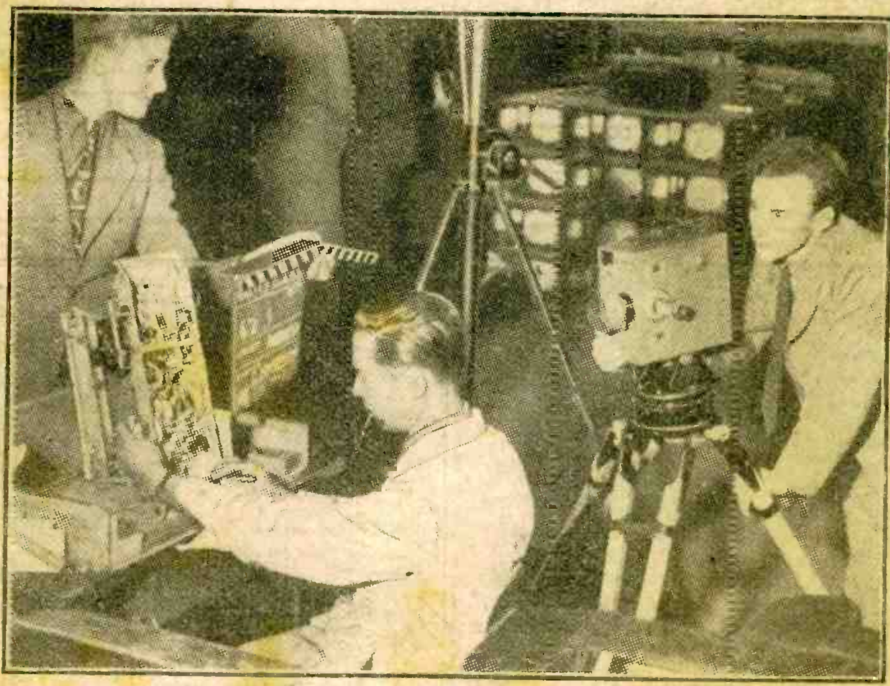
Graphic

A FOUR-RANGE THREE

Practical Wireless

9D. EVERY MONTH

Vol. 24. No. 501 || Editor: F. J. CAMM || APRIL, 1948



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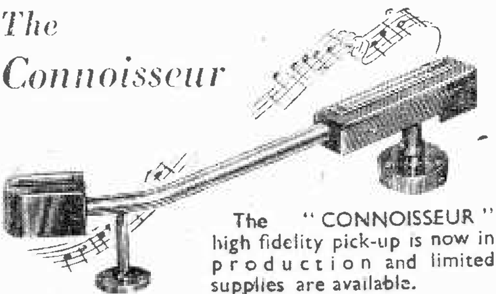
PRINCIPAL CONTENTS

The

Connoisseur



The "CONNOISSEUR" high fidelity pick-up is now in production and limited supplies are available.

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RAYMART.—Ceramic valveholders. English type :—4 and 5 pin, 1/- ; glazed, 1/3 ; 7 pin and Mazda Octal, 1/6 ; B9G (EF50 type), 2/-. American type : 4, 5 and 7 pin, 1/3 ; glazed, 1/6 ; International Octal, 1/6 ; Acorn, 2/6.
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Please include postage and packing for orders under £2.

SOUTHERN RADIO & ELECTRICAL SUPPLIES
85, FISHERTON ST., SALISBURY, WILTS.
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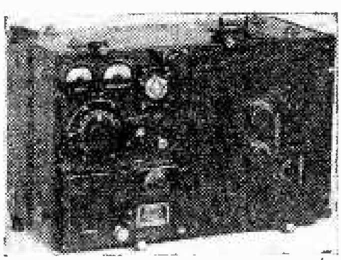

Transmitter-receiver for short waves 40 metres. Provision for crystal control. Uses standard headphones and microphones. Battery operated, requiring standard 120 volts h.t. and 2 volts l.t. Includes 9 valves standard English types. Six valves in receiver and three in transmitter. Circuit Rx. 2RF., Det., 2 Audio and Power. Tx. Osc. PA and modulator.

£6 carriage paid.

THE STAMFORD RADIO CO.
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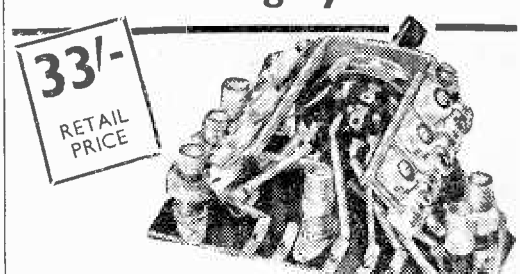
Small But Highly Efficient



Maximum Efficiency, Minimum Size 3½"x2"x1½"

The "Q" pack is a certain signal booster. Will improve the sensitivity of any superhet, and its compactness greatly facilitates construction of midget receivers. Employs six high "Q" coils on polystyrene formers, with adjustable iron cores. One hole fixing and only five connections. Three models : L.M.S., M.2.S, L.M. Trawler. Special terms to set makers, wholesalers and export.

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Practical Wireless
16th YEAR OF ISSUE
and PRACTICAL TELEVISION
EVERY MONTH
VOL. XXIV. No. 501. APRIL, 1948.
Editor F. J. CAMM

COMMENTS OF THE MONTH BY THE EDITOR

Interference Suppression

THE interference caused by automobiles and by other apparatus is one of the greatest drawbacks to television reception. Now is the time for measures to be introduced, either by co-operation with manufacturers of the offending apparatus or by legal compulsion, to eliminate such interference. At present 30,000 viewers at the most are affected, but as the television service is developed to provide a national service the problem will assume national proportions.

Before the war there was a great deal of discussion upon this problem, and component manufacturers produced suppressors which could be fitted to the sparking plugs and effectively eliminate it.

The campaign now being conducted by the Radio Industries Council, and which has as its object the suppression of car ignition interference with television reception in the area at present served by the television service, is meeting with success. The National Road Transport Federation, the Society of Motor Manufacturers and Traders, the railways, the London Transport Executive, and the Home Office, have pledged their support. All the vehicles owned by the B.B.C., the G.P.O. and the police are suppressed.

Radio dealers could give a lead by suppressing vehicles owned by them and by drawing local attention to the problems in the Press and by means of window displays, including diagrams showing the simplicity and the cheapness of suppression.

The scheme at present, however, relies upon the voluntary co-operation of the public, and we are not hopeful that it will be wholly successful. A motorist who does not own a television receiver is unlikely to be persuaded to spend money buying suppressors to enhance the enjoyment of those who own television receivers, human nature being what it is. It seems inevitable, therefore, that sooner or later legislation will be introduced making the fitting of suppressors compulsory.

At the present time there is no end to the making of laws and regulations, but we cannot see any other solution to this problem. Firms are being invited to have suppressors fitted, and this will help, but unless suppression is general the campaign can only be partially successful.

Editorial and Advertisement Offices : "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. 'Phone : Temple Bar 4363.
Telegrams : Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

When we discussed this problem before, we pointed out that a good deal could be done at the manufacturing end, and we felt that the manufacturers had a measure of responsibility in seeing that their receivers incorporated suppressor circuits. We are glad to note that several manufacturers have adopted this suggestion in their current models. This arrangement considerably reduces interference, even though it may not entirely eliminate it.

Of course, suppression is best carried out at the source. The fitting of a resistor of from 10,000 to 15,000 ohms in the H.T. lead connecting the ignition coil with a distributor is usually effective in reducing interference by at least 90 per cent. This method is in accord with the B.S.I. code of practice CP1001 entitled "The Abatement of Radio Interference Caused by Motor Vehicles and Internal Combustion Engines."

Several manufacturers are making suppressors, and at least one of them does not entail the cutting of the H.T. lead, because it is screwed into the standard distributor cap after the H.T. lead has been disconnected. The lead is then refixed into the top of the suppressor.

This does not apply in every case, so another type is available in which the lead to the centre of the distributor cap is cut, the two ends being screwed into the opposing ends of the suppressor. Dealers should take steps to carry a stock of these.

Service Charges

A contributor elsewhere in this issue comments on the extravagant charges often made for repairing comparatively minor defects in receivers. He rightly says that it is difficult to eliminate this form of ramp, which is often practised by really competent service engineers who yet have a streak of dishonesty in their make-up.

The standardisation of charges gives no assurance to the public that those charges will be adhered to. The appointment of selected agents in particular districts is similarly not a safeguard either.

The Radio Retail Trade seems to be following the same lines as the dishonest garage proprietor and the dishonest watch repairer, all of whom take advantage of the untechnical public.

ROUND THE WORLD OF WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ended December 31st, 1947.

Region	*Number*
London Postal	2,069,000
Home Counties	1,445,000
Midland	1,572,000
North Eastern	1,710,000
North Western	1,449,000
South Western	951,000
Welsh and Border ..	635,000
Total England and Wales	9,831,000
Scotland	1,050,000
Northern Ireland ..	176,000
GRAND TOTAL ..	11,057,000

Pictures by Wireless

PHOTOTELEGRAM service between Britain and Barbados (West Indies) was opened on Monday, January 19th, by Cable and Wireless, Ltd.

Empire rates will be charged: £5 per picture measuring up to 24 sq. ins., and proportionately for larger sizes up to 90 sq. ins. The London-Barbados picture circuit is the eighth to be opened with oversea Empire countries.

Sixteen phototelegraph services are now open between Britain and destinations overseas.

Chairman, Radio Industry Council

MR. J. W. RIDGEWAY, O.B.E., of the Edison Swan Electric Co., Ltd., has been elected chairman of the Radio Industry Council for the current year in succession to Mr. G. Darnley Smith, of Bush Radio, Ltd.

Mr. C. O. Stanley, C.B.E., of Pye, Ltd., has been elected vice-chairman.

Television Licence

OWNERS of television receiving sets are reminded that a special comprehensive licence costing £2, covering both sound and television, is required for the use of television receiving sets, and such licences should be taken out immediately a television set is installed. £1 (sound only) licences may be surrendered when the £2 comprehensive licences are purchased, and a rebate will be allowed at the rate of 1s. 8d. for each month of the unexpired portion of the surrendered licences.

U.N.O. Live Transmissions of Debates

LIVE transmissions of discussions in the General Assembly, one of the Councils or one of the Committees, with running-commentaries in English and French, are beamed direct to Europe every day (except Sundays), usually from 16.00 G.M.T. (or exceptionally from 15.00 G.M.T.), and from 20.00 G.M.T. on the following wavelengths:

	19.83 metres	15,130 kilocycles
	16.52 ,,	18,160 ,,
	13.88 ,,	21,610 ,,
20.00 G.M.T. only	25.47 ,,	11,780 ,,
,, ,, ,,	30.95 ,,	9,700 ,,

These live transmissions are announced in advance at 14.30 G.M.T. on 16.84 and 19.75 metres.

First Director of Radio Research

THE Lord President of the Council has approved the promotion of Dr. R. L. Smith-Rose, D.Sc., Ph.D., M.I.E.E., to the new post of Director of Radio Research in the Department of Scientific and Industrial Research.

Next Radiolympia in 1949

THE Radio Industry Council is planning to hold the next National Radio Exhibition ("Radiolympia") in the autumn of 1949, and is discussing arrangements with the management of Olympia.

An official of the Council said recently: "This date has been chosen in preference to a date in 1948 to enable the industry as a whole to concentrate on production for its export target and to allow the manufacturers of radio and television receivers more time for the development and production of new sets."

Loading a consignment of 250 Airmec receivers to satisfy a recent urgent order from the Middle East. The cost of sending the receivers was over £1,000.

Danish "Engineering House" Reopened

COL. SIR STANLEY ANGWIN, chairman of Cable and Wireless, Ltd., represented the British Institutions of Civil, Mechanical and Electrical Engineers at the reopening recently of "Engineering House," Copenhagen home of the Danish Institution of Civil Engineers.

Sir Stanley is a past-president of the Institution of Electrical Engineers, and a member of the Council of the Institution of Civil Engineers.

The British Institution of Radio Engineers

A LONDON Section members meeting was held on February 12th last, at which a paper by J. R. Brinkley, Esq., on "A Multi-carrier V.H.F. Police Radio Scheme" was read and discussed.

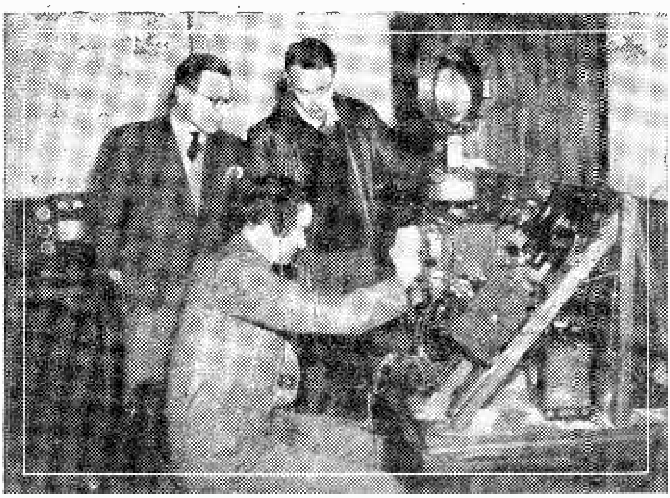
Multicore at R.C.M.F. Exhibition

PRACTICALLY the whole of the Ersin Multicore Solder exhibit on Stand 77 will be shipped immediately after the close of the Exhibition to the U.S.A. for display at the Chicago Parts Exhibition.

New Record Licence Total

AT the end of December last the number of broadcast receiving licences in force in Great Britain and Northern Ireland reached the new record total of approximately 11,056,900, which is an increase of 278,950 in the past twelve months. The total included 32,700 television licences.

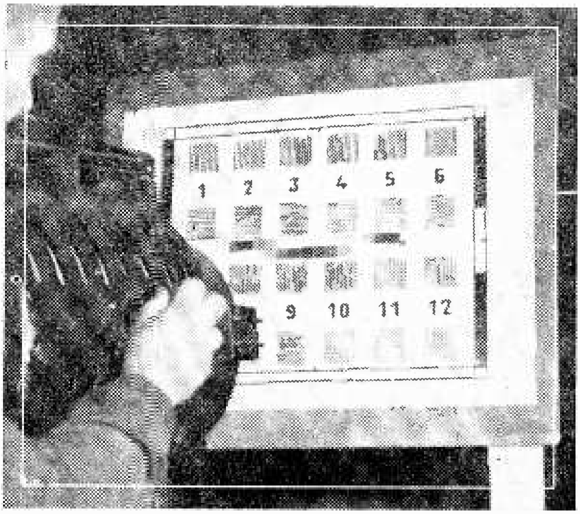
Unlicensed wireless receivers are still being used and, during 1947, 4,821 offenders were convicted. Fines up to £10 were inflicted, and in at least five cases, in addition to the fines, the Court ordered the confiscation of the offenders' sets.



The popular "Marconi Geep" or T.1155 being adjusted by members of the "Air University" which has trained almost 800 pupils from all parts of the world since it opened in April of last year.

Radio in Egypt

THE Telegraph and Telephone Department of the Government of Egypt has submitted plans to Parliament for the setting up of a chain of broadcasting stations in the provinces, and thereby bring radio to about 2,000 Egyptian villages. It is reported that stations will be built for groups of 50 villages and varied programmes on agricultural, technical, sanitary and social questions are to be broadcast by these subsidiary stations at times when the main Cairo station is not on the air. To overcome the fact that many villagers do not possess sets, the broadcasts will be relayed by P.A. equipment in public squares and other public meeting places.



The test card at present being used by the French Television Service for lining-up and testing receivers.

B.I.F. Appointment

IN view of the increasing responsibilities of the Director of the British Industries Fair (Mr. R. E. J. Moore), the Export Promotion Department of the Board of Trade has appointed Mr. W. H. Young, who has been associated with the organisation of the B.I.F. in London since 1922, to be Deputy Director of the Fair.

Television Newsreel

THE B.B.C. Television Newsreel, which began with a change of programme once a week, is already introducing bi-weekly changes. A completely new edition is now televised every Monday at 8.30 p.m., with a repeat at 9.45 p.m. on the following Wednesday. In the third weekly showing—on Fridays at 8.30 p.m.—half the items will be new. The last transmission of the week is on Saturdays at 9.45 p.m.

Modifying the Wartime A.C. Utility Receiver

How to Convert This Receiver for All-wave Reception

By E. K. N.

LAST month we described how the popular A.C. war-time utility receiver could be modified to enable long waves to be received. However, quite a number of listeners find great interest in short-wave reception, and it has been found that it is not a very difficult matter to convert the receiver in question for all-wave working. There are on the market at the present time quite a number of all-wave packs, and the idea was considered of utilising one of these. It was found on examination that there was only one pack which could conveniently be mounted in the available space and this is the "Osmor" pack, Type H.O. It is a three-band model giving the following ranges:

Short, 15 to 52 metres.
Medium, 200 to 590 metres.
Long, 800 to 2,000 metres.

This particular pack will be found to fit in with the minimum of displacement of components, and will give the receiver a new lease of life.

As was shown last month, the circuit of the utility consists of a frequency-changer, I.F. amplifier feeding a metal rectifier which provides A.F. and A.V.C. for the first two stages, and a pentode output stage. The frequency-changer in the original model has its oscillator section series-fed, and the new coil pack calls for shunt-feeding (see Figs. 1 and 2), so an additional resistor of 50K and two capacitors of 100 pF. and 200 pF. (one each) are required. The 200 pF. should be suitable for 200 volt working as it is a voltage stopper; I found silver mica jobs suitable.

Construction

Reference to Fig. 3 will show that the components in the receiver are mounted on a sub-panel running the length of the chassis underneath and, to make room for the coil pack, capacitors C.6 and C.7 and resistor R.14 must be moved. The dotted lines show the original position, the *full* lines the final position. C.6 and C.7 are merely unsoldered and resoldered to the same tags on the opposite side of the panel. The resistor R.14 is removed, fitted with longer leads and the bottom lead replaced on the same tag on the bottom of the panel, leaving the top end free.

Oscillator coils L.3, L.4 (Fig. 1) are removed together with oscillator tracking capacitor C.5 (.0005μF), and oscillator grid resistor R.3 (47K, Fig. 1). R.3 was refitted by soldering direct between pin 5 of V.1 and chassis. The A.V.C. decoupling capacitor may require to be disconnected and refitted by screwing one end down under one of the tuning gang holding-down screws so that it lies close to the underside of the chassis. Coils L.1, L.2 (Fig. 1), which are mounted above deck between the tuning gang and mains transformer, are removed. A careful note of the connections should be made as the coils are removed, for the receiver is the product of the combined radio industry and connections will probably vary as between manufacturers.

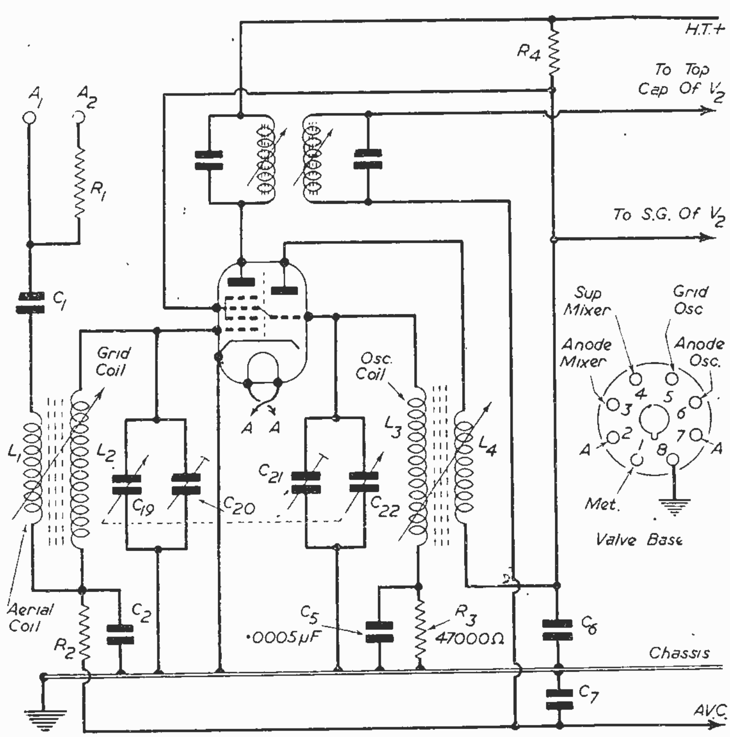


Fig. 1.—*Original circuit of the F.C. stage of the Wartime Utility Receiver.*

Mounting the Pack

Directly below the tuning gang will be found a hole in the chassis front member which should be made into a slot so that the coil pack can be slid into position. A small hack-saw will do this job in a few minutes. Next, two wires about 3in. long are soldered to the tuning gang connections where they protrude through the chassis and their free ends placed so as to coincide with tags 3 and 4 on the coil pack when fitted. The coil pack is then taken, the soldering tags bent up a little and the nut of the wave-change switch slacked off, the coil pack placed in position and the nut tightened up, thus making the pack firm to the set chassis. The sub-panel may have to be sprung a very little to let the pack chassis pass the top runner of the sub-panel. It may also be that one or two of the resistors may have to be refitted on the other side of the sub-panel in the particular model in hand, but this was not necessary in the original model.

Wiring

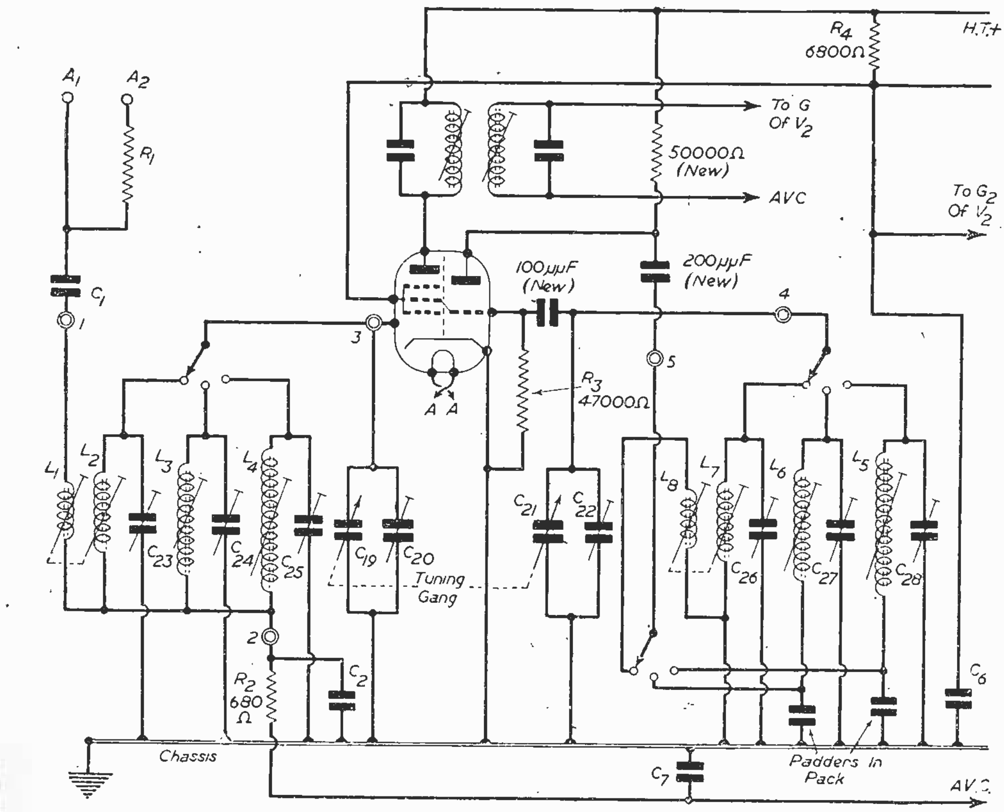
The free ends of the wires from the tuning gang can now be soldered in, and this is important—a soldering iron with a small pencil type bit is necessary, as room is decidedly cramped and it would not do to burn any of the coils in the coil pack.

The new 200 pF. capacitor is joined between tag 5 on the pack and pin 6 on V.1. then the new 100 pF. capacitor is joined between tag 4 on the pack and pin 5 on V.1. The 50K. resistor is joined between tag 12 on the sub-panel (where the oscillator anode coil of Fig. 1 was removed) and pin 5 on V.1. Tag 1 (aerial) on the pack is joined direct to tag 15 bottom, on the sub-panel; tag 2 (coil pack A.V.C.) to tag 11 bottom on sub-panel. The top lead of resistor R.14 is then replaced on tag 16 top, on sub-panel.

This completes the work of conversion to the new coil pack.

A careful check of all work should now be made and if all is in order the set is switched on. If all has been correctly done stations will be immediately heard on the medium-wave band.

The receiver is designed with a 460 kc/s I.F. and the coil pack with a 465 kc/s I.F.; therefore the I.F.s will require to be realigned to the new frequency although in the original case, when this was done, no difference was detectable by the ear. However, if you are, as you should be, on good terms with the local service-man you may be able to



Note: ◎ Indicates Connections To Soldering Tags On Pack. Switches Integral With Pack.

Fig. 2.—Final circuit with new components and coil pack fitted.

have him realign the I.F.s or maybe borrow his signal generator and do the whole job yourself. Having got the I.F.s up to the mark the next thing to be tackled is the different wave bands, and this is quite a simple matter.

Calibration

Proceed as follows. Set wave-change switch in medium wave position. Tune in a weak station round the 210 metres mark and adjust trimmers for maximum output, then travel to the top of the dial (slight rocking of the tuning gang is required throughout this setting-up). The long wave range is treated in exactly the same manner but set up for maximum output on 1,500 metres. The short-wave band can be adjusted at both ends of the scale on actual signals if a signal generator is not available.

As a further refinement the set may be fitted with a new volume control with switch as shown (Fig. 3), leaving the original switch (Sw.1, Fig. 3) permanently in the OFF position.

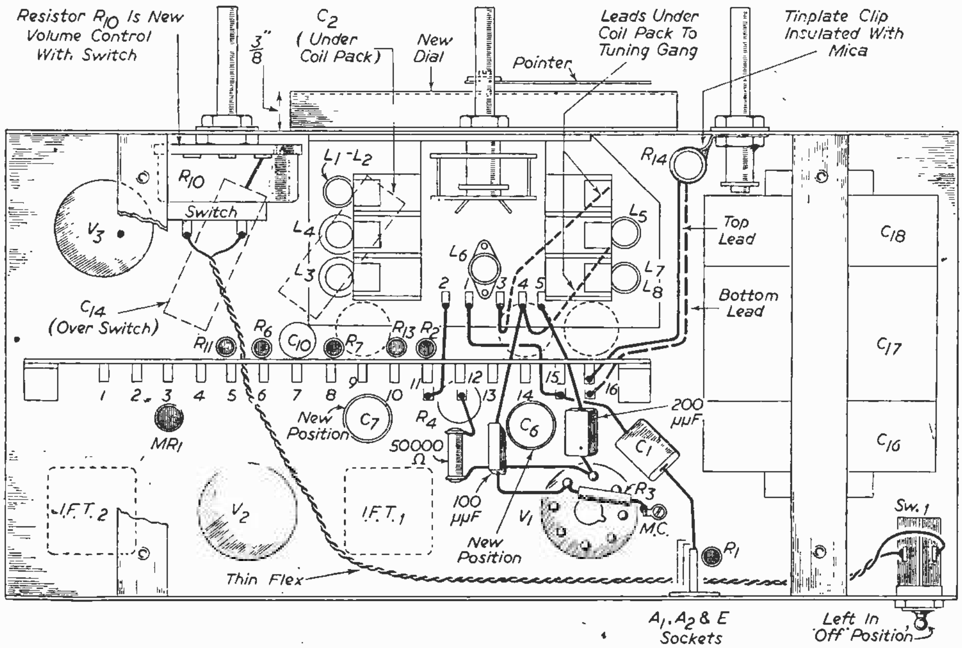


Fig. 3.—Under-chassis view showing coil pack in position. Dotted lines at tags 9, 14 and 16 on sub-panel show original position of C.7, C.6 and resistor R.14.

and tune in a weak station near the 550 metre mark and adjust the cores for maximum output (a broken bone knitting needle of about gauge 9 filed like a screw-driver is ideal for this). Repeat this process until no further gain is noticeable.

New Dial

A new dial will be required, and can easily be drawn on paper, stuck over the old dial and calibrated—either in degrees or just those stations which can be tuned and heard.

U.N.O. Daily Bulletins

OFFICIAL programmes of news, interviews and background talks on the work of the United Nations and Specialised Agencies are broadcast to Europe every day except Sunday, as follow:

Language	*Time—G.M.T.*	*Wavelengths* (metres)	*Frequency* (kilocycles)
English	22.00–22.15	16.91 19.62 25.58	17,750 15,290 11,725
French (Programme)	21.35–21.45		
French (News)	21.45–22.00		
French (Relayed by Radiodiffusion Française)	18.30–18.45	13.88 16.52 19.83	21,610 18,160 15,130
French (News and Programme)	19.30–20.00		
Dutch (News—Re-broadcast by Dutch Radio)	18.50–18.55		
Arabic	19.10–19.20		
Turkish	19.20–19.30		
Hebrew (Fridays only)	18.40–18.50		
Arabic (Repeat)	21.15–21.25	16.91 19.62 25.58	17,750 15,290 11,725
Turkish (Repeat)	21.25–21.35		
Russian	15.30–16.00	16.84 19.75	17,820 15,190

Dual Purpose Signal Tracer

Constructional Details of a Handy Service Aid

THERE is no doubt that the principle of signal tracing is the simplest and most direct method of fault finding in radio receivers, using as the key factor—the signal itself.

The signal tracer to be described incorporates a valve voltmeter and also the means to check the signal quality audibly, either by loudspeaker or headphones. The power supply can be either A.C. or, if a portable outfit, all-dry battery power.

Unlike many signal tracers of the diode type, this improved model offers high sensitivity and also a very high input impedance so that there is no loading of the circuit under test up to frequencies above 10 Mc/s.

The Circuit

The basic circuit consists of a grid-leak valve voltmeter and a single stage of audio amplification. The detector circuit consists of a 1T4 or 9001 valve, connected as a triode, with a .0002 μF coupling condenser and a 20 megohm grid leak. The 1T4 valve is for use on battery supplies.

A switch in the anode circuit provides for operation either as a valve voltmeter or an audio amplifier stage. When there is no signal applied to the grid, current flows in the anode circuit because there is no bias on the grid. When a signal is applied to the grid, rectification takes place and the current flowing through the grid leak biases the valve, causing the anode current to drop.

In order to make the meter give positive readings for decreases in anode current, the meter is connected in reverse (positive side to anode) and a "bucking" voltage applied across the meter to bring the reading to zero when there is no signal.

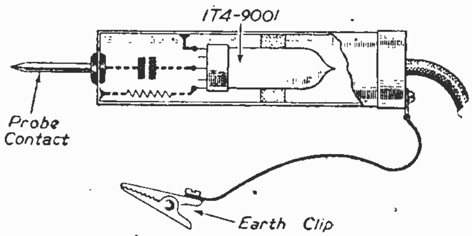
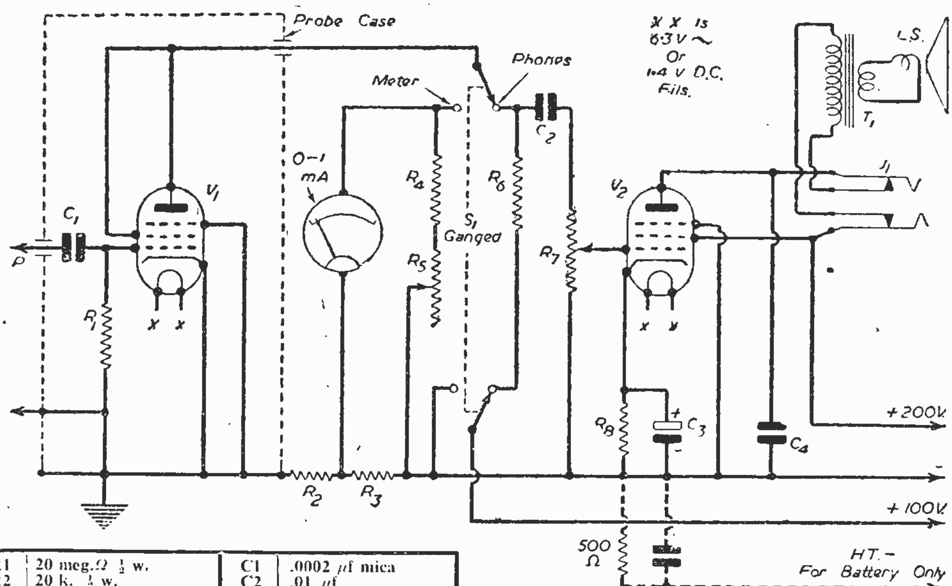


Fig. 2.—Details of the Probe.

Meter current is adjusted to zero by means of the 500 ohm potentiometer. Then, when a signal is applied to the grid, the meter reads "up scale" in the usual manner. The calibration is not in volts, but in relative signal strength.



R1	20 meg.Ω ½ w.	C1	.0002 µf mica
R2	20 k. ½ w.	C2	.01 µf
R3	1,000Ω ½ w.	C3	25 µf 25v. elec.
R4	500Ω 1 w.	C4	.002 µf.
R5	500Ω rheostat	M1	0-1 D.C. m/ammeter
R6	50 k. ½ w.	S1	D.P.D.T. switch
R7	½ meg.Ω pot.	J1	Closed circuit jack
R8	Bias resistor to suit	T.1	O.P.T.
V.1	A.C.=9001 | Batt. 1T4	L.S	5in. p.m. L/S.
V.2	A.C.=6F6 | Batt. 3Q5	P	Metal probe

Fig. 1.—Theoretical circuit of the Signal Tracer.

With the switch in the 'phones or speaker position the 1T4 or 9001 acts as a stage of audio amplification, which drives the 3Q5 or 6F6, feeding either the speaker or the 'phones through the jack.

Construction

The 1T4 or 9001 valve is housed in a small torch case, together with the .0002 μF mica condenser and 20 megohm grid leak, and is connected to the main unit by shielded cables.

In the all-dry operated model the only departure from the circuit as shown will be to omit the cathode bias resistor from the 6F6, and to place a 500 ohm resistor in the negative battery lead to the common earth point; a by-pass condenser should be fitted in the usual manner.

A flying lead with a clip is used for an earth connection, joined to the set under test.

The whole can be mounted in a small case with the controls on the front panel, and the "probe" can be connected via a multi-way plug connector if desired.

It will be seen that, with this tracer, the signal can be checked for relative strength and quality right from the aerial circuit to the speaker.

Aids for the Deaf

Details of the New-type Mullard Midget Valve

HIS MAJESTY'S GOVERNMENT have placed an order with the Mullard Wireless Service Co., Ltd., for 400,000 valves for use in the state-sponsored hearing aid, known as "Medresco." This device is to be made available to all persons suffering from defective hearing, and will be distributed through Ministry of Health clinics when the National Health Service Act comes into operation on July 7th next. It is stated that 400,000 units are to be produced, together with 100,000 annual replacements, and that the whole scheme will cost £5,000,000 a year.

The "Medresco" unit is a wedge-shaped instrument of very small dimensions. The maximum width at the top is 2½in. and at the bottom 1½in. The overall length is 3¾in. and it is 1in. thick. In this confined space is housed an amplifier using two of the new Mullard sub-miniature voltage amplifying pentodes DF70 and either a DL71 or DL72 output pentode. These valves are similar in basic design to the American types CK505AX, CK502AX and CK506A, but have the very important advantage of a marked reduction in power consumption.

Size

These valves are 10mm. (0.4in.) in diameter, the lengths being 30mm. (1.16in.) for the DF70, and 38mm. (1.5in.) for the DL71 and DL72 output pentodes. The extremely small size of these valves can be gauged from the fact that three DF70 voltage amplifying pentodes placed end to end, approximate the length of a standard cigarette.

Construction

The electrode structure is built up on a flat glass disc, in a manner basically similar to that employed in the well-known all-glass technique which has been perfected in this country in the Mullard laboratories. This method of construction ensures a high degree of rigidity, and consequent freedom from microphony. The lead-out wires are tinned to facilitate soldered connection into the circuit.

Filament Ratings

Reference to the chart below will show that the filament current ratings of the Mullard sub-miniatures are extremely low. This advance will be apparent when it is considered that the three-stage amplifier in the hearing aid consumes a total filament current of only 50 milliamperes as compared with 75 milliamperes for a similar circuit employing American sub-miniatures. This represents a saving in current of over 30 per cent.

Anode Ratings

Taking into consideration the high performance obtained with the Mullard sub-miniatures, the anode current ratings are also extremely low. The nominal anode voltage rating for the DF70 is 30 volts, whilst the voltage rating for the DL71 and DL72 is 45 volts.

The DL71 output pentode is intended for use with the hearing aid circuit designed to work with a crystal earpiece of the insert type, and delivers a power output of 6mW. at a distortion level of not more than 10 per cent. An alternative circuit

PRINCIPAL CHARACTERISTICS

Type	Vf	If (mA)	Va	Vg2	Vg1	Ia (mA)	Ig2 (mA)	gm (mA/V)	W	Gain
Mullard DF70	0.625	25	30	30	0	0.375	0.125	0.22	—	R_a=1M R_g=3M 40
Mullard DL71	1.25	25	45	45	−1.25	0.6	0.16	0.55	6mW. Dt= 10%	—
Mullard DL72	1.25	25	45	45	−1.5	1.25	0.4	0.5	23mW.	—

is available for use with an external magnetic-type earpiece. This incorporates the higher-powered output pentode DL72.

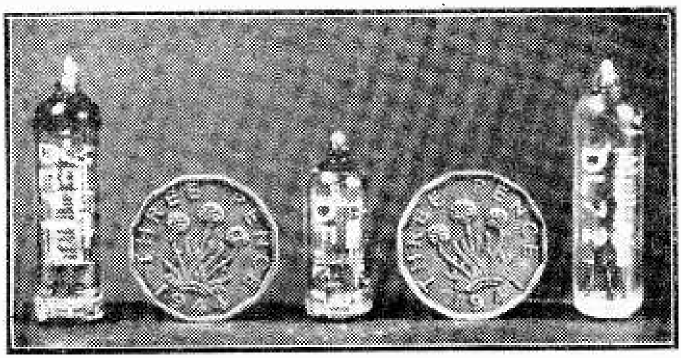
The Total Power Consumption of the Hearing Aid

The choice of earpiece is governed by the particular needs of the deaf subject, but in either case the total power consumption of the hearing aid is extremely low. For example, the circuit for use with a crystal-type earpiece normally consumes not more than 1/10th watt, whilst the total power consumption of the circuit intended for use with a magnetic-type earpiece is not greater than ⅛ watt. By way of comparison, it may be well to consider that 600 amplifiers of the first type consume less electrical energy than a single 60-watt electric lamp.

Conclusion

Commander H. St. A Malleson, of the Mullard Wireless Service Co., who conducted the negotiations with the Ministry of Supply in respect of the provision of these new British sub-miniature valves, at a recent interview said:

"The development of special sub-miniature valves by the Mullard Valve Co., for use in the new hearing aid, requires particular emphasis. This development represents a marked advance in British valve-manufacturing technique, and enables Mullard to enter a world market previously dominated by American valve manufacturers. There appears to be every hope that this achievement in sub-miniature valves will open up new possibilities in all kinds of electronic design applications where size is the limiting factor. Moreover, there is every possibility that, faced with the acute dollar position, the manufacturers of commercial hearing aids in this country will cease using the American sub-miniatures, in favour of the corresponding Mullard types."



This view gives an idea of the size of the new valves.

Test Instrument Design—4

This Month the Cathode-ray Tube is Described and Its Uses Explained by P. E. TOOKE

PERHAPS the most versatile of all pieces of electronic gear—the cathode-ray tube—is the answer to a radio engineer's prayer.

Its uses are too numerous to describe in detail. As an inertialess meter it will check D.C. or A.C. volts, show distortion in any R.F. or A.C. circuit, or check for ripple, leakage, etc., in D.C. circuits. It is one of the most accurate sources for checking frequencies and for calibration purposes. In fact, it has an infinite number of uses, limited only by the ingenuity of the person using it.

A brief description of the C.R. tube at this stage will not be amiss, then from that can be built up a complete picture of the instrument known as the "oscilloscope."

The cathode-ray tube, or the C.R.T., is itself based on the principle that a high-speed electronic stream impinging on certain chemical compounds will cause these compounds to emit light, or glow.

The method of making this effect do useful work is shown in Fig. 1. A heater and cathode circuit produces the electronic cloud in the normal way. A positive potential on the plate attracts the electrons; but with this difference. Instead of having only one plate, several are used, two or three in fact; also, each plate has a small aperture in the centre. Now the chemical screen is coated on the inside of the bulb opposite the final plate. If increasing voltage is put on each plate, the electronic stream will get faster and faster as it passes through each plate in turn and finds a higher potential to attract it. It will be found that by the time it passes through the final plate, and hits the screen, it has quite an appreciable velocity.

If the above arrangement alone were used, all it would succeed in producing on the screen would be a large, irregular blob of light, which for our purpose is useless. In the diagram you will notice a further set of electrodes between the final plate and the screen, consisting of four plates, two horizontally and two vertically mounted. After the cathode a grid, and then a round cylinder called the "gun."

The purpose of the grid is to control the quantity of electrons passing to the gun, and it works exactly as in a radio valve, the only difference being that as it controls the quantity of electrons passing through to the screen, it also controls the brilliance of the resultant image. So by connecting up a suitable circuit whereby we can vary the negative potential on the grid, we can control the brilliance of the spot. The spot, however, is still a blob; although we can make it bright or dull at will, it still needs focusing. This is the function of the "gun."

The "Gun"

If a negative voltage is put into the gun the electrons speeding through it to the first plate are repelled, and, as the gun is a cylinder, the farthest they can get from the charge is the centre; thus, the electronic stream is concentrated into a fine beam, and focused. Having now obtained a spot which can be focused and of which we can control the brilliance, the next stage is to make it work usefully. This is where the horizontal and vertical electrodes come in. These electrodes are called X and Y plates, and a tube which has these is called an electrostatic tube. (Another type of tube, which is not used for test gear and therefore does not concern us here, is the electro-magnetic—so called because the deflections of the beam are by a magnetic field made by coils mounted round the tube's neck.)

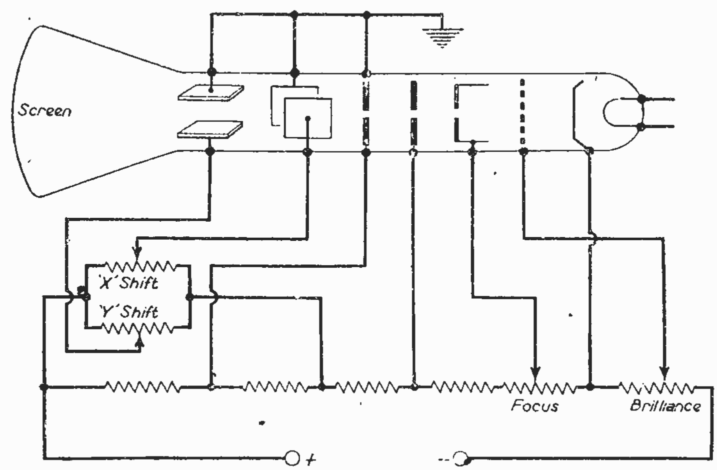


Fig. 1.—C.R.T. shift network, showing method of arranging X and Y shift controls.

By means of a voltage on the X or Y shift plates, the beam is deflected either up, down, or right and left of the screen. So by suitable voltages on each shift plate the spot can be made to go anywhere on the screen; thus, we have complete control over it.

If the C.R.T. is fitted into a circuit such as just described, so that complete control is had over the beam, it is then the oscilloscope in its simplest form.

Starting from this elementary circuit and building up, the first thing to be added is a time base.

The Time Base

Now if a voltage is built up on the X plates (the plates which shift the beam horizontally) and suddenly discharged, the beam moves across the screen and flies back again to its starting point.

Such a voltage recurring over and over again is, of course, A.C., and its waveform would be in the form of Fig. 2, called a saw tooth.

Now if another A.C. voltage is fed to the Y plates and the speed of the X plate voltage adjusted to the same frequency as the Y plate voltage, a picture of the waveform of the voltage fed to the Y plates will appear on the screen.

This, then, is one of the principal uses of the oscilloscope—examining waveforms. Further to this, if the frequency of the X plate voltage is known and can be varied, a means of checking frequency is at hand.

The saw tooth waveform of the time base is generated in many ways. One used in the first type of oscilloscope and still used for special gear is the mechanical method—a potentiometer being tuned by a motor of some sort and so increasing the voltage and suddenly bringing it back to zero again.

Electronic methods are, however, mostly in use now. The simplest is a neon tube with a suitable condenser and resistance, the voltage charging the condenser until the striking point of the neon is reached, then the charge is discharged across the resistance.

Then comes the "hard valve time base," where a condenser is charged and discharged continually by a valve in similar fashion to a multi-vibrator.

The thyratron, or gas-filled triode, also makes a good saw-tooth generator. This valve acts as a relay which resets itself, so that quite a range of time base frequencies can be had with this circuit.

As the voltage applied to the Y plate has to be fairly large to give a suitable deflection, an amplifier is needed for most work to pre-amplify the voltage before it is applied.

It is important that this amplifier has the minimum of distortion and a high voltage gain, not an easy combination. For it, a large valve should be used with a high plate load, and great care taken in the lay-out.

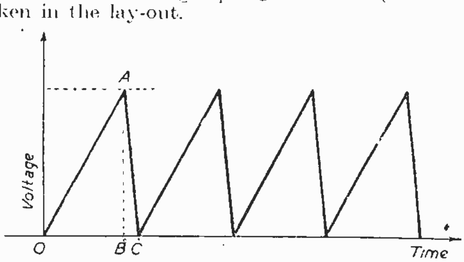
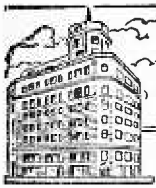


Fig. 2.—Linear time-base waveform, where OA equals the sweep, and BC is the flyback time.

If desired, a switching circuit can be arranged so that the output of the amplifier can be switched to the X or Y plates at will, as sometimes it is necessary to amplify the signal on the X, as well as the Y plates.

That then is basically an oscilloscope circuit. For some reason the amateur who builds transmitters and complex gear with impunity fights shy of the oscilloscope. There is no reason why he should, however, as, except for the high voltages used, its circuits are no harder to construct than any other.



ON YOUR WAVELENGTH

By THERMION

"Do You Get a Square Deal?"

ON several occasions I have commented on the sharp practice adopted by some service "engineers" and have exposed many of the rackets practised by incompetent rogues. Like a watch, the inside of a wireless set is a complete mystery to millions of listeners—those, of course, who are not readers of this journal. The non-technical are thus an easy prey to the charlatans and mountebanks who exist in the radio trade.

The industry itself is most concerned about the problem, and has made attempts to purge the trade of such people, not, however, with much success. Some of the larger firms will not grant agencies for spare parts to unapproved firms, whilst others have training schemes so that their dealers can methodically check a broken down receiver for faults, and service it quickly.

This, however, does not go far enough, for some of those who practise the rackets to which I refer are not incompetent, but dishonest. It is not only the unskilled who make fantastic charges for simple repairs.

It is difficult to see what system could be devised to eradicate the trouble. A list of standard charges does not go far enough since the dealer could always charge for defects which did not exist in the receiver, and the customer has no means of challenging overcharges made in this way.

I was therefore interested when Alan Tomkins, of the *Sunday Dispatch*, in a feature article, explained his efforts to get a wireless set repaired. He had a wireless set repaired six times in 26 days in, as he says, an attempt to answer a question which bothers most radio set owners—is the non-technical listener cheated when his set is repaired?

So he chose a second-hand four-valve portable as a test set and broke a wire which any mechanic would be able to spot at once as the reason for the failure of the set. The wire in question was the one, 3in. long and covered with insulation, which is connected between the variable condenser and the on-off switch. He then took the set to an East End radio dealer, who told him to come back in a few days, which he did, to be told that the repair would cost 27s. 6d. He asked what was wrong with the receiver without satisfactory reply.

No receipt was offered for the 27s. 6d. Examination showed that the free end of the wire had not been soldered to its appropriate point but had been wrapped round a small bolt sticking through the metal chassis.

Tomkins again disconnected the wire and took it to a West End dealer, who gave him a receipt for the set with the request to call back the following afternoon for an estimate. He was then told that the repair would cost 10s. The following morning he collected the receiver and was told that as the accumulator had also been charged the price would be 11s. The assistant did not know what the trouble was, as the "works" were elsewhere.

Again the wire was broken, and the receiver taken to a Brighton radio shop. Five days later the set was returned with an itemised bill for 17s. 6d. for: "Dismantling, tracing through, locating faults, repairing faulty wiring, cleaning switching, adjusting, assembling, testing, etc." The wire had been correctly soldered.

Then the receiver, with the wire broken again, was taken to a well-known establishment in Windsor, where he was told that the receiver would be ready the following day. It was, together with a bill for 22s. for: "Dismantling set, to testing through, anode fixed resistance faulty—replaced, break in neg. wiring made good, recharge accumulator, and tested O.K."

Travelling to Richmond, having broken the wire again, he was told that the job would be ready in three days, and so it was, with a 15s. bill for: "Test out valves and components and repair as required, repair on and off switch." Asked what was wrong, the dealer said that it was a very complicated switch!

The receiver was then transported to Bradford, Yorkshire, and the dealer there had the set ready the following day with a bill for "service—12s. 6d." The reason here given was that there were a few wires and bits and pieces underneath!

It will be seen that the cheapest price was in the West End, namely, 11s.

As there are over 11 million licence holders it is easy to comprehend the vast possibilities of exploiting the non-technical listener.

In view of this exposure I think that the trade might renew its efforts to find a solution, although I am not hopeful of the results. My own experiences on the few occasions when I have returned a receiver to the manufacturers because I was unable to obtain spares have not been very happy.

One very large and well-known firm kept the receiver for a fortnight before demanding an "examination fee" of 30s., and stating that upon receipt of this they would proceed with the work and send me a further bill for labour and materials. I therefore had the receiver returned to me and by substituting components of another make, at a total cost of 8s. and half an hour's work, had the receiver working again.

On another occasion, and under similar circumstances, the receiver came back to me with certain components missing entirely. Apparently owing to the shortage of components they were robbing Peter's receiver to repair Paul's. As I had declined to put the work in hand I got my receiver back without the parts. Correspondence followed, and I was assured that the set had been returned to me exactly as they had received it!

I was having none of this, and upon threatening to take action and to expose them I was supplied with the missing parts—plus an admission that some assistant must have forgotten to replace them.

A Load-corrected Output Meter

Making a Valuable Test Instrument for Experimental and Laboratory Use

By E. N. BRADLEY

THE measurement of power output from a radio receiver or an amplifier would appear, on first consideration, to be a simple matter. Provided that the impedance or resistance in which the power is dissipated is known the power can be stated in terms of either voltage or current, the two well-known formulae being

$$P=I^2.R$$

or

$$P=\frac{V^2}{R}$$

where P is the power in watts, I is current in amperes, V is the voltage and R is the resistance. Since the audio power derived from an output stage is actually in the form of an alternating wave it would, of course, be more correct to state the formulae using the term Z (for impedance) in place of the term R and making any necessary correction for power factor, but the simpler D.C. equations for power are commonly used for all ordinary applications.

In a normal output stage such as shown in Fig. 1, then, the power may be measured either by connecting an A.C. voltmeter across the primary of the output transformer, an isolating capacitor being used to prevent D.C. flow through the voltmeter circuit, or by connecting an A.C. ammeter in the secondary circuit in series with the speech coil. In the first place the power will be given by dividing the square of the voltage by the load resistance of the valve, and in the second case the power will be given by multiplying the square of the current by the impedance of the speech soil, and it will be realised that in either case the voltmeter and ammeter may be transposed—the voltage across the speech coil may be measured or the A.C. through the transformer primary (as distinct from the D.C. flow through the winding and valve). The first methods are, however, the more convenient.

There are several obvious disadvantages in the use of an A.C. ammeter—the voice coil circuit must be broken, a thermo-electric ammeter must be used in order that frequency error may be avoided, the current is fairly low and thus not easily measured on such an instrument—and so the voltmeter method is the one most often chosen.

If the isolating capacitor is made large the error due to its use is negligible, whilst modern instrument rectifiers have practically no frequency errors up to as high a frequency as 100,000 cycles and certainly no error that matters at 10,000 cycles or so, and the accuracy attainable by the voltmeter method of power measurement is therefore quite good. There is, however, one serious drawback not immediately obvious—the voltmeter cannot be calibrated in terms of power, for "R" in the equation $P=\frac{V^2}{R}$ varies with the valve supplying the output power. Using the PX4, for example, R (which is of course the optimum load into which the valve should be matched) is 4,000 ohms, so that the voltage developed and measured for a 2 watts output will be by transposition of terms.

$$V=\sqrt{2\times4{,}000}$$

or $V=89.4$ volts approximately.

If now the voltmeter is used to measure an output of 2 watts delivered by a 6L6 into the correct load for this valve, 2,500 ohms under one set of working conditions, the voltage is given by

$$V=\sqrt{2\times2{,}500}.$$

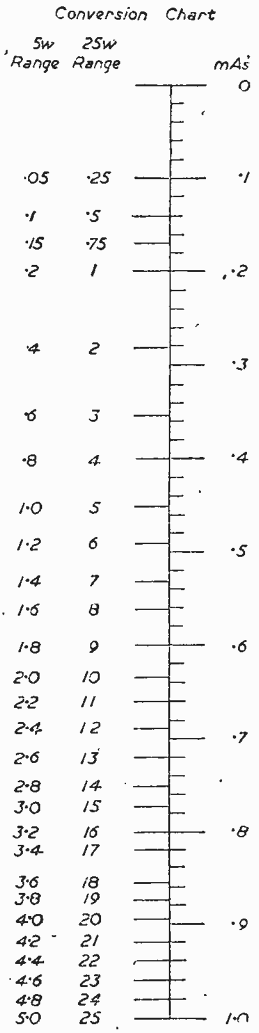
or $V\approx70.7$ volts approximately.

Thus in each case the power output is 2 watts, but the two voltage readings differ considerably, and not only is it impracticable to calibrate the voltmeter in terms of watts, it is also impossible to prepare a series of correction charts to cover all the valve loads and powers which may be met.

An Improvement

It was to improve upon this state of affairs that the load-corrected output meter, shown diagrammatically in Fig. 2, was designed.

The meter reads output powers over two very useful ranges, 0 to 5 and 0 to 25 watts, and is



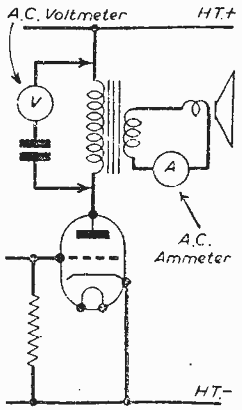


Fig. 1 (below).—Method of measuring Output Power. Fig. 3 (right).—Conversion Chart, mA-Watts (correct to scale).

correct for 12 different loads chosen to cover as well as possible the load impedances of present day output valves both in single-ended and push-pull output stages. The principle underlying the method of working of the meter is simple; the voltage range of the meter is changed to suit the load across which the power is to be measured. As an example of the manner in which this is accomplished two further sets of figures may be studied, the voltage produced across a 10,000 ohms load by 5 watts, and the voltage produced across 5,000 ohms by 5 watts.

In the first instance V is given by

$$V=\sqrt{5\times 10{,}000}$$

so V=223 volts approximately,

and in the second instance,

$$V=\sqrt{5\times 5{,}000}$$

so V=158 volts approximately.

To make an output meter with a maximum range of 5 watts which could be calibrated in terms of power, therefore, and covering the two stated loads, it would be necessary only to make a double range voltmeter, the instrument having a maximum reading of 223 volts when measuring power across the 10,000 ohms load and a maximum reading of 158 volts when measuring power across the 5,000 ohms load. These two ranges might be controlled by a two-position switch and the switch coded as "5 watts, 5,000 ohms" and "5 watts, 10,000 ohms."

The instrument would, in other words, be a simple load corrected output meter. Not only would the full scale reading of 5 watts be correct at the two loads for which the meter was designed, but all the intermediate scale points would also be correct. The much more complicated circuit of Fig. 2 works on the same principle. The meter is arranged as a voltmeter with a number of series resistances, each calculated to give the correct full scale and intermediate readings across the load for which it was designed.

To make this possible 24 series or multiplier resistances are needed, 12 for the 12 loads at a maximum power of 5 watts with a further 12 selectively added in series for the 12 loads at a maximum of 25 watts. As might be expected the multiplier resistances do not work out conveniently to round figures, and a total of 44 resistors is required. These are all standard values with 5 per cent. tolerances as taken from Messrs. Erie's standard value list, and no difficulty should be

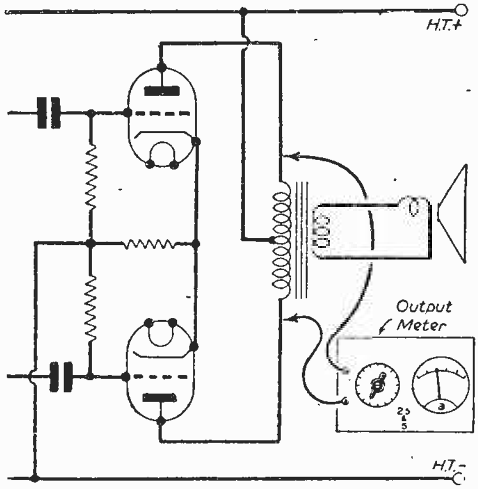


Fig. 4.—Measuring Output of a Push-pull Circuit.

encountered in obtaining the values required at a good store.

The switching is extremely simple. The 12 loads are selected by rotating a 12-point, 2-pole switch, the switch positions being coded as loads, and the full scale power of either 5 or 25 watts is selected by a single-pole, single-throw toggle switch.

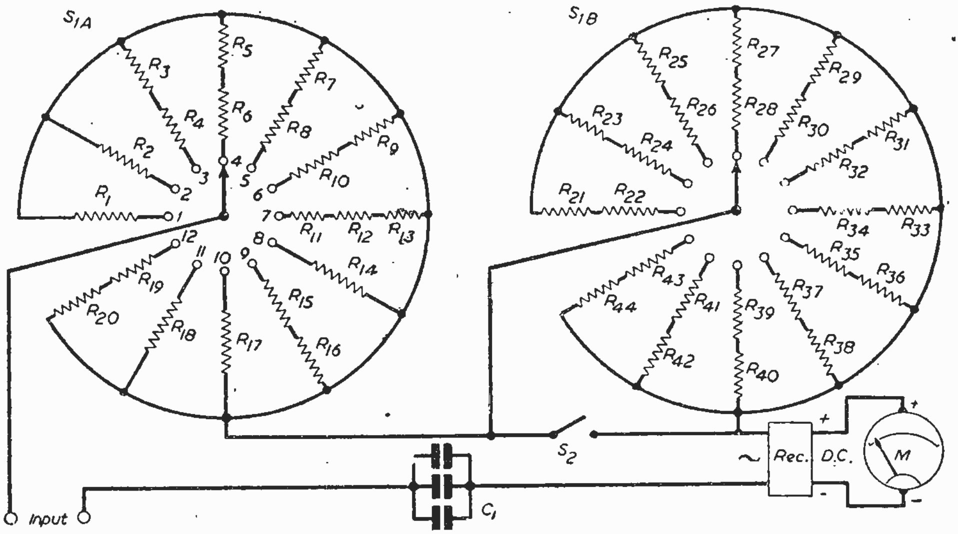


Fig. 2.—Circuit Diagram of the Output Meter described in this article.

Measuring the Power

To measure power, therefore, the correct load on the valve under test is found from the makers' figures, the load corrector is turned to that load figure, the 5 or 25 watts range selected, the meter is connected across the primary of the output transformer with the stage working normally and the power read off either from the meter scale direct or from the conversion chart shown in Fig. 3.

The indicating instrument may be any 0-1 m/A moving-coil meter with an internal resistance of not more than 500 ohms, and the scale of this meter may be calibrated, if desired, from Fig. 3, but the amateur is not advised to carry out this operation. A moving coil instrument is very easily damaged once the cover is removed, whilst to draw all the points given in the conversion chart would be a very difficult task to accomplish neatly and legibly. A duplicate chart cemented to the panel of the completed meter and varnished over with clear lacquer is much more satisfactory and as simple to read since the current shown on the meter scale is immediately read off as a power.

All resistors 1 watt rating, 5 per cent. accuracy. One per cent. resistors are to be preferred, but are difficult to obtain.

Construction

The output meter may be built up in any type of case. Layout automatically follows the circuit diagram, and the best method of mounting the resistors will be found to be radially, as shown in Fig. 2, each resistor or series combination being wired between the appropriate switch point and a ring of stout wire.

The resistors should be gripped by long-nosed pliers on their wire ends, when being soldered into place, to conduct heat away from the bodies of the components.

The switches should be coded as follows:

S1a, b. "Load Selector"

Position 1	2,500 ohms.
Position 2	3,000 ohms.
Position 3	4,000 ohms.
Position 4	5,000 ohms.
Position 5	6,000 ohms.
Position 6	7,000 ohms.
Position 7	7,500 ohms.
Position 8	8,000 ohms.
Position 9	9,000 ohms.
Position 10	10,000 ohms.
Position 11	12,000 ohms.
Position 12	15,000 ohms.

These 12 loads are those across which the meter will give correct readings. To take a reading of power in any other load two readings may be taken, one at the nearest figure above, and one at the nearest figure below the actual load, when a mean of the two readings will generally give a very good indication of the actual power.

S2. "Range Multiplier"

Position 1 (or "On," contacts closed), 5 watts full scale.

Position 2 (or "Off," contacts open). 25 watts full scale.

The Conversion Chart

A great advantage of the output meter is that it requires no setting or calibration when first built. As soon as the wiring is completed and the conversion chart drawn (or the chart of Fig. 3 may be cut from the page and used), the meter is ready to operate. The conversion chart shows the current indications for the full range of power covered, and since clear readings are given for all powers between the two standards of 50 milliwatts (0.05 watt) and 500 milliwatts (0.5 watt) up to 25 watts there are few tasks which the meter cannot carry out.

COMPONENTS LIST (Fig. 2)

R1	100,000 ohms.
R2	110,000 ohms.
R3, R21	120,000 ohms.
R4, R26	6,800 ohms.
R5, R23	130,000 ohms.
R6, R30	12,000 ohms.
R7, R25	150,000 ohms.
R8, R24	6,200 ohms.
R9, R11, R27	160,000 ohms.
R10, R32, R40	8,200 ohms.
R12	13,000 ohms.
R13	1,000 ohms.
R14, R15, R29	180,000 ohms.
R16	11,000 ohms.
R17, R31, R33	200,000 ohms.
R18, R35, R37	220,000 ohms.
R19, R39	240,000 ohms.
R20	5,100 ohms.
R22	4,700 ohms.
R28, R38	16,000 ohms.
R34	15,000 ohms.
R36, R42	2,000 ohms.
R41	270,000 ohms.
R43	300,000 ohms.
R44	4,300 ohms.
C1	6 or 8 μF 1,000 volts working. Made up of 3 or 4 2μF capacitors in parallel. Paper or oil—*not* electrolytic.
Rec.	1 m/A instrument rectifier, Westinghouse.
M	0-1 m/A moving-coil meter.
S1a, S1b	2-pole, 12-way selector switch.
S2	Single-pole, single-throw switch.

Wire, sleeving. Suitable containing case. 1 control knob. Leads and test prods, screws, etc.

To supplement the chart of Fig. 3 the figures are given in Table 1, by means of which it may be duplicated or enlarged.

Since the power scale is set and correct for all ranges the output meter may also be calibrated, if desired, in terms of decibels. Different constructors will have different requirements but by the use of a decibels reference table any zero decibel level may be chosen and the decibels conversion chart made up from the reference table.

One example may be given using the 25 watts range and with 1 watt as zero decibel level. The decibel calibration of the output meter then becomes as in Table 2.

For use with all single-ended output stages the output meter is connected directly across the output transformer primary just as is the voltmeter, with its capacitor, in Fig. 1. The capacitor is contained, of course, in the output meter circuit.

It is of some importance that the stage should be working correctly both before and after the output meter is connected into circuit: switching off the output stage with the output meter connected, or connecting the output meter in before

(*Concluded on page* 156)

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Frame Aerials and D/F

Interesting Details of the Directional Type of Aerial.

By E. J. HARTLEY (G2FBI)

WE are liable to forget in these days of multi-valve receivers, regular transatlantic communication, television, etc., that some of the very earliest experiments ever carried out in radio were conducted by Hertz in 1888, using a wavelength of two-thirds of a metre, or, if you like, 450 megacycles!

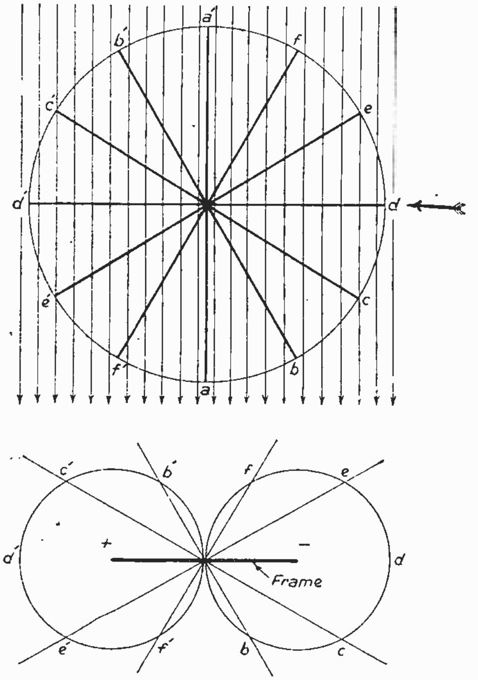


Fig. 1.—A typical frame aerial and the field plotted round it.

One of his famous experiments was to show that, when a loop of wire with a spark gap fitted to the open ends was placed in certain positions with respect to a source of radiated wireless waves, a spark would pass across the gap, but if the loop were orientated, and with the distance from the radiating source still maintained, a spark would no longer be produced. Here then was one of the first experiments in direction finding, for it is upon this property that all loop direction finding is based.

Fig. 1 shows a typical frame aerial and it is assumed that the frame is so small in comparison with the wavelength that the flux in the neighbourhood of the frame may be taken as uniform. It will be seen that the maximum number of lines are linked with the frame when it is pointing in the direction of travel of the wave. Also that when it is rotated so as to be broadside on to the direction of travel, no lines are linked and therefore no signals received. The conditions existing at intermediate positions can be found by taking successive movements of the frame in a uniform magnetic field and by counting the number of lines linked. From the diagram, in position a a¹, there are no lines linked: at b b¹, there are 10: at c c¹ there are 18; and 20 at d d¹, after which the linkage begins to fall off. There are 18 lines at e e¹, 10 at f f¹ and none when the frame reaches a¹ a. The growth

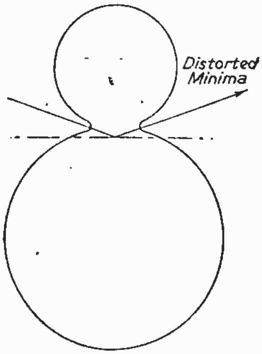


Fig. 2.—A figure eight Polar diagram, showing the normal distortion which is experienced. Compare this with the Polar diagram in Fig. 1.

in linkage and hence the induced e.m.f. now recommences reaching a maximum at d¹ d and falling to zero again at a a¹, having taken the frame through one complete revolution. It is important to notice that although the same number of lines are linked at f f¹ as b b¹, the lines do not pass through the frame in the same direction. The e.m.fs. induced will be in opposite directions round the frame. The results can be plotted as shown and when this is done, the points will be found to lie on the circumference of two circles, one which is of positive linkage value and one of negative linkage value. The diagram is the well-known figure eight and is characteristic of the simple frame aerial when the dimensions of the frame are small compared to the wavelength. This figure eight diagram is very largely used for direction finding and two methods are open to use, one using the frame when loudest signals are an indication of direction, the other when the minimum signal is received. Glancing at Fig. 1 the loudest signal position will be very "flat" as far as the true direction is concerned. The other method using the minimum signal position produces a far "sharper" indication of the true direction since a small change of angle brings about a large change of signal strength. For this reason it is common practice to use the minimum signal position with the pointer and scale of the frame suitably arranged.

Not a Solution

From the theoretical polar diagram one would surmise that the frame aerial principle is a complete solution of the problem of direction finding, but a number of serious defects are discovered when such an aerial is used in practice. The most common of these is the distortion of the normal figure eight diagram in the manner shown in Fig. 2. This distortion is characteristic of the frame aerial and applies to all types of loop D.F. systems. This distortion is due to many causes, the chief ones being:

(1) The tendency of the aerial to oscillate direct to ground through the capacity of the receiver. This is known as *aerial effect* or *vertical*.

(2) Direct reception of signals by the receiver circuits. This is known as *pick-up*.

(3) Due to misphased re-radiation from nearby conductors in the vicinity of the loop. This is known as *quadrature effect* and is not actually a defect of the loop but has to be considered when correcting for the loop.

Re-radiation or quadrature effect is most prominent when the frame is used near metalwork which itself is energised by the electro-magnetic field. The solution consists of finding a site for the frame where the quadrature field is small and then neutralising the remainder by the introduction of an e.m.f. from an auxiliary aerial.

Phantom Loop

When a solenoid frame is placed in the minimum reception position the vertical sides of the successive turns are spaced in the direction of propagation of the waves and will have e.m.fs. of varying

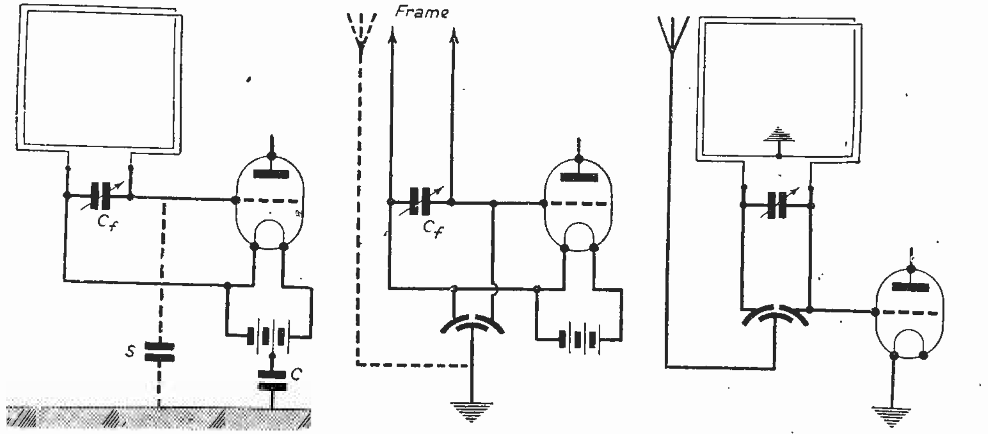


Fig. 3.—Three methods of correcting a circuit to avoid what is known as the "vertical effect."

(4) *Displacement currents* due to the capacity of the solenoid form of loop.

Vertical has been seen to be due to the unbalanced capacity to earth of the receiver. A possible method of correcting this is shown in Fig. 3a by connecting a small condenser from grid of the first valve to earth, which is equivalent to putting a condenser in parallel with *S*. This is adjusted until the total value of *S* and the extra condenser is equal to *C*. When there can be no potential induced across *Cf* except due to the loop, because the two parallel paths have equal impedance. Fig. 3b shows a practical arrangement using a differential condenser. In certain cases better results are obtained by connecting the moving vane to an open aerial. Still another method is to connect an earth to the mid point of the frame, as shown in Fig. 3c. This is very effective and performs a double function of a fine adjustment on capacity balance and also of a quadrature effect zero cleaner.

The oscillatory circuits of any receiver consist of inductances and condensers which can be considered to be tiny aerials and will receive signals weakly, this reception will be independent of the frame. The figure eight diagram will be modified according to the strength of the received signals on the components and connecting wires. In the case of a very small loop, the pick-up by the components may be large compared with that from the frame and large distortions will result. This effect can be minimised by screening the coils, leads from the frame and, if necessary, the whole receiver.

intensities induced in them. Between each turn there is also a capacity and so a phantom loop is formed which has its plane at right angles to the plane of the actual frame aerial. Therefore, when the frame is set for minimum reception this phantom loop is in a maximum reception position. This effect can be minimised by using a pancake form of coil but the capacity to earth may be greater. Multi-turn frames are sometimes constructed with a combination of box and pancake design.

The effective height of a frame aerial represents the factor which, when multiplied by the field strength in micro-volts per metre, gives a measure of the e.m.f. generated in the loop in micro-volts.

It is given by: $h = \frac{2\pi nA}{\lambda}$ metres

Where n = number of turns.

A = area of each turn in square metres.

λ = wavelength in metres.

In passing it will be noticed that by removing the horizontal top of a single turn-loop we have the familiar *Adcock* "U" aerial with unscreened lower section and this reduces the effective height by 60 per cent. of the value given above.

(*To be continued*)

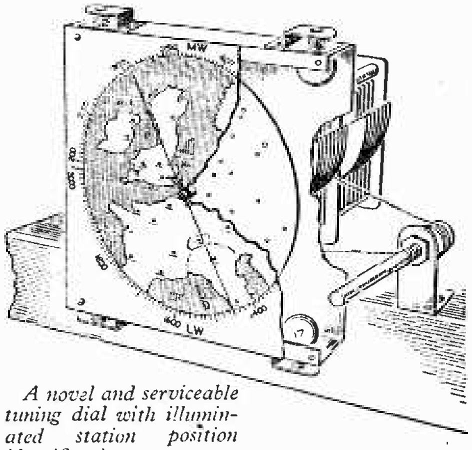
Practical Hints

New Form of Tuning Dial

THE tuning dial on a medium and long waveband superhet was modified to take the form of a map of Europe. Dots, representing the stations tuned to, lighting up in the approximate geographically correct position.

The sketch gives the general form of the device.

The map of Europe was drawn on thin white card about 6in. square and held by a frame of aluminium as shown. A rotating disc of thin brass soldered to a boss with a grub screw was mounted on the tuning condenser spindle close up to the map.



A novel and serviceable tuning dial with illuminated station position identification.

The back of the disc is illuminated brightly by four dial lamps shining on the white-painted surface of the frame.

The centre of the spindle must be opposite a portion of the map where there are no stations, such as the English Channel.

Small holes are punched in the map (about the size of a pin head), where stations occur, care being taken if two stations are punched at the same radius marked from the centre of the dial, for the station may light up twice in some circumstances. The names of the stations should be printed near the holes.

The stations should then be accurately tuned in, one by one, and the hole corresponding to each station marked through on to the brass disc, after which the disc may be drilled or punched.

If the spindle is allowed to project through the dial, the usual double ended pointer may be mounted thereon and a wavelength scale printed around the edge of the map.

It is advisable not to be too ambitious and to keep the number of stations marked on the map down to about twenty well-received ones.

Finally, the map may be coloured as desired and also the bulbs may be lacquered so that the dots show up in colour.—H. J. R. TOWNSEND (Newport, Mon.).

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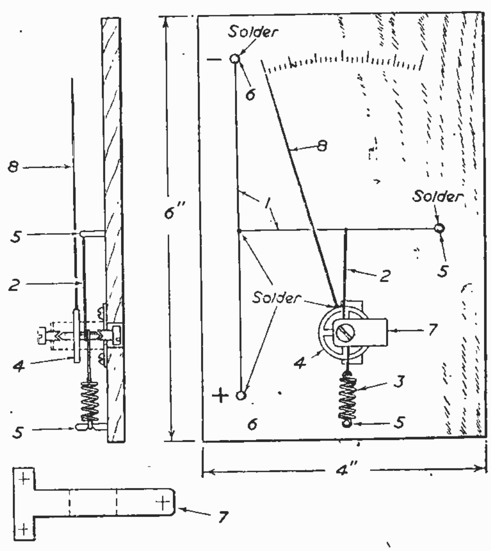
All hints must be accompanied by the coupon cut from page iii of cover.

A Milliamp Meter

ANYONE with the average tool kit will find it quite easy to make the milliamp meter described here. All one needs is a piece of wood or ebonite for the baseboard, two terminals, some resistance wire of a gauge suitable for the strength of current with which the meter is intended to be used, a balance wheel and an old clock and some patience. The sketches explain themselves. Measurements are not given because all measurements depend on the size of the balance wheel. The resistance wire is soldered to the two terminals as well as at the junction at Figs. 1 and 5.



Making an efficient meter

With a main length of resistance wire of No. 40 gauge between terminals it is surprising what a wide swing of the pointer can be obtained using a practically worn out single cell battery two years old.

The pointer is a piece of No. 18 gauge wire. It is advisable to have the pointer as long as possible where fine readings of small currents is desired.—T. ANDREWS (Old Trafford).

A Four-ra

A Short-wave Receiver Covering a Wide Banc

As the circuit in Fig. 1 shows, this receiver is quite straightforward and no difficulty should arise in any stage of the wiring. Switching is provided to select either of the four wavebands. This is more convenient than plug-in coils and makes the receiver more compact, because the extra loose coils which would otherwise be necessary do not require keeping nearby.

The receiver is designed for short-wave reception, but long- and medium-wave coils may be added. If this is done, the low maximum capacity of the tuning condenser will curtail the wave-range, although a useful band-width can be covered and the scope of the receiver thereby increased.

To simplify switching the R.F. stage is untuned. It provides some amplification and removes hand-capacity and tuning-drift introduced *via* the aerial system. There are only four battery connections, bias being obtained automatically from the voltage drop across a resistor. The output valve is resistance-capacity coupled. This gives complete stability and ample volume for headphone reception. Satisfactory speaker reproduction will be obtained from the more powerful stations, including U.S.A. transmitters when conditions are good.

The Chassis Layout

None of the components is critical and they may be obtained from advertisers whose announcements appear in these pages. The switch is a 2-pole 6-way component, two sets of contacts being ignored unless additional ranges are added. The two high-frequency chokes should be of good quality or some slight loss of volume will arise.

The chassis may be made from plywood, with ¼in. thick wood for the side runners. It is 7in. by 5in. by 2in. deep. Three holes for the valve-

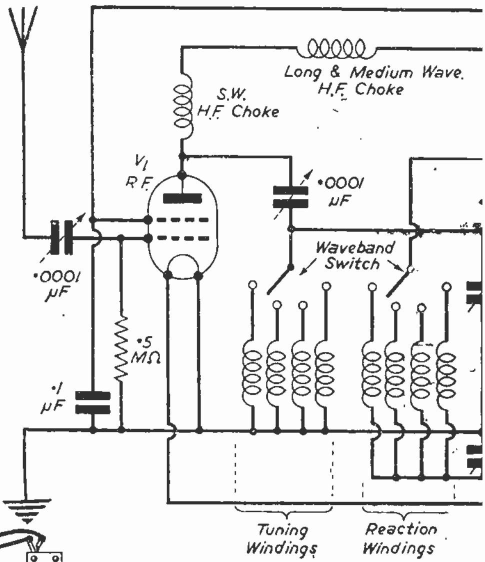


Fig. 1.—Theoretical circui

holders should be drilled near the rear, as shown in Fig. 2. The holders may be fixed to either the top or bottom of the chassis. Low-loss holders are used in the R.F. and detector positions.

When wiring, there are only three leads to take through the chassis. One goes from the H.F. choke to H.T.+. Two go from the tuning condenser,

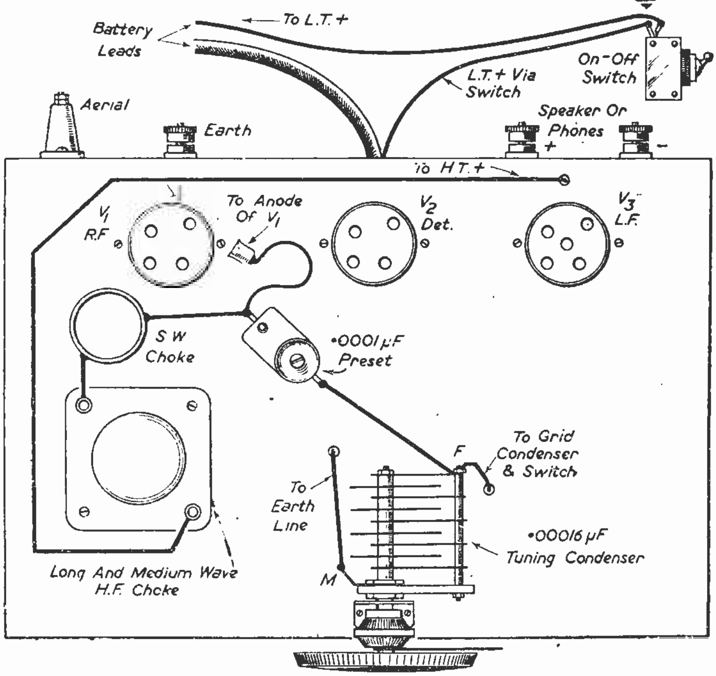


Fig. 2.—Above-chassis wiring details.

LIST OF CO

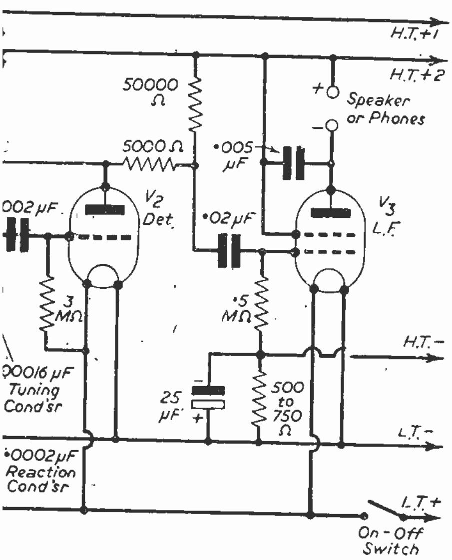
.00015 or .00016 μF tuning condenser with reduction drive.
.0002 μF reaction condenser with knob.
Resistors: 500-750 ohm; 5,000 and 50,000 ohm; two .5 megohm grid leaks; one 3 megohm leak.
Condensers: .005 μF.; .02 μF.; .0002 μF.; .1 μF.; 25 μF. 25-volt working biasing condenser. Two .0001 μF. pre-set condensers.

..nge Three

..Without Coil Changing

By F. G. RAYER

..the moving plates being connected to the earth return line and fixed plates to the switch and grid condenser. The tuning condenser and



..f the Four-range Three.

reduction drive are supported on a component mounting bracket.

As shown in Fig. 2, the .0001 μF pre-set coupling the R.F. stage to the detector is suspended in the wiring directly between the R.F. valve cap (anode) and fixed plates of the tuning condenser. The S.W. choke is connected from the valve cap, and this choke should not rest too near the metallised covering of the valve.

Sub-chassis Components and Wiring

Fig. 3 illustrates the position of all the parts below the chassis. If good reception on 9 to 10 metres is desired care should be taken to keep the grid and anode leads of the detector (including those from the switch to the coils) as direct as possible. On wavelengths near 20 metres a little extra length in the leads is of less importance, so it is best to wire the smallest short-wave coil first (coil 1), following by coil 2 and so on.

The junction of the 25 μF condenser, bias resistor and .5 megohm grid leak is supported by a tag screwed to the side runner of the chassis. A screw may also be used to secure the junction of the 5,000 and 50,000 ohm resistors with the .02 μF condenser.

Battery leads are taken out through a hole in the rear runner of the chassis. As shown in Fig. 2, the on-off switch is connected in the L.T.+ lead so that it can be mounted on the side of the cabinet.

A stand-off insulator is used for the aerial connection. Earth and speaker connections may be taken to terminals mounted directly on the back runner, which may be of plywood or ebonite.

Switch Wiring

The switch connections cannot be shown in full in Fig. 3, but Fig. 4 shows them, and they are very straightforward. An examination of the switch, or test with a meter or battery and bulb, will show which of the outside contacts are connected in various switch positions. The coils are then wired to the switch so that at each switch

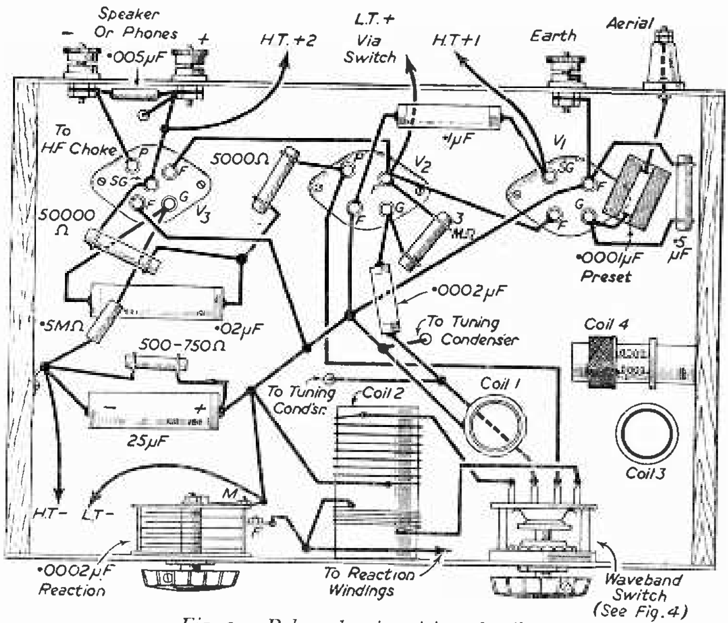


Fig. 3.—Below-chassis wiring details.

..ONENTS

..wo 4-pin valveholders. One ..5-pin ditto.

..W. choke. Long- and medium-wave choke.

..pole 6-way rotary switch with knob.

..tand-off insulator; on-off switch, etc.

..alves: 210VPT (or similar type for R.F.); HL2 (or similar type for detector); 220HPT (or similar type for output).

..oils: Wearite, etc. (see text).

position the grid and reaction windings of one of the coils are connected. Fig. 4 makes this clear.

All the earth ends of the grid windings are returned to the L.T. – line, and short connec-

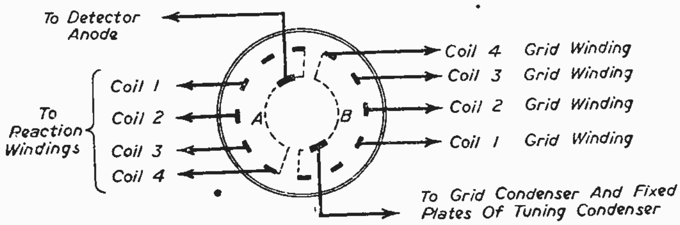


Fig. 4.—Details of connections to the switch.

tions are necessary with the coils which will operate at the higher frequencies. The same applies to the reaction windings, returned to the fixed plates of the reaction condenser.

The Tuning Coils

Suitable small tuning coils may be obtained ready made. For the higher wave ranges iron-cored coils can be used. If coils are to be made, the connections are shown in Fig. 5.

The smallest coil, for tuning the 10-metre band, can be made from six turns of 20 s.w.g. tinned-copper wire wound on a former ¾in. in diameter. For reaction five turns will be necessary. Ten turns of 20 s.w.g. wire on a ⅞in. diameter former can be used for coil 2, with eight turns for reaction. Eighteen turns of 22 s.w.g. wire can be used for coil 3, with 12 turns for reaction. Thirty turns of 24 s.w.g. wire on a 1¼in. former will be required to tune the 80-metre band.

Long- and medium-wave coils may be mounted in the space to the right of the tuning condenser, if desired. They should be connected to the spare contacts on the switch.

Operational Notes

The setting of the .0001 μF pre-set condenser on the top of the chassis will to some extent govern the ease with which the detector oscillates. For average results a mid-way position is generally suitable. Opening this condenser will reduce volume slightly and increase selectivity.

The pre-set under the chassis should also be set to about half capacitance, unless the aerial is very short, when it may be closed up. For a long aerial a lower capacitance is recommended. If the receiver is to be used for long- and medium-wave reception, this condenser

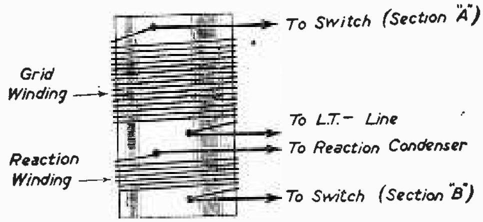


Fig. 5.—Coil winding and connection details.

should not be set at too low a value, or volume will fall.

LOAD CORRECTED OUTPUT METER

(*concluded from page 148*)

the output stage is switched on or warmed up to operating temperature may result in surges which could damage the rectifier.

When the output meter is used with push-pull stages it must be connected across the whole transformer primary as shown in Fig. 4.

If a true reading of output power is required the stage should be fed from an audio oscillator. A programme signal or, in the case of an amplifier, recorded music, gives wide swings of output and no useful reading will be obtained (unless transient performance, etc., is under survey).

Table 1.

Conversion Chart Figures for 5 and 25 watt ranges.

Meter Reading m/A's.	Power, 5 Watts Range.	Power, 25 Watts Range.
0.1 m/A.	0.05 watt.	0.25 watt.
0.14 ,,	0.1 ,,	0.5 ,,
0.17 ,,	0.15 ,,	0.75 ,,
0.2 ,,	0.2 ,,	1 ,,
0.28 ,,	0.4 ,,	2 ,,
0.35 ,,	0.6 ,,	3 ,,
0.4 ,,	0.8 ,,	4 ,,
0.45 ,,	1 ,,	5 ,,
0.49 ,,	1.2 ,,	6 ,,
0.53 ,,	1.4 ,,	7 ,,
0.56 ,,	1.6 ,,	8 ,,
0.6 m/A.	1.8 watt.	9 watt.
0.63 ,,	2 ,,	10 ,,
0.66 ,,	2.2 ,,	11 ,,
0.69 ,,	2.4 ,,	12 ,,
0.72 ,,	2.6 ,,	13 ,,
0.75 ,,	2.8 ,,	14 ,,
0.77 ,,	3 ,,	15 ,,
0.8 ,,	3.2 ,,	16 ,,
0.82 ,,	3.4 ,,	17 ,,
0.85 ,,	3.6 ,,	18 ,,
0.87 ,,	3.8 ,,	19 ,,
0.89 ,,	4 ,,	20 ,,
0.92 ,,	4.2 ,,	21 ,,
0.94 ,,	4.4 ,,	22 ,,
0.96 ,,	4.6 ,,	23 ,,
0.98 ,,	4.8 ,,	24 ,,
1 ,,	5 ,,	25 ,,

Table 2.

m/A's. and Watts to Decibels.

dbs.	Watts.	m/A's. scale reading.
– 6	0.25 watt	0.1 m/A.
– 3	0.5 ,,	0.14 ,,
0	1 ,,	0.2 ,,
+ 3	2 ,,	0.28 ,,
+ 6	4 ,,	0.4 ,,
+ 9	8 ,,	0.56 ,,
+12	16 ,,	0.8 ,,
+14	25 ,,	1 ,,

Practical Television Construction—3

In This Concluding Instalment the Question of the Layout is Considered

By W. J. DELANEY (G2FMY)

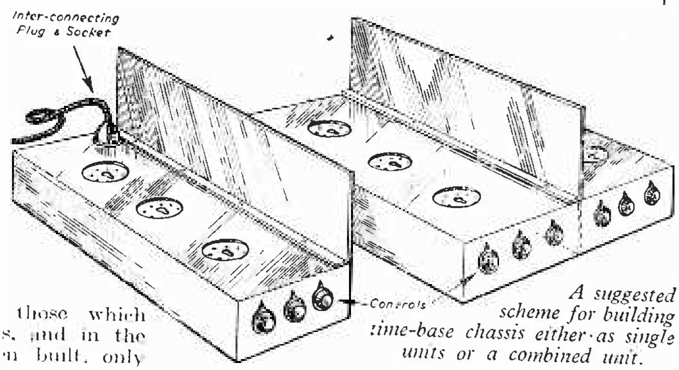
SO far we have covered the main features of the principles of the practical television receiver, and all that now remains is to decide upon what style the finished set is to be built. Although the type of circuit will play a part in this final consideration, it is not an important one, and, generally speaking, practically any of the modern types of circuit can be accommodated in any desired form of layout. Probably the only main consideration in deciding upon a layout is the question of accessibility. After being constructed the receiver has to be set up, by which is meant that the time bases must be adjusted to give the desired type of output, and the receiver(s) must be accurately lined up. Together with this main question is that of daily adjustment, or, to put these two points into one phrase, one might say that the layout must be arranged to have manual and pre-set controls.

Screening

The only other point of importance in deciding upon the layout is that of screening. It has already been pointed out that interaction between the line and frame time bases cannot be permitted. Similarly, on the receiver side it is imperative to keep vision and sound signals in their respective channels. So far as the latter point is concerned, much may be done with circuit design, and screening is not quite so important as it is with the time bases, where circuit filters are not easily arranged. The next point is that of housing the complete equipment. There are no ready-made cabinets available to the home constructor, and the total layout of a modern television receiver (including the power pack(s) and loudspeaker) takes up quite a bit of space, so that the cabinet will be on the large side. As the question of accessibility of certain controls is bound up with cabinet design, our task is simplified. Experience with a home-built receiver has shown that although certain controls may be put at the back of the set, as they are theoretically only needed for the initial setting up, ageing of valves, resistors and other components call for their adjustment at somewhat frequent intervals. Like many wireless receivers, however, slight deterioration from week to week is not noticed, and it is only by comparison or re-adjustment that one realises that there has been a falling-off in results. To avoid removing the back of a cabinet or the use of a mirror when making adjustments, therefore, it is recommended that ALL controls be on the front of the chassis. To avoid an unsightly appearance in the finished receiver, however, it is possible to hide those which come under the heading of pre-sets, and in the experimental model which has been built, only two controls are visible on the cabinet front.

Controls and Layout

Among the pre-set type of control are all the time-base adjustments, all the radio circuit trimmers and, in most parts of the reception area, the sensitivity or "contrast" control. It has been found that once this has been adjusted for the particular aerial system in use, and local reception conditions, there is no need to touch it unless some change in these conditions takes place. It will thus be seen that the only panel controls are those associated with the C.R. tube itself, and are the bias or "brilliancy" control and that which adjusts the focus. There is no means of mounting these on the tube so that they are in effect "floating," which is all to the good, as they may then be put at any convenient place on the cabinet front. In general the lengths of the leads to these two controls are not critical and they may be up to three feet long, whilst those feeding the tube base may also be up to that length provided they are of suitable size where current is passed, and, in the case of the E.H.T. lead, are of adequate insulation. A length of standard car ignition cable is ideal, and may be bound up with the rest of the leads without risk of breakdown. It will therefore be seen that the final layout resolves itself to a C.R. tube assembly which may be mounted at a suitable height in the cabinet (or if sufficient height is not forthcoming, at an angle to make viewing comfortable) and below that the rest of the equipment, setting it back from the cabinet front and providing on the cabinet front a hinged or easily removable flap which conceals all of the controls. The two tube controls above referred to may then be placed either one on each side of the tube mask, or below it as individual tastes dictate. The tube should be mounted in a wooden cradle, using for the front one of the special rubber masks as supplied by Messrs. Long & Hambly, the front of the mask being covered with a sheet of plate glass, at the corners of which suitable clamps



A suggested scheme for building time-base chassis either as single units or a combined unit.

may be mounted to hold the tube rigid and safe from damage.

Chassis Arrangements

The two time bases may be built on standard receiver chassis which can afterwards be placed side by side with a vertical screen between them, as shown on p.157, or on a single large chassis with a vertical screen running along the top and on the underside to separate the two sections. The advantage of the latter arrangement is the saving of inter-connecting plugs and sockets, and the disadvantage is that of making separate modifications to either base. An exactly similar state of affairs exists with regard to the receivers, although again the vision section being so critical and so adaptable for experimental schemes that it is preferable to have it as a self-contained unit. Thus the final assembly will consist of either four chassis, arranged side by side with vertical screens separating them, or two double-bank chassis, a power pack or double pack if it is decided to keep vision and sound separate, a loudspeaker unit, and a C.R. tube unit. Such an arrangement is ideal for laying out on the test bench for test and initial setting up, is easily arranged in a normal type of console cabinet, and may easily be modified at any future date should changes in the transmission system call for it.

All that remains is to decide what circuits to adopt for the time base. There are the two main alternatives already mentioned, i.e., gas-discharge or hard-valve circuits, and there are so many schemes that constructors will no doubt have their own ideas as to what is most suitable.

Home-made Pick-up

Constructional Details of an Efficient Instrument with Carrier Arm

By R. L. G.

THE gramophone pick-up about to be described was constructed with simple materials from a radio spares box. Whilst results equal to commercial instruments were not anticipated or obtained, this little pick-up gave a very good performance indeed and took but a few hours to construct, with the added thrill of something home-made that works really well.

As will be seen from the illustrations the instrument was built around that excellent little Eclipse pocket magnet, now readily obtainable from most ironmongers or electrical suppliers. This magnet, although so small in size, retails at 2s. and is exceedingly powerful, and is supplied as usual with a short, soft iron bar "keeper." It was noticed that two of these keepers could be utilised as extension pole pieces between which an armature might be arranged to produce a pick-up.

Full details are given in the drawings of both construction of the parts and assembly of the pick-up head, and the simple swivel arm for using the pick-up with any normal 9in. turntable.

General Design

The pick-up head itself is electromagnetic in nature and consists merely of a small armature wound with two layers of fine-gauge enamelled wire. This armature floats between the extended poles of the Eclipse magnet.

The separate parts and their assembly as a whole are shown in Fig. 2, the several parts being further numbered 1 to 8 for easy reference.

Fig. 3 shows the pick-up mounted on the simple arm, full dimensions of the latter being given. Fig. 1 gives full dimensions of the pick-up parts as made by the author. Sketch No. 1 in Fig. 2 shows how the Eclipse magnet and two keepers

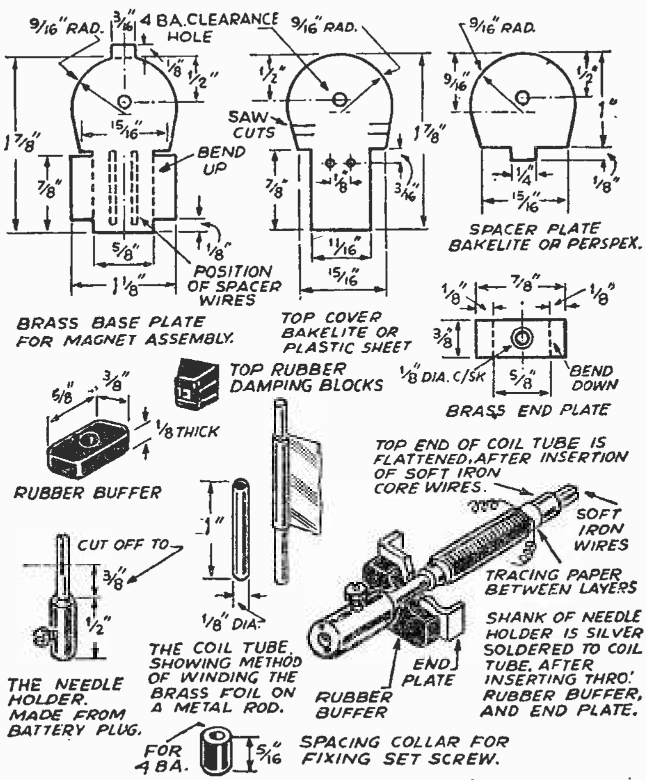


Fig. 1.—Main features of the pick-up.

are arranged to give two extended poles approximately 7-8in. long. These keepers might, of course, have been substituted by short lengths of mild steel bar material of suitable cross-section. As it was not found possible to arrange for any fixing screw holes without resulting in injury to the magnet a bottom supporting base and top spacing plate were made to keep the magnet assembly perfectly rigid. This was found very necessary, as the magnet is a very powerful one and the extension pole pieces naturally tend to come together if suitable support is not provided.

The base plate (Sketch 2) was made from fairly stout gauge sheet brass (non-magnetic) and was arranged with two side pieces, bent up, to act as outer supports for the pole pieces. Also, a small lug was bent up at the back. This was to keep the magnet itself positioned, but it was found that when the whole assembly was clamped together by the fixing set-screw the magnet was quite firm and the lug was really unnecessary.

The side supports were arranged to be short by ⅛in. at the front to allow for the armature end-plate.

The Armature

The two keepers were next placed against the side pieces and two short lengths of 16 s.w.g. tinned copper wire were placed against the inside bottom faces of the keepers and soldered to the base plate.

These space the keepers at the bottom. It was found that with the keepers assembled on the magnet (as shown in Sketch 1, Fig. 2) the distance between faces of side supports required was ⅝in. inside, and the pieces were bent up to give this required measurement.

A clearance hole for the 4 B.A. set-screw was drilled ¼in. from the top circumference of the base plate, and the similar holes in both top cover and spacing plate were made to coincide with this.

The several parts made for the armature are shown in Sketch No. 3, whilst these parts are shown assembled, complete with the winding, in Sketch No. 4.

The construction for this important part was as follows: A brass end-plate was first made from stout sheet brass having a countersunk hole in its exact centre and with ¼in. flanges, ⅝in. apart. The hole was intended merely as a centring hole, the shank of the needle holder passing through it, but by means of the rubber buffer and countersunk hole free play was possible for the armature.

The ⅛in. thick rubber buffer was cut from a rubber tap-washer, the hole in it being arranged to present a tight fit on the shank of the needle holder.

Needle-holder

For the needle-holder the metal part of an ordinary battery plug was utilised with the pin cut off to ⅜in. long. Although the hole in this type of plug was found slightly larger than required for the normal gramophone needle the original set-screw was found effectively to grip the needle without the necessity of fitting any sleeving.

The coil tube, or cylinder, was next constructed. This consisted of a 1in. wide strip of the thinnest brass foil obtainable, the foil used being not much thicker than ordinary writing paper. A rod, of similar diameter to the shank of the needle-holder, was chosen and the foil wrapped around it until a tube 1in. long by not more than ⅛in. external diameter was obtained. The foil was then cut off and the seam carefully soldered, the resulting tube being then slipped off the rod.

The needle-holder was then passed through both rubber buffer and the brass end-plate, the end of the coil tube pushed on to the shank and sweated thereto. Care was needed to avoid the solder running on to the end-plate, and to prevent this a thin piece of aluminium, arranged with a small slot, was inserted, being withdrawn after the soldering operation was completed.

The Winding

This consisted of two layers of 38 s.w.g. enamelled wire, close wound, with thin tracing paper both over the brass tube itself and between the two layers of the winding. No holes were drilled for the ends of the winding. The start was merely anchored by lapping back one turn. After completing one

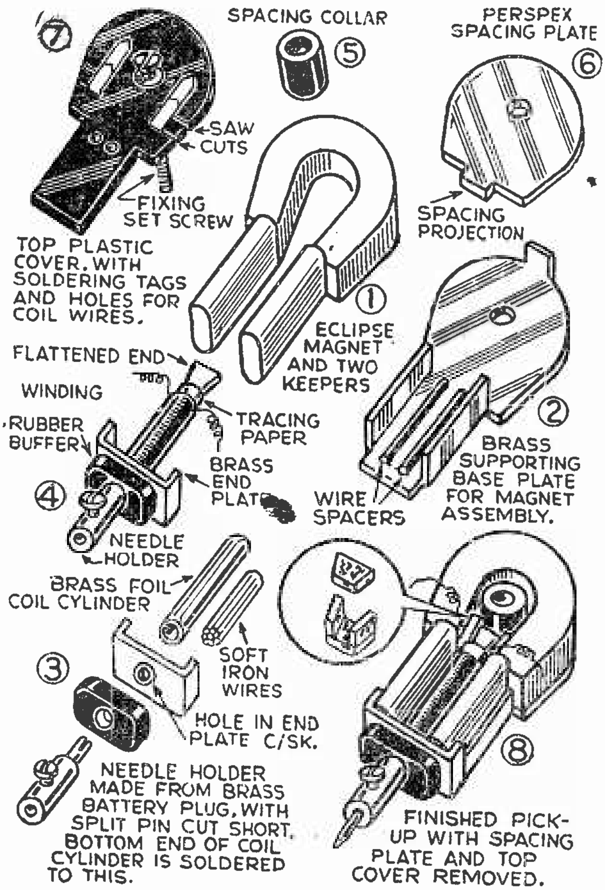


Fig. 2.—Main assembly details.

layer some shellac varnish was brushed over the turns and allowed to dry. A piece of the thin tracing paper was next wrapped round and the second layer of wire wound on, this layer also being treated with shellac varnish. The varnish was found effectively to keep the turns in place, and no binding for the end was found necessary. On completion of the winding, a small bundle of soft iron wires, each 11/16in. long, was pushed into the coil tube and the end of the tube carefully flattened by use of a pair of flat-nosed pliers. This procedure not only sealed the core but, when sandwiched between the top rubber damping blocks, prevented the possibility of rotation of the armature when fitting a needle, and the resulting severance of the wire ends of the coil. A part section of the armature is shown in Fig. 1, which shows the iron wires of the core partly inserted.

The spacing plate was next made from 1/16in. thick Perspex. It was made with a small projection, the purpose of this being to lock the pole pieces at the top. The pole pieces, when assembled as shown, were found to be 1/16in. higher than the thickness of the Eclipse magnet, which was the reason for selecting 1/16in. thick material. The lug piece could have been made to the full length of the pole pieces if suitable holes were drilled for the coil wires.

The spacing plate is shown in Sketch 6, Fig. 2, and the dimensions in Fig. 1. The spacing collar, Sketch 5, was made from the plastic casing of the battery plug and was cut 5/16in. high, this being the thickness of the magnet. A top cover was next cut out of bakelite sheet, as shown in Sketch 7, with holes for the coil wires and fixing set-screw. The simple form adopted for the soldering tags is shown in this view. Two saw cuts were made at each side and two strips of brass foil passed through, bent over and soldered on top.

The magnet assembly was next mounted on the base plate, together with collar, and with one of the wedge-shaped rubber damping pads in correct position. These rubber damping pads were cut from very soft india-rubber.

The complete armature was then carefully pushed on to the pole pieces, and the remaining damping pads placed at the sides and top respectively.

The top spacing plate was next placed in position, taking care that the lug projection fitted between the pole pieces. Finally, after carefully threading the wire ends of the coil through the holes in the top cover, allowing some slack for the wires inside, this cover was placed in position and the fixing set-screw passed through the whole assembly and securely fixed by its nut. The two ends of the winding were then bared and soldered to the tags.

Quite a simple swivel arm was constructed, as shown in Fig. 3. The arm was made from thin sheet aluminium, the sizes given being for a 9in. turntable.

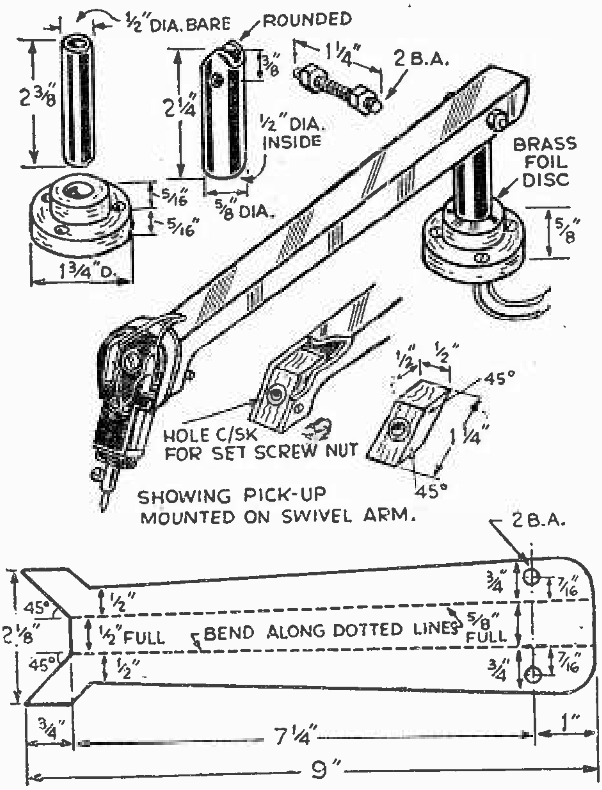
The small wood block was shaped to give the pick-up an angle of 45 degs. with the turntable. This block was drilled with a countersunk hole to accommodate the fixing nut of the set-screw, a further nut being used to clamp the pick-up to the block in the arm. The 4 B.A. fixing set-screw was found to be 1¼in. long.

Two short lengths of paxolin tubing were used to make the swivelling pillar support for the arm. The inner tube was a nice sliding fit to the inside of the outer tube. This inner tube was forced into the end of part of a wooden bobbin, cut to size with the hole itself enlarged for this purpose. Three fixing holes were drilled in the flange.

The outer tube was drilled right through at the top to take the short pivot, this being made from a 1¼in. length of 2 B.A. screwed rod.

A thin disc of brass foil was inserted between the bottom of the outer pillar and the base in order to give a smooth swivelling motion.

When tested and found quite satisfactory, the brass end-plate of the armature was soldered to the base plate for added rigidity. A length of flex was then soldered to the two tags and passed through two holes in the front end of the pick-up arm and through the inside of the rear pillars, for internal connection to the amplifier. It was found preferable to use a matching transformer of approximately 1-50 ratio with this pick-up, and a loudspeaker matching transformer was utilised for this purpose, the flex from the instrument going to the primary.



ALUMINIUM SWIVEL ARM, CUT FROM ONE PIECE

Fig. 3.—Carrier arm details.

Transmitter Technicalities—2

In This Article DYNATRON Concludes His Discussion on the Load Impedance Conundrum

THE details given last month show that we cannot consider the valves separately. A sine-wave of E.M.F. is induced in the *whole primary*. Since it is a sine-wave it must be *a continuous function of time*—there is nothing "intermittent" about it. When we make a detailed analysis of the circuit and current waveform on this basis, nothing like auto-transformer principles exist. Each valve is not supplying *A.C.* power intermittently. The whole circuit has to be considered, when it boils down to a case of two resistances in series.

Every push-pull arrangement must be the equivalent of a series circuit, where the true A.C. resistance in each half is *one-half* of the total anode-to-anode resistance, exactly as in Class A. The mean power supplied by each valve is one-half of the total mean power from two, and, at half of the total primary voltage, this demands an A.C. load resistance per valve of half the total.

Whence, then, the quarter value which each valve actually sees? My last piece of argument seems to contradict flatly the main thesis we set out to discuss. I started by saying it is perfectly true that each valve in Class B feeds into one quarter of the anode-to-anode load (see the text-books). Almost in the same breath I am now apparently saying the proportion is one half!

It is a little confusing—because both statements are true. From the point of view of a pulse current (but sine-wave voltage) a pulse load of one quarter of the anode-to-anode load has to be considered—we shall see in a moment why. But in reckoning the true A.C. power (note carefully the qualification "*A.C.*") output, only one load value can possibly give the correct answer—*one-half*, and not one-quarter, of the anode-to-anode resistance.

You can use the pulse load value in calculating power output. If you do, you will have inserted various substitutions in your formulæ which bring you back to the proper A.C. load value all the time! You are using expressions for the power content of a sine-wave, not a pulse, and you will really be using one-half, and not one-quarter, for resistance.

For calculating average A.C. power output, we must use the fundamental load, not the pulse load, otherwise we will arrive at queer results such as the conclusion that each valve is supplying the same output as two!

The Solution

Thus, for all practical purposes other than when we are dealing with the valve pulse, a load value of one-half the anode-to-anode load must be taken in Class B push-pull, exactly the same as in Class A. Yet, a valve load line will exhibit the one-quarter value!

When arguments were raging concerning this one-quarter figure, I observed a curious fact which had been entirely missed in the search for involved explanations. It was remarkably simple—nothing but Ohm's Law, in fact. Moreover, it had nothing to do with push-pull, or any auto-transformer action in the output circuit.

To get the problem into its simplest terms, I made use of a single valve, in R.F. Class B, as in Fig. 2a. As said earlier, with a resonant load of this type the output voltage developed across the L.C.-circuit will be sinusoidal, the valve delivering half-wave pulses of current.

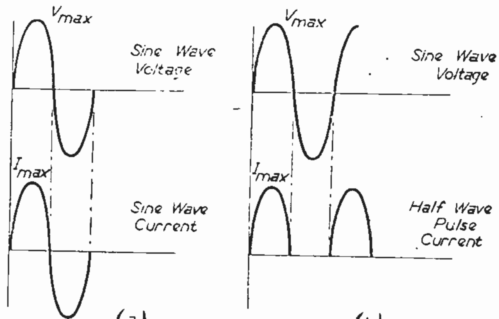


Fig. 4.—In an ordinary A.C. circuit, (a), V/I = a Resistance, R = Vmax/Imax, where V and I are R.M.S. values, and Vmax and Imax peak *values. If the voltage is a sine-wave, but the current intermittent half-waves as in (b), does Vmax/Imax still mean the resistance R? Actually, it is a* pulse load *value.*

Now, it is well known that a resonant circuit has a certain *dynamic* A.C. resistance, as measured, for example, by suitable gear supplying a sine-wave current. Suppose this is 1,000 ohms, in Fig. 2a. Since this 1,000 ohms is a pure A.C. quantity (existing only with respect to a sine-wave voltage and current), there is no reason whatever for supposing the resistance to be 1,000 ohms to a pulsating current! In fact, a little reckoning showed it was utterly impossible.

Thus, suppose this Class B stage was supplied with H.T. at 200v. The output from the particular stage I have in mind may be taken as 10 watts approximately, which requires a peak emission from the valve of something like 280mA., i.e., the peak instantaneous value of the pulse supplied by the valve must be 280mA.

For 10-watts output, load resistance 1,000 ohms, we require a *peak* sine-wave voltage of 141v. across the tank circuit, which is some 70 per cent. of the available H.T. For higher conversion efficiencies, it would be possible in many cases to drive the stage harder to utilise 80 to 90 per cent. of the H.T. as peak alternating volts across the tank load. But, the available peak volts cannot exceed the H.T.—we can only drive a stage to convert as much as possible of the D.C. volts into alternating volts across the load.

Yet, if the load looks like 1,000 ohms to a pulse current peak of 280mA. (0.28 ampere), Ohm's Law tells us there must be $0.28 \times 1,000 = 280$v. peak across the load—exactly twice the true figure of 141v., and 80v. more than the total available H.T. !

It cannot possibly be true, of course. In relation to the pulse peak of 280mA., the load cannot be 1,000 ohms, but exactly half this resistance=500 ohms. The peak A.C. volts will then work out correctly at 140v. approximately, i.e., $0.28 \times 500 = 140$v. The valve sees, not 1,000 ohms, but a pulse load of 500 ohms.

But, again, you would have to be careful in using this 500-ohms figure to estimate the power output. If you supposed that a sine-wave voltage of 140v. peak exists across 500 ohms, you would be quite wrong. You would get an answer of 20 watts—exactly twice the mean output our valve is supplying—thereby concluding, as some people did, that if you used two such valves in push-pull each is delivering 20w. ! The right answer of 10w. is got by making use of the fundamental load of 1,000 ohms.

We have seen that in a single-valve stage the pulse load is one-half of 1,000=500 ohms. In push-pull, the total anode-to-anode load would be twice 1,000=2,000 ohms—or the fundamental load per valve is one-half of the anode-to-anode load. But, the pulse load which the valves alternately see is, 500 ohms=one-half of 1,000 ohms, but one-quarter of 2,000 ohms.

The figure becomes one-quarter simply because one-half is the correct ratio of the fundamental load values in push-pull. As we have seen, the pulse load with a single-valve in Class B is one-half the nominal A.C. resistance of a resonant tank circuit. It then follows at once that it will be one-quarter of the total A.C. resistance if another valve is added in push-pull.

First Harmonic Current

The 500 ohms is a direct consequence of the fact that in Class B the peak current must be pushed (i.e., must *change*) by twice the amount that would be necessary in Class A for the same output.

The same 10w. output could be got in Class A by a peak A.C. amplitude of only 140mA., instead of 280mA.—though at a much poorer conversion efficiency. To obtain this output from Class B, we must push up the peak current to 280mA. —exactly twice the amplitude of the corresponding sine-wave current in Class A.

This may be stated another way. Pulsing the output circuit by a half-wave current is *exactly equivalent to energising it by a sine-wave current of half the amplitude of the pulse current.* In fact, our pulsating waveform is a complex type, made up of a number of *even harmonics*, which are pure sine-waves. One of these, the *fundamental*, or *first harmonic*, can be proved to be one-half the peak value of the pulse. Thus, to get a "fundamental" of the same peak as the sine-wave obtained from a Class A amplifier, we must drive a Class B stage to a pulse peak of twice the fundamental peak desired.

The fundamental (sine-wave) volts are developed solely by the first harmonic current—which sees 1,000 ohms in Fig. 2a. But as the pulse current goes up to twice the first harmonic peak current, the pulse load will appear as one-half of 1,000 ohms, as above.

Text-book References

The following seem to be the two principal works which give the pulse load as one-quarter (anode-to-anode) load for the Class B push-pull audio-frequency amplifier :

Radio Designer's Handbook. Edited by F. Langford Smith (Iliffe), p. 17.

Radio Engineering. F. E. Terman (McGraw-Hill), p. 311, Eq. (164)—see also footnote to p. 310 giving derivation of this equation.

I hope to consider in detail these and other formulæ in a later article. One thing should be clear from our present discussion. Both writers make use of the peak *pulse* current, denoted by "Imax." When divided into the peak *alternating* volts, this necessarily gives the pulse load value—which is what may be called the "apparent load" each valve sees in relation to voltage and current swings.

An interesting point which arises in this connection is whether the ratio *voltage/current* expresses any real "load resistance" at all, when the waveforms are so different ? Imax is the peak value of a half-wave pulsating current, whilst the peak voltage Vmax is the maximum value of a sine-wave. Are we entitled to write, Vmax/Imax=R—a physical resistance—under such conditions ?

As seen, the pulse load value is a direct result of doing this. The equivalent alternating current is only one-half the amplitude of a pulse. It is one of the questions we must defer for further consideration.

It may be thought the thing is too obvious (once explained !) to warrant any text-book treatment or article. All I can say is that it is by no means "obvious" if, as actually happened, the pulse load is used for calculating power output, and the fallacious result is described as a "pulse power !" Text-books, at least, might be expected to touch upon fundamental principles of this kind.

Radio Data Charts

"RADIO Data Charts," by R. T. Beatty, M.A., B.E., D.Sc., revised by J. McG. Sowerby, B.A., Grad.I.E.E. Fourth edition, second impression. Published by Iliffe & Sons, Ltd. 93 pages—44 abaci. Price 7s. 6d.

First published in 1930, this collection of nomograms is a standard work of reference for radio receiver designers—professional and amateur. It reduces the labour of calculation in upwards of forty routine design problems and obviates possibilities of error in the interpretation and application of formulæ.

The subjects covered range from the design of RF coils and transformers to the calculation of loudspeaker dividing networks and include problems relating to parallel-wire coaxial and quarter-wavelength transmission lines.

Each chart is accompanied by an explanatory introduction and worked examples, and the student will find the charts an invaluable adjunct to the ordinary text-books on radio engineering.

Programme Pointers

In This Article MAURICE REEVE Discusses Musical History

THE B.B.C. has just commenced what promises to be a memorable event. For the next three years the Third Programme is going to put over a "history in sound of European music from mediaeval times to the present day." Three years, even in these days of kaleidoscopic and world-ranging change, is a long time. And many are the farmers, industrialists and Cabinet Ministers who would like to be able to plan, successfully, for that time ahead. But don't let it deter you: after all, I am quite sure that thousands among my readers have gone so far as to fix their social and domestic lives for much longer than that, solely to listen-in to Itma, Twenty Questions or even Dick Barton at their fixed and immovable times. If, and there is not the slightest reason to suppose they won't, the compilers of the venture have the knowledge, research and initiative called for by such an undertaking, then it should be of outstanding delight and absorbing interest.

Music is known to have been practised from time immemorial. All the classic writers tell of it, whether it be the chanting that accompanied pagan rites and sacrifices or the single line of notes performed on a solitary reed in ancient drama. That none of it has been preserved for us as the other arts of those times have is our loss. The important thing to note is that it was there, alive in some sort or another, performed and listened to. Obviously it was not reduced to a language and made recordable and preservable until long after the spoken word.

Limited Knowledge

Yet the knowledge of all but the pedagogue or specialist covers little outside and beyond the last three hundred years of musical history; very few know hardly anything that was written before 1648 and a large number anything created in the last twenty-five years, that is, since the major works of Sibelius, Strauss, Debussy, Ravel and Elgar were accepted.

It has been proved, conclusively and beyond a peradventure, that music has not only passed through many cultural periods based on various systems of scale and harmony, all resulting in several and opposing ascetic conceptions, but that all have passed away and given place to the new -- hideous—music of its day. That the symphonic diatonic conception of the last two hundred and fifty years will also go the way of all things is also generally accepted as being inevitable. Whether this is to be lamented or otherwise does not come within the scope of this article.

I have just said that most of us are only acquainted to any extent with the music of the last three hundred years. One might limit it to much less than that and confine it to the period between the birth of Bach and Handel, both in 1685, to the death of Elgar, in 1934—250 years. That is the period we are regaled with at 99 out of every 100 concerts and recitals we attend or listen-in to. Little bits of Purcell or Monteverdi (pre 1685) or Bartok or Martinu (post 1934) make no odds. Very broadly and briefly speaking, we may say that, although our familiar musical alphabet and grammar were well established before Bach and Handel, it was these two giants who clamped down on them and who, in a series of masterworks, idolised to this day, which took harmonic (chromatic) and contrapuntal inventiveness beyond anything ever dreamed of before, moulded our musical thought and speech for the whole of that great period. Beethoven determined the forms and shapes of major musical composition in most branches of the art, notably the symphony. We do not notice any real desire or effort to seek new paths or of discontent with what had flourished for so many generations until Wagner, followed by Debussy and Ravel, started new trains of thought and commenced to look forward rather than to either stand still or look backwards.

Some Landmarks

Tschaikowsky sounds very different from Mozart: so does Brahms from Haydn; but it is only their handling of the same materials that is so different—they all spring from the same parent tree. The landmarks of the last three hundred years are generally admitted to be Bach's "St. Matthew Passion," Mozart's opera "Don Giovanni," Beethoven's 3rd Symphony, Wagner's opera "Tristan and Isolde" and the works of Debussy. These works, in the irrespective spheres, took existing music down channels carved by the composer and plus the composer's idiom and personality. Thus, we say that the symphony to-day is still being fashioned to the laws laid down by Beethoven, or that harmony is still, prior to Wagner and Debussy, largely as Bach used it. Meaning that the same language and rules are being used to-day, as is the case, say, between Shaw and Shakespeare. Wagner and Debussy are among the first to open definitely new vistas, the one with his music dramas, the other with his handling of the whole tone scale which, by the way, he didn't actually invent.

Interest of To-day

To-day—that is to say, this century—we are witnessing the growth of seeds planted quite recently, and of the young cuttings and graftings taken therefrom. As we all know, the reactions on our nervous systems, sometimes even on our faith in music itself, startlingly varies. So much so that I have little doubt that the present overwhelming box office attraction of the hoary old classics is largely a reaction therefrom. But music will continue in labour for some time to come yet and will eventually bring forth someone who will send her art on as entirely a new path as Bach, Handel and their immediate predecessors did. For make no mistake about it; they seemed just as weird, strange and noisy as their experimenting descendents do to-day. Bach was the Bartok of his day, Mozart the Martinu and Schubert the Shostokowitch; the critics of their day are still extant to prove it. And to come nearer to our own day, Wagner was unquestionably the modern Webern and

Debussy the devil himself, so contemporary opinion would have us believe.

It will be the task of the designers of this series of programmes, which, by the way, are limited to half an hour per week, to unfold to us what Bach, Beethoven and Brahms came from, and what two or three of their periodic or stylistic forebears evolved from, the instruments they wrote for, the standard of performance, the atmosphere of the time and many other enthralling topics. The period of time covered by the survey, and the geographical limitation of the area to be investigated, do not embrace music from A to Z. But they should be ample to give us at least as thorough a picture of what any ordinary person wants to know of the greatest of the arts as, say, the Promenade Concert programmes do of orchestral music of the last much maligned two hundred and fifty years.

Do not miss the future broadcasts of the young Italian pianist Michelangeli. Still in his twenties, he combines a technical brilliance with a poetic insight into the music that places him at the head of pianists of his age. His popular "Emperor Concerto" recently—a recording—was wonderful in every way.

Limitation of Peak Loads

THE acute shortage of generating plant, plus increased demands for electric power during the past few years, has necessitated large-scale power shedding all over the country, causing considerable inconvenience to both industrial and domestic consumers alike. Several schemes to relieve this situation have already been introduced, but have proved to be unsatisfactory in that they all involve some departure from normal working hours. The necessity for staggering of working hours can, however, in large measure be obviated by the modern method of controlling consumption by means of a peak load supervisor.

Quite apart from the present-day necessity for the limitation of peak loads, it is frequently advantageous to the power user to restrict his maximum demand. If power is supplied under a tariff which includes a direct charge per kW. or per kVA. of maximum demand, very substantial monetary savings can be made by keeping the maximum load within prescribed limits.

A typical example of the type of supervisor now available may be found in the G.E.C. range of electrical goods. This model, which has recently been introduced by Messrs. Chamberlain and Hookham, Ltd., is capable of giving timely warning to the consumer whenever a pre-selected maximum demand target is likely to be exceeded. At the same time, the period during which an excessive load has been maintained is automatically recorded on a visual type indicator.

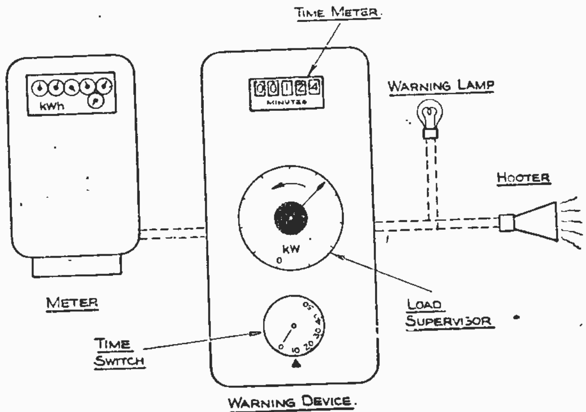


Diagram showing the method of arranging the warning device.

How It Works

The supervisor comprises an electricity meter fitted with a contact-making device, which transmits electrical impulses to an electrically-operated mechanism, advancing the latter step-by-step at a rate proportional to the magnitude of the load on the meter. This mechanism is provided with a scale graduated in kW. or kVA., and an adjustable index which can be hand-set to any desired point on the scale. A timing device is also incorporated, and this disconnects the meter from the step-by-step mechanism at regular intervals of five minutes, and restores the mechanism to its initial position.

During a cycle of operations the meter, which is in series with the load to be controlled, sends electrical impulses to the load supervisor at a rate proportional to the load. Each impulse moves the index progressively from its initial position towards the zero point on the scale, at which position an insulated pin is located. Assuming that the load is not excessive, the index will not reach the zero point within the five-minute interval controlled by the timing element and at the end of this interval the index will be released and will fly back to its initial position to commence another excursion. If, however, the load is above target the index will reach zero before the five minute interval is completed and will make contact with the insulated pin. This contact completes a circuit and operates a warning device consisting of a hooter, or lamp or both.

Warning is not given unnecessarily, but in ample time for effective steps to be taken to reduce the load to the desired limit without the inconvenience of a complete shut down.

Immediately a warning is given, the consumer should reduce the load to within the prescribed limits. The warning continues to operate until the end of the five-minute interval, after which it is switched off and another cycle of operations commences. If necessary, the warning is repeated during the next five-minute interval, and so on until the load is reduced.

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Underneath the Dipole

Television Pick-ups and Reflections. By "THE SCANNER"

TELEVISION fan mail is growing. I hear that the daily post-bag at the Alexandra Palace steadily expands, not with the overnight rapidity of the bobby-sox mail of a new film star (which, alas, frequently decreases equally rapidly), but with the less spectacular growth of public appreciation of work well done. Occasionally the post vans arrive crammed full, but on those days the B.B.C. staff realise before opening the letters that they have televised something that was *not* appreciated. Indeed, on such occasions a goodly percentage of the correspondence verges upon the uncomplimentary, to say the least, and usually starts with " Dear Sir, If last night's entertainment is the best you can do . . . then . . ." and so forth. A discreet veil may be drawn over the later remarks.

The fact is, the highbrows and the ultra lowbrows are dumb and unresponsive until some innocent television producer dares to put before them their pet aversion. They rarely write to the B.B.C. about the things they like, and would probably never take up their pens at all were it not for some particular items which they simply hate!

Close Contact

Television is a friendly medium, giving close contact between artiste and viewer; but let the artiste in front of the Emitron camera become too tongue-in-the-cheek friendly (as a couple of film directors did), too objectionably rude (as a newspaper film critic did), or too dictatorial (as a documentary feature was), then a few hundred viewers will wield a vitriolic pen. Fortunately, the B.B.C. television boys are not intimidated, and it is unlikely that such extremes of correspondence will reduce the programmes to that common denominator of tastes which is itself tasteless.

A well-known impresario recently admitted that he was a fairly regular viewer and was asked his opinion of the programmes. He said: "Pretty dull on the whole, but now and again there is a flash of brilliance which simply cannot be ignored." He still views television, stifling a yawn, no doubt, but tremendously appreciative when that brilliant flash turns up. One man's caviar is another man's tripe.

The News Reel

Before the war the B.B.C. used to televise regularly one or two of the cinema trade's newsreels. But since the war the film people have not been so friendly, for divers reasons, and have banned their products from television. After a great deal of negotiation which proved useless, the B.B.C. were forced to organise their own television newsreel and learn the pitfalls and problems of that highly specialised business themselves. Following a very unpromising start, in which they duly made all the mistakes, the B.B.C. Television Newsreel has settled down into an interesting magazine film with no great emphasis on the news. This, however, is a style of editorial make-up frequently employed by the cinema newsreels during the foggy seasons when their cameras are "grounded." At such times, stock items filmed weeks or months before are brought out from the vaults, a snappy commentary added to give freshness—and another newsreel edition is "put to bed." Since its commencement, the crew making the B.B.C. newsreel have learned to keep their cameras steadier, to record the sound better and to take more care with the cutting scissors. There is still a tendency to cut-in short flashes of close-ups of people's faces in a haphazard manner which is most disturbing. In my opinion, the cutting tempo should be slower than for cinema newsreels, and the choice of cutting places from shot to shot much more carefully made.

Documentary Television

Apart from the usual magazine features, such as "Picture Page" and "Kaleidoscope," there has been an increase in the number of general interest items. Some of these have been of a blunt documentary type, reminiscent of the more dictatorial type of Central Office of Information films. The first edition of "Searchlight" was in this category and was chiefly notable for the embarrassing sight of one of the speakers fainting; otherwise, it proved to be a dull collection of propaganda clichés, served up with a production technique foreign to the friendly medium of television. Documentary material requires very careful handling before the television camera to retain the interest and sympathy of the viewers. I don't think many viewers were enthusiastic about the various discussion group programmes either, of which "Short Commons" was possibly the least attractive. In this, as in all programmes of this type, the arguments advanced are feeble, the chairman has obviously formed his opinion before the discussion takes place and the propaganda motive is thinly disguised. And even the B.B.C. must have taken a dislike to the "Viewers' Viewpoint" series, in which the chairmen encouraged their brains trusts to say what they dislike about television. Unpleasant remarks were passed about personalities who are popular with a large section of viewers. Usually, I hand the B.B.C. television people bouquets each month in this article, but this time, and in this paragraph, I have added a few brickbats to those thrown in "Viewers' Viewpoint."

Bouquets

It is, however, much pleasanter to hand out bouquets than to throw brickbats, and, though these notes will go to press some time before you read them, I think most viewers will remember the items I mention. The television play is a well-established and popular feature of the programmes, and it calls for special qualities in the producer. He must be a man of resource and invention, capable of quick decisions. He must have a thorough knowledge of the stage, of films and of the peculiar technicalities of television. He must, indeed, be a walking phenomenon of the arts and sciences. That is why the regular viewers look first for the name of the producer when deciding what plays or other television entertainment they are going to see during the week. And that is why George More O'Ferrall's name has become so important in this field. Here is a master of smooth continuity, who punctuates the flow of his story by cutting from shot-to-shot with a precision which must be the envy of cinema film editors, who disdains the use of continuous camera trickery and yet is not afraid to use such technical tricks on occasion. His "Hamlet" was masterly and, in a different way, "Quartet" was equally brilliant.

Cliff Gordon leads in the lighter programmes with the witty revues he writes, composes and appears in, and the "Once Upon a Time" and "Twice Upon a Time" series now has many enthusiastic followers. Diana Decker, his leading lady, is a brilliant young comedienne, thoroughly at home before the television cameras, easy to look at and possessing that delicious sense of burlesque which comes over so well. These are all obvious television enthusiasts, confident in their approach to that "bloodthirsty monster," the Emitron camera. These are the people who will be responsible for doubling the number of television viewers during the next six months—unless the B.B.C. blot their copybooks with a lot more "Searchlights."

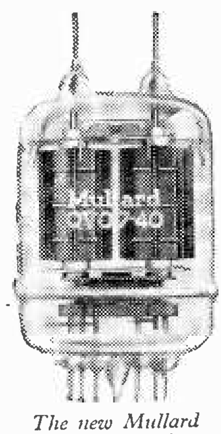
Trade Notes

Stamford Radio Co.

FROM the above company we have received one of the ex-R.A.F. well-known TR/9 transmitter-receivers, which they are offering for £6. As most readers will know, this consists of a transmitter (T.1336) and receiver, the particular combination we have inspected being the TR/9H. The apparatus is intended for battery operation, and is, of course, unsuitable for use without modification, and readers are reminded that transmitting apparatus must only be acquired by holders of the P.O. transmitting licence. Most amateurs will wish to purchase apparatus of this type merely for the components, which in this particular case include two useful meters, one reading 30 mA, and the other being a thermo-couple reading .5 A. There are nine valves in the complete equipment, the receiver section being, of course, usable without modification except so far as the tuning ranges are concerned. The set is simple to operate and very efficient, and this is one of the many ex-Service bargains which are at present obtainable.

Mullard QVO4-7 Valve

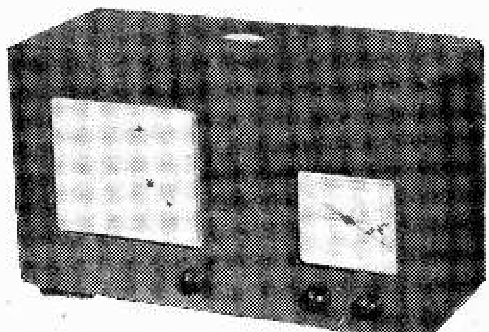
AMATEUR transmitters are now taking greater interest in the very high frequencies, and the difficulty is arising of finding suitable valves for certain purposes. The special Mullard tetrode in this group, and which attracted so much attention at the Amateur Radio Exhibition, is the QVO4-7, which may be used as a master oscillator, buffer amplifier, doubler or trebler up to 150 Mc/s. In the QV range there are also the QVO5-25, which is a direct equivalent of the 807, two double-beam tetrodes, the QVO4-20 (equivalent to the 815), and the QVO7-40 (equivalent to the 819B). The former is capable of giving a C.W. output of about 40 watts and functioning up to 200 Mc/s at reduced ratings, and the latter giving about 60 watts C.W. with a top frequency limit of about 250 Mc/s. Further details of these and other useful valves may be obtained from the Mullard Company.



The new Mullard QVO7-40 Valve

Teleradio "Space Ranger"

THIS is a kit-set utilising a 5-valve superhet A.C. operated circuit costing £8 10s., plus P.T., for the kit of parts. We have had a receiver, constructed from the set of parts, under test for some time, and have found it a very satisfactory receiver, not to be confused with the average type of midget 5-valve superhets. It is a standard superhet, utilising all-wave coils and a valve combination consisting of 6K8, 6Q7, 6K7, 6V6 and 5Z4, with an I.F. of 470 kc/s. Negative feed-back is incorporated in the output stage (from the output side of the transformer), and provision for the use of a pick-up is made. The coil pack and I.F. transformers are supplied correctly aligned and trimmed, but in case they lose their setting during transport, etc., trimming instructions are provided. The ranges covered are 15 to 50, 200 to 600 and 800 to 2,000 metres. Construction is quite simple and the efficiency of the receiver is due mainly to the special coil pack supplied. The makers can supply suitable cabinets, and the accompanying illustration shows the receiver in the satin walnut cabinet, which is supplied for an extra £3 5s. The chassis may be obtained factory assembled and tested for 12 guineas, plus P.T.



The Teleradio "Space Ranger"

Impressions on the Wax

Review of the Latest Gramophone Records

ONE of the highlights of the latest releases is Elgar's "Enigma Variations, Op. 36," recorded by the Hallé Orchestra, conducted by John Barbirolli, on four 12in. records—*H.M.V. C*3692-5. The Variations are dedicated to "my friends pictured within," and these friends are referred to by initials and pseudonyms. Who these people are, or were, is of neglible importance in the enjoyment of Elgar's score: their identity can presumably be traced in biographies of the composer. "Enigma" had an immediate success at its production at the end of the last century, and no amount of repetition has worn it thin.

Rachmaninoff's "Rhapsody on a Theme of Paganini, for Piano and Orchestra, Op. 43," also received a special mention this month and has been recorded by that famous pianist, Artur Rubinstein, with the Philharmonia Orchestra, conducted by Walter Susskind, on *H.M.V. DB*6556-8. This Rhapsody, which consists of twenty-four variations upon the melody of the same Paganini caprice that Brahms used for his Variations, is extremely characteristic of Rachmaninoff's strong personal idiom. It begins with a lively introduction in which the theme is foreshadowed. But before the actual theme appears the orchestra plays, staccato, a skeleton version of it which is in itself a variation of it. Then the first violins, accompanied rhythmically by the piano, give the theme in full. In the twenty-three variations that follow, the composer exploits the resources of the modern orchestra with great skill and, as one would expect, the solo pianoforte part is treated with the mastery of a great pianist.

Vocal Recordings

This month James Johnston selects two arias that have warmed the hearts of countless opera-goers. They are "Your Tiny Hand is Frozen," from "La Bohème" (Puccini), Act 1, and "All Hail Thou Dwelling," from Gounod's "Faust," Act 3. James Johnston's wide experience of operatic singing enables him to handle these songs in the way established by the tradition of the best opera houses; and he is ably backed up by the Covent Garden Opera Orchestra under the subtle directorship of Lawrence Collingwood—*Columbia DX*1455.

"Behold Titania!" is the polonaise in Act II of "Mignon," and joins with the gavotte, the air "Know'st Thou the Land," and the overture being the popular survivals of an opera seldom given nowadays. The polonaise is sung by an actress who has just been playing in the "Midsummer Night's Dream." A brilliant thing, it shows off Gwen Catley's technique to great advantage. The Seraglio aria, "I Was Heedless in my Rapture," is also sung by Gwen Catley on the reverse side of *H.M.V.* 3696.

Peter Dawson's new record—and who has a longer and more popular list of recording achievement behind him?—is well in line with the kind of thing he does best, and he sings, "Gentleman Jim" and "Whalin' Up the Lochlan," with exhilarating gusto on *H.M.V. B*9618. "Whalin' Up the Lochlan" is his own composition, under the pseudonym of "J. P. McCall."

Finally, I can recommend a new Webster Booth recording of "My Dreams" and "Nirvana" on *H.M.V. B*9617, and a delightful recording of the popular "Clair De Lune," sung in French by Maggie Teyte, on *H.M.V. DA*1876. Gerald Moore is at the piano.

Light Music

I start off this section with a recording by Charles Shadwell and his Orchestra of "The Spice of Life" and "Without a Song" on *H.M.V. B*9619. This popular orchestral leader has formed an organisation specifically designed to deal with music to suit all tastes and moods, from the classical through light entertainment numbers to out-and-out swing. He has a full complement of strings, guitar, saxophones, flute, oboe, brass, piano and drums. "Spice of Life" is, of course, the signature tune used by Charles Shadwell with the B.B.C., and now taken over for use with his own orchestra.

The orchestral version of "Hora Stacato" (Dinicu-Heifetz) was scored by an American, Adolf Schmidt, and here, under the able leadership of Sidney Torch, receives a spirited treatment that is entirely in keeping with the tone of the original gipsy piece on *Parlophone R*3084. The concert treatment of "Intermezzo" on the reverse side will make an immediate appeal to those who are familiar with the film success "Escape to Happiness." This new orchestration is noteworthy for its intriguing harmonic structure, and the beautiful performance by the solo violin.

Harry Davidson, expert conductor of dances of an older day, has given a generous selection of truly "evergreen quadrilles" on *Columbia DX*1459-60. He fills the last side of his two records with the attractive "Chrysanthemum Waltz," of Lehar, which carries on the atmosphere and exists happily in harmony with the quadrilles.

Dance Music

This month, Britain's leading "sweet" band has appropriately enough chosen to record a leading tune, for "Near You" is already established as the number one song in America's Honour Roll of Hits. The orchestration, by Geraldo's talented young alto player, Wally Stott, offsets the voice of Archie Lewis, and is taken at slow fox-trot tempo. Soft, muted brass and delicate playing by the sax ensemble are a distinguished feature throughout this recording by Geraldo and his Orchestra on *Parlophone F*2271. "If This Isn't Love," which comes from the recent West End stage show "Finian's Rainbow," is on the reverse side and Denny Vaughan sings the lyric to his own orchestral arrangement.

Yet another melodic composition from the fluent pen of Billy Reid is "A Tree in the Meadow," and this month Joe Loss and his Orchestra have recorded it on *H.M.V. BD*5997.

Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Shoulder-strap Five

SIR,—I have just completed the "Shoulder-strap Five," details of which were given in the December and January issues of PRACTICAL WIRELESS.

Results so far have been fairly satisfactory except that I have had some difficulty in modifying the coils as suggested.

I wonder whether I could get in touch with any of your readers who have constructed this set so that I can exchange experiences on this matter. —N. BOUCHIER, Clifton Restaurant, 16, Regent Street, Clifton, Bristol.

Valve Data

SIR,—Regarding F. L. Medhurst's letter, in your February issue, about Telefunken 612GW the valve line up is surely CY1 or CY2 not AZ1 and would be for 230 volt A.C. mains. CF7 with 13 volt .2a heater, CL4 33 volt .2a, CY1 20 volts .2a or CY2 30 volt .2a and the barretter would be EUVI.

The EUVI could be replaced by a dropper resistance of 770 ohms wired to a valve base.—A. SUTCLIFFE (Bradford).

SIR,—I hope the following data and notes will be helpful to Mr. Medhurst, who wanted information on valves of a Telefunken set.

Starting with barretters first.

The replacement barretter, valvo CIO, IP20 are the correct equivalents of EUVI and EUVII respectively. But since some pins of valvo barretter are internally connected together, precautions have to be taken to see that nothing else is connected to the rest of the barretter base, as is often the case.

The AZ1 is a full-wave directly heated rectifier. Mullard, Phillips and Tungsram manufacture the same type of valve under the same code number, i.e., "AZ1." No change of base is required.

The CL4 is an output pentode. Mullard and Phillips equivalents are CL4 and Tungsram PP34s. Also no change in base connection is required.

The CF7 is a H.F. pentode. Equivalents are Phillips, Tungsram SP13A. Again no change in base is required.—K. COHN (St. Albans).

"Bond-tester"

SIR,—Having recently obtained a "Bond-tester" as used by the R.A.F. during the war, and which is made by "Record." I have been unable to obtain any information about this, even from the makers. I wonder if any reader of PRACTICAL WIRELESS could give me this information, or if there was any way of modifying this instrument so that it could be made useful. It is a moving-coil type instrument with a free swinging pointer and is very well made.—WM. M. MARSHALL 17, Corporation St., Clitheroe, Lancs.

Cathode Follower Amplifier

SIR,—In the February issue Mr. J. Porter (Colindale) states that he built an amplifier with the output taken from the cathode circuit of the push-pull output valves without success and would like to hear from readers who have experimented on these lines.

I have such an amplifier in use which gives great satisfaction when coupled to a three-valve superhet, also of my own construction. It hasn't been used as a gramophone amplifier yet, as I haven't been able to obtain a turntable.

The valves used are as follows: A 6J5 as cathode follower input coupled via a bass and treble tone control to a 6J7 connected as a L.F. amplifier. The volume control is between this valve and another 6J5 as a "phase-splitter," followed by two 6J7s as L.F. amplifiers driving two 6V6s in push-pull with the output transformer in their cathode circuits. The mains transformer gives 350-0-350 at 100 m/A 6 v. 3A., 5 v. 1 A. Nothing special about that!

The special transformer which Mr. Porter's friends recommend is required only when the output valves used are directly-heated triodes, then each valve will require its own C.T. heater winding.

The 6V6s being indirectly heated can use a common heater winding, the cathodes being connected to either side of the O/P transformer primary.

The speaker used is a 12in. Vitavox mounted at the top of a piece of 4ft. × 18in. × ¾in. board standing in a corner of the room. Not an acoustically perfect arrangement perhaps but the best that can be done with present shortage of timber!

If Mr. Porter or any other reader would care for a copy of the circuit I shall be pleased to oblige.—J. JENKINS (Cwmfelinfach, Mon.).

[*We thank all those readers who supplied details of this particular type of amplifier. All others have been passed on to Mr. Porter—Ed.*]

Ex-Service Apparatus

SIR,—I endorse the statements put forward by K. A. Roosenburk that amateurs should attend ex-Government radio parts surplus sales besides dealers.

As most of these dealers are of the "shop in the back street," variety and usually charge according to standing and dress of the potential customer. I think it's about time amateurs themselves found out where to get what the dealers can buy. I suggest that Government surplus supplies be listed and sold through various Army-Air Force centres where from time to time a sale be advertised, then amateurs can "go-to-it," and the profits of the sale be given to Soldier-Airmen funds.

There must be tons of radio surplus lying idle in Government stores and ex-factory stock that could be used by the amateur rather than the dealers' financial use.

A firm I worked for have made quite a profit on Government scrap, buying so much scrap by weight and sorting out the usable stuff, patching up and selling sometimes at original new prices or making £25 on a £5 expenditure, in this case, air compressors up to 200lbs. per sq. in.

Yet I have bought from the same source as my firm or even from the firm by the simple method of buying £1 or £2 of scrap iron with (pre-selected) usable parts comprising it. I am not working for this firm now, but I can still buy scrap iron, so what now, amateurs, you too can get things done if you keep your eyes skinned.—Z. M. E. PREECE (Middlesboro').

A Dealer Replies

SIR,—With reference to the letter of K. A. Roosenburk (Liverpool), February issue of PRACTICAL WIRELESS, and the confirming letter of A. W. Mann, March issue, may I beg your space for my comments from the "other side"?

Because of the many fallacies contained in Mr. Roosenburk's letter, it is evident that dealers did not offer a reply, but now that one of your contributors backs him up, then it *is* time for one of the accused to reply.

Mr. Roosenburk's ideas on business, are, to say the least, quaint. He supposes that an article bought at, say, 3s. nets a profit of 3s. if sold at 6s. He does not take into consideration time spent at sale, cost of removal of goods from site to shop, sorting of usable items from useless, cleaning up, along with the normal overheads associated with the running of a business. All goods purchased ex-M.O.S. are not in resaleable condition and the loss sustained must be redeemed on the saleable items.

Many ex-M.O.S. items are offered at different prices by different firms, but the higher price firms are not necessarily making the highest profit; they may have bought the same item but at different sales and at different prices. Again, a large majority of M.O.S. material is bought by "job line merchants" for pure speculation and the genuine trader must pay their prices if he requires items they have purchased. Often these merchants, with pockets full of money, will overbid genuine radio dealers.

On other occasions "lots" are too big for the smaller trader (as myself); then of necessity purchase must be made via the original buyer, who may be, to my knowledge, a timber merchant, builder, poultryman, scrap merchant, ex-car wrecker, etc., with idle cash to speculate.

Mr. Roosenburk is wrong in assuming that the public do not get a chance to buy direct from M.O.S. Entry to a sale is normally obtained by purchase of a catalogue. The purchase by individuals is restricted by the numbers offered in any particular "lot." He may require one of an item; 50 may be offered or 500.

Prices would, perhaps, be lower if "bidding" was confined to the particular trade or if the items were offered by M.O.S. to bona-fide dealers in the particular item, but what a headache that would be for M.O.S. and auctioneer!

My shop is visited by most of the local "hams," and I have their assurance that my prices are the fairest in town (and, at many times, lower than outside).—WILLIAM A. BENSON (Liverpool).

Cathode-ray Tube Data

SIR,—I would like to add some information to February issue on C. R. Tubes.

V.C.R.97. There are three anodes in this tube instead of two shown.

These three anodes are all brought out to base contacts; A1 and A3 are *not* internally connected, neither is the screen. The missing information is, therefore,

Pin 5 A1, Pin 7 screen. Pin 10 A.3, *not* A1.

It is essential to provide push-pull deflection on x and y plates in order to avoid trapezium distortion and defocusing. It is advisable to couple x and y plates direct to anodes of paraphase amplifier, and to obtain shift by variation of cathode bias on one of these valves, thus avoiding differentiation due to coupling condensers when used, which is bad practice.—W. G. WOOD (Bristol).

SIR,—I wish to point out two errors in "Cathode-ray Tube Data," of PRACTICAL WIRELESS, February, 1948.

The first is in diagram 2—the cathode of the 3 BP1 should be joined to the positive end of the brilliance control.

The second error, which is rather more misleading, states that the V.C.R.97 has a long afterglow. It should read—All cathode-ray tubes, except the *V.C.R.*517 mentioned in the table on page 56, have short afterglow. The V.C.R.517 has a long afterglow.

I would be very interested to hear of others' experience with the circuits in Figs. 3 and 4 of "Cathode-ray Tube Data."—J. C. THWAITES (Whitstable).

Readers' Thanks

SIR,—I wish to thank you for publishing my letter in the February edition of PRACTICAL WIRELESS. Because of this publication, I received dozens of letters, containing many bits of information, circuits, etc. One letter came from a friend in France who, I believe, was an original member of that gallant body of men—the "resistance." I have written to him, and the others, thanking them. Sir, I thank you for your part in assisting me to get my little set fixed up. I am ready to help any other reader with Model 3 Mk. II (B.2) troubles. —PETER P. SKIVINGTON (Enfield).

SIR,—Please allow me to tender my thanks to all your readers who so readily responded to my appeal in last month's PRACTICAL WIRELESS, re connections for sets 19 and 58.—THOMAS WILLS (Sheffield).

OUR COVER SUBJECT

THE Government made some time ago a film entitled "Production Drive." This showed the progress being made in various industries, and among the various factories which were filmed was that of the Philips Company at Mitcham. Our cover illustration this month shows one of the cameras at work filming one of the Philips operatives wiring a standard radio receiver.

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