2½in. Flush	circular	12/6
20 amps	D.C.	2in. Proj.	circular	7/6
40 amps	D.C.	2in. Proj.	circular	7/6
300 volts	A.C.	2½in. Flush	circular	25/-
500 volts	A.C.	2½in. Flush	circular	25/-

BC 221 FREQUENCY METERS

Coverage 125 kc/s to 20 Mc/s. and known the world over as a first class standard. Complete with original calibration book, crystal, valves, and instruction book. Used, but in very good condition. ONLY £16. Illustrated descriptive leaflet available on request.

"P.W." 6 TRANSISTOR PERSONAL RECEIVER



Designed by the technical staff of *Practical Wireless*, easy to build, using printed circuit, and 1st Grade Matched Transistors and Diode. Full Medium and Long Wave coverage to internal speaker. All parts sold separately (new components only) enabling you to buy as required, and full detailed price list will be sent on request. Constructional details 1/6. TOTAL COST INCLUDING BATTERY AND CABINET, **£8/19/6.**

AMPLIFIER N24. As previously advertised. 4 valves, rack mounting, with internal A.C. mains pack for nominal 110/230 volts. Output to 600 ohms line, provision for 600 ohms or High Impedance Input. A first-class job. ONLY **89/6** (carr. 10/6).

BC 342 RECEIVERS. A few only of these famous American sets covering 1.15-18.0 Mc/s., in six bands. Internal 115 v. A.C. Mains pack. A super receiver in first-class condition and perfect working order. ONLY **£20** (carriage 15/-).

UNISELECTOR. 25 way 8 bank 15 ohm coil for 24 volt operation, unused, ex-brand new equipment, only **62/6.**

SPRAGUE CONDENSERS. Metal cased wire ends. New, .01 mfd. 1,000 v. and .1 mfd., 500 v. **7/6** per dozen. Special quotes for quantities.

"GOOD COMPANION" 6 TRANSISTOR COMBINED PORTABLE AND CAR RADIO

The finest Transistor Portable ever designed for the constructor.

- ★ 750 mW Output.
- ★ 6 Transistors plus 2 Diodes.
- ★ Covers 540-1,640 Kc/s (180-550 metres) and 160-285 Kc/s (1,050-1,880 metres).
- ★ Latest printed circuit technique.
- ★ Pre-aligned I.F.T.s.
- ★ Very fine tuning with calibrated dial.
- ★ Internal high gain aerial with car aerial socket.
- ★ Brilliantly styled 2 colour cabinet size 11in. × 8in. × 3in.

Technical knowledge is not required to build this set, the easy-to-follow illustrated data which can be purchased for 3/6 making construction simplicity itself.

TOTAL COST INCLUDING CABINET AND DATA (Battery 3/6 extra.) **£9.19.6**

All parts sold separately, detailed list on request.

Cash with order please, and print name and address clearly
PLEASE ADD POSTAGE OR CARRIAGE COSTS ON *ALL* ITEMS

HARRIS ELECTRONICS
(LONDON) LTD.

Radio Corner, 138 Gray's Inn Road, London, W.C.1. Phone: TERMINUS 7937

Open until 1 p.m. Saturdays. We are 2 mins. from High Holborn (Chancery Lane Station) and 5 mins. by bus from King's Cross.

G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

UNIVERSAL AVOMETERS

All models offered are in first-class condition throughout, fully tested and checked, guaranteed perfect and are supplied with instructions, leads and batteries.

MODEL "D" 34 ranges............£8 : 19 : 6

MODEL "7" 50 ranges............£12

MODEL "8" 20,000Ω/volt.........16 GNS.

Regd. post 5/- extra on all models.

P.C.R. COMMUNICATION RECEIVERS

6 VALVES. Frequency coverage on three bands:—850–2000M. 190 550M. 6 18M:/s.
Super slow motion drive. Aerial trimmer. Volume and tone controls. Output for 3 ohm speaker or phones.

Available as follows:—
AS NEW WITH BUILT-IN SPEAKER, £7/19/6.
USED BUT IN FIRST-CLASS CONDITION WITH SPEAKER, £6/19/6.
Carriage 10/- extra on all models.

All above models can be supplied with a built-in power unit for operation on 200/250 volt A.C. at an additional cost of 39/6 or alternatively the original plug-in A.C. mains power units are available at 35/- extra.

BUILD THIS HIGH GRADE SIX TRANSISTOR RADIO!!

USING OUR MATCHED COMPONENTS

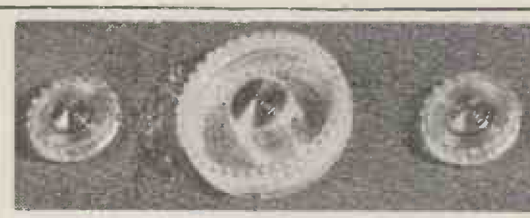
★ PRINTED CIRCUIT, READY DRILLED
★ MW/LW FERRITE AERIAL
★ OSC./I.F. TRANSFORMERS
★ DRIVER & OUTPUT TRANSFORMERS
— 500 mW OUTPUT ! —

BASIC COMPONENTS AND PRINTED CIRCUIT, AS SHOWN BELOW **55/-** Post 2/-
WITH FULL PARTS LIST OF COMPLETE RECEIVER AND DETAILED ASSEMBLY INSTRUCTIONS.

CIRCUIT, LAYOUT & PARTS LIST (SEPARATE) 2/6

LIST — TRANSISTOR COMPONENTS

LIST		
35/37.	Set of 4 miniature transistor coils 9/16in. diam. ROUND. 450/475 Kc. Q160	23/-
39.	Miniature Driver Transformer, ⅞in. x ⅞in., with clamp. Ratio 3.6/1 + 1, for single-ended push-pull	10/3
38/40.	Pair miniature Driver and O/P transformers 500 mW. ⅞in. x ⅞in. With clamps ... pair	18/-
30.	Ferrite aerial MW/LW, with clips. 7in. x ⅜in. for standard sets	9/3
31.	Ferrite aerial MW/LW with clips. 4½in. x ⅜in. for personal sets	8/-



A PROFESSIONAL FINISH FOR YOUR SET!

Set of high-lustre clear plastic knobs, push-on type, suitable for any transistor or valve radio set. Attractive red centre discs

LIST		
47/48.	A. Three knobs, as illustrated, for direct drive tuning condenser	7/6
46/48.	B. Three knobs, as illustrated, with extra hair line cursor dial for S.M.	8/6
49.	C. Metal tuning dial. Dia.: 2½in. printed M.W. and L.W. Station names, and wavelengths, red and black on lustre gilt background. 2-hole fixing	2/6

Knob sets A and B available with gold lustre centres at 1/- extra per set.

SUNDRY MINIATURE COMPONENTS

51.	Case handle clip, red plastic, to suit ¾in. wide flexible straps, 4BA x ½in. fixing ... pair	2/9
52.	Speaker escutcheon, 5in. x 3½in. Suitable for fabric or metal mesh background, red plastic, to match above knobs	6/6
53.	Speaker escutcheon, 5in. x 3½in., beautifully finished gilt lustre plated, otherwise same as Type 52	7/9
54.	Tuning knob for personal sets 1½in. diam. x ½in., Serrated edge control, for standard ¼in. flatted spindle, printed 200-500 M. and Long	1/9
55.	Red plastic escutcheon for personal sets. 4½in. x 2⅞in., to suit knob 54 above	3/-
56.	Plastic brackets, rubber inserts, single screw fixing, for ⅜in. ferrite rod ... Set of 2	2/-
57.	Plastic brackets, rubber inserts, single screw fixing, for ¼in. ferrite rod ... Set of 2	2/-
58.	Plastic brackets, small type, for personal sets, for ¼in. ferrite rod ... Set of 2	1/3

Trade & export enquiries welcomed. Prompt despatch. *No C.O.D. under £2 in value. Please include some postage.*

NOMBREX LTD. SALES DEPT. W.8. ESTUARY HOUSE, CAMPERDOWN TERRACE, EXMOUTH, DEVON. PHONE 3515

G.W. SMITH & CO (RADIO) LIMITED

Phone GERRARD 8204/9155
Cables SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

SPECIAL OFFER!
EDISWAN MAZDA TRANSISTORS

Unrepeatable. Brand New. Guaranteed.

XA 103. I.F. Amp. 3/6
XA 104. F/C or L.O. 4/6
XB 112. L.F. Amp. 3/-
XC 141. Audio output. Class A or Class B. 11 watts at 80°C. 10/-
XA 121. Drift I.F. Amp. 6/6

The following are R.F. drift types with 30 mc/s. cut-off.

XA 123. R.F. mixer 7/6
XA 124. F/C or L.O. 7/6
XA 126. R.F. Amp. 7/6

Postage extra.

FAMOUS AMERICAN RECORDING TAPES.

First grade quality. Fitted with leader tapes and stop foil.

5in.	std. play	600ft.	13/-
5in.	long play	900ft.	16/6
5in.	double play	1200ft.	32/-
5¾in.	long play	1200ft.	19/6
5¾in.	double play	1800ft.	37/-
7in.	std. play	1200ft.	21/-
7in.	long play	1800ft.	28/6
7in.	double play	2400ft.	47/-

Postage extra.
Send for full list of tape bargains.

CRYSTAL CALIBRATORS NO. 10.

1.5 to 10 mc/s. Can actually be used from 500 kc/s. to 30 mc/s. Few only available. Brand new with instruction manual, 72/6 each. Postage 3/6.

G.E.C. SELECTEST MULTI-RANGE TESTMETERS

1,000 ohms per volt AC/DC. 37 ranges. Fitted with automatic overload cut-out. Supplied in perfect condition complete with batteries and leads. £9/19/6 each. Reg. post 5/- extra.

PARMEKO TABLE TOP TRANSFORMERS. Input 230 volts. Output 620/550/375/0/375/550/620 volts 250 ma. 2 x 5 volt 3 amp. New, boxed, 45/- ea. Carriage 5/-.

24-AMP. VARIAC TRANSFORMERS. Input 230 volts. Variable output 185 to 250 volts 24 amps., £12/10/- each. Carriage 10/-.

RC.221 HETERODYNE FREQUENCY METERS. 125 kc/s. to 20 Mc/s. As new condition. Supplied complete with valves, crystal and calibration charts, £16 each. Carriage 7/6. Also available less charts, £9/10/- each.

PAINTON MINIATURE JONES PLUGS AND SOCKETS. 2 pin 2/6 pr., 4 pin 3/6 pr., 6 pin 4/- pr.; 8 pin 4/6 pr., 12 pin 5/6 pr., 18 pin 7/6 pr., 24 pin 8/6 pr., 33 pin 10/6 pr. Post extra.

SPARES KITS FOR CR.100 RECEIVERS. Contains 15 valves, condenser and resistor kits, pots, output transformer, etc. All new and boxed, 59/6 each. P/P 3/6.

COLLARO STUDIO TAPE TRANSCRIPTORS. Latest 1961 model. 3 speeds. 3 motors, digital counter, press button switching, etc. Supplied brand new, guaranteed, with instructions and spare 7in. spool. £10/10/- each. P/P 3/6.

BRAND NEW MEDRESCO HEARING AIDS. Supplied complete with earpiece, leads and battery pouch. Only 32/6 each. P/P 1/-. Batteries 5/- extra.

1,000 WATT MAINS ISOLATION TRANSFORMERS. 230-volt primary, 230-volt secondary. New, boxed, ex-Admiralty, £5 each. Carriage 10/-.

7.5 KVA. AUTO TRANSFORMERS. 115/230 volts. New, boxed, ex-U.S.A., £15 each. Carriage 10/-.

R.C.A. PLATE TRANSFORMERS. Primary 200/250 volts. Secondary 2,000/1,500/0/1,500/2,000 volts 500 ma. New, boxed, £6/10/- each. Carriage 10/-.

FIELD TELEPHONES TYPE F.

Ideal for all intercom. systems, house, office, building sites, etc. Generator bell ringing, 2 line connection. Supplied complete with batteries and wooden carrying case, fully tested, £4/19/6 pair. P/P 5/-.

R.C.A AR 88D RECEIVERS

This world-famous 14-valve receiver offered reconditioned, perfect working order and in superlative condition throughout. Frequency coverage on 6 bands 500 kc/s to 32 mc/s. Circuit incorporates variable selectivity with crystal filter, tone control, aerial trimmer, b.f.o., a.v.c., R.F. and A.F. gain controls, mechanical bandspread, etc. Output is for phones or speaker. Operation 115 or 230 volts A.C., £35 each. Carriage 30/-.

PORTABLE PRECISION VOLTMETERS. Brand new moving iron instruments housed in polished teak case with 8in. mirror scale. 2 ranges, A.C. or D.C. 0–160 v. and 0–320 v. Accuracy within 2%. £5/19/6 each. P/P 3/6.

MINE DETECTOR NO. 4A

Will detect ferrous and non-ferrous metals. Complete and as new in transit cases. Supplied fully tested with instructions. 39/6 each. Carriage 10/-. Batteries 8/- extra.

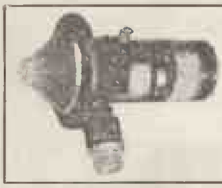
MARCONI TF-373 UNIVERSAL IMPEDANCE BRIDGES. Reconditioned to maker's spec., £35 each.

SOUND POWERED TELEPHONE HANDSETS. Brand new boxed, 15/- each. P/P 1/6.

BRAND NEW Boxed 100 MICROAMP METERS. Standard 2½in. flush panel mounting. Scale calibrated 0-100 microamps, 42/6 each. P/P 1/3.

NATIONAL H.R.O. RECEIVERS

Senior model, table mounting. Supplied with complete set of 9 coils covering 50 kc/s to 30 Mc/s. Special features include: S meter, variable selectivity, crystal, phasing. Output for phone or speaker. Supplied fully tested and aligned, superb condition throughout. Price 21 gns. Carriage 10/-. Power units available 59/6 each extra.



24 VOLT D.C. FUEL PUMPS.

Perfect condition, 15/6 ea. P/P 2/6.

AN/APR4 SEARCH RECEIVER. Covers 38 to 1,000 Mc/s. with 3 plug-in R.F. units, TN-16 TN-17, TN-18. Operation 115 v., 50–2,400 c.p.s. Reconditioned to maker's spc. £75 each.

SELENIUM L.T. METAL RECTIFIERS. Full wave bridge connected, all new and guaranteed.

12/18v.	1 amp.	4/3	24/36v.	4 amp.	18/6
12/18v.	2½ amp.	6/9	24/36v.	6 amp.	22/6
12/18v.	4 amp.	9/9	24/36v.	10 amp.	45/-
12/18v.	5 amp.	12/6	24/36v.	15 amp.	47/6
12/18v.	6 amp.	13/6	36/48v.	6 amp.	32/6
12/18v.	10 amp.	22/6	48/60v.	2 amp.	18/6
24/36v.	1 amp.	9/6	48/60v.	10 amp.	82/6

Please add postage.

L.T. TRANSFORMERS. All primaries tapped 200/250 volts. 3.5, 9 or 17 volts 1 amp., 9/9; ditto 2 amp., 14/3; ditto, 4 amp., 16/6. 9 or 17 volt 6 amp., 26/-. 3, 4, 5, 6, 8, 10, 12, 15, 18, 20, 24 or 30 volts 2 amp., 18/6. Ditto, 4 amp., 27/6. Please add postage.

AMERICAN ARB RECEIVERS

Frequency coverage on 4 bands 195 kc/s to 9.05 mc/s. Precision vernier drive. Valve line-up: 12SA7, 4-12SF7, 12A6 and 991. Operation 24 volts D.C. Supplied fully tested and checked, £6/19/6 each. Carriage 7/6.

1 OHM 14 AMP. SLIDER RHEOSTATS, 15/6 each. P/P 2/6.

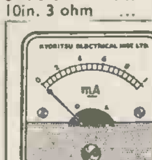
PHOTO VOLTAGE AMPLIFIERS

These special units contain a 1 microamp. Tinsley mirror galvanometer, twin selenium photo cell. 12 v. lamp, lamp housing and focusing unit. Brand new, boxed, £9/19/6 each. Carriage 7/6.

AR.88D SPARES. Complete wavechange switch assembly with screens, new, boxed, 17/6 each. P/P 2/6. 1st L.F. transformers, new, boxed, 3/6 each. P/P 9d.

SPEAKER BARGAINS
All brand new and guaranteed.

2½in. 35 ohm	17/6	12in. 3 ohm	29/6
2½in. 70 ohm	17/6	12in. 15 ohm	42/6
2½in. 3 ohm	17/6	7 x 4in. 3 ohm	15/6
3in. 3 ohm	17/6	8 x 2½in. 3 ohm	17/6
4½in. 3 ohm	15/6	8 x 6in. 3 ohm	17/6
5in. 3 ohm	15/6	10 x 2½in. 3 ohm	17/6
6½in. 3 ohm	17/6	10 x 6in. 3 ohm	27/6
8in. 3 ohm	19/6	13 x 8in. 3 ohm	47/6
10in. 3 ohm	27/6	Please add postage.	



MINIATURE PANEL METERS

Entirely new range of meters with clear plastic cases. 1¾in. square front Panel hole 1½in. dia. Brand new guaranteed, individually boxed. Available in the following ranges.

50 MICROAMPS 39/6
500 MICROAMPS 32/6
1 MILLIAMP 27/6
VU METER.
Range −20–0+3VU
0–100% (OVU)
at 600 ohms 42/6
"S" METER. Range "S" Units—
0-9 terminating
+10 and +30db
0–5 and 0–10 linear scale 35/-

PYE COMMUNICATION RECEIVERS

World coverage on these famous Communication Receivers. They are the simplest type to use yet bring in stations that will amaze you. The ideal domestic receiver for medium wave during the day with Amateur stations at night. **All have been converted to 230 v. A.C. mains and are guaranteed to work immediately.** Incorporate Wave Switch, Audio gain aerial trimmer, high and low tone control, station locking device, aerial and earth inputs, speaker output sockets, etc. Size 17 x 8 x 9½in. Black crackle finish front panel. On demonstration at 87, Tottenham Court Road.

P.C.R.3. Medium wave and 2-7 and 7-23 Mc/s. Less speaker. Few only. **Brand new** **£12.12.0**

P.C.R.2. Medium and long waves and 6-23 Mc/s. Used. Less speaker. Excellent condition **£8.19.6**

P.C.R. Medium and long waves and 6-18 Mc/s. With speaker. Excellent condition **£9.19.6**

Carriage 10/6 each type.

Order early to avoid disappointment!

19 SET Mk. III POWER SUPPLY. With 2 dynamotors. H.T.31. 12 v. input, 250 v. output at 125 mA. H.T.32. 12 v. input, 490 v. output at 60 mA.
DON'T MISS THIS BUY! **ONLY 25/-.** P. & P. 5/-.

Collapsible POCKET BINOCULARS

Precision All-purpose Pocket Binoculars—centre focus—aligned lenses—brilliant design—carry them everywhere for sport, theatre, etc.—open and close instantaneously—terrific value at ONLY 3/6.

CALLERS SPECIAL!!

RCA.AR88D RECEIVERS	£35 0 0
HRO.5T (four coils)	£22 0 0
BC.312 RECEIVER, 12 v. (1.2/18 Mc/s.)	£20 0 0
No. 11 OSCILLOSCOPES	£12 0 0

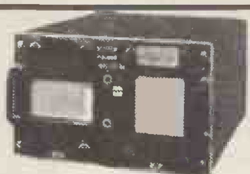
Complete HEADPHONE AND MICROPHONE ASSEMBLY. A must for every Constructor and "Ham," consists of moving coil, padded headphones and "press to talk" microphone. 10/-. P. & P. 3/6.

V.H.F. MOBILE 2FT. AERIAL and base with PYE connection, as used by Taxis, Police, etc., 7/6, post paid.

12ft. TAPERED WHIP AERIALS	10 0
INDOOR T.V. AERIALS	£1 5 0
CAR RADIO AERIALS	£1 4 0

FANTASTIC SCOPE BUY!

Double Tube Indicator



Complete in black crackle lightweight case, size 11 x 7 x 13½in. Contains 2 new 5FP7 tubes. All controls accessible on front, all connections at rear. 1000's already converted for TV monitoring. **OFFERED BRAND NEW AT ONLY 30/-. P. & P. 5/-. FEW REMAIN.**

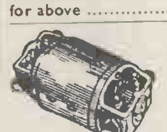
SUPER TRANSISTOR RADIOS *With Miniature Speaker*

Gives reception over the entire broadcast band. Each kit is supplied with all latest miniature parts including ★ two transistors ★ ferrite rod ★ speaker ★ coloured plastic case ★ step by step illustrated instructions. 4 x 3 x ¾in.
ONLY 27/6. P. & P. 1/6. **Battery 1/- ex.**

ONLY 60/- EACH P. & P. 4/-.
2 for £6 post free

PORTABLE TRANS/RECEIVER SETS Consisting of trans-receiver covering 7.4-9 Mc/s. range up to 10 miles, complete with 5 valves, headphones, microphone, junction box and 6ft. telescopic aerial. Operates from standard 120 v. and 3 v. dry batteries.

SPECIAL 135 v. H.T. BATTERIES. Ideal for above 12/6



HOOVER ROTARY TRANSFORMERS. 12 v. input, 500 v. output at 65 mA. or 6 v. input, 250 output at 75 mA. **ONLY** 10/6 each. P. & P. 2/-.

SPARE VALVE KIT

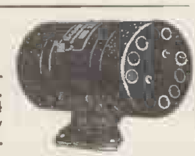
Here's a gift for all 38 and 18 set owners! Case containing 4 ARP12 and 1 ATP4 valves.
Only **10/-** P. & P. 2/6.

AERIAL VARIOMETERS These magnificent instruments will enable you to receive maximum signal strength on all Short Wave receivers. Precision calibrated control. 12/6. P. & P. 2/6.

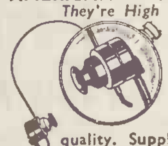
LEAD ACID ACCUMULATORS (unspillable), 2 volts 16 A.H. Ideal for 6 volts and 12 volts supply. Brand new, original cartons.

Size 4in. x 6in. x 2in. **5/6** each. P. & P. 1/6.
3 for 15/-. P. & P. 3/6.
6 for 27/6. P. & P. 5/-.

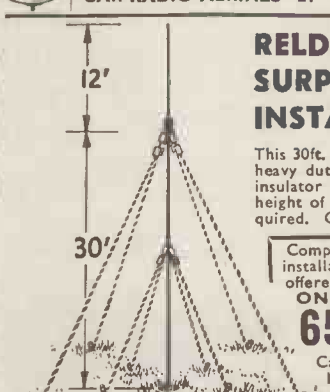
U.S.A. DYNAMOTORS manufactured by EICOR (as illus.). Input 12 v., output 400 v. at 180 mA. Size 7 x 4 x 4½in. Brand new 45/-. P. & P. 3/6.



AMERICAN LIGHTWEIGHT HEAD SET *They're High and Low Impedance!*



These H.S.30 phones are the smallest used by U.S. Air Force. 250Ω imp. using soft rubber miniature ear moulds for maximum music and voice reproduction of the finest quality. Supplied free is a small transformer unit with cord and plug which steps impedance up to 4,000Ω. **Only** 15/-. P. & P. 2/6.



RELDA OFFERS THE FINEST SURPLUS AERIAL MAST & INSTALLATION OF ALL TIME!

This 30ft. mast can be used as a complete aerial by fixing the heavy duty insulator at the base or just as a mast with the insulator at the top holding the 12ft. Aerial Whip giving a height of 42ft. The 12ft. whip can be used separately if required. Complete kit comprises:

Complete installation offered at **ONLY 65/-** Carr. 15/-.

- 1 Large Canvas Bag.
- 10 Rods 3ft. x ⅞in. dia.
- 1 Heavy Duty Insulator.
- 1 Large Base Stake.
- 1 Small Stake with Insulator.
- 1 Metal Carrying Case.
- 1 Hammer.
- 1 Small Canvas Bag.
- 1 Aerial Adaptor.
- 10 Ground Stakes.

Also all necessary Guy Ropes, Link Insulators, etc.

STOP PRESS!!

110v. PORTABLE 30 WATT SOLDERING IRONS
With collapsible handle, carrying bag, lead and mains plug. Very limited quantity offered once only at **10/-.** P. & P. 1/6.

TRANSISTOR SPECIAL!! 5K EDGEWISE MINIATURE VOLUME CONTROL with switch. As used in all miniature transistor radios. 4/6 EACH.

CHROME MINIATURE PLUGS AND SOCKETS. Size: plug barrel 1in., socket ½in. These will give your equipment that expert finish! 3/6 PER SET.

No. 7. MOVING COIL MICROPHONE INSERTS. Ultra sensitive. As used in many Govt. Microphones! Size 1¾in. dia., 1¼in. deep. Brand new and guaranteed. 6/6 EACH.

Mail Orders:
(DEPT. W.) 32a COPTIC STREET, LONDON, W.C.1

Relda Radio Ltd

Callers welcome at:
87 TOTTENHAM COURT ROAD, LONDON, W.1. MUS. 9606

Stereophonic Sound by Stern's

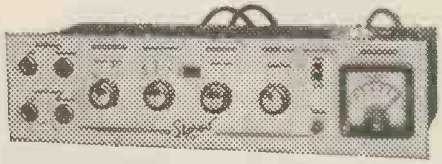
THE "STP-1" STEREO TAPE PRE-AMPLIFIER DESIGNED TO OPERATE WITH

TRUVOX Mk. VI TAPE DECK, incorporating the latest 4-TRACK MINIFLUX TAPE HEADS.

BRENELL Mk. V TAPE DECK, incorporating similar 4-TRACK MINIFLUX TAPE HEADS.

COLLARO "STUDIO" TAPE DECK, incorporating the latest 4-TRACK REUTER TAPE HEADS.

- PUSH PULL OSCILLATOR CIRCUIT.
- 4-SPEED EQUALISATION.
- FERROXCUBE OSCILLATOR TRANSFORMER.
- SENSITIVE METER FOR SIGNAL LEVEL.
- SEPARATE GAIN CONTROLS IN EACH CHANNEL.
- MULLARD VALVES INCORPORATED.



OVERALL SIZE CASE 13½ x 3in.

FRONT PANEL (choice of Black or White) 14 x 3½in.

PRICE

£26 . 0 . 0

Including separate Power Supply Unit.

Deposit £5/4/-, 12 months £1/18/2.

COMBINED PRICE SCHEDULE

THE "STP-1" PREAMPLIFIER IS OFFERED WITH TAPE DECKS AS FOLLOWS:

TRUVOX Mk. VI 4-TRACK MODEL.......................... **£45 . 0 . 0**
DEPOSIT £9, 12 months £3/6/-.

BRENELL Mk. V 4-TRACK MODEL.......................... **£65 . 0 . 0**
DEPOSIT £13, 12 months £4/15/4.

COLLARO "STUDIO" 4-TRACK MODEL.................. **£41 . 10 . 0**
DEPOSIT £8/6/-, 12 months £3/0/11.

THE MULLARD "10+10" STEREO AMPLIFIER (described opposite) with the "STP-1" PREAMPLIFIER and one of the TAPE DECKS provides a COMPLETE Stereophonic Installation. WE OFFER "10+10" AMPLIFIER, "STP-1" PREAMPLIFIER and the TRUVOX Mk. VI DECK.. **£65 . 0 . 0**
Deposit £13, 12 months £4/15/4.

As above with BRENELL Mk. V DECK .... **£85 . 0 . 0**
Deposit £17, 12 months £6/4/8.

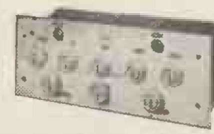
As above with COLLARO "STUDIO" DECK.............. **£61 . 10 . 0**
Deposit £12/6/-, 12 months £4/10/2.

PLEASE ENCLOSE S.A.E. WITH ALL ENQUIRIES

STEREOPHONIC RECORD PLAYER UNITS
MICROPHONES and TWIN LOUDSPEAKERS
ARE AVAILABLE FROM STOCK

STEREO DUAL CHANNEL PRE-AMPLIFIER

This model incorporates two 2-valve Pre-Amplifiers (described above) combined into a Single Unit enabling it to be used for both STEREOPHONIC and MONAURAL operation. It is designed primarily to operate with our range of MULLARD MAIN AMPLIFIERS but will also operate equally well with any make of Amplifiers requiring an input of 250 m/v.



Price: COMPLETE KIT OF PARTS **£12.10.0** Alternatively ASSEMBLED and TESTED **£15.0.0**
H.P. Terms on assembled unit: £3 Deposit and 12 months of £1/2/-.

MULLARD'S "10+10" STEREO POWER AMPLIFIER

A HIGH FIDELITY DESIGN BASED ON THE FAMOUS MULLARD "5-10." PROVIDES UP TO 10 WATTS (per channel). SUPERB REPRODUCTION. FREQUENCY RESPONSE FLAT TO WITHIN 3 db from 3 c/s. to 60 Kc/s. at 50 mW. TOTAL HARMONIC DISTORTION AT 10 WATTS......................... 0.1%

PRICE:
(a) ASSEMBLED COMPLETE AMPLIFIER, including CONTROL UNIT (as illustrated) **£21.0.0**
Deposit £4/4/-, 12 months of £1/10/10.
(b) A complete KIT of PARTS for.................................. **£18.10.0**

This amplifier is built to the very highest technical standards and presented strictly to MULLARD'S specification. It incorporates a complete Mullard valve line-up including two of the new triode-pentodes, type ECL86, in each channel. Two specially designed GILSON OUTPUT TRANSFORMERS with 20% taps are used in class AB push-pull output stages for ultra linear operation.

The matching CONTROL UNIT is designed to be either attached to the Amplifier (as illustrated) or it can be detached for separate mounting on a Cabinet panel. It provides inputs for CRYSTAL PICK-UPS, RADIO TUNING UNIT, and also for replaying from our STEREO TAPE PREAMPLIFIER (briefly mentioned below).

AS AUDIO SPECIALISTS WE CONFIDENTLY RECOMMEND THIS DESIGN it is a MUST to the serious-minded sound enthusiast.

We can also supply the assembled MAIN AMPLIFIER only (excludes control unit) for operation with our DUAL CHANNEL PREAMPLIFIER, this provides for a more versatile or elaborate installation and would be essential if a low output Magnetic Pick-up, such as the Decca, is to be used.

PRICE: (a) THE ASSEMBLED MAIN AMPLIFIER with the ASSEMBLED DUAL CHANNEL PREAMPLIFIER........ **£30.0.0**
Deposit £6, 12 months of £2/4/-.
(b) A complete KIT of PARTS for both Units for............ **£26.0.0**
When ordering specify loudspeaker impedance.

STEREO 'TWIN-THREE' AMPLIFIER with specially designed PORTABLE CASE

A most compact portable design consisting of TWIN CHANNEL AMPLIFIER based on the latest design by MULLARD LTD., incorporating top grade Output Transformers, and the new audio Triode-Pentode Valves Mullard ECL86. Separate Bass and Treble controls. Suitable for use with Crystal Pick Ups and capable of genuine high quality reproduction up to 3 watts per channel. An attractive and contemporary portable Case in two tone colours. The unique feature of the design is the loudspeaker mounting. Two 8 x 5in. p.m. elliptical loudspeakers are separately baffled and mounted in the lid, which is detachable, allowing for each speaker to be individually positioned in any part of the listening area.

We offer a very versatile stereo arrangement tested and guaranteed which can be assembled in the minimum of time, at a comparatively Very Low Cost.

PRICE for the ASSEMBLED AMPLIFIER. Two 8in. x 5in. ROLA SPEAKERS and PORTABLE CASE £14 0 0
Deposit £2/16/-, 12 months of £1/0/6.

INDIVIDUAL UNITS available SEPARATELY . . .

ASSEMBLED AMPLIFIER supplied for..............................	£7 15 0
8in. x 5in. ROLA LOUDSPEAKERS (3 ohms), each	£1 1 0
PORTABLE CASE	£5 0 0

A CHOICE OF SINGLE RECORD PLAYERS and AUTOCHANGERS is available from Stock (send S.A.E. for details).

A BULK PURCHASE OF MARCONIPHONE TAPE RECORDING EQUIPMENT ENABLES US TO OFFER

THE MODEL MTR/1
PORTABLE TAPE RECORDER

(FOR ONLY **£25.0.0**
Carr. & Ins. 10/- extra)

Deposit £5, 12 months of £1/16/8.

The list price of the MTR/1 is £44/2/-. It is a 3 Speed Twin Track Recorder incorporating the latest Collaro "Studio" Tape Deck and operates at 1⅞, 3¾ and 7½ in./sec. speeds. It incorporates a "Pause" Control, a safety interlock device which ensures that a recorded tape cannot be accidentally erased and a low level output socket so that the output may be fed into an external high fidelity amplifier for monitoring purposes or for high quality reproduction on playback.

WE CAN ALSO SUPPLY

The MTR/1 AMPLIFIER & LOUDSPEAKER with the COLLARO "STUDIO" TAPE DECK

all assembled on a top board
TESTED AND READY FOR USE **£19.19.0**

Deposit £4, 12 months £1/9/4. (Carr. & Ins. 10/- extra)

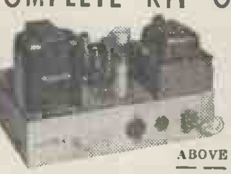
STERN RADIO LTD. DEPT. W. 109 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

Still by far the finest value

STERN'S MULLARD DESIGNS

COMPLETE KIT OF PARTS

Designed by MULLARD—presented by STERNS strictly to specification



MULLARD "5-10" MAIN AMPLIFIER

For use with the MULLARD 2-stage pre-amplifier with which an undistorted power output of up to 10 watts is obtained. We supply SPECIFIED COMPONENTS AND NEW MULLARD VALVES including PARMEKO MAINS TRANSFORMER and choice of the latest Ultra-linear PARMEKO or the PARTRIDGE Output Transformer.
Price: COMPLETE KIT (Parmeko O/put Trans.)............ **£10.0.0**
Alternatively we supply ASSEMBLED AND TESTED.... **£11.10.0**
ABOVE INCORPORATING PARTRIDGE OUTPUT TRANSFORMER £1/6/- extra.

MULLARD'S 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT

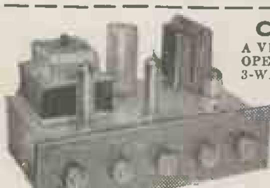
Employing two EF86 valves and designed to operate with the Mullard MAIN AMPLIFIER but also perfectly suitable for other makes.
Supplied strictly to MULLARD SPECIFICATION and incorporating
- Equalisation for the latest R.I.A.A. characteristics.
- Input for Crystal Pick-ups and variable reluctance magnetic types.
- Input (a) Direct from High Imp. Tape Head. (b) From a Tape Amplifier or Pre-Amplifier.
- Sensitive Microphone Channel.
- Wide range BASS and TREBLE Controls.

Price: COMPLETE KIT OF PARTS **£6.6.0** ASSEMBLED AND TESTED **£8.0.0**

COMPLETE MULLARD 5-10 AMPLIFIER

The popular and very successful complete "5-10" incorporating Control Unit providing up to 10 watts high quality reproduction.
Specified components and new MULLARD VALVES are supplied including PARMEKO MAINS TRANSFORMERS and choice of the latest PARMEKO or PARTRIDGE ULTRA Linear Output Transformers.
Price: COMPLETE KIT. Parmeko Transformer **£11.10.0**
Alternatively we supply ASSEMBLED AND TESTED.... **£13.10.0**
Hire Purchase (Assembled Amp. only). Deposit £2/14/-, 12 months at 19/10.
ABOVE incorporating PARTRIDGE OUTPUT TRANSFORMER £1/6 extra.

COMPLETE MULLARD 3-3



A VERY HIGH QUALITY AMPLIFIER DEVELOPED FROM THE VERY POPULAR 3-VALVE 3-WATT AMPLIFIER DESIGNED IN THE MULLARD LABORATORIES.

Price for COMPLETE KIT OF PARTS **£7.10.0**
(Plus 6/6 carriage and insurance.)
Alternatively supplied ASSEMBLED AND FULLY TESTED (Plus 6/6 carriage and insurance) **£8.19.6**

H.P. TERMS: Deposit £2 and 8 monthly payments of £1.
Our kit is complete to the MULLARD specification including supply of specified components, valves and PARMEKO OUTPUT TRANSFORMER. We also include switched inputs for 78 and L.P. records plus a Radio position. Extra power to drive a Radio Tuning Unit is also available.

COMPLETE STEREO AMPLIFIER

Meets the many requests for a low priced but good quality Stereophonic Amplifier. Output power is 4 watts. Inputs for Crystal Pick-ups and Radio Tuner.
KIT OF PARTS **£8.10.0** or ASSEMBLED **£10.10.0**

Mk. II "Fidelity" FM TUNING UNIT

An attractively presented Unit incorporating MULLARD PERMEABILITY TUNING HEART and corresponding Mullard valve line-up. Very suitable to operate with our Mullard Amplifiers.
FOR THE CONSTRUCTOR **£10.0.0** or ASSEMBLED **£14.5.0**

SPECIAL CASH ONLY OFFER ! !

The very attractive PORTABLE AMPLIFIER CASE together with a good quality GRAM AMPLIFIER and a matched P.M. SPEAKER. ALL FOR ONLY **£8.7.6** Plus 7/6 carr. and ins.). The Amplifier consists of a 2-stage design incorporating the 3 modern BVA valves and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Grey Colour Rexine—WE ALSO SUPPLY SEPARATELY:—

(a) The 2-stage (plus Rectifier) AMPLIFIER £4 2 6
(b) The PORTABLE CARRYING CASE £3 17 6
(c) 6½in. P.M. SPEAKER 18 9
(Carriage and insurance 4/- extra).

!! A BARGAIN !!

WE ARE ABLE TO OFFER BRAND NEW and FULLY GUARANTEED

TRUVOX Mk. VI TAPE DECKS

List Price £26.5.0 FOR **£18.18.0**
Deposit £3/16/- and 12 months £1/7/8. (Carr. & Ins. 7/6 extra).
A twin track model operating on 3¾ and 7½ in/sec. Speeds and incorporating Pause Control and Rev. Counter.

THE ABOVE INCORPORATING THE LATEST 4-TRACK MINIFLUX HEADS FOR STEREO OPERATION IS AVAILABLE FOR **£21.10.0** (Carr. and Ins. 7/6 extra).
Deposit £4/6/-, 12 months of £1/11/7.

"COMBINED ORDER" PRICE REDUCTIONS

(a) The COMPLETE KIT OF PARTS to build both the "5-10" Main Amplifier and the 2-stage Pre-Amplifier Control Unit **£15.15.0**
(b) The "5-10" and the 2-Stage Pre-Amplifier both Assembled and Tested **£18.13.0**
H.P. TERMS: Deposit £3/16/- and 12 months of £1/7/8.

RECORD PLAYERS

Many at REDUCED PRICES ! ! !
Send S.A.E. for ILLUSTRATED LEAFLET

THE COLLARO "JUNIOR" 4-speed single player with separate crystal pick-up..........	£3.15.0
B.S.R. MONARCH UA8 4-speed Mixer Autochanger with crystal pick-up	£6.19.6
THE NEW COLLARO "C60" 4-speed autochanger unit with Studio "O" pick-up	£7.19.6
The NEW COLLARO Model RP594 4-speed Single Record Player Studio Cartridge..............	£9.18.6
THE E.M.I. 4-speed Single Record Player, incorporating a high output crystal pick-up....	£6.9.6
B.S.R. MODEL UA14, a 4-speed Mixer Autochanger with crystal pick-up	£7.10.0
Available incorporating the B.S.R. STEREO Pick-up, plays L.P. and 78 records...........	£8.13.10
GARRARD RC210 4-speed Autochanger fitted with latest crystal pick-up	£10.10.0
The latest GARRARD TRANSCRIPTION MOTOR "301"	£22.7.3
The new GARRARD Model 4HF High Quality Single Record Player fitted with the latest T.P.A. 12 pick-up arm and G.C.8. crystal Cartridge ..	£19.8.7
GARRARD Model TA/Mk. II Single Record Player fitted with high output crystal Pick-up, detachable head..........................	£8.10.0

HIRE PURCHASE TERMS available on all units £8/19/6 and over. Carriage and insurance on each above 5/- extra.

MULLARD FOUR CHANNEL MIXING UNIT

Self powered Cathode follower output. Incorporates two inputs for CRYSTAL MICROPHONES, one for CRYSTAL PICK-UPS and a fourth for Radio or Tape.
KIT OF PARTS **£8.8.0**
ASSEMBLED AND TESTED **£10.0.0**
Terms: Deposit £2 and 12 months at 15/-. Model I.L. one microphone input matched for moving coil or ribbon mike £1/17/- extra.

STEREO "3-3" MAIN AMPLIFIER

Comprise two MULLARD 3-3 Main Amplifiers on one chassis. Operates with above MULLARD STEREO PRE-AMPLIFIER. Output power 6 watts. Inputs for Crystal Pick-up and Radio Tuner
KIT OF PARTS **£10.0.0** or ASSEMBLED **£11.15.0**

STERN'S INTER-COMM or BABY ALARM

A small versatile Unit employing the new MULLARD ECL86 valve and designed to provide two (or three) way conversation up to extreme distances. Operates from A.C. mains 200 to 250 volts and as in all our designs only new high-grade and guaranteed components are incorporated. PRICES—MASTER UNIT and ONE EXTENSION.
KIT OF PARTS **£6.17.6** ASSEMBLED AND TESTED **£8.0.0**
The equipment consists of a MASTER UNIT, size only 8½in. × 5½in. × 6in. and ONE EXTENSION (a second extension may be added at any time). The Master Unit incorporates switching and power supply and with the chassis completely isolated from the mains is operated in absolute safety. Attractively presented in cases covered in quality leatherette.

! ! HOME CONSTRUCTORS ! !

A RANGE OF "EASY TO ASSEMBLE" PREFABRICATED CABINETS
Designed by the W.B. "STENTORIAN" COMPANY for "Hi-Fi" Loudspeaker systems or to accommodate high quality equipment. The acoustically designed Bass Reflex Cabinets containing the very successful "Stentorian" speakers give really first class reproduction and are well recommended. Models are also available to accommodate high-quality Amplifiers, Pre-amplifiers, Tuning Units, Record Players, etc. All models are very easily assembled, in fact only a screwdriver is required.
Fully illustrated leaflets are available, including complete specifications of the various STENTORIAN LOUDSPEAKERS. Please send S.A.E.

"Hi-Fi" LOUDSPEAKERS

WE HAVE IN STOCK A COMPLETE RANGE BY
GOODMANS—WHARFEDALE—W.B.
ILLUSTRATED AND PRICED LEAFLETS ON REQUEST

SPECIAL OFFER OF TAPE

P.V.C. base on latest type Plastic Spools, New, boxed and guaranteed.

- 900ft. on 5 in. — 18/6
- 1,200ft. on 5¾in. — 21/-
- 225ft. on 3 in. — 5/9
- 1,200ft. on 7 in. — 21/-
- 1,800ft. on 7 in. — 32/6

H.P. TERMS ARE AVAILABLE ON ALL EQUIPMENT OVER £9.

STERN RADIO LTD. DEPT. W. 109 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

CRYSTAL CALIBRATOR No. 10
A crystal controlled heterodyne wavemeter covering 500 Kc/s. to 10 Mc/s. (Harmonics up to 30 Mc/s.). Requires 300 V. 15 mA. and 12 V. 0.3 a. D.C., but can be easily modified for 120 V. and 1.4 V. working. Size 7 x 7½ x 4in. Good condition, complete with valves, crystal, instruction manual and circuit. ONLY 59/6. Post 3/6. This item available complete as above. **BRAND NEW** and with spare set of valves. £4/10/-. Post 3/6.

CANADIAN CRYSTAL CALIBRATOR. Uses double crystal and multivibrator circuit to give "pips" at 1 Mc/s., 100 Kc/s. and 10 Kc/s. Incorporates Modulator. With book. 79/6, post 2/6.

MOVING COIL PHONES. Finest quality Canadian with chamois ear-muffs and leather-covered headband. With lead and jack plug. Noise excluding and supremely comfortable. 19/6. Post 1/6. **MATCHING TRANSFORMER** (for Hi impedance), i.e. for HRO, CR100, etc., with standard jack plug. 4/6.

SELENIUM BRIDGE RECTIFIERS. Funnel cooled. A.C. input 45 v. RMS. D.C. output 30 v. 10 amps. BRAND NEW. Boxed. 45/-, post 3/6.

CONSTANT VOLTAGE TRANSFORMERS. Input 190 to 260 volts, 50 c.p.s. Output 115 volts at 2 kVA. A pair of these will give a constant output of 230 volts at 4 kVA. Price £17/10/- each plus £1 carriage. Two for £35, carriage paid.

"C" CORE TRANSFORMERS. Pri. 230 v. 50 c.p.s. 510-0-510 at 275 mA. 375-0-375 at 83 mA. 6.3 v. at 9 A. 6.3 v. at 2A. (twice). 6.3 v. at 1A. (twice), 6.3 v. at 1.5A. 6.3 v. at 0.5A., 5 v. at 3A. 6¾ x 6 x 7½in. high. Weight 25 lb. Removed from equipment but in perfect condition. 32/6. Carr. 5/6.

6-VOLT VIBRATOR PACKS. HRO type, 180 v. D.C., 65 m/amps. BRAND NEW. 29/6, post 3/6. Type PU2, 200 v. D.C. 100 m/amps., with OZ4 rectifier. **BRAND NEW,** 25/- post FREE.

CHOKES. Parmeko 5 H, 200 m/amps., 6/6. AR-88 chokes, 15 H.. 90 m/amps., 8/6. Parmeko 8 H., 100 m/amps., 7/6. Postage any type, 1/6.

QQVO6—40 30/-

CO-AXIAL RELAYS (Switch Type 78A). Simultaneously switch two separate inputs to alternative outputs. 24 volt D.C. coils (can be hand operated). Size (approx.) 5 x 3 x 3in. 8/6. Post 1/6.

PRECISION RESISTORS. One Megohm 1% 1 watt wire wound, ex-U.S.A. BRAND NEW. 10/6 per dozen.

SANGAMO-WESTON VOLTMETERS
S61. Dual range 0–5 and 0–100 v. D.C. FSD 1 m/A. 3in. scale. Recent manufacture. Ideal for schools. Complete in super quality canvas carrying case, with test prods and leads. **BRAND NEW.** Boxed 27/6. Post 2/6.

PCR COMMUNICATION RECEIVERS
Made by Philips these compact 6-valve receivers incorporate an RF, two IF and a full size output stage for loudspeaker use. There is a phone jack for moving coil phones. All sets are in PERFECT WORKING ORDER and give very fine results on short waves.
Type PCR has a self contained speaker and covers 850 to 2,000, 200 to 550, and 16 to 50 metres.
BRAND NEW CONDITION £9 19 6
USED (GOOD CONDITION) £7 19 6
Type PCR 2 requires external speaker and covers 850 to 2,000, 200 to 550, and 50 to 13 metres.
USED (GOOD CONDITION) £6 19 6
CARRIAGE (any type) 10/6.
POWER SUPPLIES. The above receivers require 250 volts HT and 12 volts LT. We will supply any of the above receivers fitted with a **BRAND NEW INTERNAL POWER SUPPLY** for £2 extra. Fully guaranteed ready for use on A.C. mains.

RECEIVER R 206 MK 2
A super communication receiver with ALL the right features. 550 Kc/s to 30 Mc/s in 6 ranges. Turret tuning, osc. vernier control super slow motion tuning. Fantastic sensitivity. Complete with power supply and speaker and in first class condition. £25 plus carriage £2.

AR-88D RECEIVERS

One of the finest communications receivers ever made. Those we offer are in superlative condition, thoroughly checked and tested as regards calibration, alignment and sensitivity.
Personal shoppers can see for themselves that we have the finest receivers on the market. Those unable to choose their receiver personally can rely on our integrity to send them a first-class set for ONLY £35.

THE GOOD COMPANION
At last we are satisfied that a first-class transistor receiver with a performance at least equal to the best commercial receivers can be easily constructed. Come and hear one. The printed circuit technique, pre-aligned oscillator and I.F. transformers, American Philco R.F. transistors and Q.P.P. output of 750 mW from Mullard OC 82s ensure success. All the parts including 6 transistors, 2 diodes (all first grade), cabinet, 5in. speaker and comprehensive instructions cost £9/19/6. Uses PP9 battery, 3/6 extra.

THE POCKET FOUR
The new version consists of 4 transistors and 1 diode. Uses printed circuit and ferrite rod aerial. All the parts with comprehensive instructions (DLR 5 speaker) cost 52/6, post 2/6.

L, C & R BRIDGES
AVO Capacity 5 pfd. to 50 mFd. Resistance 5 ohms to 50 Megohms. Inductance can be measured against external standard. Balance is indicated on a meter which can be used as a valve voltmeter from 0.1 to 15 v. Leakage test and Power Factor scale. AC mains operation. Tested and guaranteed and in superlative condition. £9/10/- plus 5/- P. & P.

AVO UNIVERSAL IMPEDANCE BRIDGE No. 2. Resistance 0.5 ohms to 55 Megohm, Capacity 5 pFd to 55 mFd, inductance 50 millihenries to 550 Henry. Leakage at 25, 50, 150, 250, 350 and 450 volts. Power Factor. A.C. mains operation. These are in as new condition. £20 plus 7/6 carr.

WAYNE KERR B101 COMPONENT BRIDGES. 200-250 A.C. mains operation. 1 ohm to 500 megohms in 16 ranges; 1 pFd. to 500 mFd. in 16 ranges, 100 milli-H to 5000 Hen. in 8 ranges; Q factor of 0.5 to 300; power factor .015 to 1.0; Comparator scale plus/minus 10%; leakage from 1 to 1500 microamps. at test voltages of 6, 12, 25, 50, 150, 250, 350 and 450. Magic-eye null indicator. A first class precision bridge. Size 14 x 9 x 9in. Wt. 24 lb. In perfect working order and first class condition. £17/10/- plus 10/- carr.

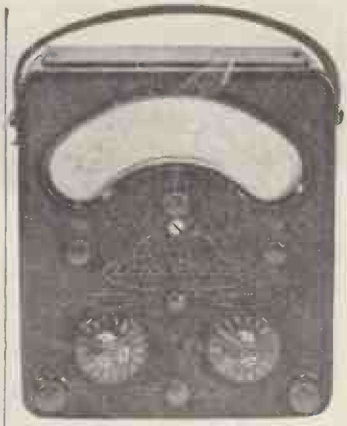
MINIATURE RELAYS (ALL BRAND NEW and BOXED)
G.E.C., sealed, wire ends, 670 2M2B H/D M1095......... 8/6
G.E.C., sealed, wire ends, 670Ω, 2 H/D makes, M1099... 15/-
G.E.C., sealed, wire ends, 5,000Ω 2 c/o., plat., M1052 17/6
Siemens High Speed 1K + 1KΩ, 1 c/over.................. 10/6

GIANT COMPONENT PARCEL
Contains 100 ½ and 1 watt resistors, 50 Hi Stab resistors, wire wound resistors, carbon and W/W pots, 100 capacitors (mica, paper, Sprague, bias, variable, etc.), valveholders, tag strips, metal rectifiers, sleeving, etc. All components are unused. GUARANTEED VALUE, 25/- plus 2/6 post.

UNISELECTORS
25 Position, 8 bank double wipers, 24-volt operation. Removed from brand new equipment, 62/6. Post 1/6.

CHARLES BRITAIN (Radio) LTD.

11 UPPER SAINT MARTIN'S LANE
LONDON, W.C.2. *TEMple Bar 0545*
Near Leicester Sq. Station. (Opposite Thorn House)
Shop hours: 9-6 p.m. (9-1 p.m. Thursdays). Open all day Saturday.



AVOMETER MODEL 7
AVO MODEL 7 £12-10-0
AVO MODEL 8 £17-10-0
All meters are in perfect working order and first-class condition. Complete with batteries, leads and instructions. Please add 5/- for registered post and packing.

BC221 FREQUENCY METER 125 kc/s. to 20 mc/s.
This crystal controlled heterodyne frequency meter is too well known to need further description. Those we offer are complete with correct individual calibration book and are carefully tested and guaranteed. Condition is very good. **£16/-/-**

RADIATION METERS
Portable close rate meter containing modern type rectangular 50 micro-amp meter CVX 494, electrometer valves, etc. BRAND NEW. In canvas carrying case. £3/19/6. Post 3/6.
PHILIPS RADIATION MONITOR. Type 1092C. A portable self-contained instrument for measuring radio-activity, uses the Mullard MX-115 Geiger counter tube, and is scaled 0–10 milli-Rontgens per hour. Supplied complete with carrying haversack. BRAND NEW. £17/10/-.

AIRCRAFT CINE CAMERA G45. Takes 25ft. of 16 mm. film. 16 frames per sec. Complete with 24 v. motor and lens. 29/6. Post 3/6.

GAUSS METERS
American type TS-15/AP. Made by Marion Electric for M.I.T. Radiation Lab. AS NEW. £7/10/-.

D.C./A.C. CONVERTERS. Input 12 v. D.C. Output 230 v. 50 c/s. A.C. at 135 watts. Fitted with 0–300 v. A.C. 2½in. meter and slider resistor for voltage adjustment. In stout wooden carrying case with lid. Perfect working order. £9/19/6. Carr. 10/6.
Input 24 v. D.C. Output 230 v. A.C. 50 c/s, 100 watts. In grey metal case. BRAND NEW. 92/6. Carr. 7/6.

MICROAMMETERS
R.C.A. 0-500 microamps. 2½in. circular flush panel mounting. Dials are engraved 0–15, 0–600 volts. As used in the American version of the No. 19 set. BRAND NEW. Boxed. 15/-.
American 0–100 microamps. 2½in. square flush panel mounting. BRAND NEW. Boxed. 42/6.

MULTIMETERS
1,000 Ω/Volt A.C. and D.C. volts 0–10, 50, 250, 500 and 1,000 D.C. current 0–10, 0–100 mA. Ohms 0–2,000, 0–200K. Bakelite case size 5¼ x 3⅛ x 2¼in. Fully guaranteed with test leads, prods and internal battery, **59/6**

CLYNE RADIO LTD.

18 TOTTENHAM COURT RD., LONDON, W.1

MUSeum 5929/0095
ALSO AT: 162 HOLLOWAY ROAD, LONDON, N.7.
NORth 6295/6/7
9 CAMBERWELL CHURCH ST., S.E.5.
RODney 2875
All post orders and correspondence to 162 HOLLOWAY RD., LONDON, N.7.

Open: Tottenham Court Rd., 9 a.m. to 6 p.m. Mon. to Fri., Sat. 1 p.m. Holloway Road and Camberwell, 9 a.m. to 6 p.m. daily. Thurs. 1 p.m., Sat. 5.30 p.m.

If not stated, please add postage on orders under £1. Cash with order or C.O.D. (charges extra).

Our advantageous H.P. and Credit Sale Terms are available on any single item over £. Your enquiries invited. Please print your name and address!!

NEW! NEW! THE "CLYMAX"

At last a 6-transistor pocket size superhet for Medium and Long Wave at a price you can afford. All required components

ONLY

£6.16.6

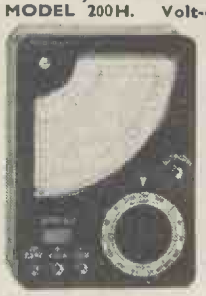
Plus 2/6 P. & P. Nothing more to buy!

- ★ Completely self contained. No external aerial or earth required.
- ★ Full medium wave coverage, plus switched Light programme on Long Wave.
- ★ Push pull output—250 milliwatts.
- ★ Matched set of latest type Mullard transistors.
- ★ Genuine 3in. P.M. Speaker.
- ★ High-Q Coils.
- ★ Ferrite rod aerial with high selectivity.
- ★ Size 5¼ x 3¼ x 1⅞in. Two tone cabinet.
- ★ Precision etched printed circuit with component references clearly marked.

Alignment service available. All parts available separately. Full assembly instructions and individually priced parts list, 2/-, post free.

OUTSTANDING METER IMPORT!
20,000 OHMS PER VOLT!!

MODEL 200H. Volt-ohm-Milliammeter



RANGES:
A.C. VOLTAGE: 10, 50, 100, 500 and 1,000 volts (10,000 ohms per volt).
D.C. VOLTAGE: 5-25, 50, 250, 500, and 2.5k. (20,000 ohms per volt).
D.C. CURRENT: 0-50 micro-amps., 0-2.5 m/a., 0-250 m/a.,
RESISTANCE: 0-6k. 0-6 meg. (300 ohm and 30 k. at centre scale).
CAPACITANCE: 10 pf. to .001 mfd., .001 mfd. to .1 mfd.
DECIBELS:—20 to +22 db.

Actual size 4½ x 3¼ x 1in.

A fully guaranteed pocket size meter, knife edge pointer, top quality, supplied complete with test prods and full operating instructions at **£6.19.6** ONLY Post free.

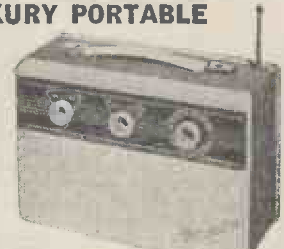
JUST ARRIVED!! Model TE10. *Identical in appearance and size with rotary type switch, but 10,000 ohms per volt.*
Ranges: D.C. Voltage: 0-6-30-120-600-1,200 volts (10,000 ohms per volt). A.C. voltage: 0-6-30-120-600-1,200 volts (10,000 ohms per volt). D.C. current: 0-120 microamp, 0-3-300mA Resistance: 0-30K, 0-3 Meg. (150 ohm and 15K at centre scale). Capacitance: 50pf to 0.01 mfd., 0.001 mfd. to 0.15 mfd. Decibels: —20 to +63 DB in 5 ranges. **PRICE £5.19.6.** Post free.
Bona-fide trade enquiries invited.
Optional extra, attractive carrying case 15/- only. Leaflet available.

RADIO JACK (25)

Covers local medium wave stations variably tuned. Compact self-contained unit requiring only connection to aerial (no power supplies required) for first-class reception when used in conjunction with your tape recorder or high gain amplifier. All necessary parts available at special inclusive price of 19/6. P. & P. 1/6.

"WAVEMASTER" 7-TRANSISTOR LUXURY PORTABLE
400 MILLIWATTS OUTPUT
NEW LOW PRICE £9.19.6 !!

To build yourself, Medium and Long waves—Push-Pull Superhet A.V.C. Perfect Car Radio reception. Size 10in. x 6¾in. x 4½in. at base tapering to 4in. at top.
Very attractive two-tone grey Vynide covered cabinet with black and gold printed escutcheon plate, cream and gold knobs, handle and cabinet fittings. ★ Weight—complete with long-life 7½-volt battery—4½lb. ★ Mullard high-grade transistors throughout. ★ High-Flux 7in. x 4in. Elliptical Speaker. ★ Slow motion tuning. ★ Co-axial socket at rear for direct connection to Car Radio Aerial. ★ Improved reception by use of seven-section plated telescopic aerial disappearing into Cabinet when closed, 34in. above Cabinet: when fully extended.



(43)

Construction simplified by Bakelite chassis board with the following components already mounted: I.F. Transformers (3). Oscillator Coil, Trimmer, Bank, Output Transformer, Interstage Transformer, Aerial Brackets and Earth Bar. SPECIAL INCLUSIVE PRICE for all required components, full assembly instructions—nothing more to buy—is £9/19/6 plus 3/6 P. & P. Alignment service available. Full assembly instructions and individually priced parts list, all of which are available separately, 2/6 post free.

THE "CITIZEN"

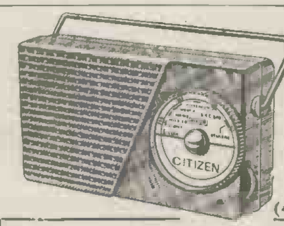
Introducing our new Sensitive 5-Stage (4 transistor plus diode) pocket transistor receiver—for full Medium Wave reception —with the following outstanding features:

- ★ Completely self-contained—no external aerial or earth required.
- ★ Genuine 2½in. High Flux P.M. Speaker.
- ★ Push-Pull output.
- ★ Genuine Mullard transistors.
- ★ Socket provided for personal listening.
- ★ Socket provided for connection to Car Aerial.
- ★ Volume Control with on/off switch—condenser tuning.
- ★ Easy assembly on pretagged circuit board.
- ★ Attractive Red polystyrene cabinet measures 5¼x3x1⅜in., chrome handle, attractive dial.

NEW LOW PRICE!

Suitable crystal deaf-aid type miniature ear-piece fitted with miniature jack plug at ONLY 7/6 extra., if required.
All parts available separately—itemised list and full assembly instructions sent for 1/6 post free.

Hear this amazing little receiver at any of our branches



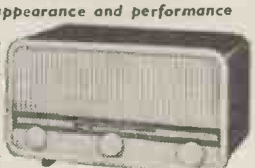
(48)

All required components including full instructions, solder, etc., and battery at special inclusive price of **ONLY 85/-**
Plus 2/6 p. & p.

Yes EIGHTY-FIVE SHILLINGS ONLY! Nothing more to spend.

SPECIAL OFFER! Owing to Manufacturers' reductions of transistor prices we are now able to offer our transistor sets at new low prices.

NEW! "POPULAR FOUR"
Improved appearance and performance



(47)

A new three-valve plus miniature contact cooled rectifier, mains T.R.F. Receiver is now available. New De Luxe Cabinet, polished walnut finish, cream trim, attractive horizontal dial (as illustrated). Quality 4in. P.M. speaker. Specially wound high gain supersensitive Denco coils. Medium and Long Wavebands. Excellent Continental reception! Overall dimensions: 12in. x 6in. x 5in. A.C. 200/250 v. Simple construction with guaranteed results. Easy to follow practical and theoretical diagrams supplied. All necessary components down to the last nut and bolt, are offered at a **SPECIAL INCLUSIVE PRICE OF £5/5/-** plus 3/6 p. & p. Instruction book available separately 1/6, post free. ALL PARTS AVAILABLE SEPARATELY.

HI-FI ENTHUSIASTS!

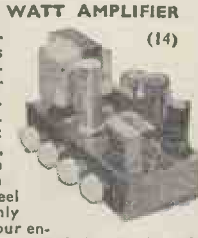
GRUNDIG TM 20, special version of TK 20, complete with pre-amplifier for recording and playback. Ready to connect. BRAND NEW. Full guarantee. Supplied complete with GCM3 microphone (listed 6 gns.) at special price of 35 gns. only, plus 15/- pkg./carr. Also TM60 STEREO VERSION, complete but less microphone at 79 gns. plus pkg./carr. H.P. AVAILABLE.

THE "MINI-4" SUPERHET!

4 latest type Mullard transistors, plus diode. Medium and Long Waves. High flux 2½in. P.M. Speaker. Ferrite slab aerial. Attractive dove grey plastic case with scarlet controls. Size only 5¼ x 3⅛ x 1 1/16in. Easy to assemble on eyeletted board. All required components at special inclusive price of £5/10/- plus 2/6 P. & P. Easy to follow assembly instructions and individually priced parts list, 1/6, post free.

THE R.C. 3/4 WATT AMPLIFIER

(14)



Compare the advantages. Treble bass AND middle controls. For crystal or magnetic pick-up. A.C. Mains 200/250v. Valve line-up: 6V6GT, 6SG7 metal, 6X5GT. Negative feed-back. Built on stove enamelled steel chassis measuring only 8in. x 4in. x 1½in. Four engraved cream knobs are included in the price of the complete kit with all necessary practical and theoretical diagrams at £4/5/- only, plus 2/6 p. & p. or instruction Book fully illustrated for 1/- post free. This amplifier can be supplied assembled, tested and ready for use at £5/5/- plus p. & p.

VISIT OUR FULLY EQUIPPED HI-FI SHOWROOM AT TOTTENHAM COURT ROAD FOR DEMONSTRATIONS OF THE LATEST HI-FIDELITY EQUIPMENT BY ALL LEADING MANUFACTURERS

i.e., Leak, Quad, Armstrong, Dulci, Ferrograph, Reflectograph, Tandberg, Vortexion, Tannoy, Linear, Wharfedale, Grundig, Goodmans, W.B., Rogers, Garrard, Lenco, B.T.H., Pamphonic, Simon, Brenell, Collaro, Telefunken, Fi-Cord, etc., etc. A full range of high quality cabinets to suit all purposes is on show. Enquire about our interesting part-exchange scheme for personal callers. H.P. Available

RECORD PLAYERS

Full range at usual competitive prices. Interesting H.P. facilities

E.M.I. MODEL 985 4-SPEED SINGLE RECORD UNIT. Very latest type. Heavy 8¾in. dia. turntable, low flutter performance. 200/250 v. with tap at 80 v. for operating amplifier valve filament if required. Complete with matching pick-up with mount and rest. Brand new and fully guaranteed. **ONLY 89/6,** plus 3/6 P. & P. Pick-up available separately, complete with mount and rest 25/-, plus 1/6 P. & P.

4-SPEED BATTERY OPERATED VERSION OF ABOVE 6 volt operation complete with pick-up £5/9/6 plus P. & P. 3/6.

TRANSISTOR AMPLIFIER now available for use with the above battery player. Compact size, 500 milliwats output, printed circuit construction, tone and volume controls. Supplied complete with 8in. x 2in. 20 ohms matching quality speaker. Price only 89/6 plus 2/6 P. & P.

LATEST GARRARD MODEL 210. Four-speed manual or automatic. 10in. and 12in. records of same speed can be mixed in any order, wired for stereo, attractive white colour scheme. Price 10½ gns., plus 3/6 P. & P.

JUST RELEASED! LATEST GARRARD 4-SPEED AUTO SLIM—Monaural, wired for stereo, £9/3/4. Plus 3/6 P. & P.

LATEST B.S.R. UA20. Small compact. 4 speed. For Stereo/Monaural use at £8/19/6. Plus 3/6 P. & P.

LATEST B.S.R. UA14. 4-speed Attractive appearance. Wired for stereo. Fully guaranteed. £7/19/6. plus 3/6 P. & P.

B.S.R. UA14. Stereo/Monaural. Fully guaranteed. £8/19/6, plus 3/6. P. & P.

This highly efficient unit is simple to assemble, extremely sensitive and may be installed in a matter of minutes. Completely **SAFE** employing a double wound mains transformer. Attractively finished in Red and Grey (washable) "Lionide" with cream plastic escutcheon. Size only 7½in. x 3¾in. x 6¾in. Supplied in kit form complete with mike at ONLY 72/6 plus 2/6 p. & p. or assembled and tested 89/6 p.&p. 2/6. Suitable mike flex available at 3d. a yard. Instruction book and price list separately 1/- post free A.C. 200-250 v.

TWO CHASSIS BARGAINS!

Not repeatable, limited quantity.

4 VALVE AC/DC SUPERHET (as illus.). Medium and long waves. Valve line up UCH42, UAF42, UL41, UY41. Dial size, 6¼ x 2¼in., Overall chassis size 9in. x 6¼in. x 5¼in. high. Complete with 5in. quality speaker, ready to fit, at only £5/17/6 plus 5/- p. & p. Also, as above, but FOUR STATION PRE-SET SUPERHET chassis. Two controls only, volume on/off, and simple 4 station rotary selection switch. Set to Light, Home and Third programme, also Light programme on long waves. Frame aerial included, also 5in. quality speaker mounted on chassis. Overall measurement 9in. x 6¼in. x 5¼in. high. Only £4/17/6 plus 5/- p. & p.

FRUSTRATED EXPORT. Not repeatable! L., M. and S.W. SUPERHET RECEIVER. Manufactured by McCarthy for export. At present for operation on 6 volts. but conversion details supplied free.

Valve line-up: 6K8G, 6K7G, 6Q7C, 6F6G, 6X5G and 6 volt 4-pin non-synchronous vibrator. 8in. P.M. Speaker, 4 watts output. P.U. socket. Ext. L.S. socket, etc. Tone control. Fitted in polished wood cabinet, size 21½in. x 10½in. x 10½in. These cabinets are slightly soiled owing to storage, but each is guaranteed unused, in serviceable condition, tested prior to despatch. Price £5/19/6 only plus P. & P. 7/6, plus 28/6 for A.C. Mains Conversion Components if required. **OUTSTANDING BUY!**

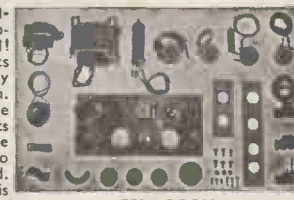
A.M. RADIOGRAM CHASSIS. Manufacturers' surplus. Brand new and fully guaranteed. Long, Medium and Short Waves. ECH81, EF89, EBC81, EL84, EZ80, slow motion tuning, tone control, ferrite rod aerial. Provision for gram, extension speaker, and tape play-back. Chassis size 11in. deep by 8½in. wide.

Dial engraved on attractive brown and gold front panel size 16½in. x 9in. which forms escutcheon for easy fixing. LIMITED QUANTITY ONLY at £8/19/6 plus 5/- P. & P. H.P. available.

NEW! TAPE RECORDER CONSTRUCTORS

LATEST COLLARO STUDIO TAPE TRANSCRIPTOR. Latest type incorporating Record, Interlock, Lever, Button, 3 motors, 3 speeds, 1⅞, 3¾, 7½ i.p.s., takes 7in. spools. Push-button controls. **£12/19/6** plus 5/- P. & P. Usual H.P. facilities.

NEW! TAPE RECORDER AMPLIFIER TYPE 8311-V. Sub-assembled — anyone can build! Printed Circuit, all components mounted and dip soldered. Already tested. Each lead cut to length. All that is required to complete the tape recorder is for a few components to be mounted in the cabinet and the free ends of the leads soldered to terminals which are clearly marked. Everything supplied, all you need is solder iron, pliers and screwdriver. Valve line-up, EF86, ECC83, 2 x EL84, EZ81 and EM84 magic eye. Monitoring facilities, output socket for feeding to high quality amplifier, can be used as "straight" amplifier for record reproduction. EQUALISING ON TWO SPEEDS. OUTSTANDING VALUE AT £11/11/ plus 2/6 P. & P. including all necessary instructions



ATTRACTIVE TWO-TONE PORTABLE CARRYING CASE. Suitable for above amplifier and Collaro Studio deck. Fitted with 9in. x 5in. High Flux P.M. speaker for high quality reproduction. Inclusive price £5/5/. Plus 5/- P. & P.

The above 3 items purchased at one time, SUPPLIED CARRIAGE PAID N.B. Any microphone listed hereunder is suitable for use with this recorder.

CRYSTAL MICROPHONE. Sensitive Miniature Lapel-type. Complete with clip and screened lead. Brand new, 17/6. Plus 6d. P. & P. (as illustrated).

MIC 45-1. Acos latest flat pistol-grip crystal microphone. Attractive black and gold finish. OUR PRICE 29/6 plus 1/- P. & P. **ACOS MIC-39-1.** Crystal stick microphone. List price 6 gns. Our price 39/6 plus 1/6 P. & P. **MIC 40.** General-purpose crystal microphone with desk stand. Our price 22/6 only plus 1/6 P. & P. **M.C.24.** Imported crystal, attractive streamlined polished metal case, incorporates muting switch. List price 64/-. OUR PRICE 32/6 only. 1/- P. & P.

TELEPHONE PICK-UP COIL. Designed to feed into the microphone input of either a tape recorder or any high gain amplifier. Easily attached to telephone by rubber suction attachment. The coil is electrostatically shielded to minimise hum pick-up. When positioned on telephone this model is more than adequate for a fully modulated tape recording. Brand new complete with 5ft. shielded cable. ONLY 14/. P. & P. 1/6.

SUPER MAGNETIC RECORDING TAPE SPECIAL!!!
Famous American Ferrodynamics **"BRAND FIVE"**

An enthusiast's "must." Brand new (NOT SUB-STANDARD) High grade Acetate Base. 5in. 600ft. 16/, 5in. 900ft. 18/6, 5¾in. 1,200ft. 23/6 7in. 1,200ft. 25/, 7in. 1,800ft. 35/. Extra quality Mylar Dupont, 3in. 300ft. 13/-. 5in. 1,200ft. 37/6, 7in. 1,800ft. 44/-, 7in. 2,400ft. 60/-. Each on plastic spool. All Post free. *Trade enquiries invited*

PLASTIC TAPE SPOOLS. Best quality. 3in. 1/6, 5in. 2/-, 5¾in. 2/3, 7in. 2/6. **PLASTIC SPOOL CONTAINERS** for spool sizes 5in. 1/6, 5¾in. 2/-, 7in. 2/3. Any single item plus 6d. P. & P. Orders over £1, post free.

LANGUAGE COURSES ON TAPE!

Complete Elementary Course in French, Italian, German or Spanish. Phrase book supplied. 5in. long play tape, 55 minutes at 3¾ i.p.s. Price ONLY 29/6 per course. Post Free! Trade Supplied.

EXTRA SPECIAL OFFER !!

A small three-valve **PORTABLE RECORD PLAYER AMPLIFIER** mounted on baffle 12 x 7in., with High Flux 6½in. Loudspeaker. Valve line-up UCC83, EL84, EZ80. Incorporates separate bass and treble controls. Max. output 3 watts. Will match all types of high impedance pick-up. Ready for use, £5/12/6. P. & P. 3/6.

NEW STYLE CABINET finished in two-tone Leatherette. Will accommodate above Amplifier and Baffle without modification, also most types of Ancillary Equipment. Overall size 18 x 13½ x 8½in. Fitted with carrying handle, £3/9/6, plus 5/- P. & P.

NOTE. If both items purchased together they will be supplied at a special inclusive price £8/7/6, plus 6/6 P. & P.

CLYNE RADIO LTD.

THE COMPONENT SPECIALISTS

18 Tottenham Court Road, London, W.1.
162 Holloway Road, London, N.7.
9 Camberwell Church St., S.E.5.

● TURN OVER FOR MORE CLYNE BARGAINS ➜

AN ELECTRONIC ORGAN

TO BUILD YOURSELF!

FULL COMPASS
TWO MANUAL
Fully Polyphonic Great
Monophonic Solo
Complete with
Pedal Board

ONLY (approx.) **£160**
Plus cost of Console.

Also available with both Manuals fully Polyphonic at £190 approx. Plus cost of Console.

Consoles are available in Fibreglass, Oak, etc., from £25.

Large selection of Organ parts available.

ALL REQUIRED COMPONENTS AND FULL CONSTRUCTIONAL DETAILS SUPPLIED. *H.P. TERMS ARRANGED.*

Already tried and proved throughout the country!

Send stamp for full details or, better still, visit our High Fidelity showroom to see and play a working model of this amazing organ.

INCLUSIVE OFFER!!

STEREO AMPLIFIER fitted in ATTRACTIVE TWO TONE REXINE CARRYING CASE

4 watts per channel. Both speaker units are detachable (as illustrated), volume/on off, bass and treble controls. A.C. mains 200/240 v. Cabinet cut out for B.S.R. Stereo autochanger. Full connection details supplied. Special price 13½ Gns. plus 7/6 P. & P. Limited quantity only.
B.S.R. UA 14 STEREO AUTOCHANGER available at £8/19/6 extra. Plus 3/6 P. & P.
(Both items sent post free if purchased together.)

TELEPHONES!!!

The Best value yet offered!
LIMITED QUANTITY
Attractive appearance.
Operate from 6-volt battery. Ideal for Home, Office, Factory, etc. Simply turn handle and bell rings at other end. Any twin lighting type flex required for connection. Not new but good condition. Tested before despatch.
5 GNS. Per pair complete with batteries, plus C. & P. 7/6.
Suitable twin P.V.C. clear plastic flex 3d. per yard or 20/- per 100 yards.

TRANSISTORISED MINIATURE TAPE RECORDERS

The following Japanese recorders are available for Callers only:—
"SANDY" @ £10.19.6. "APOLEC" @ £12.19.6. "MINY" @ 16½gns. and the fantastic professional model, fully automatic, two speed.
"PT.4K DOKORDER" @ 49GNS.
Wt. under 3lbs. Size: 7¾" × 3½" × 2¼". Complete in leather case with shoulder strap, and every conceivable extra. Mains adaptor available
Demonstrations with pleasure!

VALVES

We have perhaps the most up-to-date valve stocks in the trade. New imported valve types fully guaranteed and P.T. paid and all the usual surplus types at special prices. We also carry a comprehensive stock of all B.V.A. types at current list prices. Send stamp for NEW list now available. Note: Certain American special purpose types can be supplied. Enquiries invited.

No. 38 AFV WALKIE-TALKIE. A wonderful offer. This famous transreceiver unit, with relay operated SEND/RECEIVE switch covering 7.4-9 Mc/s band, range approx. 5 miles. Good condition. ONLY 22/6, plus 2/6 P. & P. per unit (less accessories). Quantity export inquiries welcomed.

"PIFCO" INSTRUMENT BIT SOLDERING IRON with Integral Stand and built-in Spotlight for illuminating work, 200/250 v. ONLY 22/6. P. & P. 1/6.

SOLDER. New boxed 1 lb. reels, 16 S.W.G. 50/50 at 8/6 only, plus 1/- P. & P.

RETURN OF A WINNER!!!

(Exclusive)

We have been fortunate in obtaining a further limited supply of this fine and popular cabinet. Instantly recognised as being of leading High Quality manufacturer's stock, this trolley-type cabinet is finished in polished dark walnut. Can easily be adapted to accommodate tape recorder, amplifier, radiogram, loudspeaker enclosure, etc., etc. External measurements: 24½in. x 16in. x 29in. The whole is mounted upon "easy run" castors. Subject to being unsold £4/19/6 Plus 15/- C. & P.

ANOTHER PORTABLE CABINET BARGAIN! Ex leading manufacturer's battery portable attache type case. Attractive two-tone grey rexine finish. Size closed 13¼in. x 9½in. x 3¾in. Complete with fittings and handle. Including Medium and Long Wave frame aerial which fits in lid. On/off switch on lid stay. Limited quantity only at bargain price of 19/6 plus 2/- P. & P. Brand new.

TRANSISTOR SIGNAL INJECTION PROBE!

Quickly checks Radio, T/V Sound and all forms of Audio Circuits. Functions as a wide-band modulated Signal Generator emitting a signal rich in A.F., I.F. and R.F. Components. Range: 2 kc/s to 25 mc/s. Takes the trouble out of trouble-shooting. Actual size 6½in. long x ½in. diameter. Slips into pocket. Attractive finish, complete with full instructions and long-life Mercury battery. British made. 99/6 only, plus 1/- P. & P. Illustrated leaflet available.

EXTENSION SPEAKER CABINETS

As Illustrated; new design in light oak. Two sizes available. For 6½in. or 8in. speaker at 22/6. For 10in. speaker at 25/- only. Each plus 2/6 P. & P. Suitable reconditioned 8in. P.M. unit at 13/6 only, plus 1/6 P. & P.

SUB-MINIATURE TWO-WAY JACK PLUGS & SOCKETS
3/- Per pair
P. & P. 6d.

SUB-MINIATURE SLIDER SWITCH
Two-pole two-way ONLY 2/6 EACH. P. & P. 6d.
★ Wholesale and manufacturer quantity enquiries invited on ★ both of the above items.

JASON TEST EQUIPMENT

AUDIO GENERATOR AG10. Covers from 10 c/s. to 100 Kc/s. in four ranges. Max. output 10 volts. Min. output 100 microvolts. Square wave output with excellent rise time makes this generator very useful for checking all Audio equipment. Housed in attractive metal shelf mounting case measuring 11½in. x 6¼in. x 5¼in. high. All necessary components available, including valves, at a Special Price of £14/5/- plus 3/6 P. & P.
Fully descriptive booklet with comprehensive assembly instructions available at 2/- post free.

TO BUILD YOURSELF!

We have over 40 different circuits to build yourself, including all current JASON KITS. We are specialists in this field. A stamp will bring full list. Our reputation is your guarantee.

CLYNE RADIO LTD.

THE COMPONENT SPECIALISTS

18 Tottenham Court Road, London, W.1.
162 Holloway Road, London, N.7.
9 Camberwell Church St., S.E.5.

ALSO SEE PREVIOUS PAGES

C.R.T. BOOSTER TRANSFORMERS

TYPE A. OPTIONAL 25% and 50% BOOST. 2 V. OR 4 V. OR 6.3 V. OR 10.8 V. OR 13.3 V. MAINS INPUT. 12/6

TYPE A2. HIGH QUALITY, LOW CAPACITY, 10/15 pF. OPTIONAL BOOST 25%, 50%, 75%. MAINS INPUT. 16/6

TYPE B. MAINS INPUT. MULTI OUTPUT 2, 4, 6.3, 7.3, 10 and 13 VOLTS. BOOST 25% AND 50%. LOW CAPACITY, 21/-. Full instructions supplied.

RESISTORS. All preferred values. 20% 10 ohms to 10 meg., ¼ w., 4d.; ½ w. 4d.; 1 w. 6d.; 1½ w 8d.; 2 w. 1/-. **HIGH STABILITY.** ½ w., 1% 2/-. Preferred values 10 ohms to 10 meg. Ditto 5% 9d., 100Ω to 5 meg.

WIRE-WOUND RESISTORS 25 ohms—10,000 ohms.
5 watt 1/3
10 watt 1/6
15 watt 2/-
12,500 ohms—50,000 ohms. 10 w. 3/-

WIRE-WOUND POTS. 3 w. Pre-set Min. T.V. type. Knurled Slotted knob. All values 10 ohms to 25 K. 3/- ea.; 30 K., 50 K., 4/-. Ditto ½ w. Carbon Track, 30 K. to 2 Meg. 3/-.

WIRE-WOUND POTS. 4 w. Standard size Pots. long Spindle High Grade. All values 50 ohms to 50 K. 6/6; 100 K., 7/6. **W/W EXT. SPEAKER CONTROL** 10Ω, 3/-.

O/P TRANSFORMERS. Miniature 3V4, etc., 4/6. Heavy duty 50 mA., 4/6. Multi-ratio push-pull, 7/6. Ditto Push-Pull 10 watts 15/6. Push-pull 20 w. 6 k. P.P. 30/-. **L.F. CHOKES.** 10H 50 mA. 4/6. 10H 65 mA. 5/-. 10H 85 mA. 10/6. 10H 120 mA. 12/6. 10H 150 mA. 14/-.

MAINS TRANSFORMERS 200/250 v. A.C.
STANDARD 250-0-250, 80 mA., 6.3 v. 3.5 a. tapped 4 v. 4 a. Rectifier 6.3 v. 1 a., tapped 5 v. or 4 v. 2 a. Ditto 350-0-350 .... 22/6
MINIATURE 220 v. 20 mA., 6.3 v. 1 a. 10/6
MIDGET, 220 v. 45 mA., 6.3 v. 2 a. 15/6
SMALL, 200-0-200 50 mA., 6.3 v. 2 a. 17/6
STANDARD, 250-0-250, 65 mA., 6.3 v. 3.5 a. 17/6
HEATER TRANS., 6.3 v. 1½ a., 7/6; .... 4 amps. 10/6
GENERAL PURPOSE LOW VOLTAGE. Output 3, 4, 5, 6. 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 A. 22/6
AUTO. TRANS. 150 w., 0, 10, 120, 200, 230, 250 v. 22/6
AUTO TRANS. 500 w., 0, 115, 200, 230, 250 v... 82/6

ALADDIN FORMERS and cores, ¼in. 8d.; ⅜in. 10d. 0.3in. FORMERS 5937 or 8 and Cans TV1 or TV2. 2¼in. sq. × 2⅛in. or ⅝in. sq. × 1½in., 2/- with cores. **SLOW MOTION DRIVES.** Epicyclic ratio 6 : 1, 2/3. **SOLON.** Midget Soldering Iron, 200 or 240 v .25 w., 24/-. **MAINS DROPPERS.** 3 × 1½in. Adj. Sliders .3 amp. 1,000 ohms 4/3. .2 amps. 4/3. .1 amp. 2,000 ohms 5/-. **LINE CORD.** .3 amp. 60 ohms per foot, .2 amp. 100 ohms. per foot, 2-way, 1/- per foot, 3-way 1/- per foot.

CRYSTAL MIKE INSERT by Acos 8/6

Precision engineered. Size only 1½in. dia. × ¼in.

ACOS MIKE 40 25/- .... TSL. STICK MIKE 35/-

MIKE TRANSF. 50 : 1, 3/9 ea., 100 : 1 Potted 10/6. **LOUDSPEAKERS PM. 3 OHMS.** 2½in. 19/6. 3in. 19/6. 5in. 17/6. 8in. × 5in. Goodmans 21/-. 7in. × 4in. Rola 18/6. 10in. × 6in. Goodmans 27/6. 8in. Plessey 19/6. 6½in. Rola 18/6. 8in. Rola 21/-. 10in. R.A. 30/-. 12in. Plessey 30/-. 12in. Plessey 15 ohms 45/-. Stentorian HF1012, 95/-.
TWEETERS. 4in. 25/-.
12in. Baker 15 wt. Stalwart, 3 or 15 ohms, 90/-.
12in. Baker ditto., foam suspension, 15 ohms, £6.
12in. Baker Ultra Twelve £17/10. 20 c.p.s. to 25 k.c.s.

I.F. TRANSFORMERS 7/6 pair

465 kc/s. slug tuning miniature can 1⅜ × ⅞ × ⅞in. High Q and Good bandwidth. Data sheet supplied.

CRYSTAL DIODE G.E.C. 2/-. GEX34 4/-. 40 Circuits 3/-. **H.R. HEADPHONES.** 4,000 ohms, brand new, 15/- pair. **SWITCH CLEANER.** Fluid, squirt spout, 4/3 tin. **TWIN GANG CONDENSERS.** 365 pf. Miniature, 1⅞in. × 1½in. × 1⅞in. 10/-. 500 pf. Standard with trimmers, 9/-; Midget 7/6 with trimmers 9/-. Single 50 pf., 80 pf., 100 pf., 160 pf., 5/6. Solid dielectric 100, 300, 500 pf., 3/6. **VALVE HOLDERS.** EA50, 6d. Eng. or U.S.A. 4, 5, 6, 7 pin, 1/-. **MOULDED** Mazda or Int. Oct. 6d.; B7G, B8A, B8G, B9A, 9d. B7G with can, 1/6; B12A, 1/3; B9A with can 1/9. **CERAMIC,** EF50, B7G, B9A, Oct., 1/-; B7G, B9A cans, 1/-.

TELEVISION REPLACEMENT

Line Output Transformers
from 45/- each, NEW stock
and other timebase components
Most makes available. S.A.E. with all enquiries.

WAVECHANGE SWITCHES
2 p. 2-way, or 3 p. 2-way; short spindle 2/6
8 p. 4-way, 2 wafer, long spindle 6/6
2 p. 6-way, or 4 p. 2-way, or 4 p. 3-way, long spindle 3/6
2 p. 2 -way, 3 p. 4 way or 1 p. 12-way, long spindle .. 3/6
Wave change "MAKITS" 1 wafer, 8/6; 2 wafer, 12/6; 3 wafer, 16/-. Additional wafers up to 14, 3/6 each extra.
TOGGLE SWITCHES S.P. 2/-; D.P. 3/6: D.P.D.T. 4/-. **MORSE KEYS.** good quality with morse code, 2/6. **FULL WAVE BRIDGE SELENIUM RECTIFIERS.** 2, 6 or 12 v. 1½-amp., 8/9; 2 a. 11/3; 4 a. 17/6; 6 a. 22/6. **CHARGER TRANSFORMERS.** Tapped input 200/250 v. for charging at 2, 6 or 12 v., 1½ a., 15/6; 2 a., 17/6; 4 a., 22/6. Charger circuit free. **AMMETERS,** 4 a. and 5 a., 13/6.

THE HI-GAIN BAND 3 PRE-AMP

Cascode circuit using Valve ECC84. 17db gain. Kit 29/6 less power; or 49/6 with power pack. Plans only 6d.
Also Band I version same prices.
(PCC84 Valve if preferred)

"REGENT" 4 VALVE

"96" RANGE VALVES

KIT PRICE £6. 6. 6. Carr. 4/-

PRINTED CIRCUIT BATTERY PORTABLE KIT

Medium and long wave. Powerful 7 x 4in. high Flux Speaker. T.C.C. Printed Circuit and condensers. Components of finest quality clearly identified with assembly instructions. Osmore Ferrite Aerial Coils. Rexine covered attache case cabinet. Size 12in. x 8in. x 4in. Batteries used B126 (L5512) and AD35 (L5040), 10/- extra. Instructions 9d. (free with kit). Mains Unit ready made for above, 39/6. Sold separately.

MONARCH RECORD PLAYER

SAVE POUNDS

BUILD IT YOURSELF using 4-SPEED BSR MONARCH AUTOCHANGER
READY BUILT 3W. AMPLIFIER, HANDSOME PORTABLE CASE. HIGH FLUX 6in. LOUDSPEAKER.
FULL INSTRUCTIONS SUPPLIED.

Total Price Carr. and Ins. 5/-. **£12 . 10 . 0**

RECORD PLAYER BARGAINS

BSR

The Brilliantly Successful **Monarch** World's finest 4-speed Autochanger

4 Speed Autochangers, BSR, U.A.14	£7 10 0
Collaro Autochanger	£7 19 6
Garrard RC 209	£9 9 0
Garrard RC 210	£10 10 0
4 speed Single Players:	
EMI Monaural. £6/5/- ...... Stereo	£6 19 6
Garrard TA Mk. II........................	£8 8 0
Garrard 4 HF Transcription	£17 19 6

Garrard Stereo Heads £2 extra.

AUTOCHANGER ACCESSORIES
Suitable player cabinets (uncut boards).......... 49/6
Amplifier player cabinets with cut boards......... 63/-
2-valve amplifier and 6½in. speaker for above .... } 79/6
Ready mounted on baffle 12in. × 7in., 3 in. deep. }
All Sapphire stylii available from 6/- each.

NEW MULLARD TRANSISTORS
Audio OC71 6/-; OC72 8/6; RF OC44 10/6; OC45 9/6. "P.W." pocket six transistor kit, all parts, printed circuit and cabinet, £8/15/-.
Weyrad Printed Circuit Components in Stock.
Constructors Book 9/-. 7 × 4in. Speaker 35Ω 25/-.

465 Kc/s. SIGNAL GENERATOR. Total cost 15/-. Uses B.F.O. Unit ZA 30038 ready made. POCKET SIZE 2½ × 4½ × 1in. Slight modifications required, full instructions supplied. Battery 7/6 extra 69 v. + 1½ v. Details S.A.E.

VOLUME CONTROLS
Midget size:
Long spindle. Guaranteed 1 year All values.
5 K. ohms up to 2 Meg. No switch 3/-. D.P. Sw. 4/6
Linear or Log Tracks.

80 ohm Cable Coaxial
Semi air spaced, ¼in. dia. Ideal Band III 6d yd.
Losses cut 50%
40 yds. 17/6. 60 yds. 25/-.
FRINGE QUALITY
AIRSPACED .... 1/- yd.

COAXIAL PLUGS .. 1/- LEAD SOCKETS .. 2/-
PANEL SOCKETS .. 1/- OUTLET BOXES 4/6
BALANCED TWIN FEEDER per yd. 6d., 80Ω or 300Ω.
TWIN SCREENED BALANCED FEEDER 1/6 yd., 80 ohms.

ALUMINIUM CHASSIS. 18 s.w.g. Plain, undrilled, with 4 sides, riveted corners and lattice fixing holes with 2½in. sides 7 × 4in. 4/6; 9 × 7in. 5/9; 11 × 7in. 6/9; 13 × 9in. 8/6; 14 × 11in. 10/6; 15 × 14in. 12/6; and 18 × 16 × 3in. 16/6. Panels 10 × 7in. 2/3; 12 × 8in. 3/-; 14 × 9in. 4/-; 12 × 12in. 4/6.

BLACK CRACKLE PAINT. Air drying, 3/- tin.
P.V.C. CONN. WIRE, coloured, single or stranded, 2d. yd.
NEON MAINS TESTER SCREWDRIVERS, 5/-.
CORED SOLDER RADIOGRADE, 4d. yd., ½lb. 5/-.
PAXOLIN 1/16in. × 8in. × 10in., 1/6.

AMERICAN MAGNETIC RECORDING TAPE FERRODYNAMICS "BRAND FIVE"

5in. 600 feet......	16/-	MYLAR DUPONT	
5in. 900 feet......	18/6	Super High Fidelity	
5¾in. 1,200 feet ..	23/6	Double Play	
7in. 1,200 feet....	25/-	5in. 1,200 feet....	37/6
7in. 1,800 feet....	35/-	7in. 2,400 feet....	60/-

Illustrated leaflet S.A.E.
Spare Reels 3in. 1/6; 4in., 5in. 5¾in. 2/-; 7in. 2/6.
"Instant" Bulk Tape Eraser and Head Defluxer. 200/250 v. A.C., 27/6. Leaflet S.A.E.

RECTIFERS. RM1 5/-; RM2 6/-; RM3 8/-; RM4 16/-; RM5 20/-; FC31 27/6; 14A86 17/6; 14A100 21/-. **MINIATURE CONTACT COOLED RECTIFIERS.** 250 v. 50 mA. 7/6; 60 mA. 8/6; 85 mA. 9/6; 200 mA. 21/-; 300 mA. 27/6; Full Wave 75 mA. 12/6; 120 mA. 15/-. **COILS.** Wearite "P" type 3/- each. Osmor Midget "Q" type adj. dust core from 4/- each. All ranges. **TELETRON.** L. and M. T.R.F. with reaction, 3/6. **FERRITE ROD AERIALS.** M.W. 8/9; M. & L. 12/6. Ditto for transistor. MW - 7/6. M. & L. 10/-. **T.R.F. COILS.** A/HF 7/- pair. **H.F. CHOKES** 2/6.

JASON F.M. TUNER COIL SET 29/-. H.F. coil aerial coil. Oscillator coil two I.F transformers 10.7 Mc/s. Detector transformer and heater chokes. Circuit and component book, using four 6AM6 2/6. Complete kit FMT1 with Jason Calibrated dial and 4 valves, £6/5/-, or with New Jason Cabinet FMT2, £2 extra.

CONDENSERS. New Stock. .001 Mfd. 7 kV. T.C.C., 5/6. 20 kV., 9/6; .1 mfd. 7 kV. 9/6; 100 pf. to 500 pf. Micas, 6d. Tubular 500 v. 0.001 to 0.05 mfd., 9d.; 0.1, 1/-; 0.25. 1/6; 0.5 1/9; 0.1/350 v. 9d.; 0.1/1,000 v. 1/9; 0.1 mfd. 2,500 v., 3/6; 0.001 mfd. 2,000 v. 1/9; 500 pf. 20 kV. 9/6. **CERAMIC CONDS.** 500 v. 0.3 pf. to 0.01 mfd., 9d. **SILVER MICA CONDENERS.** 10% 5 pf. to 500 pf., 1/-: 600 pf. to 3,000 pf., 1/3. **CLOSE TOLERANCE** (1 ± pf.) 2 pf. to 47 pf., 1/6. DITTO 1% 50 pf. to 815 pf., 1/9; 1,000 pf. to 2,000 pf., 2/-. **TRIMMERS.** Ceramic 30. 50, 70 pf. 9d.; 100 pf., 150 pf. 1/3. 250 pf., 1/6. 600 pf., 750 pf., 1/9. Phillips, 1/- ea.

NEW ELECTROLYTICS. FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350 v. ..	2/-	50/350 v. ..	5/6	16/450 v.	5/-
2/350 v. ..	2/3	100/25 v. ..	2/-	32/350 v.	4/-
4/450 v. ..	2/3	250/25 v. ..	2/6	100/270 v. ..	5/6
8/450 v. ..	2/3	500/12 v. ..	3/-	5,000/6 v.	5/-
8/500 v. ..	2/9	8+8/450 v.	3/6	8+16/450 v. ..	5/-
16/450 v. ..	3/-	8+16/450 v.	3/9	32+32/350 v.	5/-
16/500 v. ..	4/-	8+16/500 v.	5/6	32+32/450 v.	6/-
32/450 v. ..	3/9	16+16/450 v.	4/3	50+50/350 v.	7/-
25/25 v. ..	1/9	16+16/500 v.	6/-	64+120/350v.	11/6
50/50 v. ..	2/-	32+32/350 v.	4/6	100+200/275v.	12/3

SUB-MINIATURE ELECTROLYTICS (15 v.)
1, 2, 4, 5, 8, 25 50 mfd., 100 mfd., 2/6 each.
SPEAKER FRET. Gold Cloth 17in. × 25in., 5/-; 25in. × 35in. 10/-; Tygan 52in. wide, 10/- ft., 26in. wide 5/- ft. Green or Red. Other colours. Samples S.A.E.

NEW and boxed **VALVES** 90 day guarantee

1R5 ..	7/6	6L6G	10/6	EA50 ..	1/6	EY51 ..	9/6
1S5 ..	7/6	6N7M	6/6	EABC80	8/6	EY86 ..	10/-
1T4 ..	6/-	6Q7G	7/6	EB91 ..	6/-	HABC80	12/6
2X2 ..	3/6	6SA7M	6/-	EBC33 ..	8/6	HVR2A	6/6
3S4 ..	7/6	6SJ7M	6/6	EBC41 ..	8/6	MU14 ..	9/-
3V4 ..	7/6	6SN7	6/6	EBF80 ..	10/-	P61 ..	3/6
5U4 ..	7/6	6V6G	6/6	ECC84 ..	9/6	PCC84 ..	9/6
5Y3 ..	7/6	6X4 ..	7/6	ECF80 ..	9/6	PCF80 ..	9/6
5Z4 ..	9/6	6X5 ..	6/6	ECH42	10/6	PCL82 ..	11/6
6AM6	5/-	12A6	7/6	ECL80 ..	10/6	PEN25 ..	6/6
6BE6	7/6	12AT7	8/-	ECL82 ..	10/6	PL82 ..	10/6
6BH6	9/6	12AU7	8/-	EF39 ..	5/6	PY80 ..	7/6
6BW6	9/6	12AX7	8/-	EF41 ..	9/6	PY81 ..	9/6
6D6 ..	6/-	12BA6	8/6	EF50 ..	5/6	PY82 ..	7/6
6FG6	7/6	12BE6	8/6	EF80 ..	8/-	SP61 ..	3/6
6H6GT	3/6	12K7	6/6	EF86 ..	12/6	UBC41 ..	9/6
6J5 ..	5/6	12Q7	6/6	EF92 ..	5/6	UCH42	9/6
6J6 ..	5/6	35L6	9/6	EL32 ..	5/-	UF41 ..	9/6
6J7G ..	6/6	35Z4	7/6	EL41 ..	9/6	UL41 ..	9/6
6K6GT	6/6	80 ..	9/6	EL84 ..	8/6	UY41 ..	8/-
6K7G	5/-	807 ..	5/3	EZ40 ..	7/6	U22 ..	8/-
6K8G	7/6	954 ..	1/6	EZ80 ..	7/6	U52 ..	7/6

DK96, DAF96, DF96, DL96 8/6 ea. 30/- set.

RADIO COMPONENT SPECIALISTS

48-HOUR MAIL ORDER
337 WHITEHORSE RD. WEST CROYDON

POSTAL SERVICE 1/-. OVER £2 FREE. C.O.D. 1/6. (EXPORT C.W.O. POST EXTRA.) Wed. 1 p.m. THO 1665 Buses 133 or 68

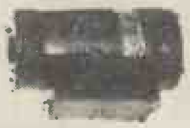
PROOPS Walk-around Store
and MAIL ORDER SERVICE

52 Tottenham Court Road, London, W.1 • *Open 9-6, including Sats., Thurs. 9-1* • **LANgham 0141**

ROTARY POWER SUPPLIES

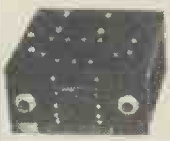
Magnificently engineered, aircraft quality, rotary power equipment originally made by famous British and American manufacturers.

TYPE 102A INVERTOR



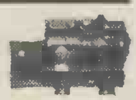
Input: 28 volts D.C. Output: 115 volts, 400 c/s, 3-phase A.C. at 625 VA. In excellent unused condition. Size: 11in. x 5¾in.

TYPE 34 REGULATOR (5UC/5820)



Self-contained voltage and frequency control unit for use with Type 102A Invertor. Both units complete **£15** Carriage 10/-.

TYPE 300 INVERTOR



Input: 27.5 volts. Output: 40 volts, 1,600 c/s, 1-phase A.C. at 50 VA. Mounted on pedestal base with built-in filter. Size: 7 x 3½ x 4in. high. **£2** Carriage 5/-.

TYPE 7 INVERTOR

Input: 24/28 volts D.C. Output: 80 volts, 800 c/s, 1-phase A.C. at 240 VA. Power factor of 1.0. Complete with built-in regulator. Size: 10 x 8½ x 5½in.high.

£4.10 Carriage 10/-

100A INVERTOR

Input: 24/28 volts D.C. Output: 115 v. 400 c/s. 3 ph. Size: 7in. x 3¾ in.

£4.10 Carriage 10/-

100B INVERTOR

Input: 24/28 volts D.C. Output: 115 v. 400 c/s. 3 ph. Size: 7in. x 3¾ in. Mounted on pedestal base containing regulator.

£4.10 Carriage 10/-

TYPE 8A INVERTOR

Input: 24 v. D.C. Output: 115 v.. 400 c/s. 3 ph. 1.8A. Size: 9in. x 4¾in.

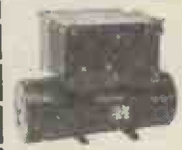
£5.10 Carriage 10/-.

TYPE 200 INVERTOR (5UB/5083)

Self-contained motor-generator unit with complementary carbon pile regulator, contactor, and associated rectifier in separate compartment on same base. Continuously rated for 25/28 volts D.C. input with 360 VA output at 115 volts, 1600 c/s, 1-phase A.C. Power factor of 1.0.

£4.10 Carriage 10/-.

TYPE 201 INVERTOR (5UB/630C)



Input 25/28 volts D.C. Output: 115 volts, 1,600 c/s, 1-phase A.C. at 1,750 VA. Similar in construction to Type 200 and complete with regulator on same base. Power factor of 1.0. Size: 15½ x 8 x 12in. high.

£4.10 Carriage 10/-

TYPE SP125 INVERTOR

Input 28 volts D.C. Output: 230 volts D.C. at 100 mA continuously rated. Size: 5½ x 3½in. dia.

£1 Carriage 5/-

COMPACT 400 c/s INVERTOR

Input: 28 volts D.C. Output: 28 volts, 400 c/s, 1-phase A.C. at 6 VA. Mounted on 1½ inch high pedestal base containing condenser filter. Size: 2½ x 4 inches long. **25/-** Carriage 2/6.

AMERICAN INVERTOR

Input: 28 volts D.C. Output: 115 volts, 400 c/s, A.C., 1-phase at 50 VA. Housed in black crackle case on anti-vibration mounted pedestal base containing condenser filter. Fan cooled. Size: 7 x 4 x 5in. high

£4.10 Carriage 5/-

TYPE HX2 GENERATOR (5U/4185)

High-grade, aircraft type engine-driven generator. Output: 29 volts at 50 Amps. Size overall: 9 x 7in. dia. Fitted with ¾ inch splined drive.

£2 Carriage 10/-.

25 c/s Tuning Fork Drive AMPLIFIER 60/- Carriage 3/-.

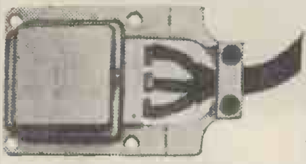
Modern light-alloy cased. Drive unit type 114 containing a robust 8½in. induction sustained 25 c/s tuning fork with attendant induction pick-ups and waveform amplifier comprising 2 DF50, CV1092 diode and 6L6 output. 5U4G rectifier and VS11Q stabiliser in power supply derived from high-cycle transformer—easily replaced by standard mains type. High grade components throughout. Easily removed, flexibly mounted tuning fork assembly energised by 6.3 volts A.C. only. Case size: 8½ x 7½ x 10½.

TWIN TUBE CRT INDICATOR

Attractive, lightweight, black crackle box 11 x 7 x 13½in. deep with 4 x 2½ and 3½ x 3in. windows on front panel for twin 5FP7 tubes. Neat arrangement of appropriate (independent) controls and variable scale illumination. Totally enclosed, detachable magnetic focusing coils. All connections to rear sockets. Ideal TV monitoring unit as used by many amateurs. In first class, unused condition.

£1 · 15 Carriage 10/-.

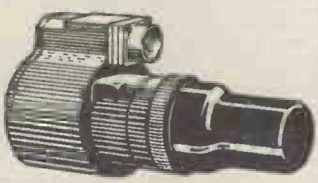
VIBRATION PICK-UPS



£4.10.0.

Type 4-260 by Consolidated Electrodynamics Corp. of America. Utilizes variable reluctance to measure acceleration from zero to 100 c.p.s. up to plus or minus 12g. Pick-up consists of spring mounted seismic mass which is the common armature of two variable inductors. Deflection of armature due to gravity, centrifugal or acceleration forces change inductance which is then measured in an a.c. bridge circuit. Range: "G"—plus or minus 12 (stops set at 15). Freq.: d.c. to 100 c.p.s. or more. Linearity 1% or less distortion with amplitude change. Nominal impedance per coil: 400 ohms at 2 kc/s (3 mh, 100 ohms d.c.) 574 ohms at 3 kc/s. Output: 45 mV per g. with 10 volt 2 kc/s carrier, 64.5 mV with 10 volt 3 kc/s carrier. Mounting base 1¼ × 2¼in. (1⅞ without cable clamp). Height: ⅞in. Weight: 2 oz. Any position mounting. Sensitive axis normal to base.

ELECTRIC ACTUATORS



Special offer of aircraft quality, precision engineered rotary actuators by leading British manufacturers. In new or first-class used condition. For 24 volt operation.

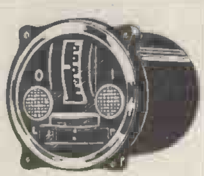
TYPE 2
Split field, series wound, reversible motor fitted with electro-magnetic brake. Max. load 50/60 lb./in. Output 0.02 h.p. at 13,000 r.p.m. Reduction gear ratio 2,857 to 1. Length 7in. Weight 2¼lb. Fitted with adjustable limit switches.

75/- Post paid.

TYPE 3
Similar in appearance to above. Designed for operation of 3-position-type valves in which actuator gives wide variety of angular settings determined by position of limit switches. Max. load 50 lb./in. Output 0.017 h.p. at 17,000 r.p.m. Full range travel: 140 deg. in 2 seconds. Weight 3.25 lb.

75/- Post paid.

VISUAL INDICATOR Model S.47



One vertical and one horizontal meter, together with two neons in durable black plastic case. Vertical meter: 0-400 microamps. Horizontal meter: 200-0-200 microamps. Neons housed in pull-out, bayonet type lampholders at rear of case. Size: 3¼in. dia. x 4¼in. overall. **Brand new.**

10/- Post & packing 2/6

ROOM TEMPERATURE THERMOSTATS

American Satchwell industrial quality type ST thermostat in neat, strong plastic case, size 1 x 1⅞ x 2¼in. deep. Heavy duty contacts rated at 15 amps. on 200/250v. A.C. (3¾ kW.), adjustable by pointer in a recess at rear to break over a range of temperatures around 70° F. Recessed screw terminals at rear. Flush metal plate at (temperature sensitive) front, with two mounting lugs protruding ⅛in. either side. Attractive red case. **Brand new 8/6.** Post paid.

8/6 post paid

CAMERA EXPOSURE METER

Extremely sensitive illumination meter by G.E.C. covering 0 to 50 foot candles and 0 to 500 Lux. Powerful 1½in. diameter photocell operates precision engineered moving coil meter with horizontal scale to provide a magnificent incident light exposure meter—particularly for colour work. Unit is brand new in E.R. case and is supplied complete with simple instructions and exposure computer for use as a 3-range sensitive exposure meter for all camera work. **Unique, limited quantity bargain offer.**

ONLY **27/6**
P. & P. 1/6.

GEIGER COUNTER TUBES

Low voltage, Halogen quenched Geiger Mueller tubes by a famous British manufacturer. Working voltage 400–450. Highly sensitive: effective length 11.8 cm. Background 90 counts/min.—max. response 30,000 counts/min. Plateau 80 volts. Stainless iron electrode. Similar to tubes fitted in high-grade instruments and used in demonstration counters on B.B.C. and I.T.V. programmes. IDEALLY SUITED FOR HOME-BUILT GEIGER COUNTERS, BASIC EXPERIMENTATION, AND INSTRUCTION AS WELL AS SERIOUS WORK. Circuits of simple, all-transistor and conventional valve counters supplied on request. Brand new and guaranteed.

25/- Postage 2/6

COLD CATHODE TRIGGER TUBES

Sub. miniature cold cathode valve developed by Ericsson primarily for computer work. Anode-cathode running voltage of 95 to 140 at 4.5 mA, and at 290 anode volts require a trigger current of only 250 microamps to cause the anode to take over the discharge. Typical ionization time: 90 microseconds. Will withstand up to 310 volts with zero trigger voltage without self-igniting. Complete with full performance data in original packs of 100 at the special price of **£5.0.0** Post paid.

Minimum quantity supplied: 6 for 10/- Post paid.

TELEVISION OSCILLOSCOPE

£6.10 Carriage 10/-.

Release of a small quantity of the latest version of the well known APN-4 Indicator Unit from the American Loran Airborn radio navigation system. This provides a golden opportunity to make a serious television servicing and development tool as described in *Wireless World*. Steel, double-deck, chassis with fully screened 5CP1 tube in the centre, all high-grade capacitors and resistors, separate tag boards and layout diagrams for individual sections etc. Modern circuit technique centred around one type of valve (14 of 6SN7 double-triodes and 8 of 6H6, plus three 6SL7 and one 6SJ7), and R.C.A. 100 kc/s Crystal. **Brand new with W.W. Circuit for conversion.**

MAINS OPERATED TIME SWITCHES

Superb, compact, precision time switches by a famous British manufacturer, consisting of absolutely silent, self-starting, synchronous clock and timing mechanism in attractive metal case. Can be preset to switch "on" and "off" in any period once in any 24 hours. Maximum switched current 10 A. Brand new.

40/- P. & P. 2/6

EXTRACTOR FANS

Brand new, 230/250 volts A.C. mains operated, extractor fans, absolutely complete except for external shrouding which can be readily made up from simple sheet metal wrapping to suit any particular installation. Continuously rated, smooth silent running induction motor. Balanced 3-bladed 6in. fan. Size 7¼in. dia. x 4in. deep.

27/6 P. & P 2/6.

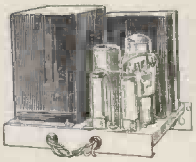
— BARGAIN OFFERS —

VCR139 (Cossor 23D equivalent) 2½in. cathode ray tube 15/-. Postage 2/6.
Mains suppressor in diecast sealed case, 2 for 5/-. Postage 2/-.
Double pole knife changeover switch on porcelain base, 2 for 4/-. Postage 1/-.
Pyrex aerial insulators, four 3in. OR one 7in., 6/-. Postage 1/6.
Neons, ten 115 volt for 19/-. Postage 2/6. Six 80 volts for 6/-. Postage 1/6.
Bulgin type "M" microswitches, 4 for 10/-. Postage 1/6.
Metal rectifiers: selenium 6-12 volt 1½ amp., 9/6. 2½ amp., 9/6. 4 amp., 16/6.
Charging transformers: Pri. 200/250 volts, Sec. 3½, 9 and 17 volts, at 4 amps., 18/6. Postage 3/-.
STC Miniature Silicon Diodes, input 50 v. peak inverse; output 15 v. 0.5 amp. D.C., 4 for 10/-. Post paid.
Mains Overload Cutout Switch. Preset at 13A. but adjustable. Instant reset. 2 for 5/-. Postage 1/-.
APN1 Transducer. 6/-. Postage 1/6.

PROOPS BROTHERS LTD., 52 Tottenham Court Road, London, W.1
Head Office and mail order enquiries, Dept. M. LANgham 0141
Shop hours 9 a.m. to 6 p.m. Thurs. 9 a.m. to 1 p.m. OPEN ALL DAY SATURDAY

AVO METER MODEL 7. Individually tested on all ranges and guaranteed. Inclusive of Test Leads. **£12/10/-** each. P. & P. 5/-.

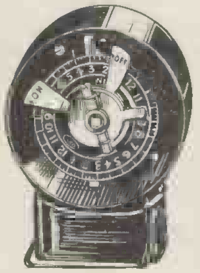
MAINS POWER SUPPLY UNITS.



Potted and sealed transformer and choke by famous maker. Mounted on metal chassis 6½ x 7½in., complete with 5Z4 rectifier valve and full smoothing.

Input tapped 220-230-240 volts.
Output: 300 V. D.C. at 100 mA.
6.3 V. A.C. at 4.5 amp.
6.3 V. A.C. at 2 amp.
Rectifier supply 5 V. A.C. at 3 amp. Very conservatively rated. Price 47/6 plus P. & P. 8/-.

MULLARD TRANSISTORS. OC170, 70 to 100 Mc/s., **13/6** each. OC171, 100 to 200 Mc/s., **14/6.**
Set of six 1 x OC44; 2 x OC45; 1 x OC81D; 2 x OC81. Six for **39/6.**



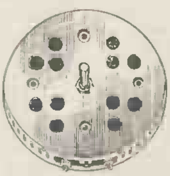
14-day clockwork TIME SWITCH

Contacts 2½ amp., 230 volt, 24 hour phase, ¼ hour divisions, allow setting for one make and one break to be made every 24 hours, complete with key. Used but guaranteed perfect. Price 27/6 each. P. & P. 2/6.

14-day clockwork TIME SWITCH as above but fitted with 5 amp. contacts and enclosed in an aluminium weather proof case. Price **35/-.** P. & P. 2/6.

Similar **TIME SWITCH,** 1 amp. contacts, loose not cased. Price **22/6.** P. & P. 2/-.

NEW RHEOSTAT.



1,750 ohms 100 watt. Wound on Ceramic former. In metal case with 1in. x ¼in. spindle. New in maker's packing. **32/6** each. P. & P. 3/-.

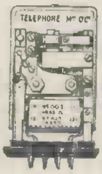
EX P.O. MAGNETIC COUNTER. 3 ohm type for 6 V. D.C. operation. 4 figures to 9,999. Price **8/6.** P. & P. 1/6.

20-WAY STRIP. Containing standard Post Office telephone Jack Sockets, overall size 11 x 3¼ x ¾in. New. Price **15/-** each. P. & P. 1/6.

NEW BALANCED ARMATURE HEADPHONES. TYPE DLR5. Guaranteed perfect. Price **12/6** each. P. & P. 2/-.

PHOTO MULTIPLIER, type 931A, for Alfa counting, film scanning, spectography, etc., new, inclusive of 11 pin valve holder. Price **£2/7/6.** P. & P. 1/-.

NSP2—CV2296 STROBOTRON FLASH. TUBE made by Ferranti, brand new, on I.O. base. Price **15/-.** P. & P. 1/-.



CARPENTER'S TYPE POLARISED RELAYS. 2 x 9,500 turns at 1,685 ohms. Price **22/6** each. P. & P. 1/-.

Bases for Carpenter relays ex new equipment, **3/6** each.

HIGH SPEED RELAY. Siemens. Two bobbins 1,000 ohms each. New, **10/6** each. P. & P. 1/-.

HIGH SPEED RELAY. Siemens. Two contacts 145 ohms each. New. **10/6** each. P. & P. 1/-.

VACUUM SEALED 3,100 OHMS RELAYS. Single pole changeover contacts in platinum. Pull in at 1.25 M.A. (4.25 volt). **Price 18/6** each. P. & P. 1/-.

G.E.C. SEALED RELAYS TYPE M1095. 24 volt 670 ohms. 2 make 2 break. Unused. Price **12/-** each. P. & P. 1/-.

G.E.C. SEALED RELAYS TYPE M1494. 24 volt 670 ohms coil. 2 pole C.O. Brand New. Price **10/-.** P. & P. 1/-.

NEW P.O. RELAYS TYPE 3000. 2,000 ohms. coil. 4 make 4 break, **12/6** each. P. & P. 1/-.

MINIATURE MOVING COIL DIFFERENTIAL RELAY. Two coils 350 ohms each.

Operating current minimum 140 microamp., nominal 400 microamp., maximum 8 milliamp. One pole two way, or centre stable. Two way contact current 100 mA. at 50 V. A.C. or D.C. Size 1¼ x ⅜ x ⅞in. Price **22/6** each.

MINIATURE MOVING COIL DIFFERENTIAL RELAY exactly as above but totally sealed in metal case. New. Price **27/6** each.

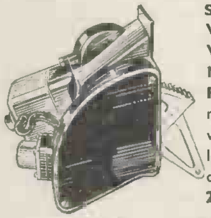
MINIATURE RELAYS 250 ohms. Two makes. For operation on 4.5-9 volt. Ideal for transistor circuits. Weight just over 1 oz. Price **12/6** each.

SIEMENS H.S. RELAY. Very latest type, sealed. H96E. 1,700 ohms plus 1,700 ohms, single C/O contacts. Brand new with fixing clip. In maker's cartons. Price **16/6** each, plus **1/-.** P. & P.

SOLENOID OPERATED MAGNETIC RELAY. Type 5CW/3945, 4 pole changeover, 10 A contacts 24 v. operation. Brand new **13/6.** P. & P. 2/-.

W.W. RHEOSTAT. New. 3.5K or 5K, 25 watts. Price **7/6.** P. & P. 1/6.

CROMPTON PARKINSON BRAND NEW ¼ H.P. MOTORS
230/250 VOLT A.C. 1,440 R.P.M.
Complete with 2in. SPINDLE.
Price £3/15/-. Carriage 8/6.



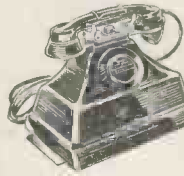
SPECIAL REVERSING 24-VOLT D.C. MOTOR 2 AMPERE. Quadrant moves 90 degrees with limit switches. Ideal for opening doors, etc. Price **22/6.** P. & P. 2/6.

CONSTANT SPEED, PRECISION MADE, BATTERY DRIVEN D.C. GOVERNED MOTOR (Elliott Bros.). Commutator/brush incorporating loading ballast resistor 2,470 r.p.m. ± 2% at 12 volt. Loss on 8.5 volt only 4%. Size 1¹⁄₁₆in. dia. x 2⅝ in. long. Spindle .77in. long x .15575in. dia. Weight 4 oz. New. Price **25/-,** plus 1/- P. & P. Ideal for portable tape recorders.

VARIABLE VOLTAGE TRANSFORMER, brand new, imported, highest quality electrical engineering, fully shrouded with voltage indicating plate. Input 230 volt A.C. Output fully variable from 0-260 volt A.C. at 20 ampere. Size 16″ × 12″ diameter. Nett weight. 53 lbs. Price **£32.10s.0d.** Carriage 15/-.

MINIATURE UNISELECTOR SWITCH. Two banks of ten plus home contacts one bank continuous of normal. 30 ohm coil for 24 volt operation. Brand new, manufacturer's packing. Price 22/6 each. P. & P. 2/6.

DESK TELEPHONE HANDSETS



Used but perfect. Complete with two-way calling system (buzzer), internal battery. All ready for simple two-wire connection. Price £3/2/6 each or £6 the pair. P. & P. 3/6 each handset.

DESK TELEPHONE SETS, similar to G.P.O. extension telephones. Each complete with automatic dial, internal bell and long connection core and junction box. Used but in perfect working order. Price **£2/17/6** each. P. & P. 4/-.

DIALS ONLY FOR AUTOMATIC TELEPHONES. Used but in good condition. Price **12/6.** P. & P. 2/-.

METERS GUARANTEED PERFECT

Charging Types	
2½ amp. D.C. M.I. 2in. fl. rnd	7/6
5 amp. D.C. M.I. 2½in. fl. rnd	11/6
7½ amp. D.C. M.I. 3½in. proj. rnd	12/6
9 amp. D.C. Hot Wire W.R. 2½in. fl. rnd.	6/6
15 amp. D.C. M.C. 2in. rnd	10/6
Voltmeters	
20 v. D.C. M.C. 2in. fl. sq	10/6
30 v. M.I. 3in. proj. rnd	10/6
300 v. A.C. M.I. 2½in. fl. rnd	22/-
400 v. A.C. M.I. 4½in. rnd	35/-
90-180 v. A.C. M.I. 4½in. fl. iron	25/-
Milliammeters	
1 mA. M.C. 2½in. fl. rnd	25/-
200 mA. M.C. 2½in. fl. rnd	12/6
500 mA. M.C. 2½in. fl. rnd	12/6
500 microamp., M.C. 2½in. rnd. F.L. scaled 15/600 volt. NEW	16/6

Postage on all meters 1/- each.

MINIATURE LATEST TYPE MOVING COIL MICROAMP METER, F.S.D. 300 microamp, flush mounting, square rim 1⅞in. x 1⅞in., round dial 1½in. Ideal as field strength meter or output level recorder or tuning meter. Price **26/-.** P. & P. 1/-.

LATEST TYPE ERNEST TURNER. 0-200 volt A.C. RECTIFIED M.C. METER. Flush mounting, round, 3in. scale. Price **37/6.** P. & P. 2/-.

SANGAMO WESTON DUAL RANGE VOLTMETER. 5 & 100 volt D.C. 3in. scale, F.S.D. 1 mA. Brand new in carrying case with Test Prods and Leads. **Price 27/6.** P. & P. 3/-.

ROTARY CONVERTER. Ex-W.D. for 12-volt D.C. input, output 230 volt 50 cycles at 100 watts. Housed in wooden carrying case with lid. Voltage control slider resistance, mains switch and 300 volt A.C. voltage output check meter. Perfect working order. Price **£9/17/6,** carriage 10/-.

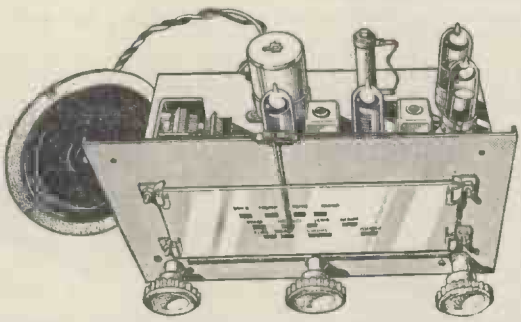
Postage and Carriage shown above are inland only. For overseas please ask for quotation. We do not issue a catalogue or list.

SERVICE TRADING Co.

PERSONAL CALLERS ONLY: **9 Little Newport Street, London, W.C.2** *Tel: GER. 0576.*
(OFF LEICESTER SQUARE)
ALL MAIL ORDERS. ALSO CALLERS AT:
47-49 High Street, Kingston-on-Thames
Telephone: KINgston 4585

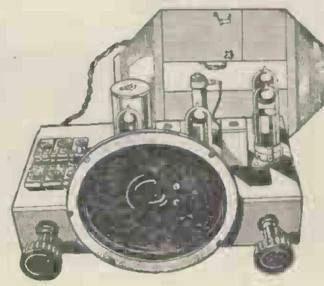
HARVERSON SURPLUS CO. LTD.

2 BAND SUPERHET CHASSIS
with Speaker **ONLY £5.17.6**
Plus 6/6 Post & Packing.



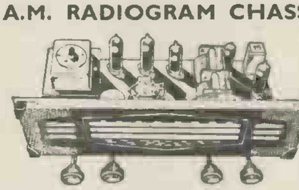
A quality 4 valve AC/DC superhet chassis made by a world famous manufacturer. Long and Medium wave coverage. Fitted with a cord and drum reduction tuning drive and attractive illuminated glass dial (size 6½ x 2½in.). Controls: Volume on/off, tuning and wave change. The receiver is self-powered, employing a mains dropper and a valve rectifier. Chassis dimensions 6½ x 9 x 5½in. high. Supplied complete with a good quality 5-inch loudspeaker, valves (UCH42, UAF42, UL41, UY41), AC/DC mains input lead, ivory knobs, etc.
DON'T HESITATE, ORDER NOW! This unbeatable bargain is bound to sell out quickly at only £5.17.6, plus 6/6 post and packing.

4 STATION PRESET CHASSIS
with Speaker **ONLY £4.17.6**
Plus 6/6 P. & P.



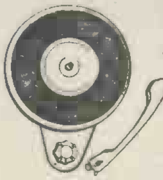
A compact, 4 station preset mains transportable receiver for operation from AC/DC mains. Two simple controls, volume on/off and 4 position station selector. The latter is set to Light Programme (Long Wave), Third Programme, Home Service and Light Programme (Medium Wave), but may of course be adjusted to alternative selections if required. A frame aerial with throw-out extension is supplied, making this receiver ideal as a general purpose transportable set for the home. A fully smoothed power supply is provided from AC/DC mains input by a mains dropper and a valve rectifier. The good tonal qualities are assisted by the provision of a quality 5in. speaker, which is ready-mounted on the chassis (this is easily detachable if alternative positioning is required). Valve line up, UCH, UAF42, UL41, UY41. This chassis (size 9 x 6½ x 5½in. high) is supplied complete with valves, knobs, mains lead, aerial, etc. It is beautifully made by a famous maker, and is a first-class buy at the rock bottom price of only £4.17.6, plus 6/6 post and packing.

A.M. RADIOGRAM CHASSIS



A chassis of distinction by a famous maker. Covering Long, Med. and Short Waves, plus gram position, this chassis (size 15½ x 7 x 6½in. high) incorporates the latest circuitry, using fully delayed A.V.C., and negative feedback. Controls: Tone, Vol. On/Off, W/Change (L.M.S. and Gram), Tuning. Tapped input 200-250 v. A.C. only. An attractive brown and gold illuminated dial with matching knobs, make this one of the most handsome, in addition to being one of the best performing chassis yet offered. Complete with valves (ECH81, EF89, EBC81, EL84, EZ81), knobs, output transformer, leads, etc. OUR PRICE ONLY **£9.19.6** plus 4/6 post & packing.

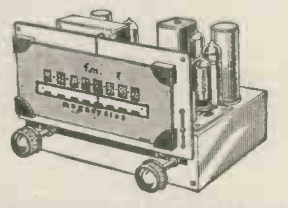
E.M.I. 4-speed Player and P.U.



Heavy 8¾in. metal turntable. Low flutter performance 200/250V shaded motor with tap at 80V for amplifier valve filament if required. Turnover LP/78 head. Price 89/6 Plus 4/6. P. & P.

CONDENSER RESISTOR PARCEL
50 mixed P.F. Condensers and 50 mixed Resistors. An assortment of useful values. All popular sizes—all new—a must for the serviceman and constructor.
ONLY **10/-** P. & P. 1/-.

HARVERSON'S F.M. TUNER KIT



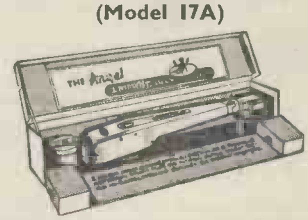
At last a quality F.M. Tuner Kit at a price you can afford. Just look at these fine features, which are usually associated with equipment at twice the price.

★ F.M. Tuning Head by famous maker. ★ Guaranteed Non-drift. ★ Permeability Tuning. ★ Frequency coverage 88-100 Mc/s. ★ OA81 Balanced Diode Output. ★ Two I.F. Stages and Discriminator. ★ Attractive maroon and gold dial (7 x 3in. glass). ★ Self powered, using a good quality mains transformer and valve rectifier. ★ Valves used ECC85, two EF80's and EZ80 (rectifier). ★ Fully drilled chassis. ★ Everything supplied, down to the last nut and bolt. ★ Size of completed tuner 8 x 6 x 5½in. ★ All parts sold separately.

£4.19.6 Plus 8/6 P.P & ins.

Circuit diagram and illustrations, 1/6, post free.

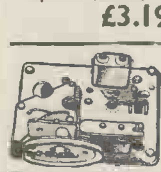
THE WORLD FAMOUS E.M.I. ANGEL TRANSCRIPTION P.U. (Model 17A)



A Pick-up for the connoisseur originally priced at £17.10.0. The last remaining few offered at £5.15.0, plus P. & P. 5/-.

SUPER STEREO KIT MK. II
A kit of ready-built units only requiring interconnection. Comprising two midget 3W amplifiers push button switch, transformer, control unit (bass, treble and vol.), power pack, two speakers, indicator light, valves (ECL82, EZ80 range), and comprehensive instructions.
£3.19.6 Plus 6/6 P. & P.

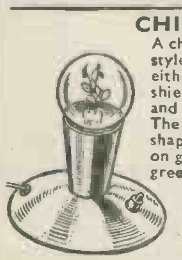
F.M. TUNER HEAD



A permeability tuned tuner head by a famous maker, supplied without valve (ECC85) 18/6 plus 1/9 P. & P. Valve 8/6 extra.

OUTPUT STAGE & SPEAKER FOR F.M. TUNER UNIT
All parts, including speaker, ECL82 valve, and simple instructions to make two-stage output unit for converting F.M. tuner into F.M. receiver. ONLY 45/-, plus 4/6 P. & P.

CHILD'S NURSERY LAMP



A child's night light of unusual design. Contemporary styled lampholder of robust construction finished in either red or yellow. Entirely safe (bulb socket shielded from "prying fingers"), complete with flex and a push-button switch. 200/250 volts A.C. only. The low-consumption bulb element is made in the shape of either flowers or angel fish, and when switched on glows in fluorescent colours (the flowers pink with green leaves, or the fish green with purple weed). Made by a famous manufacturer and originally priced at 29/6. *Please state lampholder colour preference, and whether fish or flower element is required.*
OUR BARGAIN PRICE ONLY **10/9** plus 9d., post and packing.

TRANSISTOR AMPLIFIER KIT
A complete kit of parts to build a compact 4-transistor amplifier, with volume control and printed cct. board. Two GT3 driver transistors, transformer coupled. 1 watt output from matched pair GT15. Supplied with output transformer and 2½in. 3 ohm speaker. Ideal for record player, etc. **59/6** Plus 4/6 P. & P.

SUPERHET CHASSIS—less Valves & Cabinet
Modern AC/DC chassis with printed circuit and ferrite rod aerial. Although not completely built, the main components are mounted. L. & M. wave coverage. 4 valves (UBF89, UCL83, UCH81, UY85). Everything supplied except valves and cabinet. With speaker and simple instructions. Plus 3/6 P. & P. **£3.3.6**

83 HIGH ST., MERTON, S.W.19.

CHErrywood 3985/6

AT ½ PRICE WHILE THEY LAST!
GOLDRING MU-METAL CASED PICK-UP CARTRIDGES

Sapphire styli. Brand new and boxed
Our Price £2.15.0 P & P 1/6 Including Ins.

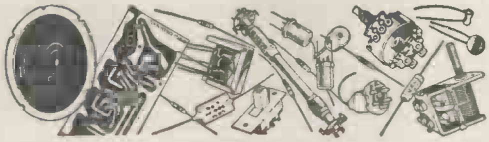
BARGAIN MONTH FOR TRANSISTORS

POWER				AMERICAN	
		OC78	6/6		
		OC78D	6/6		
OC36	10/-	GET15	9/-	2N388	6/6
OC44	9/-	GET15 (matched pr.)	16/6	2N1485	6/6
OC45	8/-	GET102	7/6	2S712	7/6
OC71	5/-	XA103	8/6		
OC75	6/6	PXA101	9/6	**DIODE**	
OC76	6/6	PXA102	9/6	OA81	3/-

Please add 6d. postage for each transistor.

6 TRANSISTOR SUPERHET KIT ★

The complete kit of parts with simple instructions, ONLY **£6/19/6.** Plus 2/6 P. & P. (Suitable cabinet if available 15/-.)



A first-class 2-waveband transistor superhet in kit form.
- ★ Printed circuit board (size 8¼ x 2¾in.)
- ★ 3 pre-aligned IF transformers.
- ★ Quality 5in. speaker.
- ★ G.E.C. first grade transistors.
- ★ Output transformer.
- ★ High gain ferrite rod aerial.
- ★ Push pull output.

VALVES

WE HAVE 20,000 IN STOCK, AT LOWEST PRICES EVER.
Send for your requirements.

OSCILLATOR COIL
Suitable for any tape deck. ONLY **5/6**, plus 6d. P. & P.

SPECIAL OFFER!
One dozen 6K7G **£1**, plus 2/6 P.& P.

REGUNNED T.V. TUBES
Any type, any size supplied.

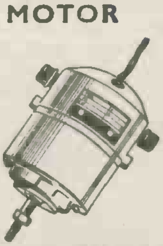
COSSOR CRT SNIP

10in. 108K	18/6
10in. 75K	18/6

EITHER PLUS 6/6 P. & P.

1/6 H.P. MOTOR

140 Watt (approx. 1/6 H.P.). Series wound, 220/250 volt 50 cycle motor. Off load 14,000 rev/min. on load 8,500 rev/min. Ideal small saw, sewing machine, etc. 30/-. Post free.



SWITCHED ATTENUATOR

Audio to V.H.F. in four steps of 20 dB ± 0.02 dB up to 300 M/cs. Cost £5.10.0. OUR PRICE Plus 1/- P. & P. **£1.19.6**

G.E.C. FIRST GRADE TRANSISTORS

Set comprising one 874 mixer, two 873 I.F.'s, one GET114 driver, two GET113 matched output and one diode. Post 1/-. **34/6**

THIS MONTH'S SPECIAL BARGAIN
PLESSEY 8 x 5 inch SPEAKER
3 OHM IMPEDANCE LARGE POT. ONLY 14/- SPECIAL OFFER Plus P.T.

COLLARO STUDIO TAPE DECKS.

We have a few only of the latest model at the Special price of
ONLY £11 Plus 5/6 post & insurance

CRYSTAL MICROPHONES

Ideal for tape recorders, use with amplifiers, intercom. etc.

T.S.L.	stick mike	**22/6**
ACOS	latest model	**18/6**

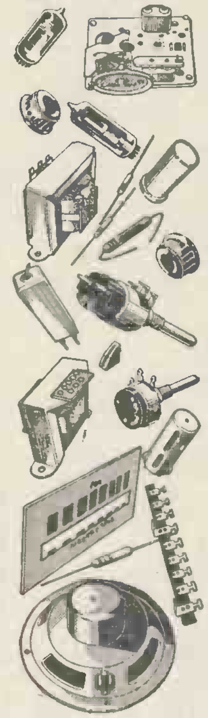
Postage 1/3 either model

THE HARVERSON COMPLETE F.M./V.H.F. RECEIVER KIT £6.19.6

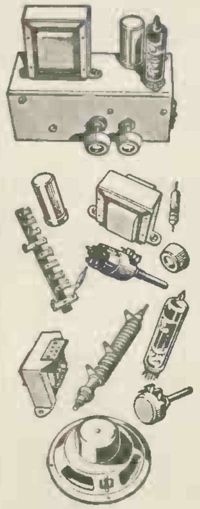
AT LAST—A COMPLETE F.M. RECEIVER IN KIT FORM !
Specially designed with the home constructor in mind, this kit enables the construction of a completely self-contained V.H.F. receiver, at fraction of the normal cost of comparable equipment. This is basically a quality self-powered F.M. tuner plus 2 separate audio amplifier stages, with output transformer and speaker.

- ★ F.M. Tuning Head by famous maker.
- ★ Guaranteed Non-drift.
- ★ Permeability Tuning.
- ★ Frequency coverage 88-100 Mc/s.
- ★ OA81 Balanced Diode Output.
- ★ Two I.F. Stages and Discriminator.
- ★ Self powered using a good quality mains transformer and valve rectifier.
- ★ Valves used ECC85, two EF80's, ECL82 and EZ80 (rectifier).
- ★ Fully drilled chassis.
- ★ Good quality speaker.
- ★ Well designed output transformer.
- ★ Attractive maroon and gold glass dial.
- ★ Two output stages (using ECL82).
- ★ Everything supplied, down to the last nut and bolt.
- ★ Compact size.
- ★ All parts sold separately.

OUR PRICE **£6.19.6** Plus 4/6 P. & P.



Introducing
HARVERSON'S Monaural Amplifier Kit — 39/6



In response to numerous requests from delighted purchasers of our "SUPER STEREO KIT" we have produced a "MONAURAL AMPLIFIER" on similar lines.

★ A UCL 82 valve provides a triode amplifying stage, and a pentode output stage (3 watts), enaling good amplification and sparkling reproduction to be combined with physical compactness (amplifier size, 7 x 3½ x 6¾in. high).

★ Modern circuitry design, good quality O.P. transformer (to match 3Ω) keep hum and distortion to a low level.

★ The controls, volume on/off and tone, are complete with attractive cream and gold knobs.

★ The amplifier has a built-in fully smoothed power supply, using a good quality mains transformer (A.C. mains only) and metal rectifier.

★ All you need is supplied including easy to follow instructions which guarantee good results for the beginner and expert. All components, leads, chassis, valve, knobs, etc., are first grade items by prominent manufacturers.

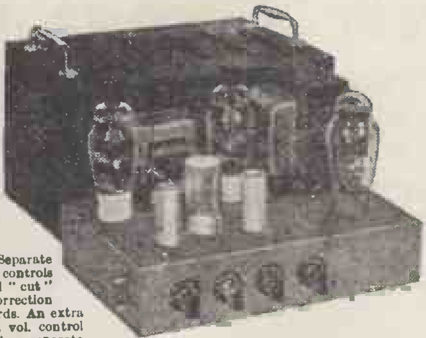
OUR PRICE Plus 4/6 Post and Packing **39/6**

5in. LOUDSPEAKER TO SUIT, 14/6 EXTRA
ALL PARTS SOLD SEPARATELY

TRANSISTOR SPEAKER

Western Electric 3Ω speaker. Size 2½ × 15/16in. deep
12/6 p.p. 1/-

R.S.C. A10 ULTRA LINEAR 30 WATT AMPLIFIER



HIGH FIDELITY PUSH-PULL UNIT EMPLOYING SIX VALVES. EF86, EF86, ECC38, 807, 807, GZ34. Tone Control Pre-Amp. stages are incorporated. Sensitivity is extremely high. Only 12 millivolt minimum input is required for full output. THIS ENSURES THE SUITABILITY OF ANY TYPE OR MAKE OF MICROPHONE OR PICK-UP. Separate Bass and Treble controls give both "lift" and "cut" with ample tone correction for long playing records. An extra input with associated vol. control is provided so that two separate inputs such as "mike" and gram, etc., can be simultaneously applied for mixing purposes. AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20 mA. and 6.3 t. 1.5 A. FOR A RADIO FEEDER UNIT. Price in kit form with easy to follow wiring diagrams.

ONLY Carr. 10/- **11 gns.** Or Factory built using latest EL34 output valves and with 12 month's guarantee. 14 GNS. TERMS ON ASSEMBLED UNITS. DEPOSIT 33/3 and 9 monthly payments of 33/3.

Protective Cover 19/9. Type 807 output valves are used with High Quality Sectionally Wound output transformer specially designed for Ultra Linear operation. Negative feedback of 20 D.B. in main loop. CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE. Frequency response ± 3 D.B. 30-20,000 c/s. Tone Controls ±12 D.B. at 50 c/cs. ± 12 D.B. to − 6 D.B. at 12,000 c/cs. hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue hammer. Overall size 12×9×9in. approx. Power consumption 150 watts. For A.C. mains 200-250 v. 50 c/s. Outputs for 3 and 15 ohm speakers. EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS OR OUTSIDE FUNCTIONS, IDEAL FOR USE WITH MUSICAL INSTRUMENTS, SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATES, etc., etc. We can supply Microphones, Speakers, etc., at keen cash prices or on terms with amplifiers. EXPORT ENQUIRIES INVITED.

FULL RANGE OF LINEAR HIGH FIDELITY AMPLIFIERS ALWAYS IN STOCK.

GL3A MINIATURE 3 WATT GRAM AMPLIFIERS

For 200-250 v. 50 c.p.s. A.C. mains. Overall size only 11¾ × 2½ × 2½in. Fitted Vol. and Tone Control with mains switch. Designed for use with any kind of single player or record changer unit. Output for 2-3 ohm speaker. Guaranteed 12 months. Only 59/6.

R.S.C. A5 4-5 WATT HIGH GAIN AMPLIFIER

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high fidelity pick-up heads in addition to all other types of pick-ups and practically all makes Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum-level is negligible being 71 D.B. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 26 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. For A.C. mains input of 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish and point-to-point wiring diagrams and Instructions. Exceptional value at only £4/15/- or assembled ready for use 25/- extra, plus 3/6 carriage. Or Deposit 22/- and five monthly payments of 22/- for assembled unit.

P.M. SPEAKERS. 2-3 ohms 2½in. Perdio 21/9. 5in. Goodmans 17/9. 7×4in. R.A. Elliptical 19/9. 6½in. Rola 19/9. 8in. Rola 19/9. 8in. Goodmans 25/9. 8×6in. Elac with high flux magnet 25/9. 10in. R.A. 28/9. 10×6in. Elliptical Goodmans 29/9. 12in. R.A. 29/11. 12 in. R.A. 3 or 15 ohms, 10 watts, 12,000 lines, 59/6.

TWEETERS. 4in. Plessey, 3 ohms 18/9. R.A. 15 ohms 25/9.

R.S.C. TRANSFORMERS Fully Guaranteed. Interleaved & impregnated.

MAINS TRANSFORMERS. Primaries 200-250-250 v. 50 c/s.

FULLY SHROUDED. UPRIGHT MOUNTING.

250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a. 2½-3-3in.	17/11
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	27/11
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	27/11
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	27/11
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	33/11
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t. 5 v. 3 a.	49/9
450-0-450 v. 250 mA., 6.3 v. 5 a., 5 v. 3 a.	59/9

TOP SHROUDED DROP-THROUGH TYPE

260-0-260 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.	17/9
250-0-250 v. 100 mA., 6.3 v. 3.5 a.	19/9
250-0-250 v. 100 mA., 6.3 v. 2 a., 6.3 v. 1 a.	21/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.	18/11
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	26/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	26/9
300-0-300 v. 130 mA., 6.3 v. 4 a., c.t. 6.3 v. 1 a., suitable for Mullard 510 Amplifier	29/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	29/9
425-0-425 v. 200 mA., 6.3 v. 4 a., 5 v. 3 a.	47/9

MIDGET CLAMPED TYPE. Primaries 200-250 v.

250-0-250 v. 60 mA., 6.3 v. 2 a., 2¾×2¾×2½in.	12/9
250 v. 60 mA., 6.3 v. 2 a. Size 2¾×2¾×2½in.	11/9

FILAMENT TRANSFORMERS

6.3 v. 1.5 a.	5/9	12 v. 1 a.	7/9
6.3 v. 2 a.	7/6	6.3 v. 3 a.	8/11
0.4-6.3 v. 2 a.	7/9	6.3 v. 6 a.	17/9
		12v. 3a. or 24v. 1.5a.	17/9

AUTO (Step Up/Step Down) TRANSFORMERS

50-80 watts 110-120 v./230-250 v.	11/9
150 watts 110-120 v./200-250 v.	27/9

OUTPUT TRANSFORMERS

Midget Battery Pentode 66:1 for 384, etc.	3/9
Small Pentode 5,000Ω to 3Ω	4/6
Standard Pentode 5,000Ω to 3Ω	5/9
Standard Pentode 8,000Ω to 3Ω	5/9
Multi Ratio, Single or P/P 3 or 15Ω	6/9
Push pull 8 watts EL84S to 3Ω	8/9
Push pull 8 watts EL84S to 15Ω	8/9
Push pull 10-12 watts 6V6 to 3Ω or 15Ω	16/9
Push pull 10-12 watts to match 6V6 to 3.5-8 or 15Ω	17/9
Push pull EL84 to 3 or 15Ω 10-12 watts	17/9
Push pull Ultra Linear for Mullard 510	27/9
Push pull 15-18 watts, sectionally wound, 6L6, KT 66, etc., for 3 or 15Ω	23/9
Push pull 20 watt high-quality sectionally wound, 6L6, KT 66, etc., or 4 or 15Ω fully shrouded	47/9

MICROPHONE TRANSFORMERS

120:1 High quabty. clamped	6/9
120:1 High quality Mu metal screened	8/9

SMOOTHING CHOKES

250 mA., 5 H., 100Ω	11/9	80 mA., 10 H., 350Ω	5/6
150mA. 7-10 H., 250Ω	11/9	60 mA., 10 H., 400Ω	4/11
100 mA., 10 H., 200Ω	8/9	1 amp. 0.5Ω L.T. type	6/6

LINEAR TAPE PRE-AMPLIFIER Type LP/1. Switched negative feedback equalistaion. Positions for Record 1⅞in., 3¾in., 7½in. and Playback. EM84 Recording level indicator. Designed primarily as the link between Collaro Tape Transcriptor and high fidelity amplifier but suitable almost any Tape Deck. **9 GNS.** Send S.A.E for leaflet.

LINEAR L45 MINIATURE 4/5 W. QUALITY AMPLIFIER Suitable for use with any record playing unit and most microphones. Negative feedback 12 D.B bass and treble controls. For A.C. mains input of 200-250 v. 50 c.p.s. Output for 2/3 ohm speaker. Three miniature Mullard valves. Size only 6×5×5½in. high. Chassis fully isolated from mains. Guaranteed 12 months. Only **£5.19.6** Or Deposit 22/- and 5 monthly payments of 22/-. Send S.A.E for leaflet.

LINEAR PRE-AMP/TREMOLO UNIT

Suitable for use with any Guitar Amplifier. Controls Volume, Frequency, Amplitude and switches. Valves: EF86 and EF80. Inputs for Guitar Pick-up or Mike, and Radio or Gram. Power required only 250/300 v. 20 mA. 6.3 v. 1 a. **5 GNS.**

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP STAGES

Two input sockets with associated controls allow mixing of "mike" and gram. as in A.10 High sensitivity. Includes 5 valves: ECC83, ECC83, EL84, EL84, 5Y3. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut." Frequency response ±3 D.B 30-30,000 c/cs. Six negative feedback loops. Hum level 60 D.B. down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs For STANDARD or LONG PLAYING RECORDS. For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc. OUTPUT SOCKET with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a RADIO FEEDER UNIT. Size approx. 12×9×7in. For A.C. mains 200-250 v. 60 c/cs. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. (Or factory built 51/- extra.) ONLY **8 Gns.** Car. 10/-

If required louvred metal cover with 2 carrying handles can be supplied for 18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/9 and 9 monthly payments of 24/9. Send S.A.E. for illustrated leaflet detailing ready-to-assemble Cabinets, Speakers, Microphones, etc. with cash and credit terms.

R.S.C. PORTABLE GUITAR AMPLIFIERS

JUNIOR 5 WATT. High Quality Output. Separate Bass and Treble "cut" and "boost" controls. Sensitivity 15 mv. High Flux 8in. l/speaker. Input sockets for Radio/Tape or Gram Pick-up and Mike /Instrument Pick-up. Handsome strongly made cabinet (size approx. 14×14×7in.). Finished in attractive and durable polychrome and fitted carrying handle.

£8.19.6 Carr. 7/6. Or Deposit £1 and nine monthly payments £1.

Send S.A.E. for leaflet.

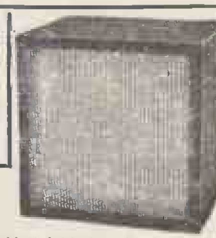
SENIOR 10 WATTS. High-Fidelity Push-Pull output. Separate Bass and Treble "cut" and "boost" controls. Twin separately controlled high gain inputs so that two instruments such as Guitar and String Bass can be used at the same time. Two Loudspeakers are incorporated: 12in. P.M. for Bass notes and one 7×4in. elliptical for Treble. Cabinet is well made and finished as for Junior model. Size approx. 18×18×8in 15 gns. Plus 10/- carr. H.P. TERMS DEPOSIT 34/9 and 9 monthly payments 34/9. SUPER HI-FI 15 WATT All facilities as 10 watt. Cabinet size 20 × 15 × 13 ins. 22 GNS. Carr. 12/6. Terms of Deposit £2.11.6 & 9 monthly payments 51/6.

COLLARO CONQUEST 4-SPEED AUTO-CHANGERS. With studio pick-up with turnover head. Latest model for 200-250 v. A.C. mains, £6/19/6. Carr. 4/6.

B.S.R. MONARCH AUTO-CHANGERS. Type UA8. 4 speed T/O Pick-up with sapphire stylus £6/19/6. Carr. 4/6.

Any of the above supplied with T/O stereo/monaural head for £1 extra.

COLLARO JUNIOR. 4-speed Single Players with Hi-Fi T/O crystal pick-up head, £3/19/6.



LOUDSPEAKER IN POLISHED WALNUT FINISHED CABINET. Gauss 12.000 lines. Speech coil, 3 ohms or 15 ohms. Only £4/19/6. Carr 5/-. TERMS: DEPOSIT 11/- and 9 monthly payments of 11/-.

12in. 20 WATT 15,000 line l/speakers 15 ohms in Cabinet finished as above. Size 18×18×8in. £7/19/6 Carr. 7/9. or Deposit 17/9 and 9 monthly payments of 17/9.

R.S.C. STANDARD EQUIPMENT CABINET. Designed to house a variety of equipment such as Tape or Record Player Unit, Amplifier and Tuned Unit. Size and appearance as per Reflex Cabinet below. These two cabinets, can be aligned to form a complete high fidelity assembly at a very attractive overall price. Only 6 gns. Set of legs with brass ferrules 25/-.

R.S.C. STANDARD BASS REFLEX CABINET for 12in. Loudspeakers. acoustically lined and ported. Size 20in.×14in.×13in. Beautiful walnut veneer finish. Especially recommended for use with Speaker below. £5/19/6. Set of four legs can be supplied with brass ferrules for 25/- per set.

PLESSEY DUAL CONCENTRIC 12in. P.M. SPEAKERS

(15 ohms) consisting of a high quality 12in. speaker of orthodox design supporting a small elliptical speaker ready wired with choke and condensers to act as tweeter. This high fidelity unit is highly recommended for use with our A11 or any similar amplifier. Rating is 10 watts. Gauss 12,000 lines. Price only £5/19/6. Or Deposit 13/9 and 9 monthly payments of 13/9.

LASKY'S RADIO

"CLARION" TRANSISTOR BATTERY TAPE RECORDER

Capstan drive, push-button controls. Constant speed $3\frac{3}{4}$ i.p.s., uses 3in. spools. High impact plastic case with transparent upper. Size: $9\frac{1}{2}\times5\times3\frac{3}{4}$in. List 25 Gns.

Lasky's Price, $16\frac{1}{2}$ Gns.

with Mike and Tape, Carr. 7/6.

The LATEST COLLARO STUDIO TAPE TRANSCRIPTOR. 3 motors. 3-speed $1\frac{7}{8}$, $3\frac{3}{4}$, $7\frac{1}{2}$ i.p.s., takes 7in. spools. Push-button controls, Digital counter. **Lasky's Price** complete with Spool, Carr. & Ins. 12/6. **£10.19.6**

TAPE PRE-AMPLIFIER

For use with any Tape Deck including Collaro, Motek, etc. Full recording facilities for $1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s., multi-position switch gives automatic equalisation by negative feed-back to each speed, 4 valves including magic eye level indicator. Overall dim.: $12\times4\times5$in. Front panel: $12\frac{1}{2}\times3\frac{3}{4}$in. Attractive gold hammered finish.

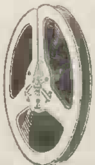
LASKY'S PRICE 9 Gns. Post 3/6.

TRANSCRIPTION MOTORS

GARRARD 4HF, stereo or mono, with plug-in head......	£19 8 7
GARRARD 301	£23 9 9
GARRARD 301 (Strobe)	£25 2 6
GARRARD A with GC8	£22 9 9
GARRARD A with GCS10	£23 5 6
PHILIPS AG/2009	10 Gns.

Carr. and Ins. 12/6.
Also Lenco, Connoisseur, etc.

FULLY GUARANTEED TAPE AT RECORD LOW PRICES



Famous make, P.V.C. base on latest type plastic spools. New, perfect, boxed, guaranteed.

1,200ft. on 7in. spool.........	18/-
1,800ft. on 7in. spool.........	28/6
1,200ft. on $5\frac{3}{4}$in. spool.........	18/6
850 ft. on $5\frac{3}{4}$in. spool.........	15/6
600ft. on 5in. spool............	12/-
225ft. on 3in. spool............	6/6
2,400ft. D.P. on 7in. spool...	55/-
SCOTCH 1,200ft. P.V.C. on 7in. (Listed 35/-)	21/-

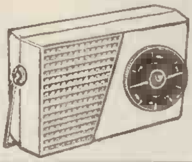
ALL OTHER MAKES, TYPES AND SIZES OF TAPE IN STOCK, INCLUDING E.M.I. AND SCOTCH.

LASKY'S FOR POCKET AND ALL TYPES OF TRANSISTOR RADIOS!

LARGEST SELECTION IN GREAT BRITAIN

An unsurpassed choice at the keenest prices, including the latest med./long and med./short wave models. Call and select or order by post.

FIDELITY 6	$9\frac{1}{2}$ Gns.
LEECO 6	$9\frac{1}{2}$ Gns.
PROGRESS 6	$9\frac{1}{2}$ Gns.
PERDIO 6	$11\frac{1}{2}$ Gns.
CROWN 6	£10 19 6
DANSETTE 6	15 Gns.
PHILIPS 7	15 Gns.
SONYA 6	15 Gns.
SONYA 8 m/short	22 Gns.
TOSHIMA 7, m/long ...	16 Gns.
NATIONAL 7, m/short	23 Gns.
N.V.C. 10, 2 short & med.	$29\frac{1}{2}$ Gns.
Regd. post and insurance,	5/-.



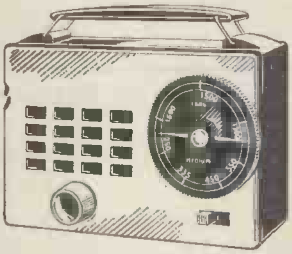
THE "TORONTO 3"

Employs three transistors plus germanium diode and built-in ferrite rod aerial. Tunable over medium and long waves. Dimensions: $5\frac{1}{2}''\times3''\times1\frac{1}{2}''$ overall. CAN BE BUILT FOR 32/6. Post 1/6. Circuit diagram and step-by-step instructions, 1/6 (free with parcel).

THE NEW "ALBERTA 5" TRANSISTOR POCKET RADIO

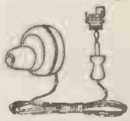
Push-pull. 200 milliwatts output. 5 transistors and tw diodes, $2\frac{1}{2}$in. moving coil speaker, ferrite rod aerial. Med. and long wave. Smart plastic case, $4\frac{3}{4}\times3\frac{1}{2}\times1\frac{1}{2}$in. overall.

CAN BE BUILT FOR 59/6 Post 2/-.



Circuit diagram and data 1/6 (free with parcel) All components available separately.

MINIATURE EARPIECES for Pocket Transistor Radios. Transparent ear-insert with 3ft. cord, sub-min. jack and socket. Fully guaranteed. Post free.



CR.5. Crystal, high imp. 9/-.
MR.4. Magnetic, low imp. 8/-.

BUILD THIS 3-SPEED TRANSISTOR RECORD PLAYER

FOR ONLY £9.19.6 Post free

6 v. operation for all L.P. and standard records. All components available separately as below.

AMPLIFIER. 300 milliwatts p.p. output using two OC71 and two OC72. Fully assembled, 79/6. Knobs, 3/6 extra. Post 2/6.

SPEAKER. 30 ohms, 7×4 elliptical, matched to amplifier, 25/-. Post 2/-.

3-SPD. TURNTABLE. 6 v. complete with t.o. crystal cartridge and two sapphire styli, 79/6. Post 2/6.

CARRYING CASE. Smart two-tone finish, size $17\times14\times5\frac{3}{4}$in. high, 49/6. (Batteries extra.) Post 6/6.

"KINEMATIX" STEREO BALANCE METER UNIT

Brand new U.S.A. import. Gives perfect balance in seconds, enabling stereo effect to be re-created in any particular area of room. For use with all hi-fi stereo amplifiers. Complete in smart polished wood Cabinet, $6\frac{1}{4}\times3\frac{1}{4}\times4$in., with instructions. Listed at 7 Gns.

LASKY'S PRICE 59/6 Post 2/6.

SPECIAL OFFER!

"VERDIK QUALITY TEN"

HI-FI AMPLIFIER & PRE-AMPLIFIER

10-watt push-pull ultra linear, using two EF86, one ECC83, two EL84 and EZ81 rectifier, 5 inputs, bass and treble controls. Grey green enamel finish with gold lettering on control panel. New and fully guaranteed.

LISTED AT £21

LASKY'S PRICE £14.19.6

Post & Pkg. 7/6.

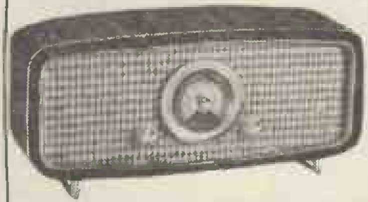
LAST FEW! AVANTIC AMPLIFIERS

SP21. Stereo Pre-amp Control Unit. £16/19/6. Carr. and ins. 7/6.

PL6/21. 20-watt Monaural Amp. and combined control unit. 19 Gns. Carr. and Ins. 7/6

"LINEAR" AMPLIFIERS

"Diatonic" 10-14 watts............	12 Gns.
"Concord" 30-watt	16 Gns.
L.45 4.5-watt	£5 19 6
LT45 Tape Deck Amp.	12 Gns.
L10 10-watt with pre-amp..........	15 Gns.
L50 50-watt	22 Gns.
L5/5 Amplifier and Pre-Amp.......	12 Gns.



"SUPER 60" 6-TRANSISTOR S/HET TRANSPORTABLE

Printed circuit construction, all components of highest quality. Uses 6 Mullard matched transistors, 1 diode, two OC81 valves in push-pull, giving 1 watt undistorted output. I.F. 470 Kc/s. Medium and long wavebands. Ferrite rod internal aerial, high flux 7×4in. Loudspeaker. Walnut veneer finish Cabinet with gold embellishments. Size $18\times8\frac{1}{2}\times5$in. deep.

CAN BE BUILT FOR £9/15/-

Circuit diagram and full data supplied. Every component available separately.

MICROPHONE BARGAINS

ACOS CRYSTAL STICK MIKE. Type M.C.39/1, complete with cable. List £5/5/-, **LASKY'S PRICE 39/6** Post free.

Crystal Hand or Table Mike, 15/-. Post free.

MINIATURE moving coil dynamic microphone. incorporating switch and pocket clip. As used for the "Fi-Cord" 35/-. Post 1/6.

LASKY'S MIDGET T.R.F.

An enormously popular Table Radio for A.C. mains 200/250 v. Med. and long wave. Can be built absolutely complete for only **99/6** Post 5/-. Full data, circuit diagram, etc., 1/6. (Free with parcel.)

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

LASKY'S RADIO

★ *Largest and most comprehensive stocks of all components, test gear, etc., and finest values in Great Britain.*

DON'T MISS THIS BATTERY CHARGER BARGAIN

Mains input 200-250 v. A.C. 6 and 12 volts, 2 amp. output. Latest type rectifier. Metal case, 6×3×3in., hammered grey finish. Lasky's Price **21/-** P. & P. 3/-.

4-SPD. AUTO-CHANGERS

B.S.R. UA12, STEREO	£7 19 6
B.S.R. type UA8	£6 19 6
B.S.R. UA8, STEREO	£7 19 6
B.S.R. type UA14	£7 19 6
COLLARO Studio C60 wired for stereo, with monaural p.u.	£7 19 6

Post on all above 5/-.

GARRARD

Model 120	£8 8 0
Model 121	£9 9 0
Model 209	£9 19 6
Mdl. 210 STEREO	£11 0 0
Mdl. 210 MONO/STEREO	£12 10 0
RC.88	£12 19 6
RC.88 STEREO	£13 10 0
RC.98	£14 19 6

SINGLE PLAYERS

Auto start and stop. Complete with pick-up and crystal cartridge.

GARRARD 4SP	£6 19 6
GARRARD TA Mk. II, wired for STEREO, plug-in head	£8 9 0
E.M.I. 4-spd., wired for STEREO, fitted mono cartridge	£5 19 6
As above, STEREO	£6 19 6

Post on all above 5/-.

COLLARO JUNIOR 4-speed motor and separate pick-up 75/-
B.S.R. TU9, non-auto Turntable and separate pick-up 79/6
Post free.

PICK-UP CARTRIDGES

ACOS, G.P.67 turn over crystal cartridge with L.P. and standard styli. List 39/7. **Lasky's Price 18/-**

ACOS 73-1A STEREO. List 52/6. **Lasky's Price 29/6** post free.

SPECIAL LOW-PRICED F. M. TUNER PARCEL

Uses Philips permeability tuning heart, freq. coverage 88-100 Mc/s. 2 I.F. stages. 3 valves, plus magic eye and EZ80 rect. Self-powered. Dim.: 8×6×5½in. Complete Parcel circuit diagram. data.

99/6 P. & P. 8/6.

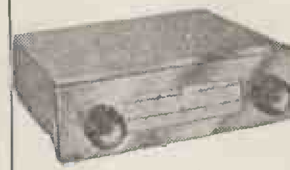
All components sold separately.

SPECIAL OFFER! World-famous "BOGEN" TAPE RECORDER HEADS. 4 track, high fidelity full frequency range. Type UK.205 RECORD/PLAY BACK. Type BL.216 ERASE. Listed at 16 Gns. per pair. **Lasky's Price £9/19/6. Post 2/6.**

HIGH FIDELITY TAPE RECORDER HEADS. Leading make, new and unused. Upper or lower track. RECORD/PLAYBACK, high impedance. Double wound and will reproduce up to 12,000 c.p.s. at 7½ i.p.s. Azimuth adjustments. Output 5 millivolts at 1 Kc. at 7½ i.p.s. ERASE, low impedance. **Lasky's Price 29/6** Post free. Per pair. Please specify upper or lower track. **SET OF 4** (upper and lower) **49/6.**

LASKY'S CAR RADIO

CAN NOW BE BUILT ABSOLUTELY COMPLETE FOR £9.19.6



- ★ Small size. Will fit any car
- ★ 12 volt operation
- ★ New Hybrid circuit
- ★ Transistor output
- ★ New type Brimar valves
- ★ No Vibrator, 12 volt H.T. & L.T.
- ★ T.C.C. Printed Circuit and Condensers.
- ★ Tuned R.F. stage
- ★ Medium and long waves
- ★ Permeability tuning
- ★ 7in.×4in. elliptical speaker

Instruction Booklet giving full details, illustrations, dimensions, circuit diagram and shopping list, 2/6 post free (returned if you order).

Better than ever!

OUR NEW 1961/2 COMPONENTS CATALOGUE

Completely new edition of over 100 pages, 8½in.×5½in., copiously illustrated, packed with money-saving bargains! Invaluable for the "ham" or service man.

Price 2/-, post 6d.

Our latest 12-page "Bargain Bulletin" included free (separately, by post, 6d.).

TRANSISTORS

P.N.P. Junction types.

AUDIO, suitable for high gain and low freq. amplifiers and for output stages up to 250 milliwatts. Double spot—yellow and green........ 3/6

R.F., suitable for medium and low freq. oscillators, freq. changers and I.F. amplifiers (1.5 to 8 Mc/s.). Double spot—yellow and red... 4/6

Type TS1. Suitable for all audio applications .... 2/6 Post 6d. One dozen 28/- post free.

Type Z, audio........ each 2/- One dozen, 23/- post free.

Special prices for larger quantities.

OC44	OC45	OC70	OC71	OC72
11/-	10/-	6/6	6/6	8/-
OC73	OC75	OC76	OC81	OC26
16/-	8/-	8/-	8/-	25/-

OC78 8/6 (Matched Pair, 17/-).

EDISWAN MAZDA TRANSISTORS. The very latest types: XB/102 7/6; XB/103 7/6; XC/101 10/6; XA/101 12/6; XA/102 12/6.

SPECIAL OFFER. Set of 7 Ediswan Transistors: XA/101, XA/102, 2 XB/102, XB/103, 2 matched XC/101. Price 49/6.

CRYSTAL DIODES. General Purpose GEX00, each 1/-, Per doz. 9/-. All other types in stock.

"GOLTOP" POWER TRANSISTORS

All types in stock. Example: V15/10P. Ideal for output stage of car radio, will give approx. 3 watts operating from 12 v. Each 15/- post free. Suitable Output Transformer for above, correct ratio, matched to 3 ohms, 9/6. Post 1/-. Driver Transformer, 9/6. Post 1/-.

SUB-MIN COMPONENTS

As used in the smallest Japanese pocket transistor radios. Coils, Loudspeakers, I.F. transformers. Ganged Condensers etc., in stock at lowest prices. Also all T.S.L. transistorised Miniature Units.

12-CHANNEL TURRET TUNERS

Large selection, many by famous makers such as Cyldon, Brayhead, Plessey, Cossor, etc., all I.F.'s. New and unused. Let us quote you for the model required. Examples: 33-38 mc/s., 29/6; 6-9 mc/s., 59/6; 9-14 mc/s., 59/6; 14-25 mc/s., 59/6

P.M. SPEAKERS

3½in.	4in.	5in.	6½in.	8in.	10in.
17/6	19/6	10/6	16/-	16/6	25/-

12in. 27/6. ELLIPTICAL:—

7×4	9×6	10×2½	10×6	10×7
12/6	22/6	25/-	25/-	25/-

Post extra.

WHARFEDALE 12in. FULL FREQUENCY HIGH FIDELITY SPEAKER

Mdl. SUPER 12/FS/AL. Aluminium voice coil, 15 ohms, 17,000 lines, foam plastic suspension. 15-30 watts peak. Brand new in maker's cartons. List £17/10/-. **LASKY'S PRICE £12.19.6** Carr. 7/6.

G.E.C. 8in. METAL CONE SPEAKER

Listed at £9/10/-. **LASKY'S PRICE £5.19.6** Carr. 4/-.

Presence Units 59/6. Post 3/6. All G.E.C. accessories available including auto-trans., cabinets, etc., at greatly reduced prices.

C.R. TUBE BARGAINS

NEW AND UNUSED

FERRANTI 12in. types T12/44 or 9in. type T9/3 4 v. heater........ 49/6
FERRANTI 17in. type TR17/10, 6.3 v. .3 amp. heater........ £6/19/6
Carr. and Insur. 12/6.

16in. METAL CONE, famous make, type T901/A, 6.3 v., 0.3 amp. heater £6/19/6 Carr. & Insur. 21/-.

17in. 90 degrees C.R. TUBES Seconds but in perfect working order and guaranteed........ 79/6 Carr. and insur. 12/6.

RE-GUNNED C.R. TUBES
GUARANTEED FOR 12 MONTHS

Type	From	Carr. & Ins.
12in. round	£5 10 0	12/6
14in. rect.	£5 10 0	12/6
15in. & 16 round	£5 19 6	12/6
17in. rect.	£5 19 6	12/6
21in. rect.	£7 19 6	21/-

RE-BUILDING CLEARANCE BARGAINS

at 42 Tottenham Court Road. Innumerable oddments and components clearing at silly prices. Callers only. Pay an early visit!

KAPURA Model U1 MULTI-TEST METER

Sensitivity: 1,000 ohms per volt A.C. and D.C. **Ranges:** (A.C. and D.C.) 0-15-50-250-500-1,000 v. D.C. current 0-100-500 m/a. 0-1 m/a. (used at 0-10 v. range). **Resistance:** 12,000 ohms (centre 24 ohms), 100-20,000 ohms (centre 2.4 k.). **Size:** 5in.×3in.×2½in. Complete with test leads **59/6** Post 2/6. Brand new fully guaranteed.

OTHER MULTI-METER BARGAINS

Model EP-10K, 10,000 ohms per volt, A.C./D.C., £5/19/6. Post 2/6.

Model 200H. 20,000 ohms per volt, A.C./D.C., £6/19/6. Post 2/6.

TAYLOR 127A. 20,000 ohms per volt, A.C./D.C., £10. Post free.

20,000 VALVES IN STOCK Brand new surplus and imported also full stocks of B.V.A. valves. List post free.

33 TOTTENHAM COURT ROAD, W.1.

2 mins. Oxford Street. Nearest Station, Goodge Street MUSeum 2605

207 EDGWARE ROAD, W.2.

Few yards from Praed Street PADdington 3271/2

Both addresses open all day Saturday. Close 1 p.m. Thursday.

PLEASE ADDRESS ALL MAIL ORDERS TO DEPT. W, AT ABOVE EDGWARE ROAD ADDRESS.

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

Wilkinsons EST. 1921

NEW STOCKS OF METERS

A.C. rectifier type 3½in.
moving coil—flush round

MICROAMMETERS & VOLTMETERS

Best Makes ★ Delivery off the shelf ★ Send for lists

Selection from our other stocks

Postage on meters 1/6

New Taylor pocket-size Multimeter Model 127A, 20,000 ohms per volt, 20 megohms, 20 ranges. A.C. & D.C. £10. Post 2/6.

F.S.D.	Size	Type	Price
100 Microamp	3½in.	MC/FR	80/-
50 Microamp	2½in.	MC/FR	75/-
250 Microamp	2½in.	MC/PR	40/-
500 Microamp	2½in.	MC/FR	37/6
1 Milliamp	2½in.	MC/FR	35/-
2 Milliamp	2½in.	MC/FR	25/-
100 Milliamp	2½in.	MC/FR	25/-
1 Ampere	2½in.	MC/FR	35/-
3 Ampere	2½in.	MC/FR	35/-
5 Ampere	2½in.	MC/FR	35/-
10 Ampere	2½in.	MC/FR	35/-
20 Volts	2½in.	MC/FR	35/-
30 Volts	2½in.	MC/FR	35/-
40 Volts	2½in.	MC/FR	35/-
500 Microamp	2in.	MC/FR	25/-
1 Milliamp	2in.	MC/FR	27/6
5 Milliamp	2in.	MC/FR	27/6
10 Milliamp	2in.	MC/FR	27/6
20 Volts	2in.	MC/FR	27/6
30 Volts	2in.	MC/FR	27/6
40 Volts	2in.	MC/FR	27/6
15 Amps	2in.	MC/FR	15/-
3 Amps	2in.	MC/FS	27/6
5 Amps	2in.	MC/FS	27/6
30-0-30 Amps	2in.	MC/FR	17/6
50-0-50 Amps	2in.	MC/FS	17/6
25 Amps D.C.	2¾in.	MI/FR	7/6
300 Volts A.C.	2½in.	MI/FR	25/-

Post 2/- on all meters

A.C. MOVING IRON METERS 4IN. Suitable for flush or projection fitting. Matching types 600 volts £5/10/-; 50 amps. **£3/10/-**, post 4/-.

WEE MEGGER. 500 volt. In leather carrying case, **£17/10/-**. post 4/-.

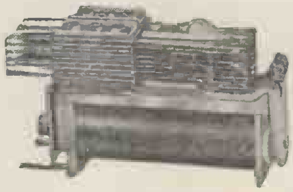
FREQUENCY METERS. 45-55 cycles per second, 230 volts, 6in. dia. Flush Round. Brand new in maker's box, £10/10/- post 4/-.

PORTABLE VOLTMETER. 0-160 volts A.C./D.C., accuracy within 2%, 8in. mirror scale, knife pointer, in polished case. A precision moving iron instrument at a very low price, **£4/19/6**, post **4/-**.

PORTABLE AMMETER. 0-3 amp. A.C./D.C. 3in. scale in case 35/-, post 2/6.

AMMETER. 0-3 amps. D.C. by Turner, MC/FR, 6in. 90/-, post 3/-.

MICROAMMETER. 250 F.S.D. 3½in. F.R. Sangamo Mod. S37. Scaled for valve voltmeter. Circuit available free, **55/-**, post 2/-.



RELAYS P.O. TYPE 3000

Built to your own specification
Keen Prices
Quick Delivery
Contacts up to 8-Changeover

MINIATURE RELAYS

Siemens High Speed Sealed		
2.2Ω+2.2Ω	H96A	15/6
500Ω+500Ω	H96D	22/6
1700Ω+1700Ω	H96E	25/-
Siemens High Speed Open		
100Ω+100Ω	H85N	15/-
1000Ω+1000Ω	H95A	17/6

S.T.C. and G.E.C. Sealed

700Ω	2 C.O.	4184GD	19/6
2,500Ω	1 m HD	4186EE	22/6
180Ω	2 m 2 b	M1087	19/6
670Ω	4 C.O.	M1092	21/6
670Ω	2 m 2 b	M1095	21/6
2,500Ω	1 C.O.	M1022	22/6
5,000Ω	2 C.O.	M1052	25/-

Comprehensive range available from stock.

RELAYS MAGNETIC SOLENOID OPERATED

24 volts D.C. 4 make and 4 break 10 amp. contacts. 5C/3044. Brand new, complete with dust cover, 12/6 each, post 2/-.

BARTLETT ELECTRIC DRYING OVENS. Internal dimensions 20in. × 20in. × 20in. 230 volt A.C. with adjustable thermostat giving automatic temperature control. Temperatures up to 160° Cent. shown on built-in gauge. Rotary on/off switch with pilot lamp. Brand new, **£40**, carriage 20/-.

HEADPHONES. High resistance 4,000Ω with cords, **17/6**, post 2/-.

ATTENTION ALL MANUFACTURERS.
ONE HOLE FIXING SWITCHES. Single-pole double-throw 3 amp., 250 volts A.C. 1/6 each; 12/- doz.; £37/10/- per 1,000. Ask for quotation for 5,000 or upwards. 100,000 available from stock now!

Your Own Telephone 75/-

TELEPHONE SET TYPE " A." Ringing and speaking both ways on a four-core cable. Carries the voice loudly and clearly over any distance. Two handsets are supplied as illus. and the set is comp. with Pushes, Buzzers, Battery, Plugs and Sockets. Suitable 4-core PVC cable **10d.** per yd. Price **75/-** set, post **4/-**.

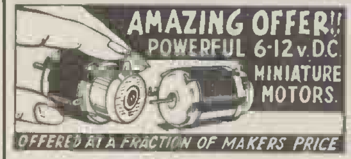
TELEPHONE SET TYPE " K." The most compact telephone set available as the 4½in. flat battery and buzzer is built-in to the hand instrument. Ringing and speaking both ways on twin wire. Instrument is complete with 5ft. flex. Easily hangs on the wall. Set of two instruments, **£5/10/-**, post 4/-. Two core flex, **3d.** yard.

RACKS—POST OFFICE STANDARD. 6ft. high with U-channel sides drilled for 19in. panels, heavy angle base.

BULKHEAD FITTING. 9in. diam.; flat tripod type, suitable for lamps up to 100 watt, complete with pushbar switch lampholder. Ideal for farm buildings, garages, greenhouses, etc. Brand new, **17/6**, post 3/3.

T.C.C. CONDENSERS. Paper block type, 6 mfd. 400 v. A.C. wkg., **12/6**, post 2/6. 1 mfd., 10 kv. **65/-** each. All types of condensers available.

RESISTORS EX STOCK IN QUANTITY. WIRE WOUND, HIGH STABILITY CARBON, ETC. BEST MAKES AT LOWEST PRICES ALSO POTENTIOMETERS AVAILABLE



WONDERFUL VALUE, ONLY 15/6. Post 1/3. Weighs only two ounces. 7,000 r.p.m. Reversing switch. Free length of polythene drive.

¼ H.P. CAPACITOR MOTORS

230/240 volts, 50 cycles, 1,420 r.p.m. ½in. shaft on standard foot mounting or with ⅝in. shaft, resilient mounting. Either type, **£5/10/-**, carriage **10/-**.

VACUUM PUMP AND COMPRESSOR. Edwards type IV, ½in. shaft, complete with flywheel, couplings, oil and filter union, **£6/10/-**, post **6/-**.

CERAMIC WAFER SWITCHES. Full list available.

1 Bank 1 pole 3-way	4/6 each	2 Bank 2 pole 4-way	10/6	each
1 Bank 1 pole 5-way	5/6 each	3 Bank 1 pole 11-way	18/-	each
1 Bank 2 pole 2-way	5/6 each	8 Bank 6 pole 2-way	7/6	each
2 Bank 1 pole 11-way	12/6 each	3 Bank 4 pole 3-way	7/6	each
2 Bank 1 pole 12-way	7/6 each	4 Bank 2 pole 4-way	18/6	each

Others, incl. Paxolin types, 1 Bank 3/6, 2 Bank 5/-, 3 Bank 6/6, post 1/6.

ELECTRO MAGNETIC COUNTERS

Counting up to 9999

Large size as illustrated, 2-6 volts D.C., or 75-120 volts D.C. **15/-**.

HIGH SPEED TYPE

1×1×3½in. operating from 100-120 volts D.C. Coil resistance 2,300 ohms. Ten counts per sec. Type 100B **35/- each,** post **2/-**.

LOUDSPEAKER BARGAINS. AXIOM 150 dual cone 12in., 15 watts 15 ohms. Fully dustproof, **£7/19/6**, carr. 7/6. **ELAC** 5in. round, 3 ohms, **11/6**, post **2/-**. **PYE** 10in. Portable. 3 ohms. Built into wooden carrying case and complete with 45ft. waterproof flex and jack plug, **50/-**, carr. **7/6**.

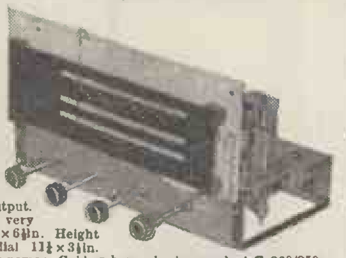
FANS INDUSTRIAL TYPE. 230/240 volt A.C. Capacitor Motor, 16in. blades, adjustable louvres, filter. Ideal for paint shop, **£20**, carr. 25/-.

AIR BLOWER powered by a 230 v. A.C. motor, 15in. fan. Volume of free air at max. r.p.m. is 1,250 cu. ft. per min. At maximum efficiency 900 cu. ft. per min. Brand new, **£25**, carriage 30/-.

L. WILKINSON (CROYDON) LTD.
19 LANSDOWNE RD. CROYDON SURREY
Phone: CRO 0839 Grams: WILCO CROYDON

7 VALVE AM/FM RADIOGRAM CHASSIS

Valve Line-up: ECC85, ECH81, EF89, EABC80, EL84, EM81, EZ80.



Three Waveband and Switched Gram positions Med. 200-500 mm., Long 1,000-2,000 m., VHF/FM 88-95 Mc/s. Philips Continental Tuning insert with permeability tuning on FM and combined AM/FM IF transformers, 460 Kc/s. and 10.7 Mc/s. Dust core tuning all coils. Latest circuitry including AVC and Neg. Feedback. Three watt output. Sensitivity and reproduction of a very high standard. Chassis size 13½ x 6¾in. Height 7½in. Edge Illuminated glass dial 11½ x 3½in. Vertical pointer. Horizontal station names. Gold on brown background. A.C. 200/250 v. operation. Magic-eye tuning.

***Aligned and tested ready for use.* £13 . 10 . 0** *Corr. & Ins. 5/-.*

Complete with 4 Knobs—walnut or ivory to choice. Indoor FM aerial 3/6 extra.

3 ohm P.M. Speaker only required. Recommended Quality Speakers 10" H/DUTY PLESSEY 30/-, 8" H/DUTY ROLA 25/-. P. & p. 2/6.

RECORD PLAYER BARGAINS Latest 4-speed models

NEW RELEASE by E.M.I.—4-speed Single Player Unit fitted with latest stereo and monaural Xtal cartridge and dual sapphire styli. Auto stop and start. A fidelity unit and bargain buy at only £6/19/6, carr. & ins. 3/6.

SINGLE PLAYERS B.S.R. (TU9), 79/6; COLLARO JUNIOR studio P.U., 75/-.

AUTOCHANGERS, B.S.R. (UA8), £6/15/-; U8 STEREO, £6/19/6; B.S.R. (UA14), latest model, £7/19/6. COLLARO "C60" Latest Model, £7/15/-.

RECORD PLAYER CABINETS

Cabinet Price

£3.3.0

Carr. and Ins. 3/6.

Contemporary style, rexine covered cabinet in mottled red and white polka dot. Size 18½ x 13½ x ht. 8½in., fitted with all accessories including baffle board and anodised metal fret. Space available for all modern amplifiers and autochangers, etc. Uncut record player mounting board 14 x 13in. supplied.

2-VALVE 2-WATT AMPLIFIER

Twin stage ECL82 with vol. and neg. feedback Tone control. AC 200/250 v. with knobs, etc., ready wired to fit above cabinet. £2/17/6. P. & P. 1/-. 6in. Spkr. & trans., 22/-. P. & P. 1/6.

TRANSISTOR COMPONENTS

Midget I.F.'s—465 Kc/s ⁷⁄₁₆in. diam.	5/6
M/W 5-3, M-L/W	5/9
Midget 3.5 : 1	6/9
Midget P-Pull—3 ohms	6/9

Elect. Condensers—Midget Type 1 mfd-100mfd. ea. 1/9. 6V/12V wkg.

Condensers 150v. working:

.0mfd., .03mfd.	9d.
.05mfd., .1mfd.	1/-

.25mfd. 1/3; .5mfd. 1/6 etc.

Vol Controls—Midget Type with edge Control Knob. 5K, 47K, 1 M/ohm, ea. 2/6.

Speakers P.M.—2½in. EMI 3 ohms 17/6. 7in. x 4in. Plessey 35 ohms 23/6.

Ear Plug Phones—Min. Continental type, 3ft. lead, jack plug and socket. High Imp. 8/-. Low Imp. 7/6.

VALVEHOLDERS—**Paxolin**; Int. Oct., EF50, 6d. **Moulded**: Int. Oct. Mazda Octal, 7d.; B12A (CRT), 1/3; B8G, 9d. each; **Nylon or Moulded, Ceramic**: B7G, B9A unskirted, 9d. each; B7G, B9A skirted, 1/- each; B7G with Can. 1/6 each; B9A with Can, 1/9 each; EF50, B7G, 1/- each; B9A ditto, 1/3 each.

RE-GUNNED TV TUBES

NEW REDUCED PRICES

PRICES REDUCED AGAIN— 12 months' guarantee!

All tubes rebuilt with new heater, cathode and gun assembly—and now all tubes are completely rescreened and aluminised at no extra cost. Reconditioned virtually as new.

12in. £5, 14in. £5/5/-, 17in. £5/10, etc.

Exchange Allowance on old tube—12" 5/-, 14"/17" 7/6.

Carr. and ins. 10/-. Comprehensive stocks—quick delivery.

"POCKET 6" TRANSISTOR RADIO KIT—Med & L/W size

5½ x 3½ x 1⅞in.

Osmor Ferrite Ae 10/-. Osc. Coil & 3 IF's 22/6. Driver & O/P Trans. 22/-. Tuning Gang 10/6. 2½in. PM Speaker 17/6. Set 6 Transistors & Diode 45/-. Printed Circuit 8/6. Vol. Control 8/-. W/C Sw. 3/6. Cabinet & Dial 8/-. Resistor Set 5/-. Condenser Set 15/-. Handbook, full details 1/6.

Complete Kit *REDUCED PRICE* **£8/10/0** Carr. 2/6

Wavechange SWITCHES, Midget Type—2 pole 2 way, 1 pole 6 way, 2/6 each; 1 pole 12 way, 2 pole 6 way, 3 pole 4 way, 4 pole 2 way, 4 pole 3 way, 3/6 each.

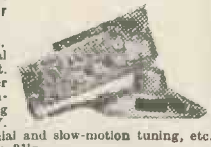
METAL RECTIFIERS, STC Types—RM1, 4/9; RM2, 5/6; RM3, 7/6; RM4, 16/-; RM5, 21/-; RM4B, 17/6.

WESTINGHOUSE—Contact Cooled. FC116, 250V, 60mA, 11/9; FC101, 250V, 200mA, 21/-; FC31, 250V, 300mA, 28/6.

SIEMENS TYPES—Contact Cooled: 250V, 50mA, 7/6; 250V, 85mA, 10/-; 250V. 125mA, 15/-; 250V, 300mA, 26/6.

"6 plus 1" TRANSISTOR RADIO KIT

BEST EVER VALUE! . . . Using 3 latest type Surface Barrier Transistors



MANUFACTURERS SURPLUS BARGAIN OFFER. —Further kit supplies now available. Original purchases of this popular kit were rapidly sold out. This kit is a modern, sensitive quality Receiver Unit with all the latest features. Six BVA transistors and 1 diode, printed circuit med. and long waves. Ferrite aerial, car radio input 500 mW. push-pull output into 3 ohm speaker, calibrated dial and slow-motion tuning, etc. Size approx. 8 x 2½in. Cabinet size 9in. x 5½in. x 3¾in.

KIT of Parts including printed circuit **5 gns.** | BARGAIN OFFER! **Complete Kit £6/19/6** less speaker

SET of 6 Transistors and 1 Diode, 45/-.

3 ohm Speaker 7in. x 3¾in.—ONLY 15/6, carr. 1/6. Send 3d. stamp for full details. Circuit and Instructions 1/6. Cabinets now available 25/- extra. Carr. 2/6

BARGAINS GARRARD PLAYER UNITS

SINGLE PLAYERS:
Model 4SP £6/17/6. Carr. 3/6.
Model TA Mk. 2 £7/19/6. Carr. 3/6.
Model 4HF. £17/19/6. Carr. 4/6.

AUTOCHANGERS:
Model RC 210 with plug-in GC8 head, 10 gns. Carr. 4/6. Model A Transcription Auto Changer—just released. £18/19/6. Carr. 5/-.

Comprehensive range in stock.

NEW BOXED VALVES ALL GUARANTEED

1T4	6/-	ECL82	10/6	PCF80	9/6
1R5, 1S5	7/6	ECL80	10/6	PCL83	12/6
3S4, 3V4	7/6	EF80	8/-	PCL84	12/6
DAF96	9/-	EF86	12/6	PL81	12/6
DF96	9/-	EL84	8/6	PL82	9/6
DK96	9/-	EY51	9/6	PL83	10/6
DL96	9/-	EY86	10/-	PY32	12/6
ECC81	8/-	EZ81	7/6	PY81	9/6
ECC82	8/-	GZ32	12/6	PY82	7/6
ECC83	8/-	PCC84	9/6	U25	12/6

JASON FM TUNER UNITS

Designer-approved kits available.
FMT1, 5 gns. 4 valves, 20/-.
FMT2, £7. 5 valves, 37/6.
JTV Mercury, 10 gns. 3 valves 25/-.
JTV2, £13/19/6. 4 valves, 32/6.
NEW JASON F.M. HANDBOOK, 2/6.
48 hr. Alignment Service, 7/6 plus 2/6.

COAX 80 ohm CABLE

High grade low loss Cellular Air Spaced Polythene—¼in. diam. Stranded Cond.

Now only 6d. a yard

BARGAIN PRICES—SPECIAL LENGTHS 20 yds. 9/-. P. & P. 1/6. Coax. Plugs 1/-. 40 yds. 17/6. P. & P. 2/-. Sockets, 1/-. 60 yds. 25/-. P. & P. 3/-. Couplers, 1/3.

VOLUME CONTROLS—5K—2 Megohms. 3in. SPINDLES. MORGANITE MIDGET TYPE. 1¼in. diam. Guar. 1 year. LOG or LIN ratios less Sw., 3/-. D.P. Sw., 4/6. Twin Stereo less Sw., 6/6. D.P. Sw., 8/-.

TRANSISTOR BARGAINS!

Brand New—BVA 1st Grade.

OC44	10/6	874	9/6
OC45	9/6	873	9/-
OC81	7/6	GET114	6/6
2/OC81	15/6	OC72	7/6
XA102	10/-	OC70	5/6
XA101	9/6	OC71	6/-
XB103	7/6	GEX34	2/9
XC101	8/6	OA70	2/9
SB305	9/6	OA81	2/9

CONDENSERS—Silver Mica. All values, 2 pf. to 1,000 pf., 6d. each. Ditto, ceramics 9d. Tub. 450 v. T.C.C., etc., .001 mfd. .01 and .1/350 v., 9d. .02-1/500 v., 1/-. .25 Hunts 1/6. .5 T.C.C. 1/9 etc., etc.

CLOSE TOL. S/MICAS. 10% 5 pf.-500 pf., 8d. 600-5000 pf., 1/-. 1% 2 pf.-100 pf., 9d. 100 pf.-500 pf., 11d. 575 pf.-5000 pf., 1/6.

RESISTORS—FULL RANGE 10 ohms—10 megohms 20% ¼ & ⅛ w., 3d., ½ w., 5d. (Midget type modern rating), 1 w., 6d., 2 w. 9d. HI-STAB. 10% ½ w., 5d. ½ w., 7d. 5% ¼ w., 9d. 1% ½ w., 1/6, etc.

W/W RESISTORS. 25 ohms to 10K 5W., 1/3, 10 w., 1/6, 15 w., 2/-.

PRE-SET T/V POTS. W/W 25 ohms-50 K., 3/-. 50 K-2 Meg. (Carbon) 3/-.

TURRET TUNER BAND I/BAND 3

Ex-manufacturers current production offer—Standard type 13-channel unit, 35-38 mc/s I.F. complete with PCC84 and PCF80 valves and coils for channels 1-3-9. No knobs or circuit diagram but connection data supplied. Clearance bargain, only 32/6, carr. 2/6. Worth 5 gns.

Electrolytics All Types New Stock

TUBULAR	CAN TYPES	
25/25 v. 50/12 v. 1/9	8+8/450 v.	4/6
50/50 v. 100/25v. 2/-	32+22/275v.	4/6
8/450 v. 4/350 v. 2/3	50+50/350 v.	6/6
16+16/450 v. 5/6	60+250/275 v.	12/6
32+32/450 v. 6/6	100+200/275 v.	12/6

Transistor Midget Types—all values 1 mfd. to 100 mfd. 1/9 ea. 6v/12v.

SPEAKERS P.M. 3 ohms. 2½in. Elac 17/6. Goodmans 18/6. 5in. Rola 17/6. 6in. Elac. 18/6. 7in. x 4in. Goodmans, 18/6. 8in. Rola 20/-. 10in. R. x A. 25/-. 9in. x 6in. Goodmans 25/-. E.M.I. Tweeter 29/6.

TYGAN FRET (Contem. pat.), 12 x 12in., 2/-; 12 x 18in., 3/-; 12 x 24in., 4/-; etc.

RECORDING TAPE—Famous American Columbia (CBS) Premier quality tape at NEW REDUCED PRICES. A genuine recommended Quality Tape—TRY IT! Brand new, boxed and fully guaranteed. Fitted with leader and stop foils.

Standard		Long Play		Double Play	
5in. 600ft.	15/-	900ft.	19/6	1200ft.	31/6
5¾in. 900ft.	16/6	1200ft.	22/6	1800ft.	39/6
7in. 1200ft.	21/-	1800ft.	32/6	2400ft.	47/6

Post & Pack., per reel, 1/- plus 6d. ea. for additional reels.
SPECIAL OFFER. 3in. mfrs. surplus tape, 225ft. 5/6. P. & P. per reel 6d.
TAPE REELS. Manfrs. surplus. 7in. 3/6, 5¾in. 3/3, 5in. 3/-, 3in. 2/6.

TAPE RECORDER KIT

ONLY £16 10s.

Latest 5-valve circuit based on Mullard's design. Magic eye and tone controls. Printed circuit already wired. A sensitive quality recorder. B.S.R. Amp. Kit 95/-. B.S.R. Tape Deck £8/10/-. Collaro Amp. Kit £6/5/-. Collaro Tape Deck £12/10/-. Set of 5 valves 45/-. Special Unit Kit Prices—Send stamp for detailed list. Handbook (full constructional and circuit details) 2/6.

2 WAVEBAND CAR RADIO KIT

Recommended Buy

12 v. operation Med & Long Waves

Modern development of the famous Brimar Hybrid vibratorless car radio circuit. Five latest type Brimar low voltage valves and power transistor. R.F. stage and permeability pre-aligned Cyldon Tuner Unit provide extremely good sensitivity and signal noise ratio. Printed circuit for easy construction and 7 x 4in. elliptical speaker for fidelity output. Self-contained in neat metal cabinet 8 x 7 x 2⅜in., with attractive calibrated dial. Speaker and power transistor stage mounted separately approx. 8 x 5 x 3in.

Complete Kit Bargain Price **£11.19.6** P & P 3/6.

Instruction booklet and parts list available. 3/6 post free.

Terms: C.W.O. or C.O.D., post and packing up to ½lb. 7d. 1lb. 1/1; 3lb. 1/6; 5lb. 2/-; 10lb. 2/9.

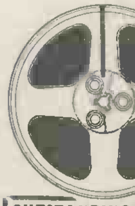
RADIO COMPONENT SPECIALISTS

Established 1946

70 BRIGSTOCK RD., THORNTON HEATH, SURREY

Tel. THO 2188; *Hours:* 9 a.m.—6 p.m. 1 p.m. Wednesday.

DON'T MISS THIS SUPER QUALITY HI-FI AMERICAN "CBS" TAPE



BRAND NEW & GUARANTEED

CIP-6	600ft. 5in.	Std. Play	13/-
LP-9	900ft. 5in.	Long Play	17/6
CMXP-12	1,200ft. 5in.	Dble. Play	32/-
CIP-9	900ft. 5¾in.	Std. Play	16/-
LP-12	1,200ft. 5¾in.	Long Play	19/6
CMXP-18	1,800ft. 5¾in.	Dble. Play	37/-
CIP-12	1,200ft. 7in.	Std. Play	21/-
LP-18	1,800ft. 7in.	Long Play	28/6
CMXP-24	2,400ft. 7in.	Dble. Play	47/-

OUTSTANDING VALUE! Also 3in. 275ft. extra play 5/3. Limited quantity. 3in. D.P. message tape 400ft. with spare spool 10/-. Many other types available including "Scotch," "EMI," "Triton," "Syncrotape," etc. Send s.a.e. for our huge money-saving literature on Tapes and Accessories. *ALL TAPE ORDERS BY RETURN OF POST.*

R.C.A. AR88-D RECEIVER. Mint condition. Freq. coverage 540 Kc/s., 32 Mc/s. £50. Carr. 20/-. Also L.F.s available. Freq. coverage 75-550 Kc/s., 1.5-30 Mc/s. £45. Carr. 20/-.

12 VOLT D.C. AMPLIFIER (Parmeko). As new, 15 watt push-pull output Mike and gram. inputs, tapped output transformer, £9/19/6 Carr. 10/6. (Hand microphone for above 30/- extra.)

50-WATT EX-GOVT. AMPLIFIER. Type III with 4KT66's in paralleled push-pull. Standard 200-250 v. A.C. input. Output imped. 600 ohms line. High imp. gram. and mike input. Bass boost control fitted. Quality amplifier housed in strong metal case ready for use. Terrific performance, £25. Carr. £1.

TELEFUNKEN STEREO HI-FI AMPLIFIER
110/250 v. A.C. input. 5 watt undistorted output (10 watts nominal) size 12 × 9 × 2in., weight 9lb. illustrated leaflet available, our price £9/15/-, carr. 5/-.

RE-ENTRANT LOUD HAILERS

(Ex-Govt.) Heavy Duty 20 watts all-metal. 15 ohms. Diameter 15in. length 15in. (approx.), good cond., £6/10/-. Carr. 10/-. Ditto. Brand new, £8. Carr. 10/-.

SMALL MOBILE RE-ENTRANT LOUD HAILER. 15 watts. 15 ohms. Approx. 7in. dia., 7in. long. As new £5. Carr. 5/-.

JUST ARRIVED! BEAM PROJECTION EXPONENTIAL HORN. Smaller version of above. 19in. long, 12in. square flare. Complete with mounting bracket. Ideal for mobile use. Brand new. £6/10/-. Carr. 5/-.

TRUVOX/TANNOY LOUD-HAILERS

With 180 ohm line transformer and condenser. Impedance 7½ ohms, handling capacity 8 watts. Complete in slope front wooden case. Brand new 27/6. Carr. 4/6.

Send S.A.E. for comprehensive list of P.A. equipment for outdoor and indoor use.

NEW AND UNUSED ACCUMULATORS
12 v. 75 A.H., 15 × 8 × 11in., £4/10/-. Carr. 8/6.
12 v. 25 A.H., 10 × 10 × 4½in., 45/-. Carr. 7/6.
2 v. 100 A.H., with carrying handle. Size 6½ × 6½ × 3½in., 15/- each. Carr. 3/6.
2 v. 16 A.H., 7½ × 4 × 2in., 5/- each. P. & P. 2/-. 6 for 24/-. P. & P. 10/-.
6 v. 75 A.H. Ideal for starting or storage. 59/6. Carr. 7/6.
6 v. 20 A.H. Comprising three 2 v. celluloid-cased cells in wooden case. Overall size 5 × 5 × 7½in., 17/6. P. & P. 3/6.

MINIATURE LEAD ACID ACCUMULATORS
2 v. 1.5 A.H. Size 4 × 1½ × 1in. Wt. approx. ¾lb., 6/6.
12 v. 0.75 A.H. Size 4 × 3 × 1½in. Wt. approx. 2lb., 22/6.

G.P.O. RACKS
19in. Heavy duty all steel Standard drilling 5ft. 6in. angle uprights £3/10/-. Carr. 15/-. 6ft. Channel uprights £5. Carr. 15/-.

QUALITY TEST EQUIPMENT

BRAND NEW CRYSTAL CALIBRATOR. No. 10. (Battery powered 1.4 v. valves). Complete with full working Instructions, circuit diagram, carrying haversack, connecting lead and spare valves. Frequency range: 1.5 to 10 Mc/s. (nominal) but can actually be used up to 30 Mc/s. Weight 5lb. Size 7 × 7½ × 4in. As fully described in "Practical Wireless," Dec. issue, pages 691-693. ONLY £4/17/6. P. & P. 2/6.

MULLARD BRIDGE. Type GM. 4140/1. Mains operated from 100-250 v. A.C. Will test resistances from 0.1 ohm to 10 megohms and condensers from 10pf to 10mfd. Good condition and complete with instruction booklet. £6/19/6. P. & P. 2/6.

AVO MODEL 7. Latest Ministry release of this well-known test instrument Supplying 50 ranges of current, voltage and resistance tests. Complete with leads and batteries. Ready for use. Perfect condition, £12/10/-. Carr. 5/-.

MARCONI SIGNAL GENERATOR TYPE TF517-F/1. Covering 10-18 Mc/s., 33-58 Mc/s., 150-300 Mc/s., in very good condition. Complete with full technical data and instructions. Unrepeatable at only £12/10/-. Carr. 20/-.

WAVEMETER CLASS D. Freq. band 1,900 Kc/s. to 8,000 Kc/s. (158-37.5 metres) in two ranges. 1,900 Kc/s.-4,000 Kc/s., also 4,000 Kc/s.-8,000 Kc/s. Supply 6 v. D.C. input. Complete with twin crystal, spare vibrator, head phones, original instructions manual and transit case. As new £5/5/-.

EVERSHED & VIGNOLES wee megger 100v. 0-20 meg., £5/5/-.

POCKET TEST METER MODEL CT.500

20,000 O.P.V.
FOR ONLY **£6.5.0** Post Free

A pocket size individual circuit tester. Complete with test leads. Ranges: D.C., Volts: 0-2.5-10-50-250-500-5,000 v. A.C. Volts 0-10-50-250-500-1,000 v. (10,000 o.p.v.). D.C. Current: 0-0.05-5-50-500 mA. Resistance: 0-12K-120K-1.2M-12M ohms (by 2 1.5 v. internal batteries). Decibels: —20 to +62db. Size: 5¼ × 1½ × 3¼in.

Also available: **MODEL TK.50** 1,000 o.p.v. Ranges: D.C. mA: 1–250 mA., D.C. and A.C. Volts: 10–250–500-1,000 v. Ohms: 0–10 K ohms 0-100 K ohms, £3/7/6.

MODEL TK.60. 4,000 o.p.v. Ranges: D.C. volts, 10-1,000 v.; A.C. volts, 10-1,000 v. (2,000 o.p.v.). D.C. current 250 µA/10mA/250mA. Resistance: 0-10 K ohms/1-1 M ohms (by 3 v. internal battery). Decibels: —20 to +22db. £4.

SUPER QUALITY TEST LEAD KIT No. 520

Comprises leads and prods. English and Continental type plugs, spade terminals and crocodile clips. Complete in attractive case. Post paid. **10/-**

SUPER QUALITY HI-FI DYNAMIC (M/C) MICROPHONE with built-in transformer

MODEL MD.180

200 ohm or 50 k. impedance
Suitable for hand or stand use. Complete with screened lead.
OUTSTANDING VALUE **£4.15.0** POST FREE (State imp. reqd.)

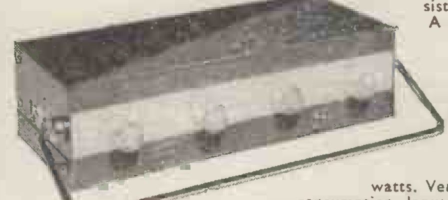
CRYSTAL MICROPHONE

MODEL BM.3
Three-way mike for hand, desk or floor stand use. Response 100–8,000 c/s. Sensitivity —62dB. Length 7in. Head dia. 1¼in. Supplied with neck band, lead and standard jack plug. **Terrific performance!**
OUTSTANDING VALUE AT ONLY **39/6** P. & P. 2/-.
Also available: MD.170. Similar in design to BM.3 but moving coil with built-in transformer. Guaranteed. Outstanding value. £4/7/6, post free.

TELESCOPIC FLOOR STAND. HEAVY 9in. dome chromium base, chromium stand with screw top. Extends to approx. 6ft. Suitable for above mikes, etc., £2/10/-. Carr 5/-.

COLLARO "STUDIO" TAPE TRANSCRIPTORS. Brand new in original cartons. 3 speeds. 1⅞, 3¾, 7½ i.p.s. 3 motors, digital counter, etc. Complete with 7in. spools, instructions and fixings. A.C. 200/250 v. operation. **SPECIAL PRICE 10 GNS.** Carr. 3/6.

FULLY TRANSISTORISED PORTABLE HI-FI AMPLIFIER MODEL JTM.12



A completely transistorised Hi-Fi Amplifier powered by 8 1.5 v. dry batteries or any 12 v. D.C. external supply. Power output 12 watts. Very low power consumption. Inputs for mike and gram can be used together for maximum usefulness. Separate volume controls for mike and gram. bass and treble tone controls. Size approx. 5in. × 11¾in. × 3in. Ideal for outdoor or indoor use for calling, announcing and entertaining. The only portable Hi-Fi amplifier available at this special price of only Brand new with full instructions. £22

GEE BROS (RADIO) LTD

15, LITTLE NEWPORT ST., LONDON, W.C.2
Telephone: GERrard 6794/1453
Adjoining Leicester Square Tube Station Open 9-6 Mon.-Fri. 9-1 Sat.

THE D·T·V GROUP

Instruments for the Radio, TV and Electronic Industries

Have you had your copy of the latest publication from the D.T.V. Group ?

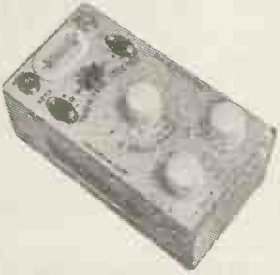
If not, and you are an industrial user of electronics, please ask for one NOW. An invaluable desk reference book, it covers a wide range of equipment and materials, all backed by the D.T.V. Guarantee of Service, with a special 16-page feature on instruments alone.
Detailed listings and prices are given for a useful range of components and accessories, transformers, valves, valve-holders, etc.
Everyone connected with electronics will find this new book a valuable and practical guide, saving time, money and trouble.

BEULAH D800

An attractively styled, compact, low-priced Closed Circuit Television Camera

Beulah Electronics' newest development and the focus of interest in the technical press and at every exhibition where it has been shown, the new D.800 Camera makes a dramatic and outstanding contribution to the technique of closed circuit television. Ask for free illustrated brochure giving full details.
Dealers! Dealerships are still available for this unit in certain areas. Write and tell us about the facilities you can offer in your area.

With an external meter, forms equipment equal to an instrument costing in the region of £30 . . .



The D900

a compact, dynamic TRANSISTOR TESTER/POWER SUPPLY.

- Makes possible dynamic transistor testing in situ.
- Tests CURRENT GAIN (A.C.), ALPHA GAIN.
- Tests CURRENT GAIN (under D.C. conditions), BETA GAIN.
- Measures leakage currents between Collector/Base and Collector/Emitter at any voltage between 0-25 v.

The D.900 makes possible quick and easy testing of transistors and transistor receivers, in many cases without removing the transistor from the circuit. The unit has its own self-contained power supply, providing smoothed D.C. 0-25 v. Avoids the necessity for drawing batteries from stock . . saves time and money. Ask for special leaflet. **Retail Price £12.**
Trade and wholesale prices on application.

Model O-12U/F Laboratory 5″ OSCILLOSCOPE £45 . 15 . 0

plus carr. Complete with 48-page handbook. Factory made and factory tested.

Heathkit Model O-12U £36 . 10 . 0

Large 5in. flat screen ensures great accuracy and facilitates observation. Patented sweep circuit of exceptional range covers 10 c/s to over 500 kc/s in five steps, many times the sweep, range of other 'scopes. Gold-plated printed circuit. Wide band amplifier for TV and FM servicing. Vertical bandwidth 3 c/s to over 5 Mc/s. Electronically stabilised power supply.

Some of the other top-grade Beulah Electronics Instruments available, factory assembled, wired and tested.

Capacitance Decade Box DCIU/F	£9	7	6
Model DCIU (in kit form)	£6	5	6
Resistance/Capacitance Bridge C3U/F	£13	9	6
Model C3U (in kit form)	£8	6	6
Audio Valve Millivoltmeter AV-3U/F	£19	19	0
Model AV-3U (in kit form).....................	£13	18	6
Audio Wattmater AW-1U/F	£20	14	6
Model AW-1U (in kit form)	£14	14	0
Electronic Switch S-3U/F	£15	17	0
Model S-3U (in kit form)	£10	15	6

Deferred terms are available on most items. Please ask for details. See the full range at our London Showrooms: **138, Lewisham Way, New Cross, London, S.E.14.**

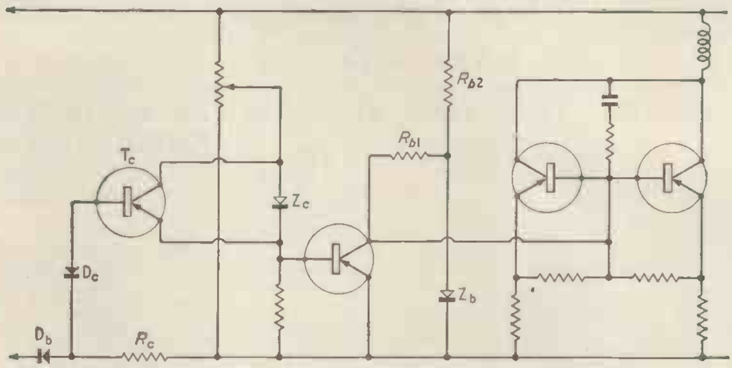
PLEASE SEND CASH WITH ORDER NOW OR WRITE FOR ILLUSTRATED LEAFLETS on the instruments in which you are interested.

— THE D·T·V GROUP —

DIRECT TV REPLACEMENTS LTD · DIRECT TV WINDINGS LTD · BEULAH ELECTRONICS

TIDeway 6666. 138, Lewisham Way, New Cross, London, S.E.14. *Day and night automatic service: TIDeway 6663.*

Transistor Control of A.C. Generators



In the current October issue of ELECTRONIC TECHNOLOGY one of the many interesting articles is concerned with a transistor control system for a.c. generators which are engine-driven and have to operate satisfactorily over very wide speed ranges. The need for such a system is briefly discussed and reference is made to the limitations of conventional methods. The theory of the transistor control system is given and it is shown that, with present-day components, it is possible to maintain the output of low-voltage high-current generators to a very close tolerance over a speed range of the order of 10 to 1. Finally, refinements of the basic circuit are considered and the circuit is presented.

ARTICLES IN THE NOVEMBER ISSUE INCLUDE:

SILICON P-N-P-N SWITCH

This article deals with the development of a four-layer semiconductor device which is known as the p-n-p-n diode. The theory of operation is given and various aspects of the device design are considered including the effect on performance of alteration of the basic parameters. In addition, methods for the construction of practical devices are discussed, with reference being made to their particular advantages and disadvantages.

LINEAR FREQUENCY DISCRIMINATOR

A simple method is presented in this article for the distortionless demodulation of low-frequency f.m. signals with large deviations, as used in multi-channel communication systems utilizing the so-called f.m.-f.m. method of frequency multiplexing. The design of a practical discriminator circuit is discussed and its performance is analysed theoretically to determine the conditions for maximum linearity. The theoretical results are confirmed experimentally.

Electronic technology

POST THIS COUPON TODAY

TO ILIFFE ELECTRICAL PUBLICATIONS LTD., DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1, ENGLAND

Please enter my name as a subscriber to: ELECTRONIC TECHNOLOGY for 12 months commencing with the November issue.

I enclose remittance £3.7.0d.

(U.S.A and CANADA $9.50) (THREE YEARS $19.00)

NAME ....

ADDRESS ....

....

DATE ....

ORDERS CAN ALSO BE PLACED THROUGH ANY NEWSAGENT

PREMIER RADIO

23 Tottenham Court Rd., London. W.1. Tel: MUSeum 3451/2

AND AT 309 EDGWARE ROAD, W.1. TELEPHONE PADDINGTON 6963

THE PREMIER TR/2 TAPE RECORDER

PRICE including Microphone, Tape and Spare Spool. **19 Gns.** Plus 15/-. P. & P.

Once again Premier is first with another magnificent offer. Introducing the "TR/2" the latest and cheapest addition to our range of popular Recorders.

Star features:
★Latest BSR Tape Deck with interlocking device to prevent accidental erasure.
★Single speed 3¾in. per sec.
★Playing time 5¾in. std. tape—1½ hours. L.P. tape—2 hrs. 8 mins.
★Volume on/off and tone control.
★Power output 3 watts.
★Input sockets for Microphone, Radio/Gram.
★Extension speaker socket.
Size: 13½ × 9¾ × 6in., weight 17 lb.

THE WALTER TRANSISTORISED BATTERY/MAINS PORTABLE TAPE RECORDER

ORIGINAL PRICE **55 Gns.** NOW ONLY **27 Gns.**
P. & P. 20/-.

STAR FEATURES:
★7 Stage 3 watt Push-pull amplifier. ★ 7 × 4in. High Flux Speaker. ★ Large 5¾in. Spools. ★ 3¾ i.p.s. Tape speed. ★ Revolution Counter. ★ Mixing facilities. ★ Superimpose facilities. ★ Safety device on record (preventing accidental erasure). ★ Volume On/off and Tone Controls. ★ Magic Eye Tuning Indicator. ★ Overall dimensions: 14 × 13¾ × 5¾in. ★ Weight 17½ lb. (less Batteries).

In fact, all that could be desired of a Portable Tape Recorder. For use on 200/250-v. A.C. Mains 50 cycles. Or 3 Ever Ready PP9 9-v. Batteries or equivalent (Batteries Extra). SEND NOW FOR FULL DESCRIPTIVE LITERATURE.

THE 'MID-FI' A NEW DESIGN 4½ WATT AMPLIFIER

KIT 95/- Plus 3/6 p.p.
BUILT £6 POST PAID

A new circuit for the home constructor requiring a good quality medium-powered Amplifier for reproduction of Records or F.M. Broadcasts. Technical Specifications: separate bass and treble controls. Valve line-up EF86, EL84, EZ80. Voltage adjustment for A.C. mains from 200/250 volt 3 or 15 ohms impedance. Negative feedback Size 7 × 5 × 2in., overall height 5in. Silver-hammered finished Chassis.

WHY NOT DO IT YOURSELF!

SUPERHET may be built for **£7 . 7 . 0** Plus 3/- P. & P.
T.R.F. may be built for **£5 . 10 . 0** Plus 3/- P. & P.

These two receivers use the latest type circuitry and are fitted into attractive cabinets 12 × 6½ × 5½in., in either walnut or ivory Bakelite or wood 1/- extra. Individual instruction books 1/- each, post free.

30 Watt PORTABLE SOLDERING IRON. Complete with Vinyl Bag, lead and plug. 18/9. plus 1/3 P. & P.

THE 'CLARION' Transistorised miniature battery-operated TAPE RECORDER **16½gns.**

★ Completely transistorised circuit.
★ Constant governed speed of 3¾ I.P.S.
★ Recordings interchangeable with other recorders.
★ Remarkable reproduction on both speech and music.

Price includes Microphone and Tape. Batteries 3/4 extra. P. & P. 5/-.

BARGAIN OFFER!

A COMPLETE SELF POWERED

FM TUNER

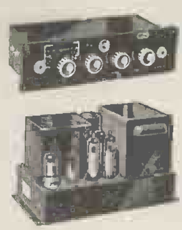
MAY BE BUILT FOR ONLY **£4.19.6** PLUS 4/- P. & P.

This tuner has been designed to the highest possible modern standards with all the features found only in the more expensive Units and yet still within a price range that all can afford. No extras required.

STAR FEATURES
★ Self powered
★ EM84 Magic Eye Tuning Indicator
★ Permeability Tuning
★ Philips FM Tuning Unit
★ Absolutely no drift
★ Frequency coverage: 88-100 mc/s.
★ Two IF Stages and Discriminator
★ OA 81 balanced diode output
★ Valve lineup: ECC85, 2-EF80, EZ80 Rectifier, EM84 Magic Eye.

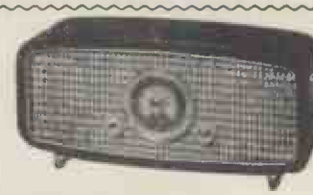
Attractive full vision maroon and gold Glass Dial size 7in. × 3in., overall dimensions of Tuner 8 × 7½ × 5½in.

THE VERDIK QUALITY TEN AMPLIFIER & PRE-AMPLIFIER



A truly High Fidelity Ultra-linear Amplifier with a push-pull output of 10 watts and incorporating negative feedback. Provision for tuner, also bass and treble control and 5-position selector switch for Microphone, Radio Tape and L.P. and Standard Recordings. Finished in an attractive grey/green stove enamel.

FOR A LIMITED PERIOD ONLY **£14.19.6**
Original cost 23 gns. P. & P. 7/6.



The SUPER 60

6-Transistor Battery Receiver

MAY BE BUILT FOR **£9.15.0** Plus 4/6. P. & P.

Ever Ready Battery PP10 Extra 11/-.

STAR FEATURES:
★ Six 1st grade Mullard Transistors and one Diode.
★ Internal Ferrite Rod Aerial.
★ 7in. × 4in. Elliptical Speaker.
★ Printed Circuit.
★ 500 mW Push-Pull Output.
★ Full medium and long waveband coverage.
★ Calibrated Direct Drive Dial Drive Assembly
★ Full point-to-point instructions supplied.
★ Dimensions 18in. × 7¾in. × 5¾in.

The Receiver is housed in an attractive contemporary mahogany finished cabinet trimmed with gilt, supported by gilt stands.
The Receiver will operate for months on one 9-volt long life battery.
Instruction Book separately at 2/6 p.p.

Introducing THE TELEFUNKEN STEREO HI-FI AMPLIFIER

FOR ONLY **£9.19.6**
Original Price 16gns.
P. & P. 5/-

- Power Output 5 Watts total (2½ watts per channel).
- Frequency Response 30 c/s to 40 Kc/s 2dB. 45 c/s to 30 Kc/s ½dB.
- Sensitivity sufficient for all normal inputs from Tape Recorders, Pick-ups, Microphones, Radios.
- Power Requirements 110, 125, 150, 220, 240 volts A.C.
- Piano key selecting.
- Preselected tone control.
- Size 12in. wide × 9in. deep × 2in. high.
- Finish: Hammered enamel in grey/green with gold trimmings. Controls and press buttons in cream.

Why not convert your battery portable to mains operation with the COSSOR MU2 BATTERY ELIMINATOR? This Eliminator is completely assembled and supplied with 4ft. of Mains Lead and Torpedo Type of On/Off Switch. It is housed in 2 Metal Containers approximately the same size as the AD35 and B126 Batteries, and suitable for receivers using DK96 range valves for use on 200-250V A.C. mains. Size: L.T. Unit 3in. × 2¾in. × 1¾in. H.T. Unit 4in. × 2¾in. × 2in. Original price 3 gns. OUR PRICE for a limited period only **39/6** (plus 2/- P. & P.)

VALVES BY RETURN POST

ALPHA

AZ1 ...10/-
AZ31 ...10/-
DAF96 9/-
DF96 ... 8/-
DK96 ... 8/-
DL96 ... 8/-
EABC80 9/-
EAF42 ... 9/6
EB91 ... 4/6
EBC3 ... 5/-
EBC33 6/9
EBC41 8/9
EBF80 9/9
EBF89 9/6
ECC81 8/-
ECC82 7/6

ECC83 9/-
ECC84 10/-
ECC85 9/6
ECF80 12/-
ECF82 10/6
ECH42 9/6
ECH81 9/-
ECL80 9/6
ECL82 10/6
EF41 ... 9/6
EF50 ... 5/-
EF50SYL 7/-
EF80 ... 7/-
EF85 ... 7/-
EF86 ...12/6
EF89 ... 8/9

EF91 ... 5/9
EF91 (BVA) 9/-
EF92 ... 6/-
EF183 12/6
EK32 ... 7/-
EL32 ... 4/6
EL33 ...14/-
EL41 ... 9/-
EL84 ... 9/-
EL91 ... 4/6
EM34 ... 9/6
EM80 ... 9/6
EM81 ...10/6
EY51 ... 9/6
EY86 ...10/-
EZ40 ... 7/6
EZ41 ... 7/6
EZ80 ... 7/-
EZ81 ... 7/-
FC13 ... 5/-

FW4/500 10/-
GZ32 11/6
HL23DD 8/6
HL42DD 10/-
KT2 ... 5/-
KT33C 8/6
KT61 ...13/6
KT101 10/-
KTW61 6/6
MX40 12/6
OZ4 ... 5/6
PCC84 8/6
PCC85 11/6
PCF80 8/9
PCF82 11/6
PCL83 13/6
PCL84 10/6
PL36 ...13/6
PL81 ...11/-

PL82 ... 8/6
PL83 ... 9/6
PX25 ...12/6
PY80 ... 7/6
PY81 ... 8/6
PY82 ... 7/-
PY83 ... 8/6
PEN4VA 10/-
PEN25 6/-
PEN45 8/-
PL84 ... 9/6
SP4 ... 5/-
TH30C 5/-
TP22 ...10/-
U10 ... 9/6
U25 ...13/6
U26 ...12/6
U50 ... 8/-
UABC80 9/-
UAF42 9/6

UBC41 8/6
UBC81 11/4
UBF80 9/-
UCC84 13/11
UCC85 9/6
UCH42 9/6
UCH81 9/6
UCL82 11/6
UCL83 13/6
UF85 ... 9/-
UF89 ... 9/-
UL41 ... 9/-
UL84 ... 9/-
UY1N 12/6
UY41 ... 7/6
UY85 ... 7/-
VP23 ... 6/6
VR105/30 8/-
VR150/30 7/6
VU39(MU 12/14) 8/9

Y63 ... 7/6
Z359 ...12/6
1A7GT 13/6
1C2 ...11/6
1C5GT 12/6
1H5GT 9/-
1N5 ...10/6
1R5 ... 7/6
1S5 ...... 6/6
1T4 ...... 5/6
3D6 ... 5/-
3Q4 ... 7/6
3Q5GT 9/6
3S4 ... 7/6
3V4 ... 8/-
4D1 ... 3/-
5R4GY 9/6
5U4G ... 6/-
5V4 ...11/6
5Y3G ... 8/-
5Y4GT 7/6

5Z4G ... 9/-
6A7 ...10/-
6A8G ... 9/-
6AK5 ... 5/-
6AL5 ... 4/-
6AM5 ... 7/6
6AM6 ... 4/-
6AQ5 ... 7/6
6AT6 ... 8/6
6BA6 ... 7/6
6BE6 ... 7/6
6BH6 ... 9/-
6BJ6 ... 9/-
6BW6 9/-
6C4 ... 4/6
6C5GT 6/6
6C6 ... 5/-
6D6 ... 5/-
6CH6 ... 8/6
6F6G ... 7/-
6F6M ... 7/6

6J5GT... 5/-
6J5M ... 6/6
6J6 ...... 5/6
6J7G ... 6/6
6K7G ... 4/-
6K7M ... 6/9
6K8G ... 6/6
6K7GT 5/9
6K8GT 10/-
6L6G ... 8/-
6L6M ... 9/6
6L18 ...11/6
6N7GT 7/6
6Q7G 7/6
6Q7GT 9/6
6SK7 ... 6/-
6SL7GT 8/-
6SN7GT 7/6
6SQ7 ... 9/3
6U4GT 12/-
6V6G ... 6/-
6V6GT 7/9
6X4 ... 7/6
6X5G ... 7/-
6X5GT 7/-

6/30L2 12/6
7B6 ...10/6
7B7 ... 8/6
7C5 .. 8/-
7C6 ... 8/-
7H7 ... 8/-
7S7 ... 9/6
7Y4 ... 8/6
10F1 ...12/6
10P13 ...23/3
12A6 ... 5/-
12AH8 12/-
12AT7 7/5
12AU7 8/-
12AX7 8/-
12BA6 9/-
12BE6 ... 9/-
12C8 ... 7/-
12J7GT 10/6
12K7GT 6/6
12K8GT 13/6
12K8M 13/-
12Q7GT 6/6
12SK7 ... 6/-

12SL7 ... 8/-
14S7 ...17/3
15D2 ... 7/9
25A6 ... 9/-
25L6GT 10/-
25Z4 ... 9/6
25Z5 ... 8/-
25Z6 ...10/-
30FL1 ...10/6
30L15 ...23/3
30P4 ...15/-
30P12 ...12/6
30PL1 ...12/6
35L6GT 10/-
25Y5 ... 9/9
35Z4GT 8/-
42 ...... 8/-
35Z5GT 9/-
50L6GT 8/6
75 ......10/6
80 ...... 8/6
142BT 3/6
210DDT 4/6
210VPT 3/6

MULLARD TRANSISTORS

OC19	48/-	OC72	8/-	OC78D	8/-
OC35	25/6	OC72pr	16/-	OC81	8/-
OC44	11-	OC73	16/-	OC84	11/-
OC45	10/-	OC75	8/-	OC170	13/6
OC70	6/6	OC77	10/-	OC171	14/6
OC71	6/6	OC78	8/-	OC201	12/6
				OC202	36/-

A SPECIAL OFFER OF SIX MULLARD TRANSISTORS
1 OC44, 2 OC45, 1 OC81D, 2 OC81. Only 37/6 set.

EDISWAN TRANSISTORS
XA104 12/-, XA103 10/-, XB102 6/6 ea.

LOUDSPEAKER UNITS
All brand new

2½in. square EMI 18/6
4in. square Elac Tweeter 12/6
5in. round Plessey with O.P.T.... 16/6
6½in. round Celestion 17/6
8in. round Richard Allen 18/6
12in. round Plessey 29/6
6in. x 4in. Plessey 19/6
7in. x 4in. Plessey 19/6
8in. x 5in. Celestion and Richard Allen 19/11
10in. x 6in. Celestion and Plessey 21/6

HI-FI TRANSISTOR FM TUNER

for the Home Constructor, complete kit £18/18/-. Fully illustrated booklet with diagrams, full shopping list, etc., 3/6.

RECORDING TAPE

Special Offer of Top quality recording tape, 3¼in. spool 200ft. 5/3, 5in. spool 600ft. 13/9, 5¾in. spool 850ft. 18/6, 7in. spool 1,200ft. 23/-. Extra-play tape, 3¼in. spool 300ft. 7/-, 5in. spool 900ft. 21/-, 5¾in. spool 1,275ft. 26/6, 7in. spool 1,800ft. 37/6.
Empty spools, 3¼in. 1/6, 5in. 2/-, 7in. 3/-.

MICROPHONES

★ **Acos Mic., 39/1.** Crystal stick microphone for use as a hand, desk or floor stand unit. Listed at 3 gns. OUR PRICE 37/6. Table Stand 7/6 extra. Floor stand adaptor, 12/6 extra.

★ **Acos Mic. 40,** as supplied with modern tape recorders with a folding rest and 8ft. lead. Listed at £1/15/-. OUR PRICE 19/6.

★ **GBS Microphone,** pencil stick type fitted with muting switch, 42/-.

★ **T.S.L. Crystal "Stick" Microphone,** Model MX3, for general purpose use, complete with table stand, 45/-.

★ **T.S.L. Moving Coil Microphone,** for high or low impedance. Brown and cream plastic case with a fold-in table rest, 6ft. cable and a standard 3-way connecting continental plug, £4/4/-.

★ **Acos Mic. 45,** dual purpose, designed to fit into the hand, has built-in stand for desk use, die-cast case for a variety of applications, from music to dictation, with lead, 25/- each.

LOUDSPEAKER CABINETS

Type suitable for an 8in. unit ... 21/-
Type suitable for a 10in. unit ... 25/6
Type suitable for a 7 x 4in. unit... 17/6

CRYSTAL CALIBRATOR No. 10

Crystal controlled. Directly calibrated. Functions: Crystal, controlled oscillator providing fixed frequency signals of 500 kc/s and all harmonics of 500 kc/s up to 30 Mc/s variable oscillator from 250 kc/s–500 kc/s enabling all intermediate frequency between 250 kc/s to 500 kc/s to be produced and modulated. Complete in carrying case/bag with all valves, leads and instruction book. £4/10/- each.

TELEFUNKEN STEREO HIGH FIDELITY AMPLIFIER

Five watts total output (2½ watts each channel), size 12in. wide x 9in. deep x 2in. high, weight 9 lbs. Hammered enamel finish in green/grey with gold trim, control and press buttons in cream with black, blue and red lettering. Provision made to feel the amplifier from radio, tape recorder, FM tuner, etc. Listed at £16/16/-. **SPECIAL ALPHA OFFER £9/19/6**

CAR RADIO KIT

Can be built absolutely complete for £11/19/6. (Post 3/6.) ★ Small size. Will fit any car. ★ 12 volt operation. ★ New Hybrid circuit. ★ Transistor output. ★ New Type Brimar valves. ★ No Vibrator, 12 volt H.T. and L.T. ★ T.C.C. Printed Circuit and Condensers. ★ Tuned R.F. stage. ★ Medium and Long waves. ★ Permeability tuning. ★ 7in.x4in. elliptical speaker. Instruction Booklet giving full details, illustrations, dimensions, circuit diagram and shopping list, 2/6.

METAL-RECTIFIERS
WESTINGHOUSE
All available ex-stock.

011L999 .... 5/6
4A88 .... 21/-
4C1017 .... 7/6
4D958 .... 6/-
5D1 .... 3/6
13B989 .... 59/-
14A86 .... 23/-
14A97 .... 26/6
14A100 .... 29/-
14A116 .... 31/6
14A124 .... 31/6
14A130 .... 37/6
14A144 .... 37/6
14A163 .... 42/6
14A232 .... 60/-
14A342 .... 42/-
14A366 .... 26/-
14A949 .... 26/-
14A962 .... 49/-
14A975 .... 16/10
14B35 .... 15/-
14B46 .... 16/6
14B130 .... 37/6
14B261 .... 13/-
14B979 .... 15/-
14B980 .... 13/-
14B986 .... 14/6
15B35 .... 14/6
15B39 .... 14/6
15B261 .... 13/-
15C997 .... 7/6
15D19 .... 8/-
15D39 .... 12/6
15D967 .... 10/4
16K7 .... 6/10
39K1 .... 4/2
39K2 .... 4/4
39K12 .... 6/4

39MA1 .... 4/2
L.W.7 .... 27/7
L.W.9 .... 29/8
L.W.11 .... 30/2
L.W.13 .... 30/6
L.W.14 .... 26/4
L.W.15 .... 29/8
L.W.17 .... 25/6
E.C.1. .... 17/6
E.C.9 .... 13/4
L.T. Units
LT51 .... 7/3
LT52 .... 22/3
LT53 .... 31/3
LT54 .... 42/9
LT56 .... 32/9
LT57 .... 47/9
LT58 .... 63/9
Siemens
B250C75 .... 18/6
E125C80 .... 9/-
E250C50 .... 12/-
E250C350 .... 31/-
H.T. Units
HT43 .... 39/9
HT44 .... 30/9
HT45 .... 25/3
HT46 .... 25/3
HT47 .... 25/3
HT48 .... 25/3
HT49 .... 13/9
HT50 .... 39/-
HT51 .... 45/9
HT52 .... 49/3
HT53 .... 65/3
HT54 .... 18/3
HT57 .... 27/6
HT59 .... 29/9

Meter Types
1mA 14/6
5mA 14/6
10mA 14/6
Avo multiminor 3/9
Contact Cooled Types
FC101 (14RA1-2-8-2) 21/-
FC31(14RA1-2-8-3) 26/6
16RC1-1-8-1 ....4/10
16RC-1-1-16-1 ..10/8
16RD-2-2-10-1 ..14/8
16RE-2-1-8-1 ....10/8
18RA-1-1-8-1 (FC118) 5/8
18RA-1-1-16-1 (FC116) 12/6
18RA-1-2-8-1 ....13/8
18RD2N-1-15-1 ..16/6
18RD-2-2-8-1 (FC124) 16/4
18RD-2N-1-16-1 22/-
Westectors
W2 .... 4/4
W4 .... 4/4
W6 .... 4/4
W12 .... 6/-
WX2 .... 4/4
WX3 .... 4/4
WX4 .... 4/4
WX6 .... 4/4
WX12 .... 6/-
Miniature E.H.T. Types
16EHT6 .... 7/-
36EHT40 .... 24/4
36EHT45 .... 26/10
36EHT100 .... 37/2
36EHT180 .... 101/2

SPECIAL MAINS DROPPER RESISTORS

Type	As Used In	Specification	Dimensions	Price
SMD1	Philips 209U	150Ω + 250Ω + 170Ω + 100Ω	3 × 5/16 in.	6/3
SMD2	Bush DAC81, DAC90 and DAC12	600Ω + 100Ω + 100 Ω ± 5%	3⅞ × ⅞in.	11/3
SMD3	Philips 200U, 205U and Stella ST101	430Ω + 200Ω + 180Ω ± 5%	2 × 5/16 in.	5/3
SMD4	Philips 290U and Stella ST100	530Ω + 150Ω + 150Ω ± 5%	2 × 5/16 in.	5/3
SMD5	Bush DAC90A, DAC10 and DAC11, Ekco U76, U109	950Ω + 150Ω + 150Ω ± 5%	2 × 5/16 in	5/3
SMD6	Ultra Twin 50	1,690Ω + 1,450Ω ± 5%	3 × 5/16 in.	5/3
SMD7	Ultra Twin 50	175Ω + 340Ω + 410Ω ± 5%	3 × 5/16 in.	5/3

1962 CATALOGUE

OUR 1962 CATALOGUE IS NOW AVAILABLE. PLEASE SEND 1/- IN STAMPS FOR YOUR COPY. TRADE CATALOGUE ALSO AVAILABLE FOR WHICH PLEASE ATTACH YOUR BUSINESS LETTER HEADING.

ALPHA RADIO SUPPLY CO.

103 LEEDS TERRACE,
WINTOUN STREET,
LEEDS 7

TERMS: CASH WITH ORDER OR C.O.D. POSTAGE AND PACKING CHARGES EXTRA. Single valves 9d., Minimum Parcel Post charges 2/-. Please include sufficient postage with your order. Minimum C.O.D. fee and postage 3/6. These Postal Rates apply to U.K. only. For full terms of business see inside cover of catalogue. Personal Shoppers 9.00 a.m. to 5.00 p.m. Monday to Friday, Saturday 10.00 a.m. to 1.00 p.m.

Electronics (FLEET ST.) Ltd

DEPT. B
152/3 FLEET ST., LONDON, E.C.4.
Telephone: FLE 2833
Business hours: Weekdays 9-6. Saturdays 9-1

STOCKISTS FOR THE FOLLOWING

AMPLIFIERS, STEREO AND MONAURAL, BY:
VERDIK, ARMSTRONG, ROGERS, DULCI, QUAD, LEAK, W.B. etc.

V.H.F. TUNERS BY:
ARMSTRONG, LEAK, QUAD, T.S.L., DULCI, ROGERS, etc.

HI-FI SPEAKERS BY:
GOODMAN, PLESSEY, WHARFEDALE, LORENZ, W.B., T.S.L., G.E.C. etc.

ANNOUNCING THE NEW VERDIK Mk. III QUALITY TEN AMPLIFIER

The VERDIK QUALITY TEN

10 watt push-pull ultra linear Hi-Fi amplifie- with pre-amp. control unit. Amplifier: Valves EF86, ECC83, 2—EL84, E281. Sensitivity 40 M/V for 10 watts output impedance, 4 and 16 ohms, spare supply for tuner, 200/250 v., A.C.

NEW PRE-AMP. CONTROL UNIT, ATTRACTIVELY FINISHED GOLD ON BLACK PANEL using 2 EF86 valves, separate inputs for magnetic and crystal p/ups, radio, tape and microphone, 5 position input selector, bass and treble controls continuously variable between—10DB to +12DB, bass rumble filter, treble filter for old records. **ONLY 18 GNS.** Post & Packing 7/6.

AMPLIFIER AND PRE-AMPLIFIER

MK II AMPLIFIER, POWER AMP. AS ABOVE

Pre-Amp.: valve EF86. INPUTS Radio: 100 M/V., tape. M/V. GRAM: LP 50 M/V, 78 60 M/V. MIC: 10 M/V., socket for recording direct to tape recorder. Treble: between −10DB and +12DB at 10 kc/s. BASS between −10DB and +12DB at 20c/s. Finished grey, green stove enamel, control panel in gold lettering, fully guaranteed. **OUR PRICE £14/19/6.** Post & Packing 7/6.

THE NEW VERDIK TAPE RECORDER.

The S22, fitted with Collaro studio deck, twin track, 3 speed $7\frac{1}{2}$in., $3\frac{3}{4}$in. and $1\frac{7}{8}$in. p.s. Fast rewind, frequency response 60 c/s. to 10 kc/s., microphone and radio inputs, record level indicator, ex. speaker socket, 2 watt output, attractively styled portable cabinet 18in. front to back, $15\frac{1}{2}$in. wide, $6\frac{1}{2}$in deep. Weight 26 lb.

Usual price 39 gns. **OUR PRICE 33 GNS.** Packing and insurance 15/-. **4 track model at 39 GNS.** S.A.E. for details.

THE NEW JASON RANGE FOR CONSTRUCTORS

FMT2. In kit form with free standing case, power pack. Including valves, **£8/19/6.**

FMT3. Variable tuner 88-108 Mc/s. Variable AFC control dual limiters, approx. 80 miles range. Including valves, **£10/19/6.**

JTV2 Tuner, self powered switched tuner for FM and TV sound. Both BBC and ITA, as required. Including valves. **£13/19/6.**

MERCURY II switched FM/TV sound tuner in kit form for building into cabinet. Including valves. **£10/10/-.** Power pack kit, **£2/14/9.**

JTV2 Tuner completely assembled ready for use. **£25/7/-.**

2/6 post and pkg. on all the above. S.A.E. for details. Stockists of all other Jason Kits.

The FLEET 6 PORTABLE TRANSISTOR RECEIVER

Using 6 guaranteed first-grade transistors, sensitive diode, p/pull output, medium and long wave bands, printed circuit, high Q ferrite rod aerial, 6 x 4 high flux speaker. Provision for car aerial. Attractive 2-tone cabinet, overall size 9 x 7 x 3in. Easy to follow

instructions, all components including 2-tone cabinet, transistors, speaker circuit, etc. **£9/19/6**, complete, P. & P. 3/6. Battery extra. All components guaranteed and sold separately. Send S.A.E. for details. Circuit and instructions 2/6 post free.

SPECIAL OFFER!

THE "FLEET SIX" TRANSISTOR

The "Fleet 6," a wow of a transistor set that really gets the stations. New design 6-transistor superhet pocket receiver, using 6 guaranteed first grade transistors plus sensitive diode, push-pull output, medium and long wave bands, new type printed circuit high Q internal ferrite rod aerial, $2\frac{1}{4}$in. high flux speaker, provision for car aerial, overall size $7\frac{1}{8}$ x $4\frac{7}{8}$ x $2\frac{1}{4}$in. Simple to follow instructions. All components guaranteed, service after sales. This is equal to many manufactured sets at double the price. All components including cabinet, transistors, speaker, circuit, etc., only **£8/19/6**, complete. Post and pkg. 3/6. PP4 Battery 2/- extra. All components sold separately. Send S.A.E. for details. Circuit and instructions 2/6 post free.

ASTOUNDING OFFER! THE NEW VERDIK PRECISION TAPE DECK

SPECIFICATION: Three Hi-grade motors driving from left to right, 2 knobs controlling record, replay and fast rewind, interlocked mechanically and electrically: solenoid operated brakes, giving even braking. $3\frac{3}{4}$ and $7\frac{1}{2}$ IPS, separate erase, record and p/back heads. P/back head gap length 0.0002". Simple drop in tape loading. Wow and flutter better than .2% at $7\frac{1}{2}$ sec. Quality stove enamel finish in white and grey. AC 210-250V. 70W. consumption, bias and erase approx. 65 kc/s. Bias voltage approx. 30V. erase voltage 25-30V., frequency response 40CPS-12 kc/s. Built-in Rev. counter. Fully guaranteed.

OUR PRICE £18/19/6. Post & Packing 12/6.

STOP PRESS!

Brand new in sealed carton at bargain price the famous G.E.C. 8in. **METAL CONE LOUDSPEAKER.** Specification: frequency range 30-20,000 c/s., maximum power rating 12 watts. speech coil impedance 3-6 ohms at 30-3,000 cycles, rising to 12 ohms at 10,000 cycles, flux density 13,500 gauss lines, overall depth $4\frac{1}{2}$in., weight 3lb. 6 oz.
Maker's Price £9/7/-. **OUR PRICE £5/19/6.** Post & Packing 5/-.

BUY NOW!

Definitely the last of the remaining stocks of the **AVANTIC BEAM-ECHO HI-FI EQUIPMENT**

SP21 STEREO PRE-AMP CONTROL UNIT

A twin channel pre-amp. control unit, has 6 inputs for each channel. **INPUT SENSITIVITY** for 250 M/V or 1.5 V. output. **TUNER** 100 and 250 M/V. Tape 100 M/V. flats 250 M/V. **PICK-UP** 5 and 50 M/V. Frequency response: 40 c/s. to 15 kc/s. **TAPE OUTPUT** 50 M/V continuously variable bass and treble control, loudness control and stereo balance control. Power required 6.3 V. at 1.3 amp. A.C. 350 V. at 6 M/A D.C. Will match any hi-fi amplifier. Manufacturer's price £28/10/-. **OUR PRICE** now **£16/19/6.** Carr. and packing 10/-.

AVANTIC PL6-21

High quality monaural power amplifier and pre-amp. compactly housed and suitable for shelf mounting or cabinet. Two EL84, three EF86, one ECC83, one EZ81, 20 watts peak; speaker impedance, 4, 8 or 16 ohms. Sensitivity; 4 M/V on pick-up. 3 M/V on tape. 100 M/V on tuner, intermod. distortion 1% at 10 W. equivalent. Sinewave output. Maker's price £28/10/-. **OUR PRICE 19** gns. Post and Packing 10/-.

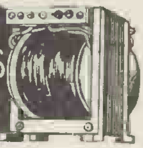
AVANTIC

STEP II Stereo pick up pre-amp. unit, 84/-. P. & P. 2/6.
STEP 21 tape pre-amp. unit, also **84/-.** P. & P. 2/6.

Samson's (ELECTRONICS) LTD.

LONDON'S LARGEST SUPPLIERS OF ELECTRONIC EQUIPMENT
9 & 10 CHAPEL ST., LONDON, N.W.1
Tel.: PAD 7851 AMB 5125

HEAVY DUTY L.T. TRANSFORMERS LONDON'S LARGEST SELECTION



No. 1. Pri. 200-240 v. Sec. tapped 4, 6, 11 v., 200 amps. **£9/10/-.** Carr. 7/6.
No. 2. Pri. 200-220-240 v. Sec. 4 v. C.T., 36 amp. Tropically rated. 25 KV D.C. insulation. Size 9 × 8 × 8 inches, plus 4in. terminals. **£9/10/-.** Carr. 10/-.
No. 3. Pri. 200-230-250 v. Sec. 24 v., 30 amps. **£6/19/6.** Carr. 7/6.
No. 4. Pri. 200-220-240 v. 20 v., 20 amps. **£4/17/6.** Carr. 7/6.
No. 5. Pri. 200-220-240 v. Sec. tapped 17, 18, 20 v., 15 amps. **£3/19/6.** Carr. 5/-.
No. 6. Pri. 240 v. Sec. tapped 12, 18 v., 10 amps. **47/6.** Carr. 5/-.
No. 7. Pri. 200-220-240 v. Sec. tapped 30, 32 34, 36 v., 5 amps., 5 amps. **59/6.** Carr. 4/-.
No. 8. Pri. 200-220-240 v. Sec. tapped 10, 17, 18 v., 10 amps. **59/6**, carr. 4/-.
No. 9. Pri. 200-220-240 v. Sec. tapped 48, 56, 60 v., 1 amp. **27/6.** P.P. 4/-.
No. 10. Pri. 230-240 v. Sec. 6.3 v. 5 amps. and 6.3 v. 1 amp. Very conservatively rated. **15/-.** P.P. 3/-.
No. 11. Pri. 200-220-240 v. Sec. tapped 12,20,24 v., 2 amps. **25/-.** P.P. 3/-.
No. 12. Pri. 110-240 v. Sec. 75 v. C.T., 0-30 amp. **29/6.** P.P. 3/6.
No. 13. Pri. 200-220-240 v. Sec. tapped 12, 20, 24 v. 2 amps. **25/-.** P.P. 3/6.
No. 14. Pri. 200-220-240 v. Sec. tapped 9, 15 v., 4 amps. **22/6.** P.P. 3/6.
No. 15. Pri. 200-220-240 v. Sec. 6.3 v., 15 amps. **32/6.** P.P. 3/6.
No. 16. Pri. 240 v. Sec. tapped 9, 15 v., 1½ amps. **15/6.** P.P. 2/6.
No. 17. Pri. 240 v. Sec. tapped 12, 24 v., 1 amp. **13/6.** P.P. 2/6.

EXCLUSIVE PURCHASE OF A.M. HEAVY DUTY TRANSFORMERS
Tapped to give the following specifications: Pri. 440-400 v. S.P. Sec. 220 v. or 110 v. 600 watts.
Pri. 220 v. Sec. 220 v. or 110 v. 600 watts.
Pri. 220 v. Sec. 55 v. 10 amps. All winding. Double wound, **£5/19/6.** Carr. 7/6.

AMERICAN HEAVY DUTY AUTO TRANSFORMERS. "C" core winding. Completely enclosed in metal container, 7½ kVA. 115-230 v., **£17/10/-.** Ex warehouse. We have London's largest selection of auto. transformers, 110-240 v. available from stock. Let us know your requirements.

SPECIAL OFFER: LATEST A.M. RELEASE. Isolation Transformers. Pri. tapped 100, 200, 220, 240 v. Sec. 225 v. 1.1 Amps. Tropically rated. Guaranteed **£3/5/-.** Carr. 7/6.

S.T.C. F.W. BRIDGE RECTIFIERS. Supplied brand new at a fraction of maker's price.
No. 1 Max. A.C. input 90 v. D.C. output 8½ amps. **£7/10/-.** Carr. 7/6.
No. 2. Max. A.C. input 45 v. D.C. output 8 amps. **59/6.** Carr. 4/-.
No. 3. Max. A.C. input 18 v. D.C. output 10 amps. **37/6.** Carr. 4/-.
No. 4. Max. A.C. input 36 v. D.C. output 8 amps **42/6.** Carr. 3/-.
No. 5. Max. A.C. input 18 v. D.C. output 6 amps. **25/-.** P.P. 2/6.

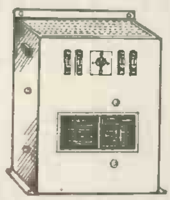
BULGIN MINIATURE MICRO SWITCHES. Type M. S350, 42/- per doz. **£7/10/-.** Cartons of 50. P.P. 2/6.

SANGAMO SYNCHRONOUS MOTORS A.C. 200-250 v. Size 1¾in. dia., **7/6.** P.P. 1/6. Also attached to gear train unit, containing over 30 gear wheels, **10/-.** P.P. 2/-. Gear train unit separately, **2/6.** P.P. 1/-.

PLEASE NOTE NEW ADDRESS

Our new premises, situated 50 yards from Edgware Road Met. line station, have five large windows crammed with electronic and laboratory equipment, and a spacious walk-round dept., we invite you to call and browse at your leisure. Monthly account orders accepted from all electronic industries, research laboratories, colleges, schools, etc. Overseas inquiries welcome.

WESTINGHOUSE HEAVY DUTY L.T. SUPPLY UNITS TYPE 115. A.C. input 200-250 volts. D.C. Output 26 amps. into a 24 volt (nominal) battery. Rating continuous. Max. ambient temp. 35 deg. C. Completely smoothed and stabilised. Built in metal case approx. size 17 x 21 x 19 inches. With fitted fuses. On/Off switch. Reconditioned as new. **£32/10/-** ex warehouse. Original maker's price over £100.



SPECIAL PURCHASE ! !
NIFE ALKALINE BATTERIES
6-VOLT 75 A.H. TYPE LR7
SUITABLE FOR ENGINE STARTING
Five 1.2 v. cells crated and connected to give 6 v. Brand new and fully guaranteed. Size of crate 15½ x 12 x 6½in. **£7/10/-.** Carr. 15/-.

CROMPTON PARKINSON 4½in. A.C. MI AMMETERS. 0-30 amps. flush mounting, **27/6.** P.P. 3/6. Supplied brand new.

A.M. 2½in. HIGH GRADE VOLTMETERS. 0-50 v. D.C. M.C. panel mounting. Basic movement 0-1 m.a. **17/6.** P.P. 2/6.

A.M. HEAVY DUTY L.T. SMOOTHING CHOKES. Designed for smoothing 12-24 volts D.C. 6 amps. Res. ½ ohm. **17/6.** Carr. 4/-.

A.M. L.T. SUPPLY UNIT No. 19. Input tapped 100-250 v. A.C. D.C. output tapped 12-24 volts continuous tropical rating 4 amps. Guaranteed 6 amp. output. Built strong grey metal case. 17 x 7 x 6½in. With fuses and on-off switch. An ideal L.T. supply unit for operating, relays, contactors, battery charging, etc. Offered at a fraction of maker's price, in perfect condition. **£4/17/6.** Carr. 7/6.

VENNER 14-DAY CLOCKWORK TIME SWITCHES. 5 AMP. SWITCH CONTACTS. One make one break every 24 hours. Complete with two pin **Mounting bracket and key, 32/6.** P.P. 2/-.

"GUNFIRE" ELECTRIC TIME SWITCHES

A.C. 200-240 v. 20 amp. switch contacts, make and break once every 24 hours. Complete with mounting bracket, and earth strip. Supplied brand new at a fraction of maker's price, **69/6.** P.P. 2/6.

A.M. CAPACITORS TROPICALLY RATED AND GUARANTEED

AMERICAN HIGH VOLTAGE CAPACITORS. 2 mfd. 10,000 volts wkg., **£8/10/-.** Carr. 7/6. 1 mfd. 20,000 volts wkg., **£7/10/-.** Carr. 7/6. 0.25 mfd. 25,000 volts wkg., **£6/10/-.** Carr. 7/6.

CAPACITORS
Micamold 10 mfd., 1,500 v. wkg. tropical. **15/-.** P.P. 2/6.
Micamold 8 mfd. 1,500 v. wkg. tropical. **12/6.** P.P. 2/6.
Western Electric 16 mfd. 400 v. wkg. **8/6.** P.P. 2/-.
Supplied brand new at a fraction of maker's price.

G.P.O. 600 TYPE RELAYS
500+500Ω 2M 1 CO. 1,300+150Ω 3 B 1 CO. 600Ω 2 B. 30Ω 2 CO. 1 M. **5/-** each.. P.P. 1/6.

AMERICAN LEACH CONTACTORS. A.C. 110 v., 3-pole, 250 v. 20 amp. contacts. Size 4½ x 4 x 3in. Brand new in maker's cartons, **25/-.** P.P. 2/6.

ADMIRALTY HEAVY DUTY A.C. 230 v. CONTACTORS. Double-pole 40 amps. contacts. Brand new in maker's cartons, **59/6.** Carr. 4/-.

ADMIRALTY 24 VOLTS 3 A.H. ACCUMULATORS. Suitable for low wattage lighting etc. Twelve 2 v. cells, crate and linked. Supplied new with charging instructions, **25/-.** Carr. 5/-. Single cells supplied separately **2/6.** P.P. 1/6.

SPECIAL OFFER. BRAND NEW A.M. LEAD ACID ACCUMULATORS. 2 volt 14 A.H. Size 6¾in. high, 2in. sq. Ideal for constructing 6 or 12 volt batteries. **4/11** each. P.P. 2/-. Six for **27/-.** Carr. 5/-. With charging instructions.

ADMIRALTY THERMOMETERS. 20-210 deg. F. Built-in metal cylindrical case, length 12in., dia. 1in. Ideal for the lab., workshop or the home. Brand new at a fraction of maker's price, **7/6.** P.P. 1/6.

EXCLUSIVE PURCHASE EXIDE 12 v. 4 A.H. UNSPILLABLE LEAD ACID BATTERIES. Size 4½ x 4 x 3¾in. Weight 4½ lb. Latest type. Specially designed for Rocket Electronic equipment. Maker's price £9 each. Supplied brand new with charging instructions, **52/6** each. P.P. 2/6.

BRAND NEW AIR MINISTRY POCKET VOLT METERS

M.C., D.C. double reading 0-3 and 0-30 volts. Offered at a fraction of maker's price. **12/6,** p.p. 2/-.

AMERICAN FIELD TELEPHONE CABLE. Single 2-mile drums. Brand new, at a fraction of maker's price **£7/10/-.** Ex Warehouse.

BRAND NEW W.D. TELEPHONE CABLE TWIN D8. 1 mile drums, **£7/10/-.** Ex warehouse. **TWIN D3**, 500 yard drums, **55/-.** Carr. 7/6. **SINGLE D3**, 1 mile drums, **85/-.** Carr. 7/6. Also 1/3 mile drums, **32/6.** Carr. 5/-.

COMMANDO ASSAULT TELE. CABLE. P.V.C., 1,000 yard drums, **8/11.** Carr. 4/-.

EQUIPMENT WIRE. P.V.C., 1/036, 100 yard coils, **6/6.** P.P. 1/6. 14/0076, 100 yard coils, **10/6.** P.P. 2/6.

RADIO CLEARANCE LTD.

TRADE ENQUIRIES INVITED

27 TOTTENHAM COURT RD., LONDON, W.1
The oldest Component Specialists in the Trade

Telephone : MUSEUM 9188
EST. 30 YRS.

ATTENTION! ATTENTION!

Bargain Offer—While They Last

THE "COUNTESS"

THE "COUNTESS" The latest patented compact design 89 gns. TAPE RECORDER at a fraction of its original cost — limited quantity only. Compare these ● special features with **ANY** machine on the market at **DOUBLE** the price. COMPLETE WITH 1,200ft. of Scotch Tape, Crystal microphone, spare plugs, mains lead, manual and circuit diagram—a high-class instrument in every respect.

- Three Unique Electro-Magnetic Heads.
- Three Heavy duty motors.
- Fully interlocked push-button operation.
- Twin track, two speeds, $3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s.
- Mixing, superimposing and monitoring facilities.
- Recording level indicator.
- Clock face spool indicator.
- Automatic braking.
- Two separate inputs.
- Output for separate amplifier.
- Provision for external speaker with automatic muting switch.
- Attractive cloth covered case.

Size $13\frac{1}{2}'' \times 11\frac{3}{4}'' \times 7\frac{3}{4}''$

- Patented design for any size up to 7in. spools—only one of its kind in Europe.
- High Fidelity Amplifier—can be used straight through.
- 60-12,000 c/s. at $7\frac{1}{2}$ i.p.s.

CAN NEVER BE REPEATED AT

Regret no easy Terms available.

30 GNS.
plus 15/- carriage

Trade Supplied

BRAND NEW IN MAKER'S CARTONS

Obtainable Only from us.

IN THE HOME, IN THE CAR, BY THE SEA, IN FIELDS AFAR,

THE "CONTESSA"

IS VOTED BEST OF ALL

A really remarkable 2-Band 6-Transistor Superhet Kit as displayed at the Radio Hobbies Exhibition.

The Contessa is the professional looking set with the professional performance.

Study these brilliant features which cannot be found in any other kit—

- Waveband coverage of 530 kc/s to 1,620 kc/s and 160 kc/s to 270 kc/s.
- Assured reception of at least a dozen stations in daylight!
- Large clearly-calibrated station-named dial.
- Internal high-gain Ferrox aerial.
- 5 : 1 ratio slow motion tuning.
- Fitted with the latest 12,000-line high-flux loudspeaker.
- Power of 410 milliwatts from the single-ended push-pull final stage.
- Specially designed aerial matching coil for use in a CAR.
- Only first grade fully-guaranteed Mazda matched transistors and diodes are used.
- Double tuned IF transformers for maximum gain and knife-edged selectivity.
- Fully drilled printed circuit panel marked with component numbers.
- The two-colour case measures 10 x $7\frac{1}{2}$ x $3\frac{1}{2}$in. and weighs approx. 4 lb. when assembled.
- Battery lasts 4 months with normal usage.
- Book supplied with detailed assembly instructions, diagrams and circuitry.
- Anyone can build this set—everything supplied—just a soldering iron required.

Inclusive price for all associated components, cabinet and battery, complete in every detail, or our BUY AS YOU BUILD SCHEME, any parts sold separately. Send for comprehensive descriptive Manual and Parts List, 3/6 post free.

£10:19:6
Plus 3/6 Regd. P.P.

STAMPED AND ADDRESSED ENVELOPE with any enquiry please. But regret no lists or catalogues—our stocks move too quickly!
PLEASE ALLOW FULL POSTAGE AND PACKING CHARGES

TERMS OF BUSINESS: CASH WITH ORDER OR C.O.D. ON ORDERS OVER 10/-.

VALVES

Brand new, individually checked and guaranteed

AC5PENDD 4/-
AL60 6/-
AP4 4/-
AR8 5/-
ARDD5 2/-
ARP3 4/-
ARP4 3/6
ARP12 2/9
ARP21 5/6
ARP24 3/6
ARP34 4/6
ARTH2 7/-
ATP4 2/9
ATP7 5/6
AU1 5/-
AU4 5/-
AW3 4/-
AZ31 8/-
BL63 6/-
BS4A 5/6
BT45 25/-
BT9B 25/-
BT83 22/6
CV54 5/-
CV264 35/-
CY31 7/6
D41 3/3
D77 4/3
DA30 12/6
DAF91 6/-
DAF96 8/-
DD41 4/-
DET5 15/-
DF72 7/6
DF91 3/3
DF96 8/-
DK96 7/3
DL92 6/-
DL94 6/-
DL96 8/-
DX25 9/-
EBC21 8/-
EBC91 3/9
E1232 5/6
E1323 25/-
E1436 3/6
E1524 6/6
EA50 1/6
EABC80 7/3
EAC91 4/6
EB34 1/6
EB91 3/9
EBC41 7/9
EBC90 5/-
EC52 8/-
EC70 10/-
EC90 20/-
ECC81 5/6
ECC82 6/6
ECC83 7/-
ECC84 7/-
ECC85 8/-
ECC91 4/-
ECF82 8/6
ECH42 7/6
ECH81 7/9
ECL80 8/-
ECL82 9/-
EF22 7/3
EF32 5/-
EF36 3/6
EF37A 8/-
EF39 4/3
EF50 2/6
EF54 3/3
EF55 6/-
EF70 4/-
EF73 6/-
EF80 5/6
EF85 6/10
EF86 9/-
EF89 7/9
EF91 3/6
EF92 4/6
EF95 7/6
EK32 7/-
EL32 3/9
EL33 8/-
EL35 8/3
EL41 8/3
EL42 9/-
EL84 7/6
EL85 10/-
EL91 7/6
EM80 8/-
EN31 22/6
EP71 6/6
EP72 5/-
ESU208 8/-
EY51 8/-
EY86 8/-
EY91 3/6
EZ40 7/-
EZ41 6/9
EZ80 6/6
EZ81 6/9
FW4/500 6/6
GL450 10/-
GL464A 10/-
GZ32 9/-
HL23 6/-
HL23DD 8/-
HVR2 12/6
KRN2A 19/-
KT31 8/-
KT32 8/-
KT33c 4/9
KT44 6/3
KT76 10/-
KTW62 7/6
KTW63 6/6
MH4 3/6
MH41 5/-
ML4 4/-
ML6 6/-
MS/PEN 6/-
NT37 (4033A) 10/-
OB3 7/-
OC3 5/-
OD3 5/-
OZ4 5/-
PCC84 7/-
PCC85 8/-
PCF80 7/-
PCF82 8/-
PCL82 8/6
PEN25 4/6
PEN46 5/-
PEN65 6/6
PEN220A 3/-
PENDD/1360 9/6
PL36 10/6
PL81 9/-
PL82 8/-
PL83 7/9
PT15 10/-
PT25H 7/6
PVD7 7/6
PX4 19/-
PX25 10/-
PY80 6/9
PY81 7/-
PY82 8/-
PY83 7/3
QP21 6/-
QP25 5/3
QS75/20 6/9
QS95/10 6/9
QS108/45 6/9
QVO4/7 12/6
QVO5-25 5/-
R3 8/-
R3/10 4/-
R10 12/6
REL21 25/-
RK34 2/6
RX235 10/-
SP2 4/-
SP13C 4/6
SP41 2/6
SP61 2/-
SU2150A 4/9
T41 7/-
TP25 15/-
TT11 3/-
TZ20 16/-
U17 5/-
U18 6/6
U27 8/-
U52 5/-
UBC41 7/6
UCH42 7/6
UL11 5/-
UL12 5/-
UL41 7/-
UL84 7/6
UL85 7/-
UU9 5/6
UY41 6/-
UY85 6/6
VP23 3/6
VP41 5/6
VR78 4/-
VR99 8/-
VR105/30 7/6
VR150/30 7/3
VT4C 25/-
VU39 6/-
VU111 3/3
VX3138 12/-
W31 7/-
Y63 5/-
Y66 8/-
Z31 6/-
1A3 3/-
1A5GT 5/-
1C5GT 7/6
1D8GT 6/-
1E7G 7/6
1G6GT 12/-
1L4 3/6
1LD5 3/6
1LN5 4/9
1R5 6/-
1S5 5/9
1T4 4/-
1W4 6/-
2A3 8/-
2A5 8/-
2A6 7/-
2C34 2/6
2D4A 4/-
2D21 6/-
2X2 4/-
3A4 5/-
3B7 5/-
3B24 8/-
3E29 (829B) 60/-
3Q5GT 9/-
3S4 5/-
3V4 6/-
5T4 9/-
5U4G 5/-
5V4G 8/-
5Y3GT 6/-
5Z4 8/6
5Z4G 8/-
6AB7 4/-
6AC7 3/-
6AG5 3/6
6AG7 6/-
6AJ7 4/3
6AK5 5/-
6AK7 8/-
6AM5 5/-
6AM6 6/3
6AQ5 7/-
6AT6 5/-
6B7 5/6
6B8G 2/6
6C4 3/6
6C5 6/-
6C6G 4/3
6C8G 5/-
6D6 4/6
6F6G 4/-
6F8G 6/6
6F12 4/6
6F17 7/6
6G6G 3/-
6H6M 2/-
6J5 3/6
6J5G 3/-
6J6 4/3
6J7G 5/-
6K6GT 3/6
6K7G 2/3
6K7GT 4/9
6K8G 5/9
6K8GT 8/3
6K8M 8/6
6L5G 6/-
6L6 9/-
6L6G 6/6
6L34 4/6
6N7G 5/9
6N7GT 6/-
6Q7G 6/-
6R7 8/-
6SA7 6/-
6SC7G 5/6
6SC7GT 6/-
6SG7 5/-
6SH7 4/6
6SJ7 6/6
6SJ7G 5/9
6SK7 5/3
6SL7GT 6/6
6SN7GT 4/6
6SQ7 6/-
6SS7 6/-
6V6G 5/6
6V6GT 6/-
6X4 5/-
6X5GT 6/-
6Y6G 8/-
6Z4 5/6
7B7 7/6
7H7 7/3
7C6 7/-
7C7 6/6
7Q7 7/-
7V7 5/-
7Y4 6/-
7Z4 6/-
8D2 2/6
9D2 3/-
12A6 5/-
12AH7 7/-
12AT7 5/6
12AU6 9/-
12AU7 6/-
12AX7 7/-
12C8 3/-
12E1 22/6
12H6 2/-
12K7GT 4/6
12K8M 9/-
12J5GT 3/6
12Q7GT 4/6
12SA7 7/6
12SC7 4/6
12SG7 6/6
12SH7 3/-
12SJ7 6/-
12SK7 4/-
12SL7 7/-
12SN7 8/-
12SR7 6/-
15D2 6/-
15E 8/-
15R 7/6
20A2 7/6
21B6 9/-
30 5/-
35L6GT 8/-
35T 30/-
35Z4GT 7/-
37 4/-
38 4/-
58 6/-
59 6/-
75 8/-
76 5/-
77 6/-
78 7/-
80 6/3
82 8/-
83V 12/-
84 8/-
85A1 12/-
85A3 15/-
89 6/-
210LF 3/-
210VPT 7-pin 2/6
250TH £9
274B 3/-
350B 8/-
393A 15/-
705A 17/6
715B 97/6
717A 8/6
801 6/-
803 22/6
804 55/-
805 30/-
807 AMER 6/-
807BR 6/-
808 8/-
810 80/-
813 67/6
815 40/-
816 30/-
826 10/-
829A 30/-
832 15/-
832A 35/-
843 7/4
866A 10/-
872A 35/-
930 8/-
954 2/-
956 2/-
958A 5/-
1616 3/-
1619 5/-
1625 6/-
1626 4/6
1629 4/6
6064 10/-
6120 4/-
7193 1/9
7475 5/-
8013A 25/-
8020 6/-
9001 4/6
9002 5/6
9003 6/-
9004 4/-
9006 4/-

Cathode Ray Tubes:
CV1596 (09J) 55/-
5BP1 35/-
5CP1 42/6
5FP7 45/-
7BP7 40/-
12DP7 60/-
VCRX258 (with scanning coil) 45/-
VCR138 30/-
VCI39A 35/-

Photo Tubes:
CMG8 9/-
GS16 12/6
931A 50/-

Special Valves:
2J31 45/-
3A/148I 45/-
3J/170E £35
3J192/E £37/10
723A/B 50/-
725A 30/-
726A 27/6
ACT6 200/-
ACT17 75/-
ACT25 40/-
CV691 60/-
KR3 45/-
LS7B 30/-
V1924 22/6
VX7110 15/-
WL417A 15/-

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves.

All U.K. orders below 10/- P. & P. 1/-; over 10/- 1/6; orders over £3 P. & P. free. C.O.D. 2/- extra. Overseas Postage extra at cost.

B.P.5 TRANSCEIVERS. Specially built for Parachutists during the war. Receiver Superhet Transmitter crystal controlled. CW. and phone. 2-8 mc/s., 829 valve as output. 60 w. on CW, 15 w. on microphone, together with mains power pack 120/220 v., two rotary converters to work from 12 v. battery, microphone, key and dipole aerial. **Price £15.** Carriage 30/-.

SPECIALLY BUILT POWER PACK for TCS receivers, 230 volts A.C. mains, including 6X5GT valve, £3/10/-. Carriage 5/-.

SUPPLY UNIT RECTIFIER No. 21. Fully sealed enabling all sets built for 6 v. (R209, R109, etc.) to work from A.C. mains. Input 90 v.-260 v. A.C. (taps at 10 v. intervals); output excellently smoothed up to 10 amps. with meter indicating exact output voltage. Measurements 12 x 9 x 10in. **Price £8.** Carriage and packing 15/-.

FREQUENCY METER BC221 TECHNICAL MANUAL 22/6.

VIBRATOR UNIT. 12 v./160 v. 35 m/amps. Exceedingly well filtered and smoothed. Excellent for car radios. Including one 6X5G valve and vibrator **17/6.** P. & P. 7/-.

U.H.F. SIGNAL GENERATOR TYPE TS14 3,200-3,370 mc/s., power measuring range 20-200 mW., R.F. output power −20 to −100 dbm below 1 mW. Power supply 115 w. A.C. Price **£15.** Carriage 15/-.

TELEPHONE HANDSET. Standard G.P.O. type new, **12/-.** P. & P. 1/6.

R.109 RECEIVER. Covering 2-8 mc/s. 6 v. D.C. with set of spare valves and carrier. Brand new in original packing case. **£6/18/-** including delivery in U.K.

POWER SUPPLY UNIT. Input 200/250 v. A.C., 50 cycles. Output: 1, HT 280/350 v. 300 mA. smoothed; 2, MT 150/200 v. 40 mA. (positive earthed); 3, LT 18/25 v. 4 amp. D.C. smoothed (negative earthed). 2 relay switching, H.T. and M.T., safety switch fuses on A.C. and all D.C. Two 5Z3 for H.T., one 6X5 for M.T. Selenium rectifier for L.T. Ideal for Ham transmitters. Weight 45 lb. Dimensions 14 x 8½ x 18in. **Price £12/10/-** including valves. P. & P. 25/-.

BRAND NEW ORIGINAL SPARE PARTS FOR AR88 RECEIVERS.

I.F. TRANSFORMERS. 1st, 2nd, 3rd, 4th (for type D), **12/6** each, or complete set of 6, **60/-.**
I.F. Transformers. Crystal Load, **12/6** each.
Plates escutcheons for (D and LF), **15/-** each.
Dials (for type D), **10/-** each.
Logging dial (for D and LF), **10/-** each.
Filter Chokes (for D and LF), **22/6** each.
Output Transformers (for LF), **30/-** each.
Antenna Trimmers (LF and D), **2/6** each.
Filter Condenser. 3 x 4μF, **£2/10/-.**
Condensers, 3 x .25μF (D and LF), **2/6** each; 3x .01μF (D and LF), **2/6** each.
RF Antenna Inductors (D and LF), **7/6** each.
Mains Transformers (LF), **£3** each.
Small Mica Condensers, various values, **1/6** each.
Small Trimming Tool, 7/6.
Instruction Manual for AR88D, **£1.**

FAMOUS RCA TRANSMITTER TYPES ET 4336, K. & L. Frequency 2 mc/s-20 mc/s. Power output: 350 w. telegraph, 250 w. telephone. Type of modulation—Class B high level. Audio input impedance 500 ohms. Power supply 190 to 250 v. Single phase 50-60 c. Tube complement: Crystal oscillators 807, Master oscillators 807, Intermediate amplifier 807, Power amplifier 813(2), Modulator 805(2), Rectifier 866A(4). Complete with Master oscillators, crystal multipliers, speech amplifiers, microphones, keys, instruction manual, etc. We guarantee full supply of all replacement parts for a minimum of 5 years after purchase. Price on application.

RCA 15 KW TELEGRAPH TRANSMITTER TYPE ET-4750 X. Frequency range 2-22 mc/s. Keying speed up to 250 words per minute. Power supply requirements 230 v. 3 phase 50/60 cycles. Tube complement: Oscillator—807 (1), Doubler (1st) Amplifier—807 (1), Intermediate power (2nd) Amplifier—813 (4), Power (3rd) Amplifier—889-R (2), Plate rectifier—827A (6), Auxiliary Rectifier—872A (3), Bias Rectifier—872A (2), Keyer-807 (2). Price on application.

R209 RECEPTION SET. A 10-valve high-grade Super Heterodyne Receiver with facilities for Receiving R/T (A.M. or F.M.) and C.W. frequency 1 mc/s-20 mc/s. Hermetically sealed. Built on miniature valves and incorporating its own vibrator power supply unit driven by a 6 v. battery (2 point connector included). The set provides for reception from rod, open-wire or dipole aerial with built-in loudspeaker or phone output. Overall measurements: Length 12in., width 8in., depth 9in. Weight 23 lb. In as new, tested and guaranteed condition, **£23/10/-,** including special headphone and supply leads. Carriage £1.

AR 88's. Completely rebuilt with new PVC wiring. Type "D" **£75;** Type "LF" **£70.**

COMPLETE SET OF STRONG AERIAL RODS (American). Screw-in type MP49, 50, 51, 52, 53, total length 15ft. 10in. Top diameter 0.185in. Bottom diameter 0.615in., together with matched aerial base. MP37 with ceramic insulator, ideal for car or roof insulation, **£2/10/-,** Post free.

VARIOMETERS for W/S No. 9. Fully tested and working, **12/6.** P. & P. 2/6.

CARBON INSET MICROPHONE, G.P.O. type, **2/6.** P. & P. 1/6.

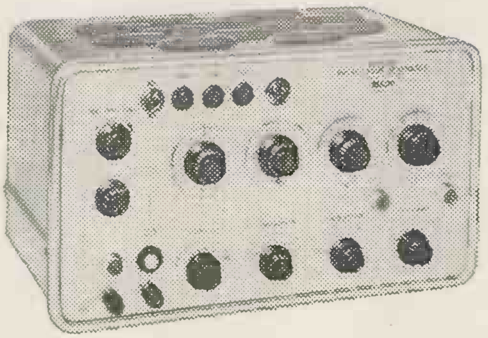
FAMOUS AMERICAN CARBON HAND MICROPHONE. Type T.17 **£2/5/-.** P. & P. 3/6.

P. C. RADIO LTD.
170, GOLDHAWK RD., W.12
SHEpherds Bush 4946

PERSONAL CALLERS WELCOME

a new square wave and pulse group generator

MODEL **5101**



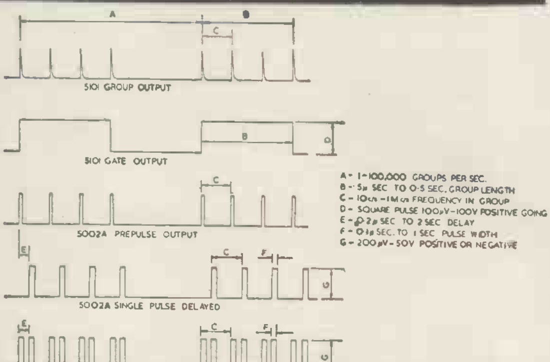
A study of the diagram may suggest how this instrument can be of use in your specific problem.

Calibrated and continuously variable groups of pulses, plus square wave output of continuously variable amplitude 100μV to 100 volts. Versatile triggering system, external or internal. Single groups of pulses by push button. For use with the NAGARD 5002 Double Pulse Generator or any other generator capable of being externally triggered.

IDEAL FOR COMPUTER TESTING by providing a simulated programme of pulses controllable in a great variety of ways.

If you already have a Nagard 5002 Pulse Generator the 5101 will extend its usefulness, besides being a good square wave generator and triggering device when used by itself.

Ask for data sheet No. 6610.



18 Avenue Road, Belmont, Surrey.
Tel: VIGilant 9161-2.

NAGARD LTD

LEO DATA PROCESSING

TRAINING TO BE ELECTRONIC COMPUTER ENGINEERS

This young expanding company offers outstanding opportunities in the maintenance of large-scale operational computers. Men with initiative and a logical and decisive approach to problems are invited to apply for the few remaining vacancies on our next training courses.

There are openings for people with any of the following backgrounds:

(i) Experienced electronic engineers with or without qualifications.
(ii) Qualified men with a degree or H.N.C.
(iii) Men with " A " level in Maths. and Physics and an active interest in electronics.

The positions are pensionable and there are excellent prospects for rapid increase in salary.

If you are interested write to:

Personnel Manager, LEO Computers Limited, Hartree House, Queensway, W.2.

NEW! DO-IT-YOURSELF TRAINING TECHNIQUE *in RADIO & ELECTRONICS* **YOU LEARN while you BUILD...**

Simple... Practical... Fascinating...

ANNOUNCING—after years of successful operation in other countries—the latest system in home training in electronics introduced by a new British training organisation. *AT LAST*—a simple way of learning—by practical means—the " how and why " of electronics with the minimum of theory and no mathematics! *YOU LEARN WHILST BUILDING* actual equipment with the components and parts which we send you—and you really have fun whilst learning! And afterwards—you have a first-rate piece of home equipment plus the knowledge of how it works and how it can be serviced. *THIS NEW SYSTEM* brings you an exciting new opportunity at a very moderate cost—and there are *NO MATHEMATICS!* Post the reply coupon *TODAY* for *FREE* Brochure, to Britain's Leading Radio Training Organisation.

BUILD YOUR OWN:—
- *RADIO EQUIPMENT*
- *HI-FI INSTALLATION*
- *TEST EQUIPMENT*

AND LEARN AS YOU DO IT

LOTS OF INSTRUCTIVE EXPERIMENTS AT HOME!

No Mathematics!

FREE— *POST TODAY*

To: RADIOSTRUCTOR (Dept. G106) Reading, Berks.
Please send Brochure without obligation to

Name...
Address...
....

BLOCK CAPS PLEASE

11.61

RADIOSTRUCTOR

BRITAIN'S LEADING ELECTRONIC TRAINING ORGANISATION

PHYSICISTS MATHEMATICIANS ENGINEERS

at the RADIO RESEARCH STATION

DSIR

Radio and Upper Atmosphere Research. Investigating the upper atmosphere and the space between the earth and the sun, with particular reference to *propagation of radio waves* through those regions, and associated problems of *terrestrial and space communications.* Work concerned with experiments on ground, and in rockets and satellites. On the experimental side it involves the design and use of suitable radio equipment including *low noise amplifiers* for use with radio telescope; research on *cosmic rays, vacuum physics,* and *spectroscopy.* For the theoretical studies a knowledge of *magnetohydrodynamics* or of *plasma physics* will be useful. A digital computer is available for the study of orbits of artificial satellites.

Appointments in grades of

SENIOR SCIENTIFIC OFFICER £1,302–£1,604 (Interim scales)

SCIENTIFIC OFFICER £717–£1,186 (under review).

Starting salary according to experience. Annual increments. Prospects of establishment with non-contributory pension benefits whilst remaining under age 32.

GOOD PROMOTION PROSPECTS

1st or 2nd class Honours Degree, Dip. Tech. or equivalent required and for S.S.O. at least 3 years' postgraduate experience.

APPLICATION FORMS obtainable from

**The Director, Radio Research Station,
Ditton Park,
Slough, BUCKS.**

Quoting Radio 5 Y/EW

TECHNICIAN FOREMAN

We require a technician keen to take some production responsibility for a small assembly and finishing section working on microwave devices.

Excellent prospects for the right man who should have some electrical/electronic qualification and/or experience.

Apply to the
Personnel Officer (T.F.)
M.O. VALVE CO., LTD.,
Brook Green W.6. RIV. 3431.
(A subsidiary of the G.E.C.)

ELECTRONIC TEST ENGINEERS AND TESTERS

Light Engineering Company in the Midlands is requiring the above for its COMPUTER DIVISION.

Applicants with a knowledge of this type of testing, and wishing to obtain well-paid positions, should apply stating qualifications and experience to The Personnel Manager, Box No. 5061, c/o "Wireless World."

STERN RADIO LIMITED
109 & 115, FLEET ST., E.C.4

have vacancies for

TWO RADIO ENGINEERS

Applicants must be experienced and possess sound technical knowledge. Good wages are offered plus Bonus and Staff Pension Scheme. Half-day on Saturday.

Phone **FLEET STREET 5812** or call at 109, Fleet Street (at Ludgate Circus, close to Blackfriars Station).

Reward for effort and enthusiasm in a challenging environment

electronic engineers mechanical engineers draughtsmen

suitably qualified engineers and draughtsmen with ideas and ambitions are invited to write 'phone or call—The Personnel Manager, The Plessey Company Limited, Ilford. Essex. Telephone Ilford 3040.

Work is on forward looking development in advanced telecommunications projects in our new laboratories.

Plessey

INTERNATIONAL AERADIO LIMITED
require an
INSTRUCTOR

to be employed at their new Training School.

Should possess a recognised professional qualification in telecommunications, with previous instructional experience. Familiarity with a range of telecommunications equipment is essential.

Salary will be commensurate with qualifications and experience and excellent working conditions apply.

The post is permanent and pensionable. Applications to:—

The Personnel Officer,
INTERNATIONAL AERADIO LIMITED,
Hayes Road, Southall, Middlesex.

Mars LIMITED

INSTRUMENT ARTIFICERS

Skilled men are required for the installation and maintenance of pneumatic and electronic equipment for automatic instrumentation and process control systems.

Candidates should be O.N.C. standard but consideration will be given to those with previous experience in electronics. The work will initially be on days but a shift rota will be worked after approximately one year. Applicants must, therefore, be prepared to work shifts or days. Rates of pay, days commencing

£ 17 11s. 0d.

Shift work commencing

£20 17s. 0d. rising to £22 19s. 0d. after 3 years

In addition to the high basic rates of pay, there is a unique and outstanding free Social Security Scheme covering Sick Pay, Life Assurance, Pensions and numerous other benefits.

If you would like further details, write or call:

P. J. Simpson
Personnel Department
MARS LTD., Fairlie Road, Slough, Bucks.

RADIO SERVICE and RADIO INSTALLATION ENGINEERS

Radiomobile at Cricklewood offer well paid and interesting employment to Radio Service and Radio Installation Engineers.

Applications should be made in writing, quoting reference SM.435, to:

The Staff Manager,
S. SMITH & SONS (ENGLAND) LTD.,
Cricklewood, London, N.W.2.

or telephone for an appointment to:—
The Service Department — GLAdstone 0171

VACANCIES FOR RESEARCH AND DEVELOPMENT CRAFTSMEN IN GOVERNMENT SERVICE IN VARIOUS PARTS OF THE U.K.

ELECTRICAL: (1) RADIO MECHANICS for the maintenance and installation of radio communication receivers and equipment.

(2) TELEPRINTER MECHANICS for the maintenance of teleprinter and cypher machines and associated telegraph equipment.

(3) WIREMEN for prototype sub-assembly lay out, wiring and testing of radio and computer type chassis.

MECHANICAL: Instrument makers and general machinists with bench fitting and machine shop experience for construction of experimental and prototype electronic apparatus.

BASIC PAY: £9/18/2 plus merit pay in the range of 10/- to 100/- per week. Merit pay will be assessed at interview based on ability and the necessary basic qualifications.

Opportunities for eventual permanent and pensionable posts. Five-day, 42 hour net, week; good working conditions; single accommodation available.

Apply in writing to: Personnel Officer (RDC/3), Government Communications Headquarters, 53, Clarence Street, Cheltenham, Glos.

SOLARTRON *development leads the world*

PROTOTYPE WIREMEN TEST ENGINEERS

We can offer systems work on Radar Simulators, industrial control and data logging equipment, computers, instrumentation and business machines.

Our new factory and Research and Development Laboratories offer excellent working conditions and our internal promotion system gives unequalled opportunities to get to the top.

Staff status—general non-contributory Sickness Benefit and Pension Schemes, 40-hour week and top rates.

Please call, write or 'phone

S. H. Fothergill, Personnel Officer,
THE SOLARTRON ELECTRONIC GROUP LTD.,
Victoria Road, Farnborough, Hants.
Tel. Farnborough 3000.

PHYSICIST or ENGINEER

is required by

W. H. ALLEN SONS & COMPANY LTD.

for the Electronics Section of their Laboratory at Bedford. The work involves the use of a wide range of electronic equipment in the solution of engineering problems, including research into engineering noise and vibration problems. An ability to design and develop special instruments and techniques is essential.

The successful candidate will be a man who has either

(a) A good grounding in electronics to at least H.N.C. together with some practical industrial experience; or

(b) recently obtained a Degree in a relevant field and though practical experience is desirable it is not essential.

An interest in mechanical and electrical engineering and an ability to write clear and concise reports are essential.

Application forms and conditions of service can be obtained from:—

The Personnel Manager (Ref. 1607/D/1)
Queens Engineering Works,
BEDFORD

TECHNICIANS—
ELECTRONICS

The Automation Department has vacancies for Staff Technicians in the Electronic Development Section.

The job entails the construction and testing of prototype electronic equipment, the installation and commissioning of the equipment, and the supervision of work done by Contractors.

Candidates should possess some experience of the design and application of Industrial Electronics and be in possession of a H.N.C. in Electrical Engineering, with endorsements in electronics or physics; or, a City and Guilds Full Technological Certificate in Telecommunication or equivalent qualifications.

Please write for application form to—

Superintendent, Personnel Services,
THE STEEL COMPANY OF WALES LIMITED
(STEEL DIVISION)
Abbey Works, Port Talbot, Glam.

CAREERS FOR RADIO TECHNICIANS IN CIVIL AVIATION

Vacancies for radio technicians aged 19 or over at Airports and Radio Stations throughout the United Kingdom maintaining radio communication and electronic navigational aids.

A fundamental knowledge of radio with some practical experience required for entry. Training given on the equipment in use.

Salary according to age and station, approx. £810 at age 25, rising to £930.

Three and half weeks' holiday with pay. Paid sick leave.

Facilities to study for higher qualifications giving good prospects of pensionable posts and promotion to Telecommunications Technical Officer Grades with salary maximums £988, £1,128 and £1,388.

Apply for further details to Ministry of Aviation (EST/5a), Room 755, The Adelphi, John Adam Street, London, W.C.2, or any employment exchange quoting order No. Westminster 3552.

WIRELESS OFFICERS

Urgently required by Government of BRITISH SOLOMON ISLANDS PROTECTORATE on contract for two tours each of two years in the first instance. Salary according to age and experience in scale (including Pay Differential) rising to £1,288 a year. A salaries commission is at present in the Protectorate and it is possible the salary of the post may be increased whilst the selected candidates are in post. Outfit Allowance £32. Children's Education Allowances. Free Passages. Liberal leave on full salary.

Candidates, under 45 years of age, should possess 1st class P.M.G. Certificate or technical qualifications in the maintenance of one or two of the following:

(a) Medium powered H.F. transmitters and receivers.

(b) Telephone system C. B. and Auto including V.H.F. Units.

(c) Pulse modulation techniques and shipborne radar.

Apply to **CROWN AGENTS 4 Millbank, London, S.W.1.,** for application form and further particulars, stating age, name, brief details of qualifications and experience and quoting reference M2A/51435/WF.

TELEPRINTERS . PERFORATORS REPERFORATORS . TAPE READERS

Picture Telegraph Equipment; Morse Equipment; Pen Recorders; Switchboards; Rectifiers; Tape Pullers and Rewinders; Motors; Suppressors; Teleprinter and Teletype Tables; Silence Covers; Terminals; V.F. Equipment; Telephone Carriers and Repeaters; Send/Receive Low and High Pass Filters; Teleprinter Testers; Relay Testers; Oscilloscopes; Valve Testers; Electric Meters; Teleprinter and Teledeltos Paper; Plugs; Sockets; Key, Push Miniature and Other Switches; Cords and Cables; Relays and Relay Bases; Counters; Uniselectors; Telegraph and Mains Transformers; Racks and Consols; Miscellaneous Accessories.

BATEY & CO., GAIETY WORKS
AKEMAN STREET, TRING, HERTS.
Ring: TRING 2183 or 2310
CABLES: RAHNO TRING

DAMAGED METER?

Have it repaired by Glasers

Reduce overheads by having your damaged Electrical Measuring Instruments repaired by L. Glaser & Co. Ltd.

INSTRUMENT REPAIRS

We specialise in the repair of all types and makes of Voltmeters, Ammeters, Microammeters, Multirange Test Meters, Electrical Thermometers, Recording Instruments, etc.

As contractors to various Government Departments, we are the leading Electrical Instrument Repairers in the Industry. For prompt estimate and speedy delivery send defective instrument by registered post, or write to Dept. W.W.

L. GLASER & CO. LTD.
96-100, Aldersgate Street, London, E.C.1.
Tel.: Monarch 6822

TOP CLASS HI-FI & STEREO EQUIPMENT

Bought, sold and exchanged player cases and equipment cabinets always in stock.

Send for details and lists.

H. C. HARRIDGE
8, Moor Street
Cambridge Circus, W.1
OPEN DAILY EXCEPT THURSDAYS

SOLARTRON

TEST ENGINEER

is required by our Test Department for the fault finding and testing of electronic instruments to government specifications.

Applicants should have had previous experience in this work, or dealt with radar in the Services or have serviced televisions and radios.

Ref. No. 577/WW.

Please apply—

Mrs. G. E. Mills,
Deputy Personnel Officer,
Solartron Laboratory Instruments Ltd.
Cox Lane, Chessington, Surrey.
Telephone: Lower Hook 2150

SOLARTRON

RELIABILITY TEST ENGINEERS

Test Engineers are urgently required to operate a reliability proving section on finished products as part of the quality control system in this expanding company. Experience in final testing of electronic instruments is the main qualification required; an appreciation of statistics would be advantageous. Interviews will be held by Mr. D. J. Hewitt.

Please apply initially to:

B.B. LYNCH,
Personnel Officer,
SOLARTRON LABORATORY INSTRUMENTS LTD.
Cox Lane, Chessington, Surrey.

Plessey

PRINCIPAL ENGINEERS
SUPPORTING ENGINEERS
DRAUGHTSMEN

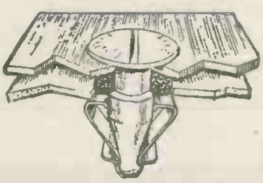
A newly formed department of the Plessey Company involved in designing and developing complex electronic equipment for marine applications is now expanding and laying down long term programmes to extend its present activities. These offer excellent opportunities to able and creative engineers and draughtsmen to join teams engaged on this work which entails the use of the techniques associated with:

Pulse circuits • Transistor circuits • Ultrasonics
Servomechanisms • Radar • Analogue computing
Military Electronics

The more senior appointments offer very attractive positions to engineers who can make original contributions when faced with challenging problems.

Please reply, giving full details of qualifications and experience to The Personnel Manager, The Plessey Company Limited, Vicarage Lane, Ilford, Essex.

ODDIE FASTENERS



THE FASTENER WITH ENDLESS APPLICATIONS - SIMPLE - POSITIVE SELF-LOCKING. MADE IN A VARIETY OF TYPES AND SIZES. SPECIAL FASTENERS TO SUIT CUSTOMERS' REQUIREMENTS. WIDELY USED IN THE RADIO INDUSTRY.

Illustrated brochure and other information will be gladly sent on request

DEPT. "W.W."

Oddie, Bradbury & Cull Ltd., Southampton

Tel. 55883 Cables: Fasteners, Southampton

RADIO POLICE NORTHERN RHODESIA

Radio Technicians required for appointment as INSPECTOR/SENIOR INSPECTOR OF POLICE, NORTHERN RHODESIA on agreement for one tour of 3 years in first instance with prospects of permanent and pensionable employment. Salary according to age and experience in scale rising to £1,380 a year. Plain clothes allowance £24 a year. Married accommodation with heavy furniture available immediately at low rental. Free passages. Liberal leave on full salary.

Candidates, 23 to 35 years of age, should have sound knowledge of installation and maintenance of modern low and medium power V.H.F. static and mobile equipment, H.F. transmitters and receivers, including S.S.B., and petrol generator and diesel electric sets. Knowledge of installation and maintenance of teleprinters and the possession of maths. and physics at G.C.E. "O" level standard would be an advantage.

Apply to CROWN AGENTS, 4 Millbank, London, S.W.1, for application form and further particulars, stating age, name, brief details of qualification and experience and quoting reference M2A/51291/WF.

DRAUGHTSMEN

Vacancies exist in our expanding

ELECTRONICS DIVISION
for
MECHANICAL AND ELECTRO-MECHANICAL DRAUGHTSMEN

The work involves the design of Consoles, Electronic Units for Government and Commercial Projects.

Preference will be given to men over the age of 25 years capable of working with the minimum of SUPERVISION.

Familiarity with the use of Ministry Specifications and preparing Drawings to D.E.F. 33 would be an advantage.

Applications giving full particulars should be sent to The Personnel Manager, Box No. 5060, c/o "Wireless World."

RADIO OFFICERS
MERCHANT NAVY

Vacancies exist in the Royal Fleet Auxiliary Service for Radio Officers holding 2nd or 1st Class P.M.G. Certificates.

Service is varied and interesting, in tankers and dry cargo vessels, which call at foreign ports not normally visited by Merchant Ships.

Non-contributory pension scheme and generous leave.

Contract rates of pay up to £115 monthly and additional pay for " In charge " allowance, First Class Certificate and in certain ships which serve with the Royal Navy.

Apply to the Director of Stores (3B), Admiralty, Whitehall, London, S.W.1, or telephone WHI 9000 Ext. 683.

UNITED KINGDOM ATOMIC ENERGY AUTHORITY
PRODUCTION GROUP
INSTRUMENT MECHANICS

Windscale and Calder Works, and Chapelcross Works require experienced men with knowledge of electronic equipment and/or industrial instrumentation for fault diagnosis, repair and calibration of a wide range of instruments used in nuclear reactors, radiation laboratories and chemical plant. This interesting work involves the maintenance of instruments using pulse techniques, wide band low noise amplifiers, pulse amplitude analysers, counting circuits, television and industrial instruments used for the measurement of pressure, temperature and flow.

Men with Services, Industrial or Commercial background of radar, radio, television, industrial or aircraft instruments are invited to write for further information. Training Courses in Specialised Techniques are provided for successful applicants having suitable Instrumentation background.

Married men living beyond daily travelling distance will be eligible for housing. A lodging allowance is payable whilst waiting for housing. Working conditions and promotion prospects are good.

Applications to:

Works Labour Manager, Windscale and Calder Works, Sellafield, Seascale, Cumberland

or

Works Labour Manager, Chapelcross Works, Annan, Dumfriesshire, Scotland.

NEW—Quality Tools at cut prices.
ENGINEERS 12-in. ADJUSTABLE SQUARE WITH SPIRIT LEVEL 9/9. 5in. VERNIER CALIPERS WITH DEPTH GAUGE 10/6.
WHIT. OPEN END SPANNERS, drop forged and plated, set 6, $\frac{3}{16}$in. to $\frac{1}{2}$in., **14/-.**
POCKET NEON TESTER, with retractable screwdriver, **5/-. 5in. SIDE CUTTERS 6/-. 5in. PLATED ROUND NOSE TAPERED PLIERS, 6/-. 7in. FLAT NOSE BOX JOINT TAPERED PLIERS, 8/6. 7$\frac{1}{2}$in. COMBINATION PLIERS, 6/6.**
TUB. HACKSAWS (Eclipse type), **12/9.**
H.S. TWIST DRILLS. Set of 7. $\frac{1}{16}$in. to $\frac{1}{4}$in. **4/-.** Full size in wallet, **6/-.** Set of 13—**9/6.** Set of 17, $\frac{1}{16}$in.-$\frac{5}{16}$in. in wood case, **16/-.** Set of 21—$\frac{1}{16}$in.-$\frac{3}{8}$in. **23/6.** Double Geared $\frac{5}{16}$in. Chuck hand drill **24/-.** $\frac{1}{4}$in. Chuck **15/6**
OUR FAMOUS TRANSFORMERS. Input 200/250 v. Output tapped 3, 4, 5, 6, 8-9, 10, 12, 15, 18, 20, 24, 30 v., 2 amp., **25/-.** 17, 11 v., 8 a., **31/-.** 5 a., **25/-.** 3.5 v. 9, 17 v., 1 a., **13/-.** P.P.
12in. SPEAKERS WITH 5in. TWEETERS by leading makers, **76/-.** Less than half list price.
NEW CELESTION OVAL SPEAKERS. 8$\frac{1}{4}$ × 5$\frac{3}{4}$in. **24/-.**
RELAYS. Single make contacts, 24 v. 25 amp., **15/-.**
RELAYS. 4,000 ohm. S.M. or S.B., **6/-.**
P.V.C. Recording Tape. Finest Quality. 850 ft. reels, **19/6.**
ACOS CRYSTAL MIC. INSERTS 1$\frac{3}{8}$"dia. **8/-.**
Hi-Fi CRYSTAL MICROPHONES in Grey Bakelite case, **16/6.**
G.B. ELECTRONIC CRYSTAL STICK MICROPHONE in polished steel case. 1$\frac{1}{8}$×6in., complete with lead and plated Bulgin jack plug, **42/6.** Weight 5 ozs.
F.W. METAL RECTIFIERS. 12/6 volt, 1 a., **7/6;** 3 a., **13/-;** 4 a., **17/6;** 6 a., **28/-;** 12 v. 6 amps., **30/-;** 12 v. 16 a., **45/-.**
ARCO SLIDE SWITCHES. D.PDT. **2/6.**
TOGGLE SWITCHES DPDT **3/6.** SP **1/9.**
MICRO SWITCHES, spring leaf, Make and Break, **5/6.**
MAINS TRANSFORMER AND RECTIFIER giving 12 v. 1 a. D.C. Output, **20/-.**
NICKEL NIFE BATTERIES. 1.2 volt. 2.5 amp. Size 3×2$\frac{3}{4}$×1in. Practically everlasting. **6/-** or 3 for **17/-.** 4 for **22/-.**
Ex W.D. MORSE KEYS. 3/6, 6/- and **8/6.**
1,000 NEW S.T.C. FREQ. CRYSTALS 13,740 kc/s. to 19,872 kc/s., **5/6** each. Plus 6d. postage. Lists available.
PAXOLIN PANELS 12×6×$\frac{1}{8}$in., **3/6.** P.P. 4ft.×3$\frac{1}{2}$in.×$\frac{1}{8}$in. **10/6.**
W/W RHEOSTATS 12 v. 1 a., **2/6;** 5 a. 4$\frac{3}{4}$in. Dia. **10/6.**
12 v. MINIATURE RELAYS. 1$\frac{1}{2}$×1$\frac{1}{4}$×1 in. Wgt. 1$\frac{1}{2}$ ozs. S.P.C.O., **8/6.** S.P.C.O. and 3 M. **9/6.**
12 v. D.C. RELAYS 2 make **6/-;** 2 for **11/6.**
BENCH GEARED HAND-GRINDER. 6×1in. stone **35/-.**
BENCH VICE. 2$\frac{1}{2}$in. with or without clamp. **16/-.**
EX. W.D. 12 v. D.C. Reversible Geared Motors. 2$\frac{1}{2}$×1$\frac{1}{4}$in. Ideal for all model use, **16/6.** Wgt. 10 ozs.

RELAYS—WE HAVE 100,000 PLAIN AND SLUGGED WHICH WE CAN OFFER AT EXTREMELY COMPETITIVE PRICES TO INDUSTRIAL USERS.

Enquiries welcome for RELAYS to meet your requirements. Please state operating voltage and/or current. Contacts and applied voltage.

Lists sent on request. All post paid.

THE
RADIO & ELECTRICAL MART
P.O. Box 9 G.P.O. Tunbridge Wells, Kent

Z. & I. AERO SERVICES LTD.

Head Office: 14 South Wharf Road, London, W.2

Tel.: AMBassador 0151/2 **Cables: ZAERO, LONDON**

A.R.B. Approved Stockists

RETAIL BRANCH (personal callers only): 85 TOTTENHAM COURT ROAD, W.2 Tel.: LANgham 8403

Please send all enquiries, correspondence and Mail orders to Head Office

OVERHAULED, TESTED AND GUARANTEED TEST EQUIPMENT FOR DELIVERY EX STOCK

SIGNAL GENERATORS: MARCONI TF144G, 85 kc/s.-25 mc/s.; Type 106, 5.5-52 mc/s.; MARCONI TF-390G, 16-150 mc/s.; MARCONI TF-517F, 18-58 and 150-300 mc/s.; GENERAL RADIO 804, 7.5-330 mc/s.; WAYNE KERR CT-53, 8.9-300 mc/s.; TYPE 101, 400-650 mc/s.; R.C.A. 710A, 370-560 mc/s.; MEASUREMENTS CORPORATION TYPE 84, 300-1,000 mc/s.; HEWLETT PACKARD TYPE LAE, 520-1,300 mc/s.; BC-1277, 2,700-3,400 mc/s.; TS-14, 3,200-3,370 mc/s.; TS-45/APM-3, 8,700-9,525 mc/s.; TS-35/AP, 8,700-9,500 mc/s.; TS-13/AP, 9,305-9,445 mc/s.

WAVEMETERS: BC-221, 125 kc/s-20 mc/s.; LM, 125 kc/s-20 mc/s.; LR-2 (Combined Heterodyne Frequency Meter and Calibrator Equipment with direct indication of difference frequency): 160 kc/s 60 mc/s; MARCONI TF-783, 3-60 mc/s; TS-173, 90-450 mc/s.; TS-175, 80-1,000 mc/s.

AUDIO-VIDEO OSCILLATORS: FURZEHILL No. 1, 0-10,000 kc/s.; B.S.R. LO-50 B.F.O., 0-16,000 c/s., MARCONI TF-195L, 0-40,000 c/s.; GENERAL RADIO WIDE RANGE B.F.O. TYPE 700A, 50 c/s.-5 mc/s.; MARCONI TF-885A VIDEO OSCILLATOR, 25 c/s. to 5 mc/s.

OSCILLOSCOPES: DUMONT SINGLE BEAM TYPE 208, COSSOR DOUBLE BEAM TYPE 339, COSSOR DOUBLE BEAM TYPE 1035, MULLARD-TYPE L101 DOUBLE BEAM (Switched); AIRMEC TYPE 723 SINGLE BEAM: AIRMEC TYPE 830 SINGLE BEAM: E.M.I. TYPE 3794TA SINGLE BEAM ON TROLLEY; TS-34 SINGLE-BEAM PORTABLE OSCILLOSCOPE.

R.F. OUTPUT POWER METERS: TS-118, 25 mc/s. to 750 mc/s., 5-500 watts; TS-36, 8,700-9,500 mc/s., 1-1,000 mW.; TS-3/AP, 2,750-3,400 mc/s., .5-250 mW.; TS-226, 405-425 mc/s., 0-1,000 watts.

A.F. OUTPUT POWER METERS: MARCONI TF-340, 0-5 watts; TAYLOR 150A, 0-5 watts; TAYLOR 160A, 0-2.5 watts.
VALVE VOLTMETERS, INSULATION FLASH-OVER TESTERS, IMPEDANCE BRIDGES, etc. 3cm. and 10 cm. ECHO BOXES. Please write for new edition of Test Equipment Catalogue.

METERS

50μA D.C. MC 2½in. Rd. Proj. Mtd. 45/-
200μA D.C. MC 2½in. Rd. Fl. Mtd.:
Calibrated 0-200μA 35/-
Calibrated 9·30%, sealed 35/-
500μA D.C. MC 2in. Rd. Fl. Mtd., Ferranti or Elliott, with Ring Nut fixing, FGX4 .... 30/-
500μA D.C. MC 2in. Rd. Fl. Mtd. Victoria 20/-
500-0-500μA D.C. MC 3½in. Rd. Fl. Mtd., Calibrated 50-0-50 yds./sec. 30/-
750-0-750μA D.C. MC 2in. Rd. Plug-in, uncalibrated, with Centre zero and FSD marks 25/-
1 mA. D.C. MC 2½in. Rd. Fl. Mtd., calibrated 0-30/0-100 sealed 30/-
1-0-1 mA. D.C. MC 2½in. Rd. Fl. Mtd., calibrated 100-200-400 with centre zero, sealed 22/6
15-0-15/30-0-30mA. D.C. MC 2½in. Rd. Fl. Mtd. Dual range with three terminals, Turner model 505, FGX4 .... 25/-
75mA. D.C. MC 2½in. Rd. Plug-in, FGX4 .... 15/-
150mA. D.C. MC 2in. Rd. Panel Mtd., FGX4 .... 15/-
200mA. D.C. MC 2in. Rd. Fl. Mtd. 20/-
1 Amp. D.C. MC 2½in. Rd. Fl. Mtd. 25/-
1 amp. R.F. Thermocouple, 2in. Rd. Panel Mtd. 15/-
2 amps D.C. MC 2½in. Rd. Fl. Mtd. 25/-
5 amps. D.C. MC 2½in. Rd. Fl. Mtd. 25/-
5 amps. A.C. MI 2½in. Rd. Fl. Mtd., calibrated 0·80 amps. or 0-200 amps. 15/-
10 amps. D.C. MC 2½in. Rd. Fl. Mtd. 25/-
40 amps. D.C. MC 2in. Rd. Proj. Mtd. 10/-
100 amps. A.C. MI 2½in. Rd. Fl. Mtd. 17/-
30-0-30 volts D.C. MC 2½in. Rd. Fl. Mtd. 17/6
36 v. D.C. MC 2in. Rd. Fl. Mtd., supporessed zero; zero deflection reads 18 v.; sealed 20/-
150 v. A.C. MI 2in. Rd. Fl. Mtd. 25/-
150 v. A.C. MI 2½in. Rd. Fl. Mtd. 20/-
300 v. A.C. MI 2½in. Rd. Fl. Mtd. 25/-
300 v. A.C. MI 6in. Rd. Fl. Mtd., Turner 32 .... 80/-
500 v. A.C. MI 2½in. Rd. Panel Mtd., Ferranti, Waterproof, FSD—250Ω/V; complete with external resistance; movement, 200Ω/V. 20/-
Signal strength meters, 2in. Rd. Panel Mtd. Basic movement 1 mA. D.C. Translucent scale with provision for internal lumination, calibrated from 0-20 "S" units at half scale, and from 0-40 dB above 20 "S" units 35/-

AVOMETERS MODEL 7

Fully overhauled and guaranteed £12 10 0 p.p. 10/-
Ditto Mark II .... £13 0 0 p.p. 10/-
Leads: 15/- extra per pair.

BLOCK PAPER CAPACITORS

1μF 1,250 v. Dubilier 8/-
1μF 2,000 v. TCC 14/-
1μF 5,000 v. Dubilier 17/6
1μF 7,500 v. Dubilier 22/-
2μF 600 v. Tubular, single nut fixing 2/6
2μF 800 v. Dubilier 3/6
2μF 2,500 v. Dubilier 15/-
4μF 200 v. Dubilier 5/6
4μF 600 v. 6/-
4μF 4,000 v. Cornell-Dubilier 25/-
8μF 200 v. Dubilier or TCC 6/-
8μF 1,250 v. Dubilier 10/-
8μF 1,500 v. Dubilier 12/6
Postage and packing 9d. per capacitor.

ELECTROLYTIC CAPACITORS

T.C.C. MICROPACK 4μF 350 v. pk. wkg. 2/-
T.C.C. Lectropack 8×8μF 450 v. pk. wkg. 3/-
16×16μF 500 v. D.C. Dubilier Plug-in type, B5 base 1/9
Postage and packing 6d. per capacitor.

INSULATION TESTERS

EVERSHED MEGGER SERIES 2. 500 v., 100 megohms £25
EVERSHED MEGGER SERIES 2. 1,000 v., 200 megohms £40
EVERSHED BRIDGE MEGGERS. These have built-in four-decade resistance box with five setting of ratio arms and facilities Insulation, Resistance and Varley Loop measurements:
250 v. 50 megohms £35
500 v. 100 megohms £65
1,000 v., 200 megohms £72
All the above are fully overhauled and guaranteed.

FIELD STRENGTH METERS

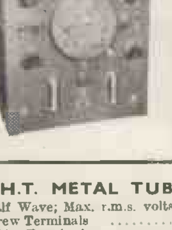
TYPE CT.10 (designed by D.S.I.R.)

Frequency range 20-30 mc. and 40·650 mc. Range of measurement 0·140 dB above 1μV/metre. Maximum sensitivity 4μV/metre at 20 mc. dropping to 400μV/metre at 600 mc. The instrument will measure field strength of C.W., M.C.W. and pulsed signals. Power supplies required—two 6V. batteries. Complete station consists of IF amplifier unit, C.R. tube indicator unit, five plug-in mixer units (one for each band) five di-pole aerial units, aerial tripod, connectors and feeders, and manual with calibration charts, all packed in four transit cases £250

R.C.A. TYPE 301B

Frequency range 18-125 mc. Range of measurement 5-100,000 μV/metre at 18 mc., and 100-2,000,000 μV/metre at 125 mc. Field strength is indicated on the meter and can also be recorded and monitored by headphones. Both FM and AM signals can be measured. Complete equipment consists of calibrated receiver, substitution oscillator assembly and case with aerial di-poles, tripod and connectors. Power requirements—dry batteries. Complete with manual and calibration charts .. £130

GENERAL RADIO LR.2 COMBINED HETERODYNE FREQUENCY METER AND CALIBRATOR EQUIPMENT



Frequency range 160 kc.·60 mc. and 0-5,500 c/s. In the latter range, the instrument will also work as audio oscillator with an output of 3V. into 600 ohms. Precision 100 kc. crystal accurate to ±1 cycle drives a multi-vibrator providing check-points at 100, 20 and 10 kc. Direct reading interpolator indicating the different frequency between the measured signal and the wavemeter setting. Power supplies 120 V. A.C. Price £150
Packing and Carr. £6.

E.H.T. METAL TUBULAR RECTIFIERS

Half Wave; Max. r.m.s. volts 1,220 v. at 2 mA.
Screw Terminals 7/6
Solder Terminals 5/-
P. P. 9d. per rectifier.

CRYSTAL TEST SET

TYPE 193

Mains operated, rack mounted tester for checking crystal oscillation and frequency (in conjunction with suitable wavemeter), crystal activity and equivalent parallel resistance. Secondhand in good condition and tested. Price £15

TYPE 330

Similar to the above, but having tuned oscillator circuit tunable from 55 kc. to 2,000 kc. Built-in crystal sockets for ½in., ¾in., 2-pin, B7G and octal bases, mains operation. Price £15

TYPE CT.79

Tuned oscillator circuit from 40 kc. to 25 mc. Incremental capacity scale from 0·500 PF (residual capacity 60 PF). Complete with accessory case containing the following crystal sockets—octal, 2-pin ¾in., 2-pin ½in., 2-pin ½in. small, B7G; crystal ovens and one lagged cover. Mains operation. Price £45

POWER UNITS

WESTINGHOUSE SELENIUM RECTIFIER POWER UNIT

Input 115-230 V. Fully smoothed and fused. Output adjustable from 80-140 V. D.C. by means of tap switches in the transformer secondary winding. Maximum continuous current 400 mA. Dimensions 17½in. × 10½in. × 3½in. Price 40/-
P.P. 7/6.

RECEIVER POWER UNIT DRAWER

Input 115-230 V. A.C. Output 6.3V at 6 A. A.C., and 250 V. H.T. at 200 mA. Fully smoothed and fused. Built-in cooling blower. Dimensions 6¾in. high × 13½in. wide × 17½in. deep. Weight 32 lbs. Price, complete with connectors and fully guaranteed £5
P.P. 20/-.

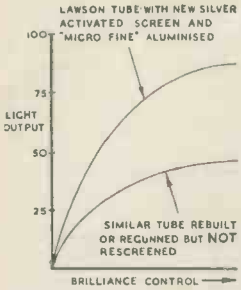
TRANSMITTER POWER UNIT DRAWER

Input 115-230 V. A.C. Output 6.3 V. A.C. at 10 A.; 24 V. D.C. at 60 mA. Smoothed to peak ripple of .1%; 24 V. D.C. at 240 mA. for control circuits etc.; fixed bias of minus 8 V.; adjustable bias from zero to minus 30 V; two independent outputs of 300 V. at 135 mA. with peak ripple of 1% and 300 V. H.T. at 215 mA. with peak ripple of 5%. Built-in cooling blower. Dimensions 8½in. high × 13½in. wide × 19¾in. deep. Weight 60 lbs. Price £10/10/-
P.P. 25/-.

3-RANGE MICRO-MILLIAMMETER

Basic movements 50μA D.C. M.C. Ranges of 50μA. 250μA and 1mA. switched by a trigger switch in the back, geared with sliding scale having separate graduations for each range. Instrument is fitted with leads for soldering to test prods or crocodile clips (not supplied) 50/-

LAWSON



EXPRESS SERVICE
Orders received by 3 p.m. are dispatched same day. Special direct services to Ireland and Scotland.

TRADE AND QUANTITY DISCOUNTS

LAWSON TUBES
156, PICKERSLEIGHS ROAD, MALVERN, WORCS. TEL.: 3798

DIRECT REPLACEMENT
Reprocessed **TV TUBES**

12 MONTHS ***FULL REPLACEMENT*** **GUARANTEE**

ENGINEERS WITH EXPERIENCE

Know that as a television tube gets old not only does it become low emission but the light efficiency of the phosphor screen has also seriously deteriorated (up to 10% per year). This deterioration of the screen obviously continues if the tube is only rebuilt or regunned. Don't risk a "dead screen". Enjoy the brilliant, crisp, high definition of a **Lawson Tube.** Tubes which are absolutely **BRAND NEW** throughout (excepting the glass) and which incorporate the very latest CRT developments. New silver activated screens, "micro fine" aluminising, high efficiency gettering, brand new **direct replacement** electron guns by Britain's premier manufacturers, Mullard, Mazda, Emiscope, Brimar, Emitron, E.E., Cossor, etc.
ALL MAKES AND TYPES FROM STOCK

LAWSON. The ONLY replacement tubes for which all types are guaranteed, correct and direct plug in replacements.

12" – £4:10:0
14" – £5: 5:0
15"-17" – £5:15:0
CARR. & INS. 7/6

C.O.D. or C.W.O
10/-
Gladly refunded if you wish to return your old tube (excepting 12")

36/50 SWG ·0076"-.001"
VERY HIGH SPEED
TENSIONING & DE-REELING

FOR COST CUTTING IN COIL WINDING

★ FAST STARTS AND STOPS
★ VERY HIGH SPEEDS
★ CONSTANT REVERSIVE PULL
★ LARGER REEL SIZES
★ SMOOTHER WIRE FEED
★ CUTS BREAKS AND SCRAP
★ VERY LIGHT MOVING PARTS
★ STATIONARY SUPPLY REEL
★ MODELS FOR LARGER WIRES

SHAWNDEL FLYERS LTD.,
DEPT. WW1161, 72 QUEEN STREET, MAIDENHEAD, BERKS, ENGLAND.
Tel. MAIDENHEAD 890

IMMEDIATE DELIVERY
PO 3000 & 600 Type
RELAYS TO SPECIFICATION

KEYSWITCH RELAYS
I Sales Manager
IRONGATE WHARF ROAD, PRAED ST.
LONDON W2. Tel: PADdington 2231 (6 lines)

Instrumentation at its best . . .

SIFAM ELECTRICAL INSTRUMENT CO. LTD.
WOODLAND ROAD, TORQUAY Tel. 63822/3

ELECTRIC TOOLS

Direct bulk purchase enables us to offer latest D.500 Black & Decker drill and 20 item multikit the lot for only £7/7/-, 2 years makers' written guarantee. Hundreds of other electric tools, attachments, appliances, transistor radios, and hand tools all at trade prices. Catalogue 6d. stamps. Home trade and export. Our engineering section now has capacity available for all types of assembly and metalwork.
K.E.P. PRODUCTS LTD., Ashmead Road, London, S.E.8
Tideway 2449. Callers welcome. Established 83 years.

MALVYN ENGINEERING WORKS
Engineers to the Radio and Electronic Industries

Manufacturers of : Chassis, Small Pressings, Machined Components, Wiring and Mechanical Assemblies, to specification.

Single and Production Quantities
7 CURRIE STREET, HERTFORD, HERTS.
Telephone: Hertford 2264

RACKS & PANELS

All types, open and enclosed, to G.P.O. or customer's specification.
SOUND SALES LTD.
Works & Laboratories.
West Street, Farnham, Surrey
Farnham 6461

SOUTHERN TECHNICAL SUPPLIES
TRANSFORMERS FOR ALL MULLARD AMPLIFIERS

OUTPUT TRANSFORMERS (Secondaries for 3.75 and 15 ohms)
T.44. 5-10 amp. ultra linear, 8,000 ohm. 43% tappings **30/-**. P/P. 2/6
T.162. 5-10 amp. and Osram 912, 6,600 ohm. 20% tappings, **30/-**. P/P. 2/6.
T.142. 7 watt stereo amp, 9,000 ohm. 20% tappings, **26/-**. P/P. 2/6.
T.140. 3 watt amp., type A tape amp., 3 watt stereo, 5,000 ohms, **12/-**. P/P. 1/6.
MAINS TRANSFORMERS (Primaries 240-220-200; 0-10 v. 50 c/s).
T.55. 5-10 amp. and tuner, 300-0-300 v. 120 mA., 6.3 v. 2.5 a., 6T, 6.3 v. 2.5 a., 6.3 v. 1 a., **32/-**. P/P. 3/-.
T.56. 5-10 amp. 300-0-300 v. 100 mA. 6.3 v. 2.5 a., cT 6.3 v. 1 a., **27/-**. P/P. 3/-.
T.101. Two 5-10 amp. Low loading, 300-0-300 v., 150 mA., 6.3 v. 4 a., cT. 6.3 v. 1 a., **34/-**. P/P. 3/3.
T.143. 7 watt stereo 250-0-250 v., 150 mA., 6.3 v. 4 a. cT., 6.3 v. 1 a., **33/-**. P/P. 3/-.
T.141. 3-watt, 300-0-300 v., 60 mA., 6.3 v. 1 a., cT., 6.3 v. 1 a., **22/-**. P/P. 2/6.
TRANSISTOR TRANSFORMERS. (Drivers for Single Ended Push-Pull).
T263. Ratio 3.6 : (1+1) Two OC72's 200 mW., **10/-**. P.P. 9d.
T261. Ratio 5.5 : (1+1) Two OC81's 500 mW., **11/-**. P/P. 9d.
All transformers fully guaranteed, all shrouded fully except T140 and Transistor. Write for our fully illustrated catalogue, with all data.
SPECIAL OFFERS T44 and T55, **59/-**; T143 and two T142's, **82/-**. P/P. 4/- on both.
Mullard's latest Publication detailing the complete range. "**CIRCUITS FOR AUDIO AMPLIFIERS,**" 8/6. P/P. 1/-.
MULLARD REFERENCE Manual of Transistor Circuits 12/6. P/P. 1/-.
SOUTHERN TECHNICAL SUPPLIES, 83, Station Road, Portslade, Sussex

LANGUAGE COURSES with your tape recorder

FULL ELEMENTARY COURSE 3 gns
(including book)
COMPREHENSIVE COURSE 6 gns
(including handbook)

CONVERSION PULLEYS
for Collaro Mark 4 deck to run at $1\frac{7}{8}$", $3\frac{3}{4}$", $7\frac{1}{2}$" per sec. Cost complete 21/-

(Please Note Change of Address)

TUTOR TAPE COMPANY LTD.
66 Sloane Street, London, S.W.1. Bel 1405

Wireless World Classified Advertisements

Rate 9/- for 2 lines or less and 4/6 for every additional one or part thereof, average lines 6 words. Box Numbers 2 words plus 1/-. (Address replies: Box 0000 c/o "Wireless World," Dorset House, Stamford St., London, S.E.1.) Trade discount details available on application. Press Day December 1961 issue, Thursday, November 2nd. No responsibility accepted for errors.

WARNING

Readers are warned that Government surplus components and valves which may be offered for sale through our displayed or classified columns carry no manufacturers' guarantee: Many of these items will have been designed for special purposes making them unsuitable for civilian use, or may have deteriorated as a result of the conditions under which they have been stored. We cannot undertake to deal with any complaints regarding any such items purchased.

RECEIVERS AND AMPLIFIERS SURPLUS AND SECONDHAND

ZENITH receiver, cost £96, 8 bands, excellent condition; offers over £25.—17, Dukes Rd., W.C.1. [9741

51J2 Collins Communications Receiver, 30 bands, 0.5/30.5 Mc/s, in perfect order, in table cabinet; £195.—Box 5055. [9692

HRO Rx's, etc. AR88, CR100, BRT400, G209, S640, etc., etc., in stock.—R. T. & I. Service, Ashville Old Hall, Ashville Rd., London E.11. Ley. 4986. [0053

51—J—3 Collins, Hallicrafter's, S-27CA, S-36A, S-37, 388/URR, R.D.O., 13/URR, 35/URR, AR-88, RT-67/RT-70A, R-109/GRC, .5mc/s-4,000mc/s, frequency meters, BC-221, TS-174, TS-175A, TS-323, USM-45, 125kc/s-11,000mc/s.
WRIGHT, 4a, Nepal Ave., Atherton, Manchester. Tel. 991. [0023

AMERICAN R.C.A. General Purpose Communications Receiver Model A.R.—88D 6 bands 535 to 32000 k c, equal new, headphones, loudspeaker, spare valves.—97, Lichfield Road, Bloxwich, Walsall. [9765

"WIRELESS World" 7-valve F.M. tuner, unused, with cathode follower, magic eye and power supply for use on 200-250 volts, A.C., fitted with latest type F.M. components of the highest grade including specified temperature, compensating capacitors, price £12/15 including 7 valves, accurately aligned and tested, ready for use, approx. half original price, exceptionally good reproduction, ideal for use with all high fidelity amplifiers and recorders, limited number bargain, above are sent in boxes lined with foam rubber to ensure safety in transit.—Box 5063. [9755

NEW LOUDSPEAKERS

DUODE sound units give most natural results from tape, disc or radio—because their famous, unique dual drive, built-in crossover and feedback, linen cone with graded compliance, produce 20-15,000 cps with smooth non-resonant, dead-beat crystal clarity; buy Duode for your lasting pleasure and finest long-term good sound investment.
DUODE, Ltd., 16, Brunswick Rd., Sutton, Surrey. [9678

NEW TEST EQUIPMENT

HEATHKITS can now be seen in London and purchased on easy terms; free brochure.—Direct TV Replacements, Ltd., Dept. W.W. 30/11, 138, Lewisham Way, S.E.14. Tideway 6666. [9240

BRAND new 5,000 volt insulation testers, output 0-5,000 volts A.C. or D.C., max. output current 5 m/a D.C., 10 m/a A.C.; voltage indicator meter magic eye leakage indicator, variac voltage regulator; input 200/250 volts A.C.; complete leads and prods; one prod has microswitch for absolute safety; dimensions 18in×18in×13in, weight 301b; cost Government nearly £100; in original transit cases, £27/10 each, cash with order, carriage forward; 14-day refund guarantee.—R. Sankey, Regal Cinema, Atherstone, Warwicks. Tel. Atherstone 2220. [9619

TEST EQUIPMENT—SURPLUS AND SECONDHAND

COSSOR 1035 Oscilloscope, as new, with trolley and cover; £70.—B. Buckler, 5, Langfield Close, Nazeing, Essex. Naz. 3360. [9754

SIGNAL generators, oscilloscopes, output meters, wave voltmeters, frequency meters, multi-range meters, etc., etc., in stock.—R. T. & I. Service, Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [0056

TEST EQUIPMENT WANTED

EDISWAN pen recorder and amplifiers.—Box 5059. [9730

NEW!

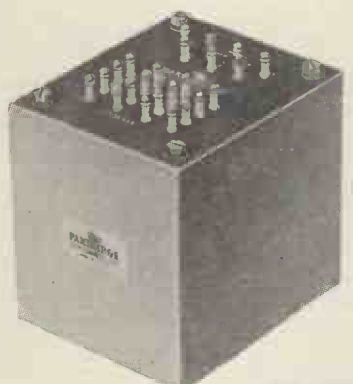
Partridge

P.4160

WIDE FREQUENCY RANGE

U.L. TRANSFORMER

Ten years' development and research are behind this newest Partridge Push-Pull Output Transformer.



PRICE : 210/-

The Partridge P4160 transformer is a wide frequency range U.L. transformer. We regard this new transformer as the biggest step forward in Audio output transformer development in the last decade, i.e. since we produced the famous CFB range in 1950. We would stress that we consider this to be the finest transformer it is possible to manufacture with present known techniques.

- Primary resonance greater than 100 kc/s.
- Primary resonance impedance: 1,200Ω at 100 kc/s. 900Ω at 80 kc/s.
- Specially balanced leakage inductance between various sections.
- Very low D.C. resistance on primary and secondary windings.
- Power rating: 20 watt, 20 c/s-50 kc/s. 35 watt, 25 c/s-30 kc/s.
- Enclosed in robust steel shielding case, resin filled, suitable for H2 operation.
- Weight: 10½lb.

Post the coupon now for latest release details on this new type.

To Partridge Transformers Ltd.,
Roebuck Road, Chessington, Surrey
Latest Release on the P.4160 please
NAME ....
ADDRESS ....
.... WW/11/61

NEW COMPONENTS

LINE output transformers and scan coils for most makes, exact replacements, from 25/- used, and 45/- new; send s.a.e. for imm. quote; just a few examples from our extensive range in stock; add 2/6 for p. & p.; telephone orders sent same day c.o.d.
NEW L.O.P.T.s for Pye V4/V7, VT4/VT7, 52/6; scan coils for above, 62/6, Ferranti L.O.P.T. 14T3/4, 17T3/4, 45/-; Ferguson 992/6/8 L.O.P.T., 69/6; Murphy 240/250 L.O.P.T., 62/6; Bush TV24, 67/6, TV43 67/6 L.O.P.T.s.
T.C.S., Ltd., 28, Brockley Cross, S.E.4. Tid. 5394, and 112, Camberwell Rd., S.E.5. [0334

COMPONENTS—SURPLUS AND SECONDHAND

SEND for catalogue No. 14—500 illustrated items; 2/6 post free.—Arthur Salis Radio Control, Ltd., 93 (c) North Rd., Brighton. [0193

MANUFACTURER'S stocks of radio cores, components and measuring instruments for disposal; send for free lists, enclosing s.a.e., to S.E.I., Stock Disposals, Gee St., Heywood, Lancs. [9758

NEW GRAMOPHONE AND SOUND EQUIPMENT

SAVE on tapes, ask for Sound News imported tape; list; see trade. [0131

TAPE decks and recorders by Ferrograph, Vortexion, Brenell, Telefunken, Reflectograph. Bradmatic, amplifiers and tuners by Quad. Leak, Dulci, Chapman, Rogers.
MICROPHONES by Reslo, Lustraphone, S.T.C., Grampion, A.K.G. All tapes and accessories.
GOOD quality equipment welcome in part exchange.
CLOSED circuit television for schools and industry from 119 gns.
SPECIALIST audio service and sound recording. Hire purchase facilities available.
LAMBDA RECORD COMPANY LIMITED, 95, Liverpool Road, Liverpool, 23. Telephone Great Crosby 4012. [9014

GLASGOW.—Recorders bought, sold, exchanged; cameras, etc., exchanged for recorders or vice-versa.—Victor Morris, 343, Argyle St., Glasgow, C.2. [0201

"EROICA" RECORDING STUDIOS (Est. 1949).—For the better class tape recorders for industry, research, music and private use; Ferrograph, Brenell, etc.; complete recording service; music for industry, tape/disc.—31, Peel St., Eccles, Manchester. Eccles 1624. Studio, Director Thurlow Smith, A.R.M.C.M [0122

BARGAINS (new): Armstrong PCU 21 stereo control unit and two A6 amplifiers, £25 the lot; STD 399 VHF tuner, £14/10; Richard Allan Princess enclosure with golden eight unit, £12/10 complete; B. J. Sonetta, light oak, £12/10; Dulci Stereo II control unit and S.P. 44 stereo amplifier, £16; second-hand or demo. models, as new: two Jason Prefect VHF/FM tuners, £2/15 each; worth this for the parts; one Stirling VHF/FM tuner, £2/10; Goldring Lenco transcription unit on polished mahogany playing desk, £15; Astronic stereo amplifier integrated 4 plus 4, £12/10; Pamphonic integrated stereo amplifier model 3000, £22/10; STD octagonal speaker enclosure in walnut, £10, might take £9 from caller, to take away; Grundig TK 35 tape recorder, £58; Decca H LP head fitted diamond and ditto 17 head sapphire, £2/5 the two; Brown's earphones, cost £5, £2/5; terms, cash with order plus p. & p.; send 15/- balance returned.—"The High-Fidelity Centre," 61, West St., Dorking. [9728

GRAMOPHONE AND SOUND EQUIPMENT —SURPLUS AND SECONDHAND

RECORDING tape; save up to 30%; send for list; also 50 second-hand recorders in-stock. —E. C. Kingsley & Co., 132, Tottenham Court Rd., London, W.1. Eus. 6500. [0035

EXPERT GRAMOPHONES, Ltd., have for disposal from time to time used items of mono/stereo equipment, including preamplifiers, main amplifiers, loudspeaker columns and complete units; all equipment offered has been thoroughly tested in our workshops and is fully guaranteed; send us your requirements; quotations without obligation.—235a, Bensham Lane, Thornton Heath, Surrey. Tel. Thornton Heath 4139. [9747

TAPE RECORDING, ETC.

TAPE to disc, Adanac recordings.

SEND a personal Xmas message this year; records from 12/6.—E. H. Jackson, 36, Bannatyne St., Lanark, Scotland. [9721

ASK your dealer for American Ferrodynamics "Brand Five" recording tapes; the best tape value! [0270

RENDEZVOUS RECORDS offer comprehensive 78/45/33 tape to disc recording facilities.—Leaflet from 19, Blackfriars St., Manchester, 3. [9386

TAPE-TO-DISC Service, E.P.s, L.P.s, editing and dubbing, standard, comprehensive leaflet from—Toucan Sound Productions, 122, Fernlea Rd., Balham, London, S.W.12. [9682

TAPE RECORDING, ETC.

TAPE to disc recording—finest professional quality, 10in L.P. 30/- (32 mins.), 12in L.P., 35/- (45 mins.), 7in E.P. 17/6; 48-hour postal service; s.a.e. for leaflet to:—Deroy Sound Service, 52, Hest Bank Lane, Hest Bank, Lancaster. [9735

TELEFUNKEN tape recording heads, record and erase 60 to 20 Kcs, 30/- the pair twin track, rectifiers 12/24 volt 5 amp, 15/-; elapsed hour meters Sangamo movement, new! suitable clock conversion, etc., 19/6 each; all post paid.—A. Fanthorpe, Ltd., 6/8, Hepworth's Arcade, Hull, Yorkshire. [9694

TAPE/DISC/TAPE transfer editing; duplicating; if quality and durability matter (especially with L.P.s from your precious tapes), consult Britain's oldest transfer service; new tape recorders supplied with a free service guarantee; latest American tapes, 1,800ft 29/-, now available.—Sound News Productions, 10, Clifford St., London, W.1. Reg. 2745. [0192

PRE-RECORDED TAPES

PRE-RECORDED tapes.—Unique 40-page catalogue listing all makes, mono, stereo, 7½ and 3¾ i.p.s.; send 2/6, refundable on first tape record purchased.—Dept. TR5, Teletape, Ltd., 33, Edgware Rd., W.2. Pad. 1942. [0020

VALVES

VALVE cartons by return at keen prices; send 1/- for all samples and list.—J. & A. Boxmakers, 75a, Godwin St., Bradford, 1. [0172

NEW and surplus valves, fully guaranteed, huge stocks, genuine valve bargains; s.a.e. for list; also reclaimed valves, perfect, 5/- maximum, plus 6d p. & p. each.—Lewis, 46, Woodford Avenue, Ilford, Essex. [9744

VALVES WANTED

NEW valves wanted, any quantity, best cash price by return.—Stan Willetts, 43, Spon Lane, West Bromwich, Staffs. Tel. Wes. 2392. [9632

ALL types of valves British or American, transmitting and receiving; keenest cash prices paid. What have you to offer?—Write or call Lowe Bros., 9a, Diana Place, Euston Rd., N.W.1. Tel. Euston 1636-7. [9567

WE purchase new valves, old or modern type, for cash; full details, please, including price required, in your first letter.—Waltons Wireless Stores, 15, Church St., Wolverhampton. [0102

WANTED, EXCHANGE, ETC.

WANTED, new valves, speakers, components, etc., for cash.—A.D.A. Mfg. Co., 172, Alfreton Rd., Nottingham. [9676

WANTED, all types of communications receivers and test equipment.—Details to R. T. & I. Service, Ashley Old Hall, Ashville Rd., London, E.11. Ley. 4986. [0163

A PROMPT cash offer for your surplus brand new valves, speakers, components, test instruments, etc.—R.H.S., Beverley House, Mannville Tce., Bradford 7 [0190

URGENTLY wanted, manuals or instruction books, data, etc., on American or British Army, Navy or Air Force radio and electrical equipment.—Harris, 93, Wardour St., W.1. Gerrard 2504. [9623

WANTED for cash, good quality test gear, amplifiers, Ham RXS, freq. meters, com. RXS, microwave equipt., etc., etc.—Call, write or send. Tel. Miller's Radio, 38a, Newport Court, Leicester Sq., W.C.2. Ger. 4638. Est. 18 years. [9629

PROMPT cash for the purchase of surplus stocks of televisions, tape recorders, radios, amplifiers and domestic electrical appliances of every description, substantial funds available.—Spears, 14, Watling St., Shudehill, Manchester. Blackfriars 9432 (5 lines). Bankers: Midland Bank, Ltd. [0216

REPAIRS AND SERVICE

BOULTON'S OF BRADFORD.

LOUDSPEAKER pressure unit, and microphone repairs, D.C.B., cone assemblies and field coils in cartons, service and satisfaction guaranteed. —D. C. Boulton, 134, Thornton Rd., Bradford, 1. Tel. 22838. [0171

MAINS transformers wound to any specification.
MOTOR rewinds and complete overhauls; first-class workmanship, fully guaranteed.
F.M. ELECTRIC Co., Ltd., Potters Bldgs., Warser Gate, Nottingham. Est. 1917. Tel. 54898. [0113

WE undertake the manufacture of transformers singly or in quantities to any specification; all work guaranteed for 12 months.
LADBROKE Transformer Co., Ltd., 820a, Harrow Rd., London, N.W.10. Tel. Ladbroke 0914. [0222

METERS, expert, guaranteed repairs to all types and makes, single or multi-range, prompt service.—R. Hawkins, 103, Roxborough Rd., Harrow, Middx. Tel. 4791. [9706

SPEAKER repairs, cones fitted, fields and clock coils wound, guaranteed satisfaction, prompt service.—L. S. Repair Services, Pluckley, Ashford, Kent. [0223

BOOKS ON FREE TRIAL!

No. 8
Pin-Point
TV troubles in 10 minutes

Find the exact sound or picture trouble in ANY TV set from 700 possibilities! 300 pages; 300 diagrams; check charts! 31/6.

No. 9
Pin-Point
Transistor troubles in 12 minutes

Trouble-shoot every type of circuit in ALL transistorized equipment! 525 pages; hundreds of illustrations; 120 check charts. 47/6.

TRY ANY THREE BOOKS ON NO RISK FREE TRIAL

No. 4. Latest Instruments for Servicing Radio and Television. Coyne. 26/-.
No. 7. Transistor Circuit Handbook. Louis E. Garner. Coyne. 39/6.
No. 12. Radio Designer's Handbook. F. Langford-Smith. Iliffe. 55/-.
No. 16. Principles of Frequency Modulation. B. S. Camies. Iliffe. 21/-.
No. 11. Principles of Transistor Circuits. S. W. Amos. Iliffe. 21/-.
No. 20. Principles of Semiconductors. M. G. Scroggie. Iliffe. 21/-.
No. 10. Television Receiver Servicing, Vol. 1. Spreadbury. Iliffe. 25/-.
No. 17. Electronic Computers. Principles and Applications. Iliffe. T. E. Ivall, 2nd. Edition. 25/-.
No. 15. Wireless Servicing Manual. W. T. Cocking. Iliffe. 17/6.
No. 14. Radio Circuits. Miller & Spreadbury. Iliffe. 15/-.
No. 5. Practical Television and Trouble Shooting Manual. Coyne. 34/-.
No. 6. Television Servicing Cyclopedia. Coyne. 47/6.
No. 38. Colour Television. NTSC System, Principles and Practice. P. S. Carnt, G. B. Townsend. Iliffe. 85/-.
No. 22. Pin-Point Colour Television Troubles in 15 Minutes. Coyne. 47/6.
No. 21. Basic Mathematics for Radio and Electronics. Iliffe. 17/6.
No. 23. Introduction to Laplace Transforms. For radio and electronic engineers. W. D. Day. Iliffe. 32/6.
No. 24. Radio Valve Data, Compiled by Wireless World. Iliffe. 6/-.
No. 25. The Oscilloscope at Work. A. Haas and R. W. Hallows. Iliffe. 18/-.
No. 26. Numerical Methods for High Speed Computers. G. N. Lance. Iliffe. 42/-.
No. 27. Second Thoughts on Radio Theory. Cathode Ray of Wireless World. Iliffe. 25/-.
No. 28. Foundations of Wireless. M. G. Scroggie. Iliffe. 15/-.
No. 1. Coyne Elementary Practical Radio-Television. Set of three volumes, total 1,038 pages, sturdy vinyl, washable covers. Special Offer £3-12-6 the set.
No. 18. Mullard Reference Manual of Transistor Circuits. 12/6.
No. 19. Refrigeration Service Manual. H. P. Manly. Drake. 24/-.

Just mail coupon for free trial. After 7 days send only low price or return book and pay nothing!

Postage: £3 or less 1/6, £3 or more 2/-

FREE TRIAL OFFER! Mail coupon NOW!

Mail Order Division, SIM-TECH BOOK COMPANY, Dept. WW14, Gater's Mill, West End, Southampton, Hants.

☐ RUSH BOOKS No.............................. for 7 days' FREE TRIAL as per offer.

☐ Tick here if enclosing full price. We pay postage (Coyne Books only) Same 7-day money-back guarantee.

NAME ....

ADDRESS ....

City.......................... County..........................

REPAIRS AND SERVICE

ALL transformers manufactured to specification, estimates. Auto. transformers 50 to 600 watts. Bulk demagnetizers for tapes and tools 27/6.—Osmabet, Ltd., 46, Kenilworth Rd., Edgware, Middx. Tel. Stonegrove 9314. [0070

TRANSFORMERS to any specification, singles, small or large batches, quick and efficient service, competitive prices, estimates.—Messrs. Newman & Son, 1, Grove Crescent, South Woodford, E.18. [0330

MISCELLANEOUS

TX-RX RT 18/ARC-1, complete with 29 valves and crystal, £8/10, plus carriage 10/-.
TX-RX TR 3173A, complete with 20 valves, £5/10, carr. 10/-.
T.B. S3-4 transmitter and receiver, 60-80 MC/S, 5 tuning meters, all 24 valves, circuit, £10/10, carr. £1.
TB. S7 magnetic controller, 230V DC, 39/6, carr. 7/6.
RECEIVERS R-9B/APN-4, new, 14 valves, 55/-, carr. 10/-.
R1392D, 95-156 MC/S tuning meter, 15 valves, 77/6, carr. 10/-.
U.E.L. type BRIIII input 6V DC, CV2302 tube and valves, etc., 70/-, carr. 7/6.
PANEL L.53, contains CV35 Klystron 30 other valves, Tranys, CR unit 36, chokes, coils, etc., one only; over 2½cwts, £12/10; carr. 25/-.
MARCONI crystal oscillator, complete with valves, 200-50V AC input containing thermostatically controlled crystal oven with crystal holders, £5/10, carr. 10/-.
SPEECH amplifier CME-50055, 110V AC input, telephone, meters, 6 valves, complete, £5/10. carr. 20/-.
WAVEMETER-W1646 and test set 223A, 18-87 MC/S, graphs, 110 or 230V AC input, £6/10, carr. 7/6.
INSULATION test set No. 3, 0-5KV AC or DC output, with meter input 200-50 AC, £8/10, carr. 10/-.
RANGE monitor and delayed sync. unit, 13 modern valves, plus CV 1526, C/R tube, £2/10, carr. 10/-.
P.38 and 234 power units, 200-250V AC input with meter, £2/10, carr. 10/-.
STABILIZED power units type rectifier D.E.S34, valves 6-12 Ei, 4-5U4G plus 5 others, outputs variable (1) —2250.V, (2) —150, (3) +350, (4) +200 input 80V AC at 1500 C/S, £6/10, carr. 20/-.
MORSE training sets, WT. Mk.III, oak case. valves, atmospheric producer, circuit, new. 39/6, carr. 5/-.
POWER valves ACT9, 1100 watts, output £3/10. carr. 5/-; GU 20.1.5 AMP at 13KV, 30/-; 807, 5/-; ARP37, ATP4, AR8, ARTP2, set 10/6; PX25, 5/-.
J. T. SUPPLY, 309, Meanwood Rd., Leeds, 7. [9750

APPROX. 2,500 service sheets for sale, radio and TV; no reasonable offer refused.
SPEAKERS.—200 pairs of matched 3in, 5in, 8in and 10in speakers at 21/6 a pair; p. & p. 2/6.
TUNERS.—Cyldon, Brayhead, Ferg., Cossor, etc., all makes to be cleared at 20/- each less valves; p. & p. 2/6.
ALL the above have been used, but are offered for sale after careful examination; orders over £3 post free.
HADLEY BROS. (RADIO & ELECTRIC), Ltd., 39-43, Soho Rd., Handsworth, Birmingham, 21. Tel. Northern 5571. [9714

RADYNE 1 KW R.F. Heater for sale as new. £225, will consider exchange w.h.y.—Richardson, 69, Bedford St., Cardiff. [9704

METALWORK, all types cabinets, chassis, racks, etc., to your own specification. capacity available for small milling and capstan work up to 1in bar.
PHILPOTT'S METAL WORKS, Ltd., Chapman St., Loughborough. [0208

NOTICES

THE ASSOCIATION OF PROFESSIONAL RECORDING STUDIOS, Ltd. To protect and encourage the interests of member studios engaged in electrical sound recording.—Write to the General Secretary. A.P.R.S., Flat 4, 34A, Arterbery Rd., London, S.W.20. [0173

CAPACITY AVAILABLE

GERALD FISHER ENGINEERING, Ltd., Lancs.—All types of electronic and electrical assembly work undertaken to your requirements; chassis wiring, cableforms, groupboards.—Hampden Rd., Shaw, Lancs. Shaw 7509. [9621

SERVICES OFFERED

RADIO, TV Engineers desire sole agency, assembly and or servicing leading German, Italian, Japanese sets, r/grams.—Box 5062. [9753

AUDIO installations and service to the trade and public.—City Electronics, Ltd., Newnham Terrace, Hercules Rd., S.E.1. Waterloo 4236.

SITUATIONS VACANT

TESTERS, E. K. Cole, Ltd., Southend-on-Sea, have vacancies for radio and television testers and fault finders.—Apply Personnel Manager. [9731

TEST engineers.—Applications are invited from test engineers with previous industrial experience of testing radio communications, receivers and transmitters; successful applicants will be offered positions on the company's permanent staff; starting salaries commensurate with qualifications and experience.—Apply in writing, giving full details to Personnel Officer, Redifon, Ltd., Broomhill Rd., S.W.18. [0252

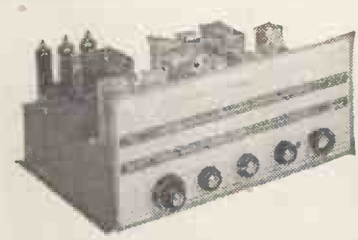
Armstrong

HIGH QUALITY RADIOGRAM CHASSIS

STEREO 12 Mk. 2 £44.15.0

The most complete chassis ever produced, combines AM and FM Tuners, a Stereo Control Unit and two High Fidelity Amplifiers in one compact unit. Eight watts push-pull output from each amplifier provide a total of 16 watts for both mono and stereo. Other features include automatic frequency control on VHF; ferrite aerial, two IF stages and miniature tuning indicator for medium and long waves; inputs for tape recording, playback, pick-ups and stereo radio (should this come about); separate wide range bass and treble controls and balance control; booster units available for low output pick-ups; alternative matching for any loudspeakers.

STEREO 55 £33.15.0



A junior version of the Stereo 12 Mk. 2 providing ten watts output, five watts from each amplifier and covering the VHF and medium wavebands. Ideal for a complete hi-fi system where the higher power output of the Stereo 12 Mk. 2 is not required. Like the Stereo 12 Mk. 2 it can be used for mono only and a second loudspeaker added at a later date.

JUBILEE Mk. 2 £31.15.0

A hi-fi mono chassis giving eight watts push-pull output and covering VHF, medium and long bands. Tape recording and play back inputs.

AF 208 £23.15.0

An AM/FM chassis providing 5 watts output and covering the full VHF and medium wavebands. Tape recording and playback inputs

Post this coupon or write for descriptive literature or call at our Holloway showroom for full demonstraton. Open 9-5 including Saturdays.

NAME ....

ADDRESS ....

.... W.N.C

ARMSTRONG WIRELESS & TELEVISION CO. LTD.
Warlters Road, London, N.7
Telephone: NORth 3213

SITUATIONS VACANT

SPACE research.

TWO Physicists (men or women) required as Experimental Officers (min. age 26) for the Royal Aircraft Establishment's Space Research programme at (a) Aberporth, Cardiganshire, and (b) Bramshott, Nr. Farnborough, Hants. Quals.: Pass degree, H.N.C., Grad. Inst.P. or equiv. Applicants must be experienced in handling and use of precision mechanical instruments, have interest in astronomy and ability to deal with simple electrical and electronic equipment. Work involves irregular hours and observations at any hour of night. The officers appointed will organise and carry out, with assistance, routine observations of artificial satellites with high-precision photogrammetric equipment, including harmonisation of observations with Universal Time to high accuracy. In addition, at Bramshott, they will assist in research and development of appropriate photogrammetric methods. Salary Range: £1,087-£1,336.—Write to Mr. M. J. Lighthill, F.R.S., Director, R.A.E., Farnborough, Hants., quoting reference M.O.A. HC/2D/714. [9734

UNIVERSITY OF GLASGOW.

ELECTRONIC Research and Development.

APPLICATIONS are invited from experienced electronic technicians for two new appointments in the Department of Electrical Engineering, The University of Glasgow. Both posts come under a recognised Superannuation Scheme, with good holiday provisions. Well-equipped workshops and laboratories in a new building provide excellent working conditions.

APPLICANTS should preferably have Higher National Certificate or similar qualifications, though candidates with less experience will be considered for appointment at a more junior level.

VACANCY No. 1 is for appointment to a Research Group in which experience in the design and construction of electronic apparatus for research purposes is desired. Familiarity with pulse circuits and/or V.H.F. is desirable. Salary according to qualifications and experience in the range £895-£1,015 per annum.

VACANCY No. 2 relates to the development of electronic equipment and instrumentation for research and teaching, and applicants should preferably have a wide experience. Commencing salary in the range £690-£815 per annum, depending upon qualifications and experience.

APPLICATIONS with full details of career and qualifications should be sent to Assistant Secretary of University Court, The University, Glasgow, W.2, marked "Technician." [9742

UNITED BRISTOL HOSPITALS.

MEDICAL electronics.

APPLICATIONS are invited for the following vacancies in an expanding laboratory attacking a wide range of problems covering the application of electronics to medicine.

(1) SENIOR Electronics Technician.

TO help in the development, construction and installation of specialised X-ray dose recorders in certain hospitals in the South Western Region. Car an advantage. Salary within the range £710-£815, new entrants to the service would start at £710.

(2) STUDENT Electronics Technician.

TO be trained in general medical electronics. Study for higher qualification encouraged, weekly study day with pay. Salary £255 at 18 to £440 at 24 or over.

APPLICATIONS giving age, education, qualifications and experience, with names of two referees should be sent to the Chief Physicist, Department of Medical Physics, Bristol General Hospital, Guinea Street, Bristol, 1. [9729

ROYAL NAVAL SCIENTIFIC SERVICE.

GOVERNMENT Communications Headquarters, OAKLEY, Priors Road, Cheltenham.

VACANCIES for Senior Scientific Officers and Scientific Officers.

APPLICATIONS are invited from graduates and post-graduate research workers as follows:—

PHYSICISTS (with an interest in telecommunications, electronics or computing).

MATHEMATICIANS.

ELECTRICAL Engineers (radio and electronics).

CANDIDATES must normally be natural born British subjects of natural born British parents with 1st- or 2nd-class hons. degrees or equiv. quals.; S.S.O.s must have min. 3 years' post-graduate experience and be not less than 26 years of age.

SALARIES: S.S.O.: £1,342-£1,654 (National). S.O.: £738-£1,222 (National).

APPOINTMENTS unestablished (with F.S.S.U. benefits) but opportunities exist for those between the ages of 21 and 32 to compete for established posts.

THERE are also vacancies for supporting staff in the Experimental Class; candidates should possess G.C.E. Advanced Level in 2 Science or Maths. subjects plus 3 subjects at "O" Level; a Pass Degree, H.N.C. or equiv. quals.

SALARIES: Exp. Officer: £1,087-£1,336 (National).

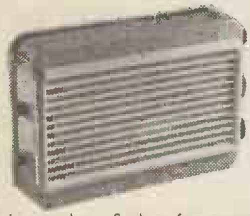
ASST. Exp. Officer: £458 (age 18) (National); £801 (age 26)—£983 (National).

FORMS from Ministry of Labour Technical and Scientific Register (K), 28, King Street, London, S.W.1, quoting A 405/1A. Closing date 18 November 1961. [9761

CENTRAL London firm requires competent organiser of postal and equipment sales; age immaterial; refs. wanted; part-time application considered.—Box 5043. [0133

NEW PUSH-PULL SIX DESIGN

Med/Long Waves and Trawler Band. 6 name brand transistors plus 2 diodes.



2 RF stages. Attractive 2-tone case. Take it anywhere. No aerial required (except for car use suitable areas) 3in. top grade full size speaker. Sockets for car aerial. A pleasure to listen to. May now be built for **£5/19/6** p.p. 2/6.

Send 1/3 for parts price list and easy-build plans.

"Scottish Home, 'light' and Norwegian Service—no aerial. At night 208 and several of the Home programmes and foreign stations at sea level—not bad for a '6' am quite satisfied." T.H.W. on holiday in the Shetlands. "Trawler Band very good indeed. Radio Luxembourg and many others loud and clear." H.B.—Penzance.

POCKET FIVE DESIGN

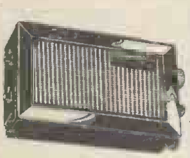
Med/Long Waves and Trawler Band. 5 name brand transistors plus 2 diodes.

"Lovely tone, and performance really good—no aerial required." L.S.—Brierley Hill, Staffs. Total cost of necessary items including 3in. speaker **£4/18/6**, p.p. 2/6.

Send 1/3 for parts price list and clear assembly diagrams.

"TRANSONA-4"

Medium, Long Waves and Trawler Band. 4 name brand transistors plus 2 diodes.



Miniature speaker. Pocket size. Case black and red. Test receiver tuned in nearly 30 stations one evening. All components 52/6, p.p. 2/6. Send 1/3 for parts price list and easy-build diagrams.

PUSH-PULL SIX POCKET DESIGN.

Medium, Long Waves and Trawler Band. 6 name brand transistors plus 2 diodes. Pocket case red and black. Sensitivity of a superhet, tonal quality of a TRF. 3in. high grade speaker. May be built for **£5/9/6**, p.p. 2/6.

Send 1/3 for parts price list etc.

AFTER SALES SERVICE.

ALL PARTS SOLD SEPARATELY

American manufacture miniature headphones, high or low impedance with matching transformer. Brand new, boxed 25/-. Slightly used, good condition 16/6, post free.

2½in. ⅞in. deep speakers 15/- (first grade), post 1/3.

RADIO EXCHANGE COMPANY

27 HARPUR STREET, BEDFORD

Phone: 2367. Closed 1 p.m. Saturday.

SITUATIONS VACANT

HACKER RADIO, Ltd., require:—

SENIOR production tester to take charge of line production of transistor and valve domestic equipment.
PRODUCTION testers and fault finders for transistor and valve receivers.
JUNIOR technicians of good education for training as radio engineers.
DESIGN draughtsman with knowledge of electronic circuits.
DEVELOPMENT engineers with good knowledge of radio and audio engineering.
ELECTRICAL testers and servicemen for nucleonic instruments.
COMPONENT and material schedule clerk for development and production planning.
SKILLED prototype wirers.
ALL posts have excellent prospects in a rapidly expanding organisation making only first-quality equipment.
HACKER RADIO, Ltd., Norreys Drive, Cox Green, Maidenhead, Berks. [9739

UNICAM INSTRUMENTS LIMITED.

THIS Company specialises in the production of high-quality optical instruments for use in spectrum analysis and has an international reputation as a leader in this field; at all stages of manufacture the best standards of workmanship are needed. We have vacancies for men with electronic experience for testing. Radar and radio technicians with fault-finding experience would be suitable. If you have the kind of background which you think would fit you for this interesting work in a pleasant University City, please let us have full details of your qualifications and experience.—Apply to the Personnel Manager, Unicam Instruments, Ltd., York St. Cambridge. [9736

MIDLANDS ELECTRICITY BOARD.

THIRD Assistant Engineer (Communications) required in the Chief Engineer's Department at Headquarters.
DUTIES will cover work associated with the design, development, operation and maintenance of wired and radio telephone communications and control systems, together with similar work on other associated electronic and light current equipment; technical qualifications desirable.
SALARY within the range £1,285/£1,610 per annum, according to qualifications and experience (N.J.B. Schedule "B," Grade 6 BX); superannuable.
APPLY, by letter, within 14 days, stating age, experience, present position and salary, to The Secretary, Midlands Electricity Board, P.O. Box No. 8, Mucklow Hill, Halesowen, Nr. Birmingham.
F. W. CATER, Secretary. [9760

HERTFORDSHIRE County Council.

MID-HERTS College of Further Education.
THE Campus, Welwyn Garden City, Herts.
PRINCIPAL: W. V. Lloyd, Ph.D., M.Sc., Dip. Ed., A.R.I.C., F.R.S.A., Department of Engineering.
WANTED 1st January, 1962.
ASSISTANT, Grade B, to teach Radio Service Work and Telecommunications, technicians work to intermediate and final standards.
MINIMUM qualifications: H.N.C. (Electrical).
SALARY: Burnham Technical Scale, minimum £700X£27/10 to £1,150, with additions for qualifications, training and experience.
GOOD housing prospects for married teachers.
APPLICATION should be made to the Principal at the College. [9757

WAR OFFICE—vacancies for technical staff.

WAR OFFICE requires technical staff at Grade II and III level for duties in Commonwealth Communications Army Network Stations in Malta, Cyprus, Kenya and Singapore.
APPLICANTS for either grade should possess an O.N.C. in Telecommunications or in Electrical Engineering with a knowledge of telecommunications, or equiv. qual. Successful completion of a Foreman of Signals Course, Armament Artificer (Radio) Course or Sergeant X Class I Course may be accepted in lieu.
APPLICANTS for Grade II posts must be fully experienced in operation and maintenance of SSB/ISB and FSK equipment in transmission or reception, or multi-channel VFT equipment and auto-tape transmitters and teleprinters, and must have a wide theoretical knowledge of related duties.
APPLICANTS for Grade III posts must have a good working knowledge of these duties and an understanding of the related theory.
TOURS of duty are for 3 years with the prospect of extension. Officials may be accompanied by entitled members of the family. Opportunities for promotion and for appointment to established pensionable posts occur from time to time. Salary scales are at present: Grade III £752-£1,043 p.a., and for Grade II £1,043-£1,888 p.a. Starting salary depends on age and quals. Foreign service, overseas family, outfit and trunk allowances are payable in addition. Foreign service allowances are substantial and non-taxable, and in some cases double the salary depending on family status and the overseas station in question. Details will be given to candidates interviewed. Closing date for application is 15 November, 1961. Application forms should be obtained from Manager (PE1956), Ministry of Labour, Professional & Executive Register, Atlantic House, Farringdon St., London, E.C.4. [9738

SALESMAN required, with experience of marine radio telephone equipment.—Box 5058. [9717

LEWIS have the CABINET for YOU

FROM THE MOST EXTENSIVE RANGE IN THE COUNTRY

THE CONTEMPORARY
Price £13.13.0

This beautifully designed Contemporary Cabinet can be supplied in Oak, Walnut or Mahogany veneer and has a waxed semi-matt finish.
This cabinet can be fitted with any of the latest Hi-Fi units.

THE GROSVENOR
Price £22.1.0

This elegant cabinet is available in veneered figured walnut and polished to a high gloss in a medium shade. Gold embellishments are an attractive feature of the design. A unique three sliding door system reveals ample storage room and space for equipment.

TWO NEW LEWIS CATALOGUES—

FREE!

The Cabinet Catalogue

The Equipment Comparator Catalogue

(Designed to assist your choice of cabinet and equipment.)
Please send me details of your two new catalogues.

Name ....

Address ....

....

BLOCK CAPITALS, PLEASE W111

LEWIS radio

100 CHASE SIDE, SOUTHGATE, LONDON, N.14

Telephone: Palmers Green 3733/9666

SITUATIONS VACANT

ROYAL INSTITUTION OF GREAT BRITAIN.
ELECTRONICS Technician required for maintenance of electronic equipment, valve and transistorized, used in research laboratory. Experience in pulse techniques desirable. Much of the equipment is newly developed in the laboratory for the automation of experiments. Salary within range £600-1,000, according to qualifications and experience.—Applications to Sir Lawrence Bragg, F.R.S., Royal Institution, 21, Albemarle St., W.1. [9740

ARE you interested in joining a team of Design and Development Engineers engaged in producing auto-pilots for new helicopters now under development?
LOUIS NEWMARK, Ltd., of Croydon, are desirous of appointing Design Engineers and Assistant Engineers to these posts, senior and junior appointments are available.
PLEASE send details of qualifications and experience to Personnel Manager, Louis Newmark, Ltd., Gloucester Road, Croydon. [0337

TESTERS, Ekco Electronics, Ltd., Rochford, Essex, have vacancies for experienced electronics testers.—Write giving details of qualifications and experience to Personnel Manager. [9732

PROTOTYPE wiremen are required by Pye T.V.T., Ltd., to join a special products group concerned with the building and setting up of television broadcast and industrial equipment.
WHILST previous T/V experience would be helpful, applicants who have wired electronic equipment of similar complexity from circuit diagrams would be considered; there are good prospects for candidates with ability and ambition.
PLEASE write to the Engineering Personnel Officer, Pye T.V.T., Ltd., St. Andrew's Rd., Cambridge, quoting "PWT/W," and giving brief details of age, qualifications and experience. [9743

ENGINEEER, mainly field service television and radio, clean licence; minimum five years' experience; congenial situation.—Sherbourne, 50 Topsfield Parade, Hornsey, N.8. Mou. 1987. [9751

ASSISTANT Executive required for Sales Manager of public address equipment. Duties require a knowledge of and experience in sales and surveys for sound installations, also preparation of estimates, etc.—Box 5065. [9763

TELEVISION test engineers required for television factory; television experience essential but not necessarily factory production experience; superannuation scheme.—Apply Rediffusion Vision Service, Ltd., Fullers Way South, Chessington, Surrey. [9748

ELECTRIC organ service engineer required to deal with the servicing of the Hammond organ both in this factory and at customers' premises; the suitable applicant must be thoroughly experienced in this type of work and good conditions are offered to the right man.
APPLY: Boosey & Hawkes, Ltd., Deansbrook Rd., Edgware, Middx. Tel. Edgware 5581. [9749

ELECTRONIC Draughtsman, age 20-40, £800-£1,000, preparation of layout and wiring drawings for production of interesting range of scientific/electronic instruments, 5-day week, pension scheme.—Details in writing to: Technical Director, Shandon Scientific Co., Ltd., 65, Southern Row, London, W.10. [9759

TECHNICAL Writer required for compiling Radio and Television Service Manuals: must have good theoretical and practical knowledge of radio and television receivers, and the ability to write good English; apply with details of age, experience, etc., to—Personnel Officer (Ref. P.C. 555), Murphy Radio, Ltd., Welwyn Garden City, Herts. [9752

TECHNICAL assistants wanted for wide range of interesting work on "Specials" assembly and wiring, testing, prototypes, service (inside and outside). Non-contributory pension scheme available; country area within easy reach of London; some experience of wiring or radio essential but keenness and ability to learn quickly most important.
APPLY, stating age and wage required to The Managing Director, Elcontrol, Ltd., Wilbury Way, Hitchin, Herts. [9737

EXPERIENCED electronic engineer required for development work on interesting and varied projects, must be able to work on instrument design to production stage with minimum supervision, knowledge of bridge measurement techniques is an advantage for this staff position; write stating previous salary, age, experience.—Addison Electric Co., Ltd., Belmont Rd., W.4, London. [9746

NATO cataloguing.—Engineers required to take charge of sections engaged on scheduling and cataloguing of electronic equipment to NATO standards. A wide, though not necessarily detailed knowledge of electronic, electrical and mechanical engineering is required. High rates of pay are being earned in this interesting occupation. All work is on Government contracts. Conditions of work are congenial. Here is an opportunity to enter an expanding organisation engaged on work whose importance is increasing daily. Specialised training will be given to successful applicants. —Call, write or telephone to: Technical Services Division, Archiprint Services, Ltd., 12, Worcester Rd., Malvern, Worcs. Tel. Malvern 1551-2. [9687

CABINETS, ENCLOSURES AND EQUIPMENT BY STAMFORD

Specialising in Enclosures to Goodmans specifications. Write for new illustrated list.

Speakers supplied.
See "EQUIPMENT" listed below.

S.51. Corner Enclosure in three sizes.
(a) For Axiette. Price £10/10/- or 42/- deposit and 18 payments 10/9 monthly.
(b) For Axiom 110 and 112. Price £11/10/- or 46/- deposit and 18 payments 11/9 monthly.
(c) For Axiom 300 or the 3-Way system including ARU No. 172. Price £18/5/3 or 73/6 deposit and 18 payments 18/7 monthly.

HI-FIDELITY EQUIPMENT
Only 5% interest charged on Credit and H.P. Terms for equipment

	Cash Price			H.P.	
SPEAKERS	£	s.	d.	Dep.	18 m/s
Goodmans 8" Axiette	6	12	1	26/5	6/4
,, 8" Triaxiette	13	10	0	54/-	12/10
,, 10" Axiom 110	5	0	0	20/-	4/10
,, 10" Axiom 112	8	10	0	34/-	8/2
,, 12" Axiom 300	11	5	9	45/2	10/10
,, Trebax 5K/20XL	7	0	0	28/-	6/9
,, Midax 650	9	10	0	38/-	9/1
Wharfedale 8" Column 8/145	6	19	11	28/-	6/8
,, 8" Super 8/FS/AL	6	19	11	28/-	6/8
,, 10" Golden/FSB	8	6	7	33/4	8/-
Whiteleys WB 10" HF 1012	5	0	0	20/-	4/10
,, WE 10" HF 1016	8	4	0	33/-	7/9
Elac 4 speaker HPP/2	10	16	3	43/3	10/5
LOUDSPEAKERS—COMPLETE SYSTEMS					
Goodmans AL/100	23	10	0	94/-	22/7
,, AL/120	29	10	0	118/-	28/4
,, Sherwood I	32	11	0	130/-	31/2
Wharfedale W2	29	10	0	118/-	28/4
,, W3	39	10	0	158/-	37/11
,, SFB/3	39	10	0	158/-	37/11
GRAM UNITS ETC.					
Lenco GL 58/580	23	15	8	95/4	22/10
Garrard 301 Strobe	25	2	6	100/6	24/-
Garrard 4 HF (Mono)	19	8	7	78/-	18/7
Garrard TA Mk. II (Mono)	8	19	3	36/-	8/7
Garrard 4 HF (Stereo)	20	4	2	81/-	19/7
Garrard TA Mk. II (Stereo)	9	14	10	39/-	9/3
Garrard 210 (Mono)	13	5	11	53/2	12/9
Decca FFSS Pick-up	21	0	0	84/-	20/2
AMPLIFIERS					
Leak TL 12 Plus/Vari III	34	13	0	138/8	33/5
Rogers LG88	38	10	0	154/-	36/7
Leak Stereo 20/Vari III	55	9	0	221/10	53/3
Quad 22 and 2 Amps.	70	0	0	280/-	67/2
Jason J2 10	40	19	0	163/10	39/4
TUNERS					
Leak Trough Line Mk. II	35	15	0	135/-	32/6
Acoustical Quad F.M.	28	17	6	115/6	27/8
Rogers Junior Switched	15	19	3	64/-	15/3
CHASSIS					
Armstrong Jubilee Mk. II	30	9	0	121/10	29/3
,, Stereo 55	33	12	0	134/5	32/6
,, Stereo 12 Mk. II	44	2	0	176/5	42/4
TAPE					
Brenell 3-Star Recorder	60	18	0	243/7	58/5
,, Mk. V Deck	29	8	0	117/7	58/3
,, Mk. V Amplifier	24	0	0	96/-	23/-

B2/E 46in. × 16in. DECK
B2/EX 46in. × 18½in. DECK

PRICE £22/-/- or £4/8/- Deposit. 18 payments of 22/3.
PRICE £23/17/6 or £4/15/6 Deposit. 18 payments of 24/5.
Also supplied at same prices with tape or record storage on left and deck 33in. long.

Write for lists of Equipment, Cabinets and Enclosures. We specialise in supplying any equipment currently available. Demonstrations at our Weymouth Terrace Showroom. Our Products are supplied in oak, walnut and mahogany veneers finished in shade required. Delivery 15/-. England and Wales. 25/- Scotland.

Visit our Hi-Fidelity Showrooms at:
84/86/98 Weymouth Terrace, off Hackney Road, LONDON, E.2. Telephone: SHO 5003.
No difficulty in Parking.
Showroom hours: Monday-Saturday, 9.30 to 5.30.
Late night Wednesday, 7 p.m.
Directions: No. 6 bus from Liverpool Street Station to the Odeon, Hackney Road, walk back two turnings.

A. L. STAMFORD LTD. (DEPT. P.4)

SITUATIONS VACANT

INSTRUMENT mechanic required to assist in maintenance of wide range of commercial and special electronic instruments and equipment in the development laboratories. Initiative and fault finding ability are essential qualities for this post in a rapidly expanding company.
GENEROUS salary; staff status, pension scheme, canteen facilities.—Apply in writing to the Technical Director, R. B. Pullin & Co., Ltd., Phœnix Works, Great West Rd., Brentford, Middx. [9727

INSTRON LIMITED, manufacturers of precision materials testing instruments, require for their new factory in High Wycombe, an electronic technician with good theoretical and practical knowledge of low frequency amplifiers, oscillators, phase-discriminating circuit and relay operated controls; excellent prospects.—Applications, giving details of qualifications and experience, to: Instron Limited, Halifax Rd., High Wycombe, Bucks, or Tel. High Wycombe 4646 for an interview. [9767

RADIO/Radar Technicians with experience of ground and airborne radio/radar equipment for the operation and maintenance of R.A.F. piston and jet aircraft and associated ground radio/radar aids. Vacancies in all grades including supervisory posts and inspection. Staff status, top rates and bonus, good security. Single accommodation available immediately, prospect of unfurnished houses to rent in near future.—Marshalls, Shawbury Aerodrome, near Shrewsbury, Shropshire. Telephone Shawbury 351, Ext. 20. [9764

UNIVERSITY OF BIRMINGHAM.—Electronic Technician to assist in the development and construction of electronic instruments to be used in rockets and artificial earth satellites; desirable qualifications are experience in transistor circuitry and familiarity with pulse techniques; some experience of miniaturisation techniques would be an advantage, though not essential; salary up to £800 p.a. according to experience.—Applications in writing to the Secretary, Electron Physics Department, The University, Birmingham, 15. [9756

ELECTRONICS engineers, Ekco Electronics, Ltd., have vacancies for electronics engineers based at Rochford, Essex, for installation and service laboratory duties. Work is in connection with industrial nucleonic systems, nucleonic counting equipment and general nucleonic instrumentation. Permanent progressive posts in expanding organisation. Requirements, good theoretical electronic fault-finding experience. Salary commensurate with ability.—Please write stating age, qualifications and experience to Personnel Manager, E. K. Cole, Ltd., Southend-on-Sea, Essex. [9733

SENIOR Electronic Development Engineer required to lead small team in newly created R. and D. Company. Candidates must have at least 10 years' experience in the Electronics Industry covering Telecommunication Developments and possess a comprehensive knowledge of Semiconductor Techniques. A Degree or Membership of one of the Professional Institutes is essential. This appointment might lead to a Directorship for the right type of man. Apply stating age and full details of experience to—The Managing Director, Box 5064. [9762

INTERNATIONAL AERADIO, Ltd., has periodic vacancies overseas for Radio Technicians, City and Guilds Intermediate Telecoms. an advantage but not essential if applicant has considerable experience installation/maintenance H.F./V.H.F. low/medium power comms. Equipment; applications ex-service personnel or fully skilled categories welcomed; posts are permanent and pensionable; normally accommodation is provided with tax free emoluments equated to local conditions; additional marriage and child allowances; free air passages and insurance; kit allowance; generous U.K. leave; apply in writing.—Personnel Manager, 40, Park St., W.1. [0262

MEDICAL Research Council require technical officer at Molecular Biology Research Unit, Cavendish Laboratory, Cambridge; applicants should hold or be studying for Higher National Certificate (Electrical or Mechanical Engineering) or University Degree; needed, designer-draughtsman with practical experience of instrument design for development mainly of X-ray diffraction equipment; experience of high vacuum techniques desirable but not essential, salary at point on scale rising to £1,260 p.a. with possibility of promotion to higher grade, superannuation, 3 weeks' holiday, 5-day week.—Write, giving names two professional referees, to Director at above address quoting reference E/243/7. [9745

PATENT Examiners and Patent Officers. Pensionable posts for men or women for work on the examination of Patent applications. Age at least 20 and under 29 (36 for Examiners) on 31.12.61, with extension for regular Forces service and Overseas Civil Service. Qualifications: normally a degree, or a Diploma in Technology, with first or second class honours in physics, chemistry, engineering or mathematics, or equivalent attainment, or professional qualification, e.g. A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E., A.R.I.C., A.Inst.P. Inner London Salary £793 to £1,719; provision for starting pay above minimum. Promotion prospects.—Write Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting S/128/61, and stating date of birth. [9726

As old as the "Wireless World"!

Smith's of EDGWARE ROAD

COMPONENT DISTRIBUTORS

Guaranteed components— made specially for us :—

1% tol. SILVER MICA CAPACITORS
84 standard values always in stock.

5-1000pF	9d.	1200-2000pF	1/-
2200-3000pF	1/3	3300-5000pF	1/6

1⅛in. dia. **POTENTIOMETERS** 2in. shaft
10K, 25K, 50K, 100K (linear), 250K, 500K, 1M, 2M (log.) 3/-. With switch 4/6.

MINIATURE MAINS TRANSFORMERS
Pri. 0-200-220-240 v. Sec. 250 v. 40 mA., 6.3 v. 1.5 amp. Stack size 2¼ × 1¾ × 1¾in., 14/6.

CELLULOSE WADDING for resonance damping, 40 ply 36in. wide, 5 yd. roll 18/-, carriage 3/-.
Sole distributors for this area.

IMPORTED COMPONENTS
Miniature High Stability Resistors 5% tol.
"Preferred value" range (144 values, 12Ω to 10 MΩ) ¼ watt, ⅜" × 5/32" or ⅛ watt, ¼" × 3/32"....6d. each.
WIMA "TROPYDUR" PAPER CAPACITORS
Flat oval shape. Small size. Glazed surface.

mfd.	tol.	250V	500V	mfd.	tol.	250V	500V
.01	20%	6d.	7d.	.15	10%	1/1	1/2
.015	20%	6d.	7d.	.22	10%	1/3	1/4
.022	20%	8d.	9d.	.25	10%	1/3	1/4
.033	20%	8d.	9d.	.33	10%	1/4	1/6
.047	20%	9d.	10d.	.47	10%	1/6	1/9
.068	20%	10d.	11d.	.68	10%	1/7	2/3
.1	10%	1/-	1/1	1.0	10%	2/1	2/6

"SURPLUS" HIGH STABILITY RESISTORS
Best makes. Largest selection available. 145 standard values plus many others.

5% ¼W. 7½d.	½W. 9d.	1W. 10½d.
2% ¼W. 10d.	½W. 1/-	1W. 1/3
1% ¼W. 1/3	½W. 1/6	1W. 1/9

Ordinary Carbon Resistors ¼W. 3d., ½W. 4d. Also Carbon and Wire wound up to 200W. Full list No. 5.

AND OF COURSE, OUR OWN PRODUCTS

BLANK CHASSIS

Precision made in our own works from commercial quality half-hard Aluminium. Two, three or four sided.
SAME DAY SERVICE
Of over 20 different forms made up to YOUR SIZE. Order EXACT SIZE you require to nearest 1/16in. (Maximum length 35in., depth 4in.)
Specials dealt with promptly.
SEND FOR ILLUSTRATED LEAFLET
or order straight away, working out total area of material required and referring to table below which is for four-sided chassis in 16 s.w.g.:

48 sq. in. 4/-	176 sq. in. 8/-	304 sq. in. 12/-
80 sq. in. 5/-	208 sq. in. 9/-	336 sq. in. 13/-
112 sq. in. 6/-	240 sq. in. 10/-	368 sq. in. 14/-
144 sq. in. 7/-	272 sq. in. 11/-	and pro rata
post 1/3	post 1/6	post 1/9

Quantity and trade discounts. Finishes arranged for quantities of 25 or over.
FLANGES (¼in., ½in., or ¾in.), 6d. per bend.
STRENGTHENED CORNERS 6d. each corner.
PANELS
Any size up to 3ft. at 4/6 sq. ft.
Postage (sq. in.): 72 9d.; 108 1/3; 144 1/6; 432 1/9; 576 2/-.

THE WELL-KNOWN
COOPER-SMITH HI-FI AMPLIFIERS

Each the best in its class— yet you can build it yourself!

	KIT			BUILT		
STEREO Control Unit	£12	12	0	£15	0	0
STEREO Main Amplifier	£13	13	0	£16	0	0
Mk. II Control Unit	£7	17	6	£10	17	6
B.P.I. Main Amp. 10/12 W.	£12	5	0	£14	5	0
"MAGNUM" 20 W. Power Amp.	£21	2	6	£23	12	6
'PRODIGY' 6/9W. Integrated	£12	10	0	£15	15	0
'BANTAM' 3/4W. Integrated	£7	10	0	£8	5	0

Building instructions 2/6 each.
(Bantam 1/6. Magnum 5/-).

Please add postage for all orders under £2

H. L. SMITH & CO. LTD.
287/289 EDGWARE ROAD, LONDON, W.2
Telephone: Paddington 5891/7595

SITUATIONS VACANT

MINISTRY OF AVIATION requires electrical engineers (assistant signals officers) for aviation telecommunications and electronic navigational aids; min. age 23, 1st or 2nd class degree in Physics or Engineering, or A.M.I.E.E. or A.F.R.Ae.S. (candidates with Parts I, II and III of A.M.I.E.E. or Parts I and II of A.F.R.Ae.S. or equiv., or of very high professional attainment without those qualifications considered). Salary £835 (age 23) to £1,318 (age 34) max. £1,490; slightly lower outside inner London; prospects.—Forms from Ministry of Labour, Technical and Scientific Register (K), 28, King St., London, S.W.1, quoting D 411/1A. [9683

AIR MINISTRY have vacancies for Civilian Radio Technicians at R.A.F., Sealand, Cheshire; R.E.U. Henlow, Bedfordshire; and various other R.A.F. stations throughout the United Kingdom, for the servicing, repair, modification and testing of air and ground radio and radar equipment. Commencing salary (National) (according to age) is £630 to £810 p.a., max. salary £930 p.a. Rates are subject to small deduction at certain provincial stations. Houses may be available for renting at West Kirby, some 15 miles from Sealand. Apply to Air Ministry, C.E.3h, Princes House, Kingsway, London, W.C.2, or to any employment exchange, quoting City O/N3057. [0038

THE Scientific Civil Service needs men and women for pensionable posts as (a) Experimental Officers and (b) Assistant Experimental Officers in mathematics, physics, meteorology, chemistry, metallurgy, biological sciences, engineering, miscellaneous (geology, library and technical information services). Candidates must, on 31.12.61, be at least 26 and normally under 31 for (a), and at least 18 and normally under 28 for (b). Qualifications should normally include H.S.C., or G.C.E., or equivalent, or H.N.C., a University degree, or a Diploma in Technology. Provisional admission if taking examinations in 1961. Inner London salary scale (a) £1,147-£1,396; (b) £503 (at 18) to £856 (26 or over) rising to £1,038. Promotion prospects. Further education facilities.—Write Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting S/94-95/61. [9725

TECHNICAL TRAINING

LEARN Radio and Electronics the New Practical Way! Very latest system of experimenting with and building radio apparatus—"as you learn"—Free brochure from Dept. W.W.10. Raidostructor, Reading. [0241

CITY & GUILDS (electrical, etc.), on "No Pass—No Fee" terms, over 95% successes. —For details of modern courses in all branches of electrical engineering, applied electronics, automation, etc., send for 148-page Handbook—free and post free.—B.I.E.T. (Dept. 388A), 29, Wright's Lane, London, W.8. [0017

TUITION

FULL-TIME courses for P.M.G. Certificates, C.G.L.I., Telecommunications and Radar Maintenance Certificates.—Information from College of Technology, Hull. [0111

FIND TV set troubles in minutes from that great book, The Principles of TV Receiver Servicing, 10/6, all book houses and radio wholesalers.—If not in stock from Secretary, I.P.R.E., 20, Fairfield Rd., London, N.8. [0089

THE Incorporated Practitioners in Radio & Electronics (I.P.R.E.), Ltd., Membership Conditions booklet, 1/-; sample copy of I.P.R.E. Official Journal, 2/-, post free.—Secretary, 20, Fairfield Rd., London, N.8. [0088

WIRELESS.—See the World as a radio officer in the Merchant Navy; short training period, low fees scholarships, etc., available boarding and day students; stamp for prospectus.—Wireless College, Colwyn Bay. [0018

TV and Radio.—A.M.Brit.I.R.E., City and Guilds R.T.E.B. Cert., etc., on "No Pass —No Fee" terms, over 95% successes.—For details of exams. and home training courses (including practical apparatus) in all branches of radio, TV and electronics, write for 148-page Handbook—free—B.I.E.T. (Dept. 397A), 29, Wright's Lane, London, W.8. [0016

RADIO and TV Servicing, all aspects from basic principles, guaranteed coaching for City & Guilds, R.T.E.B. Cert., Brit.I.R.E., etc.; study at home under highly qualified tutors; no books to buy.—Write for free prospectus, stating subjects, to I.C.S., Intertext House, Parkgate Rd. (Dept. 442), London, S.W.11. [0034

"HOW and Why" of Radio and Electronics made easy by a new, no-maths, Practical Way. Postal Instructions based on hosts of experiments and equipment buildings carried out at home. New Courses bring enjoyment as well as knowledge of this fascinating subject.—Free brochure from Dept. W.W.12, Raidostructor, Reading. [0240

A.M.I.Mech.E., A.M.Brit.I.R.E., City & Guilds, G.C.E., etc., bring high play and security: "No Pass—No Fee" terms; over 95% successes.—For details of exams. and courses in all branches of engineering, building, electronics, etc., write for 148-page Handbook—free.—B.I.E.T. (Dept. 387B), 29, Wright's Lane, London, W.8. [0118

D. & B. TELEVISION

Phone: Cherrywood 3955

131 & 131a KINGSTON ROAD SOUTH WIMBLEDON, S.W.19

FOR THE FINEST, FASTEST SERVICE IN THE COUNTRY. We are Open from 10 a.m. Until Midnight. For any information or problems you have Call or Phone, we are always pleased to help.

SEND FOR OUR COMPREHENSIVE L.O.P.T. SCAN COIL L.B.O., F.B.O., F.O.P.T. LIST
Prices of nearly all makes and models, 2/6, post 6d. Invaluable as a service aid. The finest list ever compiled.

TRANSISTORS

Genuine Mullard Transistors in sets of Six: 1, OC44; 2 OC45's; 1, OC81D; 2, OC81's in matched pair. Including OA81, Diode, for ONLY £2/2/6.

Genuine G.E.C. Transistors in Sets of Six: 1, GET874; 2, GET Q873; 1, GET114; 2, GET114's in matched pair; plus 1, GEX34 for ONLY £1/18/6.

SINGLE TRANSISTORS PRICE LIST

Mullard: OC44, 10/-; OC45, 9/-; OC70, 6/-; OC71, 6/-; *OC72, 7/-; OC76, 7/-; OC78, 7/-; *OC81, 7/-; OC81D, 6/-.
G.E.C.: GET874, 9/-; GET873, 8/6; *GET 114, 5/9.
* Available in matched pairs at 1/- extra.
Mullard Diodes: OA70, 2/9; OA79, 2/9; OA81, 2/9; OA91, 3/6.
G.E.C.: GEX34, 3/3.
All above are genuine manufacturers new 1st grade.

SURPLUS TRANSISTORS

Red Spot, A F, OC71 and 72. Equivalent .. 4/3 each
White Spot, R F, OC44 and 45. Equivalent.. 5/- each
Diodes, general purpose .... 1/- each
Various other types in stock. Please ask for prices of types not listed.

TURRET TUNERS. Various Makes: 10, 16, 38 Mc/s, 40/-

EXAMPLE OF TRANSFORMER LIST

	L.O.T.		SCAN COILS	
FERGUSON:	(New)	(Used)	(New)	(Used)
103T, 105T	69/9	35/-	60/-	35/-
992/4/6/8	69/9	35/-	60/-	35/-
PYE:	(New)	(Used)	(New)	(Used)
V4, VT4, V7	52/6	35/-	55/-	35/-
VT7, CTM4	52/6	35/-	55/-	35/-
MURPHY:	(New)	(Used)	(Used only)	
V214, V240, V250 ..	60/6	35/-	45/-	
ECKO:	(New)	(Used)	(New)	(Used)
221, 283	47/3	30/-	40/6	27/6
231, 284, 293	54/-	35/-	40/6	27/6

REGUNNED CATHODE RAY TUBES

all with 12-month Guarantee

ALL MAKES: 12in., £3/15/-; 14in., £4/5/-; 17in., £4/15/-.
ADD: 10/- for 90° tubes: 15/- for 100° tubes; 5/- for Electrostatic types.
SECONDS, with 12-month Guarantee—ALL MAKES: 12in., £2/15/-; 14in., £3/5/- (when available); 17in., £3/15/-.
SECONDS, No Guarantee—ALL MAKES: 12in., £1/5/-; 14in., £1/15/- (when available); 17in., £2/15/-.
NOT APPLICABLE TO NO GUARANTEE SECONDS: 10/- allowance on old tube if in good condition.

THE FABULOUS R.T.D. TRANSISTOR SIX LATEST ON THE KIT MARKET
Spec.: Six transistor plus diode, printed circuit, superhet, ferrite rod aerial. Automatic gain control to stop overloading. Output 450mW in push pull. All components brand new and guaranteed. Neat, small, two-tone grey cabinet. Two radios in one, portable and car radio. Incorporates car aerial input socket. Everything to build this superb Transistor Radio. Only £8/9/6.

AZ31s	8/6	EY51	7/9	U26	12/-	6AM6	3/-
B36	5/6	EY86	7/6	U31	9/6	6CD6	27/6
D77	3/-	EZ40	6/-	U50	8/6	6D2	3/-
DH77	4/6	KT33C	6/-	U52	7/-	6F1	5/-
DK91	5/9	KT36	8/6	U191	9/-	6F12	3/-
DK92	8/-	KT66	15/-	U281	9/-	6F13	7/-
DK96	7/6	PCC84	7/-	U282	20/-	6F14	9/6
DL92	5/9	PCC89	8/6	U301	20/-	6F15	9/6
DL94	6/9	PCF80	7/-	U801	22/6	6L1	12/6
DL96	7/6	PCL82	10/9	UAF42	8/-	6V6	5/-
EB91	3/-	PCL83	11/3	UBC41	7/9	10F1	4/6
EBC33	5/-	PCL83	9/6	UCH42	7/-	10C1	10/-
EBF80	9/6	PL33	8/6	UF41	8/6	10C2	13/-
ECC81	5/3	PL38	10/9	UF42	3/9	10P13	9/-
ECC82	5/9	LP38	14/6	UL41	7/3	10P14	9/-
ECC84	8/-	PL81	8/6	UL46	7/3	12AT7	5/6
ECF80	8/-	PL82	6/9	UL44	11/6	12AU7	5/9
ECH35	9/-	PL83	7/-	UY41	6/6	20D1	8/6
ECH81	6/-	PY31	7/-	UU8	14/6	20F2	9/-
ECL80	6/9	PY32	10/-	UU9	6/6	20L1	12/6
EF39	5/-	PY80	6/6	SP41	2/3	20P1	10/6
EF50	3/9	PY81	6/-	SP61	2/3	20P3	12/-
EF80	4/6	PY82	6/6	W77	5/-	20P4	16/6
EF91	3/-	PZ30	10/-	Z77	3/-	27SU	14/-
EF92	5/-	U22	9/6	5U4	5/-	30C1	7/-
EL33	8/6	U24	10/-	5V4	9/-	30L1	7/-
EL38	14/6	U25	12/-	5Y3	10/6	30P4	10/9
EL84	7/-			5Z4	10/-	185BT	14/-
EY51SE	6/-			6AL5	3/-		

These are only examples of our valves: if you do not see what you require send stamped addressed envelope for special quotation.

We pride ourselves that we can obtain and supply any TV spare. **OUR GIGANTIC STOCKS INCLUDE:** *Line Output, Frame Output, Sound Output, Line and Frame Blocking. Osc. Trans. and Scan Coils for any make or model Television. Please ask us for ANY components you require—we are almost certain to have them.*

TERMS: S.A.E. all enquiries. C.W.O. or C.O.D. 3/- extra Postage on Valves 6d. each. C.R.T.s 12/6 inc. insurance
SATISFACTION ASSURED. RETURN POST SERVICE.

BOOKS, INSTRUCTIONS, ETC.

W.W. 1950/1960 complete, offers.—Bart, 43, The Fairway, N. Wembley, Middx. [9766

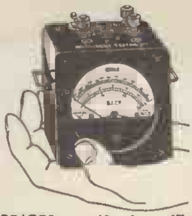
WEBB'S log-book for recording signals heard and worked, 112 pages 9¾in×8.n. approved format, semi-stiff covers, excellent value, 6/1 post free, or callers, 5/4.—Webb's Radio, 14, Soho St., London, W.1. [0021

"ADVANCED Theory of Waveguides." By L. Lewin. Sets out various methods of treating problems arising in work on this complex subject. The author has selected for discussion a number of topics as representative of the field in which the centimetre-wave engineer is engaged, many of the examples being concerned with the rectangular waveguides. 30/- net from all booksellers. By post 31/- from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

"SECOND Thoughts on Radio Theory." By Cathode Ray of "Wireless World." Forty-four articles reprinted from popular "Wireless World" series, in which the author examines various aspects of elementary radio science, explains them clearly, and shows that there may be more behind them than is apparent from the usual text-book. This volume deals with basic ideas; circuit elements and techniques; circuit calculations; and some matters in lighter mood. An entertaining and helpful text-book for the student, refresher course for the engineer, and reference book for all combined; 25/- net from all booksellers. By post 26/4 from Iliffe Books Ltd., Dorset House, Stamford St., S.E.1.

"ABACS or Nomograms." By A. Giet. Translated from the French by H. D. Phippen and J. W. Head. Most engineers have made use of nomograms at some time in their careers, and are fully alive to the fact that they are a very convenient tool when the same formula has to be solved repeatedly for several sets of variables. It is fair to say, however, that only a small proportion of even those who habitually employ nomograms know how to construct them for their own use. Most of the comparatively small literature on the subject is written for mathematicians and is extremely difficult for the practical engineer to comprehend. This book is essentially practical, and not only demonstrates the many and varied applications of the abac or nomogram, but shows how even those without highly specialized mathematical knowledge may construct their own charts. 35/- net from all booksellers. By post 36/- from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

SOUTHERN RADIO'S WIRELESS BARGAINS



TEST METERS, PORTABLE. 3¾ x 3¾ x 2½in. D/C. M/C. Ranges: 0-5,000 ohms; 0-60 mA.; 0-3 volts; 0-1.5 volts. Range can be extended to suit individual requirements by addition of resistances. (Featured in Practical Wireless, March issue.) **NEW AND TESTED.** 12/6 each plus 2/- P. & P. SPECIAL QUANTITY PRICES: 12 for £7. Carriage paid U.K. (ex. sea routes).

METERS. 30-0-30 and 3-0-3 volts combined ranges with prods, 15/-.

TRANSMITTER RECEIVERS TYPE "38" with 5 valves. New but untested. No guarantee. 25/- each. Post Paid.

ATTACHMENTS for "38" TRANSMITTER-RECEIVERS Mark II. HEADPHONES 15/6 per pair; THROAT MICROPHONES 4/6; JUNCTION BOXES 2/6; AERIALS, No. 1 2/9, No. 2 5/3; WEBBING 4/-; HAVERSACKS 5/6; VALVES. A.R.P. 12 4/6, A.T.P.4 3/6; SET OF FIVE VALVES 19/-. Postage on each item except valves 1/6 extra.

RECORDING BLANKS. Brand new. Ready for cutting. 13in. 6/- each or 15 complete in metal case, £4.

RESISTANCES. 100 assorted useful values; New wire end 12/6. NEW.

CONDENSERS. 100 assorted Mica; Tubular, etc., 15/-. NEW.

INSULATORS. Porcelain egg type 7/6 per doz.

CONTACTOR TIME SWITCHES. 2 impulses per sec., in case, 11/6.

REMOTE CONTACTOR. For use with above, 7/6.

LUFBRA HOLE CUTTERS. Adjustable ¾in to 3½in. For Metal, Plastics, etc., 7/-.

MAGNETS. Strong Bar type, 2 x ¼in., 1/6 each.

MORSE TAPPERS. Midget type 2/9; Standard 3/6; Heavy type on base, 5/6. ALL BRAND NEW.

MORSE PRACTICE SET. TAPPER with BUZZER on base. Complete with battery, 12/6. BRAND NEW.

PACKARD-BELL AMPLIFIERS. Complete BRAND NEW, with valves, relay, etc., etc., 17/6 each.

ATTACHMENTS for "18" TRANSMITTER-RECEIVERS Mark III. HEADPHONES 15/6 per pair. HAND MICROPHONES 4 a., 12/6. AERIALS 5/9; MORSE KEY 6/6; VALVES: ARP12 4/6, A.R.8 7/6, A.T.P.4, 3/6; SET OF SIX VALVES 25/-. Official booklet "18" T/R circuits, etc., 6/6 post paid. Postage on each item except valves 1/6 extra.

BOMBSIGHT COMPUTERS. Recent purchase, ex-R.A.F. Ideal for experimenters. A wealth of gears, motors, blowers, etc., etc., £3/12/6 carriage paid.

QUARTZ CRYSTALS. TYPES F.T.241/F.T.243. 2-pin, ½in. space. Frequencies (F.T.243) 5,700 kc/s. to 8,650 kc/s. (F.T.241) 20 Mc/s. to 38.9 Mc/s. (54th and 72nd harmonics). 4/6 each. List of available frequencies on request.

BRAND NEW. CRYSTAL BASES. FT.241, FT.243 1/3 each.

CRYSTAL CASES. FT 241/243 types. 10/6 per dozen.

STAR IDENTIFIERS. Type I.A.-N. covers both hemispheres. 5/6.

COMMAND RECEIVERS. B.C. 454 3-6 Mc/s. B.C. 455 6-9 Mc/s. Complete with 6 valves. 47/6 each.

DYNAMOTORS FOR ABOVE. 28 volts. 15/-.

VISUAL INDICATORS (10Q/4). Type 3. With 2 meter movements and two neons. New in cover. 12/- each.

TRANSPARENT MAP CASES. Plastic 14in. x 10½in. Ideal for Maps, Display, etc., 5/6.

Post or carr. extra. Full list Radio Books, etc. 3d.

SOUTHERN RADIO SUPPLY, LTD.
11, LITTLE NEWPORT STREET, LONDON, W.C.2. GERrard 6653

GUARANTEED *Tubes*

NEW LOW PRICES
PEAK QUALITY
Carr. & Ins. 12/6.

ALL MULLARD MAZDA BRIMAR CATHODEON COSSOR etc. CRTS rebuilt in our own Factory. New Mullard and U.S.A. Guns used.

REVACUUMED G/tee 6 Mths.		REBUILT G/tee 13 Mths.	
12/14 inch	£3 0 0	12/14 inch	£4/10/-
15/17 inch	£3 0 0	15/17 inch	£5/-/-
21 inch	£5 0 0	21 inch	£7/-/-

(Bowl allowance if returned in good condition.)

NEW TYPES G/tee 12 Mths.
MW31/74 MW36/44 AW36/20 AW36/80 £6/12/6
MW43/69 MW43/80 AW43/80 AW43/88 £7/12/6

VISIT OUR NEW SHOWROOMS OPEN ALL DAY SATURDAY

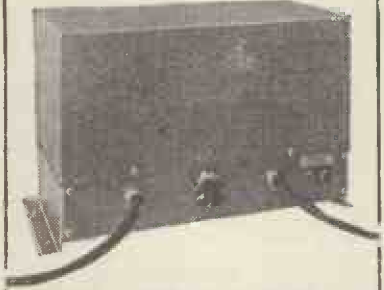
13 CHANNEL T/Vs. TABLE AND CONSOLE MODELS. FAMOUS MAKES. Carriage, etc., 19/6
Huge purchase direct from source enables us to offer unequalled value. These are complete but untested and are not guaranteed to be in working order.
12in. £3 10 0 14in. £5 10 0 17in. £9 10 0
ALSO 12in. 5 Chan. T/Vs 50/-.

MARLEY SUPPLIES CLEVELAND HOUSE, 21 PITLAKE, CROYDON, SURREY. Tel: CROYDON 8800

CLEAN AND SILENT D.C. to A.C.

UP TO 100 WATTS

WITH THE FELGATE ELECTRONIC INVERTER MK II



FROM 210/250 VOLTS D.C.
NO MOVING PARTS
FREQUENCY CONTROL

Manufactured by

McCARTHY RADIO AND ELECTRONICS LIMITED
STUDLAND HALL, STUDLAND STREET, LONDON, W.6.

FOR SOLDERING THAT'S CERTAIN...

HENLEY SOLON
Trade Mark

Best electric soldering irons in the business — first choice with Industry for over 25 years. Full range available. 25 watt model illustrated.
For leaflet write:

AEI CABLE DIVISION

Associated Electrical Industries Limited
Distribution Equipment Sales Department,
145 Charing Cross Road, London, W.C.2
Tel: GERrard 9797.

TUBES

Guaranteed 12 months. Carriage Free. Speedy Passenger Train despatch.

NEW
12in. MW 31-74 etc. £5 5 0
17in. CRM 171, 172 £7 0 0

Completely Reprocessed. Rebuilt, Rescreened, Realuminised.
14in. £5 5 0
15-17in. £5 10 0
21in. £8 0 0

ASTOUNDING BARGAIN! The "CLARION" Transistor Battery Tape Recorder. Push-button controls, 3¾ i.p.s. Portable. Durable plastic case. List price 25 Gns. Complete with Mike and Tape. Our Price ONLY **16 gns.** Carr. 7/6.

WESTWAY RADIO
S.A.E. with enquiries please
5 Westward Way, Preston Road, Harrow, Middx.

LINE OUTPUT TRANSFORMERS

Direct Replacements for 500 sets.

Bush. TV 11A, B; 12A, B; TVF 12A, TUG12A, B; TRG 12A, B	45/-
TV12AM; TV22, 24; TRG24, TUG24	60/-
Cossor. 930, 931, 933, 934, 948, etc.	58/-
Ekco. TS146; TS113-114; T161	45/-
T221, 231; TSC311, etc.	50/-
Ferguson. 841, 2, 3; 941 to 945	55/-
990T-998T; 103-145T; 203-246T	66/6
Ferranti. 14T3, 14T4, 17K3, 17T3	45/-
14T2, T1205, T1215, T1225, T1325, T1405, T1415, T1425, T1505, T1825	65/-
Murphy. V114C, V116C, V118C	45/-
V120C, V180, V178, V200, V202C	57/6
V240, 250......62/6; V214, 216	69/-
Philips. 1114 UF/UM, 1115 U, 1437 U, 1446 U, 1726 U, 1746 U, 1747 U	65/-
383A, 463A, 563A, 663A	60/-
Pye. LV30, 16T, CS17, VT17	60/-
CTM4, V4, VT4, V7, VT7	52/6
Ultra. 814, 815, 817, 915, 917, VW80, Y/YA730, YVW84, VWY720, V710 (complete assembly with U25)	95/-
14/53, 15/60, 17/50, 17/53, 17/60, 17/63-4, 17/70-1-2, 21/50, 21/60, 21/70-1-2	60/-

Add 2/6 Postage.

INDEX TO ADVERTISERS

Printed in Great Britain for the Publishers, ILIFFE ELECTRICAL PUBLICATIONS LTD., Dorset House, Stamford St. London, S.E.1, by CORNWALL PRESS LTD., Paris Garden, London, S.E.1. *Wireless World* can be obtained abroad from the following: AUSTRALIA and NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd.; William Dawson & Sons (S.A.), Ltd. UNITED STATES: Eastern News Co., 306 West 11th Street New York 14.

ADCOLA PRODUCTS LIMITED (Regd Trade Mark)

TRADE MARK

SOLDERING EQUIPMENT

Highest Standards Obtained

SPECIALISTS FOR BENCH LINE PRODUCTION REQUIREMENTS

Ranging from Subminiature Soldering Jointings to General Audio Equipment.

Illustrated Instrument List No. 64 Protective Shield List No. 68 Fitted with Accessory List L.700.

Designed and Manufactured in England.
British & Foreign Patents Reg. Designs, etc.

APPLY HEAD OFFICE SALES & SERVICE

ADCOLA PRODUCTS LTD

ADCOLA HSE. CLAPHAM HIGH ST.
LONDON. S.W.4.

Telephones: MACAULAY 3101-4272
Telegrams: "SOLJOINT" LONDON, S.W.4.

Radio Show firm wins big U.S. order

By RAMSDEN GREIG

What is thought to be th[e] biggest order received from the United States by a radio show exhibitor was picked up today at Earl's Court by Multicore.

The order is for SOLDER— a quarter of a million pounds of it. It is worth more than £64.000. It comes from British Industries Corporation of Port Washington, New York, an associate of the Am-rican company Avent Elec-...

EVENING STANDARD

£64,260 ORDER AT RADIO SHOW

WHAT is believed to be the largest order ever received from the United States by a Radio Show exhibitor was secured at Earls C[ourt to]day.

The order is worth ... and has been place[d with] Multicore Solders. ...

They ...

EVENING NEWS

U.K. SOLDER FOR U.S.

$180,000 ORDER FOR MULTICORE

By Our Radio Correspondent

Multicore Solders, of Hemel Hempstead, yesterday received at the Radio Show an order worth $180,000 (over £64 ...

FINANCIAL TIMES

U.S.A. Manufacturers import British Ersin Multicore Solder and bear the additional costs of freight and Import Duty because it is superior to any locally made cored solder.

It is the consistent high quality of Ersin Multicore Solder with its 5 cores of non-corrosive Ersin Flux which has made many of the leading Electronic Manufacturers throughout the world standardise on Ersin Multicore—they know that they can rely on it.

(Multicore Solders are covered by British Patent Nos. 433194, 675954, 704763, 721881.)

ERSIN Multicore SOLDER

Twenty years of specialising in the manufacture of Ersin Multicore Solder has produced the finest cored solder in the world.

Only virgin metals of the highest possible purity and a high grade rosin flux manufactured under laboratory controlled conditions are used.

All these factors combine to produce an even-flow solder characterised by a freedom from dry joints.

MULTICORE SOLDERS LTD. HEMEL HEMPSTEAD HERTS BOXMOOR 3636