Here's a unique opportunity for radio-equipment manufacturers needing special multi-unit low-loss cables...!
Let BICC design and manufacture them to meet your requirements. Our engineers have had extensive experience in this field and can also place at your disposal the vast research and production facilities of the BICC organisation.

BICC have designed and produced numerous multi-unit cables to meet specialised needs including flexible cables for electronic equipment. Some of these are shown below.

Write to us and let us assist you with your problems.

Multicore polythene-insulated and sheathed T/V Camera Cable.
Double-quad polythene-insulated audio-frequency cable.
Multicore polythene-insulated P.V.C. sheathed flexible T/V Camera Cable.
Polythene-insulated P.V.C. sheathed multicore cable for film studio use.

**BICC**

**LOW-LOSS CABLES**

**BRITISH INSULATED CALLENDER’S CABLES LIMITED**

**NORFOLK HOUSE, NORFOLK STREET, LONDON, W.C.2**
In This Issue

EDITORIAL COMMENT ................................................................. 201
NARROW-BAND PULSE COMMUNICATION.
By Thomas Roddam ...................................................................... 202
SHORT-WAVE CONDITIONS. By T. W. Bennington ...................... 205
TELEVISION MONITORS. By J. E. B. Jacob ................................. 206
SCREENING. By “Cathode Ray” ................................................... 211
THAMES RADIO SERVICE ......................................................... 215
MODERN SOFT-SOLDERING TECHNIQUE.
By R. W. Hallows ......................................................................... 217
WORLD OF WIRELESS ............................................................... 220
ELECTRONIC CIRCUITRY. By J. McG. Sowerby ......................... 223
AMPLIFIERS FOR CARDIOGRAPHY. By B. J. Shelley ................. 227
TRENDS IN COMPONENTS ......................................................... 229
UNBIASED. By “Free Grid” ......................................................... 236
RANDOM RADIATIONS. By “Dialist” ........................................... 237
LETTERS TO THE EDITOR .......................................................... 238
MANUFACTURERS’ PRODUCTS .................................................. 240
THE OPTICAL SYSTEM

The picture produced on the screen of the MW6-2 picture tube occupies an area approximately 2in. x 1½ in. The optical unit of the Mullard Projection Television System enlarges this picture so that an image of one of the standard sizes (ranging up to 16 in. x 12 in. for cabinet viewing or up to 48 in. x 36 in. for wall projection) is seen on the viewing screen.

Of the various methods of optical enlargement available, that in which a spherical mirror is used as the enlarging element has been selected on account of its simplicity, its suitability for manufacture on a mass-production basis, and its high luminous efficiency.

The optical principle is indicated in the diagram where C is the MW6-2 picture tube, D a front-silvered concave spherical mirror, E a plane mirror mounted at an angle of 45° to the axis of the picture tube, F a lens of special contour to correct for spherical aberration, G a second plane mirror mounted at right angles to E, and H the viewing screen which for cabinet viewing is of the dispersive type and for wall projection of the reflective type.

A picture element A formed at the top of the raster emits light which is collected by the spherical mirror and is reflected as a convergent beam to mirror E and thence, via corrector lens F to mirror G from which it is again reflected, still as a convergent beam, to point J at the bottom of screen H, where it is visible as a magnified image of picture element A.

Similarly a magnified image of a picture element B situated at the bottom of the raster is brought to focus at K at the top of screen H.

The length of the optical path, i.e. the combined distance from corrector lens F to mirror G and from mirror G to screen H must, of course, be such that the spot is correctly focussed on screen H. The correct distance is determined by the contour of lens F, and the five standard models of the optical unit differ only in the design of the corrector lens, each model being suitable for a specified throw distance and corresponding picture size.

Equipment manufacturers are invited to send their enquiries to:

MULLARD ELECTRONIC PRODUCTS, LTD.,
SETMAKERS DEPARTMENT,
CENTURY HOUSE, SHAFTESBURY AVE., W.C.2
Amenities and Necessities

Radio communication has now reached a stage where the "amenity" use for non-vital purposes tends almost to overshadow its original functions. First accepted as an indispensable aid to the safety of life at sea, and then as an adjunct to existing methods of marine navigation, it soon became of equal—perhaps even greater—importance to aviation. Wireless in the service of many other human activities is now making a niche for itself.

In the past the Post Office has been accused of over-cautiousness in failing to encourage secondary uses of radio for purposes where its advantages are evident, but where some other form of communication would, at a pinch be made to serve the purpose, even if less effectively. Such accusations against the monopolistic power that rules our destinies are not entirely without foundation, but a good case can be made out for our national policy of making haste slowly in this matter. It is only quite recently that transmitting and receiving apparatus operating in the h.f. bands has reached a state of development where it could be entrusted to untrained policemen, taxi drivers, firemen and all the others who are today using it successfully. Reliable and easily operated gear is now made by a number of firms. Many technical obstacles to the growth of "amenity" radio have been overcome, and others are being tackled energetically. Organizational obstacles are similarly being overcome, and Wireless World is satisfied that the Post Office no longer refuses a sympathetic hearing to applicants for licences who can make out a good case for using radio communication for any new purpose.

Typical of the newer applications is the Thames Radio Service, described elsewhere in this issue, which provides for linking vessels in the Thames estuary with the inland telephone service. This radio link is primarily intended for small craft, and so has a limited traffic-handling capacity. Somewhat similar services for large passenger ships inside the harbour limits of several of our seaports would certainly provide a much-appreciated radio amenity but, as the traffic handled would be compressed into a very short space of time, the organizational problem would probably be greater than the technical.

Studying Television

During the recent visit of the C.C.I.R. Study Group the delegates have been given a good picture of the technical progress of television in this country. No effort has been spared to show them everything that will help in their task of advising on transmission standards for Europe.

No secret has been made of the wish generally entertained here that the delegates' choice will fall on the British 405-line system, and so allow us to participate in international exchanges of programmes. It is unnecessary to repeat here the many arguments adduced as to the extreme practicability of our system. Demonstrations to the delegates have suggested that the 625-line system, towards which European opinion has tended to incline, is hardly worth the virtually doubled bandwidth which it requires. It has also been demonstrated to them that such transmissions, confined to a sub-optimum bandwidth, are clearly inferior to the 405-line standard.

We have gained the impression that some of the delegates fear the adoption by their countries of so low a definition as 405 lines would incur the risk of early obsolescence. That is natural enough, but the doubters may perhaps be reassured by knowing that more than one British television engineer has said that, if we were today starting the service *ab initio* in this country, we would be well advised to choose the present standard. With that opinion Wireless World agrees.
Narrow-Band Pulse Communication

New Method of Reducing Inter-channel Interference in Time

Division Multiplex

By THOMAS RODDAM

This is not the first article on pulse modulation that has appeared in Wireless World. Judging by the amount of work which is being done on pulse systems it will not be the last. The chief interest of the pulse system to be discussed in this article is that it is the first narrow-band pulse system which has been described. All earlier systems have used bandwidths which were monstrously extravagant in terms of the actual information transmitted: ten channels of 4 kc/s would occupy 2 Mc/s video bandwidth, a ratio of 50:1. The return for this squandering of bandwidth is, of course, an improvement in signal-to-noise ratio, and in systems like pulse code modulation the theoretical improvement is almost achieved.

When engineers started to build pulse multiplex systems they made a most important discovery. It is very much cheaper to divide up one millisecond into ten equal time intervals than it is to divide up 40 kc/s into ten equal frequency intervals. Gating circuits for producing time allocation multiplex cost much less than crystal filters for producing frequency allocation multiplex. The full significance of this was not appreciated at first, but as the idea went home the telephone administrations and the firms which supply them realized that long-distance telephone circuits, especially those using coaxial cables, involved a huge amount of capital expenditure at the terminal stations, and that the filters for the frequency allocation multiplex systems represented an important part of this cost. If a pulse system can be appreciably cheaper, the first firm to get on the market will scoop in quite a lot or orders.

The problem with which the engineer is confronted is that of applying a pulse system to a cable, the bandwidth of which is limited, in such a way that a maximum number of channels can be used. The microwave honeymoon is over, and indeed even the microwave people are beginning to watch the bandwidth price pretty closely. The aim has been to get the bandwidth down to 4,000 c/s for each speech channel, which means an overall reduction of 90 per cent (useful bandwidth/bandwidth occupied).

The solution which has been receiving the most attention, unless someone is hiding a surprise, was hinted in an article on Communication Theory*. In that article I showed how a local circuit at the receiver could compensate for distortion caused by a restricted bandwidth. In Fig. 1(a) we see the very short pulse which we intend to modulate, and in Fig. 1(b) we see the train of oscillations produced by passing this pulse through a filter to limit the bandwidth. As soon as the pulse has risen to A, however, the local circuit generates a compensating wave. The result is shown in Fig. 2, and it will be seen that after the point C the output is cleared and ready to accept a new pulse. I have sketched through this quickly because the article quoted does make it all quite clear.

Gaussian Pulses

In this discussion I assumed, for simplicity, that the compensating circuit was required to clear the base-line completely once the pulse had been established. Life becomes a great deal easier, however, if we use pulse amplitude modulation, because we need only clear the base-line for very short intervals corresponding to the middle of each pulse. Inside the receiver we can use as much bandwidth as we like, so that we could, if we knew how, arrange a new pulse centre to occur at each of the crossing points of the first diagram in Fig. 1. What has actually been done is formally equivalent to this, but differs in rather important practical details.

First of all, the short square pulses and the oscillating trains produced by ordinary filters are very inconvenient to work with. The short square pulse is not too bad, but as quickly as possible we convert it into what is called a Gaussian pulse. This is a very important type of pulse, and I cannot remember anyone explaining it, so we will digress for a moment. The Gaussian pulse has the equation \( e^{-t^2} \), and is, to use rather outmoded slang, a smooth job. It just gets bigger and bigger, and then gets smaller and smaller, as shown in Fig. 3(a). The frequency spectrum is shown in Fig. 3(b): the dotted part is what

---

the mathematics says happens for negative frequencies. As you see, the time response and the frequency spectrum are the same shape. The simplicity does not end here. Suppose that a pulse like this is passed through a filter which cuts off quite smoothly and gently, and has a response which is also Gaussian, the output pulse is, as the enthusiasm

for this shape must have made you expect, a Gaussian pulse, longer than the original, but still that simple bell-like shape.

The reader may have noticed one awkwardness: the Gaussian pulse started at \( t = -\infty \), and lasts, theoretically, for ever. There is another difficulty: the Gaussian filter, which must have a linear phase shift, cannot be obtained by means of a finite number of components. We seem to be staring into infinity on all sides. A good approximation to the right pulse shape can be obtained, however, either by using the curvature of a valve characteristic, which I mention only because that is the first method proposed, or by putting a short pulse through an amplifier with a lot of simple RC couplings. The third and most efficient way is to use an amplifier with several "maximal flatness" stages and one plain RC stage. Once we have our Gaussian pulse we can arrange that all the amplifiers which we shall need along the length of the cable, and which we must call repeaters when we talk to the telephone men, are of this Gaussian kind. Then our pulses will be lengthened but will not be changed from their essential Gaussian shape.

**Elimination of Cross-talk**

Let us now take a look at Fig. 4. In row (a) we have a set of nice short pulses, which we shall assume belong to different speech channels. Only channel 3 is modulated, and the shading shows that the amplitude lies somewhere within the limits indicated. An \( n \)-channel system will have \( n \) pulses in about \( 1/8,000 \)th second (\( 125 \mu \text{sec} \)) and will then start a new train, because we need about 8,000 pulses per second for each speech channel. If we have 5 channels, as I have shown, the spacing between the circuit pulses is 25 \( \mu \text{sec} \).

After these pulses have been passed through the Gaussian amplifier at the transmitter they will have the appearance shown in Fig. 4(b), and after traveling along the cable with its Gaussian amplifiers we shall have the shape shown in Fig. 4(c). It will be seen that the signal at the receiver is made up of pulses which are overlapping, so that the modulation on pulse 3 will have some effect on the amplitudes of the neighbouring pulses, 2 and 4. When we cram the pulses together by reducing the bandwidth still more, even pulses 1 and 5 are affected by the modulation on pulse 3.

At the receiver we want to eliminate the effect of the modulation on pulse 3 from channel 4. We therefore "gate" pulse 4 at its centre, and subtract a voltage obtained by delaying pulse 3 for 25\( \mu \text{sec} \) and attenuating it suitably. The amount of attenuation is determined by balancing out the modulation produced in channel 4 from channel 3. We do not need to know the exact shape of the pulse, provided it remains constant. Obviously we can also get rid of the cross-talk from channel 3 into channel 5 by using a 50\( \mu \text{sec} \) delay network...

The smooth shape of the pulses implies that channel 3 will produce cross-talk in channel 2. All we need is a network which produces a nega-

---

tive time delay of 25\mu sec. The trick which is used is to tap off a little of pulse 2 and feed it in, with reversed sign, to a delayed pulse 3. The total circuit of the compensation system is shown in Fig. 5, with the values appropriate to the example we have chosen. The units marked A are attenuators, and may include reversing circuits. At the instant when the centre of pulse 3 is available at the output of A₂, the centres of pulses 1, 2, 4 and 5 are also available at the outputs of A₁, A₂, A₄ and A₅, and a suitable portion of each of these pulses is used to balance out the corresponding tail which is passing through A₀. The shape of the pulses is shown more accurately in Fig. 6. The amplitude of the tail of pulse 2 which occurs at the epoch of the centre of pulse 3 is a₁, and this is cancelled by the small delayed pulse obtained at the output of A₂ in Fig. 5. The other pulse tails are balanced out in the same way by the outputs of the other A's.

The reports so far available suggest that in experimental systems the balancing of the cross-talk can be made to be sufficiently good for commercial use, even when the pulses are so elongated that the bandwidth is only 4 kc/s per channel. It seems likely that successful operation is obtained because the balancing operation is fairly simple: not quite so simple as this account suggests, because there is interaction between the settings of the various attenuators. The main problem is to make sure that the pulse shapes, which are not in themselves critical, do not alter as the equipment is running. I do not propose to discuss this problem because it is purely one of engineering refinement: can we make a system using a coaxial cable have exactly constant response? Can we make a perfectly constant f.m. system? The real problem is one of cost.

Fig. 7 shows the general arrangement of the terminal equipment at the sending end. The modulators are actually gating circuits, which are opened in turn by pulses produced in the master pulse generator, the order being maintained by tapping off the gate pulse along a delay line so that the pulse spacing is absolutely independent of valve characteristics. The receiving end is very much the same. Additional circuits are used to provide synchronization between the two ends, but these are not parts of the basic system. It will be seen that the complex filters of the frequency allocation multiplex systems have been replaced by the single delay line in this pulse system. Unless there are some exceptional difficulties, the pulse equipment should be very much cheaper.

**Future Developments**

The details cannot be discussed any further, because nothing has yet been published about systems of this type which will satisfy the standards needed for European telephone circuits. Lengthy field tests of a number of different arrangements will be needed before we can see just what performance can be achieved in practice, both on lines and using frequency-modulation links. It is even possible that in the final form the compensating device will be used in conjunction with pulse code modulation, because it must be noted that by using the arrangement described we do not gain anything in signal-to-noise ratio.

One very interesting point is probably mainly of theoretical interest. If we have a connection between the output of the transmitting terminal and the input of the receiving corrector circuit which is absolutely

---

**Fig. 6.** Detail of Fig. 4 (c) to explain the cancellation process.

**Fig. 7.** Transmitting terminal equipment.

**Fig. 8.** Response of corrector regarded as a filter.

**Fig. 9.** Pulse after passing through corrector.
linear, the corrector can be transferred to the transmitting end. We may then regard the corrector as a rather queer sort of filter which some readers may recognize as a sort of big brother to the re-entrant line filters used occasionally in feeders. The sort of response which this filter will have is shown in Fig. 8, and it is obviously what its makers call a "comb filter." When a pulse input is applied to such a filter the output takes the form shown in Fig. 9, and the amplitude is seen to be zero at all multiples of $25\mu$sec before and after the pulse peak. Thus the use of the corrector at the transmitter amounts simply to the use of a special filter circuit which produces a pulse having zero amplitude where it can interfere with the other pulses. The reason why this is not so useful in practice is that the operation of balancing cross-talk is very much easier to carry out than the operation of adjusting the filter to the exact characteristic needed. This is an example of how it is sometimes better to think in terms of physical behaviour than in terms of standardized concepts like frequency response or transient response.

When I wrote, 12 months ago, that "the thoughts of a few philosophers will set in motion many men who have no understanding of their philosophy," I did not expect that we should be so soon within sight of a new system with such enormous application. I do not know how many frequency allocation multiplex systems are operating in Europe, but I would guess that there must be of the order of one hundred thousand channels altogether. Each new coaxial cable carries nearly one thousand channels. The system described here may make all the terminal equipment obsolete. It looks as though we should all be pretty busy.

**SHORT-WAVE CONDITIONS**

**April in Retrospect: Forecast for June**

By T. W. BENNINGTON (Engineering Division, B.B.C.)

During April the average maximum usable frequency for these latitudes decreased considerably during the day and increased somewhat during the night, these being the normal seasonal variations. Both by day and night they were considerably lower than during April of last year, due, no doubt, to the effect of the "decreasing" phase of the sunspot cycle.

Day-time working frequencies decreased appreciably, though, on the whole, they were higher than had been expected. U.S.A. stations on frequencies above 28 Mc/s were seldom heard during the month, and U.S.A. 28-Mc/s amateurs, though they were more or less regularly received during the first part of the month, were rarely heard towards the end. South and Central Americans on this frequency were, however, coming through well till the end of the month. Frequencies as high as 15 Mc/s were often usable till after midnight.

Sunspot activity was, on the average, somewhat lower than during the previous month.

April was a very disturbed month, and frequent periods of poor conditions occurred. The most disturbed periods were the 1st, 4th, 8th, 12th, 16th, 20th, 24th, and 30th. No less than fourteen Delinger fadeouts were reported during the month, the two most severe of these occurring on 14th; at 1242 and 1335 G.M.T.

Forecast.—During June, day-time m.u.f.s in these latitudes should continue to decrease towards their lowest seasonal value, which should be reached towards the end of the month. Night-time m.u.f.s should reach their highest seasonal values at about the same time.

Working frequencies for long-distance transmission should therefore be generally lower by day, and higher by night, than during May. Over east-west circuits it is unlikely that frequencies higher than about 22 Mc/s will ever be usable, while even over north-south circuits 28 Mc/s is likely to be usable most of the time. 15 Mc/s should remain usable till well after midnight over many circuits, and the lowest night-time frequency for regular communication should be of the order of 12 Mc/s.

For medium distance transmission—up to about 1,900 miles—the E or F, layers will control transmission for long periods during the day, and in these cases, day-time, as well as night-time, working frequencies should be higher than during May. Transmission by way of Sporadic F over medium distances is likely to be a frequent occurrence, and may often take place on exceptionally high frequencies. Trouble from ionospheric storms is not usually very bad during June.

The curves indicate the highest frequencies likely to be usable over four long-distance circuits from this country during the month.
Television Monitors

Performance Requirements


It has long been the practice in sound broadcasting to provide high quality reproducing equipment specifically designed for monitoring the transmitted signal. Little or nothing has so far been published about similar equipment for television, although there is evidence in the current literature of the need for vision monitors specially designed for the purpose.

The station vision-monitoring equipment should be designed to furnish the quality-checking engineer with the best picture obtainable within the prescribed bandwidth of the particular television system in use. The equipment should, therefore, be of considerably higher quality than any likely to be in the possession of home viewers. The ideal to be aimed at is that the observing engineer should be able to detect and rectify any small loss of picture quality long before the ordinary viewer becomes aware of it at all.

The monitor should preferably receive the radio-frequency output of the transmitter in the normal way so as to check the overall performance of the station, but if this is not convenient it should be connected to a point in the transmitting chain as near to the aerial as possible.

Recently two line-operated vision monitors, fitted with 20-inch diameter direct-viewing cathode-ray tubes and capable of very good performance, have been supplied to the British Broadcasting Corporation. It is proposed to indicate in this article some of the measures required, as compared with an ordinary television receiver, to provide the improved performance.

Fig. 1 shows a detailed block schematic diagram of such a monitor. In general, of course, it embodies the same equipment as is required in any television receiver, but each part is designed from the performance point of view, cost being a relatively secondary consideration.

The degree of complexity of the monitor depends partly on the performance required and partly on the quality of the input signal. The signal may be subject in varying degrees to different types of interference and the various units comprising the monitor must be designed to minimize unwanted disturbances of the picture.

The cathode-ray tube used in a high-performance monitor is perhaps the most important single component. The ability of the monitor as a whole to reproduce the required quality picture depends finally on the tube, however good the performance of the circuits may be. The magnetically-focused and deflected tube, when so designed, is eminently suitable for this particular purpose.

The dimensions of the monitor picture should be such that it can be examined in sufficient detail at a reasonable viewing distance and experience has shown that for a 405-line system a 12-in (30 cm) diameter tube is just adequate though a 15-in (38 cm) tube is to be preferred. The screen should be of the largest possible radius of curvature consistent with the necessary mechanical strength.

The tube should be capable of a picture highlight brightness of at least 25 foot-lamberts with a contrast range of 100:1 or better. An aluminized screen operated at 12-15 kV, and 200-300 μA in the highlights is quite satisfactory for our purpose and has the additional advantage of preventing negative-ion burn.

The electron gun must be so designed that (1) it can provide the necessary beam power, with a reasonable expectation of life, for exciting the fluorescent screen to the required brightness and at the same time the size of the focused spot must be such that, in relation to the picture size, the full definition of the picture can be reproduced, and (2) the gamma of the tube, which may be defined as the slope of the curve connecting the logarithm of the brightness with the logarithm of the driving voltage from the beam-current cut-off point, should be of the same order as that of the average picture tube in a typical home receiver.

This latter factor is of considerable importance, for if the monitor tube has a gamma markedly different from the average, the picture-quality checking engineer at the transmitting station will gain a false impression of the tone quality of the picture as it appears in the average home.

The majority of current tubes designed for use in the home have a gamma which lies between 2 and 3 and a good average value is 2.5.

The 20-in diameter cathode-ray tube which has been used in high performance monitors is fully capable of meeting these requirements.

The Magnetic Lens

The magnetic lens must be designed to focus the relatively large diameter beam without introducing appreciable spherical aberration. One of the necessary conditions to achieve this object is that the beam should pass centrally through the lens and, subsequently, the deflector. In case the gun is misaligned in the tube, means must be provided, therefore, to deflect the beam before it is focused or deflected so that it passes along the common axis of the lens and deflector.

An additional desirable feature in the design of the lens is that it shall be so constructed as to enable its power to be varied in a suitable manner in synchronism with the line- and frame-scanning waveforms.

Distortion of the picture can arise from two main sources. In the first place, the television picture would ideally be presented on a flat surface as we have all, in the course of our lives, developed the ability to appreciate perspective in a flat representation of a three-dimensional scene. Unfortunately, due to other considerations, the screen of the cathode-ray tube is usually a spherical surface and some distortion is bound to occur when an ideal flat picture is reproduced on it. The distortion can be made to occur in a form which is, for our particular purpose, the least objectionable by the use of a suitable geometrical projection to relate the flat picture to the spherical one.

If the spherical and flat surfaces are imagined to be in contact at the centre of the picture and corresponding points in the two pictures are joined by projection lines, a stereographic projection will be obtained when the projection lines pass through the opposite pole of the sphere. The recommendation for this type of projection is the accuracy with which shapes are reproduced all over the picture. An object moving outwards from the centre of the picture will become slightly smaller in size, but its shape will be accurately maintained. The corner angles and indeed all angles all over the picture are correctly reproduced.

A second form of distortion arises because in modern cathode-ray tubes, using wide-angle deflection, the centre of curvature of the screen is not coincident with the centre of deflection and consequently the distance moved by the spot from the centre of the screen is not proportional to the angle through which the beam is turned. This results in pin-cushion distortion which can be corrected by means of a suitably positioned static 8-pole magnetic field. As applied to a cathode-ray tube, the field is arranged to pull out the edges of the picture in the horizontal and vertical directions and to compress the picture in the intermediate 45° directions. The pin-cushion corrector is only part of the complete solution. It reduces the distortion in the 45° directions, but increases it in the horizontal and vertical directions.
Its usefulness arises from the fact that this redistribution converts all the distortion into a form which can be corrected by simple changes in the linearity of the scan generators. Without this facility it would be necessary either to intermodulate the two scanning waveforms or to modify the scanning yoke in an empirical manner to provide a correction. Neither of these methods is to be recommended since intermodulation of the scanning waveform is impracticable for most purposes and modification of the scanning yoke necessarily implies non-uniformity of the deflection fields, which is certain to introduce more deflection astigmatism than can be tolerated in this case.

It follows that the scan generators must be designed to produce scanning currents of the correct waveform, in order that, when used with a deflection yoke designed to produce uniform deflecting fields (which introduce a minimum of astigmatism) and in conjunction with a pin-cushion corrector, the picture shall be a stereoscopic projection of the ideal flat picture. The waveforms should be correct to within ±2% since a 10% error is objectionable and 5% is still noticeable. In addition, the frame-scan generator must be designed to interface accurately under all normal conditions of service.

Focus Modulation

The use of wide-angle deflection causes the picture to be defocused in the corners due to the depth of focus of the magnetic lens being inadequate to handle the variations of throw distance between the centre of deflection and the screen as the spot scans the picture area. The power of the lens can be varied in a suitable manner to correct this defect by adding two small alternating-current components of parabolic waveform, repeating at the line and frame frequencies respectively, to the main direct-current component required by the focus coil. A cathode-ray tube which is designed, focused and scanned in accordance with the principles outlined above will require a "spot wobbler," but since this has been described in some detail elsewhere in this journal (May 1950, p. 180) it will not be dealt with here.

Picture monitors fall into two general types, those which receive a radio-frequency signal and those which are fed by means of a transmission line at video frequency.

The first type will contain a radio receiver which must be designed to exploit to the full the quality of the transmission. It will need only a fairly simple video amplifier to raise the level of the signal from the detector to that required to modulate the cathode-ray tube. Normally the d.c. component present in the transmission will be preserved since its constancy or otherwise will be of interest to the observer.

The overall frequency response, including the aerial, should be level from zero to a frequency just above the maximum useful value radiated by the transmitter followed by a rapid cut-off.7 No useful purpose is served by extending the bandwidth beyond this value, as the home viewer cannot receive it and the monitor picture may have an undesirably high noise level in consequence.

The sharp cut-off will result in appreciable phase distortion which can, and should be, corrected.8 This will result in ripples being observable on close examination of the picture both before and after narrow vertical bars and sharp edges, but they are of small amplitude and do not detract from its quality at the normal viewing distance. In fact there is a net gain in picture quality since the maximum use is made of the prescribed bandwidth of the transmission.

The signal will probably be subject to some degree of impulse interference and some form of signal limiter should be fitted to the amplifier.

The design and complexity of the video amplifier required for the line-fed monitor will depend to a large extent on the quality and level of the signal presented to it. If the input signal is of the order of 1 volt overall, picture and sync, as seems likely as this is now an international standard, it is not practicable to use a directly-coupled amplifier even though the d.c. component may be present. The gain of the amplifier will necessarily be of such a value that drift of the d.c. level is likely to be troublesome. Moreover, if the transmission line is of considerable length it may happen that a 50-c/s sine-wave signal of considerable amplitude, as well as other forms of interference, become added to the signal.

---

Fig. 3. Circuit of frame synchronizing-signal separator.

Thus it is necessary to use a.c. coupling at the input and to include some precise form of d.c. insertion which maintains the signal level constant during the "back porch"; i.e., the picture-suppression interval after the synchronizing signal.

The amplifier must be fitted with a gain control which should be so arranged that neither the black level of the signal nor the amplitude of the synchronizing signals change as the gain is varied.

The amplitude distortion introduced by the radio- and video-frequency amplifiers should be kept to a minimum in order to avoid modifying the gamma of the picture to any appreciable extent.

One method, due to Nuttall, of controlling the black level in the picture is to feed the output vision signal from the video amplifier into a circuit which compares its voltage level during the back porch with a reference voltage. The signal arising from the difference, if any, between the black level and the reference is fed back to the input stage of the main video amplifier with the required polarity to correct the error at that point.

By this means the black level in the picture can be maintained constant to a high degree of accuracy despite sudden changes in the picture content or the addition of a relatively large amplitude of low-frequency sine wave to the signal. Since this is a feedback circuit, with appreciable loop gain, any drifting of the black level due to the d.c. coupling in the amplifier is automatically reduced to negligible proportions.

The feedback circuit is only complete during the specified period and is brought into operation by a switching pulse derived from the synchronizing signal.

Synchronizing Signal Separation

The synchronizing-signal separator must be designed with an eye to the conditions in which the monitor is required to operate. If the signal is free from interference of all kinds, the separator can be of conventional design with the proviso that the frame-synchronizing signal is of such a form that the frame-scan generator will interlace properly.

If, however, the monitor has to operate in conditions in which various forms of interference may be superimposed on the signal, the separator must be designed to ignore as far as possible such unwanted signals.

The separator described is one type which is suitable for a monitor and affords good protection against impulse interference.


Fig. 4. Waveforms appearing in frame synchronizing-signal separator, (a) grid of \( V_1 \), (b) grid of \( V_2 \), (c) cathode of \( V_2 \).
The separation of the synchronizing signals is carried out in two stages. The first stage serves to separate the synchronizing signals from the vision signals and can be quite conventional. The second stage operates on the mixed synchronizing signals and provides the following outputs:

1. Frame-frequency synchronizing pulses.
2. Line-frequency synchronizing pulses.

3. A 4-µsec switching pulse for the Black Level control unit (not necessarily required in the radio-
   frequency monitor).

A block diagram of the complete separator is shown in Fig. 2 and the basic circuit of the frame-frequency separator in Fig. 3. The mixed synchronizing signal, Fig. 4(a), is fed to the grid of V, which has in its anode circuit an artificial delay line, comprising L1, C1, and C2, open-circuited at the end remote from the valve. The total time taken for a signal to travel to the end of the line, suffer a reflection and return to the sending end, is adjusted to be slightly longer than the duration of the line-synchronizing pulses, a suitable delay time is 12 µsec. The effect of this arrangement is that, as the reflected signal is the same polarity as the original, the line-synchronizing pulses appear side by side with their reflections. In the case of the frame pulses, however, which are of longer duration than the "echo" time of the line, the reflected signal adds on to the original and produces a total voltage excursion at the anode of twice the original signal as shown in Fig. 4(b).

The modified signal is then fed to a limiter stage, V2, adjusted to pass only signals in excess of the amplitude of the original pulses applied to the delay line, with the result that only those parts of the waveform in which the pulse duration is longer than the echo time of the line appear at the output, Fig. 4(c).

The advantages of this type of frame-synchronizing signal separator are:

1. Although the leading edge of the pulse is delayed by several microseconds, the delay is caused by a passive network and the timing of successive pulses is as accurate as in the original waveform.
2. Equalizing pulses are not required to obtain accurate interlacing as the leading edge is identical on odd and even frames. The only difference between the frames is that the pulse, Fig. 4(c), occurs only in the odd frames but does not affect the synchronizing.
3. A large proportion of the impulse interference which may be mixed with the original signal will be suppressed since the great majority of such pulses will be very short (approximately 0.33 µsec) if the overall bandwidth is 3 Mc/s compared with the echo time of the line and they will only appear in the output if they occur during a frame-synchronizing pulse or if a second interference pulse occurs at the instant the echo of a preceding pulse returns to the anode of the valve.

The line-scan generator is synchronized from the mixed synchronizing-signal waveform and is designed to ignore the alternate double line-frequency pulses which occur during the frame-synchronizing interval. The waveform is subjected to exactly the same process as that used for the frame pulses, in order to suppress impulse interference, except that the echo time of the delay line is reduced to 0.8 µsec.

The use of the interference-suppression circuit results in the line pulses being delayed with respect to the picture signal by 0.8 µsec and, although part of this delay is cancelled out by the time taken for the picture signal to pass through the video amplifier, allowance must be made for it in the design of the line-scan generator.

Black Level Control Switching Pulse

The switching pulse is derived from the mixed synchronizing signal. The signal is first "cleaned" and is then fed to a valve having a short-circuited artificial delay line in its anode circuit. The echo time of the line is designed to be 4 µsec and the signal polarity is arranged so that the pulse derived from the trailing edge of the line-synchronizing pulses (i.e., it occurs during the back porch) is passed to the output.

The artificial delay lines used in a synchronizing-signal separator of this type can be two-terminal networks designed in accordance with Foster's reactance theorem with the advantage that they are more easily made and adjusted than the corresponding four-terminal networks.

The remainder of the equipment in the monitor is in no way unusual and will only be mentioned briefly.

The performance of the sound channel, if required, should be in keeping with the quality of the vision equipment and requires no comment here.

The power supplies of the monitor can be of conventional design. All the d.c. supplies, including the e.h.t. supply, should be stabilized against mains input voltage and load-current fluctuations. The transformers and smoothing chokes should be orientated so that there is negligible stray magnetic field from them in the space occupied by the cathode-ray tube. The monitor must be capable of being operated when the frame frequency is not locked to the mains without brightness or focus modulation being visible in the picture and with deflection effects in any direction reduced to the absolute minimum.

A device for protecting the cathode-ray tube screen from damage in the event of failure of either or both scan generators should be incorporated.

So far, vision monitors have been built which incorporate all the features outlined above with the exception of a pin-cushion corrector and focus-current modulation, though these have been used in other equipment.

The quality of picture obtainable on the 405-line standard when full use is made of the 2.7 Mc/s transmitted bandwidth is considerably better than many people imagine. On seeing a first-class picture, received by radio in the ordinary way, reproduced on a high-performance monitor, it is clear that the decision to continue with the 405-line standard was the right one and that there is plenty of room for improvement in both transmitting and receiving equipment in the years to come before it can be said that the system is being exploited as fully as possible.

This article is based on a paper read by the author before the British Institution of Radio Engineers on March 23rd, 1950. The author's thanks are due to his colleagues for help and advice and in particular to Mr. T. C. Nuttall, who is responsible for many of the circuit techniques used and for the work on the reduction of scanning distortions.


Wireless World, June 1950
Screening

Back to First Principles When "Rules of Thumb" Fail

By "CATHODE RAY"

CERTAIN people pride themselves on being "practical" and can scarcely hide their contempt for "theorists." They joyfully quote the story of the Professor of Mathematics who came off worst in an argument with the bus conductor about the correctness of his change.

It is true that the learned are often found to be strangely out of touch with practical affairs, even in their own field of study; but that is no reason why knowing as much as possible about the theoretical basis of a job should not make the practical man better at it. I can think of nothing that illustrates this better than screening. It is a thoroughly practical subject, but its rules of thumb are complicated and liable to let one down when tackling anything a bit out of the usual. Lots of questions arise, and we cannot be sure that the answers for one application will fit another even when it seems similar.

There is a surprising vagueness about the subject in most of the books, and (it is to be feared) in many of the minds. This, I am sure, is due to vagueness about the underlying principles. It may possibly comfort a beginner to picture the screen-grid in a valve as a kind of sieve that lets the tiny electrons through and holds back the electric fields, or to suppose that a can round a coil protects it from stray fields much as a roof over one's head keeps out the rain. But when he comes to devising his own apparatus, that sort of idea isn't good enough. What he really needs is a clear picture of the theory of fields. Given that, he knows all (or nearly all) the answers.

This is hardly the place for a complete exposition of fields from the beginning. What I am about to do is to emphasize a few facts about them in relation to screening.

The first, which hardly needs emphasis, is that (so far as Wireless World is concerned) there are two kinds of field—electric and magnetic. The only point in mentioning it is in case someone says: what about an electromagnetic wave; is that a third kind? It is true that an electromagnetic wave has certain peculiarities not possessed by electric or magnetic fields considered separately; such as the ability to go on after whatever caused it has been switched off. But that is merely a matter of organization; the magnetic and electric fields of which electromagnetic waves consist are exactly the same in themselves as the fields around the loudspeaker magnet and the h.t. terminal in the power pack. It happens, however, that a moving magnetic field generates an electric field, and a moving electric field generates a magnetic field; this mutual back-scratching pact makes it possible for electric and magnetic fields to keep one another going without any visible (or invisible) means of support, once they have been started.

The starting process necessitates field movement or variation, so no electromagnetic radiation results from a constant fixed field of either kind. Theoretically, there is radiation wherever there is a.c. (though it is negligible at low frequencies such as 50 c/s). And since electromagnetic radiation consists of electric and magnetic fields in equal proportions, one can theoretically only have one kind without any trace of the other when it is quite steady, such as that produced by an electrostatic charge or a permanent magnet. But at low frequencies the radiation is generally so small that it is possible for one kind of field to predominate, even though it is alternating. The field close to a low-voltage coil carrying a heavy 50 c/s current is almost entirely magnetic, and the field close to high-voltage open-circuited terminals is almost entirely electric. But at radio frequencies the tendency is for the production of a strong magnetic field to necessitate a high voltage across the coil (and hence an electric field); similarly, a high voltage can hardly exist without producing at least a capacitive current (and hence a magnetic field).

This matter of frequency keeps coming into the question of screening.

Now for methods of screening. There are two basic types of weapon in our armoury: diverting the

---

Fig. 1. For the lowest frequencies, the best protection against magnetic fields is a substantial cover made of special low-permeability metal, with no joints or gaps such as XX in the way of the flux.

Fig. 2. Electrical analogy of Fig. 1.
course of the field; and cancelling it out with an opposing field.

Fig. 1 shows an example of the first method applied to the magnetic field from a coil. It consists in shutting it up in a box of high-permeability material, which provides such an easy path for the magnetic flux that very little spreads out into places where it would be unwelcome.

Magnetic Screening

Anybody who is not used to magnetic circuits may perhaps grasp the principle more clearly by studying the electrical analogy. Fig. 2. Here the electromotive force of the battery, E, corresponds to the magnetomotive force of the current-carrying coil in Fig. 1, and R₁, R₂ are high resistances corresponding to the large magnetic reluctances of the air spaces at the ends of the coil. Before the low resistances R₃, R₄ are connected, the full voltage E appears between the points AB; but with R₃, R₄ in place this voltage is more or less short-circuited. Similarly, the low reluctance of the screen reduces to a very small amount the magnetomotive force available for driving flux through the surrounding space. The single pair of dotted lines representing such flux in Fig. 1 does not mean, of course, that the flux consists of lines; it is spread throughout the space, but (if the screen is a good one) very thinly.

Just as any breaks in R₃ and R₄ would nullify their action, so one has to take care that the arrangements for opening the box do not introduce even the smallest gap in the flux path as seen from the outside—across XX, for example. It is all right to have a crack along the flux lines such as YY.

If the box is to be reasonably thin and light, it must have a very high permeability indeed to offer a far easier path for the flux than the much thicker chunk of space outside. Ordinary iron or steel is not really good enough; that is why a special high-µ alloy much as Mumetal is recommended.

Note that this kind of screen tends to increase the inductance of the coil by increasing the flux produced by a given current.

This method is at its best with zero- or low-frequency current in the coil. As the frequency is raised the µ drops, and at radio frequencies it is too little to be much help. That is where we bring out our other weapon. Suppose the box to be made of copper. As the µ of copper is practically the same as of air it is completely useless as a flux diverter. But what it does do is to act as a short-circuit of the secondary winding to the coil, and the current induced in it sets up a field that very nearly cancels out the field of the coil.

If the copper were to be wrapped closely around the coil winding, so as to be close coupled to it, as in a transformer, the inductance of the coil would be reduced nearly to zero, so that it would cease to be worth screening. To avoid this, the screen should be as large as space and cost will allow.

In Fig. 3, the lines abc are graphs showing how the flux density falls off rapidly the farther one gets away from the coil. Just outside the coil itself, it is very intense, as indicated by the height of a. At the screen it is much less (b); and c denotes the density at some point outside the screen, where it is less still, but presumably more than is wanted. Since the flux is supposed to be alternating, and the copper screen forms a closed circuit around the coil, it generates currents in the screen which set up their own flux. And if the resistance of the screen is very low, a very much smaller flux than b is sufficient to generate enough e.m.f. to drive enough current through the screen to produce a reverse flux equal to b. (If you don’t follow that at the second attempt, try reading on before going back to it!) What happens is that the reverse flux, b’, grows until it nearly neutralizes b, the small difference between them being what is needed to generate b’. The screen can never neutralize the coil’s field completely, because if it did there would be nothing to generate the neutralizing field. But it can be made to do so very nearly by making the resistance of the screen very low in the direction of the current. The direction of the current is quite different from the direction of the flux in Fig. 1; it is in a continuous ring parallel to the turns in the coil. So a gap at XX in Fig. 1 would be allowable, but one along YY (supposed to be continued right down the screen) would interrupt the screen currents and make it useless.

The Fig. 1 screen would not in any case work well as a neutralizing screen, because high-µ materials have a far higher resistance than copper.

The field strength and flux density due to the screen also fall off on each side, and Fig. 3 shows that outside the screen this is just what is wanted; for example, c’ practically cancels c. But inside the screen the cancellation becomes less and less as one gets near the coil; which again is just what is wanted.

If the screen is spaced well away from the coil, a’ does little to cancel a, and the inductance of the coil is only slightly reduced. But if you draw a diagram like Fig. 3, for a screen fitting tightly round the coil, you will see how nearly it would neutralize the coil as well.

Obviously this type of screen is no good at all against a d.c. field, because d.c. can induce no screen currents. And it is not very good at low frequencies, because such a lot of screen current is needed to generate the neutralizing field, and the difference between b and b’ is comparatively large. So the two
methods are complementary: Mumetal for a.f. and lower frequencies; copper for r.f. But remember to have the lids in the right places relative to the coil!

So far we have considered the problem to lie in shutting up a source of objectionable magnetic field, but, of course, the same methods work in reverse, if the interfering field is outside and the screen is for protecting the coil inside.

**Electric Screening**

You will have noticed that nothing has been said about earth, because earthing has nothing to do with magnetic screening. But it has everything to do with electric screening. The method corresponding most closely to Fig. 1, which would consist in enclosing the source of electric field in a high-permittivity box, is (so far as I know) never used, because even the latest titanium ceramics do not offer a \( \times \) anything like so high as the available \( \mu \); and such materials are not very handy for screen-making anyway. If you regard metals as materials having practically infinite permittivity, that is different. But it is more usual to regard metallic screens as working by virtue of their conductivity. However they are regarded, the fact is that they do work, and very well too, especially at low and zero frequency. All one has to do is to shut up the offending (or offended-at) article in an earthed conductor.

In Fig. 4, V represents some component, such as a rectifier, having a high voltage to earth or other zero-potential structure such as the chassis, represented by E. The electric field, when there is no screen, is suggested by the dotted lines in diagram (a), which mean that every point in the space around is at some potential between those of V and E, and therefore not zero. In (b) the offender is shown shut up in a metal box S, connected to E. All points on S are thus brought to the same potential as E, so there can be no electric field between S and E.

This is strictly true for unvarying fields, even if the resistance of S is not negligible; because any charge that the first switching on may have set up on parts of S leaks off more or less rapidly to E, and there is nothing to renew it. But if the potential of V is varying at high frequency there will be capacitive currents induced in S, and unless S has a low resistance, these currents will cause a voltage drop in it. This situation could be represented as in Fig. 5, where C is the capacitance between any selected part of the screen and V.

Unless C is rather large and the frequency and voltage of V is very high, the current is not likely to be enough to set up an appreciable p.d. across the extremely low resistance of even a thin metal screen. But if these conditions exist, one does have to think of using thickish copper sheet. Or, better still, two screens, one inside the other. For most purposes, however, the thinnest tinfoil is good enough. It is not even essential to have continuous metal, so long as it makes a good contact to earth. A sort of parrot cage is quite effective. Suppose Fig. 6 represents V and a few wires of such a screen, looking down on it from above. If one maps out the field by the methods described in the books one finds very little of it exists much beyond the boundary of the screen, even when the gaps are fatter than the wires. But a vertical spiral or coil of wire would be bad, because it would place a comparatively large resistance—and inductance—between the upper part of itself and E.

For the same reason it is not a good idea to screen a wire by winding a spiral of wire around it, earthed at only one or two places.

In general, the need to avoid contact resistance is not so acute in an electric screen as in a magnetic, because it is usually a high-voltage low-current system, whereas a magnetic screen is exactly the opposite. So, although a push fit between a can S and its base E puts a contact resistance in the direct line of current, it is usually good enough.

As in Fig. 3, the farther the screen is away from the screened, the better. A close-fitting screen increases the capacitance to earth of its contents, which is often a bad thing in itself, and in so doing it also increases the screen currents and so reduces the effectiveness of the screening.

![Fig. 4. (a) Unscrened object V at high potential relative to E. (b) Same object with screen, S. The electric flux is denser, but confined inside the screen.](image)

![Fig. 5 (above). Equivalent circuit of Fig. 4(b) when the screen has appreciable resistance to earth.](image)

![Fig. 6 (right). Showing how an earthed grid or cage is nearly as effective as continuous metal.](image)

![Fig. 7. An earthed metal can is effective against both fields, provided that the resistance is low throughout the paths of magnetically induced currents (such as M) and electrically induced currents (such as E). If there has to be a joint or seam, it is better for it to affect E than M.](image)

__Wireless World, June 1950__
One advantage of knowing the underlying principles of screening, and thereby the directions in which screen currents or flux take, is that it enables one to contrive a screen so that it deals with either electric or magnetic field alone, or with both.

When the object to be screened is such a thing as a tuning coil, one usually wants to screen both fields, and an earthed copper can does both jobs very effectively, provided, of course, that there is nothing (such as a doubtful seam) to obstruct the currents induced in the screen. The circles marked M and the straight lines marked E in Fig. 7 are typical current paths necessary for screening alternating magnetic and electric fields respectively.

But sometimes one wants to stop electric (capacitive) coupling without interfering with magnetic coupling—between the windings of a transformer, for example. If the primary were completely enclosed in a copper cylinder before the secondary was wound on, it wouldn't be a very good transformer! All one has to do to remove the magnetic screening while retaining effective electric screening is to stop all the magnetically induced currents by slipping a strip of non-magnetic material across the overlapping edges of an earthed non-magnetic sheet (Fig. 8).

The reverse process—magnetic screening without electric—is not normally a requirement, but if it were it could be accomplished with a set of insulated rings, like hoops round a barrel, parallel to the wire in the coil.

C.C.I.R. VISIT

Studying British Television Progress

Some fifteen countries were represented in the delegation of the International Radio Consultative Committee which has been here to study television. They have also visited America, France and Holland.

During a visit to the E.M.I. works delegates saw the manufacture of Emitron camera tubes and had 405- and 625-line television demonstrated on a closed circuit. A direct comparison between the two was possible. A 3 Mc/s bandwidth was used for 405 lines and a 5.5 Mc/s for 625 lines. The difference of picture quality obtained was remarkably small. The sensitivity of the cameras was demonstrated by pictures of a scene illuminated by 1 ft candle.

The new vision transmitter for Holme Moss was shown by the Marconi Company at Chelmsford and an evening television party was given at Great Baddow. In addition to 405-line closed circuit demonstrations, which included good pictures at dusk, a series of demonstrations of television effects was staged. Among these was an experiment showing that a 50-c/s frame frequency is no bar to the attainment of a flicker-free picture which is bright enough for viewing under conditions of high ambient illumination.

In their visit to the B.B.C. research station the delegates were shown 405- and 625-line pictures transmitted through a carefully equalized 3 Mc/s channel. Known amounts of delay and echo distortion could be introduced and their effect on the picture observed. It was clearly demonstrated that a delay distortion of 0.02 sec, which it is difficult to avoid in cable links, caused only moderate distortion of the 405-line picture it intolerably degraded the 625-line one. Cinema-Television, Ltd., demonstrated large-screen television, as reported on page 220.

Club News

Birmingham.—A talk on the radio control of models will be given to members of the Slade Radio Society on June 9th by Dr. A. C. Dawes. The second discussion in the series on television fundamentals will be opened by W. E. Merrill on June 23rd. Meetings are held on alternate Fridays at 7.30 in the Parochial Hall, Broomfield Road, Erdington. Sec.: C. N. Smart, 110, Woolmore Road, Erdington, Birmingham.
THE navigable stretch of the River Thames—a distance of some 50 miles—comes under the control of the Port of London Authority and it was as a result of their request for radio-telephone facilities to their patrol launches which led to the introduction by the Post Office of the service now linking small craft plying on the Thames with the public telephone service. An article giving a survey of the problems involved and a description of the equipment used for this service was given in the January issue of the Post Office Electrical Engineers’ Journal.

Two-frequency working is provided, with transmission in each direction on frequencies separated by several megacycles; this allows full duplex operation as on the ordinary telephone. Six channels are planned with 100-kc/s spacings and a frequency separation between incoming and outgoing carriers of 4.5 Mc/s. The carriers of the first and second channels of the Thames Radio Service—as it is called—are 157 and 157.1 Mc/s (mobile to fixed) and 161.5 and 161.6 Mc/s (fixed to mobile). Amplitude modulation is being used in conformity with the recent decision to standardize a.m. for marine services in the U.K.

The lower reaches of the Thames flow through rather flat country and the number of sites on which it is possible to obtain the necessary height for the aerials of the fixed stations is very limited. After tests it was decided to utilize two water towers—one north of the river and the other south. Since the introduction of the service it has been found that the southern station at Shooters Hill (see map) gives adequate coverage and the second site—at Langdon Hills—is not being used, unless it is subsequently

Location of the fixed station at Shooters Hill and the site of the proposed second station north of the Thames are shown on this map. The route of the cable link between the existing station and the exchange in central London is also shown. Equipment at the Shooters Hill station is shown below. A & B, main 50-watt transmitter and standby; C, main receiver and analyser; D, spare receiver and analyser; E, control unit; F, power equipment.
Marconi equipment as installed on river craft for the initials tests for the Thames Radio Service.

decided to extend the scope of the service. Simple centre-fed vertical dipoles for both the transmitter and receiver are mounted on the top of the 530-ft water tower. The receiving dipoles are connected to a pre-amplifier installed at the top of the tower and filters are inserted in the feeders to prevent high voltages from the transmitting aerials—which are within a few feet—being applied to the receivers. The pre-amplifier consists of an earthed-grid triode with a broadly tuned anode circuit. Power for the amplifier is superimposed on the co-axial cable connecting the amplifier to the receivers which are at ground level.

The radiated power from the fixed station can usefully be greater than that of the mobile transmitters, but this increase can only be effective in improving range, or quality of service, if the receivers at the fixed station are correspondingly more sensitive than the sets afloat. The fixed receivers at present in use have a noise factor of approx. 5.0d and, with the simple aerials installed, their sensitivity is such that an average signal/noise ratio of 15db is obtained on

This Pye equipment was used to demonstrate how seagoing vessels may benefit from the Thames service when their deep-sea radio is closed down.

Telephone Exchange in central London—a distance of 7 miles. The proposed site of the second station is, however, some 23 miles from central London. As a precaution therefore against difficulties which might have been encountered due to the difference in transmit time should two stations be used, the line from Shooters Hill is routed circuitously so that it is approximately equal to that from the second station.

Whilst the service is provided by the Post Office it is the responsibility of the owners of boats to equip and maintain the gear on board, which, however, has to conform to a P.O. specification. Two manufacturers are now producing the equipment and typical sets are illustrated. The sets are similar to those used for land mobile services—such as in police cars. The use of frequencies around 160 Mc/s is, however, comparatively new and the Thames Radio Service is the first mobile service in the U.K. to use full duplex working with a common T/R aerial.

The operating procedure for the service, which is available throughout the 24 hours, is as follows in the case of calls from river craft. On lifting the telephone handpiece from its hook the monitoring loudspeaker, which is used for calling the craft for incoming calls, is disconnected and the transmitter is brought into operation. The automatic signal radiated from the transmitter operates the calling lamp at the International telephone exchange and the operator on being asked for the required number completes the circuit. In the opposite direction—land to water—telephone subscribers served by any exchange in the U.K. may make a call to a boat. At the moment the operator broadcasts a call for the boat required and when a reply is received the correspondents are linked. A refinement—a selective calling system—is, however, being introduced.

EQUIPMENT AFOAT

The mobile equipment supplied by Marconi's for the Thames Radio Service is the standard Type H16 adapted for use in the 750- to 184-Mc/s band. The receiver (shown on the left of the above illustration) and transmitter are separate units which mounted together on a rack, measure 16 inches square by 8 inches high.

The Pye equipment used is shown in the photograph on the left. It is the high-band version (100-185 Mc/s) of the Type 703, slightly modified for the Thames Radio Service. R.F. output of the transmitter is up to 12 W.
Modern
Soft-Soldering
Technique

Present-day Methods for
Obtaining Speed and Reliability

By R. W. HALLOWS, M.A. (Cantab), M.I.E.E.

SOLDERING is amongst the most ancient
branches of the metal worker's art, for soldered
joints are found in the gold chains and in a con-
siderable variety of the other jewels taken from the
oldest Egyptian tombs, and from those belonging to
other early cultures. Until comparatively recently,
all of the three methods of soldering—brazing, silver-
soldering and soft-soldering—remained parts of the
"art and mystery" of skilled metal-working crafts.
To a great extent this is still true of the first two;
but the same cannot be said of soft-soldering, which
is now regularly done, mechanically or by semi-skilled
labour, in factories; and in an unknown number of
workshops (and on a still less ascertainable number of
kitchen tables!) by amateur craftsmen the world
over.

Soft-soldering was mainly the speciality of the tin-
smith until the advent of electrical power and light-
ing. Almost every kind of electrical apparatus must
contain many soldered connections in its make-up.
Means had to be found, and were duly found, of so
simplifying the technique that it ceased to be the
prerogative of expert craftsmen. With the coming
first of radio and later of television, further simplifica-
tion was needed, for the average broadcast receiver
contains some 500 soldered joints and there may be
from 1,500 to 2,000 or more in a combination tele-
visor-radiogram.

At this point we had better, perhaps, settle just
what we mean by soldering (hard, silver or soft) and
by the term "dry joint."

Soldering of any kind may be defined as the process
of uniting two pieces of metal by means of a thin
layer of another metal of lower melting point than
either: this last metal is the solder. The correct
procedure is to apply the solder to the joint, then heat
the latter until the solder becomes liquid. A sound
joint can be made only if the solder "wets" the sur-
faces of both the metals to be joined. By "wetting"
means that the solder penetrates each surface to
molecular depth and forms a thin layer of "inter-
metal," which is virtually an alloy. This condition
is illustrated diagrammatically in Fig. 1 (a).
Fig. 2 (b) shows what happens in the case of a dry joint. As the term suggests, a dry joint occurs when the solder fails to wet one or both of the surfaces to be joined. The solder adheres to some extent to the surface irregularities, and may penetrate between the particles of oxide to make contact with the metal at one or two places (A and B for instance), but there is no genuine union. Owing to the very small contact areas at such points as A and B, the joint would have a high resistance which would vary considerably with vibration or mechanical strain.

Another particularly deceptive dry joint sometimes occurs when a wire is being soldered on to a tag, using resin flux, and the tag has not been properly tinned. As can be seen from Fig 2, a layer of solidified flux collects on the tag and sticks the wire in position, whilst the solder simply forms a blob on top, giving every appearance of a well-soldered joint. Then again, even if the solder does wet the tag, it often happens that the wire is not properly wetted but is merely clamped mechanically by the solder solidifying around it.

Feeling that readers, both professional and amateur, would like to know something of the latest developments in the soft-soldering used in radio and television construction, I consulted Richard Arrib of Multicore Solder Ltd., as an admitted authority on the subject, and from him I obtained a mass of interesting information.

The making of a successful joint of the kind used in electrical apparatus depends upon the use of:

(a) The proper quantity of the right kind of flux.
(b) A solder which is a suitable alloy of tin and lead.

Fig. 3. Illustrating the process of fluxing and tinning.

(c) A temperature, applied by iron, blowpipe, or other means sufficient to ensure "wetting."

The main purposes of the flux are as follows. First, it removes any oxide coating from the surfaces of the metal to be joined. The oxide is dissolved by the advancing edge of the flux and forms a metallic salt in solution, as shown in Fig. 3. As a result, the advancing edge of flux often becomes highly viscous and stops flowing—which may explain the failure of some materials that are theorelically good fluxes. Sometimes a phenomenon known as "gaseous fluxing" takes place as well. When the flux material is heated, certain substances in it are volatilized into gas, which attacks the oxide before the ordinary liquid flux can get to it. The effect can be seen by a bright corona of cleaned metal surrounding the advancing edge of the flux.

Secondly, a flux serves to lower the surface tension of the molten solder, enabling it to flow readily. In fact, some fluxes, which are not chemically strong enough to dissolve the oxide, act by virtue of this tendency, always provided that the oxide coating is not thick enough to prevent the solder from wetting the metal.

Thirdly, it goes without saying that the molten flux acts as a very effective seal against the atmosphere, and so prevents the formation of any more oxide whilst the soldering-iron is heating up the metal.

Resin-cored Solder

Metals such as copper and tin are known as "easy" from the soldering point of view, since there is comparatively little difficulty in wetting them with solder. But there are "difficult" metals, of which aluminium is the outstanding example. The trouble with aluminium is that oxidation occurs almost instantly after the surface has been cleaned and that ordinary fluxes cannot keep pace with it. The Mullard supersonic soldering tool, designed particularly for dealing with aluminium, tackles this special problem in an entirely new way; the vibrations set up literally shake off the oxide film as it forms.

In radio work we are concerned mainly with "easy" metals and the problems are to some extent simplified. There is, however, only one generally available basic flux which satisfies all electrical requirements. This is resin. The main constituents of resin are abietic or pimaric acids which, in the molten state, do the work of dissolving the oxide, but have the great virtue of being non-corrosive when the resin has set once more into the solid and the soldered joint is made. In the early days of radio, many of us tried our hands at soldering, using powdered resin as a flux—and didn’t we make some nasty looking messes! Powdered resin is definitely not an easy flux to use, at any rate for fine work. Later, fortunately, somebody conceived the idea of dissipating the powder in industrial spirit, which made it very much more convenient to use.

The advent of resin-cored solder brought about something like a revolution in electrical soldering methods. With a well-designed resin-cored solder, reasonably clean surfaces and an iron at the right temperature, it is next to impossible to fail to make good joints with "easy" metals.

One essential of a cored solder is that the resin should be chemically "activated" in order to ensure speedy action, since resin by itself is a slow-acting flux—at any rate, far too slow for modern radio pro-
duction. Moreover, there are one or two difficult surfaces, such as on nickel- and cadmium-plated components, for which activated resin is the only answer, since plain resin will not remove the oxides. It is important, however, that the activating substance, whilst being strong enough in the molten state to dissolve the oxide, should leave a non-corrosive residue. Furthermore, the residue should have good insulating properties and be non-hygroscopic, for otherwise it would absorb water under humid conditions and so cause electrolytic leakage. Another point is that the residue should be hard and non-sticky to prevent the collection of dust and moulds, which again would lead to leakage. The activators used are various, but in general are the hydrochlorides of certain organic substances, for instance, amine hydrochlorides.

Alloys are made with single and triple cores.

Two arguments are put forward for triple-core solder: one is that there is less likelihood of a discontinuity occurring in the supply of flux, and consequently less likelihood of dry joints and wastage of solder, if there is more than one core in the solder wire. The other claim is that the triple-core principle of construction provides thinner walls of solder and thus allows more rapid melting.

Now a word about the composition of solder. In radio and electrical work the solders used most extensively are alloys of tin and lead. But there is more to it than this. The actual proportion of tin to lead is of great significance, for it makes all the difference to the way in which the solder is used, and most of all it affects the melting point. Alloys with different percentages of tin and lead have different melting points, as can be seen from the curve ACB in Fig. 4. At point A we see that a predominantly lead alloy (30 per cent tin, 70 per cent lead) has a melting point of about 255°C, whilst at point B a predominantly tin alloy (80 per cent tin, 20 per cent lead) has a melting point of about 210°C. The lowest possible melting point is at point C, which is that of an alloy consisting of 63 per cent tin and 37 per cent lead. To give it the correct name, "eutectic" solder.

Now eutectic solder is a thing apart. It is the only tin/lead alloy which has no plastic or "pasty" range. It solidifies and liquefies at 183°C. All the other alloys solidify at 183°C, but become entirely liquid at different temperatures, depending on their composition. It might be thought, then, that the eutectic alloy would be the best for high-speed work, since its transition from the solid to the liquid state is the most rapid of all the alloys. Practical experience has shown, however, that for most work for which cored solder is used in the radio industry, there is an advantage in having a plastic range. Consequently 60/40 alloy is widely employed, as it obviates fractures which may occur owing to slight vibration whilst the solder is setting solid. The 6°C difference in melting point from that of the pure eutectic is so small that it is of little importance.

From the curve it will be seen that as far as obtaining a low melting point is concerned, there is no advantage in using a greater tin content than in 63/37 alloy, as the alloys with greater tin contents and higher melting points.

It may not be out of place to give one or two tips about the correct use of solder in various jobs. The wrong method is to take up a "blob" from the cored wire on the bit, for the flux is then "fried" where it has no chance of doing its proper work, and a dry joint is almost a certainty. Lay the end of the cored solder wire on the work and apply the point of the bit to it.

Next, it is of the greatest importance to use an iron that is sufficiently hot. Untold numbers of resistors, capacitors and other such components are damaged or even ruined by the use of insufficiently hot irons. If the bit is not hot enough, it has to be applied to the work for some little time before the solder runs, and during this time the body of a component may be heated up to an undesirable temperature. On the other hand, when the bit is hot enough (and the flux sufficiently active) the solder flows almost instantly. There is not time for the body of the component to be brought to an over-high temperature.

The quicker your work, the less the risk you run of injuring delicate components. The speed at which soldered joints can be made depends (given a quick-acting flux) upon the temperature of the iron and the melting point of the solder. My own practice for 60/40 solder is to let the iron warm up until the application of the bit to a piece of newspaper produces singeing in no more than five seconds.

Sweating is one of the most useful branches of soldering. It enables two metal surfaces which may be quite large to be firmly joined together. The principle is that each surface is tinned by the application of a thin and even layer of solder. The tinned surfaces are then brought together, heat is applied, the solder runs, and a firm union is made.

For making joints in this way we can use either a separate solder and flux or cored solder, or, alternatively, one of the brands of solder paste which consist of finely divided solder in a flux medium. However, perhaps the quickest method is to clamp the surfaces together, heat them, and apply cored solder to the junction; the flux and solder will then flow in between the surfaces by capillary attraction.

Recently, Multicore Solders, Ltd., have introduced a cored solder using "Arax" flux, which enables these kind of jobs to be done very quickly on "difficult" metals. It is already being used by manufacturers and amateur constructors for assembling chassis and other metal parts of radio equipment.
WORLDC OF WIRELESS

Exhibition Plans • Cinema Television • Atomic Research • German Broadcasting

Birmingham Exhibition

TELEVISION demonstrations are not to be confined to the normal transmission hours of Sutton Coldfield during the National Radio Exhibition at Birmingham (September 6-10). The organizers are installing a studio in the exhibition and with this and a film scanner a continuous programme will be provided. B.B.C. transmissions will, of course, also be used at suitable times.

The studio will be open to inspection by the public. There will be a central demonstration room where the products of exhibitors will be seen in operation side-by-side; and receivers will be demonstrated on individual stands.

To this end, the r.f. sound and vision signals will be conveyed to each stand by cable and will be at a level of 1 mV at 700. Great care is being taken to avoid interference; suitable suppressors are being fitted to the electrical equipment of the building and the use of certain types of apparatus on the stand is prohibited.

The vision and sound signals provided are to be at 45 Mc/s and 41.5 Mc/s—the London frequencies. As a result, all the receivers demonstrated will be London models. This is necessary because Sutton Coldfield programmes are not to be used all the time. Intolerable interference would result if the distribution were at Sutton Coldfield frequencies and this station started operation when the exhibition studios were in use.

It is necessary that the distribution take place on different frequencies from those of the local transmitter and it is expected that at the next London radio show Birmingham model will be used.

Large-Screen Television

A DEMONSTRATION of large-screen television was given by Cinema-Television, Ltd., at the Odlean Theatre, Penge, on 29th April, to a private audience.

The B.B.C. transmission of the Cup Final at Wembley was shown on a screen 20 ft by 15 ft, being projected by a Schmidt optical system from a c.r.t. tube operating at 50 kv. The average beam current of the tube is 1.2 mA with a peak current of 15 mA. In order to maintain good focus with such a large current, the focus current is modulated by the line- and frame-scanning circuits (see "Television Monitors" on p. 26). The tube face is cooled by an air blast. The projection mirror is of 27-in diameter with an 18-in plastic correcting plate; a metalized-fabric directional-viewing screen is used, and a high-light brightness of 71-f-lambers is obtained.

The picture obtained during the demonstration was extremely good. The detail and tone gradation were excellent and the brightness quite adequate. Judging by the reactions of the audience to events in the game, the viewers quite lost consciousness of the medium by which they saw it. Indeed, one viewer, who repeatedly exhorted Liverpool to "come on," was obviously at Wembley in the spirit.

Harwell Linear Accelerator

THE Ministry of Supply announce that a linear accelerator of the travelling-wave type, similar to that developed by the Atomic Energy Research Establishment at Malvern, has been installed at Harwell and is being used for the production, indirectly, of neutrons for research into the behaviour of materials in nuclear reactors.

A 10-cm pulse generator is used as the source of energy in the wave guide, and successive short bursts of electrons are produced with energies of 3.5 Mev and speeds approaching the velocity of light. These impinge on a metal target, or gamma rays, which are absorbed in heavy water and release neutrons from the hydrogen nuclear at the rate of 10° per second.

Development and construction was undertaken by Mullard Electronic Research Laboratories, to the basic design of a group at Harwell.

E.H.F. Broadcasting

A NETWORK of extra-short-wave broadcasting stations was introduced on the 30th April by the broadcasting organization in the British Zone of Germany—the Nordwestdeutscher Rundfunk.

Four stations will at first form the chain but will be increased later this year to six. The first stations are at Hamburg and Langenburg (88.9 Mc/s, 10 kW), Cologne (89.7 Mc/s, 1 kW), and Hanover (89.3 Mc/s, 0.5 kW—later to be increased to 10 kW). The additional transmitters will be at Eltzhorn, near Oldenburg, (88.5 Mc/s, 10 kW) and Teutoburger Wald (89.7 Mc/s).

Danish Television

WITH the resumption of tests in April the schedule of transmissions from Denmark's experimental television station has been revised and extended. Test patterns are now transmitted as follows: Monday, 1100-1600; Wednesday and Friday, 1100-1600 and 2000-2100; Saturday, 1100-1600 and 2000-2100.

According to our Danish contemporary, Radio Ekko, the frequencies used are 62.5 Mc/s vision, and 67.75 Mc/s sound, with powers of 100 watts and 50 watts respectively. Scanning rate is 625 lines with 25 pictures per second. Double sideband transmission is employed with positive picture modulation on Wednesdays and Saturdays and negative modulation on Mondays and Fridays. Sound is frequency-modulated with a maximum frequency deviation of ±73 kc/s.

Wireless World, June 1950

Interior of the television mobile central control room supplied to the B.B.C. by Emitron Television Ltd. It provides for the control of up to four O.B. units each of which uses three cameras. The picture selected for transmission to the station, either by radio or line, is displayed on the centre c.r.t.
**COLOUR TELEVISION**

**DEMONSTRATIONS of colour television were given by Pye, Ltd., in Hilversum, during the recent Utrecht Fair, and at the Milan Fair.** The system, which was demonstrated at Radiolympia last year, and more recently at the Dental School of Guy's Hospital, London, is being developed mainly for use on a closed circuit. The scanning rate is 495 lines, with 50 frames. Colour presentation is by sequential additive colour scanning using three-colour rotating discs on both the camera and the receiver. The bandwidth required is 9 Mc/s.

*Delegates of the C.C.I.R. Television Study Group also saw demonstrations during their recent visit to this country.*

**PERSONALITIES**

Lord Reith, who was the first Director-General of the B.B.C., gave oral evidence before the Broadcasting Committee of the Parliament of Ireland. He is now Chairman of the Commonwealth Communications Council.

I. J. St. A. Crawshaw, B.Sc. (Eng.), M.I.E.E., President of the Institute of Electrical Engineers, has resigned from the board of Airmec Laboratories, Ltd., of High Wycombe, one of the companies in the Radio and Television Trust Group. He joined the company in 1914, shortly after its formation, as Patent Manager, and later became Sales Manager and Director of the Laboratories.

John Dyer, who was with the Philco organization as Sales Promotion Manager prior to joining Philips in 1937, has now been appointed general sales manager of Philco Overseas, Ltd., the British subsidiary of the Philco Corp., of Philadelphia, U.S.A. The company is responsible for the design and production of British-manufactured sets.

B. Key, M.B.E., A.I.M.I.E.E., has relinquished the post of head of Philips' Technical Commercial Department (Radio and Television) in order for a position at Temgas (Electrical) & Co., of Northampton, as chief engineer. Prior to joining Philips Electrical in 1937, he was for four years in the London office of the International Standard Electric Corporation.

J. S. Smith, N.W. Area manager of the Marconi International Marine Communication Co., has retired after 40 years' service with the company. After serving for some years as a radio officer he was placed in charge of the Marconi Marine Depot in New York and then appointed Liverpool Depot manager. He has been with the company since 1919. H. C. Maguire is taking over all contracts work in the Mersey-side area upon Mr. Smith's retirement.

**IN BRIEF**

Television Licences in the United Kingdom increased by over 105,000 during the first quarter of this year, bringing the total to over 500,000. The total number of licences—both sound and vision—in force at that date was 12,143,966.

**WIRELESS WORLD, JUNE 1950**
including B.T.H. and Metrovick—who will be demonstrating electronic control gear. During the exhibition a convention will be held at which a number of papers dealing with various aspects of mechanical handling will be read. The papers for both the exhibition and the convention are obtainable from the Commonwealth Telephones Agreement, signed by representatives of the Commonwealth governments in May, 1950. Canada’s Overseas Telecommunication Corporation will be exhibiting at the Canadian International Trade Fair which is being held in Toronto during May and June. They will be exhibiting magnetic alloys—such as H.C.R., a high-permeability alloy with rectangular hysteresis loop, and Hysat, a cobalt-iron alloy—and a range of Telcosel glass scaling alloys.

**BUSINESS NOTES**

Alloys made by the Telegraph Construction and Maintenance Co., and now available in Canada, are being exhibited by the Canadian International Trade Fair which is being held in Toronto during May and June. They will be exhibiting magnetic alloys—such as H.C.R., a high-permeability alloy with rectangular hysteresis loop, and Hysat, a cobalt-iron alloy—and a range of Telcosel glass scaling alloys.

**NEW ADDRESSES**

Radio Heaters, Ltd., manufacturers of orthicon cameras, have moved to Eastheath Avenue, Wokingham, Berks. (Tel.: Wokingham 1050.)

Acoustic Products, Ltd., manufacturers of Lectrona speakers, have moved from North London to Stonefield, W.E., Victoria Road, South Ruislip, Middlesex. The new plant is large and the equipment is being handled by Edstone, Ltd., who are now at 15, Buckingham Place Gardens, S.W.1. (Tel.: Soane 0621.)

**MEETINGS**


*BUSINESS NOTES*

**Radio Heaters, Ltd.**

Manufacturers of orthicon cameras, have moved to Eastheath Avenue, Wokingham, Berks. (Tel.: Wokingham 1050.)

**Acoustic Products, Ltd.**

Manufacturers of Lectrona speakers, have moved from North London to Stonefield, W.E., Victoria Road, South Ruislip, Middlesex. The equipment is being handled by Edstone, Ltd., who are now at 15, Buckingham Place Gardens, S.W.1. (Tel.: Soane 0621.)

**MEETINGS**


**BUSINESS NOTES**

Alloys made by the Telegraph Construction and Maintenance Co., and now available in Canada, are being exhibited by the Canadian International Trade Fair which is being held in Toronto during May and June. They will be exhibiting magnetic alloys—such as H.C.R., a high-permeability alloy with rectangular hysteresis loop, and Hysat, a cobalt-iron alloy—and a range of Telcosel glass scaling alloys.

**NEW ADDRESSES**

Radio Heaters, Ltd., manufacturers of orthicon cameras, have moved to Eastheath Avenue, Wokingham, Berks. (Tel.: Wokingham 1050.)

Acoustic Products, Ltd., manufacturers of Lectrona speakers, have moved from North London to Stonefield, W.E., Victoria Road, South Ruislip, Middlesex. The equipment is being handled by Edstone, Ltd., who are now at 15, Buckingham Place Gardens, S.W.1. (Tel.: Soane 0621.)

**MEETINGS**


**BUSINESS NOTES**

Alloys made by the Telegraph Construction and Maintenance Co., and now available in Canada, are being exhibited by the Canadian International Trade Fair which is being held in Toronto during May and June. They will be exhibiting magnetic alloys—such as H.C.R., a high-permeability alloy with rectangular hysteresis loop, and Hysat, a cobalt-iron alloy—and a range of Telcosel glass scaling alloys.

**NEW ADDRESSES**

Radio Heaters, Ltd., manufacturers of orthicon cameras, have moved to Eastheath Avenue, Wokingham, Berks. (Tel.: Wokingham 1050.)

Acoustic Products, Ltd., manufacturers of Lectrona speakers, have moved from North London to Stonefield, W.E., Victoria Road, South Ruislip, Middlesex. The equipment is being handled by Edstone, Ltd., who are now at 15, Buckingham Place Gardens, S.W.1. (Tel.: Soane 0621.)

**MEETINGS**


**BUSINESS NOTES**

Alloys made by the Telegraph Construction and Maintenance Co., and now available in Canada, are being exhibited by the Canadian International Trade Fair which is being held in Toronto during May and June. They will be exhibiting magnetic alloys—such as H.C.R., a high-permeability alloy with rectangular hysteresis loop, and Hysat, a cobalt-iron alloy—and a range of Telcosel glass scaling alloys.

**NEW ADDRESSES**

Radio Heaters, Ltd., manufacturers of orthicon cameras, have moved to Eastheath Avenue, Wokingham, Berks. (Tel.: Wokingham 1050.)

Acoustic Products, Ltd., manufacturers of Lectrona speakers, have moved from North London to Stonefield, W.E., Victoria Road, South Ruislip, Middlesex. The equipment is being handled by Edstone, Ltd., who are now at 15, Buckingham Place Gardens, S.W.1. (Tel.: Soane 0621.)

**MEETINGS**


**BUSINESS NOTES**

Alloys made by the Telegraph Construction and Maintenance Co., and now available in Canada, are being exhibited by the Canadian International Trade Fair which is being held in Toronto during May and June. They will be exhibiting magnetic alloys—such as H.C.R., a high-permeability alloy with rectangular hysteresis loop, and Hysat, a cobalt-iron alloy—and a range of Telcosel glass scaling alloys.

**NEW ADDRESSES**

Radio Heaters, Ltd., manufacturers of orthicon cameras, have moved to Eastheath Avenue, Wokingham, Berks. (Tel.: Wokingham 1050.)

Acoustic Products, Ltd., manufacturers of Lectrona speakers, have moved from North London to Stonefield, W.E., Victoria Road, South Ruislip, Middlesex. The equipment is being handled by Edstone, Ltd., who are now at 15, Buckingham Place Gardens, S.W.1. (Tel.: Soane 0621.)

**MEETINGS**


**BUSINESS NOTES**

Alloys made by the Telegraph Construction and Maintenance Co., and now available in Canada, are being exhibited by the Canadian International Trade Fair which is being held in Toronto during May and June. They will be exhibiting magnetic alloys—such as H.C.R., a high-permeability alloy with rectangular hysteresis loop, and Hysat, a cobalt-iron alloy—and a range of Telcosel glass scaling alloys.

**NEW ADDRESSES**

Radio Heaters, Ltd., manufacturers of orthicon cameras, have moved to Eastheath Avenue, Wokingham, Berks. (Tel.: Wokingham 1050.)

Acoustic Products, Ltd., manufacturers of Lectrona speakers, have moved from North London to Stonefield, W.E., Victoria Road, South Ruislip, Middlesex. The equipment is being handled by Edstone, Ltd., who are now at 15, Buckingham Place Gardens, S.W.1. (Tel.: Soane 0621.)

**MEETINGS**


**BUSINESS NOTES**

Alloys made by the Telegraph Construction and Maintenance Co., and now available in Canada, are being exhibited by the Canadian International Trade Fair which is being held in Toronto during May and June. They will be exhibiting magnetic alloys—such as H.C.R., a high-permeability alloy with rectangular hysteresis loop, and Hysat, a cobalt-iron alloy—and a range of Telcosel glass scaling alloys.
Selective RC Circuits at Low Frequencies

For some purposes selective amplifiers are very useful at low frequencies, and they are used in bridge measurements, distortion measuring gear, servo-mechanisms and so on.

At frequencies of 10 kc/s upwards selective circuits are usually resonant combinations of inductance and capacitance. It is usually assumed that all the losses in the circuit—which are detrimental to selectivity—lie in the resistance of the coil, and this is nearly true at low frequencies. The selectivity of a tuned circuit is determined, at low frequencies, by the Q factor of the coil which is

\[ Q = \frac{2\pi f L}{r} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1) \]

where

- \( f \) = frequency
- \( L \) = inductance
- \( C \) = capacitance
- \( r \) = resistance

or the ratio of reactance to resistance in the coil. From (1) it is seen that for a given coil of known inductance and resistance the Q factor becomes smaller as the frequency is reduced, so that if a coil has a Q of 20 at 1 kc/s it will have a Q of only one at 50 c/s. In order to obtain a reasonably high Q of 10 or more at 50 c/s the inductance has to be increased for the same resistance, or the resistance has to be reduced for the same inductance. Either way this leads to a larger coil of thicker wire, and at frequencies of 0.1 to 1 c/s the design of a suitable coil becomes quite out of the question and other methods have to be adopted.

Effort has therefore been devoted at various times to the design of selective circuits (in particular, selective amplifiers) using only resistive and capacitive components. Such circuits are not only useful at very low frequencies outside the range of inductances, but also at audio frequencies up to 5 or 10 kc/s because of the weight and space saved by their use. Such selective amplifiers fall into two main classes, one of which uses a bridge network—or a network derived from a bridge—and it is the class of circuit the derivation of which will be considered in some detail here.

All these RC bridge selective amplifiers depend on the use of a frequency-sensitive bridge in the feedback network of a negative feedback amplifier. The overall amplification, A, of a negative feedback amplifier, in terms of the amplification, \( A_0 \), without feedback, is given by

\[ A = \frac{A_0}{1 - \beta A_0} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2) \]

or, if there is a phase reversal in the amplifier we may write this

\[ A = \frac{A_0}{1 + \beta A_0} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2) \]

If we can find an RC network to determine the feedback factor \( \beta \), such that \( \beta = 0 \) at one frequency only, there will be no feedback at that frequency and so the full amplification will be obtained. If at all frequencies, other than this one, there is some feedback the amplification will be reduced, so that a form of resonance will be obtained in the amplifier. It turns out that—as has already been suggested—the required RC feedback network can take the form of a bridge, so that perhaps a short digression on bridges will not be out of place.

Fig. 1 represents a perfectly general bridge network composed of four impedances \( Z_1, Z_2, Z_3, \) and \( Z_4 \). A supply voltage \( V_o \) is applied, and when the bridge is balanced the p.d. \( V_o \) across the detector terminals is zero. The condition for balance can be found by considering the bridge to be made up of two potential dividers across \( V_o \), each composed of two impedances. By this means the potential across \( Z_3 \) is found to be \( V_3 = V_o Z_3/(Z_1 + Z_3) = V_0/(1 + Z_1 Z_3) \), and similarly that across \( Z_4 \) is \( V_4 = V_o/(1 + Z_4 Z_4) \). Now at balance \( V_3 = V_4 \), so that

\[ \frac{Z_1}{Z_2} = \frac{Z_3}{Z_4} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3) \]

If each impedance consists of a resistor the network becomes the well-known Wheatstone bridge. In an a.c. bridge at least two of the impedances must contain reactive components otherwise a balance cannot be obtained. These reactances may be capacitive or inductive, but here we are concerned only with the former. The capacitances are sometimes arranged in the bridge so that the balance is independent of frequency, but such arrangements will not serve the present purpose.

It has been found that the Wien1 bridge of Fig. 2 is quite suitable for the purpose, because a balance can only be obtained at one frequency. This is the case because capacitance enters two arms (\( Z_3 \) and \( Z_4 \)) in different ways, being of a series combination in \( Z_3 \), and a parallel combination in \( Z_4 \). The frequency of balance is that at which the phase shift in \( Z_3 \) is

---


---

Wireless World, June 1950

Fig. 1. General bridge network.

Fig. 2. (Right) Wien bridge.
equal and opposite to that in \( Z_4 \), so that at the balance frequency \( Z_3 \) and \( Z_4 \) behave as a resistive potential divider. This balance frequency is given by

\[
f_b = \frac{1}{2\pi RC}
\]

when \( V_D = 0 \), provided the circuit proportions of Fig. 2 are maintained.

Now consider the combination of amplifier and bridge to form a selective amplifier as shown in Fig. 3. The output voltage, \( V_o \), of the amplifier is here applied to the Wien bridge and the p.d. obtained across the bridge detector terminals is fed back to the input of the amplifier. The general operation can be seen in a qualitative way by considering what happens at a very low frequency, and a very high frequency compared with that at balance.

At the balance frequency there is no feedback and the full amplification, \( A_o \), is obtained. At some very low frequency the bridge reactances become very large and approximate to an open circuit. Under these conditions \( Z_3 \) is effectively an open circuit, so that no potential appears across \( Z_4 \). It follows that \( V_D \)—the fed-back signal—must be half the output voltage, \( V_o \), as it is divided in this ratio by the resistive \( Z_3 \) and \( Z_4 \) arms. Under these conditions, if \( A_o \) is very large the overall net amplification will approximate to 2. At some very high frequency the capacitive reactances will become very small, and approximate to a short-circuit, so that again there will be no potential across \( Z_4 \), and the fed-back signal will again be \( V_D/2 \), leading to a net amplification of 2 if \( A_o \) is large. If, in fact, \( A_o = 50 \) (a reasonable value) than at resonance \( A_o = 50 \). Very far from resonance the amplification (by \( 2 \)) will be \( 50/(1 + 25) = 1.92 \). Therefore the discrimination between wanted and unwanted frequencies can never be better than 26:1 or 26.3 db. If we had started with \( A_o = 100 \) we should have obtained a maximum discrimination of 51.1 or 35.2 db, and so on.

Effectively we have now deduced the amplification at three points on the resonance curve. To find further points it is necessary to calculate the ratio \( V_D/V_A(=\beta) \) for all frequencies and, taking account of the phase shifts introduced at different frequencies, calculate the net amplification obtained. A different curve will be obtained for each new value of initial amplification \( A_o \), and curves for various values of \( A_o \) have been computed and are shown in Fig. 7. It will be seen that these curves bear a strong resemblance to the resonance curve of a tuned LC circuit. It is possible, by analogy, to find an expression which gives—roughly—the equivalent \( Q \) of an amplifier with Wien bridge feedback, and this is useful in doubtfull cases as it gives a quick means of comparison with coils that may be available for the same resonant frequency. It turns out that the equivalent \( Q \) of a Wien bridge feedback amplifier is

\[
Q_w = \frac{A_o + 1}{4} \quad \cdots \quad \cdots \quad \cdots \quad (5)
\]

with an error not exceeding 1 per cent, provided \( A_o \) is 25 or more.

Before the Wien bridge can be used as the feedback path in a practical amplifier, one difficulty—perhaps not very obvious—has yet to be overcome. All amplifiers have at least two input and two output terminals, but usually one in each pair is common, so that there are effectively only three terminals—one of which is usually "earthy." As the bridge has four terminals, such amplifiers will not be of any use. The difficulty could be avoided by coupling the bridge to the amplifier with a transformer, but apart from the phase shift troubles this is likely to introduce, a coupling transformer to work (say) at 1 c/s is just as difficult to make as the original coil we abandoned in favour of the RC circuit.

There is, however, a class of amplifier which can be pressed into service here, of which the cathode-coupled phase-splitter is an example. In such amplifiers a push-pull output is obtained when an input is applied to either of two pairs of input terminals. As the resistive arms of the bridge are equal, they may be used as the anode loads of the phase-splitter, and the detector terminals of the

---

bridge may be connected to one pair of input terminals as shown in Fig. 4.

The circuit of Fig. 4 is fundamentally a cathode-coupled phase-splitter with equal anode loads. An accurate push-pull output for an input to one grid is obtained only when Rf is very large, and consequently the grids are returned to a positive source of supply as shown, so that Rf can be made large. In further discussion of this circuit it will be assumed that the anode signal voltages are equal and opposite in phase, as this simplifying assumption leads to theoretical results only slightly at variance with practice. The time constant CgRf is long enough to ensure that even at 1/10th of the resonant frequency there is negligible loss in this coupling: Rf must be large compared with R so that the grid circuit of V3 imposes negligible loading on the reactive arms of the bridge.

At the balance frequency VD is zero, so that the input to V3 is zero and the circuit behaves as a cathode-coupled splitter as if the bridge were not present. At frequencies very low or very high compared with the balance frequency, voltage negative feedback is applied from anode to grid of V3 in the manner already described, and at extreme frequencies all the anode signal of V3 is fed back directly to its grid provided the reactance of Cg is very low, and that Rf is very large compared with R. At high frequencies the resistance (R/2) in Zb is effectively connected between the two anodes (the capacitors being a virtual short-circuit) so that r should be small compared with R/4 to preserve the amplification at high frequencies. The input is applied to the grid of V1 and the output taken from the anode of V2, as shown.

The amplification at resonance is approximately,

\[ A_v = \frac{\mu V}{2(r + r')} \]

where \( \mu \) is the amplification factor of V1 or V2, \( r = \) anode resistance of V1 or V2 from input to output, but for calculating the equivalent Q of the circuit, an amplification of twice this value must be taken. This is because the signal input, \( V_a \), to the bridge is twice the amplitude of the signal at either anode, owing to the push-pull output obtained from the two valves.

The circuit of Fig. 4 behaves well in practice, but it suffers from one snag. If, due to variations in the bridge network components, the conditions for balance call for a larger output from V3 than from V1, then instability can take place in extreme cases. Nevertheless, experience indicates that if the bridge components are built to a tolerance of 1 per cent, or, better, adjusted on test, no trouble need be expected with any of the double-triode currently available. This difficulty can be overcome in another way, however, by the use of another RC circuit which also has other advantages. This is called the parallel-T circuit and is now in widespread use.

The parallel-T circuit is shown in Fig. 5 and is particularly advantageous because it is essentially a three-terminal network, one input and one output terminal being common. It is derived from the Wien bridge and the equations describing its behaviour are identical in form to those for a Wien bridge, with one merely numerical difference. It will be remembered that in considering the output at the detector terminals of the Wien bridge at high and low fre-

---


---

**Fig. 6.** Selective amplifier using a parallel-T. Typical values \( f_s = 50c/s; V_1, V_2 = ECC 33; r = 47k\Omega; R_2 = 12k\Omega; R_1 = 330k\Omega; C_g = 0.25 \mu F; R_g = 68k\Omega; C_r = 20 \mu F; R = 1M\Omega; C = 3180pF; H.T. = 300V. For selectivity see curve in Fig. 7 labelled \( A_0 = 10.\)

**Fig. 7.** Selectivity and phase shift curves for amplifiers with parallel-T feedback circuit. Equivalent Wien bridge amplifier values included for reference.
frequencies it was found that \( V_p \) could never exceed \( V_a/2 \). In the parallel-T this is not so, and a little consideration will lead to the conclusion that at frequencies very remote from the balance frequency \( V_p \) approaches \( V_a \). The balance frequency for the parallel-T is, as for the Wien bridge

\[
I_0 = \frac{1}{2\pi RC}
\]

and the network may be used in the feedback path of a cathode-coupled phase splitter as shown in Fig. 6.

The performance of the amplifier of Fig. 6 is the same as that of Fig. 4; this can be seen by the following chain of reasoning. In the case of Fig. 6 \( V_D \) is equal to \( V_a \) at frequencies remote from the balance frequency, so that the feedback factor here is twice that in Fig. 4. On the other hand the overall amplification to the Wien bridge of Fig. 4 is twice that to the parallel-T in Fig. 6. These effects conveniently cancel so that the same result is obtained in each case. The possible instability in Fig. 4 is avoided in Fig. 6, however, so this must be regarded as the preferable circuit. The permissible tolerances on the components of the parallel-T are, as might have been expected, no wider than on the Wien bridge.

The selectivity obtained from the amplifier of Fig. 6 depends, like the previous circuit, on the initial amplification obtainable. It can be shown that the equivalent \( Q \) of an amplifier with a parallel-T is given by:

\[
Q_e = \frac{A_0 + i}{4} \quad \text{approximately}
\]

Selectivity curves for amplifiers with amplifications between 10 and 100 are shown in Fig. 7 from which results to be expected may be estimated. The transmission and phase shift curves of the parallel-T alone are also shown, from which it can be seen that the network may be used as a coupling between amplifier stages to suppress a given frequency.

In these rather brief notes it has only been possible to describe the general operation of RC selective amplifiers and numerous detailed circuits have been described at various times. One of the most interesting makes use of the 'cascade' circuit and is especially convenient when it is desired to cascade several selective amplifiers to obtain greater selectivity (as in r.f. practice), or to arrange a number of stagger-tuned amplifiers to yield a band pass characteristic.

Tuned amplifiers along the foregoing lines have been used for many purposes, some of which have been mentioned. Probably readers new to these circuits will see further applications of their use. Networks other than the Wien bridge and parallel-T have been described, and some of these may be especially useful when it is required that the resonant frequency of the amplifier be variable.

**HIGH-POWER TRANSMITTING VALVE**

What is believed to be the world's most powerful transmitting valve, a 'super-power beam triode' capable of 500 kilowatts continuous output, has been announced by R.C.A. This is the type 5831, a compact valve for its high power, standing 38 in high and weighing 135 pounds. It is intended primarily for use as a class C r.f. power amplifier, but is also useful as a class B a.f. power amplifier and modulator. For unmodulated class C working, it has a maximum anode voltage of 16 kV, a maximum anode consumption of 650 kW and a maximum anode dissipation of 150 kW. Because of electron-optical principles embodied in the design, it draws low grid current and only requires about 900 watts drive to produce an output of 500 kW on class C working.

The principle of construction has been to divide the valve into 48 independent electron systems, arranged cylindrically so that, in effect, there are 48 parallel triodes concentrated within a small space. Each electron system consists of a thoriated tungsten filament in a slot in the common beam-forming cylinder, tungsten grid rods, and the common anode. Even though the grid may be positive, a few electrons reach it because of the focusing effect of the beam-forming cylinder. An internal water-cooling system is provided for the beam-forming cylinder and the anode.


**Wireless World, June 1950**
Amplifiers for Cardiography

Simplified Input Circuit for Balancing Out Interference

As pointed out by Dr. Parnum in his review of biological amplifiers (Wireless World, Nov. 1945), the input circuit is perhaps the most important feature of such amplifiers, and the two chief difficulties concern the elimination of interference pick-up and the elimination of interaction between amplifiers connected to the same patient.

The solution of these difficulties has resulted in the development of special balanced amplifiers which effectively discriminate against interference, and admit of connection to more than two electrodes on the same subject.

In the present article a balanced input circuit is described which is particularly suitable for cardiography and has the merits of single-ended simplicity. The operation of the circuit will be better appreciated after a brief consideration of the electrical conditions involved in the patient circuit.

An electrocardiogram is obtained by attaching leads to certain agreed parts of the body and recording the potential changes between these leads as a result of the activity of the heart. A typical connection, for example, is to right arm and left leg. The potentials developed are of the order of 2 mV and take the form of triangular pulses repeated at the same rate as the heartbeat, together with certain smaller waves. The spectral composition is from about 0.1 c/s to 100 c/s, the intensity diminishing rapidly with frequency. A resistance of about 2,000Ω is measurable between the electrodes and this constitutes the internal resistance of the equivalent generator circuit, as far as cardiac potentials are concerned.

Patients are usually placed in a lying position upon a couch and may be regarded as earth-free. The disturbing effects of mains wiring and apparatus are almost wholly attributable to the action of electrostatic induction upon the subject, the interference potential assumed by a patient corresponding to his position in the disturbing field.

The intensity and configuration of such disturbing fields will vary widely according to the nature and distribution of wiring and apparatus. Measurements of the open circuit voltage induced in a subject within a laboratory, having plenty of the usual equipment operating (cathode-ray tube, generators, soldering-irons, fluorescent lighting, etc.) have shown values of about 500 mV. Fortunately, however, the equivalent generator impedance of the body—as far as interference is concerned—is that of a capacitor of about 500 pF to earth, so that the actual voltage appearing across a resistance load may be very much smaller.

Thus, for example, in Fig. 1 the voltage which appears across the resistor R is 
\[ E_r = \frac{E_g \cdot R}{\sqrt{R^2 + X_g^2}} \]

Taking \( R = 500 \, \text{pF} \), \( X_g = 1/2 \pi fC = 6.3 \, \text{M} \Omega \) at 50 c/s, if \( E_g = 0.5 \, \text{V} \) and \( R = 12 \, \text{k} \Omega \), then \( E_r = 0.001 \, \text{V} \), a reduction of 500 times as compared with the induced voltage pickup, and thus, of the same order as the cardiac potentials.

Equivalent Circuit

The simple equivalent circuit of the cardiac generator must now be modified to include the effects of the interference, and the situation may be represented as in Fig. 2. \( E_g \) is the cardiac potential it is desired to record, \( E_{g1} \) and \( E_{g2} \) are the open-circuit voltages due to interference pick-up, and \( C_1 \) and \( C_2 \) are the capacities to earth from the two electrodes on the body.

In general, \( E_{g1} \) and \( E_{g2} \) are closely equal and in phase, and likewise \( C_1 \) and \( C_2 \) are also equal, although under some conditions these equalities may not hold, particularly where the subject is very close to an interfering source. The phase equality, however, appears to be quite constant under all conditions, which is to be expected.

Now consider the patient circuit connected to the amplifier input circuit of Fig. 3. A potentiometer of 10 kΩ is connected between grid and cathode, and the slider is taken to earth (i.e. actual earth). It will be evident that by moving the slider a position will be found where the interference voltages across the two portions of the potentiometer can be made exactly equal. Also, since \( R \ll X_g \), the phases will be practically equal and the two voltages will balance,
so that only the cardiac voltage appears across the potentiometer. For example, in the diagram of Fig. 4 the phase angles of the voltages $E_{r1}$ and $E_{r2}$ are given by

$$\beta_1 = 90 - \tan^{-1} \frac{R_1}{X_0}$$

and

$$\beta_2 = 90 - \tan^{-1} \frac{R_2}{X_0}$$

Suppose that for voltage equality the values of $R_1$ and $R_2$ are 6 k$\Omega$ and 4 k$\Omega$ respectively, and that $C_1 = C_2 = 250$ pF, then at 50 c/s $X_0 = 12.7$ M$\Omega$ and the phase angles become $\beta_1 = 89.97^\circ$ and $\beta_2 = 89.96^\circ$. The difference is therefore quite negligible. This result is due, of course, to the fact that $R \ll X_0$, so that the phase angles of the voltage across the resistors is always very close to 90° and any difference between the two will be the difference between two angles (90 - $a$) and (90 - $b$) where $a$ and $b$ are both extremely small. Hence quite considerable variations in the values for $E_{r1}$, $E_{r2}$, $C_1$, and $C_2$ will produce no important difference between the phases of the two voltages. This holds good even for the harmonics of the 50 c/s mains.

By using a potentiometer of 10 k$\Omega$ the actual interference voltages developed across each section are quite small, while a load of 10 k$\Omega$ is presented to the cardiac generator, permitting 5/6 of the cardiac signal to appear at the amplifier input. This is quite a favourable condition (the Eindhoven galvanometer string presents some 3 or 4 k$\Omega$ only) and any polarizing effects due to the load current are quite small.

In practice the whole of the amplifier may be built on an insulated sub-chassis which constitutes the h.t. negative line, and this is enclosed in a metal case directly earthed, with the slider of the input potentiometer connected to this outer case. The output must not be directly earthed in order to prevent the flow of feedback currents through the lower portion of the potentiometer. A mirror galvanometer forms a most suitable indicating device, balance for d.c. being provided in any conventional manner. An interference balance indicator is a most useful adjunct and permits fine adjustment of the input circuit. This may be very simply a leaky-grid detector with anode current meter, coupled to one of the later stages, where any interference unbalance would be amplified.

Fig. 5 shows the situation which arises when several amplifiers using this input circuit are connected to the same subject. Three electrodes are shown, providing three simultaneous records. Obviously the three inputs cannot be separately balanced since the movement of any one slider will upset the inputs of the other two amplifiers. This, however, is easily remedied by the insertion of swamping resistors of about 100 k$\Omega$ in each of the three separate earth leads, so that the movement of any one slider produces a quite negligible change in the condition of the other two input circuits, and all three may now be independently balanced. The insertion of the swamping resistor produces no change in the absolute values of the interference voltages in the potentiometers, since the resistor is still very small compared with $X_0$, and is in the neutral lead.

The writer has not used the circuit described in a mains-operated amplifier, but there seems to be no serious reason why it should not be applicable, provided that certain precautions are taken; for example, the mains transformer should be fitted with an electrostatic screen to eliminate unwanted capacity coupling from mains to power supply.

As stated above, the circuit is particularly useful for cardiographic work, and it is possible that workers in the field of encephalography may find that it has possibilities of development to suit the special requirements of their own field, too.

### Published Report

**Measuring Radio-frequency Voltages**

An up-to-date presentation of fundamental principles and techniques used in radio-frequency voltage measurement is given in a booklet recently published by the U.S. National Bureau of Standards.

The subject matter has been selected to give professional workers and students a more comprehensive picture of those measurement methods than is generally available in current text-books. It is, however, limited to techniques that have proved successful in practice, with emphasis on those developed for standardization work at the National Bureau of Standards. High-precision methods based on d.c. measurements are dealt with first, then moderate-precision methods involving thermionic and other rectifiers, and finally pulse-peak voltage measurements and miscellaneous methods. The frequencies concerned range from the i.f. band to part of the e.h.f. band.


Wireless World, June 1950
Trends in Components
Review of the R.E.C.M.F. Exhibition

The annual private exhibition of components and accessories, organized by the Radio and Electronic Component Manufacturers' Federation was held in London from 17th—19th April. Our survey of exhibits in each category is followed by a list of makers. A general list of exhibitors, with addresses, is given at the end of this review.

CAPACITORS

Variables.—In order to meet the extended medium-wave coverage now needed under the Copenhagen Plan for broadcasting either a larger tuning capacitor must be used or the stray capacitance in circuit must be reduced. Catering for the first alternative, Plessey have increased the capacitance swing in some of their gang condenser assemblies to 580 pF; this has been achieved with practically no change in minimum capacitance or increase in overall dimensions. The extra capacitance is obtained by employing slightly thicker vanes for the rotor sections. Actual vane spacing, centre-to-centre, is unchanged, but the dielectric spacing is reduced and the rigidity is improved so that no more risk of microphony is entailed.

Concurrent with this change, Plessey have bonded the tips of the rotor vanes in the short-wave sections of the bandspread models to the main rotor vanes as a means of combating microphony on short waves.

Elsewhere, few changes were seen in the design of variable capacitors; Cylcon still cater for the instrument designer with a comprehensive range of high-precision variables, while Polar had, among other models, a wide selection of v.h.f. tuning and miniature air trimming capacitors. One minor change introduced by this firm is the inclusion of a locking device on one of their miniature models. This effectively locks the capacitor without the slightest change in its adjustment. The model, which measures just over \( \frac{1}{2} \) in \( \times \) \( \frac{1}{2} \) in over the ceramic base, is available in sizes of 2-20 pF and 3-30 pF.

Fixed.—In addition to minor improvements, T.C.C. have introduced three new types of ceramic capacitor, two being fully insulated and the third a metal-cased miniature. For one type the insulating coating is applied by dipping in a special hard-drying compound, while in the other the capacitor is enclosed in a glass tube with Neoprene end-seals. Since the outer case is glass, the use of synthetic rubber end-seals does not degrade the power factor of the ceramic element. A silver-plated copper sheath is used for the screened variety, and one end is swaged over and soldered to the lead-out wire connected to the outer silvering on the ceramic body. At the opposite end the "live" connection passes through a PTFE seal. This super-tropical model is an improved version of the existing "Metalicon."

Hunt has now largely eliminated cardboard tubes for paper capacitors and the latest models of this type are encased in a hard wax moulding which will also pass tropical tests. Most of the standard sizes are now available in this form, which is known as "Moldseal." Overall size is practically unchanged; indeed, in some cases the capacitor is smaller than hitherto.

The annual private exhibition of components and accessories, organized by the Radio and Electronic Component Manufacturers' Federation was held in London from 17th—19th April. Our survey of exhibits in each category is followed by a list of makers. A general list of exhibitors, with addresses, is given at the end of this review.

Group of Hunt's latest moulded cased tubular capacitors. They are suitable for use under tropical conditions.

For example, a 0.01-pF, 350-V working tubular measures \( \frac{1}{8} \) in \( \times \) \( \frac{1}{8} \) in long, while an 0.01-pF size in the W10 range, also 350-V working, is \( \frac{1}{8} \) in dia and \( \frac{1}{8} \) in long. The new models are also non-inductive.

Silvered-mica capacitors in un-
usually high values were shown by Lab. M.: the plates of 1,000 pF each, capacitances up to 0.5 µF have been produced but as the reliability of the component will be governed by the weakest plate in the stack, the larger capacitors in the series are rated at 200 V instead of 350 V working.

Many varieties of tropical capacitors were seen at the exhibition, but particular interest centres round a new range shown by S.T.C. Designed especially for very high working temperatures—100°C is the figure—these are assembled in drawn metal containers having a single seam only. The case is in two halves fitting snugly together and the edge of the outer is swaged over before soldering. The coil is assembled in a groove and contraction, and so the soldered joint is subjected to practically no strain. Oil-impregnated paper foil capacitors were employed and normal values range from 0.5 µF to 8 µF and for working voltages up to 5 kV.

Some additions have been made to the varieties of electrolytic capacitors available, but few new developments could be traced. B.E.C. had some large dual-capacitance models in various combinations, one, for example, being 100+ 200 µF. These will handle quite large ripple currents, and values up to 0.5 µF are permissible in some cases. Hunt showed a range of large capacitance dual models, this style being intended for use in the transformerless type of television receivers using half-wave mains rectification, but they have other applications as well.

Makers: B.E.C. (E.E.); B.I. Callenders (E.I.); Indulgen (T.); Cylcon (T.); Daly (E.); Dutilleux (C. E. M. P. T.); Rive (C. T.); Ferrari (E. P.); Hunt (C. E. M. P. T.); L.F.M. (C.); Mullard (T.); N.S.F. (P.); Polar (T.); Plessey (T.); S.R.C. (M.); S.T.C. (T.); Siemen (M. P. T.); Wander Instruments (C.); M.U.C. (D.); Plessey (T.).

Applications: C: ceramic; K: electrolytic; M: mica; P: paper; T: triangular and pre-set; V: air dielectric varieties.

COILS AND TRANSFORMERS

Radio Frequency.—Examples of both self-coil dust-iron core r.f. tuning coils and i.f. transformers were exhibited by Advance, while Plessey showed a wide range fitted with Caslite cores. These included television types, the i.f. transformers of which are designed for operation at 13.5 Mc/s and are screened. They are intended for use in sets designed either for London or Birmingham. The oscillator coil is self-supporting and wound with silver-plated wire; by changing the dust-iron core for one of different characteristics, the coil can be used for London or Birmingham frequencies.

Highly stable inductors for v.h.f. were exhibited by Steatite; they comprise a coil "made by a silver deposition in a groove in a steatite former. Makers: Advance, Avo, Igraine, Plessey, Steatite, Varity.

Mains and A.F.—Transformer design has not changed much in recent years, so the ordinary types are concerned, but for special purposes great improvements have been made. The Ministry of Supply showed models designed for operation at a temperature of 150°C which are about 60 per cent lighter than equivalent normal types. The core is of Hypersil Cut-C, and glass and silicone insulation is used. Parmeko showed a range of hemi-technically sealed transformers and choke the Neptune series also using a C-core wound from a continuous strip of grain-oriented high-permeability steel. A reduction by 50 per cent of the external field is claimed. Ratings of 5 VA to 2 kVA are made.

Partridge exhibited push-pull audio transformers as well as mains types. There are three PPO types rated for 12 V at 0.5 per cent distortion at 50 c/s, and there are the WWFB models intended particularly for the Williamson amplifier.

Potted mains transformers and smoothing chokes, including swinging chokes, were shown by Woden; and Ferranti exhibited a range of miniature hermetically-sealed types.


RESISTORS

Variable.—The greater variety of pre-set variable resistors attracted attention this year and most of them have been designed for use in television sets. They generally take the form of a strip-wound element with a simple sliding contact. This style of construction enables several units to be accommodated side-by-side in a small space and they form convenient banks of pre-set controls.

Some examples of the sliding contact wire-wound variety were shown by Colvern, while Egen favours a sliding contact actuated by a rotary control at one end. The control knob is knurled and slotted for either finger or screw-driver adjustment. These components take up very little panel space and the normal values extend from 1 kΩ to 40 kΩ.

Pre-set resistors with sliding contacts and fitted with carbon elements were seen among the Welwyn exhibits. In this form much higher values are possible, the normal types range from 25 kΩ to 1 MΩ. They are made in single and multiple assemblies.

Of interest to designers of precision apparatus were the newest types of cam-corrected wire-wound potentiometers made by Colvern. Much smaller models are now available, but the high accuracy and number of correcting points of the larger sizes are retained by fitting smaller correcting screws (6BA in place of 6BA). One of the new type measures 24 in diameter and 1 in deep. The moving contact has continuous rotation although the resistance element occupies 300° only. It can be centre-tapped if needed and values up to 500 kΩ are available. A linear accuracy of better than ±0.1 per cent is attainable.

Another Colvern development is a wire-wound potentiometer fitted with a helical resistance element. Its external diameter is 14 in and its depth 21 in. The helix has 10 turns and the moving contact makes 10 revolutions, giving an effective travel of 3,600°. Resistance values extend to 100 kΩ and the linear accuracy is of the order of ±0.1 per cent.

Another unusual potentiometer was a widge carbon-track type, designed for hearing-aid and small personal portables, shown by Morganite. Known as type DA, it can be had with or without a switch (10 V at 0.25 A) and is available in values up to 3 MΩ which are available in values up to 3 MΩ (0.1 V dissipation). The overall size is 29/32 in diameter and 9/32 in deep, the projecting contacts adding another 1/8 in. Knobs of the full diameter, or larger, can be fitted and various colours are available.
A number of new miniature potentiometers of orthodox design were seen on Morgantie's stand and elsewhere; for example, N.S.F. had one of only 15/16 in dia. The Plewsy pattern is 15 in. fitted with a moulded track of high stability and durability. Dubilier showed a range of small hermetically-sealed tropical volume controls known as type "Q" rated at 0.5 W. Berco a wire-wound 5-W sealed type and Erie a tropical carbon-track model rated at 0.5 W and made in values up to 3 MΩ.

Sealing of the case of these miniatures is relatively simple, but various ingenious devices are employed to obtain a perfect seal in the spindle housing. In most cases annular grooves cut in the spindle are fitted with Neoprene washers, which, being under compression, effectively bar ingress of moisture. Berco use two such seals in cascade, with a uniting ring between, while Erie have three Neoprene seals in tandem.

Fixed.—Vitreous enamelling of wire-wound resistors continues to find further adherents. A new range was shown by Painton, including types of 4-W and 5-W rating which were actually smaller in size than an average 4-W carbon type. AnotherInvariant in this field was Electronic Components whose range of "Elcohm" miniature vitreous resistors exhibit a number of interesting features, such as a secure junction of lead-out and resistance wires and satisfactory operation up to 300°C.

Hitherto specialists in wire-wound resistors of all kinds, Painton this year have turned their attention to the production of high-stability resistors using the cracked carbon technique and a ceramic base. They are fully insulated and range in size from 1 W to 2 W and from 10Ω to 18 MΩ, but the highest values are limited to the higher ratings. They can be supplied with tolerances of from 1 to 5 per cent. Protection is given by a multiple coating of a hard-drying heat-resisting varnish.

The Welwyn range of high-stability resistors has been extended to include a variant of the more orthodox design with wire ends. Their special c.h.t. types are retained for use as attenuators in waveguides. The new types are made in 1-4- and 1-W sizes and with resistance ranging from 10Ω to 2.5 MΩ.

Makers: Advance (A); Belling & Lee (S); Berco (P, V, W); Bulgin (P, W); Colvern (P, W); Dubilier (C, H, N, S, W); Egen (P, W); Electronic Components (A, V, W); Erie (C, P, S, W); Ignatie (W); Morgantie (C, P, S); Mullard (BB, NC); N.A.F.U. (P); Painton (A, H, NC, P, W, V); Pleassey (P); S.T.C. (A, NC); Taylor Electrical (W, P); Varley (W); Welwyn (BB, V, W).

Abbreviations. A, attenuators; C, composition; H, high stability; N, negative coefficient; P, potentiometers; S, suppressor; V, vitreous; W, wire-wound fixed and preset.

VALVES

The trend towards miniaturization continues, with emphasis on B7G and B6A bases. Mullard showed a number of 1-4- and miniature designs on B7G bases and had two valves of particular interest in their B6A range, a high-slope r.f. pentode EF80 and a triode-pentode ECL80. Also on view were two flat miniatures for use in lightweight hearing-aid, an amplifier pentode DP66 and an output pentode DL66. G.E.C. had complete ranges of B7G Osram valves for r.f. battery operation, a.c. operation and d.c./a.c. operation; whilst their range of miniatures for television included a new line-scan pentode KT36 and an e.h.t. rectifier U37. Another firm concerned with television valves was Ediswan, who showed a twin-triode time-base valve 20L1 with series-run heaters (6L1 being the version with a 6.3-V heater), a rectifier U25 suitable for e.h.t., and a time-base amplifier 20P.

Cathode-ray tubes were exhibited by the above firms and by Ferranti and Brimar. The last-mentioned, as well as producing an electron-tube version, has entered a new field with a 2½-in projection tube for use with the Schmidt optical system. It requires an anode voltage of 20 kV and has a beam current of 1 mA. Mullard also showed their 2½-in projection tube MWG-2.

Miniaturization was the rule in quartz crystals of the plug-in type shown by S.T.C. and Salford. One of the latest S.T.C. types measures 4 in × 57/64 in × 31/32 in and can be supplied for a range of temperatures between 20 and 20°C fundamental or 20 and 60°C on overtones. A new miniature crystal shown by Salford can be supplied for 1, 4, 10, and 14 MΩ/s and has an accuracy of 0.01 per cent. The latter firm also demonstrated an interesting 100-c/s crystal, which was built up with a two-valve battery oscillator into a portable unit to act as a replacement for a tuning-fork. The crystal itself was constructed of overlapping plates of quartz in three sections, and had an accuracy of about 20 parts in a million.

Makers: Brimar, Ferranti, Mitsubishi, R.E.C., Mullard Electronic Products, Salford Electrical Instruments.

METAL RECTIFIERS

The copper-oxide type of metal rectifier now finds its main application as an instrument rectifier and the selenium pattern is more common in power applications. The trend towards a.c./d.c. operation in television sets, in particular, has caused a demand for a heavy-duty rectifier capable of withstanding very large peak currents. Standard Telephones showed types capable of an output of 290 V at 250 mA for an input of 250 V, 625 mA, with a 60-μF reservoir capacitor. The peak current is unlimited and operation can be at an air temperature of 40°C.

Similar types are also made by Westhinghouse who, in addition to the well-known 36 series of e.h.t. rectifiers, now have a range designed for operation as "damping diodes" in economy line-scanning circuits. This is the 14D series and includes units of up to 4.47 kV peak-inverse rating with mean-current ratings of 50-100 mA; higher current patterns can be supplied, but as cooling fans are needed they become physically larger. This firm also features the use of metal rectifiers for spark suppression in switch contacts, and claims that they enable this to be done while retaining fast operation.

Makers: Salford, S.T.C., Westhinghouse.
TELEVISION COMPONENTS

EXCEPT for a yoke-type frame for self-oscillating current generator which was shown by Plessey, the deflector coils on view were of the bent-up-end type. The Plessey models have an external motor driving, but Igranic uses a stack of laminations. There is a tendency, however, to adopt special materials, and a one-piece slotted-ringed made of Ferroxcube was shown by Mullard, in particular interest for the production of coils combining high efficiency and high Q.

The same material was also shown in shapes suited to line-scans coupling transformers. The Plessey transformers employ "Caslam" cores. This material not only gives a high Q but is claimed to give a great reduction of acoustic noise. Salford showed dust-iron, three-piece cores for transformers. The advantage of these special materials lies mainly in improved circuit efficiency when using the so-called economy circuits—in particular, the ones providing h.t. boost.

Focus coils of conventional types, covered in the Igranic and Plessey stands, but development in focusing methods lies chiefly in permanent-magnet types. The Plessey unit has a front plate which can be replaced by three screws for picture centring, the unit as a whole sliding along the tube neck for focusing. The Elac model is similarly arranged as far as centring is concerned, but the focus is adjustable by varying the air gaps by the same three screws. Elac also showed an exceedingly compact focus unit for projection tubes, and centring magnets for use with c.r. tubes having ion traps.

Rubber masks for tubes were exhibited by Long and Hambly and thermoplastic materials by Igranic Plastics. These have a transparent front which replaces the usual safety glass.


SWITCHES AND RELAYS

No startling changes were to be seen in the design of switches this year, Bulgin showed a new micro-switch capable of breaking to A peak, and A.B. Metal Products had what is claimed to be the smallest rotary switch in the world, but manufacturers, on the whole, kept to their standard types. There were, however, two switch-driving mechanisms of considerable interest. One of them, shown by N.S.F. and described as a rotary relay, works on the principle that a lateral movement produced by an electromagnet is converted into a powerful rotary movement suitable for driving a bank of rotary switches. The other mechanism, by Salford, was a fully sealed stepping motor arranged to drive, in steps of 30 deg., a bank of six ceramic wafer switches. It requires an average input power of 1.6 watts and weighs 10 oz., whilst the rate of stepping is 12 impulses per second.

Several types of Carpenter polarized relay were shown by T.M.C., and one of the latest, for use in proximity to a radio receiver, incorporates an anti-interference filter. The frequencies suppressed are in the range 5-150 Mc/s, and the filter is physically small enough to fit inside the standard cover of any of the existing Type 3 relays.


CHASSIS FITTINGS

MOST of the new valveholders this year were for B/G and B/A valve types, as expected. Of particular interest was a non-microphonic B/G valveholder effective up to 500 c/s, shown by McMurdo. The valveholder proper is held in a flexible PVC moulding, which is fitted with metal eyelets to take the fixing bolts so that the PVC cannot be squashed when the assembly is bolted to a chassis. Another feature is that the spacing of the fixing holes has been made the same as for B/A and B9A valveholders, thereby simplifying chassis drilling and interchanging of valveholder can be supplied with or without screening. A B9A valveholder shown by Cinch has a new type of contact giving improved grip on the valve base.

Possibly with an eye to the high voltages used in television, two anti-corona devices have made their appearance: an anti-corona tag by Claxton and a clip by Cinch, the object in both cases being to make a connection with no sharp edges. Amongst various fittings shown by Long & Lee was a polythene-bushed terminal with the extremely high leakage resistance of 20 million megohms. New items on the Bulgin stand included a bayonet neon holder, a signal flasher and a fuseholder that unscrews like a fountain-pen and can be conveniently inserted in a conductor without being chassis mounted. A multi-way socket holder for printed circuits on glass plates was shown by Plessey, together with an unbreakable two-pin plug and socket and a high-voltage six-point plug and socket suitable for anything up to 16 kV.

Considerable interest was aroused by two new techniques in the housing of vacuum tubes, one electrically operated, demonstrated by Widney. One of them was the use of telescopic mountings to enable chassis to be slid out of their cabinets in the same way as drawers are slid out of filing-cabinet, a smooth action being ensured by the use of steel ball-bearings throughout. The other technique was that of the prefabricated cabinet. A variety of formed sections, corner ducastings and connecting brackets are available, rather on the "Meccano" principle, so that engineers and home constructors can, with the minimum of tools, assemble their own cabinets in whatever shape or form they please.


AERIALS

Two outstanding features of the television aerials on view this year were greater mechanical strength and improved directionality for fringe-area reception. Most of the aerials on view were designed to stand up to 80-100 m.p.h. gales, and had alternative methods of fixing, usually either wall-brackets or chimney lashings.

An unusual aerial configuration in the shape of a cross was exhibited by AntiFerence, two directors acting as a director and the other two as a dipole. Compared with an ordinary "H"-type dipole and reflector, this "X" arrangement possesses greater mechanical strength and gives an increase in forward gain of 2 db. It has an input impedance of 70-80Ω, forward gain of 5 db, front-to-back ratio of 22 db, and weighs, without its mounting, 13 lb.

An advantage in construction is that the four aluminium-alloy rods can be screwed into the central bakelite insulator after the aerial has been assembled, thereby connecting the director to the lower element of the dipole, a depression is made in the base of the vertical polar diagram, thereby increasing the amount of interference received from immediately below.

Another aerial for fringe areas was the "Multirod" by Belling & Lee. This has four elements in all—two directors, a dipole and a reflector—giving a forward gain of 8 db on a simple dipole and a front-to-back ratio of 24 db. A demonstration television aerial was also shown, in which a bracket supporting the pole could be clamped to an upstairs window whilst the bottom of the pole rested on the ground. A.B. Metal Products exhibited, amongst other television aerials, a fringe-area array consisting of a folded dipole and three reflector elements arranged to give parabolic focusing.

Makers: A.B. Metal Products, AntiFerence, Belling & Lee.

VIBRATORS

I was noticeable this year that the makers of vibrators were aiming at higher power ratings than have

WIRELESS WORLD, JUNE 1950
been achieved in the past. One outstanding example was the heavy-duty model shown by Wimbledon. This was a non-synchronous type, intended to operate from 220-V a.c. mains and having a power rating of 440 W. It has a double-pole double-throw action and heavy tungsten contacts. To prevent frequency drift as a result of heat, the vibrating parts are arranged to have compensating expansions and contractions, and the frequency stability claimed is 50±1 c/s. Plessey showed another heavy-duty non-synchronous vibrator which can be supplied for 6-V, 12-V and 24-V working and power ratings up to 60 W; with an output power of 15 W, its life would be in excess of 1,000 hours. A model shown by the Ministry of Supply was capable of handling approximately 100 watts at voltages up to 24 V.

Two miniature vibrator power packs, working at 400 c/s and 250 c/s, were also on view at the Ministry of Supply stand, whilst Wimbledon displayed their standard range of vibrators and power packs for input voltages of 2-24 V.

Makers: Plessey, Wimbledon.

SOUND REPRODUCTION

The general impression remaining after a tour of the principal loudspeaker manufacturers was of a marked extension in the range and variety of types now available to the set maker. This is due not only to the home demand for new designs for small portables and television receivers, but also to a willingness to supply special types with frequency characteristics modified to meet the preferences of the overseas markets. Elliptical loudspeakers for use in car radio receivers were much in evidence.

A versatile new pickup, for standard or long-playing records has been introduced by Goldring. The cartridge (Type 150), which is available separately to manufacturers, is of the needle-armature magnetic type and has an output of 150 mV (at 3.16 cm/sec r.m.s.)}

lateral groove velocity). Interchangeable sapphire-tipped stylus are colour-coded and are provided with a neat housing moulded in conjunction with the tone-arm rest. Tip radii of 0.001, 0.0025, 0.003 and 0.0035 inch are available. The stylus pressure is variable by means of an adjustable counterbalance in the tone arm, from 7 gm for long-playing records to 14 gm for standard 78-r.p.m. records. A coupling unit giving a 1:2 step up of output voltage and providing equalization for the alternative systems of recording is available as an accessory, and provides enough output for the gramophone side of the average table-model radio receiver.

Piezo-electric devices shown by Acos included a new lapel microphone (Mic28), a vibration pickup for industrial applications, (VP3), and an inertia-type pickup cartridge (VP1) designed for attachment to musical instruments. The VP1 is protected by a moulded rubber case and has an output of the order of 0.1 V with a range of frequency

Wireless World, June 1950

1. Mullard Ferroxcube "iron-circuit" for deflector coils.

2. Wimbledon heavy-duty vibrator with (right) casing cut away, (left) model for horizontal mounting.

3. Carpenter relay type 3S showing coils and resistors comprising the anti-interference filter.

4. Demonstration Widney-Dorlec pre-fabricated cabinet.

5. Non-microphonic valve-holders by McMurdo, shielded on the left and unshielded on the right.
response from 30 to 6,000 c/s.

An ingenious adaptation of a standard dialling telephone instrument to the control of tape recording machine in a multi-channel message recorder known as the "Teletape," was demonstrated by Astronic. The system is suitable for the dictation of letters, and the user, by dialling an appropriate number, can erase mistakes without calling on the services of the operator. Channels in use are safeguarded by an "engaged" signal and the system is provided with numerous other devices for foolproof operation. The same firm also demonstrated a self-contained laboratory instrument (Type Art16) with variable a.f. oscillator, metering and calibrated equalizer circuits for investigating the properties of wire recording media.

**Makers:** Aces (M, PU); Astronic (MR); Cecilton (LS); Ediswan (LS, PU); Elise (LS); Gurrard (DR, GM, GU, PU, RC); Goldring (PU); Goodmans (LS); Lee- trans (LS); Piessey (LS, GM, GU, RC, PU); R. & A. (LS); Rexlound (LS, M); Rolin (LS); Truvox (LS); Vitavox (LN, M).

**Abbreviations:** DR, disc recorders; GM, gramophone motors; GU, gramophone turntable units; RC, record changers; MR, microphone; PU, magnetic recorders; VP, pickups.

**MATERIALS**

Among insulating materials the products of firms specializing in small and intricate ceramic mouldings continue to earn general admiration. Bray have added to their already extensive range some microscopic bushes for electrode assemblies in miniature valves and Steatite and Porcelain were showing new multi-point hermetic seals. The latter firm also exhibited examples of precision grinding in ceramic materials.

The wide range of transformer bobbins and other built-up parts in impregnated laminated paper and other insulating materials made a noteworthy exhibit on the stand of H. Clarke & Co. (Atlas).

Ferromagnetic powder materials for use in dust cores now include Mumetal, which was shown by Telcon in 150- and 300-mesh grades. This firm is now producing laminations in HCR alloy for magnetic amplifiers and was also showing "Hysat," an alloy, which, as the name implies, has a very high saturation value and is suitable for polepieces.

A new brazing technique has been developed for the manufacture of composite permanent magnets of soft and active materials, and examples, including magnet assemblies for ribbon microphones, were shown by the Permanent Magnet Association. The method facilitates accurate machining and considerably reduces the cost of production.

Cables continue to be regarded as one of the basic materials of the radio engineer, and there is no doubt that the industry is well served in this category. Telcon were showing some fine examples of coaxial aerial feeders for high-power transmitters, including a polystyrene disc insulated type in a seamless aluminium outer conductor, and a helical-membrane cable, employing polythene insulation, which is not subject to the frequency limitations inherent in disc-spaced designs.

The range of television downleads made by B.I. Callender's Cables, which includes low-attenuation types for fringe areas, has been extended and includes a coaxial semi-airspaced type.

An interesting multi-strand cable with internal water-cooling pipes for coupling r.f. heaters to the work circuit was shown by Reliance.

Once again the arguments in favour of core sections of various shapes were put forward by the makers of resin-cored solders. Du Bois adopt at trefoil section, while Enthoven claim that a six-flute star section accelerates the collapse of the solder and spreading of the flux—an important point in r.f. induction soldering techniques. Multicore adhere to their original three-
**Telearchic Tuners**

Radio manufacturers expend a lot of time, energy and money in producing new types of receiver intended to incite us to break open the children's money boxes in order to possess them. Some makers tempt us with high sensitivity and the ability to pick up strange sounds from Samarkand. Others pand to our possessive instinct by giving us expensive and expansive cabinets containing not only a combined radioteleceiver (copyright reserved) but also cocktail shakers and other adjuncts to the Waters of Lethe with which we can impart to our friends and ourselves the necessary mellow mood to appreciate some of the B.B.C.'s uplift programmes.

No manufacturer, however, really gives us the set which, if it were marketed, would sweep the board. I refer, of course, to a set having associated with it a small radio control unit for the adjustment of tuning and volume from our fireside chair. Please note that I said radio control unit. We don't want any more of those units which are linked to the set by an old-world multi-wired cable over which, sooner or later, somebody trips and breaks his neck. The fact that such radio units would be popular is shown by the tremendous number of mains-powered portables that are now marketed for placing beside one's armchair.

These portables naturally fall short of the large set in the matter of quality of reproduction, partly because of the necessarily small and boxed-in loudspeaker and partly because the sound from them is at foot level. Also they possess a mains lead with its neck-breaking potentialities, whereas a radio control unit could be operated by batteries since its use would only be intermittent. The P.M.G. couldn't quarrel with it any more than he did with the r.f.-generating gramophone unit which was once produced for shooting ether-borne recordings across the room to the wireless set. Any objections, please?

**Ex-Cathedra**

Mr. H. BISHOP, the Chief Engineer of the B.B.C., is a person of no mean achievements in the realm of radio engineering and his views on any matter in this particular branch of applied science are worthy of attention and respect by all.

Man, however, he fails to remember the proverb about the shoemaker and his last; he sets forth as uncharted seas without even a second mate's certificate when he tries to interpret for us the views of the listening public on stereophonic broadcasting in his recent letter to the Editor (April).

With truly episcopal authoritarianism well befitting his name, he tells us that this system of broadcasting would interest only a relatively small number of listeners.

This is to my mind only another way of saying that few people are interested in getting as near to the goal of perfect reproduction as is scientifically possible. How does he know this so definitely? Has he been conducting a private Gallup poll of his own or has he been infringing the law by using one of his crystals for occult divination instead of for its legitimate purpose of de-wobbling wavelengths.

Mr. Bishop's technical and financial arguments, as well as his people-don't-want-it attitude, remind me strongly of those used in the very early 'twenties by people who were opposed to the introduction of broadcasting. The firm which he makes is strangely reminiscent of the Marconi Marine Co. The firm had the Inland Revenue officials in 1752. They joined the ignorant masses with their parrot cry: Give us back our eleven days, and refused to adopt the New Style Calendar, which, of course, accounts for the tax year still being calculated from Lady Day O.S. or, in other words, April 6th N.S.

**Maggie and All That**

I was very interested in the exhibition held by the Marconi Marine Co. to mark its jubilee. It consisted of a series of ships' wireless cabinets, one for each decade since the beginning of the century. Quite frankly, I feel all at sea where the modern ship's wireless rooms are concerned. I was, however, singularly fortunate in bumping into an ex-wireless operator—they call them radio officers nowadays—who explained these modern maritime mysteries to me.

His chief comment on the whole show was its lack of realism. The exhibition, he complained, just didn't smell like a ship, and—still more unlike reality—one could sit in comfort in any of the operator's chairs without the cabin lurching about all over the place. To my astonishment, he declared this was sometimes the case even in port when coming aboard in a place like B.A.; wherever that may be. Also, so he explained, ship's wireless cabins weren't always so clean and comfortable as those on show, especially after bunkering, when I gathered there was apt to be a layer of coal dust over everything, despite tightly closed ports.

His complaints made little impression on the exhibition officials, however, until in the cabin representing the early 'twenties he suddenly pounced with a whoop of triumph on the aerial tuning inductance of the receiver—a slider instrument looking like a giant reel of cotton standing on end—which he explained, had not the necessary hole bored in the top as required by H.M. Customs. The officials hastily summoned a charm-excluding individual obviously learned in the law and steered in for lots of tactfully wriggling out of awkward situations. I removed my hat in silent tribute to his genius and departed while the going was still good.

Wireless World, June 1950
**Random Radiations**

By "Diallist"

**Television and Co-ax**

Information reaches me from one who knows what he is talking about, that, instead of their present 2.4-2.8 Mc/s coverage, the coaxial cables of the future will be able to handle 4.2 Mc/s. The reason is that a cable of this kind can comfortably deal with a 4.05-line television transmission with one sidetone partly suppressed in the most modern way. The G.P.O., though, would not have gone in for wider-band coaxial cables purely for the purpose of improving television. It was found that the bandwidth increase to 4.2 Mc/s has enormous advantages for multi-channel telephony working. As you may know, in multi-channel telephony individual speech channels, each 4 kc/s wide, are combined at the sending end into groups by the first stage of modulation. Subsequent modulation stages twine groups into super-groups and super-groups into a "system." At the receiving end the system is disentangled into super-groups, the super-groups into groups and the groups into individual channels. Present cables can handle 600 speech channels apiece; with 4.2-Mc/s cables the number is increased to over 900.

**One to Fetch and One to Carry**

What a remarkable thing a coaxial cable is! Those used by the G.P.O. are under one inch in overall diameter. Inside the outer casing are two "tubes," each consisting of an outer cylindrical conductor which encloses an inner conductor, maintained in an exactly central position by low-loss insulators. One tube (or pair of tubes in a large cable) carries the outward system; the other the inward—the arrangement brings to mind the White King’s two messengers in "Through the Looking Glass": one to fetch and one to carry! Each cable contains also two ordinary pairs used for control purposes. Did you know that the 50-c/s a.c. for the repeater power packs was also carried by the cable, without any additional wires? A kind of push-pull arrangement is used, with the inner conductors of tubes acting as phase leads and the outers as neutrals.

**Good Show**

This year’s R.E.C.M.F. exhibition was even more interesting than the last—and that is saying a lot. The exhibits included not only the components of which radio sets and other electronic appliances are made up, but also the things of which the components are made—wires, solder, insulators, magnetic materials, and so on. It’s a pity in some ways that it has to be a private exhibition, with admission by invitation only, but business is business.

**Radio Slimming**

As an old hand, what interested me most was to observe the quite amazing reduction that time has brought in the sizes of radio components of every kind. Memory went back to my first three-valve receiver, built somewhere about thirty years ago. In this the grid of the r.f. valve received its input from the aerial by means of a device known as the loose-coupler. This consisted of an outer solenoid about five inches in diameter and twelve inches long with an inner coil, some four inches by six, which could be moved inwards or outwards along quarter-inch round brass guide-rods. The two 0.005 µF tuning capacitors (not ganged) were each about as large as small saucepans. The three "R" valves had much the same dimensions as the 25-watt glow lamp of to-day. The a.f. transformer weighed something like three pounds. With its batteries the set (hauled in its day as the acme of compactness) was fitted on the two tiers of a dumb-waiter, which made the receiver transportable. To-day tuning coils, capacitors and transformers have become small, light things. The miniature glass-based valve is rapidly out-sting the larger types, and a very efficient little valve it is. A battery set, for instance, containing four miniatures (including a power valve) requires a total of only 250 mA at 1.4 V from the 1.t. source.

**Soldering Economy**

As an enthusiastic solderer one of the first stands I visit at the R.E.C.M.F. show and Radiolympia is that of the Multicore people. This time they’d no novelty so spectacular as the Arax core-flux of last year; but they were showing over 300 types of cored solder wire, each designed with some particular job in view. For example, it wouldn’t perhaps strike everyone that the increasing use of miniature components means that smaller "blobs" of solder are needed to make the required joints. It struck the Multicore people, who were quick to realize that in the circumstances sound joints could be made with solder wire of considerably smaller gauge.

**A Conductivity Problem**

It is related, this time on completely unreliable authority, that there was in America a hot-tempered bus conductor who became so annoyed with one of his passengers that he pushed him off the rear platform of the bus onto the road. The unfortunate passenger was killed and the conductor was convicted of murder and sentenced to the electric chair. As he took his seat he was asked whether he had any last request to make. "Why yes," he said, "I’d like a banana." This having been provided and consumed, the final adjustments were made and then the switch was closed. At the end of a full two minutes he was completely unaffected. All efforts to carry out the sentence having proved vain, he was informed that he was a free man. He soon obtained a job with another bus company; but the ejection of a passenger whilst the bus was travelling at speed resulted in a broken neck for his victim and a second murder charge against himself. Again he was brought to the chair. Again he asked for a banana. Again the closing of the switch was ineffective. Again he was set free. "It seems," they said to him, "that those bananas somehow render you immune. Our research department is baffled; would you tell us the secret?" "See here," said he, "I’ve a kind of passion for bananas; but they don’t signify. Surely you’ve read about a bad conductor? Well, that’s me! Yes, Sir."

*Large cables have four tubes.*

Wireless World, June 1950
LETTERS TO THE EDITOR

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

British and American Television

In your issue of April, 1956, it is stated in the column "Random Radiations" that the B.B.C.'s technique is immeasurably superior to that behind the bulk of American television transmissions" (my italics). Such a sweeping statement would appear to require some qualification, if your correspondents have the same open-mindedness to criticism of the same kind as that which he makes elsewhere.

Perhaps "Diallist" would tell us in what particular respects the techniques of transmission used in the U.S.A. are so immeasurably inferior to those used in Great Britain? The quality of the received picture in this country has nearly always compared favourably with that to be seen in Britain as I remember it, and I have no reason to believe that my perceptive qualities are inferior to those of the "average listener" in either country. Neither do I recall any occasion on which the non-linearity has sufficiently bad to send me running to the telephone. In fact, the quality of picture from a good studio transmission looks slightly superior to the British equivalent. The American system appears to have a slight bend to it and immunity to impulsive interference.

There is obvious justification for past complaints that American authorities have failed to acknowledge British work, although this has been attributed in some cases to the difference in speeds with which the two countries released information for full public use. But during an extended stay in the U.S.A. I have met many, both inside and outside the engineering profession, who have shown interest in and awareness of work done outside this country, and I do not believe that the attitude of "Diallist" complaisant is typical.

D. R. A. MELLIS.
Passaic, New Jersey.
U.S.A.

Pre-amplifier Circuit

After reading the article by D. T. N. Williamson on the design of a pre-amplifier in your November issue, I should like to make the following comments:

Many pickups in use to-day are designed for direct connection to grid and earth without a coupling transformer, and I suggest the following circuit as an alternative, since it permits one side of the pickup to be earthed.

It is not new, but has not been given the attention it deserves. If the circuit constants are chosen to give a middle frequency gain of about three, and no capacity is placed in series with the lower arm of the "see-saw," then a nice "very-low-frequency" roll-off is achieved, which is adequate for normal requirements.

Bass correction is controlled by C6 and "top cut" by C5, these approximately are 600 μF and 25 μF respectively, but I advise the use of "trimmer" capacitors and these adjusted to give correct response when playing a frequency record. Worthy of mention is the importance of correct record speed; I have seen frequency runs taken without even a glance at a stroboscope.

Any further gain can be obtained from another anode-follower after this stage, adjusted to give the required level.

H. G. WARREN.
Luton, Beds.

Pickup Design

In your report in the April issue on H. J. Leak's lecture-demonstration before the B.S.R.A., I see it stated that Mr. Leak expressed his preference for a multi-turn moving-coil pickup rather than a single-turn ribbon, on the grounds that the latter was the thought liable to hum pick-up. I contend that hum pick-up is not influenced by number of turns on the coil.

If we take, for example, a single turn of coil having an impedance of 1 ohm and cut it spirally to produce 10 turns, we find that both the "signal" voltage output and induced hum voltage increase x10 across an impedance of 10² ohms, and therefore for a given output load the output voltage and signal/hum ratio are unaltered. If, on the other hand, we add nine more turns equal in size to the original, we shall get x10 the output voltage into x10 the impedance or x1/10 the voltage into a given output load, whereas the voltage due to stray-magnetic fields will have increased by only a small amount depending on the coil design.

All other things being equal, the signal/hum ratio varies in the proportion of rather less than 1/10 change in coil mass. Furthermore, since for a given coil under a constant magnet system the signal output varies in direct proportion to coil velocity, the signal/hum ratio varies directly with coil velocity.

Since both coil mass and coil velocity are reflected as point impedance, we see, first, that the signal/hum ratio can be improved solely at the expense of increased point impedance, and, secondly, that if we are considering only this aspect of design, there is an optimum proportion for the location of the moving conductor and the point relative to their common fulcrum.

I would point out—in case it is not immediately self-evident—that since the signal/hum ratio is to some degree proportional to point impedance for a given set of external circumstances, then the ribbon design, utilizing the principle that the moving coil is either supporting or substantially so, will obviously have, for a given performance, a better signal/hum ratio than a moving coil, since the "torque" of the moving coil former can be transferred to the effective working mass of the moving conductor.

Liverpool.

J. H. BRIERLEY.

In his lecture-demonstration before the British Sound Recording Association on February 24th (reported in your April issue), H. J. Leak, in discussing gramophone pickups, commented that "tungsten carbide styli were also open to the objection that the surface often showed pitting as a result of imperfections in the sintering process by which they were formed."

As manufacturers of cemented tungsten carbide, we feel that Mr. Leak must have been unfortunate in his choice of carbide needles for text. We should, of course, be the first to agree that it does at times happen that imperfections in the
sintering process, or for that matter other processes appertaining to powder metal production, may cause a slight porosity. We maintain, however, that such surface porosity can be detected when the needle is being polished, and faulty material can be rejected at this stage. We would also point out that incorrect polishing technique can be the cause of an uneven and pitted surface even when the hard metal as such is perfect.

We have recently studied the methods of grinding and polishing these needles, in the light of our experience in the finishing of carbide dies, and have established a small production unit for this purpose in our carbide die shop. Needles made under these conditions have given very favourable results on performance tests.

For Murex, Limited.

B. E. BERRY.

Rainham, Essex.

Physical Society Electronics

To the conscientious technician in search of knowledge, a visit to the Physical Society's Exhibition represents a day of exhaustion, both mental and physical. Not only does he have to expend a large part of his energies in tramping the labyrinthine corridors and stairs of the Imperial College to find what he wants, but he is then faced with the task that somebody should have done for him, of sorting the wheat from the chaff.

The blame rests partly with the organizers and partly with the exhibitors. One condition applied to the exhibitors, I believe, is that they shall have something new to show, but this does not prevent them from bringing along a mass of their standard products which are already well known. The result is congestion, and many of the new and interesting items are crowded into dark corners and corridors where they are least likely to be seen. If the exhibitors showed more restraint and the organizers more discrimination in selecting the exhibits, this would not happen. Why, for instance, cannot components and test gear be left to the R.E.C.M.F. exhibition?

Electronics being largely "a lot of uninteresting tin boxes with knobs on," as one visitor put it this year, I feel that exhibitors should be at more pains to show the inside of their "tin boxes" (dare they?) and arrange more practical demonstrations for the benefit of the non-specialist in their particular art. I am aware that the exhibition is not intended to be a fun-fair, but visible, tangible and moving things are as readily appreciated by the super-intelligent as by the infantile. Science is not degraded by being made more attractive.

"RADIOPHARE."

More than a SWITCH—a SERVICE!

The experience of 25 years behind every switch!

Famous 2-pole M.-B. long bush Toggle Switch. This model is suitable for 6-250V. circuits; max. 1A.; for all panels up to 9/16in. thick. List No. S.304.

Pear dolly for easy operation; for circuits as above. All BULGIN switches are obtainable with a wide variety of dollys, fixing nuts, bushing rings and finishes, on request. List No. S.258 P.D.


New version of long-popular single-pole M.-B. model, for 6-250V., 3A. circuits. Note the insulated front ring, available on all switches at request. List No. S.478.

Press ON; biased OFF. A popular model for 6-250V. circuits; max. 3A. List No. S.365. (Reversing action; List No. S.366).

Change-Over switch, single-pole. New version with terminals, for 6-250V. circuits; max. 2A. Guaranteed—at least 25,000 operations | List No. S.364.

BULGIN Components

"The Choice of Critics"

A. F. BULGIN & CO., LTD.
BYE PASS ROAD, BARKING, ESSEX
Telephone: Rippleway 3474-8

ILLUSTRATED COMPONENT CATALOGUE
Price 1/-
Post Free
Manufacturers' Products

New Equipment and Accessories for Radio and Electronics

Television Accessories

To combat the sporadic impulse type of interference on their television receivers, G.E.C., of Magnet House, Kingsway, W.C.2, have introduced two picture interference inverters, BT 150 and BT 151. These reverse the phase of the incoming impulses, so that black spots appear on the screen instead of the usual white ones and the beam does not suffer defocusing. The units, which derive their power supplies from the receiver and are designed to mount on the existing chassis, cost £2 5s each.

For use in areas of low signal strength, G.E.C. have also produced a television pre-amplifier. Model BT 161/L for London transmissions has a gain of five over a bandwidth of 6 Mc/s, whilst model BT 161/M has a gain of twelve over a bandwidth of 1 Mc/s; both obtain their power supplies from the main receiver and are priced at £2 5s. Where facing is prevalent, a remote armchair gain control can be added for an extra £1 10s.

In addition, the firm has a H-type dipole aerial and reflector with provision for altering the phase of the diagram, at £3 10s; a demonstration aerial for dealers at the trade price of £15 12s; 10-ft and 6-ft aerial masts in light alloy, a chimney mounting, and a wall mounting.

Television Knobs

A range of moulded knobs with special television engravings has been introduced by A. F. Bulgin and Co., Bye Pass Road, Barking, Essex. They are 1½in in diameter, have flat faces, straight sides and knurled edges to ensure a firm grip for precise adjustments. They fit ¼-in spindles and have 4BA steel grub screws threaded into brass insets with the heads of the screws sunk deep into the body of the knob for protection against high voltages.

Five engravings have been selected: they are: brightness, contrast, focus, switch and volume, the lettering being carried out in gold on a brown background. Black knobs are also available. The price is 18 6d each for either colour.

Television Converters

Non-technical viewers who wish to adapt their London television receivers for reception of Sutton Coldfield with the least possible trouble will be interested in two new converters now on the market. These are both self-contained units for insertion between the aerial and the aerial socket of the receiver, and have their own power supplies.

Model AC 14, by Spencer West, of Quay Works, Great Yarmouth, has five valves, enables either of the two stations to be selected, and costs £6 15s 6d. Model AC 18, by Sphere Radio, of Heath Lane, West Bromwich, has one 6A8GT valve and costs £6 6s. Both are fitted with coaxial input and output connections.

Cable Eccentricity Gauge

Designed for the non-destructive determination and control of the eccentricity of extruded cables and wires, this instrument (Type 153) made by the Addison Electric Company, 163 Holland Park Avenue, London, W.11, gives a direct reading of eccentricity over a minimum range of -0.5 to +0.5 mm. An internal polarized relay can be set to operate an indicator alarm, or automatic die re-setting mechanism, when the eccentricity exceeds ±0.3 mm.

The principle of operation is the exploration of the field produced by current in the central conductor, supplied from a local oscillator. Pairs of coils arranged on X and Y axes at right angles are selected alternately by a switch and their voltages are applied to a differential amplifier and calibrated output meter.

Multi-Purpose Electric Tool

Mainly for the benefit of amateurs, Wolf Electric Tools, Ltd., have produced an inexpensive and versatile tool which can be adapted for drilling, turning, sawing, grinding and polishing. The basic unit, "Wolf Cub," electric drill, costing £1 19s 6d, which can be incorporated as the driving unit in a number of different kits! For instance, one kit will convert the hand drill into a bench drill, and this, when laid flat on the bench, becomes the lathe illustrated, for an additional sum of 13s 6d. The electric drill can be seen clamped upside down, whilst the long handle used for raising the drilling platform here becomes a means of moving the back centre of the lathe. Alternatively, the bench drill can be converted into a circular-saw kit for an extra £2 8s 6d.

There are, in fact, many ways in which the amateur can ring the changes on these kits, and he is not obliged to buy them in any particular order. If all the available items are purchased, the total cost is in the region of £11. The firm is at Pioneer Works, Hanger Lane, London, W. 5.

Amatru's lathe assembled from a "Wolf Cub" kit.
A particularly useful Instrument for TELEVISION WORK...

A Signal Generator of wide range and accuracy of performance, designed for use in the laboratory or by the service engineer. Turret coil switching provides six frequency bands covering 50 Kc/s to 80 Mc/s:

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Corresponding Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Kc/s-150 Kc/s</td>
<td>1.5 Mc/s-5.5 Mc/s</td>
</tr>
<tr>
<td>150 Kc/s-500 Kc/s</td>
<td>5.5 Mc/s-20 Mc/s</td>
</tr>
<tr>
<td>500 Kc/s-1.5 Mc/s</td>
<td>20 Mc/s-80 Mc/s</td>
</tr>
</tbody>
</table>

Note these Attractive Features:

Stray field less than 1µV per metre at a distance of 1 metre from instrument. General level of harmonic content of order of 1 per cent.

Direct calibration upon fundamental frequencies throughout range, accuracy being better than 1 per cent. of scale reading.

45sin. of directly calibrated frequency scales with unique illuminated band selection giving particularly good discrimination when tuning television “staggered” circuits.

Of pleasing external appearance with robust internal mechanical construction using cast aluminium screening, careful attention having been devoted to layout of components with subsidiary screening to reduce the minimum signal negligible level even at 80 Mc/s.

Four continuously attenuated ranges using well designed double attenuator system.

Force output 0.5 volts.

Internal modulation at 400 c/s., modulation depth 30 per cent., with variable L.F. signal available for external use.

Mains input 100-130 V. and 200-260 V., 50-60 c/s, A.C.

Battery Model available having same general specification and covering 50 Kc/s-70 Mc/s, powered by easily obtainable batteries.

Fully descriptive pamphlet available on application.

Sole Proprietors and Manufacturers:

The AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO.LTD. WINDER HOUSE • DOUGLAS STREET • LONDON • S.W.1 Telephone: VICTORIA 3104/9

Mains Model £25
Battery Model £24
YOU CAN MAGNETICALLY RECORD using your Gramophone Motor as a Drive

Necessary parts, also usable later for a more ambitious job, plans available, 1 Spool Diamond Magnetic Recording Tape and 1 take-up spool, 2 Corner Brackets, 1 Roller, 1 Record-playback Head Kit, 1 Friction Clutch, 1 Dual-purpose Supersonic Oscillator and Two-stage Preamplifier and your Radio Chassis. Set of parts £7.15.0, or items supplied separately.

Also Constructional Data for Wire and Tape Recorders 5s.

PARK RADIO OF MANOR PARK, 676/8, 783 Romford Road, London, E.12
Hawaiian Airlines selected the WILCOX TYPE 361A COMMUNICATIONS SYSTEM for all aircraft. This consists of a 50 watt transmitter, a high sensitivity receiver, and a compact power supply, each contained in a separate ½ ATR chassis. Transmitter and receiver contain frequency selector with provisions for 70 channels . . . ample for both present and future needs.

**VHF GROUND STATION PACKAGED RADIO**

Hawaiian Airlines selected the WILCOX TYPE 428A FACTORY PACKAGED STATION for all ground stations. This consists of the WILCOX 406A fixed frequency 50 watt transmitter, WILCOX 305A fixed frequency receiver, WILCOX 407A power supply, WILCOX 614A VHF antenna, telephone handset, loudspeaker, desk front, typewriter well, and message rack.

**DEPENDABLE COMMUNICATIONS FOR THE WORLD’S AIRLINES**

During recent months, many of the world’s foremost airlines, UNITED, EASTERN, TWA, MID-CONTINENT, BRANIFF, PIONEER, ROBINSON, and WISCONSIN CENTRAL have placed volume orders for similar communications equipment. No greater compliment could be paid to the performance, dependability, and economy of WILCOX equipment than to be "FIRST CHOICE" of this distinguished group.

Write Today for complete information on the Type 361A VHF Air-borne Communications System and the Type 428 Packaged VHF Ground Station.

**WILCOX ELECTRIC COMPANY**

KANSAS CITY 1, MISSOURI, U.S.A.
PRECISION WORKMANSHIP
plus
HIGH PERFORMANCE OF
DOUBLE SUPERHETERODYNE CIRCUIT

EDDYSTONE '750'

COMMUNICATIONS RECEIVER
with four wavebands covering 32 Mc/s to 480 Kc/s con-
tinuous except for a small gap around 1,600 Kc/s. Eleven
valves, majority of miniature types. Separate oscillator,
supplied with stabilised H.T. Independent R.F., I.F. and
A.F. gain controls. Linear frequency scales, directly
calibrated. Mechanical bandspread, with high reduction
ratio geared tuning mechanism.

Price £45 Os. Od.
Ask Webb’s for full specification.

COME TO WEBB’S
FOR COMPARATIVE DEMONSTRATIONS OF
HIGH FIDELITY REPRODUCERS

Hear such outstanding apparatus as:-
Mordaunt “Duplex” Reproducer, a loudspeaker unequalled for
realism ... ... ... ... ... ... ... ... ... ... Price 96 guineas
Wharfedale “Corner Assembly,” gives excellent balance of bass and
treble ... ... ... ... ... ... ... ... ... ... ... Price complete £22 5 0
(also available as separate items, including concrete non-resonant corner
baffle, £3.)
Leak "Point One" Amplifier, which cannot be faulted on workmanship
or electrical specification ... ... ... ... ... ... ... ... Price £32 10 0
Cosmocord “GP 20” Pick-up, a really good high fidelity pick-up at a
reasonable price ... ... ... ... ... ... ... ... ... ... £14 10 0
Leak "Dynamic" Pick-up, must be heard before your final critical
choice ... ... ... ... ... ... ... ... ... ... ... ... ... ... Price £14 10 0
"Ventex" Loudspeaker Cabinets, the answer to the cabinet problem.
Available in a variety of beautifully finished woods and designed on scientific
lines for use with high fidelity units ... ... ... ... ... ... ... ... Price 14 guineas
Also Speakers by BARKER, WHARFEDALE, ROLA, B.T.H. etc. Amplifiers
by CHARLES, SOUND SALES, ACOUSTICAL, etc. Pick-ups by DECCA,
WILKINS and WRIGHT, CONNOISSEUR, etc.

WEBB’S NEW COMPREHENSIVE CATALOGUE NOW
READY, 6d. TO CALLERS, OR 1d. POST FREE.

Phone : GERnard 2089. Shop Hours : 9 a.m.—5.30 p.m. Sets 9 a.m.—1 p.m.

SERVOGRAPH OPERATES DIRECTLY
FROM VERY LIGHT CURRENT
SOURCES, consuming but a few Micro-watts
for full scale deflection. Its working principle
is unique and sets up a new high standard
of accuracy and robustness for graphical
recording meters. SERVOGRAPH’S accuracy
is to B.S.S. 89 for Grade 1 Indicating
Instruments—because its servo-driven pen
arm removes all load from the instrument
movement, admits a robust and trouble-free
pen, and maintains this accuracy with full
or empty ink reservoir. Needing no levelling,
it operates correctly in any position and can
be connected directly to tachometers,
thermo-couples, resistance thermometers, CO2
indicators, pH meters and so on, repeating
their accuracy on the chart. Equally useful,
too, as an ammeter, voltmeter, etc., it may
embody a moving iron, moving coil,
dynamometer or electrostatic movement.

Please write for technical leaflets 100/M.

Movements available
from 50 micro-amps. or
15 millivolts upwards.

Prices (British Isles)
from

£65

FIELDEN (ELECTRONICS) LTD.
PASTON ROAD : WYTHERSHEW : MANCHESTER
FIELDEN ELECTRONICS (AUSTRALIA) PTY. LTD.
409 COLLINS STREET : MELBOURNE : AUSTRALIA
Specialists in Industrial Electronic Equipment
Where excellent quality reproduction is essential . . .

. . . the Metrovick

AUDIO AMPLIFIER

is the instrument to use

This instrument is designed to give excellent quality reproduction with the added advantages of being a self-contained unit, portable and attractive in appearance. Thus it will prove ideal for Public Address work, educational authorities and similar organisations.

SPECIFICATION

Supply: 200/250V 50 c/s single-phase; consumption approximately 170 VA for full output.
Input: Gramophone 0.2V for full output. Microphone 0.02V for full output. The two circuits can be mixed as required.
Impedance: 7 ohms, 15 ohms and 45 ohms.
Output: 20 watts with negligible distortion.
Tone Control: Continuously variable.
Response: ± 1 db from 30 to 15000 c/s at zero position of tone control.
Controls: These are recessed to avoid damage and are illuminated when in operation.
Dimensions: 18 3/8" X 8 3/4" X 10 1/8".
Finish: The instrument is housed in an attractive steel case, stove enamelled in cream or blue as desired. A leather carrying handle is fitted.

METROPOLITAN-VICKERS ELECTRICAL CO. LTD.
TRAFFORD PARK, MANCHESTER 17
NEW!
Heavy Duty VIBRATOR

Introducing, after a lengthy period of research, a "big brother" to the popular standard WIMBLEDON Vibrators. It has all their desirable qualities, but is produced specially for heavy work. Note these advantages.—
1. Carefully designed and tested.
2. Made throughout from selected high grade materials.
3. Will give satisfactory service over a long period.
4. Reliable in operation under rated conditions of use.

Available in both SYNCHRONOUS and NON-SYNCHRONOUS Types; POWER UNITS to suit.

Write for illustrated leaflet to

WIMBLEDON ENGINEERING COMPANY LIMITED
GARTH ROAD - LOWER MORDEN - SURREY - TEL.: DERWENT 4814-5010

"VIEWMASTER" (post free)

Complete booklet on "Viewmaster" (including constructional details and blueprint). £2.50.
Complete set of C. C. Condensers as specified, £2/15/0.
Complete set of Whistley components including 1/0, £2/5/0.
Complete set of Flexoway components as specified, £2/12/0.
Complete set of Westinghouse components as specified, £2/2/0.
Complete set of Wearite coils and choke as specified, £2/7/0.
Complete set of Morganite fixed resistors as specified, £2/8/0.
Complete set of Belling & Lee components as specified, £3/0/0.
Complete set of Rolling & Lee components including fuses, £2/2/0.
G.R.C. Neon Lamp type G, £2/0/0.
Sin. Cathode Ray Tube Mullard MW21/40, £2/6/0.

QUALITY COMPONENTS
A.D.S. QUALITY AMPLIFIER

Full constructional details of our 41 watt inexpensive quality amplifier are now available including circuit diagram layout pictures. Post free, 10s.
Complete set of components for above amplifier including drilled chassis, cabinet knobs, etc. Carriage free, £2/7/0.
Complete amplifier constructed and tested. Carriage free, £2/2/0.

LOUDSPEAKERS

WharfeAe speaker 8 CHB special coil-impedance 0.23 ohms or 12/15 ohms. Suitable for reduced quality up to 4 watts (post 1/3), £4.
Wharfdale Golden Unit. Peak input 8 watts, cone dia. 10in. The most popular of the better quality reproducers (post 1/6), £4.
As above with cloth surround post 1/6, £4/10/0.
Wharfdale W10/CRS. The well known 10in. Speaker with the cloth suspension. Power handling capacity 0.8 watts dependent on mounting (post 1/6), £7/6/0.
Goodman 12in. 15 watt P.M. dust proof speaker. Ideal for small halls, etc. (carriage 2/6), £8/15/0.
Goodman Acousm 12, 12in. Twin cone high fidelity speaker (carriage 2/6), £8/8/0.
Goodman Acousm 22. The latest 20 watt High Fidelity 12in. Loudspeaker (carriage 2/6), £12/13/0.

PICKUPS

Connsantra Pick-up, a high impedance pick-up giving approx. 5 volts at the secondary of the special coupling transformer. Level frequency response from 50 to 1,000 c.p.s. Below 50 c.p.s. a rising frequency response gives a base resonance near 25 c.p.s. Above 1,000 c.p.s. the output falls steadily giving a loss of approx. 5 db at 6,000 c.p.s. and 9 db at 15,000 c.p.s. Price complete with transformer incl. P.T., £2/10/0.
Wilkins & Wright Pick-up. All g1.S weight moving coil pick-up with an overall response of type 20,000 c.p.s flat within 3 db from 50 c.p.s. to 2,000 c.p.s. 0.8 ohms, Impedance 5 ohms. Output impedance from special transformer 100,000 ohms. Approx. needle pressure 1 oz adjustable within 1 oz to 1 oz. Price complete with transformer, £2/10/7.

NEEDLES (all prices include P.T.)

Connsantra Miniature needles 20 per pkt., 2/10.
Columbia Chrome (normal size), 10 per pkt., 1/9.
Columbia 92 Miniature needles, 10 per pkt., 2/7.
PROBLEM:
Secure top of talc container so that it can be rotated under spring tension for alignment of sifter holes.

SOLUTION:
Type SFW Spire fix inside container is pressed over integrally moulded stud. Top rotates under spring tension and is permanently secured.

THAT'S FIXED THAT — FASTER, CHEAPER

It just shows how Spire, in one simple operation, can solve what threatens to be an assembly headache. Very few awkward locations or blind assemblies present much of a problem to Spire these days. And once a Spire is on it stays put—the unique double-spring action sees to that. We'd like to know if you think Spire, the fastest thing in fasteners, can help you—will you write to us?

Spire
Regd.

SPEED NUTS

Enquiries to:
SIMMONDS AEROCESSORIES LTD. BYRON HOUSE, 7-8-9 ST. JAMES'S ST., LONDON, S.W.1
HEAD OFFICE AND WORKS: TREFOREST, GLAMORGAN
Also BIRMINGHAM • STOCKHOLM • MELBOURNE
This month we celebrate our TENTH ANNIVERSARY and confess to a feeling of pride in the fact that NO B.N.R.S. STUDENT HAS EVER FAILED to pass his examination after completing our appropriate Study Course.

Whether this constitutes a record we do not know, but it is true and that is what matters.

- *Our Syllabus includes:*
  - A.M.I.E.E. (in approved cases), Brit. I.R.E., City and Guilds, P.M.G. (Theory only).
  - Maths, Examination Courses, also what we sincerely believe to be the best RADAR Course ever written.
  - TELEVISION ready soon.

- We specialise in the INDIVIDUAL COACHING of aspirants to the more responsible positions in the Telecommunications and Electronic Engineering professions.

- Arrangements can be made for most examinations to be taken anywhere aboard ship or the furthestmost outpost.

Write for full particulars to:
about the switch that is superior

'Oak' switches—both rotary and push button types—were embodied in the majority of receivers displayed at Radiolympia.

Throughout the radio world, the time-tested basic 'Oak' principles are recognised and acknowledged as superior. They form the basis for the standard inter-service wafer type switch to Specification RCS.151 of the Radio Components Standardisation Committee.

The new miniature types, embodying all 'Oak' basic features, bring the range available in line with today's requirements for miniaturised equipments.

- Self-aligning floating rotor.
- Dual contact surfaces ensure low contact resistance throughout long life.
- Fixed contacts of special spring alloy, heavily silver-plated as standard; silver alloy available if required.
- Single or multiple wafer construction.
- High grade S.R.B.P. or low-loss ceramic insulation.

Other British N.S.F. Products Include:
Cutler-Hammer appliance switches; Carbon and wire-wound potentiometers for television and radio applications; Paper tubular capacitors; Wire-wound resistors.
Recognised as the Most Reliable Valveholders

**McMurdo**
Moulded Valveholders

**B11A—Sub Magnal**
Ref. No. S.P.11U moulded in Phenol-Formaldehyde with moulded-in metal mounting plate
" " A.P.11U " " Alkathene
" " A.A.11U " " Alkathene with integral Alkathene mounting flange

THE McMURDO INSTRUMENT COMPANY LTD., VICTORIA WORKS, ASHTEAD, SURREY - ASHTEAD 3401

---

**INSTRUMENTATION BY SOLARTRON**

PRODUCERS OF WIDE RANGE INSTRUMENTS FOR RESEARCH AND TEST DEPARTMENTS.

**REGULATED POWER SUPPLIES**
From 0-500 volts up to 300 MA.
Types SRS 150 and SRS 151.

**PULSE GENERATORS**
With Variable Time Delay.
Type OPS 100.

**WIDE BAND AMPLIFIERS**
10 c/s—250 kc/s. FSD 100μV.
Types AWS 50 and AWS 51.

**UNDER DEVELOPMENT**
**WIDE BAND AMPLIFIER**
100 c/s—20 mc/s
Gain 50 db output 120 v
ENQUIRIES INVITED

**SOLARTRON LABORATORY**
22 HIGH STREET, KINGSTON-ON-THEAMES

**INSTRUMENTS LTD**
KINGston 1787
The New Valve Technique for v.h.f.

Mullard have now introduced a modern range of small, Hard-glass Valves, outstanding features of which are:

- Hard-glass Bulb
- Low-inductance Anode Lead
- Double Helical Filament—Low Hum
- Zirconium Coated Carbon Anode
- Shield to Ensure Low Anode-Filament Capacitance
- Low-loss Powdered Glass Base
- American Giant 5-Pin Base

For their size, these valves are among the most efficient in existence and are particularly recommended for equipments operating in the V.H.F. range. Other features include small size, low drive power and low power consumption for the rated outputs.

The triodes TY2-125, TY3-250 and TY4-500 form a series with increasing anode dissipations from 135 to 500 watts, and are designed for use as R.F. amplifiers, grounded-grid amplifiers or oscillators in both communications and small, compact R.F. heating equipments.

The tetrodes QY3-125 and QY4-250 are rated respectively for maximum anode dissipations of 125 and 250 watts, and are characterised by high power gains and high efficiencies at V.H.F.

MAXIMUM OPERATING CONDITIONS (CLASS C TELEGRAPHY) at 50 Mc/s

<table>
<thead>
<tr>
<th>Valve</th>
<th>Type of Service</th>
<th>Va (V)</th>
<th>Vg2 (V)</th>
<th>Vg1 (V)</th>
<th>Ia (mA)</th>
<th>Ig2 (mA)</th>
<th>Ig1 (mA)</th>
<th>Vin (pk) (V)</th>
<th>Pout (W)</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TY2-125</td>
<td>osc.</td>
<td>2500</td>
<td>—</td>
<td>—200</td>
<td>200</td>
<td>—</td>
<td>—</td>
<td>350</td>
<td>360</td>
<td>72</td>
</tr>
<tr>
<td>TY3-250</td>
<td>osc.</td>
<td>3000</td>
<td>—</td>
<td>—250</td>
<td>363</td>
<td>—</td>
<td>—</td>
<td>380</td>
<td>830</td>
<td>74</td>
</tr>
<tr>
<td>TY4-500</td>
<td>osc.</td>
<td>4000</td>
<td>—</td>
<td>—350</td>
<td>550</td>
<td>—</td>
<td>—</td>
<td>625</td>
<td>1670</td>
<td>78</td>
</tr>
<tr>
<td>QY3-125</td>
<td>ampl.</td>
<td>3000</td>
<td>350</td>
<td>—150</td>
<td>166</td>
<td>35</td>
<td>10</td>
<td>280</td>
<td>375</td>
<td>75</td>
</tr>
<tr>
<td>QY4-250</td>
<td>ampl.</td>
<td>4000</td>
<td>500</td>
<td>—225</td>
<td>312</td>
<td>50</td>
<td>8</td>
<td>315</td>
<td>970</td>
<td>78</td>
</tr>
</tbody>
</table>

GOVERNMENT PREFERRED TYPES

The QY3-125 and the QY4-250 have now been selected for inclusion in the new Government list of preferred valves for the services.

Mullard

THERMIONIC VALVES AND ELECTRON TUBES

MULLARD NEWS LETTER If you are not already on the mailing list for this service of advance information on new valves, please write to us for full particulars on your business letterhead.
It's the BACK VIEW
that's most important
— to you

We've turned this Sobell model back-to-front because we know that your knowledge of radio is not confined to knob-twiddling. You know exactly what you are buying.

This set is Sobell Model 610, 6 valve all-wave superhet receiver. Like all radios in the Sobell range it is sound value for money. We don't flinch from your expert and thorough examination. Take your time. Check everything—circuits, signal rectification, I.F. selectivity, tuning controls. You'd find that workmanship and the materials are both first rate—really wonderful value for money. It has to be so. Our 2-year free maintenance plan means that our sets—sound or vision—have to be good...or else!

You can examine this set—or any other in the Sobell range—at any Sobell dealer. We feel sure that, whatever Sobell radio you choose, you'll get technical efficiency and value for money—and a set you'll be proud to own. And for your wife's sake of course here is the good-looking side of the Sobell picture.
The Ferranti Neostron is a cold cathode tetrode filled with neon, designed for use as a stroboscopic light source, a flashing indicator, or an electronic relay.

The discharge in the anode is started by initiating a glow discharge between the screen and grid electrodes, the screen being at a fixed positive bias, a negative impulse being applied to the grid.

<table>
<thead>
<tr>
<th>Operating Characteristics</th>
<th>NSP1</th>
<th>NSPT</th>
<th>ASP1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Anode Voltage</td>
<td>400</td>
<td>650</td>
<td>400</td>
</tr>
<tr>
<td>Normal Anode Voltage</td>
<td>300</td>
<td>600</td>
<td>300</td>
</tr>
<tr>
<td>Mean Anode Current</td>
<td>40-100* mA</td>
<td>40-100* mA</td>
<td>40-100* mA</td>
</tr>
<tr>
<td>Peak Anode Current</td>
<td>250 Amps.</td>
<td>250 Amps.</td>
<td>250 Amps.</td>
</tr>
<tr>
<td>Anode Connection</td>
<td>in base</td>
<td>Top cap</td>
<td>in base</td>
</tr>
<tr>
<td>Gas Filling</td>
<td>Neon</td>
<td>Neon</td>
<td>Argon</td>
</tr>
</tbody>
</table>

*Dependent upon frequency of operation*

All types can be supplied with English 4 pin or American 4 pin bases.
Before deciding on a Magnetic Tape Recorder—

hear the “CLIFTON” MODEL M.Q.1

PRICE
£45
Microphone extra
Delivery 14 — 28 days

THREE MOTORS
HEAVY CAPSTAN
SEPARATE SUPERSONIC ERASE HEAD
TWO SPEED — QUICK REWIND
RECORD/PLAY INDICATOR LAMPS
SPECIALY DESIGNED AMPLIFIER WITH
SEPARATE BASS and TREBLE CONTROLS

also

The “CLIFTON” TAPE DESK

Specification as above
Complete with 1,200 ft. Tape
£25 Immediate Delivery

Write for particulars:

BRISTOL CINE SERVICE
33, ALMA VALE RD. Phone: 33243
TRADE ENQUIRIES INVITED

As specified for conversion of the Type 25 unit of the
T.R. 1196

Osmor 'Q' Coilpacks

As specified for conversion of the Type 25 unit of the
T.R. 1196
Blue 11m. × 8m. × 3m. Superhet. (400 Hz) and T.R.F. Pre-aligned with full circuit supplied.
Only five connections to make, with one-hole fixing, and your coil problems are solved quickly, efficiently and at low cost.
This Midget Coilpack has a terrific performance. If in doubt, ask those who have an Osmor.

Send sixpence for free Circuits and details of the latest types available including Superhet Portable Battery Models and lists of dials, matched radio and television components, etc.
also our latest Bargain Bulletin, “Viewmaster” constructional drawings, 5/-, post free.

MR. W.7.
BRIDGE VIEW WORKS, BOROUGH HILL, CROYDON, SURREY
Telephone: Craydon 1220.

“REPRODUCTION OF RECORDS—1”

by J. H. Brierley

Booklet. Price 3/6 (by post 3/1).

This booklet is the first of a series of practical booklets dealing with specialised high fidelity equipment.

After touching on some aspects of fundamental design, a preamplifier is described incorporating all necessary equalising, variable tone control and filter circuits, which requires 5 mV. at the grid of the input for an output of 2 v.—the hum and noise level not being higher than -60 db.

Twenty-one drawings and photographic illustrations are employed in giving precise wiring and constructional details: in addition the reasons why certain things must be done are fully discussed so that the reader is left with a knowledge of how to do things rather than an ability to copy slavishly some standard design.

The scope of this booklet covers also the connecting of pick-ups to pre-amplifiers, the connecting of pre-amplifiers to amplifiers, the construction of a “Rumble Filter” and advice on general layout.

Order from your local radio or book shop or direct.

J. H. BRIERLEY (Gramophones & Recordings) LTD.

46, Tithebarn Street, Liverpool, 2
HOW LONG IS A PIECE OF STRING?

To this age-old teaser there is but one answer — measure it!

It's the same with an amplifier, its performance cannot be judged merely by visual inspection; measurements must be made which are far more involved than the measurement of string...

The 'CINTEL' SQUARE WAVE & PULSE GENERATOR

enables the response and transient characteristics of an amplifier to be determined in a matter of minutes.

For full technical details and further applications of this instrument, please write for leaflet No. S.W.G.1/1.

CINEMA-TELEVISION LIMITED

A Company within the J. Arthur Rank Organisation

FOREMOST IN THE MANUFACTURE OF

- Counters & Chronometers - Metal Detectors - Oscilloscopes - Photo-Electric Cells - Cathode Ray Tubes - Geiger-Muller Tubes - Electronic Instruments

WORSLEY BRIDGE ROAD • LONDON • S.E.26

Telephone: HiTher Green 4600

Northern Agents:
F. C. ROBINSON & PARTNERS LTD.
287 Deansgate, Manchester 3

Scottish Agents:
ATKINS, ROBERTSON & WHITEFORD LTD.
100 Torridale Street, Glasgow, S.2
The diligent and enthusiastic service.

Three new arrivals . . .

Baby—Minor—Major — all doing fine

Another step forward in Extension Speaker Design is taken with these new models, Balette Baby 39/6, Balette Minor 52/6, Balette Major 65/. All fitted with out of sight volume control. Finished in walnut veneers.

Transformers extra and Baby Minor 6/. Major, 8/. Supplies are now reaching distributors.

Richard Allan

M.R. SUPPLIES Ltd.

(M.R. SUPPLIES Ltd., established 1936.)

Selected material only—all new and perfect. All prices nett.


GEARED MAINS MOTORS (Capacitor-induction) 200/240 v. A.C./D.C. Size 75m. long by 62mm. wide, delivering 500 watts 220 v. A.C. or 1,875 r.p.m. with 1,250 watts 240 v. D.C. or 2,200 r.p.m. These are substantially built to a precise standard for continuous duty and full load application, and are fitted with capacitor and diagram 64/10 (is. 10½).

GEARED MAINS MOTORS, 250 v. 350 v. 450 v. (Will also run on D.C.—series wound). 6,000 r.p.m. These are not converted rotary transformers but mains motors made for the purpose. Body 4x4x2.5, with 4x1.5, shaft. Fully shrouded with grease caps each end. Suitable for moving machines, pumps, cine projectors, etc. Approx 1,000/500 H.P. 28/6 (des. 12/6). Also BRAIDED POLY MOTORS (Hoover) 300/350 v. A.C. Suitable for Wire and Tape Recorders, Cooling and Extractor Fans, Cine Projectors, etc. 200/250 v. D.C. 47/6. (200/250 v. A.C.)

Output transformers extra.


Williams’ codes to Author’s specification 23/12. Chokes for Williams’ Amplifier. 30H at 20 m.a., 16/6; 10H at 150 m.a. 29/6. Choke CS. 40 m.a., approx. 5 H., 160 ohms. 3/3. C.W.O. (add 1//- in £ for carriage), all IIF, full load and carriage paid. Trade inquiries invited.

H. ASHWORTH

(Dept. W.W.)

676 GT. HORTON ROAD

BRAFORD, YORKS.

M. R. SUPPLIES Ltd., 68, New Oxford Street, London W.C.1

Telephone Museum 2958
Some points about the CB/E which have made this machine the considered choice of many discriminating broadcasting concerns throughout the world.

1. **HEAVY CAST IRON TURNTABLE**, accurately balanced, ensures freedom from wow.
2. **TWIN DUAL SPEED FRICION DRIVES** designed to reduce vibration and ground noise to a minimum.
3. **ROBUST MILD STEEL BASE PLATE** 1" thick ensures rigidity, stability and freedom from vibration.
4. **GROOVE SPACING CONTROL** gives continuous adjustment of pitch when cutting outside/in or inside/out.
5. **GROUND STEEL LEADSCREW HOUSING TUBE** provides a generous cutterhead arm bearing free from side-play.
6. **HAND OPERATED TRAVERSING CONTROL** provides easy scrolling off and scrolling on.
7. **PATENTED ELECTRO MAGNETIC CUTTERHEAD** with built in equaliser, possessing exceptionally stable characteristics.
8. **CHANGE SPEED LEVER** provides instantaneous change to either 78 r.p.m. or 33 r.p.m.

Full details and technical data on request.
The G.E.C. M863B I.F. Alignment Unit — a most convenient "plug-in" unit makes possible thorough examination of the frequency response curve, width of the pass band and the peak separation in I.F. amplifiers.

**Specification:**
- Oscillator Mid-Frequency 400 Kc/s to 520 Kc/s — variable.
- Frequency deviation — Maximum ± 70 Kc/s — variable.

Price £8 10. 0. Please ask for leaflet No. X475.

**Double Beam unit**

With the addition of the M862B Double Beam Unit — the "Miniscope" is the most versatile and complete miniature oscilloscope available today. The Double Beam Unit employs a 1½" C.R.T.

**Specification:**
- Amplifier gain, maximum, X 40 approx.
- Frequency response, ± 1.5 db up to 40 Kc/s.

Price £12. 0. 0. Full particulars are in leaflet No. X365.

**Miniscope**

Miniature Cathode Ray Oscilloscope

**THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2**

**You are offering**

**^PEAK^ PERFORMANCE with the**

**THE IDEAL MICROPHONE FOR P.A. WORK, BROADCASTING AND RECORDING**

Here is a wide range high fidelity moving coil type Microphone which combines good sensitivity with a level response curve. Equally suitable for Auditorium or Outdoor Work, and its use can confidently be advised for Amateur as well as Professional use. Housed in modern streamlined die cast alloy case of great strength and finished in hampered metallic lacquer with chromium plated grille. Delivery from stock. List price £8.80

Dimensions 3" diam. 3½" back to front, Net weight 2 lb. Frequency response 60-9,000 c.p.s. Output impedance 15 ohms. Fitting 5/16" B.S.F. Connection 2-pin plug.

**SPHERE INSTRUMENTS**

**TELEVISION ADAPTOR UNIT TYPE S.C. "88"**

Adaptor Unit

S.C. "88" eliminates costly troublesome conversions

IT ADAPTS THE "LONDON"-DESIGNED TELEVISION RECEIVER FOR SUTTON COLDFIELD RECEPTION — PERFECT SOUND AND VISION

Small and compact, the unit, embodying power-pack, and all the necessary "works," is simply fitted between aerial and set. Set itself is entirely untouched, and in its original state—thus retaining its full "design-efficiency." Of particular interest to "Fringe" viewers. Real saving of time, trouble and cost. Full details supplied.

Price 6 Gns. nett

**Manufacturers:**

**SPHERE RADIO LIMITED**

HEATH LANE, WEST BROMWICH, ENGLAND
Your career in **RADAR** starts in the R.A.F

First in the field with Radar, Britain still leads the nations in research into its future. That is why the Air Force is the finest Radar School in the world and offers such a wonderful opportunity to make Radar your career. You earn while you learn. You get an important job at the end of your training—as Radar fitter mechanic, assistant.

And Radar is only one of the many skilled trades open to men between the ages of 17½ and 33 who sign on for five years in the R.A.F.

**Learn your trade in the**

**ROYAL AIR FORCE**

**and be trained for life!**

---

**TO:** AIR MINISTRY

DEPT. 3A, VICTORY HOUSE, KINGSWAY, LONDON, W.C.2

*Please send full details of R.A.F. careers.*

**NAME**

**ADDRESS**

**AGE**

EX-AIRMEN SHOULD ASK FOR DETAILS OF £125 BOUNTY SCHEME
"The All Metal Way" tells you how to build 4 simple, safe and efficient E.H.T. units with

**WESTALITE**

RECTIFIERS

and also gives details of rectifiers for H.T. and L.T. supplies and detection.

Three E.H.T. units are described where E.H.T. up to 5kV is obtained from the 350-0-350 volts winding of the normal mains transformer; and one unit which gives up to 6kV from the line output transformer.

**TELEVISION from 50 OR 110 VOLT D.C. SUPPLIES**

BUILT TO MEET THE NEEDS OF THE MOMENT BY VALRADIO—THE CONVERTER PEOPLE.

This Power Unit is designed for driving the **PYE UNIVERSAL AC/DC TELEVISION RECEIVER** from Low Voltage D.C. supplies of 50 or 110 volts.

The output is D.C., with less than a ½-volt ripple, resulting in an exceptionally steady picture. The conversion efficiency is 80% with a current consumption of 1.4 amps on 110-volts or 2.8 amps on 50-volts supply.

**TYPE No. 240/125/110-A or TYPE No. 240/125/50-A.**

**PRICE £16-0-0**

Literature upon request to

**VALRADIO LIMITED**

57 FORTESS ROAD, LONDON, N.W.5

**GULiver 5165**
The magnitude of EKCO

This is the symbol of the Ekco organisation, whose products are recognised throughout the world as among the finest in their class.

Ekco Radio and Car Radio are already in service in many lands, and as overseas television transmission develops Ekcovision will follow. Valuable contributions to the safety and efficiency of civil aviation have been made by Ekco VHF Aircraft Communications Equipment, and will be made in the future by Ekco Cloud and Collision Radar Equipment. Famous ships of many nationalities, including the "Queen Mary" and the "Queen Elizabeth" employ the Thermovent system of electric space heating, as do the homes and offices of countries far and wide. Scientific research is aided by the wide and fast-growing range of Ekco Nucleonic Equipment, while industries of every kind turn for the solution of their moulding problems to Ekco Plastics.

Such is the magnitude of the Ekco organisation, whose long-standing reputation for quality and reliability is your assurance of satisfaction.
THE NEW
ULTRA
'TWIN 50'

SOME DESIGN FEATURES

★ Built-in frame aerial.
★ Two Wave Bands—Medium Wave 190 to 550 metres, Long Wave 1150 to 2000 metres.
★ Equal performance on A.C. mains, D.C. mains or battery.
★ Separate H.T. and L.T. batteries for increased economy.
★ High Q coils and I.F. transformers with silver mica capacitors giving maximum stability, conversion gain and selectivity.
★ Specially cushioned detector valve and tuning condenser.
★ Automatic mains to battery change-over.
★ 5in. moving coil speaker.

★ Valves — V1, Mazda ICI low noise frequency changer; V2, Mazda IF3 high gain I.F. amplifier; V3, Mazda IFD9 high amplification diode pentode for A.V.C., detection and audio amplification; V4, Mazda IP11 output pentode. Metal Rectifier. These valves are button base miniature valves, giving very high performance with low current consumption.

★ New handsome design. Weight only 11lb. with battery.

See it ... hear it ... at your Ultra dealers ... and walk out with it for

£15.16.6 tax paid
(including battery)

ULTRA ELECTRIC LTD., WESTERN AVENUE, ACTON, LONDON, W.3

B.P.L. TEST SETS
NOW AVAILABLE
AT NET PRICES

B.P.L. UNIVERSAL TEST SET
£5 - 10 - 0

B.P.L. SUPER RANGER 1,000Ω/v.
£12 - 5 - 0

B.P.L. SUPER RANGER 20,000Ω/v.
£14 - 10 - 0

Prices include postage and packing.

Send your order direct to:

BRITISH PHYSICAL LABORATORIES
HOUSEBOAT WORKS, RADLETT, HERTS

Tel: Radlett 5674-5-6
Smaller Vacuum Thermal Delay Switches

These two new delay switches are recommended for use wherever a switching delay of 30-180 secs. is required. They have been developed for use in applications similar to those of the EDISWAN DLS10 but, in line with modern equipment design — which makes the physical size of the switches of prime importance — the dimensions have been reduced to the minimum compatible with reliability and ruggedness.

The DLS15 is intended as a plug-in replacement for the DLS10 while the DLS16 fulfils the demand for a delay switch with a 6.3v heater and an International Octal base.

### DLS15 Rating.
- Filament Voltage (volts) ... ... ... 4
- Filament Current (amps) ... ... ... 0.75* (at approximately 4 volts)
- Delay time at 4 volts (secs.) ... Min. 30 ; Max. 90
- Minimum Peak Current (low voltage rating) 5 amp at 240v.
- Maximum Peak Current (high voltage rating) 100mA at 1 kv.
- Maximum overall length (not including pins) 60 mm.

### DLS16 Rating.
- Filament Voltage (volts) ... ... ... 6.3
- Filament Current (amps) ... ... ... 0.48* (at approximately 6.3 volts)
- Delay time at 6.3 volts (secs.) ... Min. 30 ; Max. 90
- Minimum Peak Current (low voltage rating) 5 amp at 240v.
- Maximum Peak Current (high voltage rating) 100mA at 1 kv.
- Maximum overall length (not including pins) 65 mm.

* at approximately 6.3 volts
EFFICIENCY and ELEGANCE

ANTIFERENCE CAR AERIAL

A single mounting telescopic aerial of brass tubular construction with heavy chromium plated finish. The smartly styled mounting provides for adjustment of the angle of the telescopic rods to suit the body line of the car. This greatly improves the appearance of the angle when fitted. The insulator has a built-in standard co-axial socket enabling the lead to be easily plugged after mounting. The socket is fitted with a special retaining spring preventing any loosening of the plug through vibration. All parts of the aerial assembly are non-rusting and easy telescopic action is ensured by lubricated packing glands which also completely prevent rattling.

Why you should use...

Superspeed SPECIAL Activated ROSIN CORED SOLDER

1. Maximum "Wetting" Capacity.
2. Accelerated Fluidity.
3. Moderate soldering bit temperatures.
4. Mechanical bonding and perfect Electrical conductivity ensured.
5. Minimum amount of solder used per joint.
6. Residue sets hard, is non-corrosive, and of high dielectric strength.
7. No harmful fume deposits.
8. Continuous, unvarying core.
9. Even distribution of activator in core.
10. Approved by Air Ministry and General Post Office.

Supplied in a wide range of Gauges and Alloys on 1 lb and 7 lb reels, works coils, or as required. Prices on application.

Sole Manufacturers:

H. J. Enthoven & Sons, Ltd.
89, UPPER THAMES STREET, LONDON, E.C.4.
Phone: Mansion House 4033. Works: Rotherhithe, Graydon, Derbys. H.S.

Research and industry

The CONSTAC Transformer

A versatile constant voltage transformer which provides a fully stabilised heater supply in addition to a variety of stabilised H.T. outputs. Available in a range of types suitable for 110v. or 230v. 50 or 60 c/s supply and for loads of 20VA to 300VA. Output voltage maintained within 1% over working range.

* Made under licence by The Banner Electric Co. Ltd.

ELECTRONIC INSTRUMENTS LTD
17, PARADISE ROAD, RICHMOND, SURREY, ENGLAND
CERAMICS FOR TRIMMER CONDENSERS and all radio components FREQUENTITE-FARADEX-TEMPRADEX

STEATITE & PORCELAIN PRODUCTS LTD.

Stourport-on-Severn, Worcestershire  Telephone: Stourport 111  Telegrams: Steatain, Stourport
THE RADIO TELEPHONE YOU CAN TUCK UNDER THE DASH

THE RADIO TELEPHONE YOU CAN TUCK UNDER THE DASH

ACCELERATION of production-line speed means economy . . . .

Wherever heat applications are specified in production lines, consult Radiant Heating Ltd. Our special gas equipment can give optimum speed together with precision and economy . . . .

Write to:

RADIANT HEATING LTD

for advice on heating problems

9 BARNSBURY PARK, N.I. "Phone: NORth 1677/8

NOTE THESE FEATURES

Size T/R. 11\(\times\)8in. \(\times\)4in. (30 cm. \(\times\)21 cm. \(\times\)10 cm.)
Power Pack 8in. \(\times\)5\(\frac{1}{4}\)in. \(\times\)3\(\frac{1}{2}\)in. (21 cm. \(\times\)14 cm. \(\times\)8 cm.)
Weight T/R 15\(\frac{1}{2}\) lbs. (7 kg.), Power Pack 9\(\frac{1}{2}\) lbs. (4.2 kg.)

The Transceiver is easily installed below the instrument panel with the small power pack in any convenient place. The remarkably low battery drain permits connection of the set to the car batteries, obviating the cost and weight of auxiliary accumulators or larger dynamo.

B.C.C. V.H.F.
RADIO TELEPHONE EQUIPMENT

The B.C.C. Mobile Radio-Telephone illustrated here will give two-way communication with the Fixed Station up to a distance of 25 miles or with the portable Pack-set up to 5 miles.

This B.C.C. equipment sets a new standard in V.H.F. Communications Technique and has been approved by the G.P.O. The complete range consists of:

- Fixed Stations ... Models L111 & H111
- Mobiles ... ... Models L67 & H67
- Pack Sets ... ... Models L45V & H45V
- Hand Portables ... Models L45AV & H45AV

This equipment can be supplied to cover any spot frequency in the 75-100 Mc/s or 150-185 Mc/s bands.

Write now for full details and outstanding features of this remarkable equipment.

BRITISH COMMUNICATIONS CORPORATION LTD. Gordon Avenue, Stanmore, Middlesex. Tel. GRImsdyke 1455

ACCELERATION of production-line speed means economy . . . .

Wherever heat applications are specified in production lines, consult Radiant Heating Ltd. Our special gas equipment can give optimum speed together with precision and economy . . .

Write to:

RADIANT HEATING LTD

for advice on heating problems

9 BARNSBURY PARK, N.I. "Phone: NORth 1677/8

TELEVISION KITS! £20

- 21 VALVES
- SUITS 9", 10" or 12" TUBES
- LONDON OR BIRMINGHAM
- POINT TO POINT WIRING
- ADVICE DURING CONSTRUCTION

Write for details

FOR LONG RANGE RECEPTION
High Gain Pre-Amplifiers
One Valve 30/- Two Valves £2
Fully aligned and tested, with valves

HOUGHTON & OSBORNE LTD.
Electron Works, Thame, Oxon.
Telephone: Thame 182
The Cossor general purpose Oscillograph is designed and built by electronic engineers who are themselves familiar with the everyday problems which technicians have to face.

The instrument consists of a Double Beam Tube operated at 2kV., a Time Base, Y Deflection Amplifiers and Internal Power Supplies. The 90mm. screen is flat, and traces are presented over the full area. Signals are normally fed through the Amplifiers, and the calibrated Y-Shift controls provide a measurement of the applied voltages. The Time Base operates repetitively, or by external trigger (for single stroke operation), or at trigger pulse repetition frequency for continuous scanning. A calibrated X-Shift Control is provided for the measurement of Time.

Further details obtainable on application to:

A. C. COSSOR LTD., INSTRUMENT DIVISION, Highbury, London, N.S
Where the "H" Type Aerial is not good enough — use the Model 63 High Gain "Fringe" Aerial. Gives more than 8 db's gain over a half-wave dipole, and 30 db's. + back-to-front ratio. Spacing is 0.1 λ and 0.15 λ for the Director and Reflector respectively, reducing the input impedance to a very low figure. The impedance is then restored to the 80 ohm level by the use of a folded dipole. The Aerial is supplied with a 10ft. x 2in. Diameter Mast and double-lashing chimney fixing at £8 10s. retail.

Excellent results in Bristol and many other "fringe" areas. Suitable cables for above are:—

Cat. 476. Twin Screen feeder, 1/6 yard.
Cat. 341. Coaxial (Stranded Core), 1/- yard.
Cat. 385. Low-loss Coaxial, 2/ yard.

**MODEL 63**

The well-tried Inverted "T" Loft Aerial can be relied upon to give excellent results within sight of the transmitter.

**MODEL 53**

Requires only two screws to fix and may be used as a "V" or "L" Aerial and can be mounted in a loft, attic or upper room. Taking standard coaxial cable, the aerial is entirely non-directional. Price 25/-.

Cat. 341 Coaxial Cable, 1/- yard extra

CASTLE WORKS, STALYBRIDGE, Cheshire
THE combination of wide-range, high accuracy and low distortion will commend the Advance H.1 Audio Generator to all critical Service Engineers. The 15 c/s to 50 Kc/s coverage is achieved by the use of a bridge type resistance-capacity oscillator with three switched ranges. Stability throughout is attained by a highly efficient stabilizing circuit followed by two amplifier stages with heavy negative feedback.

Output: Sine wave 200 microVolts to 20 Volts, plus/minus 1 db, or Square wave 400 microVolts to 40 Volts (800 microVolts to 80 Volts peak to peak). Measured distortion is less than 1% at 1,000 c/s. In attractive cream enamel sprayed steel case, $13\frac{3}{4}$" x 10$\frac{1}{2}$" x 8". Weight only 14 lbs.

LIST PRICE £20

*The Scale reproduced above is actual size.
**Video Oscillator**

Type. 0.222 7 Kc/s - 8 Mc/s

Amplitude range of adjustment: +10 db to -55 db on 1 volt peak to peak, adjustable - 0.5 db steps. Amplitude constant to ± 0.2 db at any frequency setting. Harmonic content better than 50 db below fundamental - output impedance 75 ohms ± 5%.

The instrument is built to meet a specification of the Design Department of the B.B.C. It can be mounted to a standard G.P.O. 19" rack or alternatively is supplied with a light transportable case as illustrated.

---

**DURALUMIN FOR T-V AERIALS**

**JAMES BOOTH & COMPANY LIMITED**

DURALUMIN, the aluminium alloy which combines great strength with lightness, is ideally suitable for television aerials. It is of good appearance, withstands wind and weather, will not rust and is non-magnetic. Moreover, DURALUMIN is easily workable without the aid of special tools.

Our range of non-ferrous metals covers every requirement in the wireless field, whether it be aluminium alloys, brass or copper, and is available in a variety of forms including extruded rods and sections, tubes, sheet, strip and wire.
NEW high efficiency
E.H.T. rectifier
for
Television Tubes

RATINGS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament Voltage</td>
<td>1.4 volts</td>
</tr>
<tr>
<td>Filament Current</td>
<td>0.14 amp</td>
</tr>
<tr>
<td>Peak Inverse Voltage</td>
<td>15 max. kV*</td>
</tr>
<tr>
<td>D.C. Output Current</td>
<td>2 max. mA</td>
</tr>
<tr>
<td>Peak Anode Current</td>
<td>12 max. mA</td>
</tr>
<tr>
<td>Surge Anode Current</td>
<td>40 max. mA</td>
</tr>
<tr>
<td>Anode to filament capacitance</td>
<td>0.65pF</td>
</tr>
</tbody>
</table>

* For circuits where anode and filament voltages rise at approximately the same rate, e.g., as in fly-back and R.F. oscillator circuits. Where used on power input circuits with full A.C. anode voltage applied on switching, the maximum P.I.V. is 10 kV.

MINIATURE BULB

The Osram type U37, because of its low filament rating and capacitance, greatly improves circuit efficiency. This miniature directly-heated half-wave rectifier has been primarily designed to provide EHT for cathode ray tubes from an R.F. source or by rectification of the fly-back voltage. It is also suitable for use in peak reading voltmeter circuits where its low capacitance allows satisfactory operation at high frequencies and its 1.4 volt filament may be operated from a single unit cell. It is a soldered-in type valve, 48 mm. overall excluding connections.

THE GENERAL ELECTRIC CO. LTD. MAGNET HOUSE, KINGSWAY, W.C.2
The Police "999" emergency call system depends for its successful operation on instantaneous radio communication between Police headquarters and the fleet of patrol cars. Radio equipment in the patrol cars is used under the most arduous conditions but it must be available for instant use 24 hours in the day.

No wonder then that more and more Police authorities throughout the country are using G.E.C. quartz crystals in their radio equipment.

Pioneering research and experience in making over a million units, ensure a product of the highest quality. For all your quartz crystal requirements be sure to specify G.E.C.

Quick delivery service for urgent requirements for experimental or replacement purposes.

Write for our leaflet QC.4904.

22,050
22,250
22,350

20 years ago, a high standard of reproduction was being set by Voigt high flux density speakers with over 16,000 gauss across a 2 mm. gap.

Later an improved diaphragm with speech coil operating in a 1½ mm. gap at higher density, effected a further advance.

Our new rematched diaphragm (which fits existing VOIGT Units) has a speech coil requiring a 1 mm. gap only. Our open type P.M. Units with revised pole tips provide a flux density still higher in a 1 mm. gap.

The figures above give our measurement of 3 out of the first 5 P.M. open type 1 mm. gap Units assembled in 1950. They show that a density between 22,000 and 22,500 can be achieved under practical conditions. As this 40% increase over the original 16,000 provides a magnet well ahead of present day requirements, and is within 90% of the maximum obtained under "stunt" conditions, we are stabilising our design and making 22,000 gauss the 1 mm. gap poss. figure for our open type P.M. Units.

**VOIGT SPEAKERS ARE INTENDED FOR HORN LOADING**

Price £40 ex-Works. Suitable horns (in the white), £19/10/- and £47/10/- ex-Works.

SEND YOUR ORDER TO:-

c/o BCM/Voigt
W.C.1.

(Trade supplied against pro forma)

*Patents granted and/or pending.*

---

**TEL-E-RADIO (1943) LTD.**

177, EDGWARE ROAD, LONDON, W.2

**COMPONENTS FOR QUALITY AMPLIFIERS.**

Chassis punched and drilled...

Partridge mains transformer 425/150 mA...

Partridge mains transformer 425/200 mA...

Partridge smoothing choke 25H 40 mA...

Partridge smoothing choke 13H 200 mA...

Partridge Williamson output transformer (wire ends)...

Partridge Williamson output transformer (Tag Board)...

Wharfedale L.S. W10/CS 10in. cloth suspension...

Wharfedale L.S. Golden 10in. Unit 2/3 & 15 ohms...

Wharfedale L.S. Super 8/CS. 2/3 and 15 ohms...

Goodman's single cone loud speakers Audio 60...

Goodman's double cone loud speakers Axom 12...

Vitavox K 12/10 loudspeaker...

Partridge output transformer PPO/0 6,000 ohms A-A, Sec. 3-75 & 15 ohms...

Partridge output transformer PPO/1 8,000 ohms A-A, Sec. 3-75 & 15 ohms...

Partridge output transformer PPO/2 10,000 ohms A-A, Sec. 3-75 & 15 ohms...

Matched KT66 valves per pair...

Matched 6V6 valves per pair...

Matched 6F6 valves per pair...

Matched PX4 valves per pair...

Matched PX25 valves per pair...

Matched 684 valves per pair...

Matched 2A3 valves per pair...

"The Williamson Amplifier" booklet as reprinted from "Wireless World," post free, 3s. 9d.

Williamson quality amplifier can be seen and heard at our premises in Edgware Road. When ordering please include sufficient for postage and packing. Shop Hours: Monday-Saturday 9 a.m.-6 p.m. Thursday, 9 a.m.-1 p.m. Phone: PAD 616 or 5068
WALKIE-TALKIE (Transmitter and Receiver)

250-0-250 v., 4 v., and 6.3 v.

NEW MAINS

Loudspeaker for A.C. mains 220/250 v.

aerial tested. Complete with Power Pack and Enclosed In metal case. Every receiver is Required to operate.

UNUSED IN

Freq. range 7.5 me/s 75 kc/s in five wavebands.

PHONE is mounted on a fully adjustable stand AND HEADSETS (Sound Power).

JUNE, 1950

WIRELESS WORLD

RECEIVER ONLY

BRAND NEW ACCUMULATORS

the four ARP12, one ATP4 valves.

(Carr. and pkg. 10/6).

£11.10.0

Complete with components, Type 1155 TRANSFORMERS. 16/

Mk. 38

38

Mk.

83

Weight, 12 x 9 x 7 in.

27/6

10/-

0

8/-

10/-

Carriage and packing 5/-.

6 v.

Size

45 lb.

6 v., 4-

ohm.

necesssary. High fidelity reproduction,

bodies, such as the B.B.C. and G.P.O. for speaker transformer.

These ended spindles. 220-250 v.

Orders to New

33

£3.19.6

British

in

6 v., 4-VALVE USED SUPERHET

216.10.0

Price

21/-.

21/-.

21/-.

21/-.

21/-.

Limited Number only

33

£3.19.6

RADIO STORES

Setting-Earing Table Microphone

Call and inspect our stocks of Audio and Applications.
Sit back and enjoy the NEW—
‘CONCERT MASTER’!

This latest high fidelity amplifier has all the features which you have asked for. Of impeccable performance, it is of compact size and includes a detachable control panel which is quite unique. It contains no valves, and has no H.T. or L.T. voltages. It is instantly removed by snap fasteners and makes the amplifier eminently suitable for fitting into a cabinet, the main amplifier being placed at the bottom and the control head on its six feet cable can be placed just where you want it. This last word in amplifier design will take high or low output pick-ups and has provision for radio and microphone inputs.

Write for your copy of our fully illustrated catalogue today!

THE TRICORNE SPEAKER CHAMBER

For optimum acoustic performance with any good 12-in. speaker. Labyrinth construction, walnut veneered and cross-braced.

Price 11 gns. plus 20/- deposit (returnable) for crate.

Phone : WESTern 3350

DEPENDING LABORATORIES

TO, LORD AVENUE, ILFORD, ESSEX

SOLVE YOUR RADIO PROBLEMS WITH

OUR HOME CONSTRUCTOR UNITS!

ANYONE can build our handsome SUPERHETS!*

The performance will equal that of commercially built units at half the cost, so you can be EXTRA PROUD of your achievement!

As our delighted friends already know the secret is our 30 TUNING UNIT comprising the famous 3 band 30 Coil packs, "MM" I.F.T.'s, new Dial and 2 gang—ALIGNED AND MATCHED AS A UNIT! Price 54/9 (inc.) or 76/6 with J.B. S.L.E. spin-wheel Tuner. All parts and full construction Sheets available for Feeder Units, 4, 5 and 6v. sets. Quality Amplifiers, Test Gear, etc. For details, all the circuits, data, etc., send 1/4 NOW for NEW ENLARGED EDITION (44 pp.) of "Home Constructor's Handbook". All items supplied by Mail DIRECT ONLY from:

R.A. TUNING UNIT


THE K.I. AMPLIFIER


DEFERRED TERMS AVAILABLE ON ALL MODELS

FOR THE UTMOST REALISM FROM RECORDS & RADIO

DEPENDABILITY

Reception conditions range from excellent to very poor, signal strength from strong to very weak, and to cope successfully with all such conditions you need a pair of highly sensitive and dependable headphones.

For maximum reception results, insist that your local dealer supplies you with a pair of the rightly famous S. G. BROWN Type "F" headphones. Sea, land and air W/T operators, servicemen, experimenters and radio amateurs all vouch for their dependability.

TYPE "F" (FEATHERWEIGHT)

PRICE 30/- PER PAIR

YOUR LOCAL DEALER CAN SUPPLY

Send for descriptive Brochure "W.W.", it gives details of full range. Prices from 36/- up to 105/- for Moving Coil Type K.

HEADPHONES WHICH UPHOLD BRITISH PRESTIGE

Telephone : Watford 2411

S.G.Brown, Ltd.

SHAKESPEARE STREET, WATFORD, HERTS.
In this new Ambassador Radiogram we have put quality reproduction before anything else. Its six valve A.C. superhet circuit possesses unusual features which contribute to the receiver's most outstanding fidelity of reproduction. The response of the whole L.F. system to the L.S. terminals is flat within 1.2 D.B. limits from 50—12,000 c.p.s. Push-pull output via a high quality output transformer feeds a 12" high flux density loudspeaker.

**PRICE £72.00 TAX PAID**

**STYLED AND PRODUCED BY**:—

**AMBASSADOR**

RADIO WORKS, HUTCHINSON LANE, BRIGHOUSE, YORKS

---

**SIZE**

- 2\(\frac{1}{2}\)^"  
- 3\(\frac{1}{2}\)^"  
- 5^"  

**RANGE**

- 25\(\mu\)A to 50A  
- 10\(\mu\)A to 50A  
- 10\(\mu\)A to 50A  

**PRICE**

- 50\(\mu\)A: 55/-  
- 200\(\mu\)A: 45/-  
- 1mA: 35/-  
- 61/-  
- 51/-  
- 41/-  
- 93/-  
- 83/-  
- 73/-  

All sizes available with MIRROR SCALE  
1st Grade Accuracy

**SENSITIVE PANEL MOUNTING METERS**

For particulars of these and our full range of measuring instruments write to:

**BRITISH PHYSICAL LABORATORIES**

HOUSEBOAT WORKS · RADLETT · HERTS · Telephone: RADlett 5674-5-6
Wireless World

Suppliers of Loudspeakers to Britain's foremost Radio Manufacturers.

Reproducers and Amplifiers Ltd.
Wolverhampton, England.

In handsome Black Bakelite holder complete with series resistance and leads, to show Pink, Red, Amber or Green, on 230v or 400v AC or DC. Specially designed for easy assembly in ½-inch mounting hole.

Send now for full details, prices and terms.

THE ACRU ELECTRIC TOOL MFG. CO. LTD.
123, Hyde Road,
Manchester, 12.

ACRU
neon indicator lamps

For SWITCHBOARDS.
INDICATOR PANELS.
MACHINE CONTROLS.
HEATING APPLIANCES.

ONE-HOLE FIXING

Valves!! Valves!!
Receiving, Transmitting, Magnetrons, Klystrons, Cathode-Ray Tubes, Photocells, ETC.

Large Quantities & Great Varieties
Immediate Deliveries from Stock

Write or 'phone:—

S. Szymanski
(Pronounced SHE-MAN-SKEE)
Electronic Engineer & Stockist
95 Strodes Crescent
Staines - Middlesex
Staines 3971

Probably the Largest Actual Stockist in England

Export Enquiries Welcomed
At the turn of a switch you have two speeds, 33 1/3 or 78 r.p.m. The Turntable is a full 12" diameter; its main spindle precision ground and lapped, runs in phosphor bronze bearings. The synchronous motor is virtually vibrationless and is suitable for playing standard, transcription and microgroove recordings. Guaranteed mechanically perfect. New super lightweight pick-up available with the interchangeable heads for microgroove and standard recordings.

Manufactured by
A. R. SUGDEN & CO. (ENGINEERS) LTD.
WELL GREEN LANE
BRIGHOUSE
YORKS.

The TRUE TEST of an instrument is RELIABILITY

The "SELECTEST" is built for the main job in radio servicing — that of measuring VOLTS, AMPERES and OHMS — and nothing else. That was the intention. The result is that it does this job accurately and reliably — and will continue to do it. There is no better instrument for the job. You can rely on a "SELECTEST" — it's a G.E.C. Measuring Instrument.

Cat. No. M4111.

<table>
<thead>
<tr>
<th>VOLTS</th>
<th>AMPS</th>
<th>OHMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.C. 7.5, 15, 75, 150</td>
<td>A.C. 75, 150, 750mA</td>
<td>1,000</td>
</tr>
<tr>
<td>300, 600, 750, 1,500</td>
<td>1.5, 7.5, 15 A</td>
<td>10,000</td>
</tr>
<tr>
<td>D.C. 150mV, 300mV</td>
<td>D.C. 1.5, 3, 15, 30, 150, 300mA</td>
<td>100,000</td>
</tr>
<tr>
<td>1.5, 7.5, 15 A</td>
<td>1.5, 3, 15, 30 A</td>
<td>1 Megohm</td>
</tr>
<tr>
<td>1,500 V</td>
<td>F.S.D. 1 mA</td>
<td></td>
</tr>
</tbody>
</table>

Please send for leaflet No.X334

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2.
HOMELAB SIGNAL GENERATOR
(100 kcs — 130 mcs)
PRICE £9 - 9 - 0
C.O.D. or Cash Orders and enquiries to:—
HOMELAB INSTRUMENTS, 116, Grove Road, London, E.17
Showrooms: 374, High Road, London, E.11

Quality HR Television

Sets, Chassis and Components

NEW

PM FOCUSING UNIT
Rear operated shift controls.
Remote focusing control, worked through gears by key extending beyond cap of CR tube.
Alcomax Ill magnet.
Tube supporting plate for solid fixing concentric with neck of tube.
Type PM1.5A for tetrodes and PM20A for triodes.
Price 36/-
For further details ask for Technical Publication No. 44.

SCANNING UNITS for aluminised CR tubes, for circuit see Technical Publication No. 38 A
10KV. RF. E.H.T. UNITS:

TELEVISION RECEIVERS and COMPLETE SETS in SINGLE CHASSIS FORM, all with ALUMINISED CR TUBES.
Circuit booklet 1/6 post free.

HAYNES RADIO LTD. Enfield, Middx.

Unfortunately we have to increase the price. The rising cost of materials is partly to blame—the rest is due to our striving after perfection. Hundreds of HOMELABS have now been supplied, and in the course of production all improvements resulting from continued development have been incorporated. The result is an instrument of really outstanding performance which is being used in Universities, Industrial Organisations, Medical Research and other fields where the requirements are exacting and the price a secondary consideration.

For those experimenting with television and radio receivers the HOMELAB with its wide frequency coverage is an ideal instrument, and many are being used very successfully for these purposes. Why not call and see it yourself, not just the finished article in its attractive cabinet, but the works as well—we have nothing to hide. If you cannot call send s.a.e., for full particulars enclosing P.O. for 2/6 if the circuit diagram is required.

IMPORTANT. Orders at present on our books will be executed at the old price.

DELIVERY. 'The HOMELAB is not yet available ex stock. The supply position of difficult items has improved and a steadily increasing rate of production is being achieved. All enquiries will receive our prompt and courteous attention.

WIRELESS WORLD
JUNE, 1950

What we find is that many people are striving after perfection, and the cost of materials is partly to blame—the rest is due to our attention.

All goods post free over £1. Satisfactory guaranteed or cash refunded instantly. Return of post service.

Starz for Sale!

MOTORS
R.R.R. shaded pole types for recorders, fans, display, models, etc. AL, 3N/0.25watt 30/:-; R.E. 3N/0.5watt £1.50; FP16 4-pole type enclosed, 3N./0. £5.50.

GRAM MOTORS
Centre drive, variable speed, £12. convertible (no P.U.)

MODERN RIM-DRIVE types, 10kv., turntable, with magnetic pickups. Collaro AC111 £5/0; Garrard “A” £5/10/6;
Collaro AC04 with crystal P.U. £5/17/6.

AUTO-CHANGE UNITS
Marconi A.C. 100 plays 10in., or 12in., un-mixed, lightweight P.U. with matching transformer 10 mm.; De Luxe models cabinet ACP-100 £15/10/0; Collaro RC200, plays 10in., or 12in., un-mixed, RI-91 lightweight P.U. £10/15/0; Garrard ROMA plays 10in. and 12in. mixed, De Luxe model with plugs to P.U. head, £18/11/6.

PICK-UPS

SPEAKERS
W.B. Concentric Duplex with O.P.T. £8/6/0. Wharfedale De Luxe shock suspension type. Super £8/6/; Golden £6/10/0; W/S £7/6/0; 2 ohms or 15 ohms; W/T £8/10/0; W/T £7/6/0; 15 ohms only. Goodman, new enclosed streamlined type, Audiom 8/-, 12/-, £10/5/-; Axton 8/-, 12/-, £10/5/-; Axton 15/-, twin cone 12/-, £12/6/-, £10/5/0. All the above speakers have die-cast chassis.

BOOKS

(Blank page)

TV
Full supplies of parts in stock for all popular television designs, coils, transformers, capacitors, resistors, valves, G.B.T.E., transformers, chokes and controls.

JUNE, 1950

WIRELESS WORLD

Fitch Radiocraft Ltd.
MINIATURE VITREOUS ENAMELLED RESISTOR

**TYPE M.V.1**

- **RATING**: 3 watts for 250°C rise.
- **RESISTANCE RANGE**: 1-4700 ohms.
- Full rated watts over the whole resistance range
- **DIMENSIONS**: 15/32” x 13/64”

It’s so simple!

- Recording with a magnetic recorder is simplicity itself.
- The portable unit shown will record continuously for one hour and recordings may be played over on the machine as often as desired or erased and the wire used again and again for further recordings.

**IMPORTANT!**

A new TAPE RECORDER will be available shortly

**PAINTON**

of NORTHAMPTON

**KINGSTORPE, NORTHAMPTON.**

**Simon**

**SOUND SERVICE**

**It’s so simple!**

- Recording with a magnetic recorder is simplicity itself.
- The portable unit shown will record continuously for one hour and recordings may be played over on the machine as often as desired or erased and the wire used again and again for further recordings.

**IMPORTANT!**

A new TAPE RECORDER will be available shortly

---

**SIMON SOUND SERVICE**

Recorder House, 48/50 George Street, Portman Square, London, W.1, England

Telephone: Welbeck 2371 (4 lines)  
Telegrams: Simsale, Wesdo, London  
Cables: Simsale, London
TELCON have recently introduced a new 80 ohm balanced screen twin feeder for fringe area operation. This coupled with our well-known K.12.SM. covers all possible requirements for screened twin television aerial feeders.

<table>
<thead>
<tr>
<th><strong>CABLE CHARACTERISTICS</strong></th>
<th><strong>Local</strong></th>
<th><strong>Fringe</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area</strong></td>
<td>K.12.SM.</td>
<td>BA.24.PSM.</td>
</tr>
<tr>
<td><strong>Code</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Attenuation db/100 ft. at 45 Mc/s</strong></td>
<td>5.9</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Overall diameter</strong></td>
<td>0.232&quot;</td>
<td>0.297&quot;</td>
</tr>
</tbody>
</table>

Further details of these and other R.F. Cables on application.

---

**BAKERS 'Selhurst' RADIO**

Pioneers of Moving Coil Speakers since 1925

**NEW "HIGH FLUX" 1950 MODELS**

**HIGH FIDELITY SPEAKERS**

The World Famous 12" triple cone 12.B.

The standard 12" P.A. model 12.C.

The Cinema Model 18" "Duplex" C.T.

Write for Illustrated list and technical details of SPEAKERS, TUNERS and AMPLIFIERS.

BAKERS 'SELHURST' RADIO

Dingwall Road, Croydon

Telephone CRoydon 2271/2

---

**COIL PACKS**

Improved performance at lower price with the new F. P. series.

3 and 5 waveband models with or without R. F. stage.

**VALVE TESTER**

Type 218 for the Laboratory and Service Engineer.

Manufactured by:—

H. C. ATKINS LABORATORIES LTD.

World Sole Concessionaires:—

HERMES PRODUCTS (Export) LTD.

32 CUMBERLAND RD., KEW GARDENS.

Telephone—Richmond 2950.
Why not a personal Signal Generator for your design engineers—especially a portable instrument operating from interchangeable mains or battery units and covering the wide frequency range of 70 kc/s to 70 Mc/s. So much more preliminary work can be done without waiting for the standard laboratory apparatus to be free or moved from one bench to another. And if the personal Signal Generator also incorporates its own crystal check plus a useful power meter—all at the cost of one inexpensive instrument—each engineer is equipped at all times to carry out his own experimental tests. To such facilities add a reliable accuracy of output and frequency calibration and you have the portable Receiver Tester—the ideal laboratory sub-standard. Full technical data is freely available.

MARCONI INSTRUMENTS LTD.
St. Albans, Herts. Telephone: St. Albans 6161/5.


WHEN TRANSFORMERS ARE SPECIFIED
THE NAME IS USUALLY WODEN

Woden components are specified for the most popular circuits published in the leading technical journals.

Send for catalogue and details of components for the "Wireless World" Williamson Amplifier.

WODEN TRANSFORMER CO. LTD.
Moxley Road, Bilston, Staffs. Phone: BIL. 41959
Taylor moving iron meters are repulsion type instruments of an improved and patented design, noteworthy is the almost linear scale shape from 20% to full scale. Available in round flush and semi-flush rectangular types, many ranges are “ex stock”.

Illustrated catalogues of all Taylor products gladly sent upon request.

TAYLOR ELECTRICAL INSTRUMENTS LTD
419-424 MONTROSE AVENUE, SLOUGH, BUCKS, ENGLAND
Telephone SLOUGH 21381 (4 lines) - Grooms & Cables TATLINS, SLOUGH

SERIES 350
Other products include: MULTIRANGE A.C. D.C. TEST METERS SIGNAL GENERATORS - VALVE TESTERS - A.C. BRIDGES CIRCUIT ANALYSERS - CATHODE RAY OSCILLOGRAPHS HIGH AND LOW RANGE OHMMETERS - OUTPUT METERS INSULATION TESTERS - MOVING COIL INSTRUMENTS

- CONSTANT VOLTAGE -
POWER SUPPLY UNITS

MODEL 101-C

Output: 250/400v. 0.250mA max.
Stability: Better than 0.1%.
Output Impedance: Less than 1 ohm.
Output Ripple: Less than 2mV. R.M.S
Mains Supply: 200/250v. 45-60c/s.
Regulation down to zero load.

DETAILS ON REQUEST.

ALL-POWER Transformers Ltd.
CHERTSEY ROAD, BYFLEET, SURREY
Tel: Byfleet 3224S.

The Revolutionary
GOLDRING
Headmaster
HYPERFIDELITY
PICK-UP

With an interchangeable Pick-Up Head for every type of record.
Supplied in attractive Display Carton complete with Goldring Tonaliser and Transformer.

Goldring Products include:
PICK-UPS, PICK UP HEADS,
SAPPHIRE JEWEL POINT NEEDLES, AND RADIOGRAM ACCESSORIES.

Write for full Descriptive Lists and Technical Information.

ERWIN SCHARF
49-51a DE BEAUVIOR ROAD, LONDON, N.1
Telephone: CLISSOLD 3424
Sintered Permanent Magnets

The DECCA ffr pick-up uses Murex sintered permanent magnets. Where small complex shapes with high magnetic efficiency and stability are required, sintered permanent magnets are essential.

Illustrated by courtesy of the Decca Record Co. Ltd.

Actual size of MAGNETS

MUREX LIMITED, RAINHAM, ESSEX, ENGLAND
Telephone: Rainham, Essex 240

A NEW LOUDSPEAKER
with greatly increased response

The latest addition to the well-known Wharfedale range of loudspeakers is the SUPER 8/CS/AL, a special model for H.F. reproduction. Embodying all the exclusive features of the popular Super 8/CS this new model has an aluminium voice coil which extends the effective response by almost one octave.

Wharfedale SUPER 8/CS/AL

WHARFEDALE WIRELESS WORKS BRADFORD ROAD, IDLE, BRADFORD, YORKS.
Telephone: IDLE 461.
Telegrams: Wharfdel, Idle, Bradford.
Leaders in their field

TMC.10 DUAL PROGRAMME UNIT

This equipment is specially designed for the dissemination of two simultaneous radio programmes in hospitals, nursing homes and infirmaries. Use can also be made of this versatile equipment in hotels.

Two separate superheterodyne radio units covering long, medium and short wave bands, and two 15 watt power amplifiers are built into one compact and attractive cabinet.

A built-in monitor speaker enables tuning adjustments to be made to each channel. Inputs for microphone and gramophone are included and it is possible to transmit speech over both channels simultaneously.

SR.20 RADIO AMPLIFIER

A 20 watt radio amplifier superbly engineered and attractively finished in brown crystalline.

Comprises a superheterodyne radio unit covering long, medium and short wave bands, coupled to a high fidelity 20 watt power amplifier.

Microphone and Gramophone inputs provide for amplification of speech and records if desired.

A monitor speaker is included which can be switched off at will, and can be used for pre-tuning radio.

Both low and high impedance outputs are fitted.

Particularly suitable for small factories, schools, restaurants, hospitals, canteens, hotels, theatres, clubs, etc.
In This Issue

EDITORIAL COMMENT .................................................. 201
NARROW-BAND PULSE COMMUNICATION.
   By Thomas Roddam ................................................. 202
SHORT-WAVE CONDITIONS. By T. W. Bennington ............. 205
TELEVISION MONITORS. By J. E. B. Jacob ...................... 206
SCREENING. By "Cathode Ray" ..................................... 211
THAMES RADIO SERVICE .............................................. 215
MODERN SOFT-SOLDERING TECHNIQUE.
   By R. W. Hallowes ................................................. 217
WORLD OF WIRELESS .................................................. 220
ELECTRONIC CIRCUITRY. By J. McG. Sowerby ................. 223
AMPLIFIERS FOR CARDIOGRAPHY. By B. J. Shelley .......... 227
TRENDS IN COMPONENTS .............................................. 229
UNBIASED. By "Free Grid" ............................................ 236
RANDOM RADIATIONS. By "Diallist" ............................... 237
LETTERS TO THE EDITOR .............................................. 238
MANUFACTURERS' PRODUCTS ........................................ 240

JUNE 1950
THE OPTICAL SYSTEM

The picture produced on the screen of the MW6-2 picture tube occupies an area approximately 2in. x 1½ in. The optical unit of the Mullard Projection Television System enlarges this picture so that an image of one of the standard sizes (ranging up to 16 in. x 12 in. for cabinet viewing or up to 48 in. x 36 in. for wall projection) is seen on the viewing screen.

Of the various methods of optical enlargement available, that in which a spherical mirror is used as the enlarging element has been selected on account of its simplicity, its suitability for manufacture on a mass-production basis, and its high luminous efficiency.

The optical principle is indicated in the diagram where C is the MW6-2 picture tube, D a front-silvered concave spherical mirror, E a plane mirror mounted at an angle of 45° to the axis of the picture tube, F a lens of special contour to correct for spherical aberration, G a second plane mirror mounted at right angles to E, and H the viewing screen which for cabinet viewing is of the dispersive type and for wall projection of the reflective type.

A picture element A formed at the top of the raster emits light which is collected by the spherical mirror and is reflected as a convergent beam to mirror E and thence, via corrector lens F to mirror G from which it is again reflected, still as a convergent beam, to point J at the bottom of screen H, where it is visible as a magnified image of picture element A.

Similarly a magnified image of a picture element B situated at the bottom of the raster is brought to focus at K at the top of screen H.

The length of the optical path, i.e. the combined distance from corrector lens F to mirror G and from mirror G to screen H must, of course, be such that the spot is correctly focussed on screen H. The correct distance is determined by the contour of lens F, and the five standard models of the optical unit differ only in the design of the corrector lens, each model being suitable for a specified throw distance and corresponding picture size.

Equipment manufacturers are invited to send their enquiries to:

MULLARD ELECTRONIC PRODUCTS, LTD.,
SETMAKERS DEPARTMENT,
CENTURY HOUSE, SHAFTESBURY AVE., W.C.2
MVM 128
NEW TYPES FOR V.H.F. OPERATION

TYPE 5763 Miniature Beam Power Amplifier

Specially designed for use as frequency multiplier to 175 Mc/s., type 5763 will give considerable output for very small driving power. As a Class C power amplifier it will operate efficiently at frequencies exceeding 100 Mc/s.

RATINGS

<table>
<thead>
<tr>
<th></th>
<th>Doublerr</th>
<th>Tripler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Voltage</td>
<td>6.0 v.</td>
<td></td>
</tr>
<tr>
<td>Heater Current</td>
<td>0.75 a.</td>
<td></td>
</tr>
<tr>
<td>Heater Cathode Potential</td>
<td>100 v. max.</td>
<td></td>
</tr>
<tr>
<td>Anode Voltage</td>
<td>300 v.</td>
<td></td>
</tr>
<tr>
<td>Screen Voltage</td>
<td>250 v.</td>
<td>Absolute</td>
</tr>
<tr>
<td>Anode Dissipation</td>
<td>12 w.</td>
<td>maximum</td>
</tr>
<tr>
<td>Screen Dissipation</td>
<td>2 w.</td>
<td>values</td>
</tr>
<tr>
<td>Bulb Temperature</td>
<td>250° C.*</td>
<td></td>
</tr>
</tbody>
</table>

* At the hottest part of bulb surface.

Operation as Class "C" amplifier or oscillator at 50 Mc/s.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode Voltage</td>
<td>300 v.</td>
</tr>
<tr>
<td>Screen Voltage</td>
<td>250 v.</td>
</tr>
<tr>
<td>Driving Power</td>
<td>0.35 w.</td>
</tr>
<tr>
<td>Output Power</td>
<td>8.0 w.</td>
</tr>
</tbody>
</table>

Operation as Frequency Multiplier to 175 Mc/s.

<table>
<thead>
<tr>
<th></th>
<th>Doubler</th>
<th>Tripler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode Voltage</td>
<td>300 v.</td>
<td>300 v.</td>
</tr>
<tr>
<td>Screen Supply Voltage</td>
<td>300 v.</td>
<td>300 v.</td>
</tr>
<tr>
<td>Driving Power</td>
<td>0.6 w.</td>
<td>0.6 w.</td>
</tr>
<tr>
<td>Output Power</td>
<td>3.6 w.</td>
<td>2.8 w.</td>
</tr>
</tbody>
</table>

TYPE 2C26A Power Triode

This valve will function efficiently as oscillator or power amplifier at 150 Mc/s and is particularly suitable for pulse operation.

RATINGS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Voltage</td>
<td>6.3 v.</td>
</tr>
<tr>
<td>Heater Current</td>
<td>1.1 a.</td>
</tr>
<tr>
<td>Anode Voltage</td>
<td>400 v.</td>
</tr>
<tr>
<td>Anode Dissipation</td>
<td>10 w.</td>
</tr>
</tbody>
</table>

PULSE RATINGS *

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Anode Voltage</td>
<td>3,500 v.</td>
</tr>
<tr>
<td>Peak Anode Current</td>
<td>6.0 a.</td>
</tr>
<tr>
<td>Peak Grid Voltage</td>
<td>700 v.</td>
</tr>
</tbody>
</table>

* For Pulse length 10µS, Duty Cycl'ie 1 per cent.

WRITE NOW TO DEPT. 4530
for data sheets on the above valves.

BRIMAR
TECHNICAL ADVICE SERVICE

**THE ACOS G.P.20 MICRO-CELL PICK-UP**

Manufacturers: Cosmocord Ltd., Enfield, Middx.

Price: £2 10s. plus £1 1s. 5d. purchase tax.

In the interesting realm of gramophone pickups, the crystal types have always been capable of producing excellent results when designed correctly and when operated with the correct circuit constants. The Cosmocord organisation have specialised in this type of pickup for many years, and the unit now under review must be one of the finest approaches to perfection yet reached for this crystal type.

**Construction**

The pickup head is a really diminutive size, being about one inch high, half inch wide and five-eighths of an inch deep. The sapphire needle employed is mounted on a flat stiff torsion arm that freely accommodates vertical movement, and conveys the modulated track to the crystal without any lost motion. To prevent damage to the armature and needle a more rigid spring finger takes up the shock if the pickup is accidentally dropped on the record. The head is mounted in a neat moulding with an attractive chromium motif. The head is detachable from the carrying arm and contact is made via two small spring contacts. The arm is a cream moulding with an offset head in order to reduce the tracking error, and at the rear end is a beautifully smooth bearing, incorporating a counterweight so that the pickup pressure on the record is between 12 to 14 grams. The base for mounting the pickup to the motorboard is adjustable between 1½ to 2½ inches, thus accommodating all types of motor heights above the motorboard. An extremely thin screened lead from the head to the base is housed in a slot in the moulding, and due to its lightness it reduces drag to an absolute minimum.

The unit is supplied with a baseboard template for correct mounting and a moulded support for the pickup when not in use.

**Test Report**

The pickup was mounted according to the instructions, and the adjustable height of the arm greatly facilitated the correct position of the pickup head relative to the record. Frequency tests were done with various constant frequency records, with (a) an open circuit valve voltmeter, and (b) a wide range amplifier and Voigt domestic loudspeaker. The valve voltmeter test confirmed the published graph under this condition being flat from 30 cps. to 300 cps. followed by a gradual drop by 3db. to 1,000 cps. and remaining within 1 db. to above 10,000 cps. With an amplifier having a grid leak of 500,000 ohms input, the bass register fell below 100 cps. to 30 cps. By the inclusion of a simple resistance capacity filter in parallel with the pickup, the whole of the response above 300 cps. can be raised to that below and then the pickup response is sensibly constant throughout the recording range. On some of the full amplitude cut constant frequency records one always expects to hear much direct radiation from the pickup itself, but one of the most remarkable points of the Acon pickup is the almost complete absence of noise. On standard recordings of wide dynamic range, the direct noise is so small that it can be heard only when the amplifier is shut off.

Compared with other types of pickups that possess a similar wide band characteristic, the output is extremely high, for it exceeds a half volt on normal records, and can therefore be used with the majority of commercial radio receivers without the need for a pre-amplifier. A modern high fidelity magnetic moving coil and ribbon types usually have outputs in the order of millivolts or even less, and therefore it is essential to use a fair amount of pre-amplification before connecting the signal to the main amplifier. This point alone should encourage many potential customers to purchase this pickup. The vertical flexibility of the needle armature motor rumble, that is noticeable on more rigidly mounted armatures, virtually disappears. Due to the very low downward pressure of 12/14 grams coupled with the freedom of movement, the sapphire should last for many hundreds of playings before any noticeable wear is experienced. During the period of this test the needle was inspected before using it on an Adams and Hilger Shadowgraph that enlarged the needle by 50 times. After nearly twenty minutes of this treatment some 150 records were played, no measurable wear was found. The pickup was purposely dropped several times from two inches on to the record, and due to the efficiency of the spring protector no damage was suffered by the sapphire.

On physical records the results are truly outstanding. The delicacy of the violins, the soundness of the oboe, the snare of the timpani, and the pureness of the flute are all reproduced as nearly as the original as I have ever heard. Due to the lack of resonance within the recording range, the reduction of needle-scratch is most noticeable, giving a gentle "shush" in place of the normal "hiss." Transients are fully reproduced and the piano suffers none of the added damping that many pickups provide. Truly this is a remarkable pickup, and even more so when one considers the extremely low price of 50s. plus purchase tax. I am aware only of two other pickups that can compare in performance with the Acon Microcell, and both of those handsomely exceed £20. To the engineers who have developed such a remarkable crystal the manufacturers are to be congratulated with its low noise, high output and negligible record wear every praise is due, and although the U.S.A. was the home of the crystal pickup, it is still enjoyed in high popularity, they have nothing to compete with this unit.

It is understood that supplies of this pickup are now becoming more plentiful, and from now on they should be available in small quantities.
Providing technical information, service and advice in relation to our products and the suppression of electrical interference

20 MILLION

Twenty million of anything is a lot, 20 million megohms is the resistance of the new "Belling-Lee" high leakage resistance terminal specially designed for instrumentation in nuclear physics, triode electrometers, high resistance bridges, etc. A smaller type is available with a resistance of 3.6 million megohms. Tests were taken at 850 Volts D.C. 55° F and 70 relative humidity.

3-ELEMENT ARRAYS

We are often asked why we do not make a folded dipole array. Obviously if we felt that there was any practicable advantage over the type we do make, we would have done so long ago, but we have asked our Research Department for their comments which are quoted here:

1) The folded dipole enables the band width of a television aerial to be increased, but our most selective aerial, the "Multirod" 4-element array, is capable of resolving the test card 3 Mc/s bars on the better class receivers. Therefore, the use of the folded dipole would not provide any better definition, but would increase slightly the amount of input noise to the receiver and the susceptibility to interference from radio and radar stations, disheamer, and industrial R.F. heating apparatus operating on nearby frequencies.

2) The output from a folded dipole is no greater than that obtainable from a dipole when matched to the receiver.

3) The cost is obviously greater because of the additional material and assembly involved.

During the war, and in the services to-day, there are many applications for a folded dipole, largely on account of its greater bandwidth. For the purpose of television reception it seems to us that the development of the simple dipole with the impedance of 72 ohms is the most useful combination and the most economical to manufacture. We can hear the critics saying, "But 'Belling-Lee' aerials are expensive." Yes, the expense is not confined to the physical form the collector takes, there are many other considerations.

Repeating what we have often said before, raising a well designed quarter-wave spaced dipole and reflector by a few feet may give a greater improvement in signal than will be obtained by the substitution of a 3-element array at the original height. Readers will remember that we kept on stressing this point when we were asked for a 3-element array. We just do not see any useful improvement for the additional engineering involved. A 4-element array such as the "Multirod" is quite a different proposition.

LIGHTWEIGHT T.V. AERIALS

Why we prefer 1/3 λ spacing

Whereas the 1/4 λ dipole and reflector still tops the list as our standard television aerial, we have, for those not too far distant from a transmitter, or where an "H" is required only on account of its directional feature, recently introduced the lightweight range.

The elements of these new types have been reduced from 1/4 inch to 1/3 inch diameter, and the distance between dipole and reflector has been reduced. This raises the old controversy of picture flutter in wind 1/4 λ, versus 1/3 λ spacing, etc. Picture flutter is bound up with the rate of change of gain with separation of dipole and reflector. From zero spacing 1/4 λ the gain rises rapidly and thereafter falls very slowly by about 1 db. at 1/3 λ.

The effect of flutter may be demonstrated by anybody with the aid of a string on the tips of the elements by which they are pulled while the picture is being watched. There are two schools of thought, and we are ready to admit that we may have over-rated the appreciative faculties of the public, who are obviously prepared to tolerate a somewhat inferior picture in certain bad weather conditions. We have, however, not reduced the spacing of our new aerials to 1/4 but to 0.15 λ, i.e., approximately 1/3 λ; at this distance picture flutter is not likely to be troublesome as the curve depicting it is fairly flat between 1/3 and 1/4 λ. This allows us to reduce pole diameters from 2 inch to 1 1/2 inch and to supply lashings and cross-arms of lighter materials. This range must not be expected to stand up to heavy weather conditions in exposed locations, e.g., subject to south-west gales or in mountainous country.

MAKE A POINT OF PAINT

At this time of year, it is as well to remember that aerial installations may have suffered in the autumn and spring gales, and have been rendered unsafe or in need of maintenance. With the house decorating season at its height and the availability of long ladders on the premises, it is wise to arrange an inspection. Certainly all steel aerials and brackets, etc., should be treated to a coat of good paint. The cable should be examined for signs of chafing and the whole installation examined in a general way.

SUPPRESSION OF MOTOR CAR IGNITION INTERFERENCE

In the April issue, we invited readers of this page to write to us for a supply of leaflets printed by the Television Society which readers could send or hand to neighbours whose cars were "unsuppressed." The response has been most gratifying and others do please take advantage of this offer. We are beginning to feel that the efforts of the various committees interested in this matter, and our own efforts are at last bearing fruit. It has been a slow uphill fight and all can help. Viewers who have no car should also write for pamphlets. Dealers and garage owners have written for quantities and some garages fit the suppressors free of charge, presumably in the hope that the beneficiary will fill up with petrol at the same time—and perhaps come again.

"Multirod" with 14 ft. mast £13. 18s. 6d. L698 London, L699 Midland.

BELLING & LEE LTD
CAMBRIDGE AERIAL RD. ENFIELD, MIDDX, ENGLAND
Typical rack-mounted equipment

Wherever sound amplifying equipment is called for, there is a call for TRIX. From a portable outfit for a social gathering or a meeting to rack-mounted installations for large multiple-speaker broadcasting systems, the TRIX range covers every requirement — and every item backed by 25 years' experience and an unrivalled reputation for reliability.

Write for complete catalogue.

"TRIXETTE" portable automatic gramophone

12-watt High Fidelity Amplifier T101

Self-contained Portable Model B65 (open)

THE TRIX ELECTRICAL CO., LTD
1-5 MAPLE PLACE, TOTTENHAM COURT ROAD, LONDON, W.1.
TELEPHONE: MUSEUM 5817 GRAMS & CABLES: TRIXADIO, WESDO, LONDON.
HIGH QUALITY REPRODUCTION

"FIFTY and THIRTY WATT" CINEMA AMPLIFIERS
as illustrated for single or double P.E.C. input with separate adjustable bias. Full range of tone controls to suit all needs with built-in Exciter Supply if required.
PRICES range from 34½ gns. to 42½ gns.

TYPE C.P. 20A AMPLIFIER
For AC Mains and 12 volt working giving 15 watts output, has switch change-over from AC to DC and "Stand-by" positions. Consumes only 5½ amperes from 12 volt battery. Fitted with mu-metal shielded microphone transformer for 15 ohm microphone, provision for crystal or moving iron pick-up with tone control for bass and top. Outputs for 7.5 and 15 ohms. Complete in steel case with valves.
PRICE £28.0.0.

FOUR-WAY ELECTRONIC MIXER
This unit has 4 built-in balanced and screened microphone transformers, normally of 50-30 ohms impedance. It has 5 valves and selenium rectifier supplied by its own built-in screened power pack consumption 20 watts. Suitable for recording and dubbing, or large P.A. Installations since it will drive up to six of our 50 watts amplifiers whose base dimensions it matches. The standard model has an output impedance of 20,000 ohms or less, and any impedance can be supplied to order.
PRICE £24.0.0.

OTHER MODELS IN OUR RANGE OF AMPLIFIERS
"SUPER-FIFTY WATT" - - - - - PRICE 36½ gns.
"THIRTY WATT" - - - - - - - - " 30½ gns.
"10-15 WATT RECORD REPRODUCER" - - " 25½ gns.
These are fitted in well ventilated steel cases with recessed controls, as illustrated.

Full details upon request.
EXPORT ENQUIRIES INVITED.

VORTEXION LIMITED, 257-261 THE BROADWAY, WIMBLEDON, LONDON, S.W.19
Telephones: LIB 2814 and 6242-3
Telegrams: "Vortexion Wimble, London."
the user —

"I must congratulate you on your product which I think is one of the best I have heard. It compares favourably with much more expensive speakers."

the trade —

"I do agree with you when you state it to be the best speaker in domestic use. Quite candidly I will say it is the first time I have been satisfied with a speaker for quite a while . . . I can now say to my friends and customers 'There, that's the type of speaker you want.'"

the technical press —

"On a plane baffle the Concentric Duplex gives a clean and full-bodied bass response of surprisingly good quality for a 10 in. diaphragm. The diaphragm suspension is also of a type well suited for use in conjunction with a cabinet of the 'bass-reflex' type if this is preferred."

Wireless World February 1950

Table Cabinet Model - £11.3.0
Corner Console, less transformer £12.12.0

A 12in. chassis is now available and details will be sent on request.

WHITELEY ELECTRICAL RADIO CO. LTD. • MANSFIELD • NOTTS • ENGLAND

"YANKS ROLL IN LIKE LOCALS"

WHEN YOU HAVE A "D.X. PLUS TWO FEEDER UNIT" working in conjunction with the "TONEMASTER AMPLIFIER."

Every feature to ensure good listening is incorporated in this equipment, including Tone Controls, and Master Volume Controls brought out to a separate panel to facilitate mounting.

THE "D.X. PLUS TWO FEEDER UNIT" covers from 5 to 2,000 metres in five overlapping steps, plus infinitely variable selectivity, tuning indicator, etc.

THE "TONEMASTER" AMPLIFIER incorporates push-pull output, negative feedback and separate electronic tone control circuits.

OVERALL COST £44.10.0 plus purchase tax.

SOUND SALES' PRODUCTS are backed by 12 MONTHS GUARANTEE, plus 20 years' experience in the manufacture of electronic equipment.

IMPORTANT: We wish to disclaim that this company has any connection whatsoever, with any other firm marketing any product of a similar nature.

Sound Sales Limited
MANUFACTURERS OF ELECTRONIC PRODUCTS

London Office, Demonstrations
Lloyds Bank Chambers, 125 Oxford St., London, W.I. (Gertruda 8198)

Head Office and Works
West Street, Farnham, Surrey (Farnham 6461/3)
The WESTON S.75 Multi-Range Test Set

53 Ranges with Rotary Switch Selection
This uniquely comprehensive Test Set has 53 ranges for measuring AC and DC current and voltage, resistance and insulation. It is completely self-contained, with internal batteries to provide power for the ohms ranges and self-contained power pack for insulation measurement at 500 v. Selection is carried out by two 20-position switches. A fully protective safety device is fitted and is operative for forward or reverse overload. The 150 division 6" scale is uniformly divided and is fitted with an anti-parallax mirror. The set is enclosed in a handsome bakelite case and fully complies with B.S.S. No. 89 covering first grade instruments. Full details of this, and other Weston electrical measuring instruments will gladly be supplied on request.

SANGAMO WESTON LIMITED
ENFIELD, MIDDLESEX
TELEPHONE: ENFIELD 3484 (6 LINES) AND 1242 (4 LINES)
TELEGRAMS: SANWEST, ENFIELD

AREA DEPOTS:
201 St. Vincent Street, Glasgow. Central 6208
Milburn House, Newcastle-on-Tyne. Newcastle 26867
22 Booth Street, Manchester. Central 7904
33 Princess Street, Wolverhampton. Wolverhampton 21912
CERAMIC SWITCHES
For applications where only the best is good enough.
Stators and rotors of Frequentite "R" ceramic. All contact members of silver alloy.

Wright and Weaire Limited
138, SLOANE ST., LONDON, S.W.1 TEL. SLOANE 2214/5 FACTORY: SOUTH SHIELDS, CO. DURHAM

PLAN YOUR CAREER
RADIO - TELEVISION
and other INDUSTRIAL
ELECTRONIC subjects
ELEMENTARY & ADVANCED COURSES

DAYTIME
- Principles and Practice of Radio—1 year.
- Telecommunication Engineering—2 years.
- Electronic Engineering—3 years (including one year's practical training in E.M.I. Factories)—leading to C & G full Technological Certificate.
- Marine and Air Radio Officers' Course (for P.M.G. License).

also HOME STUDY
- Radio
- Television
- Industrial Electronics

Write for FREE BOOKLET to Dept: 16
E.M.I. INSTITUTES
10 PEMBRIDGE SQUARE, NOTTING HILL GATE, LONDON, W.2
Telephone: BATwater 3131/2.

STOP
AND SEND FOR DETAILS
LOOK INTO ALL THE FACTS
LISTEN TO RECORDINGS

DON'T CHOOSE UNTIL YOU HAVE ENQUIRED ABOUT
GRAMPIAN DISC RECORDERS
Grampian recording equipment has been supplied to The Egyptian State Broadcasting Corporation, Swedish State Broadcasting Corporation, G.P.O. Research Station and other authorities, and to a large number of private recording studios.

GRAMPIAN REPRODUCERS LTD.
Hanworth Trading Estate, Feltham, Middlesex
'TPhone: Feltham 2657 Grams: REAMP, FELTHAM
"I can most certainly say at this stage that the workmanship and finish are of a quality which I have never before encountered in the radio industry, despite the fact that my association with the industry in one capacity or another extends back over 27 years. I think you are to be congratulated all the more on this achievement in view of the increasing tendency nowadays towards inferior workmanship and design."

Part of a letter from a purchaser who is a very well-known engineer and whose identity is known to the Editor of "Wireless World."

UNDER CHASSIS VIEW OF THE TL/12 POWER AMPLIFIER

LEAK equipment is built to laboratory standards in materials and workmanship by experienced men.

TL/12 TRIPLE LOOP FEEDBACK AMPLIFIER Price £25.15.0
RC/PA REMOTE CONTROL PRE-AMPLIFIER Price £6.15.0

The high standard of workmanship of the TL/12 amplifier is apparent on inspection. Our claimed performance figures are substantiated by a NATIONAL PHYSICAL LABORATORY REPORT on tests they have made of the TL/12. We are the only amplifier manufacturers who publish such a report.

These amplifiers are the choice of many distinguished audio engineers for high quality reproduction in their own homes.

APPLY TO YOUR LOCAL DEALER FOR FREE 16-PAGE ILLUSTRATED BOOKLET W/TL/12 OR WRITE TO US.

H. J. LEAK & CO. LTD. (Est. 1934)
BRUNEL ROAD, WESTWAY FACTORY ESTATE, ACTON, W.3.

MINIATURE SUPERHET COIL PACK

Here is a REALLY SMALL COIL PACK which simplifies the design and construction of an ALL WAVE Superhet. It measures 3½ in. long, 1½ in. wide, and ¾ in. deep. Within these dimensions are contained the trimmers and fixed paddles. The unit is SINGLE HOLE FIXING and only four leads have to be connected to the Frequency Changer. Each unit is pre-aligned by the manufacturers and designed for an IP of 465 Kc. The ranges are Short, Medium and Long—standard ranges—and the coils wound with flat wire. Tuning capacity 500 pf.

SOLDER GUN

The Burgess Solder gun needs no introduction. It is the finest soldering instrument for radio and television engineers. No wanted elements to turn out. Press the button, count seven and the job is done.

BRAND-NEW AND BOXED

List price 7/6. OUR PRICE 52/6

2-Year Guarantee. Post free.

SUPPLY UNITS No. 1

Outputs 500 v. at 50 MA, 275 v. at 110 MA, fully smoothed and suppressed. Designed for use with Wireless Set 19. Input 12 v. D.C. This is the ideal Mobile Power Unit.

AS NEW 12/6

ALTIMETER LIMIT SWITCH

Consists of a two bank Yaxley Switch, each bank being single-pole eleven-way, and the two banks separated by two inches. Contains also eleven 2,700 ohm 1 watt resistors. Complete with dial and knob in aluminium case. Will make ideal multi-range meter selector switch.

BRAND-NEW. U.S.A. MADE

EACH 2/-

(Per post, 6d.)

POWER UNIT TYPE 228


ONLY 12/6

(Carriage, packing 7/6).

R.3515

21-valve radar units with six stage 14 MC L.F. Strip. There is sufficient space on the chassis to construct a complete TV receiver—excluding EHT. Valves: one EA50, ten 6P6G, five 6F36, three ECC33, one EF29, one EB34. (See article for specimen copy). BRAND-NEW IN TRANSIT CASES

£3 10 0

(Carr. Paid).

MINE DETECTOR AMPLIFIERS

Here is the chance to buy a spare amplifier chassis for the mine detector which you purchased. Complete with all components, but less valves.

BRAND-NEW

(Pack., 6d.)

TELESCOPIc AERIAL (as Dinsby)

Extends from 15in. to 9ft. Ideal for use with field-strength meters or portable receivers.

BRAND-NEW

(Per post, 9d.)

HAND MICROPHONES

Brand-new moulded bakelite hand microphones, with switch incorporated in handle. Complete with lead and jack. TWO for 3/-

(Pack., 9d.)

TRANSMISSION CONDENSER

A ceramic insulated condenser, having wide-spaced vanes, suitable for F.A. operation. Satisfactory for use on voltages up to 750 v. Capacity 130 pf.

£1 1/6

HIRE-PURCHASE FACILITIES ON VIEWMASTER COMPONENTS

We can offer facilities on components for VIEWMASTER television receiver according to the following scale:

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Components</th>
<th>Deposit</th>
<th>12 Monthly Payments of</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>W.B. Chassis, Tube Supports, Special Valve Holders etc.</td>
<td>£2</td>
<td>£8</td>
</tr>
<tr>
<td>B.</td>
<td>T.C.C. Condensers, LONDON</td>
<td>£2</td>
<td>9/1</td>
</tr>
<tr>
<td>C.</td>
<td>T.C.C. Condensers, MIDLAND</td>
<td>£2</td>
<td>9/6</td>
</tr>
<tr>
<td>D.</td>
<td>Westinghouse Receivers</td>
<td>£1</td>
<td>4/6</td>
</tr>
<tr>
<td>E.</td>
<td>Pleas Focus Ring etc. etc.</td>
<td>£2</td>
<td>7/-</td>
</tr>
<tr>
<td>F.</td>
<td>Morgantine Resistors, Q.Pots, Colvern Pois, Wearite Coils, Belling Feeders, Belling Connectors, G.R. Neons, Bulgin Panels and LONDON switch, MIDLAND</td>
<td>£2 5/11</td>
<td>£2 6/5</td>
</tr>
</tbody>
</table>

MINIMUM DEPOSIT £5. (Instruction Book 5/- extra).

HAVE YOU SEEN THE NEW M.O.S. NEWSLETTER?

Now in magazine style. Brings you the news and goods of the world. Send 2d. for specimen copy.

Terms: Cash with Order

MAIL ORDER SUPPLY CO.

33 Tottenham Court Road, London, W.1. MUS. 6067-9-9
Now being Delivered!

**PREMIER TELEVISOR KITS**

FOR LONDON AND BIRMINGHAM

USING 9" OR 12" MAGNETIC C.R. TUBES

£19·19·0 including all parts, valves and loud-speaker, but excluding C.R. TUBE

(Carriage and Packing 15/-)

**CIRCUIT DETAILS**

The Vision Receiver consists of 4 R.F. stages (EF54's) which are followed by a Diode Detector and Noise Limiter (6H6) which is directly coupled to the Video valve (EF54).

Complete Kit with valves, £3/16/0.

Carriage and packing 2/6.

The Sound Receiver comprises 3 R.F. stages (6SH7's) followed by a Double Diode Triode (6Q7), which acts as Detector and L.F. Amplifier. A Noise Limiter (EA50) is also incorporated. The output valve (6V6) drives a 10in. P.M. Moving Coil Speaker with closed field magnet, which is included in the Time Base Kit.

Complete Kit with valves, £3/16/0.

Carriage and packing 2/6.

The Time Bases employ blocking oscillators on both Line (6SH7 and 807), and Frame (VR137 and 6V6). E.H.T. (Non- lethal) is taken from the Line Output Transformer through a voltage doubler employing two valves (VIII). The Sync separators are 6H6 and 6V6.

Permanent Magnet Focusing.

Complete Kit with valves, £8/5/6.

Carriage and packing 5/-.

The Power Supply is from a double wound mains transformer completely isolating the receiver from the mains. The H.T. Rectifier is a 5U4G.

Complete Kit with valves £4/16/6.

Carriage and packing 5/-.

**EACH KIT OR INDIVIDUAL PART AVAILABLE SEPARATELY**

The following sensitivity figures prove that the Premier Televisor Kit is capable of reception at greater distances than any other standard commercial kit or receiver whether T.R.F. or Superhet.

**VISION RECEIVER**

Sensitivity : 25 µV for 15V peak to peak measured at the Anode of the Video Valve.

Sound Rejection : Better than 40 db.

Adjacent Sound Rejection : Midland Model. Better than 50 db.

**SOUND RECEIVER**


**"MAGNETIC" CONSTRUCTION BOOK**

3/-

167 LOWER CLAPTON ROAD, LONDON, E.5

Telephone : AMHerst 4723
SHELLARD MWD269 In Magnetron Tubes. We can offer a limited range of these new tubes. Price 25/6 each.

PREMIER MIDGET RADIO KIT. Due to greatly increased production we are now able to offer this kit at a greatly reduced price. Including an attractive Brown or Ivory Bakelite case, 12 in. long, 3 1/2 in. wide, 8 1/2 in. high. The valve line-up is 6K7, 6L7, 6V6 and a Selenium Rectifier in the A.C./D.C. model. Both are for use on 200 to 250 volt mains. The dial is illuminated, and the receiver presents a very attractive appearance. Coverage is for the new medium and long wavebands. Complete kits of parts with cabinet and diagrams, 35/- each. Purchase Tax, 6/-.

PREMIER MIDGET SUPERHET KIT. This powerful Midget Superhet Receiver is designed to cover the short wavebands between 200 and 537 metres. Two models are produced, one for 200-350 volt A.C. mains, and the other for 200-250 volt A.C. or D.C. mains. Both are supplied with the same plastic cabinet as the TRF Receiver. The A.C. valve line-up is 6K7, 6L7, 6V6 and a Selenium Rectifier. The A.C./D.C. line-up is the same, with the exception of the output valve, which is 25A6. The dial is illuminated, making a very attractive receiver. Complete kit of parts with cabinet and diagrams, 35/- each. Purchase Tax, 6/-.

PLASTIC CABINETS. - as illustrated above. In Brown or Ivory, 17/6.

COLLAR AUTOMATIC RECORD CHANGERS. Type RC100 Rim drive. Pioneers 15 in. or 12 in. records. A.C. 100 volt, with High Fidelity Magnetic or Crystal Pick-up, 10/15/-.

10/15/- With Sapphire Stylus, 15/10/-

COLLAR GRAMOPHONE UNITS. High-quality Rim-drive Motors, complete with Pick-up and Amplifier for A.C. or A.C./D.C. Mains. Type, RC100. 51/2/- With Crystal Pick-up, 6/17/-.

COLLAR GRAMOPHONES AT HALF YEARLY PRICES. Complete Lamp, Pick-up and Tuner for one unit. Auto Stop-Start, variable speed, 12 in. turntable, induction motor, 6 in. crystal, with Magnetic Pick-up, 26/6. With Crystal Pick-up, 77/6.

COWARD GRAMOPHONE MOTORS. A reliable Rim-drive Motor for A.C. 100-250 v. operation £2/17/6, with Turntable.

GOVERNMENT SURPLUS MAINS TRANSFORMERS. All types to cover from 200 volt to 50 cycle Mains. Type, 6/8-6/220. Price, 5/6 each.

220-240-250, 60 mA, 5 x 2 v., 63-9 x 2 a. 15/1.

325-240-250, 60 mA, 5 x 2 v., 63-9 x 2 a. 17/6.

250-250-250, 100 mA, 5 x 2 v., 63-9 x 2 a. 17/6.

WILLIAMSON AMPLIFIER KIT. We supply the Kit of Parts for the latest version of this fine amplifier complete in every detail for 10/- only. With Valves.

WILLIAMSON AMPLIFIER OUTPUT TRANSFORMERS to match any type of 6J7, 6L7, 6V6 or Metal Rectifiers, 45/-.

H.T. ELIMINATOR AND TRICKLE CHARGER KIT. All parts to complete an 115 volt, 2 amp. Eliminator to give an output of 120 volts at 20 ma. and 2 volts to charge an accumulator. Uses metal rectifiers. 35/-.

TELEVISION AERIALS. The K.A. Light Aerial for those who are 'into' the transmitter, London or Birmingham programmes.

WALL FIXING DIPLOE, 32/-

WALL FITTING DIPLOE, with reflector, 60/-

See our new catalogue for complete range.

SHELLARD MWD269 In Magnetron Tubes. We can offer a limited range of these new tubes. Price 25/6 each.
LONG RANGE TELEVISOR KITS
FOR THE LONDON OR BIRMINGHAM FREQUENCIES
at the same price as the standard kit
£17 - 17 - 0

As is usual in all Premier Kits every single item down to the last Bolt and Nut is supplied. All chassis are punched and layout diagrams and theoretical circuits are included.

Five Easy to Assemble Kits are supplied:

**VISION RECEIVER** with valves, carriage 2/6... £3 13 6
**SOUND RECEIVER** with valves, carriage 2/6... £2 14 6
**TIME BASE** with valves, carriage 2/6... £2 7 6
**POWER SUPPLY UNIT** with valves, carriage 5/-... £6 3 0
**TUBE ASSEMBLY**, carriage and packing 2/6... £2 18 6

This unit includes the VCR97 Tube, Tube Fittings and Socket and a 6in. P.M. Moving Coil Speaker with closed field for Television. The Instruction Book costs 2/6, but is credited if a Kit for the complete Televisor is purchased.

Any of these Kits may be purchased separately; in fact, any single part can be supplied. A complete priced list of all parts will be found in the Instruction Book.

20 Valves are used, the coils are all wound and every part is tested. All you need to build a complete Television Receiver is a screwdriver, a pair of pilers, a soldering iron and the ability to read a theoretical diagram.

The following sensitivity figures prove that the Premier Televisor Kit is capable of reception at greater distances than any other standard commercial kit or receiver whether T.R.F. or Superhet.

**VISION RECEIVER.**

| Sensitivity | 25uV for 15v peak to peak measured at the Anode of the Video Valve. |
| Sound Rejection | Better than 40 db. |
| Adjacent Sound Rejection | Midland Model. Better than 50 db. |

**SOUND RECEIVER.**

| Sensitivity | 20uV, Vision Rejection, better than 50 db. |

A well-made walnut finish PEDESTAL CABINET is available from stock at £5/10/0 plus 7/6 carriage and packing.

Working Models can be seen during transmitting hours at our Fleet Street and Edgware Road Branches.

PRE-AMPLIFIER FOR FRINGE RECEPTION AREAS

We can supply the complete kit of parts to make this wide band width Pre-Amplifier, using 2 EF54 Pentodes. Powered by the TV Kit, it is completely screened. With all parts, valves, chassis, diagrams, etc., 27/6. All parts available separately.

When ordering Televisor kits

PLEASE STATE IF THE LONDON OR BIRMINGHAM MODEL IS REQUIRED

152-153, FLEET STREET, E.C.4
Phone: CENtral 2833

Terms of Business: Cash with order or C.O.D. over £1. Send 2d. stamp for list.

207, EDGWARE ROAD IS OPEN UNTIL 6 p.m. ON SATURDAYS
ONE MORE MONTH

OUR SALE PERIOD HAS NOW BEEN EXTENDED UNTIL 31ST JUNE, AND WHERE STILL AVAILABLE PREVIOUSLY ADVERTISED GOODS MAY BE PURCHASED AT THE SPECIAL SALE PRICES UNTIL THIS DATE.

Amplifier 40 Watt
USES two 6L6's in push-pull with 6V6 of feeder, complete with power pack giving up to 300 m.A. D.C. The whole mounted on chassis size 11 x 13 x 4in. on which is also mounted push-pull output transformer. Equipment is store soiled but unused. Valves are brand new. Sale price is £14/10/6, plus partly returnable packing case deposit and carriage charge of 12/-.

Feeder Unit to Work With Above Amplifier
COMPRISLES a 3-wave band superhet and special one valve input circuits for microphone and gramophone. Controls include: microphone volume, gramophone volume, radio volume, and tone control. The equipment is store soiled, unused. Valves are brand new. Sale price is £5/10/6, plus partly returnable packing case deposit and carriage charge of 10/-.

Metal Console Cabinet
TO take the above amplifier and radio feeder unit, size 11 x 6in. high x 17in. x 33in., fitted with 8in. monitor speaker and controls for external speakers. These cabinets are finished in black crackle, but in all cases they may need revarnishing because of careless handling and storage. Price is only £5/10/6 each, plus partly returnable packing case deposit and carriage charge of £1.

Special Offer
IF you buy the three items described above, you will have a very fine public address outfit suitable for medium size works or hall. The price if you take the three units together is £39, plus partly returnable packing case deposit and carriage charge of £1.

Push-Pull Driver Transformer
MADE by a very famous company, fully imregnated and tested 1,000v. between windings and frame, primary 70,000 ohms centre tapped, 2 secondary separates, each 5 to 1, upright mounting size 3x4x4.4in. really superior quality will enhance any amplifier. Sale price 10/- each.

Push-Pull Output Transformer
SAME maker to match the above driver transformer. Primary impedance 4,000 ohms centre tapped, secondary 15 ohms tapped 7.5 x 0.012, motor winding upright mounting, size 5 x 4x4 x 3in. Sale price 12/- each.

Smoothing Choke
SAME maker and matches the above driver and output transformers, 10 Henry's at 170 m.A. D.C. D.C. resistance 100 ohms, upright mounting size 5 x 4x4in. Sale price 10/-.

Special Offer No. 2
THESE three items above for 27/6, which is only half the usual cost. All these items are new and unused and in good condition, not Government Surplus.

Air Cored Choke
INDUCTANCE 6 m/H. at 50 cycles for high current, no measurable D.C. resistance. Upsight mounting impregnated, size 5 x 4 x 4in., finest quality. Sale price, 7/6 each.

Air Cored Choke
INDUCTANCE 8.5 m/H. at 50 cycles, no measurable D.C. resistance, size 5 x 4 x 4in. impregnated, high quality finish. Sale price 7/6 each.

Very High Current Smoothing Choke
TRON cored, size 4x5x5.5in., 7 Henry, primary impedance 4,000 ohms centre tapped, secondary 15 ohms tapped to give 6.6v. and 8.v. both at 4 amps. 3,000v. insulation tests between windings and frame. Sale price 29/6.

Sensitive Relay
AMERICAN make, closes at 4 m.A., heavy duty change over contacts. Sale price 12/- each.

Tuneable Inductances
HEAVILY silver plated, with silver wheel for making contact at any point on ceramic former of the inductance turns. Sale price 27/6 each.

Army Short Wave Receiver
THIS is a 6w. car battery operated receiver, range 1.8-8.5 m/c. The vibrator unit is easily removable, thus leaving a receiver which can be operated off 2w. accumulators and a standard H.T. battery. It is an 8-valve superhet communications receiver. The case which is fitted with a metal front guard is size 14 x 10 x 11in. Unusual and in first-class condition complete with spare valves, spare vibrator and instruction book. Sale price £6/10/0, plus 10/- carriage and packing.

Ditto

Control Unit "F"
THE purpose of this unit was to remote a field telephone, as it contains the following items: hand operated magnet generator, mediate DC resistance, bell, key, three key switches, seven brass terminals, two metal rectifiers, three mainsbridge condensers, 1,000 ohm pot meter, speech transformer, three-way six-pole key switch, 2,000 ohm relay, and miscellaneous items such as plugs, pointer knobs, resistors, etc. All contained in an excellent metal box, size 10 x 6 x 6in. Sale price 9/6, plus 3/6 carriage and packing.

Test Set 72
THIS consists of two separate instruments, one an oscillator and (b) an absorption wave meter which tune over the range 200-2,400 m/s. Contains many fine components, some of which are two-vernier slow-motion drives, calibrated 0-100, magic eye viewing assembly with magic eye valves, on/off toggle switch, pot meters, flexible insulated couplings, two-gang tuning condenser, air trimmers, Yatex-type switch, miscellaneous condensers and resistors. Equipment is unused and complete with valves as follows: five H.F. pentodes, one magic eye, one V.H.F. triode and one V.H.F. diode, all 6.3 v. braters. Sale price 32/6, carriage and packing £5/- extra.

Motor Alternator
GIVING 230v. 50 cycle A.C. from a 12v. car battery. Output approximately 100v., thus large enough to work the average type of domestic receiver and many appliances. Sale price £3/10/6, plus 4/6 carriage. Ditto but 24v. input £3/10/6, plus 4/- carriage.

Indicating Watt Meter 6 in.
A SWITCHBOARD instrument for three-phase four-wire circuits, complete with current transformers and matched external resistance box, made by a very famous firm, and suitable for 200v. or 400v. Sale price £7/10/0.

Switchboard Ammeter 6 in.
SCALE reading 600 amps at 200v. or 300amps at 400v, 50 cycle matches the above watt meter. Sale price £4/10/0.

Wheatstone Bridge
IN a fine test case, really good grade instrument, with heavy stud switch and centre reading galvanometer, or direct current. It gives resistance readings to a high degree of accuracy up to 220 ohms. Sale price £2/19/6.

American Radar Unit A/ANP4
THIS is a fifteen valve airborne receiver and amplifier, with an extension to its own components the power supplies for the cathode ray indicator unit. The chassis size is 18 x 9 x 8in. and the whole receiver slips into an oblong metal container. The whole contains a host of really useful parts, to mention a few: high voltage power transformer (high cycle) complete with high voltage smoothing equipment which includes three 25 mfd. 2,500v. paper condensers, high voltage valve sockets and porcelain top cap connectors, medium and high voltage transformer (high cycle) with 8 mfd. volt smoothing condensers, 13 international octal valve sockets, four-bank four-position Yatex-type switch, three toggle switches, fuse holders, pilot lamp holders valve retaining clips, coils, trimmers, I.F. transformers, iron-dust cores and hundreds of small condensers of best makes and many sizes and capacities, ditto for resistors. Sale price 17/6, plus £5/- carriage.
Service Sheet Manuals


Service Engineers Collection

THIS is a folder containing 100 service sheets, covering British receivers which have been sold in big quantities, and has been described. Every service engineer is ultimately bound to meet. The following makers are included: Aerodyne, Alba, Bush, Corsor, Eka, Ever-Ready, Ferguson, Ferranti, G.E.C., H.M.V., Kolster Brandes, Lissen, McMichael, Marconi, Mullard, Murphy, Philco, Phillips, Pye, Ultra, and in addition the folder contains the two Champion volumes previously described. Undoubtedly a mine of information invaluable to all who earn their living from radio servicing. Sale price 1/- for the complete folder.

Miscellaneous Publications

These give circuit diagrams and details of Ex-Government receivers and equipment. In practically all cases the information has been extracted from official publications. Separate booklets for each piece of equipment. Booklets available covering the following: TR155, TR208, TR209, TR106, TR18, BC349, BC312, TR116, Wireless Set 15a, TR07, TR03, BC221, BC342, Pre-Amp from RF27, Pre-Amp from Unit 208A, T.V. Receiver from 14 mete superhet for London or Birmingham, T.V. receiver from 3170, etc. T.V. receiver type 154 strip or 155 strip. Dual band T.V. receiver. Sale price of any of these booklets is 1/9 each, 12 for 1/-.

Mains Transformers

DROP through 250-0-250 at 60 m.A., 6.3v. 3 am., 5v. 2 am. or 4v. 4 am., 4v. 2 am. Sale price 1/6 each.

Volume Controls

FULL length spindle, any value 2k-2 meg., not Government Surplus, with switch 3/9, less switch 2/6.

Contractors 25 Amp.

COIL voltage is 200 D.C., but with a rewind of a small rectifier they will close off A.C. These have very heavy silver contacts which probably have a precious metal value greater than we ask for the contractor. Sale price 1/3 each, 25/- dozen.

Vacuum Delay Switches

FOUR-PIN British base 6.3 v. one minute delay. Sale price 7/6 each.

Radio Control

HIGHLY sensitive light weight relay, closes on two milliamperes, weight only 1 oz. Solid platinum changeover contacts, adjustable pressure. Sale price 13/6 each.

Last Time at This Price

THE 10am. speaker with 12in. quality, a real precision product made by a very famous firm whose name we are not allowed to mention, but you will recognise it immediately. This speaker has three special features: (1) a solid diecast frame, (2) special coil suspension to give wider frequency response, (3) dust proof cone assembly. Speech coil is normal 2-3 ohm impedance. Sale price 15/-, plus 2/6 post and insurance.

Charging Switch Board

THIS contains five high-wattage slider type variable resistors, four flush meters reading up to 15 amperes each, and one meter reading up to 40 amperes. In addition there is a voltmeter with a selector switch to permit voltage checking of all circuits, two cut-outs, switches, fuses and terminals. The whole being mounted on a panel and enclosed in a metal case with doors and feet. A source of D.C. fed in will be split up to permit battery charging at varying currents. If used with a generator the field of same and hence its voltage output can be controlled by the first slider. Excellent break-down value, as any one of the sliders would cost much more than we ask for the whole unit. Sale price 47/-, carriage 12/6.

Radio Control

SELECTOR switch 10B, sometimes known as an impulse relay, remote selector, etc. This consists of a solenoid, the armature of which is connected to a ratchet wheel so that each time the solenoid is energised the ratchet wheel moves round one notch. Secondary switches are built-in which permit: continuous running, including, following a four-position switch and undoubtedly a host of other operations. Articles have appeared in journals showing how these may be operated by radio impulses and thus control models. Sale price 3/9 each, six for 1/-. Order selector switch 10B.

Midget Thyatron

A MERICAN make type No. 2D21, 5.3v. 6 amp. heater, peak plate current 250 A., average plate current 100 m.A. 8Y9 box ideal for radio control receivers. Sale price only 15/- each. Many other special type valves available at low prices. Send 6d. for our Sale List.

Break-down Unit

AT present day prices the spaces in this unit would cost at least £5. Here is a list of the main contents:—

1. two-metre coils;
2. tuning condensers split-stator type;
3. two-watt carbon resistors useful values;
4. tapped 20 watt resistor vitreous covered;
5. paper condensers, 0.5 mf. 1,000v. working;
6. paper condensers, 1 mf. 1,000v. working;
7. 3-watt carbon resistors;
8. bakelite moulded mica condensers .001;
9. paper condenser, 0.1 mf. 3,000v. working;
10. 2.5 watt, 150v. working;
11. 2.5 watt, 250v. working;
12. 2.5 watt, 300v. working;
13. 2.5 watt, 500v. working;
14. 2.5 watt, 1,000v. working;
15. 2.5 watt, 1,500v. working;
16. 2.5 watt, 2,000v. working;
17. 2.5 watt, 3,000v. working;
18. 2.5 watt, 4,000v. working;
19. 2.5 watt, 6,000v. working;
20. 2.5 watt, 9,000v. working;
21. 2.5 watt, 12,000v. working;
22. 2.5 watt, 18,000v. working;
23. 2.5 watt, 20,000v. working;
24. 2.5 watt, 25,000v. working;
25. 2.5 watt, 30,000v. working;
26. 2.5 watt, 40,000v. working;
27. 2.5 watt, 50,000v. working;
28. 2.5 watt, 60,000v. working;
29. 2.5 watt, 70,000v. working;
30. 2.5 watt, 80,000v. working;
31. 2.5 watt, 90,000v. working;
32. 2.5 watt, 100,000v. working;
33. 2.5 watt, 150,000v. working;
34. 2.5 watt, 200,000v. working;
35. 2.5 watt, 300,000v. working;
36. 2.5 watt, 400,000v. working;
37. 2.5 watt, 500,000v. working;
38. 2.5 watt, 600,000v. working;
39. 2.5 watt, 700,000v. working;
40. silver mica condensers assorted values, including 10, 15, 20, 40, 50, 100, 150, 300, and 500 pf. types.
41. 200K electro valve holders;
42. 200K 5-pin valve holders;
43. 1 E.F.S. type valve holder;
44. 420K electro valve holder;
45. loured casing, size 12 x 7 x 2in.;
46. heavy metal chassis size 12 x 7 x 2in.;
47. condenser clips, assorted sizes.
48. An assortment of nuts, bolts P.K., self-threading screws, tag boards, chassis mounting tag connectors, screened grid caps, plain grid caps, levers, rollers, connecting rods, output Pye sockets, etc., etc. ALL THIS COLLECTION OF PARTS FOR 4/- only, plus 1/6 postage and packing.

Tripods

WHEN fully extended the height is 9ft. They are very sturdy and would support heavy weight. Black japanned metal construction fitted with hook, and brass thread and cap. Useful for cameras and also supports for microphones, speakers, lamps, etc., etc. 3/- each, plus 1/6 post and packing (storage soiled).

Sealed Glass-Type Thermostatic Switches

CONTAINED in a glass tube these switches operate automatically at 86 deg. F. Suitable for tropical fish aquariums, etc. Sale price 3/6.

Pay Us A Visit

ON these two pages we have mentioned only a few of the many bargains which will be available during out sale. We suggest that you "Pay us a Visit" because there will be many items for callers only. Falling this you must send for our Bumper Sale List, and forget to enclose 6d. in stamps, because we shall probably have to send it out in two editions.

Orders for and enquiries relating to the items on these two pages must be sent to the address below. Where your total order is £2 or more only include the specially mentioned carriage and other charges, otherwise under £2 add 1/6, under £1 add 1/-. Postable items can be sent C.O.D. additional charge approx. 1/-. Good stock of all items at time of going to press. Bargain list 6d. p.f.
Exceptional Value in Receivers!

RECEIVER type B21

A superb communications receiver made by Marconi's Wireless Telegraph Company.

Valve line-up: two R.F. stages, frequency changer, three I.F. stages, power amplifier, B.R.O. and output pentode. Freq. coverage 1-20 mc/s. (15-300 metres) in 4 unbroken bands via turret coil change. "S" meter and valve check meter incorporated. Sensitivity for 10 db signal to noise ratio—better than 1 microvolt! Filament transformer for 230v. A.C. operation is included but the H.T. supply is required.

Necessary valves are: Internaional Octal types, two of KTV61, two of X65, three of KTV63, one of DH63 and one KT63.

Supplied complete with circuit diagram. NEW AND IN UNUSED CONDITION. Here's your chance to buy a £100 receiver for

ONLY £9-19-6 less valves or £13 complete with all valves. Carriage and packing 10s. in each instance.

SMALL QUANTITIES OF THE FOLLOWING ARE STILL AVAILABLE

Receivers are exceptionally reasonable.

Receivers R1335. Slightly soiled condition. 49/-, post 5s. carriage.

Type Receiver. Brand new and guaranteed. NEW condition. £4/19/6, plus 2½ carriage.


Receivers R1155. Brand NEW and air tested. Full technical data and modification instructions supplied. £11/10/0, plus 9½ carriage and packing in transit case.

A.C. Mains Power Pack and Output Stage for R1155. Just plug in! £3/10/0, post paid. SPECIAL OFFER. Receivers R1155, complete with power pack for £15, carriage paid.

Receivers R224. Battery superhet 30-300 metres continuous. With circuit. £4/19/6, plus 7½ carriage and packing.

Receivers R224/ARC. Complete with 10 valves (four of 71/A) and four crystals. 45/-, plus 2½ carriage and packing.


Performance Meter No. 2. NEW, contains 230v. 50 cycle A.C. power pack, etc. £2/10/-, carriage paid.

Power Pack 567. NEW, contains 11 valves all octal based, 42½, plus 5/- carriage.

18/165 Amplifier Unit. Super bargain at only £17½, post paid.

Mullard Resistance and Capacity Bridge. NEW, Instruction Book included. £8/19/6, carriage paid.

Indicator Units 116H. NEW, in transit boxes. £4/10/-, plus 7½ carriage.

R.C.A. Speech Amplifiers. Brand NEW. Magnificent instrument. £3/10/0. Callers only please, as so few remain.

PLEASE REFER TO PREVIOUS ISSUES OF WIRELESS WORLD FOR FULL DETAILS OF THE ABOVE OFFERS.

10,000 different items of equipment in stock. A treasure house for the enthusiast. Enormous stocks of valves, componenta, etc. Our prices are exceptionally reasonable. A competent technical staff always in attendance and at your service.

Best Buy at Britain's

CHARLES BRITAIN (Radio) Ltd.

11, UPPER SAINT MARTIN'S LANE
LONDON, W.C.7

TEM 05 5

3 minutes from Leicester Square Station (up Cranbourn Street)

Shop Hours: 9-6 p.m. (9-1 p.m. Thursday). Open all day Saturday.
THE HEART OF THE BURGOYNE SEVEN SECOND SOLDERING GUN. As illustrated.

200/250 v. input. 13/6 plus 1/6 post and packing. Copper bit, 6d.; automatic switch assembly, 1s., plus 6d. post and packing.

5-VALVE SUPERHET CHASSIS with transformer cut-out, size 13\(\frac{1}{2}\) in. x 6 in. x 2 in. with L.M.S. scale, size 7 in. x 3 in. Backplate two supporting brackets, drive drum, pointer, two-speed spindle, twin gang condenser. Mains transformer 250-250 v. 60 mA. 6 v. 4 amp. Pri. 200/250; 64 in. R.O.L.A. energised speaker and 6 x 5 Rect. 28/- plus 21/- post and packing.

6-STATION SWITCHED SUPERHET COIL UNIT, by famous manufacturer. Ideal for Car Radio or radio set. Range coverage Pos. 1, 200-300 m.; 2, 250-350 m.; 3, 250-360 m.; 4, 320-460 m.; 5, 400-550 m.; 6, 1100-1850 m.; no oscillator required for lining up, complete with Circuit, 15/6, post and packing. 1/-.

PRE-ALIGNED MIDGET 465 kc. Q.T20, made for the above Coil Unit, 8/6 each extra.

MAINS TRANS. TO FIT ABOVE CHASSIS. Pri. 200/250 volt. Sec. 250-0-250 v. 60 mA. 6 v. 4 amp., 13/6, post and packing 1/6.

CONSTRUCTOR'S PARCEL, comprising chassis 13\(\frac{1}{2}\) in. x 6 in. x 2 in. with L.M.S. scale. Twin gang with trimmers; pair of TRF coil; 4 international Octal valve holders; wave change switch and Erie 20k pot with switch, 17/6, plus 1/6 post and packing.

CONSTRUCTOR'S PARCEL, comprising Gidget twin gang with slow-motion drive; Pair Midget 465 kc. IFs.; frame aerial; medium wave oct. coil and layer type H.T. and L.T. Battery, 90v + 13v. 21/6, plus 2/6; P. & P.

CONSTRUCTOR'S PARCEL, comprising 5-valve Superhet chassis with Transformer cut-outs. Size 13\(\frac{1}{2}\) in. x 6 in. x 2 in. with L.M.S. dial size 7 in. x 3 in.; back plate, two support brackets; drive drum; pointer and spindle; twin gang condenser and mains transformer 250-0-250/60 mA. 6 v. 4 amp., Pri. 200/250; R.O.L.A. Bin. P.M. with transformer. 36/-, plus 2/-; P. & P.

SUPERHET COIL KIT, comprising medium and short wave coils, twin gang, pair of 465 IFs, 6 pole 3 way switch, 6 trimmers, two trackers and 5-valve superhet chassis with IF and speaker cut-outs. 14/6, plus 1/6 post and packing.

STANDARD 465 KC. I.F.'s. Air cored Q.110, 6/- per pair.

STANDARD 465 KC. I.F.'s. Iron cored Q.120, 7/- per pair.

MINIATURE 465 KC. I.F.'s. Type M4600, 12/6, plus 6d. post and packing.

CERAMIC 220 p. tolerance 10%, 6d. per thousand.

VALVE HOLDERS. Paxolin International octal, 4d. each. Moulded International octal, 6d. each. EF50 ceramic 7d. each. Moulded 87G slightly soiled 6d. each.

LINE CORD. 3-way 0.3 amp. 180 ohm per yard, 10d. per yard.

CERAMIC PFS. 3 each of the following: 330, 180 & 82, 2/6.

ENERGISED SPEAKERS.

Bin. 2000 ohm field with O.P. trans. 5000 ohm imp. 1/6. 51, 1000 ohms field with O.P. trans. 500, 000 ohm imp. 12/6. P. & P. 1/- each extra.

TUNING CONDENSERS.

0.005 twin gang with feet, 4/6. .0005 twin gang, fitted feet, trimmers and drum 4/7. Midget .00037 twin gang, fitted trimmers and Perspex dust cover, 4/6. 0.005 tuning condenser, 2/3. Post on the above items, 6d. extra.

POLISHED WALNUT RADIO CABINET.

15in. high, 17in. long, 10in. deep. 6/6. L.M.S. & dial. Size 9in. long x 4½in. wide, and 5 valve superhet chassis. Valve holder and transformer cut-outs. 2/6 plus 1/6 post and packing.

MAINS DROPPERS.

2 amp. 1000 ohms tapped 900 ohms. 1/9. 2 amp. 717 ohms, tapped 1000 ohms. 1/6. 3 amp. 520 ohms tapped. 2/4 ea.

WAVE CHANGE SWITCHES.

6 pole 3 way, 1/2. 3 pole 2 way, 1/2. 6 pole 2 way, 1/2. 5 pole 3 way, 1/2.

TELEVISION COMPONENTS.

In white rubber, 9in. 7½/6, plus 1/6 extra for P. & P.

VARIABLE TRACKERS.

300 x 300, 100 x 500, 100 x 220, 500 x 750, 2100, 150 x 150, 1000 x 1000, 250 x 250, 750, 250, 250, 50, 50, 50, 50, 50.

TELEVISION MASKS.

With white rubber, 9in. 7½/6, plus 1/6 each extra for P. & P.

METAL BRAIDED WIRE.

With PVC outer insulation. 4d. per yard.

POSTAGE STAMP TRIMMERS.

50p. 4d. each.
QUALITY COMMUNICATION RECEIVERS

HRO TYPE MX. Brand new. 4 coils covering up to 30 Mcs. Six-volt HRO Power Pack. A Beauty. £35. If desired we can supply an A.C. Power Unit to suit in lieu of 6 volt for an extra 30/-, carr. paid.

MARCONI CR100 (B38) RECEIVERS. Perfect order and fine condition. 12 valves. 65 Kc/s to 30 Mcs. Six only. £15/15/- each. Carr. and packing case £15/10/-.


ARDMIGHT TYPE 14. Brand new. 40 Kc/s to 32 Mcs. Loud speaker to match. Condition equal to NEW. One only. £45.

AR88, dito, fitted with Diversity Gain Control. Magnificent condition. One only (no loud speaker). £45.

EDDYSTONE 440. Brand new condition. First £22/10/-.

HALLICRAFTERS SKY CHAMPION. Excellent condition, 8 valves. 540 Kc/s to 43 Mc/s. Grey metal cabinet. Built-in loud speaker. A snip, £22/10/-.


R1335 RECEIVERS. Good condition. £39/6, carriage 5/- (few only).


MIDGET MOTORS. Measuring 2in. long x 1in. dia., these are supplied complete with a removable fox. They develop 1/10 H.P. with 97 v. input. Only 50/- each.

RECEIVER TYPE 21. A superb-covering 4.5-7.8 Mcs and a double superhet covering 18-53 Mcs, supplied complete with its correct power pack. This small communications receiver requires only 6 v. input, complete with two units will fit together to make a compact unit. With 9 volt two valve, B.P.O. crash limit and circuit. OUR PRICE £9/6/6.

POWER UNIT 19. Still a very few available, delivering 540 v. at 60 mA and 271 v. at 110 mA, from a relay converter, and 25 v. from a vibrator pac: 15 or 24 v. input. TO CLEAR 12/6.

TWIN CELL CYCLE LAMP BATTERIES. Of recent manufacture, and tested before despatch. THRES for 1/-.

METAL CASED SPEAKERS. BRAND NEW SPEAKERS. In various metal casings (3in. dia. x 3in. each). £0/6.

TRANSFORMERS. Heavy modulation transformers which may also be used as step down transformers, handling some 20 watts. Potted, £6 each.

METAL CASED SPEAKERS. BRAND NEW speakers, in circular metal casings (gin. o/ d.) 30/- each.

TELEVISION RECEIVERS.

H. P. RADIO SERVICES LTD.

List Available

Britain's Leading Radio Mail Order House

55 COUNTY ROAD, WALTON, LIVERPOOL, 4

Tel: Aintree 1445
Staff Call Signs, G3GDL, G3DLY
THE VIEWMASTER

The television set you can build at home from standard parts.

BRAND NEW AND UNUSED).

LASKY'S PRICE 1/- each.

SERIES UNIT TYPE 65. New and improved valve combinations for increased power output. Supplied with 6 brand new valves: 2 6U8; 2 6UG7; 2 6AK5.

LASKY'S PRICE 2/11. Carriage 6d. extra.

SAFETY GLASS SUITABLE FOR 12in. CATHODE RAY TUBES. Price 3/6 per sheet.

SAFETY GLASS SUITABLE FOR 12in. CATHODE RAY TUBES. Price 3/6 per sheet.

BRAND NEW IN ORIGINAL WOOD TRANSIT CASE. EX. M. RADIO INDICATOR UNIT. Contains 6 in. cathode-ray tube type VU/711 and metal screen. Also the following valves: 2 6SK7; 1 6AU6; 3 8AV1; 2 6L6. 10 Doms. of components including 7 plug, sockets, resistances, capacitors, etc. Complete with metal cabinet, size 12in. x 9in. x 10in. Weight 60 lbs.

LASKY'S PRICE £24.50. Carriage 7/6 incl.


Send a 2/6, stamp with your name and address (In block letters please) for a copy of our current stock list giving full details of our Ex- Government Radio and SURPLUS equipment. THE LASKY'S RADIO BULLETIN.

370 HARRROW ROAD, PADDINGTON, LONDON, W.9 (Opposite Paddington Hospital)

TELEPHONE: CUNningham 1979. Hours: Mon. to Sat. 9.30 a.m. to 5 p.m. Thurs. half day 1 p.m.
AMERICAN COMMUNICATION RECEIVERS TYPE AR.88LF. For operation on 230 v. A.C. This superlative set tunes 75-550 kc/s. AMERICAN COMMUNICATION RECEIVERS TYPE AR.88LF. For operation on 230 v. A.C. This superlative set tunes 75-550 kc/s.

NEW SATISFACTION GUARANTEED OR MONEY IMMEDIATELY REFUNDED. All these unique features at a sensational low price:—

- **Sensitivity** 1800 ohms per volt on all DC and AC ranges
- **Ranges**: DC/AC 10v., 100v., 500v., 5000v. DC 50 m.a. and 500 m.a. Resistance up to 2000 ohms (3000 centre scale), with internal battery.
- **Supplied with test prods**
- **Multicolour scale—easily readable**

MR. 5000v. H.T. test prods 9/6 extra

**PRICE**: £3.17.6

Obtainable from Radio Dealers Everywhere

If in difficulty write to:—

**AMPLION (1972) LTD.**

230 Tottenham Court Road, London, W.1.
JUNE, 1950

WIRELESS WORLD

CLYDESDALE

Bargains in Ex-Services Radio and Electronic Equipment

EX. ARMY WS-18 RECEIVER UNIT.

A 4 valve superheterodyne, tuning in 6-9 m.c.s. (50-33.3 m.), S.W. narrow and wide (VP23) F.C., 1A123P'S, L.F. and A.R.B. (HL23- DD) Auditors. Osc. 2nd det and n.f. As new. Price 1/6 each.

POWER UNIT 247.

For 230 volts, A.C. 50 cycles, output 600 volts at 200 ma. smoothened D.C. 6.3 volts, A.C. 3A. Complete power pack, with 5U40 rectifier etc., built on metal tray 10½ x 9 x 1½in., w/t, with grey finish metal cover 11 x 9 x 7½in., 2 chromium handles, red indicator and inspection door, giving access to rectifiers and fuse holder. CLYDESDALE'S PRICE ONLY 57/6 CARRIAGE PAID.

With transit box.

Brand New.

SHADED POLE MOTOR MODEL S.R.2.

A rugged and highly efficient motor, giving an amazing performance at an economical price. It will stand heavy overloads, and for intermittent ratings is capable of giving up to twice the rated load. 200-220/230-250 volts, 50 cycles. Under 30°C. Rise. Continuous rating 2.5 watts. Price 25/- each CARRIAGE PAID.

Stack Thickness

V.V.D. (Light).

R.P.M. (Light).

Suction Torque (in. ozs.).

Full Load Torque (in. ozs.).

Full Load R.P.M.

Weight.

Shaft dim. : 0.1875in.


CLYDESDALE'S PRICE ONLY 25/- POST PAID.

UNITS OF THE SCR-522 (TR504).

BC-624A Receiver Unit Chassis, frequency 100-156 m.c.s.

Complete chassis (text crystals) with 11 valves, I.F.'s, etc., relay etc. Power requirements (external) H.T. 300 v. D.C., 75 ma., L.T. 12 v. D.C. Dimensions : 18½ x 7 x 2½in. Circuit supplied. PLUS, Free Gift, BC-635-A Transmitter Unit 3 range. See price list. PRICE ONLY 14/6 each CARRIAGE PAID.

Inputs : 110 v. A.C. 50/60 c/s. 1.7 K.V.A.


The unit consists of 3 complete power supplies, one of which provides various stabilized L.V., A.C., and D.C. supplies. All are fed via double choke, conditioner input circuits.


The complete unit mounted in metal case with lid 20 4in. x 17 4in. x 17 4in. finish olive-drab crinkle with shock absorbing feet. Wgt. 420 lbs.

CLYDESDALE'S CARRIAGE PRICE ONLY £16 POST PAID.

READY JUNE !

COMPLETE ILLUSTRATED LIST No. 7 OF EX-SERVICES BARGAINS.

Plus list of Radio and Television Components by foremost manufacturers, fully illustrated, showing useful valve, coil and other data. Send 6d. to cover distribution cost. Please print name and address.

CLYDESDALE EX-SERVICES SUPPLY 2 BRIDGE STREET CO.LTD. GLASGOW - C.

Post: Smith 29369

Visit our Branches in Scotland, England and Northern Ireland
is the title of the latest publication which shows how a variety of ex-Government Radar Units can be converted with the minimum of effort into efficient Television Receivers. A second edition of the booklet carrying the same title, it has been extended to cover units other than the R.1355, and is well worth buying. Send only 2/9 for your copy (post paid) and a complete price list of the specified equipment. Start accumulating the equipment now, at the low summer prices and be ready for the long winter evenings.

**RECEIVERS R.1355.** Still in great demand for T.V. Construction. Complete with all valves. ONLY 55/- (carriage, etc., 7/6).

**R.F. UNITS TYPE 25.** Specified with above for London Area Station. ONLY 17/6 (postage, etc., 1/6).

**R.F. UNITS TYPE 26.** Specified for Birmingham Station now all sold, but we can supply one of the other R.F. Units with full details of modification, which has been fully tested some 70 miles from Sutton Coldfield. BRAND NEW IN CARTONS, ONLY 25/- (postage 1/6).

**THE 194 I.F. STRIP.** One of the units specified in the above book. A first class strip containing six valves VR65, and one each VR53 and VR92. Easily converted for vision or sound for both stations and supplied with the necessary instructions. Size 18 x 5 x 5 in. ONLY 45/- (postage, etc., 2/6).

**RECEIVER 25/73.** The receiver portion of the T.R.1196. Covers 4.3-6.7 m/cs and makes an ideal basis for an all-wave receiver. Complete with six valves: two each of EF36 and EF39, and one each EK32 and ECC33, and modification details. New condition. ONLY 25/- (postage, etc., 2/6).

**U.E.I. CORPN.**

**RURO PRODUCTS**

**GLASS DIALS**

for the NEW WAVELENGTHS

are now available for all our units

**RURO PRODUCTS**

Crown Works,

197, Lr. Richmond Rd., Richmond,

Surrey

Phone: Prospect 7463

**EX - GOVERNMENT STOCK DISPOSAL!**

The finest

**RADIO VALUES**

ever offered

SATISFACTION GUARANTEED or MONEY REFUNDED

Ex-War Surplus

**HUGE CLEARANCE SALE**

Thousands of Radio Components at Knock-out Prices

**ILLUSTRATED CATALOGUE NOW READY**

Forward P.O. 1/- to

**WESTON PRODUCTS (LIVERPOOL) LTD.**

TEL: ROYAL 5754/5.

71, GT. GEORGE STREET, LIVERPOOL 1
WE HAVE OTHER EQUIPMENT ARRIVING DAILY!

Adapagram, fitted with Garrard RC65 mixer-changer in walnut cabinet. As new. £20 0 0
Adapagram, as above fitted with AC/DC unit. £22 0 0
Eddystone 5-10 Meter Converter. As new £6 10 0
Pam Amplifier, AC200-250 volts. Perfect. £17 10 0
Simon Sound Service Recording Amplifier, Model EA25. As new £20 0 0
Portable Transmitting Receiving Equipment, Type 3 HA, II, 5 to 15 Meters, AC 250 volts. In good condition £10 10 0
Taylor 90A, as new £9 10 0
Hailcroft’s S37, rack model 100-230 A.C. Perfect £21 0 0

WE NEED GOOD USED EQUIPMENT URGENTLY.
PLEASE SEND, BRING OR PHONE FOR OFFER

Evershed’s Low Range Bridge Megger Testing Set. 100 volts. Perfect £11 10 0
Taylor 1,000 o.p.v., Model 70A. As new £8 10 0
Taylor AC/DC Minor, model 120A, as new £6 10 0
Avo Minor AC/DC, as new £5 10 0
Avo Minor, (D.C. only) as new £2 12 6
Avo 40. As new £1 10 0
Avo 47A, (Ex-W.D. as model 40). Perfect, as new £10 0 0
Taylor Cap and Res. Bridge, as new £7 10 0
Taylor 85A, 20,000 o.p.v. Test Meter. As new £12 0 0
Avo Cap, and Res. Bridge. As new £7 0 0
G.E.C. Miniscope, as new £12 0 0
Garrard AC/DC Record Changers, mixer type, Model RC65-U-16C. Brand new. At each £22 10 0
Evershed’s Bridge Megger, 500 volts, with built-in Resistance Box. In perfect condition £15 10 0
Taylor 65B Signal Generator. As new £11 0 0
Avo 1948 Model Signal Generator. As new £10 0 0
Avo Valve-Tester with Roller Panel as new, 1948 model £11 10 0
Taylor 90A, as new £9 10 0

We offer Guaranteed Used Equipment at Attractive Prices

WE HAVE OTHER EQUIPMENT ARRIVING DAILY!

Cash or Cheque with Orders. All Items Listed are Carriage Paid up to 50 Miles.

22 LISLE STREET, LEICESTER SQUARE, LONDON, W.C.2
Phone GERrard 4447 and 8582. Hours 9 to 6. Thursdays 9 to 1.
NEW!

GOODSELL
FEEDER UNIT
WITH WIDE RANGE TONE CONTROL

- Four stations at the turn of a switch.
- Soundly built for exceptional performance with Hi-Fidelity Amplifiers.
- Extremely compact.
- Attractive design with coloured 'Perspex' panel with engraved knobs.
- Seven BBA valves.

Price £13 - 13 - 0 plus tax
Leaflet on request

GOODSELL LTD.
40, GARDNER STREET, BRIGHTON, 1
Brighton 26735

Huge Demand for The Murphy T.V. Pattern Generator ★

The demand for the Murphy T.V. Pattern Generator continues to grow, and although substantial deliveries are being made, our waiting list is still a very considerable one.

Early Application is Advisable as We are Receiving Many Repeat Orders.

For those who are still unaware of the outstanding excellence of the Murphy T.V. Pattern Generator we invite you to make application for a demonstration.

The Murphy T.P.G.11 provides a small, portable equipment the complete synchronising waveform, as used by the B.B.C., in the test signal, essential for correct alignment of T.V. receivers. A pattern generator which does not give such a waveform is of very limited use, so pay the extra cost—and have a Murphy T.P.G.11.

For full specifications write to:

F. LIVINGSTON HOGG
65, BARNSBURY STREET, LONDON, N.1.
or Telephone TUDor 5277 for a demonstration

F. LIVINGSTON HOGG, SPECIALIST IN HIGH GRADE INSTRUMENTS FOR THE COMMUNICATIONS INDUSTRY.

June, 1950

G2AK

This Month's Bargains

Special Offer. Power Transformers.
620/350/375/0/375/550/620 volts at 200 mA, also plus 250 mA at the 375 v. taps. Two separate windings of 5 v. at 3 amps, each for rectifiers. Rated at 278 watts. (This is a very conservative rating and could be exceeded by at least 50 per cent. for amateur use.) Weight 24 lb. This is the transformer buy of the year. Price only 50/- Carriage paid.

Modulation Transformers.

Both of the above transformers are fully shrouded and are new and unused but some may be a very little store soiled.

Heavy Duty L.F. Chokes. Fully Potted.
30 Hz. 100 mA, 150 ohms (Wt. 14 lb.). Price 13/6.
70 Hz. 126 mA. 100 ohms (Wt. 14 lb.). Price 15/6.
30 Hz. 150 mA. 150 ohms (Wt. 18 lb.). Price 17/6.

(For Amateur use, above ratings could be doubled.)

All transformers and chokes are carriage paid except to Eire for which we must ask for 5/- extra.

Special Meter Offer.
100 microamps. Scaled 0 to 100 2 in. Only 3/1 each.
500 microamps. Scaled 0 to 500 2 in. Each
500 microamps. Scaled 0 to 1500, Each
5 amps. Scaled 0 to 15 in.
50 ohms, 12 watts.

Ideal for 'S' Meters, 1/6 each.

For Amateur use, above ratings could be doubled.

Special Offer. Power Transformers.

Backwards reading. Ideal for 'S' Meters, 1/6 each.

Postage on single meters, 6d.

Please Print Your Name and Address.

CHAS. H. YOUNG, G2AK
All Callers to 110 DALE END, BIRMINGHAM Phone: CENTRAL 1635.
Mail Orders to 102 HOLLOWAY HEAD, BIRMINGHAM Phone: MIDLAND 3254.

I KW Transmitters.
Two HF. 300's output CW operation 3.5 Mc to 16 Mc.

Hallcrafters BC.610 (or HT.48) operating over 2 Mc. to 18 Mc. and modified for 21 and 28 Mc. Crystal and V.F.O. on all bands, complete with speech amplifier, antenna tuning unit, exciter units and coils for all bands, set of 36 x-cals specially made for BC.610 and new valves.


40 W. Transceivers.
Very compact, weight 13 lbs. 829 output. 2 Mc. to 8 Mc. or 4 Mc. to 16 Mc. Phone and key. High class superhet. Complete with power pack for 110/220 V. A.C. and two rotary converters for 12 V. battery supply, two sets of aerials (dipole and counterpoise aerial), microphone, spare key and set of spare valves.

Automatic High Speed Telegraph Equipment
'T Boehme' (U.S.A.). Up to 400 signs per minute on line or wireless.

AR.88's, L.F., S.X.28's, H.R.O.'s with 5 or 9' coils.

Metal Rectifiers, type 7B. Max. D.C. output at 36 V. 56 Amps 6700 ohms, 12 watts.

SPECIAL OFFER. Power Transformers.

Price only 22/6. each.

All above items in excellent working condition. Working demonstration upon request.

Large stock of transmitting condensers, valves, crystal and other components. Alignment and repair of communication receivers and all other amateur equipment undertaken.

P.C.A. RADIO

Transmitter Division:-
The Arches, Cambridge Grove,
London, W.6. Tel. Riv. 3279

Receiver Division:-
170 Goldhawk Road,
London, W.12
ON PRODUCTION LINE

or laboratory bench, or anywhere a response curve in the audio spectrum is required, the Model 1900 Portable A.F. Response Curve Tracer will trace it in seconds on a log log or log linear scale.

The instrument may be set to repetition frequency sweep (variable rate),
or single sweep (variable speed),
or frequency may be set by hand to any part of the response curve for detailed investigation.

Built-in calibration checks are provided.
Frequency drift, harmonic distortion and hum is very low.

* THE CURVE MAY BE PHOTOGRAPHED

NOW IN PRODUCTION

* Camera available

INDUSTRIAL ELECTRONICS

99, GRAYS INN ROAD, LONDON, W.C.1

Difficult Problems?

Made in Three Principal Materials

FREQUELEX
An insulating material of Low Dielectric Loss, for Coil Formers, Aerial Insulators, Valve Holders, etc.

PERMALEX
A High Permittivity Material. For the construction of Condensers of the smallest possible dimensions.

TEMPLEx
A Condenser material of medium permittivity. For the construction of Condensers having a constant capacity at all temperatures.

Bullers

BULLERS LOW LOSS CERAMICS

BULLERS LTD., 6, LAURENCE POULTNEY HILL, LONDON, E.C.4

Telephone: Mansion House 9971 (3 lines) Telegrams: "Bullers, Cannon, London"
CELESTION
The Foremost Name in Sound Reproduction

MODEL P44

- Overall Diameter 12 1/4"
- Voice Coil Impedance ohms 3.0
- Magnet Pole Diameter 1 1/2"
- Flux Density (Gauss) 10,000
- Total Gap Flux (Maxwells) 60,000
- Peak Power Capacity 10W

CELESTION
SUMMER ROAD
THAMES DITTON, SURREY
Telephone : EMBERBROOK 3402-5

SYDNEY S. BIRD & SONS, LTD.
CAMBRIDGE ARTERIAL RD., ENFIELD, MIDDX.
Phone: Enfield 207/2. Grams: Capacity, Enfield.

MICA DIELECTRIC TRIMMERS

No. 10K1. Two Section. Range of max. capacities: Up to 1,000 pf, per section. Fitted with one insulated knob (1OK2-two knobs) for incorporating in fly-back circuit of TV Receivers. 1,344" long, 1,344" wide, 1" high.

No. 22. Capacities: Max. 50pF-80pF, Min. 30pF. 2BA. Threaded section under base for one hole fixing. 0.875" long, 0.625" wide, 0.875" high.

“Culdon”

VARIABLE Capacitors

MICA TRIMMERS to AIR DIELECTRIC
HIGH-VOLTAGE Transmitting Capacitors

“TAYLORS METERS. List on request. DECCA PICK-UPS . . . £3 15 0
DECCA HEAD for Garrard 219 0
Adaptors 2 0
COSSOR DOUBLE BEAM OSCILLOSCOPE £65 10 0
"Viewmaster" Television Kits in stock for Birmingham and London area. Please state which required.
LONDON’S OLDEST LEADING RADIO DEALERS

SAVAGE TRANSFORMERS LIMITED
NURSTEED ROAD • DEVIZES • WILTS
TELEPHONE DEVIZES 555

INTERJECT TRANSFORMER CONSTRUCTION

S A V A G E T R A N S F O R M E R S L I M I T E D
NURSTEED ROAD • DEVIZES • WILTS
TELEPHONE DEVIZES 555

18 Broad Rd., Willingdon, Eastbourne, Sussex

“Valve Luxury R/gram chassis”

Guaranteed 12 months
Data sheets on request

51

“Arthur’s
Est. 1919

PROPS: ARTHUR GRAY, LTD. Terms C.O.D. or cash with order
Our Only Address: Gray House, 150/152 Charing Cross Rd., London, W.C.2
Telephone: TEMple Bar 5833/4 and 4765

ELECTRICAL, TELEVISION & RADIO ENGINEERS.
CONSISTENTLY Accurate

PULLIN A.C. DYNAMOMETER MULTI RANGE TEST SET TYPE P.D.440 with the well known Pullin iron-free dynamometer movement combines the functions of a Precision indicating Ammeter, Voltmeter and Wattmeter. Covers an extremely wide range to fine limits of accuracy:

5 Voltages—Ranges from 25 to 500 Volts A.C. or D.C. Accuracy plus or minus 0.5%.
6 Amperes—Ranges from 0.5 to 25 (A.C. only). Accuracy plus or minus 0.5%.
30 Watts—Ranges from 12.5 to 12,500 (A.C. only). Accuracy plus or minus 1%.

Entirely self-contained in polished hardwood case with carrying handle and removable lid, as shown.
Weight 17 lbs. Size 10½ in x 13½ in x 7½ in.

Get full details without delay from:
MEASURING INSTRUMENTS (PULLIN) LTD.
Telegrams: MIPULLCO EALUX LONDON.
Tel.: 4CO 4651 & 4995

MORTLAKE TRADING CO.
Now in production
12 inch RECORDING DISCS — — — — 5/6 each or 62/6 doz.
SPECIAL TERMS TO WHOLESALERS AND RECORDING COMPANIES

We are manufacturers of TRANSFORMERS and COILS. Special Transformers to order.

<table>
<thead>
<tr>
<th>MAINS TRANSFORMERS</th>
<th>Small Mains Transformer suitable for midget receiver, 6 v. 1 amp.</th>
<th>5/-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tapped Primary 270-0-270 v. 70 ma. 6.3 v. 3 amps., 5 v. 2 amps.</td>
<td>each 14/6</td>
<td></td>
</tr>
<tr>
<td>Tapped Primary 350-0-350 v. 100 ma. 6.3 v. 3 amps., 5 v. 2 amps.</td>
<td>each 19/6</td>
<td></td>
</tr>
<tr>
<td>4 volt 8 amps.</td>
<td>each 8/6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OUTPUT TRANSFORMER</th>
<th>Chokes, 60 ma. 300 ohms, 3/--; 150 ma. 200 ohms</th>
<th>7/6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Output Transformer. Will carry 50 mA. State ratio required</td>
<td>3/4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOUD SPEAKERS</th>
<th>WHIP TYPE AERIALS, 4 sections, 2ft. each length, interlocking, complete with canvas carrying case, new, each 7/6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loud Speakers, Sin. with trans., 10/6.</td>
<td>The famous BURGOYNE SOLDER GUN, complete and new, 49/6.</td>
</tr>
<tr>
<td>Loud Speakers, Sin. less trans., 8/6.</td>
<td>V.C.R. 97 TUBES, 35/—, carriage paid.</td>
</tr>
<tr>
<td>Loud Speakers, 6in. less trans., 11/—.</td>
<td>WHITE RUBBER MASKS for above, 7/6.</td>
</tr>
<tr>
<td>Loud Speakers, 8in. less trans., 13/—.</td>
<td>MAGNIFYING LENSES for same 25/—.</td>
</tr>
<tr>
<td>Special offer of set manufacturer's surplus of Goodman's Bin., 14/—; 10/—, 17/—.</td>
<td>SEND FOR LIST</td>
</tr>
<tr>
<td>The famous ROLA REGAL extension speaker, limited number only, 27/6 new and in original cartons.</td>
<td>Terms of business Cash with order.</td>
</tr>
<tr>
<td>Rola Bin. energized, with trans., 11/6,</td>
<td>All orders under 20/- postage and packing 1/6 extra.</td>
</tr>
<tr>
<td>Rola Bin. P.M. with trans., 15/6.</td>
<td>The famous 1555 Receivers 10 valves, Aerial tested, in original transit cases, carriage paid, 69/19/6.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONDENSERS</th>
<th>A few needing service but otherwise complete, 68/19/6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrolytic, 8 mfd. tubular 450 and 500 volt, 3½; 16 mfd. 450 and 500 volt, 3½; 8-8-450 volt, 3½; 16-8-450 volt, 3½; 16 mfd. plus 24 mfd. 350 volt working, 2/9.</td>
<td>1555 Receivers Brand new and in original sealed cases, 11 valves, as specified for the inexpensive television receiver, carriage paid, 79/6.</td>
</tr>
<tr>
<td>Mansbridge and oil filled types, 4 mfd. 400 volt working, 1½; 4 mfd. 500 volt working, 1½; 4 mfd. 600 volt working, 3/3.</td>
<td>Dinghy Transmitters Valves 12SC7, 12A6, hand-wound generator, for L.T. &amp; H.T. 300 v. 40 mA, 20 v, 175A, complete with aerial, etc., carriage paid, 29/6.</td>
</tr>
<tr>
<td>2 Gangs 0005, 3/9.</td>
<td>POST ORDERS To 197, LOWER RICHMOND ROAD, RICHMOND, SURREY. PROspect 4464</td>
</tr>
</tbody>
</table>

Callers to above address and THE ARCADE (opposite G.P.O.) GEORGE STREET, RICHMOND. OPEN UNTIL 6.0 p.m. SATURDAYS. —
QUALITY LOUDSPEAKER CABINETS

An illustrated leaflet describing these attractively designed and solidly constructed cabinets is now ready. Models are available to house the majority of the leading high fidelity loudspeakers. Send for the leaflet now, or better still call and hear a demonstration.

ROGERS DEVELOPMENTS CO.


T.V. in the FRINGE AREAS

A Superior PRE-AMPLIFIER
By 'RAINBOW'

For use with CO-AX or BALANCED FEEDER
Built-in Power Pack, with Metal Rectifier, E.F.91 valve, exclusive Rainbow Coils. Complete with all Plugs, Crackle Finish, Steel Case 8 3/4" x 4 3/4" x 2 1/4".

Price £5 17 6

Alexandra Palace or Sutton Coldfield Model

It's giving excellent results with Receivers by Bush, Pye, H.M.V., Marconi, Philips, etc. It's to your advantage to write for fuller details.

RAINBOW RADIO MANUFACTURING CO. LTD.

Mincing Lane, Blackburn, Lancs., England

RELAYS AND KEY SWITCHES
LARGEST EX-GOVT. STOCK IN GT. BRITAIN

Types 600-3000 Relays — Siemens High Speed
Also A.C. 250 volts 50 cycles
Uniselector Switches, Carbon Insets, Telephone Components, Plugs, Jacks, Handsets, Co-Axial Cables — Government Contractors

JACK DAVIS (Dept. W.)

30 PERCY STREET, LONDON, W.1

Phones: MUSEum 7960, LANgham 4821

OLIVER PELL CONTROL LTD

Mains Transformers
A.F. Transformers
Thermal Delay Switches
Smoothing Chokes
Power Resistances

Made by

CAMBRIDGE ROAD, WOOLWICH, S.E.18
NEW RECEIVERS AND AMPLIFIERS

WRITE for details of:

HALLICRAFTERS dual diversity receivers, complete with power tubes and loud speakers; few only available. 46, Greyhound Rd., London, W.6.


Hallidays and radio feeders; send for details and price list. 6, Beaufort Rd., Wimbledon, S.W.19.

TRADE OFFERS in the columns carry no manufacturers' or agents' stamp. TEL. Lib. 3303.

THE outstanding radio receiver is the acknowledged finest reproducer in the world as adopted by the United States Navy. Ask your nearest quality jobber the admitted Roll-Royce of amplifiers the official 7-valve model, £22/10; and the premier model, with built-in pre-amplifier, £25/10 (ex cons.); £27/10 (ex cons.); £29/10 (ex cons.). Only the discriminating ear will be satisfied with this new, high-fidelity receiver. It is built on extra heavy gauge chassis; our model of this instrument is sold to other manufacturers for their product of this kind; in stock for further details, order now; 18, Northmore Rd., and 28, Winstanley Rd. (callers welcome).

NEW ReceIvers, aPParatus- Surplus

1 famous Williamson amplifier describes the outstanding quality of this famous receiver. It is built to the same standards as all Williamson products, and is available on terms. Write for full details of this famous product; all parts of finest quality guaranteed. 6, Beaufort Rd., Wimbledon, S.W.19.

THE new "PP0" output transformers permit the reproduction of a full A.F. range with minimum distortion. Rating is 12 watts for 0.5% harmonic distortion at 5 cycles. Six standard models are available, for accurate matching anode to anode loads of 4,000 ohms to 12,000 ohms. These standard models are available from stock, other specifica-

The "PP0" output transformers permit the reproduction of a full A.F. range with minimum distortion. Rating is 12 watts for 0.5% harmonic distortion at 5 cycles. Six standard models are available, for accurate matching anode to anode loads of 4,000 ohms to 12,000 ohms. These standard models are available from stock, other specifications can be woud to be satisfied with this new, high-fidelity receiver. It is built on extra heavy gauge chassis; our model of this instrument is sold to other manufacturers for their product of this kind; in stock for further details, order now; 18, Northmore Rd., and 28, Winstanley Rd. (callers welcome).

Full details are given in Technical Data Sheet No. 1, a copy of which will gladly be sent on request.
NEW THOUGHTS ON HIGH-FIDELITY

The incidence of the Hartley-Turner 215 speaker on the American market has raised a small storm of controversy over what one really means by high-fidelity. We are highly gratified that our speaker has now become so well known over there that it should cause even a small commotion among the cognoscenti.

The cleavage of opinion arises from two schools of thought, one of which insists on the widest possible frequency range irrespective of the musical value, and the other which insists on the music coming first. The second school insists that the first school has let the "highs" catch up on it—in other words, that it has gone "top mad." For the life of us we cannot see how the 215 doesn't sound like any other speaker—it sounds like the real music coming first. Yet the explanation of this apparent contradiction arises from the fact that from a five-dollar speaker.

We are highly gratified that our speaker has now become so well known over there that it should cause even a small commotion among the cognoscenti.

The cleavage of opinion arises from two schools of thought, one of which insists on the widest possible frequency range irrespective of the musical value, and the other which insists on the music coming first. The second school insists that the first school has let the "highs" catch up on it—in other words, that it has gone "top mad." For the life of us we cannot see how the 215 doesn't sound like any other speaker—it sounds like the real music coming first. Yet the explanation of this apparent contradiction arises from the fact that from a five-dollar speaker.

We are also in a position to quote for power transformers, as actual manufacture will be used to quote for quantity for home or export.

REVOLUTIONARIES, with separate exciters generators, 4-pole ball bearings, 1,500 rpm, output 25v, 50 cycles, 2.5 kva, €25; dito., 2-pole, ball bearing, ¥136 with various outputs, etc.; £26 delivered.

PETROL electric generator plants, comprising a J.A.P. No. 240 coupled to a petrol driven rope drive to an alternator, giving an output 220v, 20 cycles, 80 amperes, with screwed 400 mm., £186 a set; voltage and frequency regulating and filtering on generator, eminently suitable for use in combined radio on land or sea, etc., price £40; such plants can be supplied for various purposes, e.g., for 220/240 v., for oil and for gas applications.

The overwhelming proportion of those who have bought it consider that the performance is absolutely up to expectation. There are a few, particularly among engineers, who say it hasn't got enough top, and sounds as though it had very much less top than the American coaxial units. Ergo, it cannot be a high-fidelity speaker. It isn't so easy as that, and the few critics get horribly tied up. For example, for one man has said, almost in the same paragraph, "In the frequency range in which it reproduces, your 215 is delightfully clean—a large variety of isolated transients were handled better than I have ever heard from a speaker." The extreme high-out is similar to that from a five-dollar speaker.

"Now we all know that good transient reproduction demands not only superlatively good damping but a very wide frequency response, so that all the long series of overtones, which give a transient its peculiar quality, are properly reproduced. For the life of us we cannot see how the 215 could reproduce transients so well if it has no real top.

"Yet the explanation of this apparent contradiction is perfectly simple. The extreme top response of the 215 doesn't hit you in the ear, but it is there all the same. The peculiar characteristic of the Hartley-Turner speaker is that it doesn't sound like a speaker—it sounds like the real thing. Here is one of the reasons why we have always been stickly about publishing static response curves of our speakers, we are not particularly anxious to design speakers to please the "top man school." Our industrial mission in life is to design speakers for people who want music reproduced without distortion, and in that we are succeeding in Britain and throughout the rest of the civilized world. Sooner or later, the great public will be ready for real music sounds like, you will buy the 215, which costs only £5. Why not send for details now?
NEW LOUDSPEAKERS

H.1-F1 reproducer cabinet, £6.25; 110 square meters, £11.0.0. - Cabinet, £5.5.0.

LOUDSPEAKERS—SUPPLIES AND STOCKS

408 HIGH STREET LEWISHAM, S.E.1

Telephone: Lee Green 0309.

TERMS: CASH WITH DELIVERY

EARLY CLOSING THURSDAY

NEW TEST EQUIPMENT

D.C. ELECTRIC LIGHT CHECK METERS, various types, for sub-letting garages, apartments, dwellings, etc., fitted with self-contained four quadrantly type, for sub-letting garages, apartments, dwellings, etc., fitted with self-contained and guaranteed. All guaranteed, immediate delivery.

NEW TEST EQUIPMENT

1950

TRANSMITTING EQUIPMENT

SPEAKERS—SURPLUS AND SECONDHAND

SPEAKERS—SURPLUS AND SECONDHAND

SPEAKERS—SURPLUS AND SECONDHAND

GALPINS

ELECTRICAL STORES

Order: no C.O.D.

From 9.45 am until 4.15 pm Saturdays.

Main Transmitters, input 250/350/550 volts in steps of 10 volts, output 350/350/550 volts. 300 m, 660 m, 6.3 volts, 150 mamps. 6 amp., 3.6 volts 2 amp. tapped at 2 volts (electrically adjustable). Output 500/350/350/500 volts 750 mamps. 1,500 watts, 5.5 volts 4.5 amp., 3.5 volts 3 amp., 2.5 volts 2 amp. tapped at 2 volts, 676 each.

Main variable slider resistances, 4000 ohms, 9 am., 22/6 each; disto 1,500 ohms to carry 4.5 amps., 22/6 each, not provisioned, 0.45 amperes output 1,500 volts output 1.5 amperes to carry 1/4 amps., 12/6 each; 5.7 ohms to carry 1.5 amperes, 15/- each; 60 ohms to carry 1.5 amperes, 15/- each.

Main transmitters input 100/250/500 volts in steps of 10 volts. Output tapped 0, 6, 12 at 24 volts at 10/12 amps., 47/- each; delivery as above but at 25/30 amps, output 68/6 each.

Electrical Light Check Meters, quadrantal type, for sub-letting garages, apartments, dwellings, etc., fitted with self-contained and guaranteed. All guaranteed, immediate delivery.

Main Transmitters, input 250/350/550 volts in steps of 10 volts, output tapped 0, 6, 12 at 24 volts at 10/12 amps., 47/- each; delivery as above but at 25/30 amps, output 68/6 each.

Electrical Light Check Meters, quadrantal type, for sub-letting garages, apartments, dwellings, etc., fitted with self-contained and guaranteed. All guaranteed, immediate delivery.

Main Transmitters, input 250/350/550 volts in steps of 10 volts, output tapped 0, 6, 12 at 24 volts at 10/12 amps., 47/- each; delivery as above but at 25/30 amps, output 68/6 each.

Electrical Light Check Meters, quadrantal type, for sub-letting garages, apartments, dwellings, etc., fitted with self-contained and guaranteed. All guaranteed, immediate delivery.

Main Transmitters, input 250/350/550 volts in steps of 10 volts, output tapped 0, 6, 12 at 24 volts at 10/12 amps., 47/- each; delivery as above but at 25/30 amps, output 68/6 each.
AMPLIFIER CHASSIS AND COVERS

SIZE A
Chassis in 18 Gauge Steel 17 x 12 x 2¼in, fitted with base plate having rubber feet and cover in 20 Gauge Steel with rubber feet, corners giving 7in, clearance above chassis; louvered back and front, complete with two Chromium-Plated Handles. 

£5 0

SIZE B
Chassis 17 x 10 x 2½in, as above, with one Chromium-Plated Handle. 

£2 12

SIZE C
Chassis 14 x 8 x 2¼in, as above, with one Chromium-Plated Handle. 

£1 12

STANDARD FINISHES: Black, Grey or Brown Wrinkle Enamel.

CARRIAGE: Paid on Orders Over £2. 

ILLUSTRATED LISTS AND TRADE TERMS ON APPLICATION.

REOSOUND ENGINEERING & ELECTRICAL COMPANY, "Reosound Works," Golehill Road, Sutton Coldfield.

---

CONDENSERS of all types

We can offer, FOR IMMEDIATE DELIVERY from very generous stocks, a wide range of ultra-high quality fixed paper Condensers, from 0.001 μF to 8 μF. Also STOCKS of small, genuine MICA Condensers from .00001 (10 pf) to .01 μF (10,000 pf). Prices are exceedingly moderate.

Enquiries are invited for manufacturers' requirements, wholesale and export only for bulk quantities, and for scheduled deliveries over a period, as required.

Most condensers are now available for immediate delivery.

---

Please request our 4 page bulletin CONSEVEN 01114

CLAUDE LYONS LTD.
180 Tottenham Court Rd., London, W.1
and 76, Old Hall St., Liverpool 3, Lancs,
EVERY GOOD AMPLIFIER IN EVERY LAND DESERVES A BARKER LOUDSPEAKER

NEW COMPONENTS

HANNEY OF BATH oﬀers:

WIRELESS World T.V. superhet: complete set of coils would exactly to designer's specifications.

45/-.

POLYSTYRENE transformers, 15in x 3in tapped 0 B.A. for fixing with fixing hole, 1/-. 24 x 19in.

PAXOLIN forms, 19in x 3in, tapped 0 B.A. with fixing hole, 2d in 19in x 3in, 3d in 19in x 3in, 4d in 19in. x 9in, 9d; Polystyrene varnish, large bottle, 1/10.

T.B. 2 received very well, 9d. each, bric, 1/-. Zodiodyne 563 split motor, 7/6; B.T.H. G.C.1 circuit, 1/12; 114/05 rectifiers, 2/-; 100A 1/2 in. D.C. Dunlop condenser 500k 0.005 secs. 7/-. D.C. Dunlop condenser in stock for the new O.E.M. Orham radio receiver for use with high fidelity amplifiers, described in their technical publication T.P. 24; write for complete components list.

O.F. transformers, Dunlop condenser. We are also available for the P.W. television, B.C. television, and Bernard highlights television. Zodiodyne and Raymart W.B. chassis speaker, transformers, 16/5. Finney transformers and transformers, 16/0. Eddycone transformers, 16/5.

THE Viewmaster everything in stock, T.C.C.

For approved components all enquiries should be addressed to: Mr. S. H. Leach, 228-229 Merton Rd., Wimbledon, S.W. 19.
The truth about
"HIGH FIDELITY"

Come and hear the following for yourself.

CHARLES AMPLIFIER and DUAL
RADIO TUNER

SOUND SALES "TONE-
AMPLIFIER" for "DX PLUS TWO" FEEDER

LEAK AMPLIFIERS and PICK UP

VORTEXION "STEREO-
PHONIC" AMPLIFIER AND
ACOS "GP 20" PICK UP

ARMSTRONG 83 and 103
CHASSIS

A.C. BARKER'S LOUDSPEAKERS

GOODMANS "AXIOM 12 and
22" SPEAKERS

WARFEDALE and W.B.
LOUDSPEAKERS

GARRARD RECORD CHANG-
ERS and DECCA PICK UPS

AT HOLLEY'S RADIO STORE
285 CAMBERWELL ROAD
S.E.5

 Phone RODNEY 4988
Open all day Saturday

NEW COMPONENTS

TELRAD ELECTRONICS, 70, Church Rd.,
Uxbridge. Make us an offer on the following components for "View Master," Bellini & Lee, Brillini, Cifine, Colvin, Cram Ski, Purevue, Weasel, Westhinghouse, Whistle, complete parts in stock & special stocked in stock. E.E. chassis, transformers, etc. Write, call or phone your order by 5 p.m. daily.

BEL television coil sets are manufactured for all the current television sets. 82, 95, 100. Write, call or phone your order by 5 p.m. daily.

HOLLEY'S GARRARD RECORD CHANGERS and "AXIOM 12 and
WHARFDALE GOODMANS "AXIOM 12 and
ARMSTRONG VORTEXION LEAK AMPLIFIERS and PICK UP
"DX PLUS TWO"

"NO PASS-NO FEE"

IN RADIO

Open all day Saturday

In Radio

Get this FREE Book!
"ENGINEERING OPPORTUNITIES IN RADIO"
reveals how you can become technically-quali-

fied at home for a highly-paid key appointment in the vast Radio and Tele-

vision Industry. In 176 pages of intensely inter-
esting matter, it includes full details of our up-to-

the-minute home study courses in all branches of TELEVISION and
RADIO, A. M. Brit 1, R. K. E., City &
Guilds, Special Television, Sound
Film Projection, Short Wave, High Frequency, and
General Wireless Courses.

We definitely Guarantee
"NO PASS—NO FEE"

If you're earning less than £10 a week, this

engineering book is for you. Write for your copy today. It will be sent FREE and
without obligation.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY
398b SHAKESPEARE HOUSE
17/19 STRATFORD PLACE, LONDON, W.1

June, 1950
TOWARDS PERFECTION—
LOWTHER P.M.2 UNIT

fitted with Voigt's Re-matched diaphragm, is the most efficient drive unit, for horn loading.

When used in conjunction with P.W.1 cabinet, it offers at £57 (in the white) a complete loudspeaker system unequalled except by P.M.2 in conjunction with the Voigt Reflector horn at £80-10.0 (in the white complete) which, as yet, remains unsurpassed.

Further details, please write —

THE LOWTHER MANUFACTURING CO.
(The Laboratory Production Unit)

Lowther House, St. Mark's Road,
Bromley, Kent
RAV. 5225

THE HAYES COMPANY

ARMSTRONG 83 chassis, 7 valve, 3 waveband with 8 watt push-pull output, Mazda valves, amplifier kit in stock, push-button tuning, 8 inch dia, flywheel tuning, 10hm. 1ips, tone control, ready for cabinet mounting, tax paid, £18 17/1


TELEVISION CHASSIS.
We give below details of the outstanding ARMSTRONG TV20 chassis, which is giving excellent results up to 100 miles from Sutton Coldfield, and which has brilliant definition. In June we hope to have in stock other TV chassis of various makes, and also a very limited number of chassis with 15in. tubes. When used in conjunction with P.W.1 cabinet, it offers at £57 (in the white) a complete loudspeaker system unequalled except by P.M.2 in conjunction with the Voigt Reflector horn at £80-10.0 (in the white complete) which, as yet, remains unsurpassed. Readers who write to us will be kept informed as these new chassis become available.

ARMSTRONG TELEVISION CHASSIS, Superhet receiver with R.F. stage, ample gain for "fringe area" operation. Two main controls: noise limiters on sound and vision, blocking oscillator time bases and a total of 21 valves. The complete receiver is on one chassis, ready for mounting in cabinet. Definition is outstanding, picture quality compares with any set at, irrespective of price. Complete with 10hm. speaker, £66 0/6. Write for details of these and other chassis. I.T. demonstrations daily, and on Wednesday evenings, All Armstrong chassis in stock. We despach same day by passenger train.

THE HAYES COMPANY
1 ALCETER RD., MOSELEY, BIRMINGHAM, 13. 
COMPONENTS - SURPLUS AND SECONDHAND

RADIO CLEARANCE Ltd., 27, Tottenham Court Road, W1.

20-WATT amplifier kits for constructing the McMurdo 8-valve A.C.D.C. amplifier; low frequency input (suitable for moving coil microphones, etc.), by triple conversion in a metal-fronted metal chassis, E.P. 27. R.C. coupled to triode, strapped stage (R.F.), with switched bass and bass cut controls, trans coupled to output stage, using a 4-valve in parallel push-pull (O.P.T. to 1%) rectifiers, 2x (V.S.C), parallel, alternative input, and separate stage for X-tal input, tuner units, etc., reduced inputs for full output, high imp., 0.5m.

J.R.S., low imp. 1 millivolt, V.O. operates on both inputs, chassis isolated from mains, complete kit of first-class components (including parts trans), all valves, black crystal chassis (ready drilled), black crystal and chromium plate case (18x6x4), circuit diagram, everything required for the construction of a fine job.

PIONEER, 6-valve, 125W. chassis, enclosed, 4-valve chassis with 3 S.W., plastic case, 1200-1750, 8000-20000 M., 10 sets.

F. O. PERSONNEL, personal chassis for the man who wants a good kit.

A.C. 200-250 volts.

The Return of Post Mail Order Service

As supplied by us to the Ministry of Supply, R.B.C.

Education Authorities, Admiralty, etc.

Interference-screened primary transformers tapped 300/50/25

plus ARMSTRONG

Superb Quality

What more could you ask of a modern radiogram chassis? And yet that’s not all! Model EXP 83/2 also provides highly efficient noise feed-back; fly-wheel drive; special permanent pick-up switching; wave-bands covering 16-50, 200-550 and 1000-2000 M. and an audio output of 8 watts A.C. 200-250 volts.

OTHER ARMSTRONG CHASSIS Model RF 103/3.

A 10-valve all-wave radio chassis with 3 wave bands. A.C. 200-250 volts.

£19.30. Plus P.T.

Model 125/2. The “Armstrong” triumph—a 14-valve all-wave radiogram chassis with 3 S.W. bands down to 10.9 metres. The chassis for the man who wants the best. £33.12.0. Plus P.T.

ARMSTRONG TELEVISION


Write now for full information.
THE THE MODERN BOOK CO.

A Home Built FM Receiver. By K. R. Stirley. 4s. 6d., Postage 3d.
The Williamson Amplifier. Articles reprinted from "Wireless World." 5s., Postage 3d.
Television Servicing Manual. By E. N. Bradley. 4s. 6d., Postage 3d.
Data & Circuits of Modern Receiver & Amplifier Valves. Book 3. 12s. 6d., Postage 9d.
9 C.R. TUBE SUPPORTS mounting on top of Gantry Assembly
9 CREAM MASKS.

S. SHAKESPEARE RD., FINCHLEY, N.3

Phone: Finchley 2188

THE TELEVISION MANUFACTURED TO " ELECTRONIC ENGINEERING " TELEVISION SPECIFICATION.

MIDLAND T.V. Sound and Vision Panels supplied with forms and dust covers now available.

LINE OUTPUT TRANSFORMERS
New Improved

LET OF GANTRIES COMPLETE

FOCUS COILS

LINE AND FRAME SCANNING COIL ASSEMBLY

All Steel CADMIUM PLATED POWER AND TIME BASE CHASSIS valve-holders, 3 point and single socket audible buzzer-tots.

SOUND PANEL CHASSIS ASSEMBLY, fitted with screws, valve-holders, formers, and dust covers.

VISION PANEL CHASSIS ASSEMBLY, fitted with screws, valve-holders, formers, and dust covers.

9 C.R. TUBE SUPPORTS mounting on top of Gantry Assembly

9 CREAM MASKS.

RAILWAY TELEGRAPH CO.

5, SHAKESPEARE RD., FINCHLEY, N.3

5d. SHAKESPEARE RD., FINCHLEY, N.3

3d.

Vol. I, By A. W. Keen. 30s. Postage 9d.

Vol. 2, 6s. Postage 9d.

Bradley.

Sturley.

F. F. Penrose.

G. W. Bennington.

A. L. Allenden.

A. W. Keen. 30s. Postage 9d.

H. E. Penrose. 42s. Postage 6d.

RADIO ENGINEERS TO THE TRADE - ESTIMATES GIVEN - Components and valves fitted at usual trade discount.

RADIO ENGINEERS TO THE TRADE - ESTIMATES GIVEN - Components and valves fitted at usual trade discount.

W. 7A, Box 28, Tram, Finchley Rd. S. B. Blackie.

Opera U. 6.30 p.m.

RADIO TELEGRAPH CO.

44, Wandsworth Road, London, S.W.8

Phone: M.O. 4158

J. 71, 77A, Box 28, Tram, Finchley Rd. S. B. Blackie.

OPERA U. 6.30 p.m.

ALL E.E. and Viewmaster parts; Viewmaster all cadmium plated, complete set; post paid.

ALL E.E. and Viewmaster parts; Viewmaster all cadmium plated, complete set; post paid.

RADIO TELEGRAPH CO.

44, Wandsworth Road, London, S.W.8

Phone: M.O. 4158

J. 71, 77A, Box 28, Tram, Finchley Rd. S. B. Blackie.

OPERA U. 6.30 p.m.

SPEAKERS in stock, from 3M at 8/6 to Good -

ALL E.E. and Viewmaster parts; Viewmaster all cadmium plated, complete set; post paid.

SPEAKERS in stock, from 3M at 8/6 to Good -

ALL E.E. and Viewmaster parts; Viewmaster all cadmium plated, complete set; post paid.

RADIO TELEGRAPH CO.

44, Wandsworth Road, London, S.W.8

Phone: M.O. 4158

J. 71, 77A, Box 28, Tram, Finchley Rd. S. B. Blackie.

OPERA U. 6.30 p.m.

SPEAKERS in stock, from 3M at 8/6 to Good -

ALL E.E. and Viewmaster parts; Viewmaster all cadmium plated, complete set; post paid.

RADIO TELEGRAPH CO.

44, Wandsworth Road, London, S.W.8

Phone: M.O. 4158

J. 71, 77A, Box 28, Tram, Finchley Rd. S. B. Blackie.

OPERA U. 6.30 p.m.

SPEAKERS in stock, from 3M at 8/6 to Good -

ALL E.E. and Viewmaster parts; Viewmaster all cadmium plated, complete set; post paid.

SPEAKERS in stock, from 3M at 8/6 to Good -

ALL E.E. and Viewmaster parts; Viewmaster all cadmium plated, complete set; post paid.
**COMPONENTS SURPLUS AND SECONDHAND**

**TAP COILS**
- 100ohm 3kW
- 200ohm 5kW
- 500ohm 10kW
- 1500ohm 20kW
- 5000ohm 50kW

**POTS**
- 100ohm, 250ohm, 1000ohm, 2000ohm

**BARE METAL PLATING**
- 170ohm, wheel co denied adjustment, 10/- each.
- Square flush mounting, 7/8.
- 3mfd 500v, small can type, 1/- each.
- 5mfd 500v, small can type, 1/- each.

**T.M.C. CONDENSER WITH CLIP**
Size 4in. x 11/2in.

**ELECTRIC LIGHT CHECK METER**, 5, 10 and 20

**FILL RANGE OF WEARITE COILS IN STOCK**, 3/- each.

**MINIATURE OUTPUT TRANSFORMER**
- for personal receivers, 10/- each.
- 3-pin plugs and A.C. input socket. Total size, 12 x 6, 21/2in. A.C. meter with 0/P.

**METER DISTRIBUTION BOARD**
- New and Boxed, 19/6.
- 9/11, 60m, 12/11. Sin., 13/6, 10in., 19/11.

**ROLA SPEAKERS**
- New and Boxed, 2/8.

**EX-U.S. ARMY MINIATURE HEADPHONES**
- 10/- each.
- Two 6-30v, 419 2/6 Set.

**HEAVY DUTY 2-WAY (W) PLUGS AND BASES**
- 6-, 4- and 2-WAY (W) PLUGS AND BASES, 2/6 Set.

**C.R.T. 5 C.P.I. WITH MU METAL SCREEN AND HOLDER**, 35/-

**JONES PLUGS AND SOCKETS**
- 12, 10, 8, 6 and 4

**BATTERY, A.C. AND UNIVERSAL TYPES**

**COMPONENTS - SURPLUS AND SECONDHAND**

**TAP COILS**
- 100ohm 3kW
- 200ohm 5kW
- 500ohm 10kW
- 1500ohm 20kW
- 5000ohm 50kW

**POTS**
- 100ohm, 250ohm, 1000ohm, 2000ohm

**BARE METAL PLATING**
- 170ohm, wheel co denied adjustment, 10/- each.
- Square flush mounting, 7/8.
- 3mfd 500v, small can type, 1/- each.
- 5mfd 500v, small can type, 1/- each.

**T.M.C. CONDENSER WITH CLIP**
Size 4in. x 11/2in.

**ELECTRIC LIGHT CHECK METER**, 5, 10 and 20

**FILL RANGE OF WEARITE COILS IN STOCK**, 3/- each.

**MINIATURE OUTPUT TRANSFORMER**
- for personal receivers, 10/- each.
- 3-pin plugs and A.C. input socket. Total size, 12 x 6, 21/2in. A.C. meter with 0/P.

**METER DISTRIBUTION BOARD**
- New and Boxed, 19/6.
- 9/11, 60m, 12/11. Sin., 13/6, 10in., 19/11.

**ROLA SPEAKERS**
- New and Boxed, 2/8.

**EX-U.S. ARMY MINIATURE HEADPHONES**
- 10/- each.
- Two 6-30v, 419 2/6 Set.

**HEAVY DUTY 2-WAY (W) PLUGS AND BASES**
- 6-, 4- and 2-WAY (W) PLUGS AND BASES, 2/6 Set.

**C.R.T. 5 C.P.I. WITH MU METAL SCREEN AND HOLDER**, 35/-

**JONES PLUGS AND SOCKETS**
- 12, 10, 8, 6 and 4

**BATTERY, A.C. AND UNIVERSAL TYPES**

**COMPONENTS - SURPLUS AND SECONDHAND**

**TAP COILS**
- 100ohm 3kW
- 200ohm 5kW
- 500ohm 10kW
- 1500ohm 20kW
- 5000ohm 50kW

**POTS**
- 100ohm, 250ohm, 1000ohm, 2000ohm

**BARE METAL PLATING**
- 170ohm, wheel co denied adjustment, 10/- each.
- Square flush mounting, 7/8.
- 3mfd 500v, small can type, 1/- each.
- 5mfd 500v, small can type, 1/- each.

**T.M.C. CONDENSER WITH CLIP**
Size 4in. x 11/2in.

**ELECTRIC LIGHT CHECK METER**, 5, 10 and 20

**FILL RANGE OF WEARITE COILS IN STOCK**, 3/- each.

**MINIATURE OUTPUT TRANSFORMER**
- for personal receivers, 10/- each.
- 3-pin plugs and A.C. input socket. Total size, 12 x 6, 21/2in. A.C. meter with 0/P.

**METER DISTRIBUTION BOARD**
- New and Boxed, 19/6.
- 9/11, 60m, 12/11. Sin., 13/6, 10in., 19/11.

**ROLA SPEAKERS**
- New and Boxed, 2/8.

**EX-U.S. ARMY MINIATURE HEADPHONES**
- 10/- each.
- Two 6-30v, 419 2/6 Set.

**HEAVY DUTY 2-WAY (W) PLUGS AND BASES**
- 6-, 4- and 2-WAY (W) PLUGS AND BASES, 2/6 Set.

**C.R.T. 5 C.P.I. WITH MU METAL SCREEN AND HOLDER**, 35/-

**JONES PLUGS AND SOCKETS**
- 12, 10, 8, 6 and 4

**BATTERY, A.C. AND UNIVERSAL TYPES**

**COMPONENTS - SURPLUS AND SECONDHAND**

**TAP COILS**
- 100ohm 3kW
- 200ohm 5kW
- 500ohm 10kW
- 1500ohm 20kW
- 5000ohm 50kW

**POTS**
- 100ohm, 250ohm, 1000ohm, 2000ohm

**BARE METAL PLATING**
- 170ohm, wheel co denied adjustment, 10/- each.
- Square flush mounting, 7/8.
- 3mfd 500v, small can type, 1/- each.
- 5mfd 500v, small can type, 1/- each.

**T.M.C. CONDENSER WITH CLIP**
Size 4in. x 11/2in.

**ELECTRIC LIGHT CHECK METER**, 5, 10 and 20

**FILL RANGE OF WEARITE COILS IN STOCK**, 3/- each.

**MINIATURE OUTPUT TRANSFORMER**
- for personal receivers, 10/- each.
- 3-pin plugs and A.C. input socket. Total size, 12 x 6, 21/2in. A.C. meter with 0/P.
Make your own E.H.T. UNIT

2,000-12,000 volts

We can now offer a range of RF E.H.T. Coils and other components to order this range, together with full instructions for building. Complete units also available.

Prices:

- 5.5 KV COIL: 22/6
- 5 KV UNIT: 75/-
- 8 KV COIL: 30/-
- 8 KV UNIT: 95/-

If 12 KV UNIT is desired, the 8 KV unit with Voltage doubler can be used.

Please write for full details to:

HAZLEHURST DESIGNS LTD.
34, POTTERY LANE,
HOLLAND PARK, W.11.

Tel.: Park 6955.

Wireless World

June, 1950

POTENTIOMETERS

Wire wound and Composition types,
Single, Ganged, Tandem Units

Characteristics: linear, log, semi-log, non-inductive, etc.

Full details from RELIANCE

Manufacturing Co. (Southwark) Ltd
Sutherland Rd., Higham Hill, Walthamstow E.17
Telephone: LARKwood 3245

B. & H. RADIO

EAST STREET, DARLINGTON

BASS & TREBLE SEPARATOR

Enables the use of separate speakers for bass and treble.

Permits adjustment of amount of treble relative to bass and also allows speakers of different impedances to be used. Kit of parts...

£1 9 6

SCRATCH FILTERS

Marked reduction of scratch level without serious effect on treble response...

£1 0 0

WHISTLE FILTER

Steep trough, adjustable from 4 kHz upwards. Eliminates 9 kHz, whistles, etc....

£1 5 0

All items complete with diagrams and full instructions. Also available complete control units, amplifiers, standard or to specification etc.

COMPONENTS-SURPLUS AND SECONDHAND

BUILDERS. 15/- by well-known builders; FiOFO 250/285 and SR59 valve drillings to suit various standard and composition components. Single, Ganged, Tandem units available as follows:

- Single gang, 0.005 tuning condenser, 2/6 each.
- Single gang, 0.05 condenser, 5/6 each.
- Single gang, 0.5 condenser, 15/6.
- Single gang, 5 condenser, 2/6.
- Single gang, 505 coil paper condenser, 3/-.

All items complete with diagrams and full instructions. Also available complete control units, amplifiers, standard or to specification etc.

LYONS RADIO

K.E. RIVERS TYPE RS155.A. Frequency range 55 to 165 M.R.A.

Bendix 522 transformer, 2/6.

MARK II TRANSFORMER. Primary 200-250 v. 50 c.p.s. sec. 50 c.p.s. sec.

SECONDHAND TRANSFORMER. 140 ft. coil, 14 s.w.g. enamelled copper wire, 10 ft. length, 40 for 12/6 each.

BASS & TREBLE SEPARATOR. 131/2 in. long, 1 in. dia., 7 in. deep. Complete and in good order. £10.00.

Bendix 522 transformer, 2/6.

COMPONENTS-SURPLUS AND SECONDHAND

Building

THERMOMETERS-Made by G.E.C. voltages up to 200-1200 amps, temperature variable from 3500 to 35000 degrees Fahrenheit; price 25/- each; trade supplied.

G.E.C. 2000 condensers; for power factor correction, with internal safety leak, rating 275 volts 50 cycles, 4000-5400 m.f.d. special quotations for quantities.

B. & H. RADIO

EAST STREET, DARLINGTON

BASS & TREBLE SEPARATOR

Enables the use of separate speakers for bass and treble.

Permits adjustment of amount of treble relative to bass and also allows speakers of different impedances to be used. Kit of parts...

£1 9 6

SCRATCH FILTERS

Marked reduction of scratch level without serious effect on treble response...

£1 0 0

WHISTLE FILTER

Steep trough, adjustable from 4 kHz upwards. Eliminates 9 kHz, whistles, etc....

£1 5 0

All items complete with diagrams and full instructions. Also available complete control units, amplifiers, standard or to specification etc.
SOUTHERN RADIO'S WIRELESS BARGAINS

R.A.P. BOMBAYI COMPUTERS. Complete with motors, gyro's, telephone, etc. Ideal for model makers and experimenters. The best component value ever offered. Complete with 4 tubes, 2 de. carriage, SERVO UNIT ASSEMBLY for bombight computer, including 27 test sets, 10 red, 3 red, 2 white, blower, etc., 17/8.

CONTACT FOR A.C. SERIES, 10-hour movement with thermostatic control. Two impulses per second. Complete in sound-proof cabinet, 1525, 240 volts, 200+ 1/4.

TRIM SIX VALVES SUPER-SET RECEIVERS. Complete with seven tubes, 400. 200, 400, 300, 200, 300, 300, 115/10.

PERCIPES. Ex-U.S.A. Type M.R., complete with removable reservoirs, 19/6.

COMMAND RECEIVERS. B-0.440 (400) metres. Complete with six valves. Ideal for easy conversion to marine receiver or car radio, 500, plus 1/4. Conversion current to mains etc. 1/6.


LATE MODEL UPPER CUTTERS. Adjustable from 0 to 30in. For use on wood, metal, plastic, etc., 3/6. RADIO COMPASS INDICATORS, with Kelvyn motor. 3in. dial 360 degrees, 15/6.


PERISCOPES. Complete with six valves. 22/6.

SERVO UNIT ASSEMBLY for bombsight computer, 7/3.

THOUSANDS OF BARGAIN LINES FOR CALLERS.

WANTED, all kinds of laboratory test equipment, all types; highest prices paid. -Box 8485.

SOUTHERN RADIO SUPPLY LTD.

WALTON'S WIRELESS STORES, 203, Staveley Rd., Wolverhampton.

Established 1887.

REWARDS

Full comprehensive service, often by return of post.

TRANSFORMERS, CHOKES, FIELDS AS BEFORE, OR TO YOUR SPECIFICATION

See our space in classified column under REPAIRS and SERVICE

AISH & CO. LTD.

Radio Engineers

POOLE : DORSET

Telephone: POOLE 600
CABOT RADIO
A New Television Pre-amplifier


Price £3.15.0
Including 6F1 valve.

If in difficulty write direct to:
Cabot Radio Co. Ltd.,
28, Bedminster Parade,
Bristol 3
Tel: 64314
SUPACOILS
OFFER
QUALITY COMPONENTS

- Coils. A complete series of high Q variable iron dust cored coils in wave-lengths from 30 - 30,000, 75 - 150, 300 - 5,000, 1,250 - 20,000, H.F., H.V. or Oscillator at the remarkable price of £7.95 net.

- Transformer. 30 waveband superhet Coil Packs, aligned ... 2797 inc. Full selection drawings and instructions given with every pack.

- Coil Packs. A complete range of radio, television and gram components in stock, low prices, mail order.

- Enquiries are invited.

- Supply of general Radio information; assistance to radio hobbyists.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.

- A complete catalogue of coil packs, transformers, and other components such as valves, transistors, and other electrical components.
Please send a postal order for 6/6 to:-

<table>
<thead>
<tr>
<th>Your correct answer</th>
<th>4,000 ohms.</th>
</tr>
</thead>
</table>

An example of what and resistance can delay progress.

- Problems involving voltage, current, and resistance should be handled with care to avoid delays.
- A flick of the disk and there is a jiffy.

**ELECTRICAL AND RADIO ENGINEERS**

JUNE, 1950

**IONIC LABORATORIES LTD.**

A BEAUTIFUL WALNUT CABINET. EACH ANCE AND PERFORMANCE.

...THAT SELLS THE SET UNBEATABLE...

- HEIGHT 10% WIDTH 121", DEPTH 25/0-700 v. 10 m/s., 6.3 v. L5 a., 4 v. 2 a., 19/6.
- 250-0-250 v. 60 m/a., 6.3 v. 3 a., 5 v. 2 a., or 4 v. version,
- 300-0-300 v. 60 m/a., 6.3 v. 3 a., 5 v. 2 a., or 4 v. version,
- £1/19.0. Price 41/6. post free.
- 2 V. A.A. Coil consumption.
- £15,0. post free and delivered.

CROWN AGENTS FOR THE COLONIES.

...WHOLESALERS. ILLUSTRATED LEAFLETS SUPPLIED ONLY THROUGH SELECTED CUSTOMERS!

- Outfit allowance £30. Free passages. Candidates, aged between 25 and 38, must possess Postmaster General's First-class wireless - telegraph operator's certificate. have had liberal education; have had experience in electrical engineering (telecommunications) or electronics; have had high-frequency radio experience; have had experience in the operation of modern radio and/or radar high -frequency radio stations; experience in telecommunications engineering (telecommunications). Candidates must have knowledge of qualifications and experience and mention in their letters stating age, whether married or single, and full particulars for one tour of 48 months in the first instance, and for any further tours, and for any other appointment.

**NUSOUND TRANSFORMERS.**

(Taped prl. unless otherwise stated.)

- £10.50 150 m/a. 10 m/s. 18/6.
- 6.8 v. 9 a. 4 v. 7 a., 18/6.
- £4.70 15375 150 m/a. 10 m/s. 18/6.
- £3.10 15370 100 m/a. 10 m/s. 15/6.
- £3.10 15375 100 m/a. 10 m/s. 15/6.
- £2.10 15370 60 m/a. 10 m/s. 10/6.
- £1.50 15375 60 m/a. 10 m/s. 10/6.
- £1.50 15370 60 m/a. 10 m/s. 10/6.
- £1.00 15375 30 m/a. 10 m/s. 10/6.
- £1.00 15370 30 m/a. 10 m/s. 10/6.
- £1.00 15375 15 m/a. 10 m/s. 10/6.
- £1.00 15370 15 m/a. 10 m/s. 10/6.
- £1.00 15375 5 m/a. 10 m/s. 10/6.
- £1.00 15370 5 m/a. 10 m/s. 10/6.
- £1.00 15375 2.5 m/a. 10 m/s. 10/6.
- £1.00 15370 2.5 m/a. 10 m/s. 10/6.
- £1.00 15375 1.25 m/a. 10 m/s. 10/6.
- £1.00 15370 1.25 m/a. 10 m/s. 10/6.
- £1.00 15375 0.5 m/a. 10 m/s. 10/6.
- £1.00 15370 0.5 m/a. 10 m/s. 10/6.
- £1.00 15375 0.25 m/a. 10 m/s. 10/6.
- £1.00 15370 0.25 m/a. 10 m/s. 10/6.
- £1.00 15375 0.125 m/a. 10 m/s. 10/6.
- £1.00 15370 0.125 m/a. 10 m/s. 10/6.
- £1.00 15375 0.0625 m/a. 10 m/s. 10/6.
- £1.00 15370 0.0625 m/a. 10 m/s. 10/6.
- £1.00 15375 0.03125 m/a. 10 m/s. 10/6.
- £1.00 15370 0.03125 m/a. 10 m/s. 10/6.
- £1.00 15375 0.015625 m/a. 10 m/s. 10/6.
- £1.00 15370 0.015625 m/a. 10 m/s. 10/6.
- £1.00 15375 0.0078125 m/a. 10 m/s. 10/6.
- £1.00 15370 0.0078125 m/a. 10 m/s. 10/6.
- £1.00 15375 0.00390625 m/a. 10 m/s. 10/6.
- £1.00 15370 0.00390625 m/a. 10 m/s. 10/6.
- £1.00 15375 0.001953125 m/a. 10 m/s. 10/6.
- £1.00 15370 0.001953125 m/a. 10 m/s. 10/6.
- £1.00 15375 0.0009765625 m/a. 10 m/s. 10/6.
- £1.00 15370 0.0009765625 m/a. 10 m/s. 10/6.
- £1.00 15375 0.00048828125 m/a. 10 m/s. 10/6.
- £1.00 15370 0.00048828125 m/a. 10 m/s. 10/6.
- £1.00 15375 0.000244140625 m/a. 10 m/s. 10/6.
- £1.00 15370 0.000244140625 m/a. 10 m/s. 10/6.
- £1.00 15375 0.0001220703125 m/a. 10 m/s. 10/6.
- £1.00 15370 0.0001220703125 m/a. 10 m/s. 10/6.
- £1.00 15375 0.00006103515625 m/a. 10 m/s. 10/6.
- £1.00 15370 0.00006103515625 m/a. 10 m/s. 10/6.
- £1.00 15375 0.000030517578125 m/a. 10 m/s. 10/6.
- £1.00 15370 0.000030517578125 m/a. 10 m/s. 10/6.
- £1.00 15375 0.0000152587890625 m/a. 10 m/s. 10/6.
- £1.00 15370 0.0000152587890625 m/a. 10 m/s. 10/6.
WE WELCOME YOUR ENQUIRIES.

THE QUARTZ CRYSTAL Co., Ltd.
6-71 Kingston Road,
NEW MALDEN, SURREY
Telephone: MALden 0334

NAIN S TRANSFORMERS
50 kVA 110/240 v., 50 Hz.
60 kVA 110/240 v., 50 Hz.

LOUDSPEAKERS
"APLION" AD/DE TET METER.
Delivery from stock.
Price £1.75.

NEW 3515 RECEIVER CHASSIS (less valves).
Stocked with useful gear.
Outstanding value at 918, car's paid.

For-

MUTUAL USAGES
ARE AVAILABLE IN
FOR-

CRYSTAL

SERVICE

FOR-

R3515 RECEIVER CHASSIS (less
TX STAND.

LOUDSPEAKERS (Guaranteed new and housed).
271-275.

THE GOVERNING Body invite applications for the
post of Senior Assistant for Telecommunications.
The Governors invite applications for appointment
in the Registrar's Office.
Candidates should have
be graduates in electrical engineering, and be able to
achieve both theoretical and practical work to a high
standard. The successful candidate will
be responsible for teaching telecommunication
and electronics at the level of the B.E. (Eng.) Degree
of the University of London, and he will be expected
to carry out research work in these
subjects.

BRIDisco
THE SMALLEST COIL PACK
IN THE WORLD

MUTUAL USES
ARE AVAILABLE IN
FOR-

CRYSTAL

SERVICE

FOR-

R3515 RECEIVER CHASSIS (less
TX STAND.

LOUDSPEAKERS (Guaranteed new and housed).
271-275.

THE GOVERNING Body invite applications for the
post of Senior Assistant for Telecommunications.
The Governors invite applications for appointment
in the Registrar's Office.
Candidates should have
be graduates in electrical engineering, and be able to
achieve both theoretical and practical work to a high
standard. The successful candidate will
be responsible for teaching telecommunication
and electronics at the level of the B.E. (Eng.) Degree
of the University of London, and he will be expected
to carry out research work in these
subjects.

BRIDisco
THE SMALLEST COIL PACK
IN THE WORLD

MUTUAL USES
ARE AVAILABLE IN
FOR-

CRYSTAL

SERVICE

FOR-

R3515 RECEIVER CHASSIS (less
TX STAND.

LOUDSPEAKERS (Guaranteed new and housed).
271-275.

THE GOVERNING Body invite applications for the
post of Senior Assistant for Telecommunications.
The Governors invite applications for appointment
in the Registrar's Office.
Candidates should have
be graduates in electrical engineering, and be able to
achieve both theoretical and practical work to a high
standard. The successful candidate will
be responsible for teaching telecommunication
and electronics at the level of the B.E. (Eng.) Degree
of the University of London, and he will be expected
to carry out research work in these
subjects.

BRIDisco
THE SMALLEST COIL PACK
IN THE WORLD

MUTUAL USES
ARE AVAILABLE IN
FOR-

CRYSTAL

SERVICE

FOR-

R3515 RECEIVER CHASSIS (less
TX STAND.

LOUDSPEAKERS (Guaranteed new and housed).
271-275.

THE GOVERNING Body invite applications for the
post of Senior Assistant for Telecommunications.
The Governors invite applications for appointment
in the Registrar's Office.
Candidates should have
be graduates in electrical engineering, and be able to
achieve both theoretical and practical work to a high
standard. The successful candidate will
be responsible for teaching telecommunication
and electronics at the level of the B.E. (Eng.) Degree
of the University of London, and he will be expected
to carry out research work in these
subjects.

BRIDisco
THE SMALLEST COIL PACK
IN THE WORLD

MUTUAL USES
ARE AVAILABLE IN
FOR-

CRYSTAL

SERVICE

FOR-

R3515 RECEIVER CHASSIS (less
TX STAND.

LOUDSPEAKERS (Guaranteed new and housed).
271-275.

THE GOVERNING Body invite applications for the
post of Senior Assistant for Telecommunications.
The Governors invite applications for appointment
in the Registrar's Office.
Candidates should have
be graduates in electrical engineering, and be able to
achieve both theoretical and practical work to a high
standard. The successful candidate will
be responsible for teaching telecommunication
and electronics at the level of the B.E. (Eng.) Degree
of the University of London, and he will be expected
to carry out research work in these
subjects.

BRIDisco
THE SMALLEST COIL PACK
IN THE WORLD

MUTUAL USES
ARE AVAILABLE IN
FOR-

CRYSTAL

SERVICE

FOR-

R3515 RECEIVER CHASSIS (less
TX STAND.

LOUDSPEAKERS (Guaranteed new and housed).
271-275.

THE GOVERNING Body invite applications for the
post of Senior Assistant for Telecommunications.
The Governors invite applications for appointment
in the Registrar's Office.
Candidates should have
be graduates in electrical engineering, and be able to
achieve both theoretical and practical work to a high
standard. The successful candidate will
be responsible for teaching telecommunication
and electronics at the level of the B.E. (Eng.) Degree
of the University of London, and he will be expected
to carry out research work in these
subjects.

BRIDisco
THE SMALLEST COIL PACK
IN THE WORLD

MUTUAL USES
ARE AVAILABLE IN
FOR-

CRYSTAL

SERVICE

FOR-

R3515 RECEIVER CHASSIS (less
TX STAND.

LOUDSPEAKERS (Guaranteed new and housed).
271-275.

THE GOVERNING Body invite applications for the
post of Senior Assistant for Telecommunications.
The Governors invite applications for appointment
in the Registrar's Office.
Candidates should have
be graduates in electrical engineering, and be able to
achieve both theoretical and practical work to a high
standard. The successful candidate will
be responsible for teaching telecommunication
and electronics at the level of the B.E. (Eng.) Degree
of the University of London, and he will be expected
to carry out research work in these
subjects.
SITUATIONS VACANT

MINISTRY of Supply require experienced radio engineers for unestablished appointments as Technical Assistants in the A.C. Technical Publications Branch in Surrey and Worcestershire.

Technical Assistants must have British nationality and should possess good instructional ability in science and technical subjects, or experience in writing or editing publications on technical subjects. Training will be given in a degree in engineering or in physics, or be corporate members of the Institution of Electrical Engineers or have passed recognised A and B level books in technical subjects. Good standard in mathematics and physics is essential, and a working knowledge of centimeter and millimeter wave apparatus and techniques in the research and development of new designs. In particular, it is essential that the candidate should have had experience in a position of technical responsibility in the design and development of such equipments as amplifier tubes, rectifiers, and other similar equipments. The Ministry of Supply is prepared to consider suitable candidates for the assistant grade of various R.A.F. squadrons.


A EXPERIENCED radio and television service engineers required: permanent position with fair salary available to suitable applicants, North London district.—Write Box 1319, Wireless World, London, W.C.3.

A MAN wanted for small transformer and component winding, shopping. Ealing district; must be able to set down and maintain Douglas coil winders, make jigs and train winders: write, giving details of experience required.—Box 4129.

A TECHNICIAN service manager required for central depot in Bedford, good practical experience with knowledge of most leading makes of radio and television receivers; good disciplinarian capable of controlling staff; salary £450 plus.—Box 9586.

A EXPERIENCED DRIVE/DRAGOUTSMAN required for the engineering laboratory of a large light engineering firm.-Apply, quoting details of age, qualifications and experience to Box 9581.

A CANDIDATES must be able to read and write English. A.G. Auto Changer, Light Weight. Price: 10/- 1/-. Apply, giving details of age, experience, salary or grade desired, to the Personnel Officer.

A MECHANIC required for the construction and maintenance of UHF centimetric radar equipment. Experience in pulse technique; applicants should state age, details of experience, salary or grade desired, to the Personnel Officer.

A TELEVISION sale manager required for the management of a television depot in the North West area —Forward details of education, experience, and salary required to Box A 883, Central News, Ltd., Coventry, (K). special offer 11/-

A Technical Authors in the Air Ministry's large central Engineering Laboratory. Preference will be given to candidates who have had some experience of tool design. Apply, giving details of education, experience, and age to the Personnel Officer.

A ENG. ENGINEERS required for electrical design of radar equipments. Attractives include a good salary and prospects offered. Applicants, who should be of any grade or capacity and corporate members of the Institution of Electrical Engineers, will be considered. Write, giving details of experience, to Box 4129.

A MECHANICAL Draftsman required for design and development of new designs. Applicants should state age, details of experience, and salary required to Apply Personnel Department, Murphy Radio, Box 9593.

A UNIVERSITY students taking finals in physics or engineering science may be interested in vacancies at the Research Laboratories of Western Electric Co., Ltd., North Wembley, Middx.—Details will be sent to students who request this information and their record and age to the Personnel Officer.

A C.S. Engineers required. Applicants should state age, experience, and salary required to Apply Personnel Department, Murphy Radio, Box 9593.


A L 10 watts p-p.

A A 15351 Crystal Diodes : 1N22, CV102, 3/3.


A Selenium S.B.C. Neons :

A A 10 watts p-p.

A A A 9/5.

A A 6/5.


A A 250-0-250v.

A A A 22/6.

A A A 92/6.

A A A 37/6.

A A 1/6.

A A A 47/6.

A A A 22/6.

A A A 56/6.

A A A 17/-;

A A A 13/6.

A A A 132/-.

A A A 17/6.

A A A 204/6.

A A A 202/6.

A A A 21/3.

A A A 9/5.

A A A 71 in.

A A A 100v.

A A 20a.

A A 20a.

A A A 5v.

A A 6a.

A A A 10a.

A A 10a.

A A 17v.

A A A 17v.

A A A 20v.

A A A 230v.

A A A 17v.

A A A 20v.

A A A 20v.

A A A 250v.

A A A 72v.

A A A 106/-.

A A A 106/-.

A A A 17/-;

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.

A A A 10a.
SITUATIONS VACANT

EXPERIENCED Engineers required by leading
..."ENGINEERING OPPORTUNITIES"... full details of the method to pass A.M.I.Mech.E., A.M.I.E.E., C.Eng., M.I.E.E., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc., etc,
**NEW! NEW! NEW!**

**SYMPHONY No. 2.** Sensational New Audio Amplifier. A compact beauty from conception to manufacture. 10 w. push-pull output. 5 separate control sections. Mid and high bands. Bass and treble controls. Power to spare. Full 2,000 Metre, 12 month's guarantee.

**NO. 1 WATT AMPLIFIER** for A.C. Mains 25/10/9.

**NO. 5 P.A. AMPLIFIER**, 15 w. push-pull output, gross and net output, 12 tubes. Complete kit 5/39/-.

All above Amplifiers have full guarantee for Radio Fiddler input.

**NO. 1 HIGH QUALITY TUNER.** Specially recommended for home audiences and Leek, J. Williamson and Charlie Amplifiers. A.M. wave chart, L.F. interference detector, incorporates whole Wharfedale complete, built and tested 5/20/-.

**NO. 9 L.M. & S. WAVE SUPERHET TUNER.** Special quality bandwidth, beautiful full vision dial, 6/10/9. Price of COLLAR SINGLE RECORD PLAYERS, centre drive and rim.

Full range of WHARFEDALE SPEAKERS and CROSSOVER UNITS.

**NEW! NEW! NEW!**

**RADIOMETER** No. 10. Complete kit 5/39/-.

**NEW! NEW!**

**RADIOGRAM CHASSIS TYPE 1150**

This receiver forms the basis for a Radiogram of unsurpassed performance, and at great saving in cost.

**Principal features include:**
- 11 Obra Valves
- 12 Stages
- 2 F.I. Stages
- A.F. Amplifier
- 4 Stages A.V.C.
- Bandspread Dist.
- Treble Control
- Base Control

**Tropical Specification**
- 4 Stages A.V.C.
- H.F. Amplifier
- 4 Wave Bands
- Full drive.

**SPECIAL BARGAINS!**
- Quality bandwidth, beautiful large full vision dial
- NO. 2 L.M. & S. WAVE SUPERHET TUNER, special detector.
- Absolutely complete, built and tested £5/10/-.
- Ditto kit £3/10/6.

**VARIABLE** whistler input and mike inputs, 10 guineas. Complete Kit £7/10/-.

**NEW!**

**CROSSOVER UNITS.** Full drive.

**NEW!**

**VARIA.** ZENITH varic. Transformer, several sizes in stock, write for prices.

**OMMIETERS.** Bench type for high-speed production. Series 500-100 to 0-10 meg fitted large Bim. meter for quick and accurate reading. Ranges selected by push button, 200/250 volts 10/15/10.

**NEW!**

**WIRELESS INSTRUMENTS**
- 24-56 The Headrow, Leeds.
- Tel. 22262.
SITUATIONS VACANT

ELECTRICAL aircraft company has
vacancies for specialists in electronics;
applicants should have at least five years' experience since
leaving college or be qualified. In connection with important research and de-
velopment work, candidates may expect to receive valuable training in
the design and manufacture of rocket motors. Applications are invited for
positions of Research Engineer, Sales Engineer, and Designer. The point
of contact is the Ministry of Supply, London, W.1.

MINISTRY OF SUPPLY require experienced
engineers in the design and production of aircraft equipment.£250 per annum
hits for Technical Assistants and£300 for Senior Assistants. Full telephone
and motor transport facilities.

AGENCIES

RADIO engineers will be employed in Montreal, will
represent British manufacturers of comp-
ponents and sub-assemblies. Applicants must be
able to carry out all the routine duties of a radio
sales engineer. Must be able to speak French.

TECHNICAL TRAINING

City & Guilds, etc., on "No
Pay—No Fee" terms. Over 500
seats. For full details of modern courses in all
branches of electrical engineering, send for
our 176-page handbook, free and post free.—B.I.E.T. (Dept. 386A), 17, Stratford
Place, London, W.1.

TELEVISION

The Goethe Television School specializes in
training in television. All tutors possess uni-
versal knowledge of technical and professional institutions and are appointed indi-
vidually for their qualifications and experience. Maximum
competence and thorough training. Principals M.R.E.,
B.Sc., G.T.E., etc., and full team of technical
staff. Courses range from short to long, and in
all branches of television. Details from the
School's Basic Television Course as standard
price, plus£1 1/6 post free. Details from

WANTED

SITUATIONS WANTED

RADIO engineers are looking for experience
leading makes, able to drive, seeks post, in
England, preferably London. Must be
able to handle all types of service work.

RADIO and television man seeks opportunities
in the southern U.S.A. to work for a
major manufacturer. Must have full knowl-
edge of all types of television and radio.

SERVICE Engineer, at present self-employed,
seeks employment in the West End.

TECHNICAL Manager of leading North-West
company wishes to join an engineering firm,
preference for a position in the North.

MASON & SON, Ltd., Wivenhoe, nr. Colches-
ter, Essex. AGENTS WANTED

AGENTS WANTED

AGENTS WANTED

A GENTS WANTED

A GENTS WANTED

AGENTS WANTED

AGENTS WANTED

AGENTS WANTED
BASS
REFLEX CABINETS

Our RU12 is the best for the Axiom 12 & 22, the Barker, & Wharfordale Golden Units

From £10

Stamp for leaflets from CUBINETWARE SUMMIT WKS., HEYES ST., BLACKBURN

RADIOMENDERS LIMITED
FOR SPECIAL TRANSFORMERS AND REWINDS

We specialise in
AMATEURS’ WINDINGS, TRANSFORMERS
ALL TYPES, CHOKEs, PICK-UP COILS
INSTRUMENT COILs, ETC.

Highest workmanship Good Delivery

RADIOMENDERS, LTD.
Television & Radio Apparatus, Transformer & Coilswinders.
123-5-7 Parchmore Road,
THORNTON HEATH, SURREY
LIV 2261. Trade enquiries invited. Established 16 years.

OXLEY
DIFFERENTIAL AIR DIELECTRIC TRIMMER

OXLEY DEVELOPMENTS CO., LTD.,
ULVERSTON, N. LANCS. TEL. ULVERSTON 334

WALTON’S OF WOLVERHAMPTON

The leading Midland Store for all your Radio and Television accessories and units, including stocks of many lines unobtainable elsewhere.

It will pay you to make a special visit to 48, Stafford Street or 65, Tysull Road. If unable to call send S.A.E. to-day to 203, Staveley Road: all of Wolverhampton, Staffs.

A few Special Clearance lines for callers only. Partly stripped 1154’s, 1/6; 1196 TX, 2/-; No. 38 TX, 5/-; No. 18 TX, 5/-; 3515, 12/6; 1355, 37/6. and many hundreds of other items.

AUDIGRAPH LTD.
Dept. MR3, 74, Great Hampton Street,
HOCKLEY, BIRMINGHAM, 18

"ADCOLA" SOLDERING INSTRUMENTS
Reg. Trade Mark

Designed for Wireless Assembly and Maintenance, SUPPLIED FOR ALL VOLT RANGES FROM 6/7v. TO 230/50v.

The three Adcola Models covering the requirements of the Television, Telecommunication and Radar Engineers assure thorough jointing.

\[ \text{Nin. dia. Bit. Standard Model} \quad 22/4 \]
\[ \text{lm. dia. Bit. Standard Model} \quad 25/- \]
\[ \text{2m. dia. Detachable Bit} \quad 30/- \]

REPLACEMENT UNIT BIT ELEMENTS AVAILABLE. Patentted in England and Abroad.

Solo Manufacturers

ADCOLA PRODUCTS LIMITED

ALLIANCE HOUSE CAXTON STREET, WESTMINSTER,
LONDON, S.W.1.

Transmitters, 230 v. A.C. Mains. shrouded. 150-0-150 v. at 100 Mills, size 3½" x 3½" x 4½". Fitted with ceramic terminals, 4/- plus 1/- post.

TRANSFORMERS, 230 v. A.C. Mains, similar 150-0-150 v., 0, 10, 20, 30 and 40 v. all at 70 Mills, size 2½" x 3½" x 3½", 4/- ea., plus 1/- post. No heaters.

PRE-AMPLIFIERS, 10 Metres, London or Sutton Television, with EF54, dust core wide band tuning, co-ax input and output sockets, size 3½" x 4" x 4½" (any number can be linked together). 15/- ea., plus 1/- post. Please state frequency.
INDEX TO ADVERTISERS

**HIGH FIDELITY AT ANY LEVEL**

A VENTEX CABINET fitted with first quality
12 in. L.S will reproduce the full frequency range at all levels. Scientifically designed. Heavily constructed. French Polished in any veneer.

OUR COMPENSATOR, by correcting scale distortion, automatically gives true BASS response from a whisper to full volume. This ensures full enjoyment from your equipment at domestic levels. Suitable for use with all amplifiers. Replaces or can be used with existing volume control.

**C. T. CHAPMAN (Reproducers) Ltd.**

- RILEY WORKS, RILEY STREET, CHELSEA, S.W.10
- Daily demonstrations at WEBBS' RADIO

---

**TELEVISION**

**INTERFERENCE Suppressor**


**Fit in a second!**

A.F. BULGIN & Co. LTD

BYE PASS ROAD, BARKING,

ESSEX

---

**WEIRESS WORLD**

JUNE, 1950

---

**INDEX TO ADVERTISERS**

- Advertisement layout for various companies, including Candler System Co., Enthoven, H. & Sons, Ltd., Electronic Precision Equipment, etc.
- Various organizations such as the Electrical Trades Union, Cohen Cinema, etc.
- Companies like Charles Amplifiers Ltd., Chapman, C. T. (Reproducers), Ltd., Ceiestion, etc.
- Trade names such as Bullanco, British National Radio School, Bristol Cine Service, Bourne Instruments, etc.
- Products like Automatic Coil Winder & Electrical Equipment, ATA Scientific Progress Ltd., etc.
- Names of individuals and their companies, e.g., Atkins, H. C., Laboratories, Ltd., Audigraph, Ltd., etc.
- Essential information on the layout and distribution of the page, including page numbers and layout details.

---

**HIGH FIDELITY AT ANY LEVEL**

A VENTEX CABINET fitted with first quality 12 in. L.S will reproduce the full frequency range at all levels. Scientifically designed. Heavily constructed. French Polished in any veneer.

OUR COMPENSATOR, by correcting scale distortion, automatically gives true BASS response from a whisper to full volume. This ensures full enjoyment from your equipment at domestic levels. Suitable for use with all amplifiers. Replaces or can be used with existing volume control.

**C. T. CHAPMAN (Reproducers) Ltd.**

- RILEY WORKS, RILEY STREET, CHELSEA, S.W.10
- Daily demonstrations at WEBBS' RADIO

---

**TELEVISION**

**INTERFERENCE Suppressor**


**Fit in a second!**

A.F. BULGIN & Co. LTD

BYE PASS ROAD, BARKING,

ESSEX

---

**WEIRESS WORLD**

JUNE, 1950

---

**INDEX TO ADVERTISERS**

- Advertisement layout for various companies, including Candler System Co., Enthoven, H. & Sons, Ltd., Electronic Precision Equipment, etc.
- Various organizations such as the Electrical Trades Union, Cohen Cinema, etc.
- Companies like Charles Amplifiers Ltd., Chapman, C. T. (Reproducers), Ltd., Ceiestion, etc.
- Trade names such as Bullanco, British National Radio School, Bristol Cine Service, Bourne Instruments, etc.
- Products like Automatic Coil Winder & Electrical Equipment, ATA Scientific Progress Ltd., etc.
- Names of individuals and their companies, e.g., Atkins, H. C., Laboratories, Ltd., Audigraph, Ltd., etc.
- Essential information on the layout and distribution of the page, including page numbers and layout details.
It is axiomatic that experience breeds leadership—in condenser technique as in other fields of industry. That is why T.C.C. Condensers are always in the van of progress in design and efficiency.

Whatever the needs of the Electronics Industry or other users, the extensive T.C.C. range includes a suitable type, developed as a result of long and continuous research and development.

T.C.C. Condensers are exclusively specified in the View Master—the Television Set you build at home from standard parts. Constructor Envelopes (Model A, London, or Model B, Sutton Coldfield) 5 - each from all Wireless Shops.

THE TELEGRAPH CONDENSER CO., LTD.

NORTH ACTON • LONDON • W.3 Telephone, ACORN 0061
Manufacturers of radio and television equipment throughout the world find that the use of Ersin Multicore Solder effects great savings in material and labour costs. Ersin Multicore is the only solder in the world which contains three cores of extra-active non-corrosive Ersin Flax. The Multicore construction ensures flux continuity, eliminating H.R. or 'dry' joints, and giving high speed precision soldering without waste. Ersin Multicore is supplied to manufacturers in 6 standard alloys, 9 gauges and 2 flux percentages. Service Engineers and Workshops are supplied with the handy Size 1 cartons in the specifications shown.

For service engineers and radio enthusiasts two special publications are available free of charge on receipt of a stamped addressed envelope. Just include a slip of paper asking for "Hints on Soldering" and "Technical Data Card", the latter incorporates many useful radio tables including resistor colour code.

**MULTICORE SOLDERS LTD.**
**MELLIER HOUSE, ALBEMARLE STREET, LONDON, W.1 • REGent 1411**