BUILDING A 4-BAND TRANSMITTER

6D.

The Wireless World

THE PRACTICAL RADIO & TELEVISION JOURNAL

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The Wireless World

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EDITORIAL COMMENT

National Service

Training and Organisation

IN our correspondence columns this week there appear two letters that draw attention to an important point in regard to the service that wireless amateurs—and, indeed, many professionals—might render in time of emergency. The writers of both letters stress, either directly or indirectly, the need for training and organisation. Technical knowledge and proficiency, unless of the right kind, are not enough by themselves.

Most wireless people, and particularly amateurs, tend to be individualists, but individualism is quite out of place in the intricate communication system of the modern defence Services. Team work, precise synchronisation and strict adherence to rules and procedure are essential to a successful wireless service ; there is no room in the National boat's crew for the modern counterpart of the Victorian lady novelist's hero, who "pulled two strokes to everybody else's one." He would be quite as much in the way as the opposite kind of oarsman who could not stand the pace.

Specialised Training

We know that a large number of readers have already offered their services by filling in the National Wireless Register form which appeared in this journal at the beginning of the year. There is reason to believe that this ready response had been greatly appreciated by the authorities, but we now suggest that those who have responded might ask themselves whether their services might not be made more valuable if their present knowledge and experience were supplemented by specialised training, obtained by joining one of the existing Services, or in some other manner. It is the duty of the authorities, in their turn, to see that proper facilities exist for giving such training to those who are willing to devote their spare time to making themselves of greater potential value in the cause of National defence. It is suggested that in this matter the help of existing civilian wireless organisations might well be enlisted ; there can be little doubt that the fullest co-operation would be forthcoming.

Social Tendencies

Television and Decentralisation

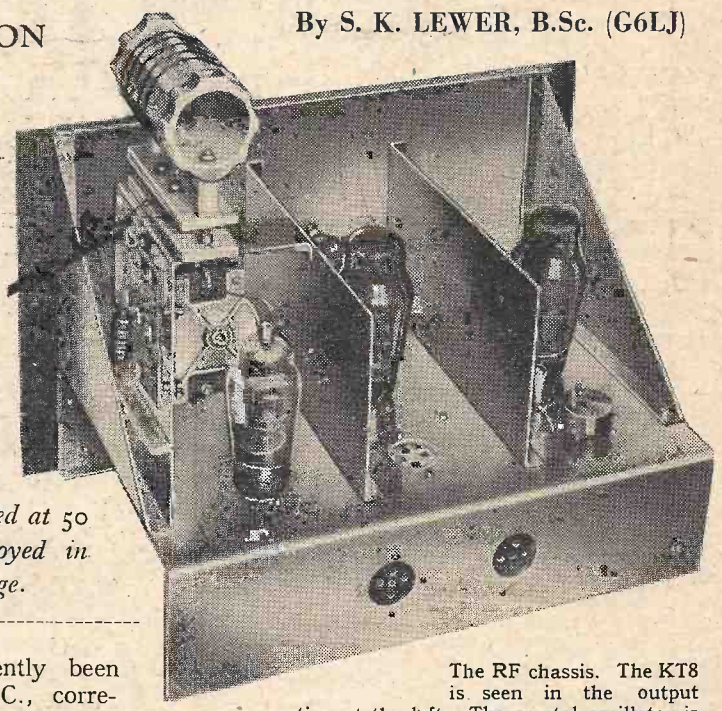
AFTER considering the applications of wireless for those purposes to which, unfortunately, we cannot shut our eyes nowadays, it is refreshing to turn towards its uses in the arts of peace and the cause of humanity.

When Mr. David Sarnoff, President of the Radio Corporation of America, has anything to say on the fundamental implications of wireless he is always worth listening to. In an article entitled "Probable Influences of Television on Society," published in the *Journal of Applied Physics* for July, he says, "With the advent of television a new force is being given to the world. Who can tell what the power to extend vision will mean ultimately in the stream of human life ?" As Mr. Sarnoff sees it, the present tendency towards decentralisation of population will be accelerated by television, which, with sound broadcasting, will provide the principal source of entertainment, education and news to those living in "satellite" areas surrounding metropolitan centres.

Four-Band Transmitter

DESIGNED FOR EFFICIENT OPERATION ON 7, 14, 28 AND 56 Mc/s

By S. K. LEWER, B.Sc. (G6LJ)

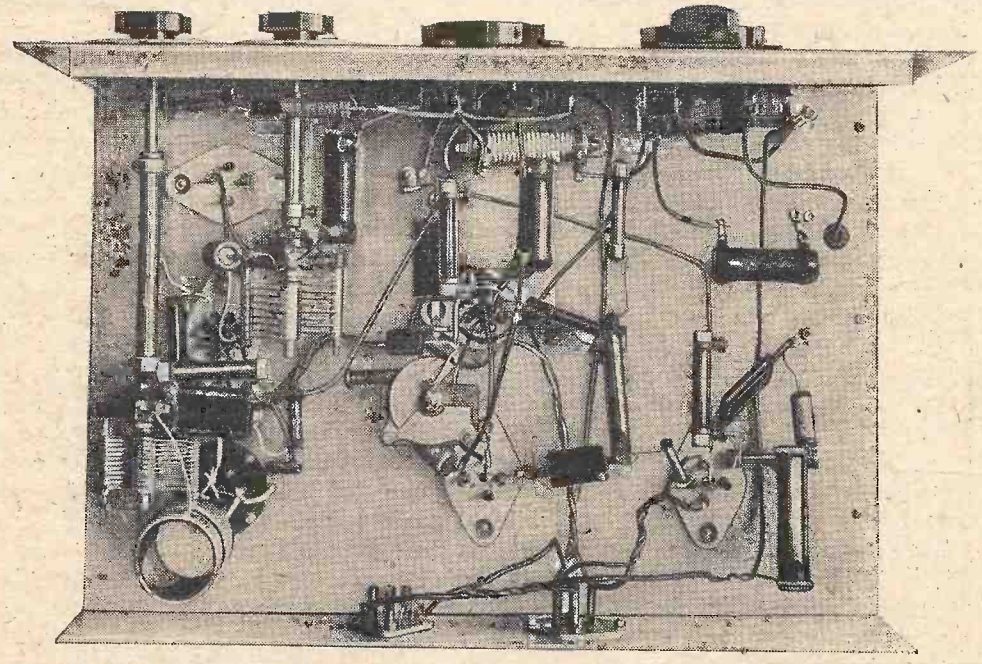


The RF chassis. The KT8 is seen in the output section at the left. The crystal oscillator is located at the opposite end, while the frequency-doubler is in the middle section. The doubler anode coil has been removed from its socket for the sake of clarity. The oscillator anode coil L2 is located between the oscillator valve and the front panel. Note the large aluminium bracket carrying the coil and variable condenser and the special blocking condenser C5.

MULTI-band operation is obtained with this transmitter by using plug-in coils and valves that perform efficiently as frequency doublers. A new beam tetrode, operated at 50 watts input, is employed in the output stage.

WHEN designing a transmitter which is to be efficient, handy, compact and inexpensive, probably the best solution for the average amateur is to adopt the practice, now becoming more and more popular, of having a self-contained transmitter capable of efficient operation on a number of frequency bands. The transmitter described in this article has been found to meet all these requirements, and at the same time it constitutes a reliable driver for a higher power output stage. In itself, however, it is a very efficient transmitter for telegraphy and telephony operation, and the description of it is given from this standpoint.

Briefly, the set is a crystal-controlled, 3-stage, 4-band, CW and telephony transmitter, of rack and panel construction. It has its own power supplies, and no grid bias batteries are required. The maximum RF power output is about 30 to 35 watts at 7 Mc/s, falling to about 10 watts at 56 Mc/s, and British valves are used throughout. The RF stages consist of a KT66 crystal oscillator, a KT66 buffer-doubler, and a KT8 as power amplifier. The modulator utilises two KT66's in Class AB-1, driven by two H63's in a phase inverting circuit. Separate power supplies are provided for the RF section and for the modulator, one U18 rectifying valve being used in each. The KT66 is, of course, the well-known British equivalent of the American 6L6G. The KT8, which has recently been released by the G.E.C., corresponds closely to the American 807 or RK39, but has a standard British 5-pin base. The KT8 has a top anode connection which with internal screening makes neutralising unnecessary and permits an efficient constructional lay-out, especially for 56 Mc/s working. Because the anode lead passes through the top of the valve, there is no disadvantage in the bakelite base with which the valve is fitted, since the losses in this material as compared with a ceramic base necessitate only a negligible increase in the amount of grid drive, even for frequencies in the 56 Mc/s band. The low price of the KT8, which is well below that of the American 807, is low enough to prevent any criticism on the usual ground that British valves are too costly.



Under-chassis view of the RF unit. The tritet cathode coil L1 is seen in the lower left corner, while the oscillator anode coil socket is in the top left corner. The doubler anode coil socket is seen in the bottom centre, with the neutralising condenser located between it and the doubler valve socket in the middle of the chassis. Note the grid and screen stoppers, R13 and R14, fixed directly to the KT8 socket at the lower right corner of the chassis.

Plug-in coils are used throughout, excepting the tritet cathode coil, and the types of formers used can be clearly seen in the photograph.

The circuits of the four separate units which make up the complete transmitter are shown in Fig. 1.

The KT66 crystal oscillator operates with a 7 Mc/s crystal, and is provided with a rather low screen voltage in order to keep the crystal current well below the danger value. Nothing is lost by doing this, since ample drive is obtainable for the following stages on all bands. The oscillator functions as a tritet only when output is required on the 28 Mc/s and 56 Mc/s bands.

"Straight" Operation

The cathode coil is, therefore, short-circuited for 7 Mc/s operation by bending the tip of one of the moving vanes of its tuning condenser so as to touch the adjacent fixed vane at the maximum setting of the control knob, and the second KT66 acts as a buffer and drives the KT8, all circuits being tuned to the same frequency.

For 14 Mc/s, the tritet cathode coil is again short-circuited, while the anode circuit of the second KT66 is tuned to 14

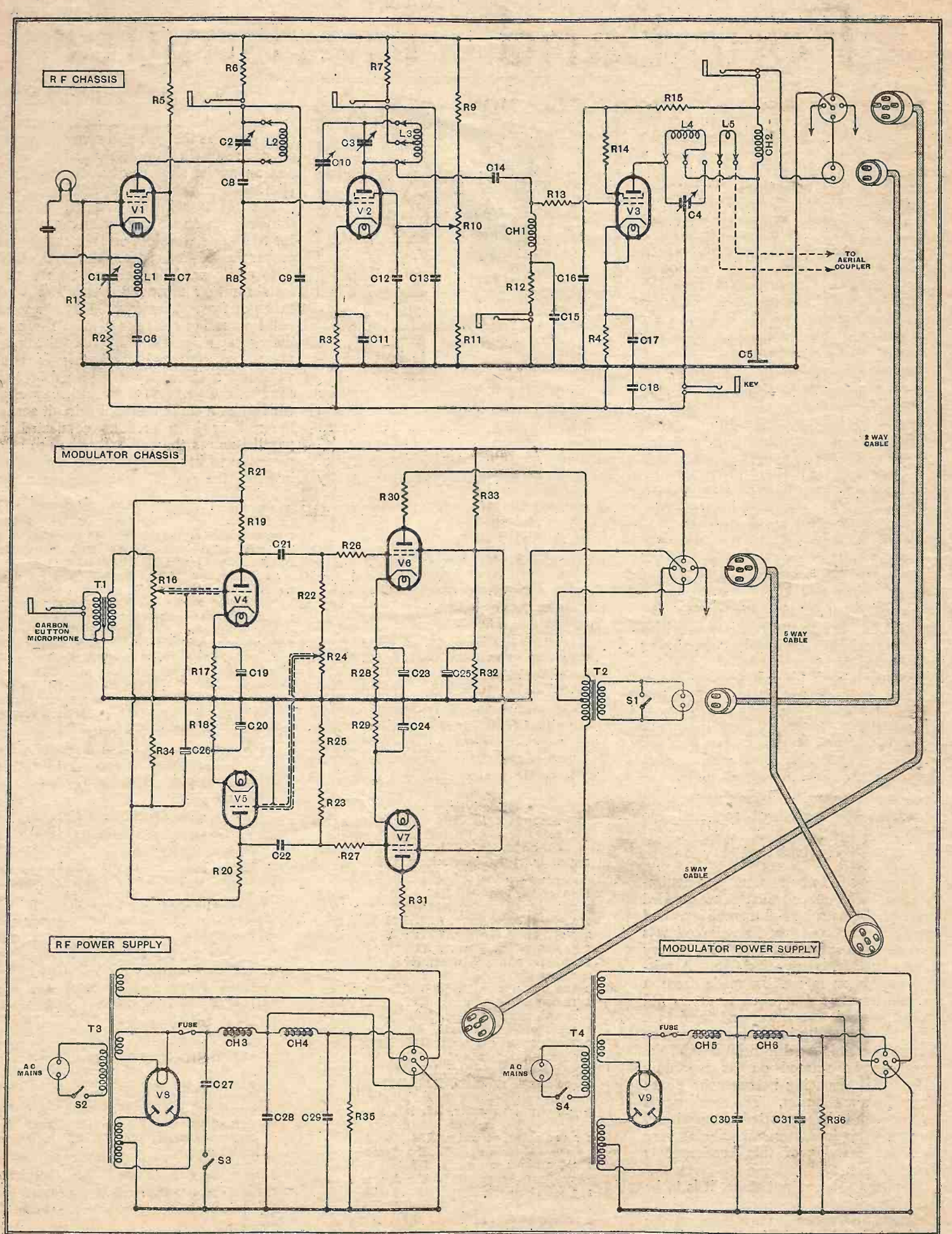


Fig. 1.—Theoretical circuits of the transmitter divided up into its individual units, consisting of RF chassis, modulator and two power supply units. Values of the components can be obtained from the List of Parts in which the circuit references are included.

Four-Band Transmitter—

Mc/s, so that this valve acts as a frequency-doubler. The KT8 gives straight amplification at 14 Mc/s.

For 28 Mc/s the tritet-cathode coil is brought into operation and the oscillator anode circuit is tuned to 14 Mc/s. The second valve doubles the frequency to 28 Mc/s, and the KT8 again acts as a straight amplifier, but with suitably tuned circuits for this higher frequency.

The most satisfactory arrangement found so far for 56 Mc/s operation is to drive the grid of the KT8 at 28 Mc/s and to use this valve as a "power" frequency-doubler. Otherwise, the circuits are tuned as for 28 Mc/s output. Some interesting experiments could be made by quadrupling the frequency either in the oscillator or in the second KT66 so as to have a 56 Mc/s drive available for the grid of the KT8. Since the KT8, however, is an excellent doubler, the arrangement described here may be relied upon to give up to 10 or 15 watts output at 56 Mc/s.

Cathode bias is used in all three stages, and consists of a 500-ohm 10-watt resistance in each case, shunted by a mica condenser of 0.01 mfd. capacity. Grid leak bias is used in addition in each stage, the oscillator having a 50,000-ohm leak R1, while the second KT66 has a 100,000-ohm leak R8 in order to give efficient frequency-doubling. The optimum leak resistance R12 for the KT8 is about 20,000-ohms.

An adjustment for controlling the amount of drive to the KT8 stage, which is rather critical, particularly when using telephony, is effected by a variable potentiometer R10 for providing the screen voltage of the second KT66. This is a 10,000-ohm 5-watt potentiometer, one side of which is connected to earth through a fixed 10,000-ohm resistance R11, while the other side is connected through a 25,000-ohm fixed resistance R9 to the HT line. In this way the screen voltage can be varied between about 100 and 200 volts.

Neutralising

It was found to be necessary to neutralise the buffer stage when it was called upon to act as a straight amplifier, and therefore a centre-tapped anode coil was used for this stage, together with a very small neutralising capacity C10. A suitable condenser is readily made from a single pair of plates taken from an old midget variable condenser and fixed to a strip of high-quality insulating material so that one plate is fixed in position and the other can be rotated on its mounting screw. The spacing between the plates should be about 2 mm. The condenser is light enough to be supported in the wiring, the connecting leads necessarily being very short. A drawing of this condenser is shown in Fig. 2.

Turning to the output stage, it is to be noted that since stable operation with high efficiency at frequencies as high as the 56 Mc/s band is required, all leads carrying RF currents must be as short as possible. With the physical layout adopted in the present transmitter, this is satisfactorily achieved, and at the same time there is no harmful coupling between the grid and anode circuits of the KT8.

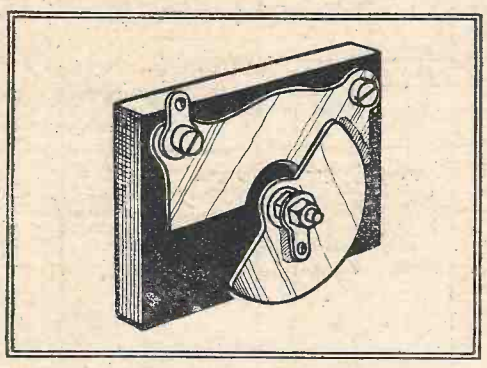


Fig. 2.—Constructional details of the neutralising condenser, which is described in the text.

Neutralisation was found to be unnecessary, even in the 56 Mc/s band.

With a different layout trouble may be experienced from ordinary self-oscillation or from parasitic oscillation. A screen stopper resistance R14 of 100-ohms (1-watt) and a grid stopper resistance R13 of 25-ohms (½-watt) were connected directly at the valve socket pins to suppress a tendency to generate parasitic oscillations. This grid stopper resistance should be kept as low as possible, consistent with stable operation, since the amount of effective drive is reduced as this resistance is made larger. A value somewhere between 10 and 30 ohms is usually sufficient. If the grid and screen stoppers do not result in completely stable operation an anode stopper of about 25 ohms (½-watt) should be tried in addition.

The KT8, being a tetrode, requires simultaneous anode and screen modulation for telephony working, and, of course, for proper modulation characteristics, the L/C ratio of its anode circuit must lie within certain rather narrow limits. The wide range of frequencies covered by the four-band operation calls for a large range of tuning capacity if the L/C requirements are to be observed, and this is conveniently obtained by using a split-stator condenser C4 of 50 + 50 mfd. capacity, with either a single section in circuit across the coil or both sections connected in parallel across the coil. By the use of a three-pin wiring arrangement for the plug-in coils, the second condenser section is

LIST OF PARTS

Variable Condensers:
- 1 50+50 mmfds., **C4** — Eddystone 1081
- 2 60 mmfds. (Microdenser), **C2, C3** — Eddystone 1093
- 1 160 mmfds. (Microdenser), **C1** — Eddystone 1131
- 1 Neutralising condenser, **C10** (see text)

Fixed Condensers:
- 1 Blocking condenser, **C5** (see text)
- 1 0.00005 mfd., mica, **C8** — T.C.C. "M"
- 1 0.0005 mfd., mica, **C14** — T.C.C. "M"
- 1 0.002 mfd., mica, **C18** — T.C.C. "M"
- 1 0.005 mfd., mica, **C16** — T.C.C. "M"
- 8 0.01 mfd., mica, **C6, C7, C9, C11, C12, C13, C15, C17** — T.C.C. "M"
- 2 0.1 mfd., **C21, C22** — T.C.C. 341
- 2 25 mfds., electrolytic, 12 V, **C19, C20** — T.C.C. "FT"
- 2 50 mfds., electrolytic, 50 V, **C23, C24** — T.C.C. "FW"
- 2 8 mfds., electrolytic, 500 V, working, **C25, C26** — T.C.C. 512
- 4 2 mfds., 1,000 V, working, **C28, C29, C30, C31** — T.C.C. 111
- 1 4 mfds., 1,000 V, working, **C27** — T.C.C. 111

Resistances:
- 1 25 ohms, ½ watt, **R13** — Erie
- 1 100 ohms, ½ watt, **R14** — Erie
- 2 1,000 ohms, ½ watt, **R26, R27** — Erie
- 2 2,000 ohms, ½ watt, **R17, R18** — Erie
- 1 50,000 ohms, ½ watt, **R1** — Erie
- 1 100,000 ohms, ½ watt, **R34** — Erie
- 2 250,000 ohms, ½ watt, **R22, R23** — Erie
- 2 100 ohms, 1 watt, **R30, R31** — Erie
- 2 10,000 ohms, 1 watt, **R21, R25** — Erie
- 1 20,000 ohms, 1 watt, **R12** — Erie
- 1 100,000 ohms, 1 watt, **R8** — Erie
- 2 200,000 ohms, 1 watt, **R19, R20.** — Erie
- 1 20,000 ohms, 2 watts, **R15** — Erie
- 1 50,000 ohms, 3 watts, **R5** — Erie
- 2 400 ohms, 10 watts, **R28, R29** — Bulgin AR500
- 3 500 ohms, 10 watts, **R2, R3, R4** — Bulgin AR500
- 1 2,000 ohms, 20 watts, **R33** — Webbs Aerovox 933
- 1 2,500 ohms, 20 watts, **R7** — Webbs Aerovox 933
- 1 5,000 ohms, 20 watts, **R6** — Webbs Aerovox 933
- 2 10,000 ohms, 20 watts, **R11, R32** — Webbs Aerovox 933
- 3 25,000 ohms, 20 watts, **R9, R35, R36** — Webbs Aerovox 933
- 1 potentiometer, 100,000 ohms, **R16** — Erie
- 2 potentiometers, 10,000 ohms, 5 watts **R10, R24** — Reliance "TW"
- 2 RF chokes, 1.25 mH, **Ch1, Ch2** — Eddystone 1010
- 1 smoothing choke, 15 H, 120 mA, **Ch6** — Webbs Radio "Apex"
- 1 smoothing choke, 15 H, 150 mA, **Ch4** — Webbs Radio "Apex"
- 1 swinging choke, 5/25 H, 150 mA, **Ch5** — Webbs Radio "Apex"
- 1 swinging choke, 5/25 H, 250 mA, **Ch3** — Webbs Radio "Apex"
- 1 Quartz crystal, frequency 7 Mc/s, amateur band mounted — Webbs Valpey
- 1 Microphone transformer, ratio 1:75, **T1** — Webbs Radio "Apex"
- 1 U.T.C. Varimatch transformer, **T2** — Webbs Radio "Apex" VM2
- 1 Mains transformer, 550-0-550 V, 250 mA; 6.3 V, 4.0 A, 4.0 V, 4.0 A, **T3** — Webbs Radio "Apex"
- 1 Mains transformer, 550-0-550 V, 150 mA; 6.3 V, 4.0 A, 4.0 V, 4.0 A, **T4** — Webbs Radio "Apex"

Miscellaneous:
- 2 large dials and knobs — Eddystone 1098
- 2 small dials and knobs — Eddystone 1099
- 5 4-pin threaded coil formers — Eddystone 936
- 3 Frequentite coil formers — Eddystone 1090
- 1 Frequentite coil base — Eddystone 1092
- 2 insulated brackets — Eddystone 1116
- 1 adjustable bracket — Eddystone 1007
- 2 Frequentite Octal valve holders — Eddystone 1120
- 1 Frequentite 5-pin valve holder — Eddystone 1074
- 6 Octal Valve Sockets, Paxolin — Webbs Radio
- 3 extension controls — Eddystone 1008
- 4 Frequentite sub-bases — Eddystone 1091
- 6 midget jacks — Peto-Scott P72
- 3 jack plugs, — Peto-Scott P40
- 4 toggle on/off switches — Bulgin S80
- 1 crystal holder — Webbs Valpey
- 1 fuse lamp, 60 mA, and holder — Webbs Radio "Apex"
- Plugs, sockets, inter-connecting cables — Peto Scott

Valves:
- 4 KT66, **V1, V2, V6, V7** — Osram
- 1 KT8, **V3** — Osram
- 2 H63, **V4, V5** — Osram
- 2 U18, **V8, V9** — Osram

Four-Band Transmitter—

automatically brought into use in the case of the lower frequency bands by including a connection from the "hot" end of the coil to the third pin.

The values of inductance, the constructional details of which will be given in a coil specification table, have been chosen so that the capacity necessary for resonance in the four bands is close to the optimum value for producing the best "flywheel" effect of the KT8 anode circuit. It should be borne in mind that if the KT8 is operated under any other conditions but those described here, the optimum L/C ratio may be quite different, and a modification to the coils may be required in order to obtain the best performance.

In Forthcoming Issues

REGENERATION: Up-to-date applications of the one principle that offers something for nothing—or very near it—in receiver design.

STEERING BY TELEVISION: Latest uses of wireless technique in navigation, particularly of aircraft.

With the coils and circuit constants employed in this set and with 50 watts input to the KT8 valve the maximum RF output is approximately 35 watts on 7 and 14 Mc/s, 20 watts on 28 Mc/s and 12 watts on 50 Mc/s.

(To be continued.)

Ferranti 1939-40 Programme

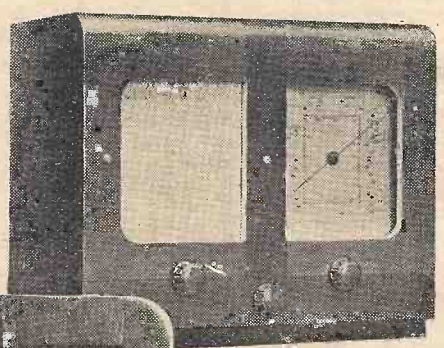
THREE TELEVISION SETS AND FIVE TABLE MODEL RECEIVERS

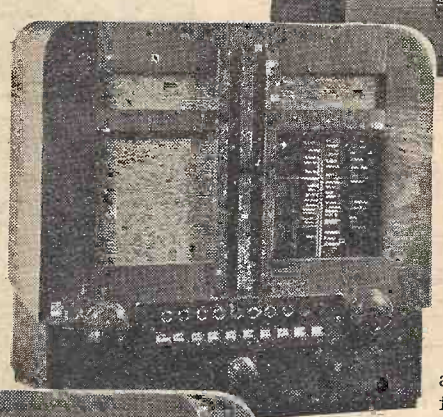
THE new broadcast receivers in the recently announced Ferranti programme are table models. They include a four-valve (plus rectifier) all-wave superheterodyne, Model 139, at 9 guineas, in a moulded cabinet, or 10 guineas in a walnut cabinet with a larger dial (Model 239). A similar chassis is used in the Model 339, which incorporates mechanical push-button tuning.

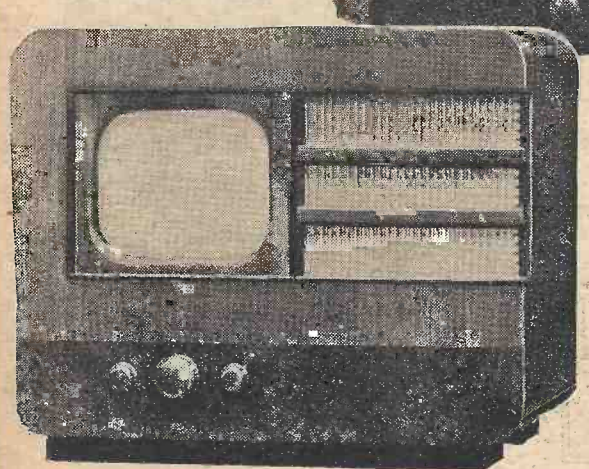
Permeability push-button tuning for six stations is provided in the Model 439 at 12½ guineas. This receiver, in which wave-range and on-off switching is also controlled by push buttons, is fitted with a cathode-ray tuning indicator and a striking three-colour tuning dial in which the appropriate waveband scale is brightly illuminated by a vertical cylindrical lens.

The range of receivers is completed by a four-valve two-waveband battery superheterodyne operated entirely from dry batteries and making use of the latest 1.4-volt valves. The price of this receiver, the Model 539, without batteries, is 7½ guineas.

The chassis which forms the basis of the three television receivers is extremely well thought out from the point of view of layout. All components are accessible and they are very evenly distributed on the underside of the chassis, so that both production and servicing are considerably simplified.







New Ferranti Receivers. (Top) Model 539 superheterodyne for operation entirely from dry batteries. (Centre) Model 439 permeability-tuned push-button receiver. (Bottom) Model T10 table television and sound receiver.

Magnetic deflection and permanent-magnet focusing are employed, and the tube in the 30-guinea table model (T10) gives a picture 7½in. × 6in. In the T8 console, at 40 guineas, which, like the T10, is for television and sound only, the picture size is 10in. × 8in. The range is completed by the Model T9, at 48 guineas, which incorporates a three-waveband superheterodyne receiver in addition to television sound and a picture 10in. × 8in.

The Model 139 is available for immediate delivery, and the remainder of the programme will be released during August and the beginning of September.

Henry Farrad's PROBLEM CORNER

No. 28.—The Missing Volts

An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction :—

Howell House,
Keston.

Dear Henry,

For a new receiver I am building I need a power unit giving 25 mA. at 300 volts. According to *The Wireless World* Valve Data Supplement, the Osram U10 rectifier gives an unsmoothed rectified output of 300 volts at half-current when supplied by a 250-0-250-volt transformer. As the full rated current is 60 mA., it looked as if it would do, because I reckoned that as 25 mA. is a little less than half the full current the unsmoothed voltage would be a little over 300, and this extra would allow for a slight loss due to the resistance of the smoothing choke.

Well, so far, I have got the transformer and the rectifier valve, and before going any farther I thought I would check the unsmoothed DC voltage. Using a multi-range meter that I believe to be reliable, I found it to be only 228 volts. The meter is 1,000 ohms per volt, so the current taken by it must be less than 1 mA.; and I cannot understand why the voltage is so low. According to the Data Supplement it ought to be 260 even at the full 60 mA. There is no choke to reduce it, and I have checked the AC voltage of the transformer with the same meter—it was over 250. So, as the rectifier is the only other component, it seems that it must be the faulty one. The man I got it from says it is a new one and must be all right, but I notice he has no gear suitable for testing it under the proper conditions. Can you suggest a reliable test?

Yours sincerely,
Philip Cowe.

Why is the voltage lower than expected? Turn to page 41 to see if your solution agrees with Henry Farrad's.

Five-metre DX

REPORTS WANTED

ON the few occasions when it has been possible to devote time to the five-metre band during the week preceding July 6th last, no unusual activity has been noticed, and it can only be assumed that conditions have not shown any tendency to favour DX signals.

It has to be remembered, of course, that location has a profound effect on reception of ultra-high-frequency signals and that reports from different parts of the country are always more indicative of the true conditions prevailing than observations from one or two stations only.

One interesting report just to hand from G6YL mentions reception of some French and Italian stations in the north of England during the last week in June. It is hoped to give more details of the stations heard next week. In order that these reports shall give an exact indication of how the five-metre band is behaving from time to time, reports of any outstanding contacts made or of signals heard will be gratefully received.

G2MC.

Distortion in Transformer Cores

Part IV.—REVISED DESIGN TECHNIQUE TO MINIMISE HARMONIC DISTORTION

By N. Partridge, B.Sc. (Eng.) A.M.I.E.E.

THE nature and extent of harmonic distortion in push-pull output transformers has been examined in detail in earlier instalments. This article, the last of the series, will be devoted to the consideration of ways and means of keeping this distortion under control.

IN designing a transformer for low distortion the first step is to select a "good" magnetic material for the core. In last week's instalment reasons were given for accepting Vicor (manufactured by Magnetic and Electrical Alloys, Ltd., of Wembley) as our starting point. An oscillogram showing the current distortion produced by this alloy at a flux density of 4,680 lines per sq. cm. was reproduced in Fig. 22, but to perform detailed calculations the distortion at all densities must be known. A series of current oscillograms at various flux densities is given in Fig. 24 and the graph obtained by analysing these wave forms is shown in Fig. 25. These two illustrations correspond to Fig. 3 and Fig. 5, which give the same information about Silcor 2. The final requirement is a curve connecting inductance with flux density. Such a curve is contained in Fig. 23, but for completeness it is reproduced here in Fig. 26.

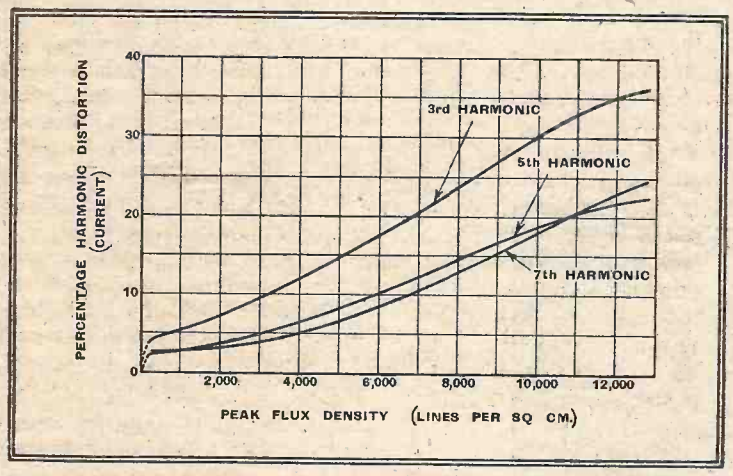


Fig. 25.—The graph obtained by plotting the result of an harmonic analysis of the wave forms of Fig. 24. The harmonics are expressed as a percentage of the fundamental.

Having fixed upon the core material, the second step is to consider how best it may be used. One could design a transformer in the conventional manner and claim an improvement by virtue of the better core. But there would still be one or two rather disconcerting criticisms. For one thing, the *intrinsic* distortion would be high. As can be seen from Fig.

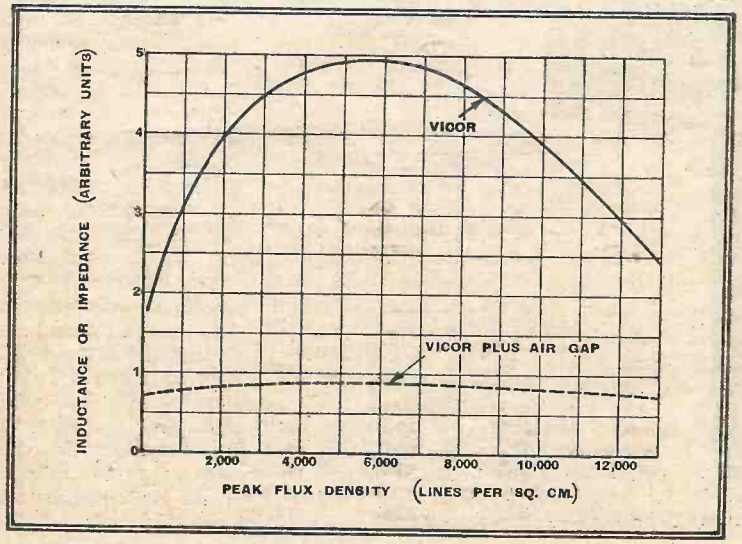


Fig. 26.—The full curve indicates the change of inductance (or impedance) with flux density in the case of a transformer having a closed magnetic circuit of Vicor. The dotted curve applies to a composite core of Vicor plus an air gap (see Table 7).

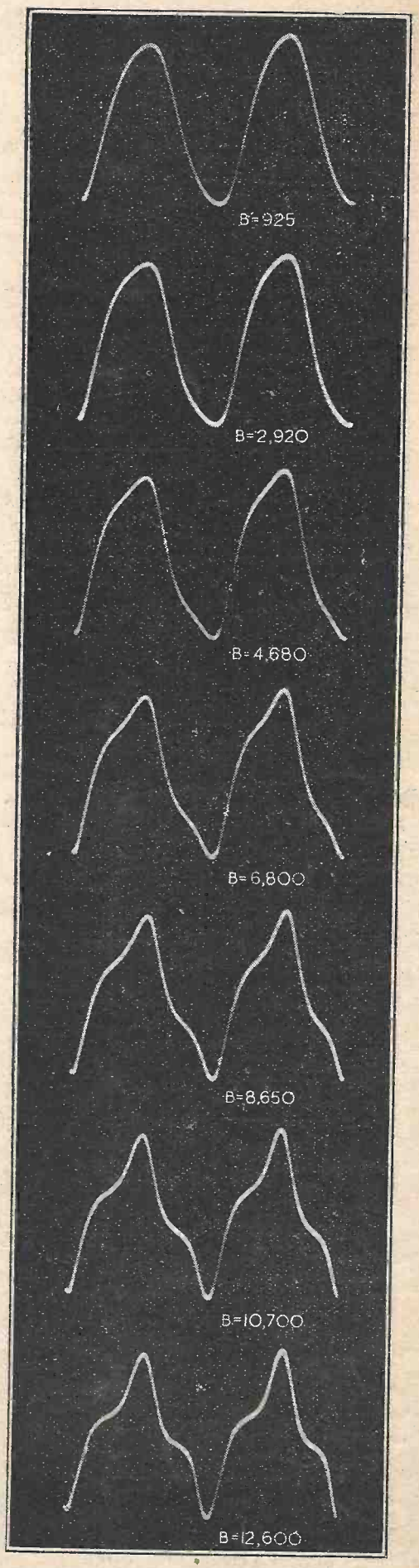


Fig. 24.—The oscillograms show how the current distortion varies with flux density in the case of Vicor. "B" is the value of the peak flux density in lines per sq. cm. The photographs should be compared with Fig. 3 (Part 1), which gave the same information about Silcor 2.

Distortion in Transformer Cores

25, appreciable distortion occurs at quite low densities and it is only the somewhat fortuitous circuit conditions $\left(\frac{R}{Z_F}\right)$ that keep the working distortion within reasonable limits. It would be more satisfying if the transformer in itself could be made distortionless apart from the external circuit. Again, a small out-of-balance between the anode currents of the two push-pull valves will be sufficient to upset all the calculations. And there is still the little matter of frequency modulation which depends upon the external circuit for correction.

There is an extremely simple device whereby most of the troubles and worries mentioned above can be substantially lessened. That is by putting a suitable air gap in the magnetic circuit. Gaps have always been used for chokes and transformers carrying DC, but as far as the author is aware, such a technique has not been deliberately used by manufacturers to reduce intrinsic distortion apart from the question of polarisation.

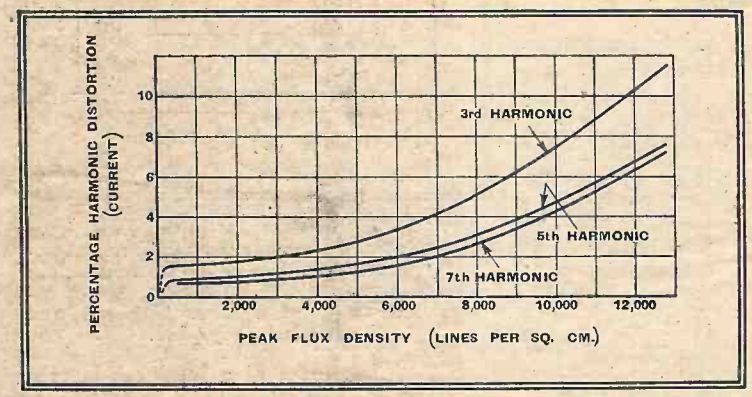


Fig. 27.—The intrinsic distortion of the core is materially reduced by an air gap. This graph should be compared with Fig. 25 which shows the distortion without a gap.

The effect of a gap can be easily understood with the aid of Fig. 26 and Table 7. Suppose a transformer, giving the relative inductances shown in the graph (Fig. 26) has a gap made in its core of a length such that the inductance at B=1,000 is reduced from 3 to, say, 0.73. These figures are, of course, purely relative, and the actual inductances may be anything, depending upon the core area and the number of turns on the primary. Since the impedance has been reduced, a greater magnetising current will flow. But the iron circuit still requires exactly the same current to magnetise it and to supply the various losses, from which it follows that the additional current must be that required to maintain the flux in the air gap. This additional current will be undistorted and will vary *directly* as the flux density.

Table 7 shows an approximate method of estimating the inductance and distortion curves for the composite core consisting of Vicor plus the air gap. Column 1 contains selected flux densities for which the relative magnetising currents taken by the Vicor are shown in column 2. These figures were obtained by testing the Vicor without a gap. The third column indicates the magnetising current required by the air gap, which is proportional to the flux density. The total current is tabulated in column 5, from which the new relative impedances can be deduced. It must be remembered that this method is only approximate because the magnetising currents for the Vicor and the air path are assumed to be in phase, and this is not strictly true.

The new impedance curve is drawn dotted in Fig. 26. The inductance has been greatly reduced by the gap but this is not necessarily important. The earlier examples have shown that any good output transformer has a far higher inductance than is strictly required for the preservation of the bass. Our new curve at least approximates to a straight line. In other words, instead of having an inductance that varies enormously with the signal voltage, we now have an inductance that remains sensibly constant. Another important advantage is that any normal out-of-balance between the anode currents will be far too small to have any effect upon the Vicor, which is protected in this respect by the gap.

Turning to the question of harmonic distortion, a change has occurred here, too. The curves in Fig. 25 give the distortion as a percentage of the fundamental. The air gap has increased the fundamental without altering the magnitude of the harmonic currents, and, therefore, these harmonics will be noticeably smaller when expressed as a percentage of the augmented fundamental. Columns 6, 7 and 8 show the revised distortion figures in the case of the particular gap chosen for the purpose of Table 7. These values have been plotted in Fig. 27.

Because the basic distortion (x) has been reduced to less than one-third of its original value it must not be assumed that

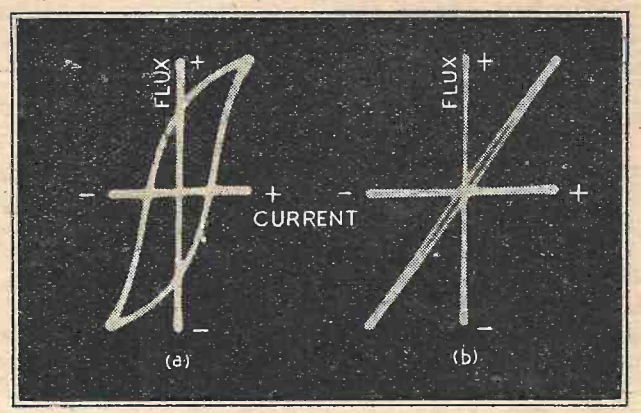


Fig. 28.—(a) shows the relationship between the instantaneous flux density and current in a closed core of Vicor. This approximates to the hysteresis loop. (b) gives the same information in the case of a gapped core. Note that the flux is almost proportional to the current.

a corresponding improvement will be found in the performance of the transformer. Actually, the working distortion has not been altered at all. Unfortunately, Z_F has been reduced just as much as x and the final result remains the same. But what we have done is to reduce the *intrinsic* distortion and make the performance of the transformer less dependent upon the external circuit. This modification is strongly reflected in the curve showing the relationship between the flux in the core and the magnetising current. Fig. 28 (a) shows this curve, which approximates to the hysteresis loop, for the ungapped transformer and Fig. 28 (b) repeats the curve for the gapped core. The latter is brought very close to the ideal, which would be a straight line.

The reader may be wondering why the gap chosen was one which reduced the inductance at B=1,000 in the ratio of 3 to 0.73. At first sight it looks as though a much larger gap would still further reduce the intrinsic distortion and make the transformer behave as though it were air cored. This reasoning is perfectly correct, but there are practical limitations to the possible magnitude of the gap. The larger the gap the lower the inductance, and hence more turns have to be wound upon the primary in order to keep the inductance up to the minimum allowable value. Increasing the turns means using finer wire

TABLE 7

Peak Flux Density	Vicor Magnetising Current	Air Gap Magnetising Current	Total Magnetising Current	Impedance of the Gapped Core	Distortion of Gapped Core (per cent.)		
					3rd Harmonic	5th Harmonic	7th Harmonic
263	4.2	7.8	12.0	71.0	—	—	—
537	7.0	15.8	22.8	75.7	—	—	—
925	10.5	27.4	37.9	79.0	1.5	0.8	0.6
2,920	22.0	86.3	108.3	87.0	1.84	0.95	0.71
4,680	33.2	138.0	171.0	88.0	2.65	1.50	1.17
6,800	48.2	201.0	249.0	88.0	3.87	2.37	1.94
8,650	69.8	255.0	325.0	86.0	5.62	3.50	3.10
10,700	107.0	317.0	424.0	82.0	8.15	5.10	4.95
12,600	168.0	373.0	541.0	75.0	11.2	7.4	6.9

Distortion in Transformer Cores

and obviously the wire gauge cannot be smaller than that which will safely carry the current. Also the DC resistance of the winding must not be permitted to reach too high a value.[1] Again, the leakage inductance must be kept within manageable proportions, and this limits the number of turns that can be employed.

With a view to showing the type of result that can be obtained with Vicor and the gap technique, a transformer was designed on a 1½in. stack of No. 4 stampings to operate with two DA30 valves in Class A push-pull. The harmonic distortion given by this transformer at 50 c/s is indicated in Fig. 29. This should be compared with Fig. 12, which gives similar data relating to a well-designed transformer with a core of Silcor 2. Note that the Partridge Distortion Index[2] for the latter was 0.5 per cent., whereas the gapped Vicor reduces this figure to 0.2 per cent.

All the examples so far have employed the No. 4 stamping. The reason for this is that it is a very popular stamping and serves for the purpose of illustration as well as any other. But the No. 4 laminations are not necessarily the most suitable ones for audio-frequency transformer design. Greater iron section would be an advantage and so would be a slightly restricted window space. The former makes it possible to work at a lower flux density and the latter aids in the reduction of leakage inductance. The No. 56 stamping (Magnetic & Electrical Alloys, Ltd.) is a very good one. The dimensions of both the No. 4 and the No. 56 stampings are shown side by side in Fig. 30 for comparison.

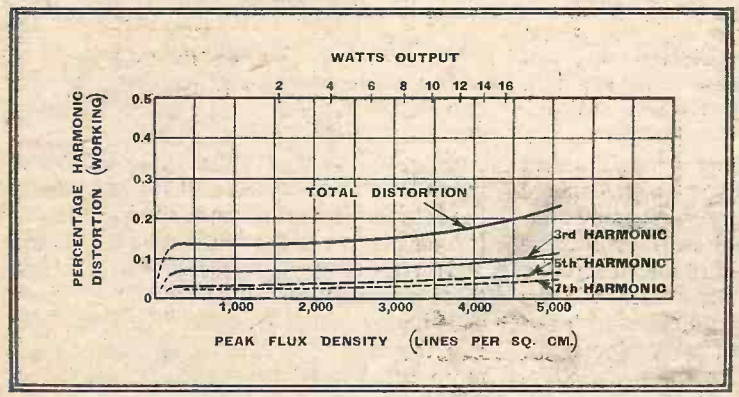


Fig. 29.—The distortion obtained under working conditions from an output transformer using a gapped Vicor magnetic circuit. The Partridge Distortion Index is only 0.2 per cent., which is very low considering the size of the component.

If expense is no great objection, the size of the transformer can be increased and, theoretically, the iron distortion can be reduced to as low a value as one wishes. A large core section with ample window space will permit the winding of a primary with a very high inductance and a large air gap will be possible without jeopardising the bass response. The intrinsic distortion will, by this means, be made extremely low, and, no matter what the external circuit conditions, such a transformer would not produce harmonic distortion. But theory and practice do not collaborate harmoniously in this respect. The larger the transformer the more difficult it becomes to preserve the high-frequency response. Also, owing to the shape of the distortion curves in Fig. 5 and Fig. 25, it requires a very considerable reduction in the flux density to bring about any worth while improvement in the transformer distortion.

The design of a good output transformer is beset with conflicting desiderata. The final solution must be a compromise and the best design is that which gives a well-considered balance of evils. The unpleasantness resulting from the loss of top, the iron distortion, etc., should all be approximately equal as judged by the ear. A superb frequency response is of no avail if harmonic distortion is high; a distortionless core is wasted if all the high frequencies are attenuated. To achieve such a balance requires not only technical knowledge but a wide practical experience as well.

Conclusion

Looking back upon the information brought to light by these investigations, perhaps the most striking thing is the fact that the articles should have been written at all so late in the development of electro-acoustics. Amplifier technique has been subjected to the most rigorous analysis in the cause of fidelity, and has long since reached a very high standard. Speech transformers were used in communication work years before radio was invented and yet, apart from vague apprehensions, nobody seems to have seriously worried very much about the extent of the harmonic distortion they produce.

As far as so-called commercial reproduction goes, iron distortion is not very important. It occurs only at low frequencies, and if true bass is not catered for in the amplifier, then it can do no harm in the transformer. But the subject must be studied with the utmost seriousness by those seeking really high-quality reproduction. Distortion at low frequencies is more dangerous than perhaps the reader has, as yet, appreciated. The characteristics of the ear are such that the sensitivity increases very rapidly from the lowest audible notes up to around 500 or 600 c/s. The effect of this is that *2 per cent. seventh harmonic contained in a 50 c/s note can sound as loud as the fundamental itself.*

This statement is truly amazing, but a few figures will prove its validity. A distortion of 2 per cent. means that the voltage of the seventh harmonic (350 c/s) is 2 per cent. of that of the fundamental (50 c/s). In other words, the seventh harmonic is 34 db below the level of the fundamental. But at a loudness level of 20 db the sensitivity of the ear increases by approximately 34 db between 50 c/s and 350 c/s. Hence the harmonic will sound to the ear as though it were 100 per cent.! One is, of course, assuming that the sensitivity of the loud speaker is the same at both frequencies. If it happens to be greater at 350 c.p.s., then the position is even worse.

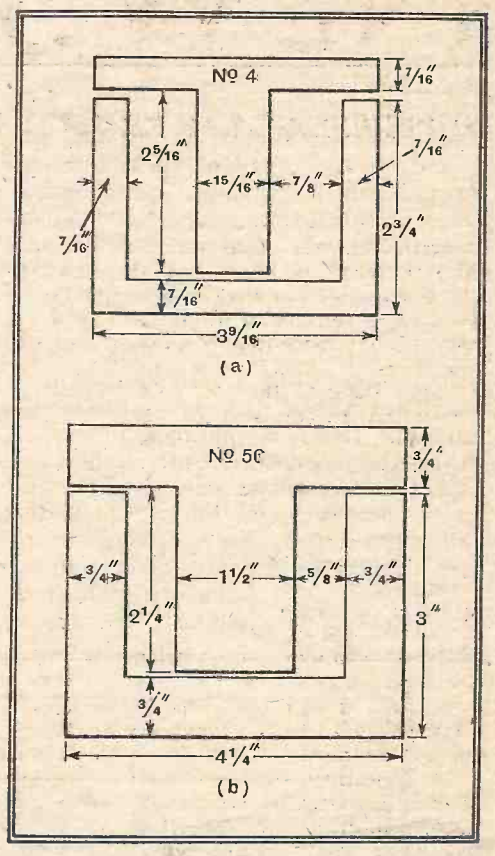


Fig. 30.—All the examples in this series have used the No. 4 stamping but this is not necessarily the best one. The No. 56 presents certain advantages mentioned in the text. The numbers are those of Messrs. Magnetic and Electrical Alloys, Ltd.

Obviously, something must be done about iron distortion. A transformer response curve is only a snare and a delusion when examined alone. The response is important up to a point, but it *must* be considered in conjunction with the transformer harmonic distortion. To do this a simple and standardised method of expressing the distortion is required, and the Partridge Distortion Index is put forward as a tentative suggestion. It may be defined as the arithmetical sum (*not* RMS) of the percentages of the third, fifth, and seventh harmonics produced under working conditions at 50 c/s when the transformer is delivering its full rated output into a resistive load of value equal to the nominal secondary load. By substituting a resistance in series with the primary to take the place of the valve AC resistance, the test can be taken using the 50 c/s mains as the source of power. This scheme eliminates all possibility of valve distortion masking the transformer distortion, and avoids the risk of polarisation.

[1] See "Output Transformers—The Effect of Resistance," *Wireless World*, January 12th, 1939.

[2] See Part II, June 29th issue and also last paragraph of this article.

NEWS OF THE WEEK

SUPPRESSING CAR IGNITION INTERFERENCE

B.B.C. and Post Office Moves

THE B.B.C.'s scheme, announced last week, to encourage members of its staff to fit suppressors to their cars, as the Corporation has already done to its own vehicles in the interests of interference-free reception on the short waves, has brought to light the fact that the War Office and Air Ministry already suppress every internal-combustion engine under their control.

At the recent television tea party, one viewer asserted that the biggest offender, as far as he was concerned, was the Post Office mail van which frequented his area. The reason for this apparent inconsistency by the champions of interference-free reception is that the mail vans are not the property of the G.P.O., but are supplied under contract.

It is learned that the engineering department has already fitted suppressors to more than 100 of its own vehicles which operate within the fifty miles radius of Alexandra Palace and that a committee is now sitting to consider the question of fitting suppressors to all Post Office vans plying within this area. It will, of course, be realised that whilst there are somewhere in the region of two million motor vehicles in this area, the Post Office fleet only runs into four figures. Even so, the cost of such a campaign, which presumably would have to be financed by the Post Office, would be considerable.

Not Television Only

It will be realised from the foregoing that the Post Office is mainly concerned with interference with television reception, which, of course, is not the only field of wireless activity which is affected. This fact is stressed by a correspondent, Mr. E. A. Watson, in the July 4th issue of *The Motor*, who, commenting on the criticism levelled at the B.S.I. specification, which was referred to in our issue of May 25th, writes: "The proposal to introduce suppression on motor vehicles has not been made in the interests of television only. There are more important interests at stake, such as Post Office short-wave links, blind-landing systems and special means of communication. The television user will certainly benefit, but there was no suggestion of the motor trade yielding to the television interests."

"All the tests," he states, "carried out by the Automobile Research Committee of the Institute of Automobile Engineers, and by our own laboratories, together with experience gathered from the trade, have indicated that suppression to the standard proposed, viz., 50 microvolts per metre at a distance of ten yards, will not involve any serious cost or inconvenience, and will not necessitate screening, which, it is admitted, would introduce difficulties."

Opposition to Compulsion

The following editorial note is appended to Mr. Watson's letter: "Mr. Watson, of the technical staff of Joseph Lucas, Ltd., was a member of the Committee. *The Motor* will strenuously oppose any proposal for making the fitting of suppressors on motor-vehicle engines compulsory."

Another Voluntary Effort

The General Electric Company has arranged for television suppressor equipment to be fitted on all its vehicles operating within the television area. The same facilities have been made available, free of charge, to members of the staff for their private cars.

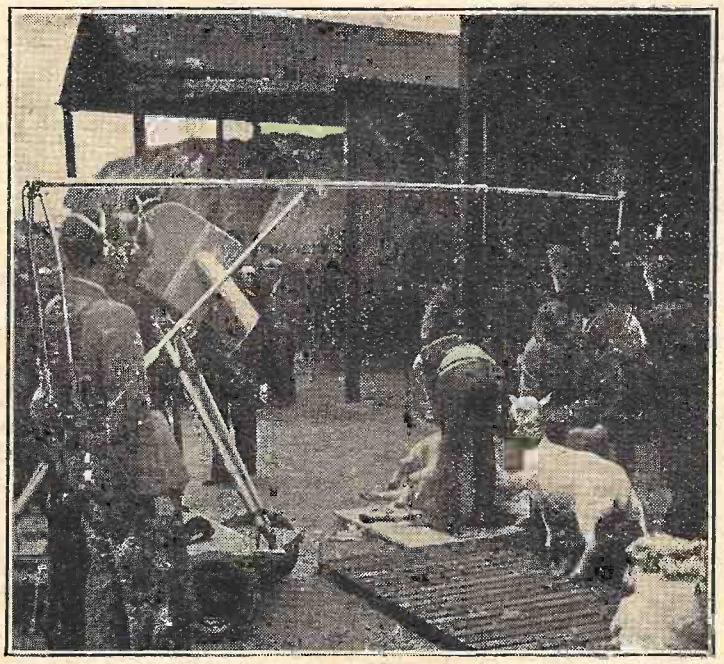
RADIO DEVELOPMENT IN THE WEST

Land's End Station

IN reply to an enquiry by Mr. Alec Beechman, M.P. for St. Ives, Cornwall, the Assistant Postmaster-General, Mr. William Mabane, stated that the Post Office Land's End wireless station is to be entirely reconstructed.

It is stated in *The Western Morning News* that the reason prompting Mr. Beechman's enquiry about radio-telephone ship-to-shore facilities around the western coast was that when on a recent visit to the Scilly Isles he found that the R.M.S. *Scillonian's* transmitter had to be linked with the Post Office station at Portpatrick, Scotland, in order to communicate with Cornish telephone subscribers.

Portpatrick radio station, which together with those at Wick and Grimsby were taken over from the Admiralty by the Post Office after the Great War, has been equipped primarily for experimental purposes in order to develop improved linking apparatus. Equipment similar to that at Portpatrick has been ordered for the station at Niton, Isle of Wight, and it is hoped to open a link service at the end of this year. The reconstruction of the Land's End station will include the installation of link equipment.



TO REPLACE the unwieldy bamboo pole used for television O.B.s, the B.B.C. now employs the metal microphone boom shown above strapped to an engineer's back during a recent O.B. from Bull Cross farm, Waltham Cross. For the purpose of portability the microphone has been fitted with a lighter case.

ANOTHER HIGH-POWER GERMAN STATION

A Significant Silence

AT Oldenburg, which is near the German-Dutch frontier, approximately 30 miles from the North Sea, the German authorities have completed a high-power broadcasting station. This station, the first mention of which was made only a few days ago, will be opened in the early autumn, and will operate on Munich's wavelength 405.4 metres (740 kc/s).

There will, it is understood, be another "general post" in wavelength distribution when this station comes on the air. Munich will use Leipzig's present wavelength of 382.2 metres (785 kc/s), while the latter will use the present Graz-Klagenfurt frequency of 886 kc/s (338.6 metres).

Oldenburg has been enjoying good reception from a local station in Bremen, and there seems no reason for this 100-kW station in this small corner of Germany, unless its transmissions are intended for listeners in Great Britain and Eire.

It is significant that there was no mention of the new station at the Montreux wavelength conference.

NEWS IN POLISH

A Plea from Poland

WITH the introduction last Wednesday of a news bulletin in Polish from Königsberg and Breslau, German stations are now transmitting news in eight languages — English, Dutch, Afrikaans, Arabic, Spanish, Portuguese, Ruthenian and Polish. The last is broadcast nightly from 8.15 to 8.35, and from 10.15 to 10.30 B.S.T.

In this connection it is interesting to record what a Polish correspondent wrote in *The Times* of July 5th regarding Polish broadcasts from England.

He says: "We have read of the continued expansion of the B.B.C. foreign news department, and I understand news bulletins are now given from London in six or seven languages. Unfortunately, as it appears to many here, this extension still follows a curious and perhaps a dangerously negligent course; whereas these bulletins are mainly directed at listeners in either openly hostile or potentially inimical countries —an admirable scheme in itself —Great Britain seems to be making comparatively little effort to cater similarly for her

News of the Week

acknowledged friends and potential allies in Europe.

"Thus we in Poland are still eagerly hoping for news bulletins in Polish to which we can turn daily for accurate information. A further point, by no means unimportant, is that, failing direct broadcasts to Czech and Slovak communities, Polish broadcasts from London are easily understood by these kindred Slavs and would provide a means of counteracting anti-British propaganda in the former Czech State."

LATIN AMERICAN NEWS

Extended B.B.C. Services

SPEAKING in Spanish, Mr. F. W. Ogilvie, B.B.C. Director-General, in the presence of the diplomatic representatives of Latin American nations, inaugurated, at 1.15 a.m. last Tuesday, the extended service of programmes broadcast from the Empire station at Daventry for Latin America. He recalled that when, on March 14th last year, the transmission of news bulletins in Spanish and Portuguese for Latin America was commenced, the B.B.C. did not have the technical facilities at its disposal, due to the exigencies of other services, to offer a satisfactory service.

Two new transmitters having been installed, the B.B.C. is now able to offer a three-hour transmission every night exclusively for Latin America.

The extended programmes commence at 11.20 p.m. and terminate at 2.15 a.m. G.M.T. daily, with news bulletins in Spanish at 11.30 p.m. and 2 a.m., and in Portuguese at midnight.

By radiating the programmes from GSO in the 19-metre band and GSC in the 31-metre band, the whole of South and Central America should be covered.

ABBREVIATED MORSE NUMERALS

THE large amount of space devoted by the general and specialist Press to reviews of our recently published sixpenny booklet, "Learning Morse," proves that the little publication has appeared at an opportune moment. One of the reviewers, writing with an obvious knowledge of the subject that is unusual to find in a lay periodical, suggests that in the abbreviated numerals section the figure 5 should be represented by one dot and not by five dots. Though admitting that the single dot abbreviation is unofficially used by operators, we would point out that the code as printed is that officially sanctioned by International agreement. As already pointed out, alterations put into force by the Cairo Conference are included.

TELEVISION AND THE CINEMA

Film Boycott

THE fact that the B.B.C. is unable to obtain films, except certain news reels, for television purposes was forcefully stressed by Mr. Gerald Cock, Director of Television, at a recent conference. This is amply borne out by a statement made by Mr. S. Eckman, managing director of Metro-Goldwyn-Mayer in this country. He said: "I am authorised to announce on behalf of my company that we shall not permit the use of any of our films, whether they be features, shorts or trailers, new or old, for television purposes.

"I am also of the opinion that exhibitors should not rediffuse public events in their cinemas. Though M.-G.-M. operate only the Empire and Ritz theatres, it is not intended to install a large screen and thus help to popularise a form of entertainment which will only assist in building up competition."

The hostility, so far as large-screen television is concerned, is not shared by Odeon and Gaumont British, who have already equipped a number of London theatres with projection television apparatus.

SCANDINAVIAN AMATEURS

THE Norwegian amateur organisation N.R.R.L. (Norsk Radio Relae Liga) has completed its central transmitter LA1C at Notodden. This station, which comprises two complete transmitters and stand-by equipment, transmits under the heading of QST-LA news of interest to hams on Mondays at 5.30 p.m. G.M.T. on 3,590.5 kc/s and at 5.45 p.m. on 7,181 kc/s, and on Tuesdays at 3.45 p.m. on 3,631 kc/s.

The N.R.R.L., which has done much to reduce the cost of amateur transmitting, including the reduction of the Norwegian transmitting licence fee from 30 to 10 kroner annually, recently announced the introduction, as from July 1st, of an arrangement whereby all QSL cards from members to amateurs abroad will be distributed free of charge.

The first 56-Mc/s two-way QSO between Denmark and Sweden was established recently by OZ7T and SM7UC, who thus become joint winners of a special 56-Mc/s cup, awarded by the Pan-Scandinavian organisation N.R.A.U.

TELEVISION SHOW PLANS

WE understand that the B.B.C. mobile television units well be in daily operation during this year's Olympia radio show. One, installed at the Exhibition, will transmit several stage shows a day for radiation from Alexandra Palace, and also provide closed circuit performances for demonstration on the stands.

The other mobile unit will operate, as last year, at the Zoo.

The two television studios at Alexandra Palace are to be overhauled during the Radio Show.

FROM ALL QUARTERS

New Sets for Old

TWENTY per cent. of the purchase price of a new receiver will be allowed on all old receivers taken in part exchange by radio dealers in Norway from August 1st, when the new agreement adopted by the Norwegian association of manufacturers (Radioleverandorenes Landsforbund) comes into operation. The cost of this arrangement will be equally borne by the manufacturers and distributors.

Advertising Time

THE National Association of Broadcasters has drawn up a code of ethics for broadcasters which is to be submitted to its national convention in Atlantic City this month. This, among many other things specifies the maximum advertising time in broadcast programmes. During the day this would be 3¼, 4½ and 9 minutes for 15-minute, half-hour and hour programmes respectively, while the equivalent evening limits would be 2½, 3 and 6 minutes.

Schwarzenburg Transmitter Fire

THE recently completed 25-kW short-wave station of the Swiss Broadcasting Company at Schwarzenburg, was destroyed by fire last Wednesday. This station, which had so far been testing on 9.535, 11.865, 15.305 and 17.784 Mc/s, was scheduled to begin a regular service to North and South America, Africa and Asia early this month.

English News from France

A NEWS bulletin in English was introduced by French stations last Thursday. This is broadcast nightly between 9.30 and 9.45 B.S.T. from Lille (P.T.T.), 247.3 metres; Radio Normandie, 274 metres; Radio Cité (Paris), 280.9 metres; Radio 37 (Paris), 360.6 metres; and Radio Paris, 1,648 metres. It will be noticed that the transmitters include Government and privately owned stations. Other French stations are broadcasting at the same time news in German, Italian, Spanish, Serbo-Croat and Arabic.

Indian Wireless Training

THE authorities of the Dacca University in Bengal are to establish a Lectureship in Wireless in their Physics Department.

Shanghai-Rome Radio-Telephone

A DIRECT radio-telephone service between Shanghai and Rome has been inaugurated. The station in China is at Chenju, a few miles from Shanghai. This station, which was destroyed by the retreating Chinese troops some months ago, has been restored by the Central China Electric Communication Company, which is a Sino-Japanese concern.

A Branly Stamp?

A SECTION of the French Press is agitating for the issue of a stamp to "render the homage due to Edouard Branly, the sole survivor of the brilliant 'team' who discovered wireless half a century ago, before this illustrious grand old man of radio receives the honour posthumously."

A. C. Cossor, Limited

AT the first ordinary general meeting of A. C. Cossor, Limited, which was held last Thursday, the chairman, Sir George Godfrey, said that since the new company was formed, February 24th, 1938, it had made an excellent showing, the net profit being £55,889. Mr. J. H. Thomas, managing director, said that the market for radio receivers now appeared to be more stabilised, while that for televisors was steadily on the increase.

Tynemouth's Relay Service

SINCE the note published in last week's issue was written, the Tynemouth Town Council has agreed, by 17 votes to 4 to permit the introduction of a wireless relay system in the borough. The reason given for this reversal of the recommendation of the Town Improvement Committee being that the rediffusion system had been "clothed by the P.M.G. in the attractive uniform of national defence."

Spanish Broadcasting

IN the reconstruction of the broadcasting services of Spain, it has been planned to erect a 120-kW medium-wave transmitter at Madrid and a 45-kW short-wave station at Seville. The latter, which is being built by German contractors, will be constructed for transmissions to America.

Historic Landmark Disappears

ONE of the most historic wireless masts in the country is now being dismantled. The 187ft. tubular steel mast, which was designed by Mr. Andrew Grey, a former Marconi Chief Engineer, was the first of its kind to be used. Built 30 years ago, at the first Marconi's Wireless Telegraph Company's works in Hall Street, Chelmsford, it is now obsolete as the Marconi research station has been removed to Great Baddow, a few miles from Chelmsford.

Indian Village Sets

THE Research Department of the All-India Radio has evolved a superheterodyne village receiver. The set combines a time switch which has already been proved successful.

No Relays in Eastbourne

THE Eastbourne General Purposes Committee has refused an application for permission to operate a wireless relay service in the town.

Magnetic Television Receiver

Part III.—VF AMPLIFIER, TIME BASE AND POWER PACK

By W. T. COCKING

IN this article the discussion of the Magnetic Television Receiver is continued. The vision-frequency amplifier is dealt with and also the DC restoration and sync separation circuits. The time-base and power supply are treated as well.

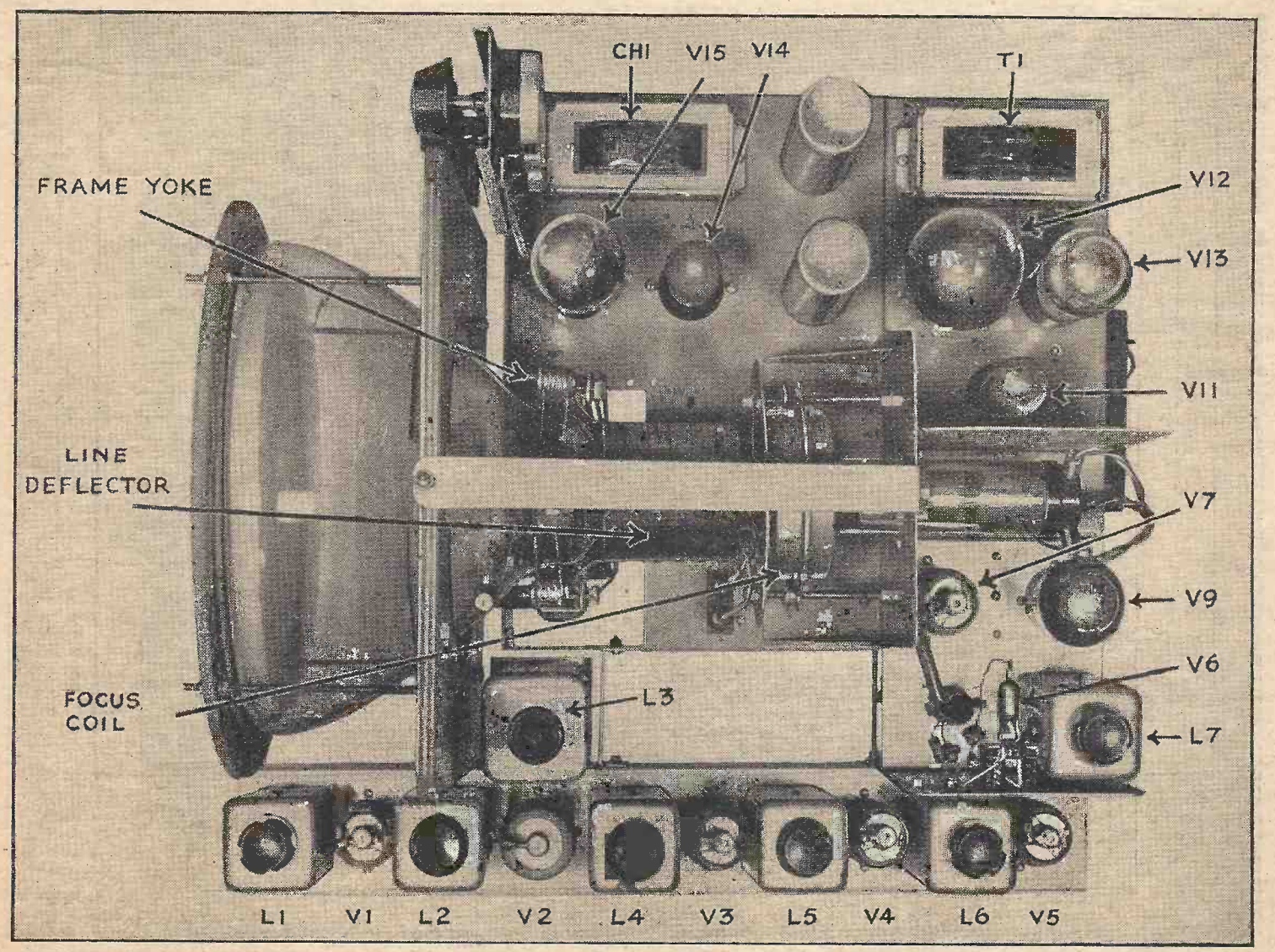
HAVING discussed in Part II the RF, FC, and IF detector stages, we now come to the vision-frequency amplifier. This is an RF pentode fed directly from the detector.

The output of the detector is in the negative sense; that is, the signal voltage changes always take place in a negative direction from the no-signal value, which is very nearly zero. As this signal is applied straight to the VF grid, this valve must be biased close to the grid-current point in the absence of a signal. The signals then always drive the grid negative from this point, and the maximum length of characteristic is obtained.

The valve used is an SP41 with a bias resistance of 37.5 ohms, obtained by using a 50-ohm resistance R26 in parallel with a 150-ohm resistance R25. A coupling resistance R27 of 3,500 ohms is used in the anode circuit, together with a correcting coil L10 of 144.5 μh. Like L8, this is really a superheterodyne oscillator coil, of which only one winding is used; it is the Wearite PO7. The resistance and coil, together with the stray capacities, constitute an impedance which is substantially constant up to about 2.5 Mc/s, and the frequency response is consequently very even up to this frequency.

The output is taken from the anode of this valve, and it is here that the circuit becomes rather unusual and, some may think, uneconomical. Certainly, more valves are used than are necessary to obtain a picture of equally good quality, but they are used to remove any risk of damage to the CR tube and to obtain very good sync separation.

The arrangement used has already been



The general layout of the receiver, time-base, tube, and focusing and deflecting coils is clearly shown in this photograph. The tube is supported at the front by being clamped between a wooden ring and board; the wood is edged with rubber where it contacts with the tube.

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described in *The Wireless World*,[1] and differs greatly from normal commercial practice. The usual course would be to join the tube grid directly to the anode of V7 and to feed the sync separator from a resistance in the cathode circuit of V7, thus saving V8 and V9.

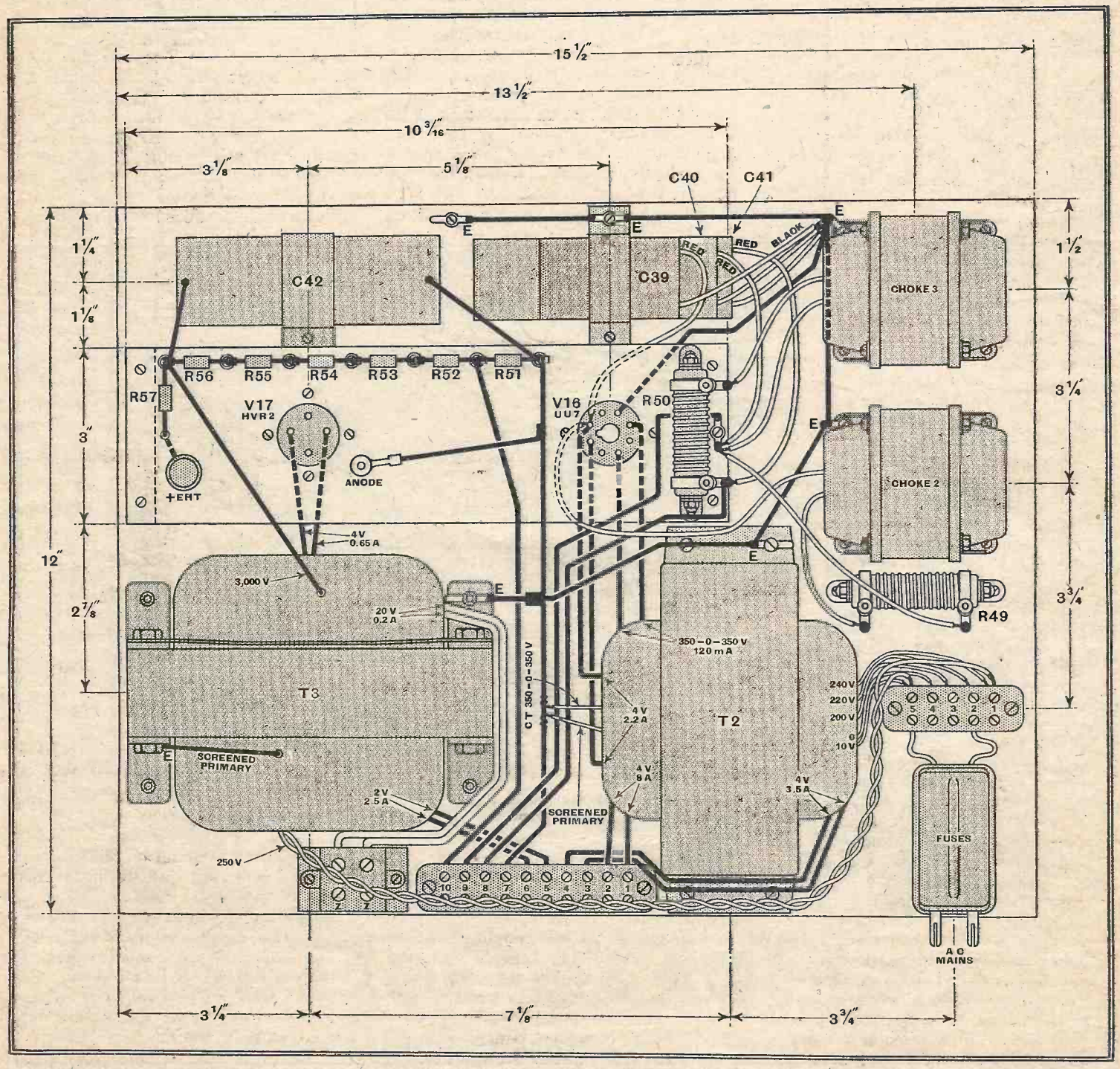
The disadvantages of this are an increase in the input capacity of V7, a rather small signal input to V10, and, most important, a risk of damage to the CR tube. This arises because with the tube grid connected to the anode of V7, it is something like 100 volts positive with respect to chassis. This must be offset by an equal additional grid bias on the tube. Now if V7 fails, the grid of the tube is carried straight up to +HT, and will be up to 150 volts more positive than it should be. There is also risk if V7 is in order, for switching on and off may cause the tube grid to be carried positive, since the various HT supplies and valve heaters take varying times to come into operation and to die away. This can, of course, be overcome by using special interlinked switches, and this is done in some receivers.

Such safety measures are usually troublesome in that they need non-standard components, and some, in particular, are ones which are quite unsuitable for use in experimental equipment. It will thus be seen that the use of a directly-connected tube causes less saving than the cost of two valves and a few resistances, for more complicated safety devices are necessary to protect the tube.

It is felt, therefore, that in this receiver it is better to adopt a circuit arrangement in which these troubles are inherently absent. In the circuit shown no more than a brief positive pulse can be applied to the tube grid through the charging of a condenser.

The tube requires an input in which the picture signal changes are in a positive direction and the sync pulses negative, while the time-base requires the sync pulses to be negative. The time-base cannot be fed directly in parallel with the tube, however, because the picture signal must first be removed. This is done by the sync separator V10 and it also reverses the phase of the signal, so that the sync pulses in its input must be in the positive direction. The tube and sync

[1] *The Wireless World*, Feb. 23rd, 1939.



This diagram shows full details of the construction and wiring of the power unit. A plywood base is used, and so care should be taken to earth the frames of transformers and chokes.

separator thus require inputs in opposite phase.

The VF stage is accordingly followed by a phase-splitter V9, which is very similar to the arrangement often used in push-pull AF amplifiers. The usual RC coupling is used from the VF stage with a condenser C24 of 0.1 μF and a grid leak R28 of 1 MΩ. A diode V8 is connected across R28 to give DC restoration, since the direct current component of the signal is lost in the coupling, and it is essential if the mean illumination of the picture is to be reproduced correctly at all times and also for proper sync separation.

The diode passes current on the tips of the sync pulses and maintains a charge on C24, which is a good approximation to the missing DC component.

The signal applied to V9 and developed across R28 is always positive with respect to chassis and may reach a peak value of 30-40 volts. The following valve must handle this input and give one output of the same order and in the same phase for the tube, and another output in the opposite phase and, preferably, of greater magnitude for the sync separator. It is obvious also that the no-signal bias should be near anode current cut-off.

A triode with a moderately large resistance in its cathode circuit and a larger one in its anode circuit meets these conditions. Actually a 354-V valve is used with a 6,000-ohm cathode resistance R30 and a 15,000-ohm anode resistance R29. With no-signal the voltage developed across R30 is sufficient to bring the grid voltage towards the anode current cut-off point.

The positive signal voltage excursions increase the anode current and hence the voltage-drops across R29 and R30. The anode voltage falls and the cathode voltage rises. The output at the cathode is taken directly to the tube, and is slightly less in magnitude than the input to V9 because of the negative feed-back along R30. The effective output impedance of V9 on the cathode side is very low on account of the negative feed-back, consequently a good frequency response is secured with a reasonable value for R30, and also it is quite possible to use a fairly long screened lead for the grid connection to the tube.

In the present case no advantage is taken of this aspect of the circuit, for the layout of components is such that a very short grid lead is secured. It should be noted that the direct connection of the tube grid to valve cathode is not attended by the same disadvantages as its connection to an anode. Voltage changes caused by valve failure or by switching now drive the tube grid negatively and do no harm.

As R29 is greater than R30, the output at the anode is greater than that at the cathode in the ratio of the resistances, and this is applied through C25 and R31 to the sync separator V10. The DC component is again lost in this coupling, but owing to the phase of the signal V10 can restore it without the need for an extra diode. It is only necessary to operate V10 without grid bias, and the grid-cathode path will act as a DC restoring diode.

The signal voltages drive this valve grid negatively, and the screen voltage is adjusted so that anode current cut-off occurs at a few volts negative. The characteristic is then swept over only by the sync pulses, and the picture signal itself always falls beyond anode current cut-off.

One component that has not yet been mentioned is C23, shunting the cathode bias resistance of the VF stage. The stage is designed to give a flat response with this resistance unshunted; there is then a small amount of negative feed-back. Using a small capacity for C23 results in the gradual removal of this feed-back at high frequencies, with the result that the frequency response rises also. This proves advantageous in correcting in some degree for the falling characteristic of the RF and IF circuits. Only a small degree of correction is possible in television if phase distortion is to be kept low, but the inclusion of C23 does appreciably improve the picture definition.

Turning now to the time-base, two saw-tooth oscillators are included for generating the line and frame scanning currents. These valves are V12 and V15

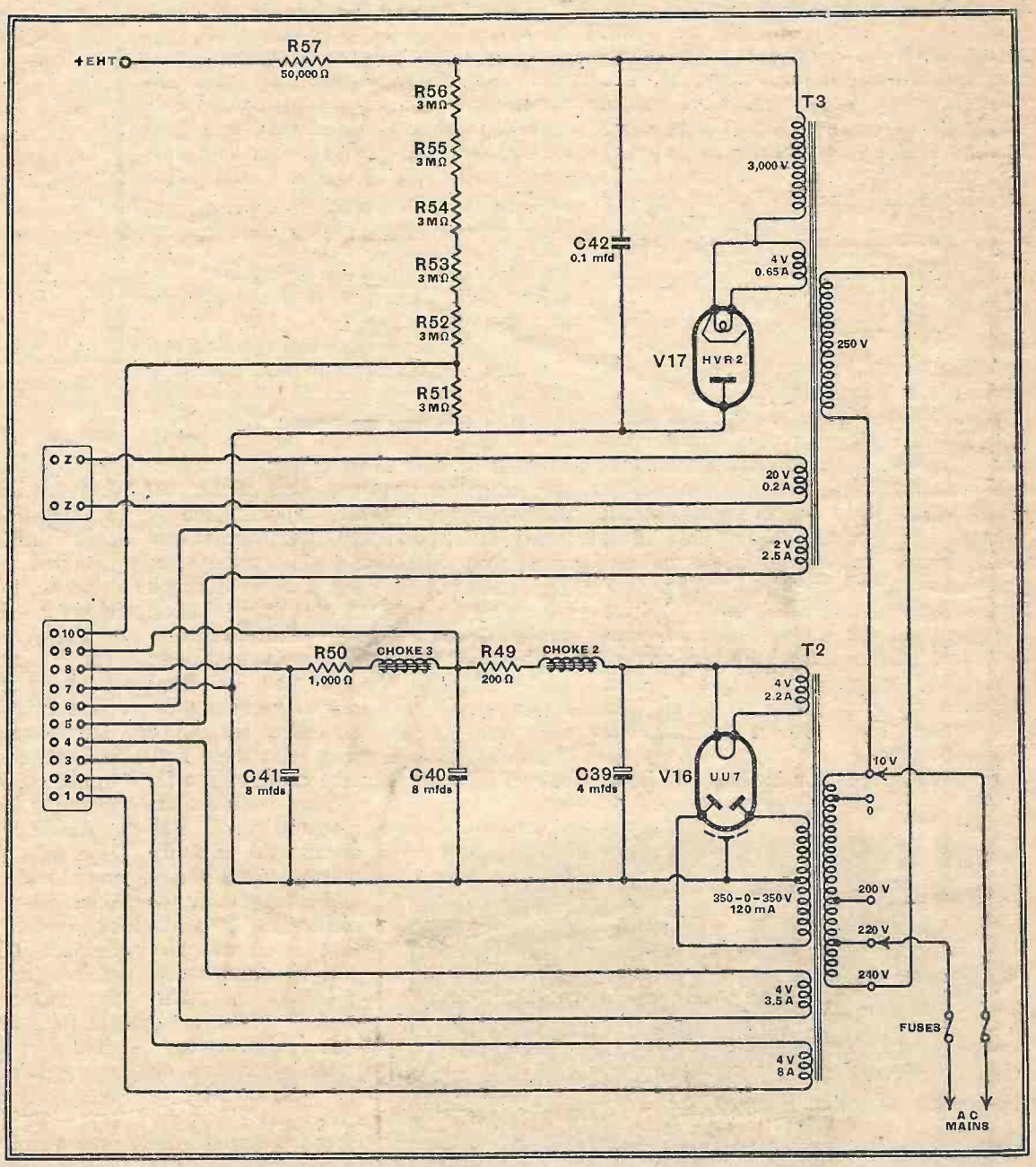


Fig. 2.—This diagram shows the circuit of the power unit. The rectifier V16 supplies HT for everything except the tube, the supply for which comes from the high-voltage rectifier V17.

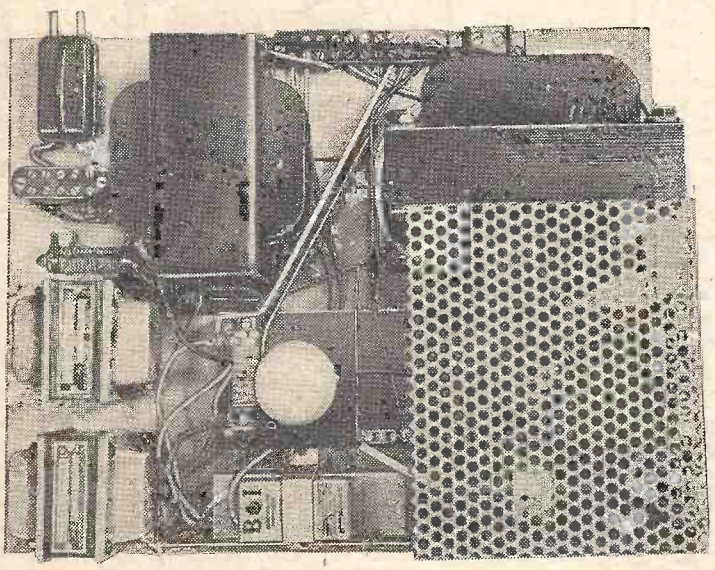
respectively. The arrangement adopted here is the one recommended by Baird Television, Ltd., the makers of the tube, from whom the necessary coils can be obtained. Its great advantage is its economy, for the whole time-base consumes only about 40 mA at 330 volts, as compared with about 120 mA for the conventional circuits with saw-tooth voltage generators and pentode amplifiers.

In the case of the frame oscillator, giving the vertical deflection, the oscillator coils are also the deflector coils. The coils L14, L15, L16 and L17 are wound on a common iron core, the ends of which are extended upwards and provided with pole pieces between which the neck of the tube is placed. L14 and L15 are the two windings of a reaction-coil oscillator, and L16 and L17 are provided merely to ensure a negligible DC magnetisation of the core.

The Frame Oscillator

At the start of the scan stroke the grid of V15 is at about zero voltage, or only a small amount negative, and the anode potential is fairly high. As a result the anode current rises, but not instantaneously as in a resistive circuit; the current takes time to rise. The changing current through L15 produces a back EMF in it, which acts to reduce the anode voltage, and at the same time it induces an EMF in the grid coil L14 which tends to drive the grid positively. Grid and anode current flow through L14 and L15 respectively and oppose one another in their effect on the core. The net result is a substantially linear rise in the magnetic field with time.

The feed-back action in the valve is, of course, regenerative in that the positive induced voltage in L14 tends to increase the anode current and drive the grid still more positive. After a time, however, the rate of change of anode current begins to fall off, with the result that the grid becomes less positive and the rate of change of current falls off still more rapidly.



A view of the power unit, showing the protecting screen over the high-voltage equipment.

When this happens the back EMF across the anode coil changes sign to try to maintain the anode current and the EMF induced in the grid coil also changes sign and drives the grid negative. The grid circuit wins in this battle and the valve is very rapidly driven beyond anode current cut-off. The anode current then becomes zero and the magnetic field collapses.

Actually, on the fly-back the grid may be driven about 2,000 volts negative and the anode about the same amount positive. V15 operates with heavy grid and anode peak currents at low voltages during the scan stroke, and very high grid and anode peak voltages, but zero current, during the fly-back. The valve used must consequently be able to withstand these severe conditions and the coil makers recommend the Mazda AC/P. On account of the high voltage the condenser C33, which shunts L14, must be of 2,000 volts rating.

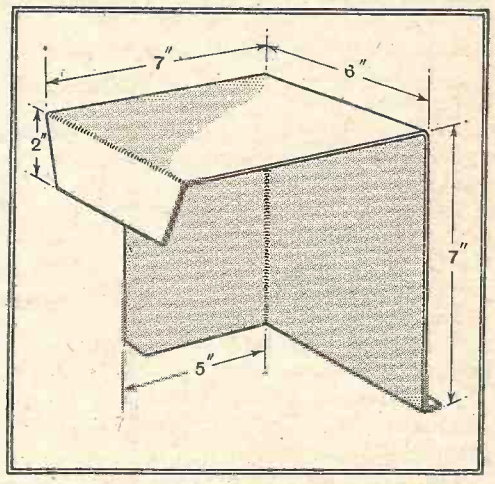
Although the currents through L14 and L15 are in opposition, their magnetic effects on the core do not balance, and the grid coil predominates. The effect is to deflect the picture off the screen of the tube, and to avoid this it is necessary to balance out the effect of the predominating grid circuit. This is done by means of L16 and L17, which are wound on the opposite side limbs of the core. The mean anode current flows through these and gives a total core magnetisation which is zero and so a central picture.

The saw-tooth current is not permitted to flow through L16 and L17, but flows through C36. In order to prevent these coils from loading the others the choke Ch1 is included in series with them and has an inductance of the order of 100 H.

Two controls are provided. R45 allows the anode voltage to be varied and consequently the picture height, while R43 controls the grid bias and consequently the saw-tooth frequency.

A negative sync pulse is required on the grid, but it cannot be applied directly, because the impedance of the coupling circuits would shunt L14 and seriously lengthen the fly-back time. The pulse is, therefore, applied through the diode V14 from the RC coupling C32 R41. The pulse drives the diode cathode negative so that it becomes conductive and allows the pulse to reach the grid of V15. The fly-back voltage across L14, however, drives the diode anode negative and thus renders it non-conductive.

The line oscillator V12 is essentially the same as the frame, but the oscillator coils are separate from the deflector coils. The mean current no longer affects the position of the picture, and the balancing coils of the frame circuit are unnecessary. A minor point of difference is that the bias voltage is developed by grid current alone through R37 and R38, instead of by both grid and anode currents. L11 and L12 are iron-cored and L11 acts also as an auto-transformer to feed the deflecting coils through C29. These coils are mounted round the neck of the tube and have an iron shroud which has projecting tags for screwing to the frame yoke.



This diagram gives the dimensions of the protecting screen, which is made of 20-gauge perforated zinc.

The valve used here is the Cossor 41MP, and the peak voltages developed on it are certainly not less than those on the frame oscillator, so that high insulation is needed everywhere. The sync pulses are applied as in the frame circuit through a diode V11, and for the same reason.

Anode circuit decoupling is provided by R39 and C31. The resistance is not made variable for a control of picture width, since it has been adjusted to give the correct width with the tube anode voltage used. It is only necessary to vary the picture height by R45 in order to obtain the correct picture ratio. If for any reason a change of picture width is desired R39 can be altered, a lower resistance giving a wider picture and vice versa. With an HT supply of 330 volts R39 should not be less than 500 ohms, or the amplitude may become excessive and the insulation of transformer or valve may break down. Similarly, R44 in the frame circuit should not be reduced below 20,000 ohms.

The Damping Valve

The diode V13 is provided to damp out oscillation on the fly-back. Without this valve the resonant circuit, consisting of L12 with the stray capacities, is kicked into oscillation, and the normal large rise in anode potential is followed by a fall of nearly equal magnitude, then another rise and so on. V13 is non-conductive as long as the anode of V12 is positive with respect to its own cathode, but becomes conductive when the anode of V13 swings

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negative. It does this on the negative half-cycles of the oscillation, and these are consequently heavily damped.

As the valve has to withstand high voltages it must be carefully chosen, and the Mullard UR1C is used. This is an AC/DC rectifier with a 20-volt heater. A separate heater winding is in any case necessary for this valve on account of the high peak voltage on the cathode, so that this unusual voltage rating does not matter. The heater winding and its wiring should be insulated for some 2,000 volts.

In the feed circuit from the sync separator to the time-base R34 and C27 are not really decoupling components, although they look like it, and actually act as such at line frequency. They are really the impedance across which the frame sync pulses are developed, and form an integrating circuit.

The time-constant is rather larger than usual, but was chosen experimentally and found to give the best results. With careful setting of the frame frequency control quite good interlacing can be obtained, but it is rather more difficult to secure than with some other forms of time-base, because it is harder to avoid coupling between the two oscillators.

This coupling occurs in two places, through the anode-cathode capacity of V11 and through the magnetic circuit directly between L13 and the frame deflector assembly. The latter is the more important and it seems impracticable completely to eliminate it.

The focus coil L18 is in series with the HT supply to the time-base, and the current through it can be adjusted precisely by R47.

LIST OF PARTS

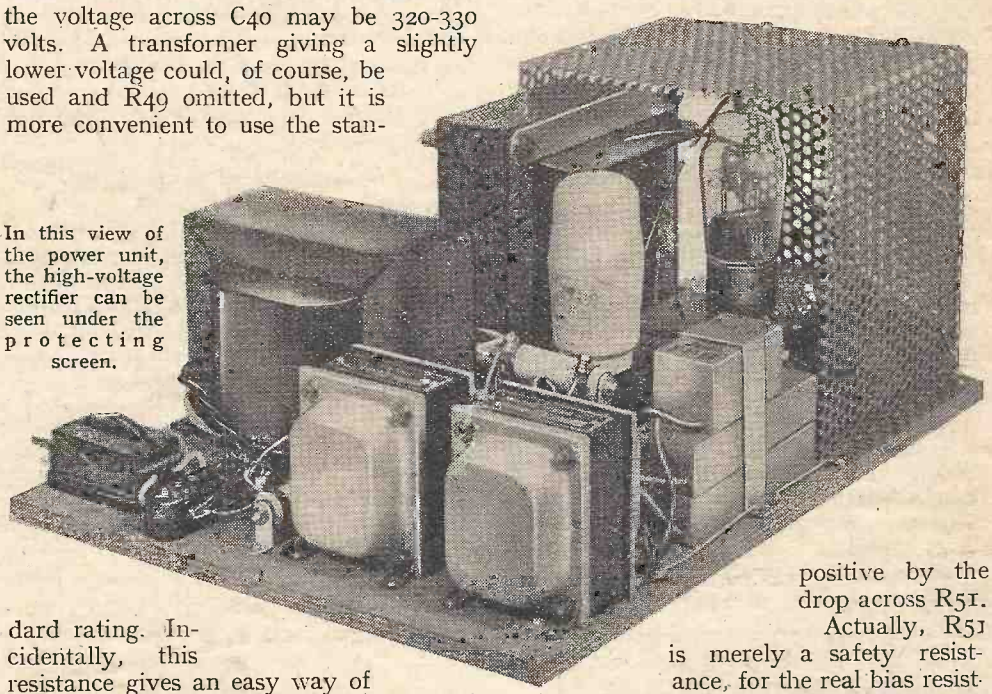
POWER UNIT.

1 Mains transformer Primary, 200-250 V; Secondaries, 350-0-350 V, 120 mA; 4 V, 2.2 A; 4 V, 3.5 A; 4 V, 8 A.	Partridge WW/T2
1 Mains transformer Primary, 250 V; Secondaries, 3,000 V, 0.5 mA; 20 V, 0.2 A; 4 V, 0.65 A; 2 V, 2.5 A.	Partridge WW/T1
2 Smoothing chokes, 10 H, 120 mA, 200 ohms, **Ch2, Ch3**	Sound Sales H10/120
Condensers:	
1 4 mfd., electrolytic, 500 V, **C39**	B.I. E.C.S.20
2 8 mfd., electrolytic, 500 V, **C40, C41**	B.I. E.C.L.40
1 0.1 mfd., 4,500 V tubular, **C42**	B.I.
Resistances:	
1 1,000 ohm, 20 watts, **R50**	Bulgin PR5
1 50,000 ohm, ½ watt, **R57**	Erie
6 3 megohm, ½ watt, **R51, R52, R53, R54, R55, R56**	Erie
1 200 ohm, 20 watts, **R49**	Bulgin PR24
1 Valveholder, 4-pin	Clix X111
1 Valveholder, British octal	Clix X128
1 Connector, 10-way	Bryce 5C6
1 Connector, 5-way	Bryce 5C4
1 Connector, 2-way	Bryce 5C1
1 Fused plug, 2A fuses	Belling-Lee 1114
1 Terminal	Belling-Lee B1001
Baseboard, panel, etc.	Peto-Scott
Valves:	
1 HVR2	Mullard
1 UU7	Mazda
	Reliance "TW"

In the list of parts, for the receiver unit, included in last week's instalment, the six valveholders, British octal chassis mounting type, should have been referred to as Clix X128.

We now come to the power supply unit, the circuit diagram of which is shown in Fig. 2. A standard 350-0-350 volt 120 mA. transformer with 4-volt windings giving outputs of 8 amperes and 3.5 amperes for the valve heaters in the receiver and time-base respectively is used. The rectifier is a UU7 with a 4-μF reservoir condenser C39.

A single stage of smoothing with Ch2 and C40 is used for the time-base HT supply, and a 200-ohm resistance R49 is inserted in series with Ch2 in order that the voltage across C40 may be 320-330 volts. A transformer giving a slightly lower voltage could, of course, be used and R49 omitted, but it is more convenient to use the standard rating. Incidentally, this resistance gives an easy way of adjusting the time-base voltage if different components are used.



In this view of the power unit, the high-voltage rectifier can be seen under the protecting screen.

The time-base is fairly critical on voltage, and if it is too great the picture will not only be too large but the current through the focus coil will be too great, even at the maximum value of R47. It is important to keep the voltage across C40 at about 320-330 volts.

The second choke Ch3 and C41 give additional smoothing for the receiver, and R50 of 1,000 ohms is included to drop the voltage to about 250 volts, or slightly less. The receiver consumes nearly 80 mA. at full gain.

The high-voltage transformer has a 3,000 volt winding and also carries the 2.5-volt winding for the tube heater and supplies 20 volts at 0.2 ampere for the UR1C heater. An indirectly heated rectifier is used for the high-voltage in order to permit time for the tube heater to warm up before the voltage is applied to it.

The peak voltage is 4,250 volts and the 0.1 μF. reservoir condenser C42 is rated for 4,500 volts. It should be noted that the peak inverse voltage across the valve may reach 8,500 volts. This also appears between certain windings on the transformer, and it is essential that a high quality component be used. A poor transformer will soon break down.

As the tube current is very small no smoothing is necessary for the anode supply, for the mean voltage across C42 is nearly equal to the peak voltage—say, about 4,000 volts. A safety resistance R57 of 50,000 ohms is connected in the tube anode lead to prevent damage in the event of a short-circuit.

A bleeder resistance of 12-15 MΩ is connected across C42. It acts as a safety device to ensure that C42 is always discharged a short time after switching off, and it also enables the tube bias to be readily obtained. The tube cathode is joined to the junction of R51 and R52, while the grid is returned through the input circuit to earth. The cathode is thus positive by the drop across R51. Actually, R51 is merely a safety resistance, for the real bias resistance is the 0.5 MΩ variable resistance R48 in the time-base. This is shunted across R51 and is generally used with a value small in comparison with R51. This last resistance is included merely to make certain that there is always a bleeder across C42. Without R51, there would be no resistance shunt across this condenser if an inter-unit lead broke or if R48 developed an open circuit.

The bias supply needs smoothing, but this is readily done by shunting R51 by a 0.5 μF. condenser C38. Again this is in the time-base.

The Controls

The high-voltage transformer has an untapped primary wound for 250 volts, and it is permanently connected across the 250-volt tapping on the other transformer. The mains are connected through fuses in the usual way to this low-voltage transformer, and on voltages other than 250 its primary acts as an auto-transformer to feed the high-voltage transformer.

An examination of the diagram of Fig. 1 will show that, apart from the RF, IF, and oscillator tuning controls, there are six variable resistances. Of these, four are regarded in the nature of occasional controls and their knobs are intended to be inside the cabinet. They are arranged in such a position on the chassis, however, that extension rods are easily fitted so that, if desired, they can be made panel controls. These controls are focus,

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picture height, and line and frame frequency

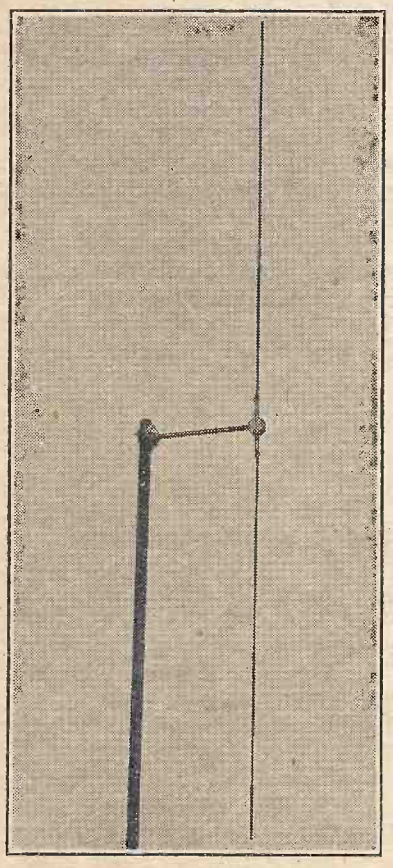
The panel controls are two only—receiver gain and tube bias, which act as brilliancy and contrast controls. These variable resistances are not mounted on the chassis, but are connected to it by long flexible leads so that they can be mounted on the cabinet in any convenient position. Actually, there is no limit to the length of these leads, so that if desired they can be extended for several yards. The two controls can thus be mounted in a remote control box if desired so that adjustments can be carried out at the normal viewing distance. This is, perhaps, an unneccessary refinement, for the controls rarely need adjustment during a programme, but it may appeal to some.

Wolsey Television Aerials

THE outstanding features of these aerials are their low weight (the single dipole weighs only 2½ lb.) and their small wind resistance. The rods are formed by thin-walled aluminium tubes closed at the ends and anodised to resist corrosion.

All interior connections are made inside a waterproof junction box with screwed sockets and rubber seals at all joints. A bracket and bolts are supplied for fixing to a mast or chimney and the price complete is £1 7s. 6d.

A reflector type aerial for masthead mounting can also be supplied and the cast



Wolsey type WT/U dipole aerial.

aluminium mast cap is designed for a 2in. diameter pole. The price is £2 15s.

The single dipole aerial can be supplied for 5-metre work with shortened rods to resonate in the 56 Mc/s band at no extra charge.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Qualifications for Service Personnel

WITH reference to the duel, Cpl. Clarke *versus* Mr. Morrow, it seems to me obvious that Mr. Morrow has got hold of some truth and Cpl. Clarke has taken him the wrong way.

As an ex-member of H.M. Forces and a graduate of the "Signal School," I can truthfully speak from experience.

The facts are these:—

Far many more operators (i.e., those who will operate and do not wish to pull the gear apart) are required than "technical wizards." This is true of all the Services, and time has proved it.

Therefore the Services aim at producing the operator first and telling him just what he needs to know about the gear to work it with efficiency. If he is desirous of increasing his technical knowledge without detriment to his "operator's efficiency," then he is certainly not discouraged.

This is the age of specialisation, and a separate staff is trained to deal with the purely technical side, and this is no doubt a desirable state of affairs, ensuring the maximum efficiency of the communications of the modern fighting services.

STANLEY GARNETT, Sgt. R.A.

Bolton, Lancs.

High-quality Recordings

WE note with interest Mr. Greatorex's suggestion in *The Wireless World*, of June 22nd, that recording companies be persuaded to catalogue records of particular interest on the score of technical excellence. We ourselves would be very glad if they were to do something of this kind, as we have considerable difficulty in finding what we term suitable demonstration records, but we fear that they are not likely to do so, (a) because it would mean admitting that some records were inferior to others, and (b) because it is probable that there will be differences of opinion as to whether a given record is outstanding from a technical point of view.

From the fact that Mr. Greatorex suggests that we might be able to furnish a useful list, it would seem that he has attended one of our demonstrations and that his opinion of outstanding records agrees fairly closely with our own.

As we do not spend our time going through lists of records as released, we are not really in a position to give him the information he requires. It is noteworthy, however, that the percentage of first-class records amongst those released during the last few years is much higher than among the records of five or more years ago.

A useful clue is to examine the outer edge of the record. If there is a "running in" line, it is probably a recent recording. By this we do not condemn all records without a "running in" line. Actually, most of our collection dates back to the time before "running in" lines were general.

Our own collection of records has been selected mainly with the object of demonstrating various features in sound reproduction, and it was necessary firstly that the records should be musically interesting to a mixed audience (which excludes many high-brow records) and secondly, that the parts to be demonstrated should be localised. That is to say that a half-minute extract should suffice to demonstrate the particular feature for which that record was selected. On those occasions when we have run through a few records to see if they were suitable, we have judged them as follows:

(a) Surface noise.
(b) General effect, i.e. quality, musical balance, etc.
(c) "Entertainment Value" (remembering the mixed nature of our average audience).
(d) Whether or not the record discloses any feature in reproduction not already covered by other records we have available.

We ask Mr. Greatorex and others to bear these facts in mind when studying the list below. You have been warned!

Organ pedal note.	Frasquita Serenada ...	Parlo. F.843.
	Intro. and finale ...	Col. DX.457.
Double bass (plucked)	Blues of Israel	Parlo. R.2224.
	Sylvia Ballet	H.M.V. C.2696.
Bass transient	Nutty Woods	Col. F.B.2120.
Xylophone		
Jazz drums	Blues of Israel	Back of above.
Drum and orchestra	Don Juan (recording slightly high pitched)	Telefunken S.K.2743
Piano	Rhapsodic Espagnole ... Charlie Kunz (chosen for quality rather than low surface noise)... ...	H.M.V. D.B.2375.
		Rex 8783.
Piano and orchestra	Piano Concerto	Col. L.X.683.
	Piano Concerto	Col. L.X.790.
	Rondo in A Major ...	Parlo. E.11292.
Violin	Albert Sandler	Col. F.B.1769.
	Kriezler	H.M.V. D.A.1627.
Trumpet	Trumpet Voluntary ...	Col. L.1986.
Triangle	Piano Concerto above ...	Col. L.X.790.
Vocal	Tenor voice	Telefunken S.K.B. 02047.
	Paul Robeson (Trees) ...	H.M.V. B.8830.
A few others	Facade	H.M.V. C.2837.
	Prince Igor (50 cycle hum recorded in certain parts of record) ...	Col. L.X.369.
	Fair Maid of Perth ...	Col. L.X.317.
	Rhapsody in Blue ...	Parlo. E.11320.
	Saxophone	Col. F.B.1834.
	Meet me by the Ice-house, Lizzie	Rex. 8745.
	Laudate Dominum (echo very effective) ...	H.M.V. C.2736.
	Bugle Call Rag	Parlo. F.1077.
	Cinema Organ (Teddy Bears' Picnic)... ...	Reg. Zono. M.R.1750

London, S.E.26. P. G. A. H. VOIGT,
Voigt Patents, Ltd.

A.R.P. and the Amateur

I READ the letter by Mr. Corsham (G2UV) in *The Wireless World* of June 29th with considerable interest, as I happen to be in charge of the Wireless Section of our O.T.C. We were due to take charge of the second-line communications for the South Bucks Area A.R.P. Council, which includes Slough, when this Council received an intimation from the Home Office that no wireless communication was to be used for A.R.P.

I think that this disposes of the charge that the Home Office are refusing amateurs' services merely because they consider them to be incompetent, since this Section, for whose training I am responsible, is presumably competent—at least I hope so—and, at any rate, is organised and disciplined. Yet, even under these circumstances, the Home Office have refused to allow R/T communication.

I have heard on very good authority that the reason for this is that the signals might be used for D/F. I know very little about D/F, but it seems very improbable to me that an invading aeroplane would carry D/F apparatus capable of taking a bearing on low-power, heavily modulated, unstabilised transmission on 60 Mc/s.

I would be interested to know if any of your readers in this district have received

any of our transmissions. The Section has been going since November, and we have been on the air at intervals since then. Since May, when I took over, we have used the call-sign EC 1—8. We finally decided on a main frequency of 64 Mc/s with subsidiary channels on 62 and 61. The rigs are transmitter-receivers with a two-stage AF. They are exceedingly portable, one man being able to operate one on the march. If anyone has received these transmissions I would very much like reports to be sent to me, c/o The Orderly Room, Eton College, Windsor.

M. C. STANLEY,
Corporal i/c Wireless Section,
Eton College O.T.C.

I HAVE read Mr. Corsham's remarks with much interest, and can heartily endorse his sentiments.

Obviously, the Home Office must realise the value in an emergency of W/T communications over line, and would welcome the help of a highly organised body of amateurs. Unfortunately, however, this, so far as the amateur transmitter is concerned, will mean *de jure* recognition and the continuance in war-time of their stations, which Government Departments, including the Post Office, seem least of all to wish.

Unfortunately, the status of the amateur in this country is still somewhat low, and, despite the activities of the R.S.G.B., we must admit that British transmitters are not so highly organised as our American friends under the auspices of the A.R.R.L.

It is a pity that the R.S.G.B. could not have worked more closely with the R.N.W.A.R., which was almost boycotted by a large number of amateur transmitters in this country, and it remains to be seen whether the C.W.R., "born in the lap of the crisis," can get along better with the R.S.G.B. or without it.

I cannot speak too highly, after six years in the R.N.W.A.R., of the knowledge of operating procedure and organisation that one derives from this experience, and without a similar organised body the present state of amateur transmitting would, in my opinion, be totally unsuitable for emergency work.

My suggestion is that the R.S.G.B. organise at once a body of transmitters who are willing to train themselves in suitable operating procedure on the lines of that used by the Navy and Army, and to keep a separate CW transmitter especially for this work. No doubt the Post Office would willingly grant a suitable frequency channel to be used in conjunction with the scheme when they realised that it was for emergency communication, and not for the endless "rag-chewing" and "QSL-hunting" which goes on on some of the frequencies allocated to us.

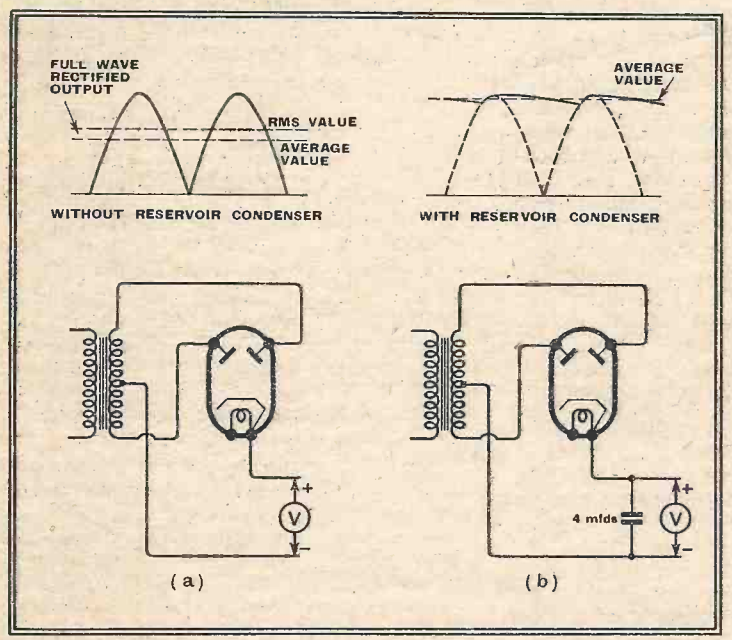
LEONARD H. LEE (G5FH).
Oldbury, Worcs.

HENRY FARRAD'S SOLUTION

(See page 29)

THERE is no need to suggest a method of testing the rectifier because there is no real ground for suspecting that there is anything the matter with it. "Unsmoothed rectifier voltage" means the voltage measured without smoothing choke or condenser, but *with* a reservoir condenser—usually 4 mfds. In Mr. Cowe's test he used only the transformer and rectifier (according to his own statement); so the reservoir condenser was lacking and the voltage across the meter followed the AC half-cycles exactly (see (*a*)) except for a small drop in the rectifier. A DC voltmeter measures the *average* value, which is about 10 per cent. lower than the RMS value. The RMS value is nominally 250 volts in this case; but, as that is presumably at full load, the voltage when loaded only by a voltmeter is slightly over—say, 265. The average value is therefore 238, so allowing for a normal small loss in the rectifier 228 is quite as it should be.

When a reservoir condenser is used, as at (*b*), it charges up to practically the *peak* value of the input—over 40 per cent. higher than the RMS value—and having nowhere to discharge except through the voltmeter it drops only slightly between peaks, and the reading would be perhaps as high as 350 volts. On load it drops to about the values stated in the Valve Data Supplement.

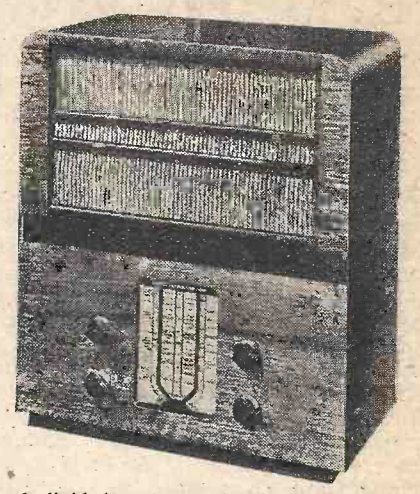


Diagrams illustrating Henry Farrad's solution of Philip Cowe's problem.

McMichael Models 390 and 399

TO meet the demand for a three-waveband AC mains receiver at a price under £10, McMichael have developed the Model 390 three-valve superheterodyne with triode-hexode frequency changer, pentode IF amplifier and double-diode-tetrode signal rectifier, AVC rectifier and output valve. The short-wave range is from 18.5 to 50 metres and an illuminated tuning scale of new design is subdivided into sections for each waveband with an indicating pointer ganged to the waverange switch. The price is £9 7s. 6d.

In the Model 399, which is the battery equivalent of the Model 390, a double-diode-triode is used for signal rectification, AVC and first-stage AF amplification, with a separate pentode in the output stage rated at 400 mW. The price is £8 15s. (batteries 21s. extra).



A sub-divided tuning scale of new design is a feature of the McMichael Models 390 and 399.

Television Programmes

THURSDAY, JULY 13th

3-4.15, "Luck of the Devil," a Parisian fantasia by Lynton Hudson, based on Leonard Sachs' recent production at the Players' Theatre, Covent Garden.

8.15, "The Desert Song," O.B. from the Garrick Theatre of the entire performance. **11.20,** News.

FRIDAY, JULY 14th.

3-5, Wendy Hiller as Grace in "The Fame of Grace Darling," a new play by Yvette Pienne.

9, "La Chauve-Souris" in selections from their repertoire. **9.35,** British Movietonews. **9.45,** Fencing: bouts at Foil, Epée and Sabre. **10.5,** Cartoon Film. **10.10,** Film, "Zoo Babies." **10.20,** E. H. Tattersall: "Club Cricket." **10.25-10.35,** Music Makers.

SATURDAY, JULY 15th.

3, Intimate Cabaret. **3.30,** Cartoon Film. **3.35,** British Movietonews. **3.45,** C. H. Middleton, "In Our Garden."

9-10.30, "Sheppey," a dramatic comedy by Somerset Maugham.

SUNDAY, JULY 16th.

8.50, News. **9.5-10.35,** "Bridge Head," Rutherford Maynes' drama of Irish life.

MONDAY, JULY 17th.

3, Scenes from the Ambassadors Theatre show, "The Gate Revue." **3.45,** British Movietonews. **3.55,** Cartoon Film.

9, "Me and My Girl," the Victoria Palace performance in its entirety. **11.25-11.45,** News.

TUESDAY, JULY 18th.

3-4, Western film, "Whistling Bullets."

9, Cantu (The Mexican Magician) and Oliver Wakefield. **9.20,** British Movietonews. **9.30,** "The Parnell Commission," a reconstruction of the famous forgery investigation of 1888–89.

WEDNESDAY, JULY 19th.

3, Riding School—the whys and wherefores of good horsemanship demonstrated by Major Faudel-Phillips. **3.15,** British Movietonews. **3.25,** Cartoon Film. **3.30,** Punch and Judy. **3.40,** Leonard Henry and Eric Cardi (Conjuror).

9, Rough Island Story—No. 5, "The New World." **9.25,** Cartoon Film. **9.30,** Starlight: Claude Dampier and Billie Carlyle. **9.40,** Gaumont British News. **9.50,** "Heurigen Garden," programme of Viennese songs and dances.

RANDOM RADIATIONS

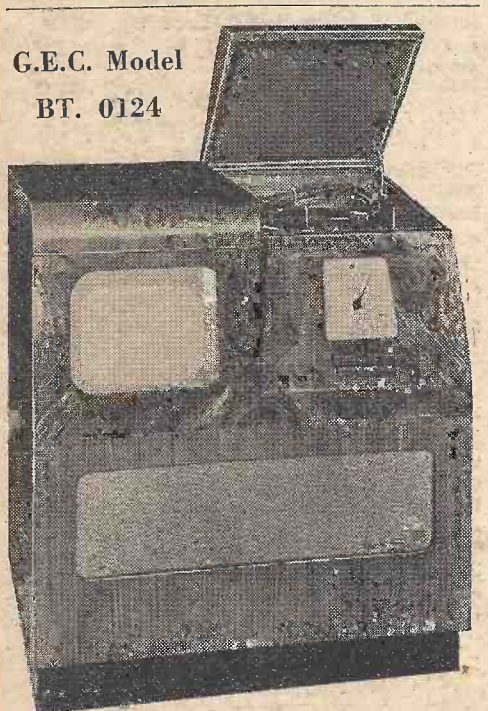
By "DIALLIST"

A Set for a Yacht

A FRIEND of mine wants a new set for use aboard his yacht. Hitherto he's been using a battery superhet worked off the normal 2-volt accumulator and dry HT battery. But the yacht has a large-capacity 24-volt DC lighting set, and it seems that use ought to be made of that. There are three ways of doing it, so far as I can see. The first is to use a nickel-cadmium accumulator HTB, so arranged that it can be charged direct from the lighting set by switching the cells into parallel groups of about 20 volts each. No. 2 is to fit a vibrator unit to provide the HT current. Nos. 1 and 2 both involve a charging board of some kind for the filament accumulator. The third possibility is an AC set worked by means of a rotary converter. Remembering that there is plenty of "juice" available, which of the three do you favour? All things considered, I am inclined to vote for the vibrator unit; but I'd be glad to know the recommendations of any readers who may have had practical experience of this or the other two methods in small ships.

An Omission

IT'S not often that an outstanding item forms part of one of the Empire programmes only and doesn't get into those of either the Regionals or the Nationals. But there was such an item the other day, and why it was made "Empire only" I can't think. I'm referring to "the Indian Police," presented by Mr. E. W. C. Wace, a Deputy Inspector-General of the Punjab, and three other officers of the same province. It was an absolutely first-rate account of life and activities in that fine force, full of interest from start to finish. The Empire programmes are published in few papers, so not many people in this country knew that this item was coming on; yet there must be thousands who would have liked to hear it. In my own little town there are a dozen households with members or relatives or friends in the Indian Police; of course, they all wanted to hear it, but some of them hadn't all-wave or short-wave sets, so I had a bumper audience, with two sets going in different rooms. The item was recorded; I hope, therefore, that the B.B.C. will put it into one of the medium-wave programmes. You'll like it if they do so.



Extensive use has been made of push-button control in this combined television and all-wave auto-radiogram just introduced by the General Electric Co., Ltd. In addition to eight buttons for station selection, there are seven additional buttons for complete television entertainment, television sound only, gramophone reproduction and waverange switching. The picture size is 10in. × 8in. and the price is 72 guineas.

"Passed to You, Please"

HARD, sometimes, is the lot of the dweller of the more out-of-the-way places of the Empire who would buy British wireless goods. I've given some instances before of the difficulties and delays that he may encounter. Here's another that has just reached me. A reader who lives in North-Eastern Rhodesia was advised by the Secretary of the R.S.G.B. that batteries of a certain make and kind might meet the somewhat exacting requirements of the local climate and conditions. In March last he wrote to the makers in this country asking for the address of their South African agents, or those in Southern Rhodesia, if there were such. The company's South African branch wrote on April 17th from Johannesburg that their Rhodesian agents at Bulawayo would give all the information required. He wrote to Bulawayo, asking for prices and particulars, and received, the following month, a reply from them stating that his inquiry had been referred to Johannesburg. They added, rather cryptically, that all inquiries by my reader would be dealt with by the Northern Rhodesia office at 'Ndola!

Still Waiting

'Ndola, he 'ntells me (sorry, but those 'ns are catching!), would be useless, as it's on the western side of Rhodesia; but, hearing a rumour of the presence of agents at Salisbury—his nearest town, a mere 500 miles away—he has written there in hopes that something may happen; but he is quite expecting to be referred to Bulawayo, Johannesburg, or even London, if and when he gets a reply. Meantime, after more than three months, he is still without the batteries that he wants; he hasn't even got the particulars of them or their prices. It appears to be, as is so often the case, the agents who are to blame. British radio firms would do well to see that their agents abroad are selected with care—and kept up to the mark.

Start Point

SO far I haven't had many reports about reception of Start Point from dwellers in the West Country, but those that have come in all speak well of the new station. I shall have the opportunity of trying it on the spot myself in a week or two, for I'm off to camp in Cornwall. When I was last in that county, a couple of years ago, there wasn't a single home station that I could receive well, though I took down a big set with me. It's a queer thing to have to say of a place in England, but we relied both for news and for entertainment mainly on the French stations! I hope I'll find that Start Point has made a big change and that I'll be able to get my news from the home station and not have to go abroad for it. I'm afraid I sha'n't have much time for DX; more's the pity; I should very much like to try the short waves on the west coast of Cornwall.

The Wireless Industry

A SWISS firm wishes to get into touch with a wholesale supplier of thorn gramophone needles. Letters addressed to this office will be forwarded.

Leaflet Com. A-7 issued by Marconi-Ekco Instruments, Ltd., Electra House, Victoria Embankment, London, W.C.2, deals with the RF attenuator, TF360. Designed for use at frequencies up to 25 Mc/s., this instrument incorporates a thermal milliammeter and has a range of 0-120 db.

A second edition of descriptive pamphlet 11a dealing with battery-charging sets has been received from Westinghouse Brake and Signal Co., Ltd., 82, York Way, King's Cross, London, N.

Full details and prices of the new "Tropa" wire-wound potentiometers for use under tropical conditions are included in Catalogue Supplement No. 1 recently prepared by F. W. Lechner and Co., Ltd., 5, Fairfax Road, London, N.W.6.

Hamrad Wholesale, Ltd., 32, St. Lawrence Terrace, London, W.10, have sent us a comprehensive list of short-wave components and materials and technical details of a new 12-valve communication receiver (Type 140). This instrument, which costs £27 10s., is fitted with a crystal gate and covers 9 to 600 metres in five bands.

Club News

Watford and District Radio and Television Society

Headquarters: Carlton Tea Rooms, 77, Queens Road, Watford, Herts.
Hon. Sec.: Mr. P. G. Spencer, 11, Nightingale Road, Bushey, Herts.

Mr. E. L. Gardiner gave an interesting talk on "Five-metre Aerials" at the last meeting. On July 15th Mr. A. W. Birt will demonstrate some portable receiving apparatus for five-metre work.

International Short Wave Club (London Chapter)

Headquarters: R.A.C.S. Hall, Cavendish Grove, Wandsworth Road, London, S.W.8.
Hon. Sec.: Mr. A. E. Bear, 100, Adams Gardens Estate, London, S.E.16.

At a meeting held on June 30th a lecture was given by Mr. M. Westcombe, of the United Insulator Co., Ltd. The lecturer's subject was "HF Insulators," and he illustrated his remarks with lantern slides and also with experiments conducted with cathode-ray oscillograph apparatus.

Slough and District Short-Wave Club

Headquarters: 35, High Street, Slough, Bucks.
Meetings: Alternate Thursdays at 7.30 p.m.
Hon. Sec.: Mr. K. A. Sly, 16, Buckland Avenue, Slough, Bucks.

At the meeting held on June 22nd the evening was devoted to morse practice. A discussion took place as a result of which it was decided that a period should be devoted at every meeting to the consideration of members' difficulties. At the next meeting, on July 6th, Mr. J. Paine gave a talk entitled "Arranging and Operating a Portable Station for the National Field Day." A discussion also took place about plans for a local field day.

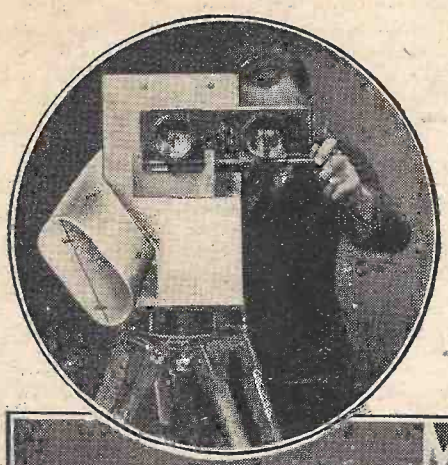
South London and District Radio Transmitters Society

Headquarters: Brotherhood Hall, West Norwood, London, S.E.
Meetings: First Wednesday in the month.
Hon. Sec.: Mr. E. Ilott, 36, Montana Road, Upper Tooting, London, S.W.17.

It is desired to call attention to the fact that there has been a change in the name and address of the Secretary. Details are as given above.

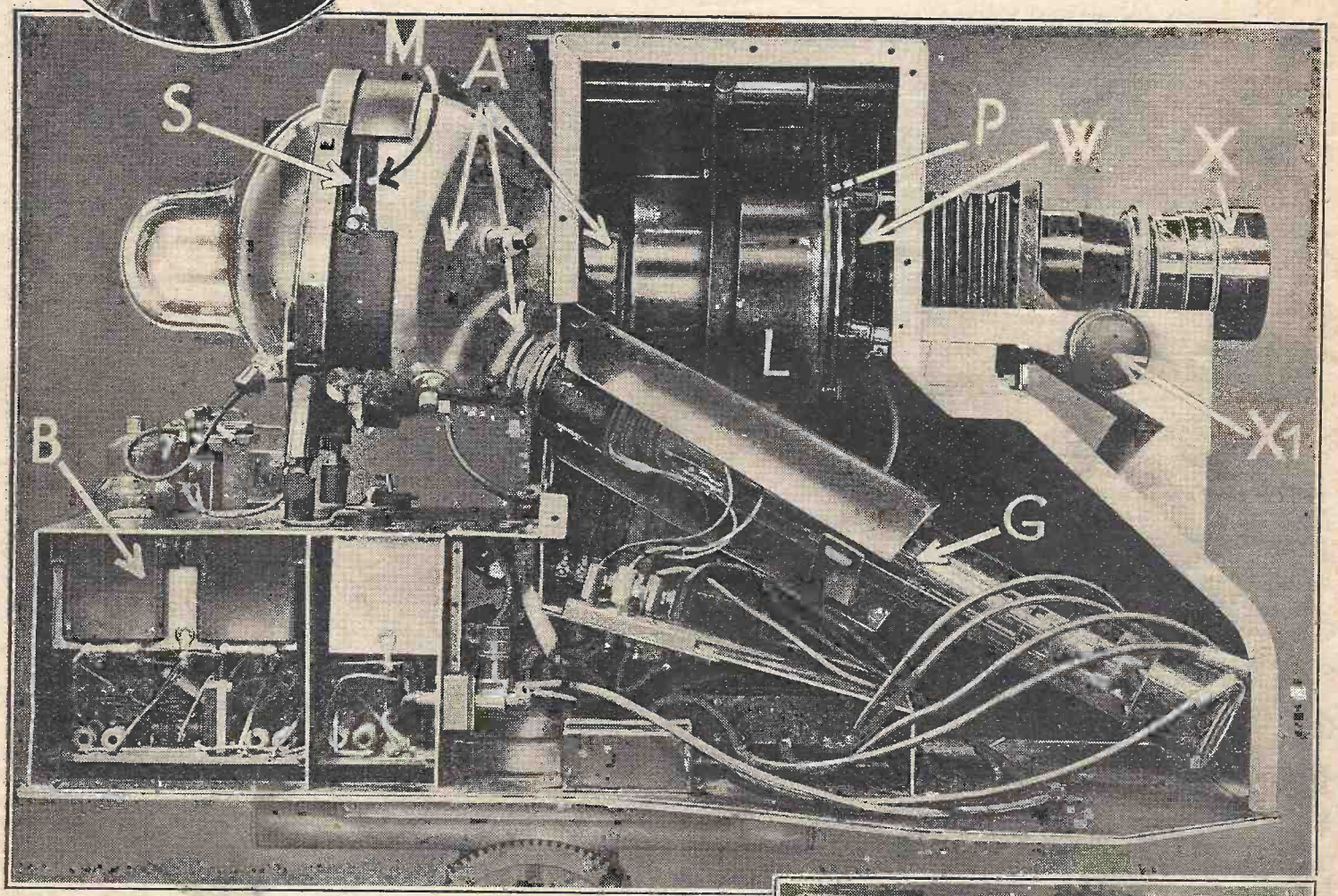
The Television Camera

Converting an Optical Image into a Train of Electrical Signals

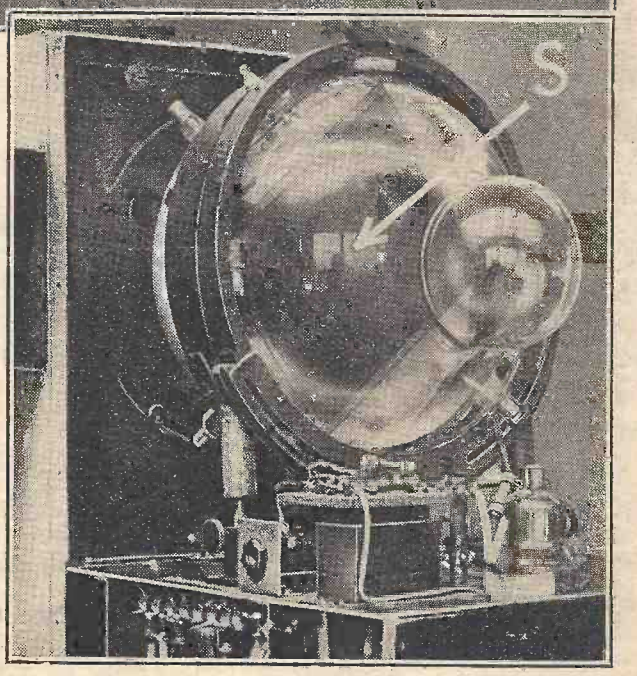


JUST as a microphone converts audible sounds into a train of electric waves, so the Super-Emitron camera converts a visible picture into a similar series of waves which, after transmission and reception, are reconstructed into an image of the original scene.

The lens X projects an optical image of the scene to be transmitted on to a transparent conducting photo-surface P through a polished glass window W. Electrons are liberated from the opposite side of this photo surface, the number at each point corresponding to the illumination at that point. These electrons are accelerated by an electrostatic field applied between the photo-cathode P and the anode A, and focused by the field of the electro-



A Super-Emitron camera with the protective covering removed to reveal the arrangement of the principal component parts. The enlarged view of a section on the right shows more clearly the mica plate carrying the storing mosaic and signal plate. The photographs were taken by courtesy of Electric and Musical Industries, Ltd., in whose laboratories the Super-Emitron was invented and developed.



S = signal plate. M = storing mosaic. A = second anode. B = head amplifier. L = magnetic electron lens. P = transparent photo surface. W = polished glass window. X = optical focusing lens. X1 = optical focusing control. G = electron gun.

magnet L to form an electron image on the mosaic M. The mosaic is carried by a mica plate, the back of which has a metal coating to form the signal plate S, which is connected to the head amplifier B. The photo-electrons falling on the mosaic are multiplied by secondary emission and produce an intensified charge distribution which corresponds to the electron image and hence to the point-to-point illumination of the photo-surface P. The mosaic is scanned in a series of parallel lines by an electron beam from the gun G. The electrons in this beam neutralise in turn the charges at each point on the mosaic, thus producing a series of potential fluctuations in the signal plate S, corresponding to the distribution of light intensity in the original image. These picture signals are communicated to the head amplifier, and thence through further amplifiers to the modulator of the transmitter.

Short-wave Adjustments

ALIGNING THE CIRCUITS OF ALL-WAVE SUPERHETS

Concluded from page 4 of last week's issue

By "TRIMMER"

AFTER discussing in general terms the problems involved in aligning the short-wave circuits of an all-wave superheterodyne, the author proceeds to describe methods of making adjustments in specific cases. Recommended courses of procedure are described.

WITH regard to the actual making of short-wave adjustments, it should be remembered that hand-capacity effects must be guarded against, and no metal adjusting tools should be used.

Of the large number of different circumstances in which adjustments of the SW side of an all-wave superhet may become necessary, there are two broad possibilities: (1) It may be known that the SW circuits are hopelessly out of adjustment and it has to be assumed that each and every available adjustment will need attention; in other words, the case may be one where the SW circuits have to be lined up "from the raw." (2) It may be a case where the SW performance is down, but one in which it can be assumed that at least some of the SW adjustments are correct.

We will deal with (1) first.

Before attempting to make any SW adjustments there are certain preliminaries to attend to. As previously stated, it is important to make certain that the SW arrangements provided are understood, particularly in connection with the tracking.

It is wise, too, to make as certain as possible that the IF stages are lined up at the correct frequency. This does not imply that the correctness of the IF value is essentially more important on the SW than on the other bands, but there are sufficient possibilities of SW adjustments being tricky without running the risk of having any added complications due to the IF being wrong. In the common case where the same IF value is used on all the wavebands it will usually pay to make sure that the calibration and general performance is quite satisfactory on MW and LW before tackling the SW adjustments. There are some exceptional cases, of course, e.g., the receiver in which an SW padder comes in series with the MW oscillator circuit so that SW should be lined up before MW.

A direct check on the IF stages alone could be made in such a case, and in the special case where the SW band uses its own IF value a direct IF check is most advisable, if the correct IF value is known. (If it is not known, see that the IF circuits are lined up and hope for the best. If trouble is afterwards experienced in connection with tracking keep in mind the element of doubt regarding the IF value).

Apart from exceptional cases it can be taken as a golden rule to leave SW to the last and to get everything perfect on the other bands first.

It will be necessary to decide upon the frequencies to be used for trimming and tracking tests. Strictly, the test frequencies ought to be those specified by the receiver manufacturers, but if these values are not known some frequency near the shortest wavelength of the band should be chosen for trimming and one near the highest wavelength end for tracking.

For shortest wavelengths of 11, 13, 16 and 19 metres respectively, trimming frequencies of 20, 20, 18 and 15 Mc/s respectively will probably prove to be suitable. For a top wave of 50m. a tracking frequency of 7 Mc/s should be tried.

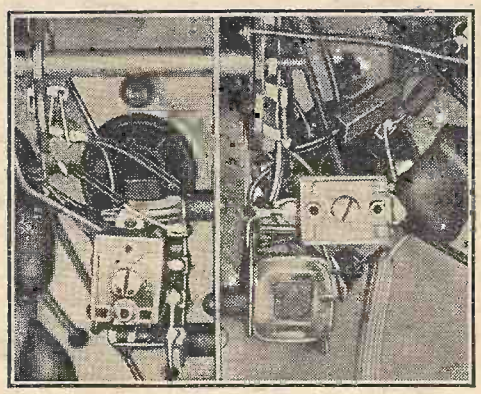
In view of short-wave adjusting work involving a number of tests at different tuning points it is desirable to be able to get the connection between metres and megacycles per sec. without loss of time. The list printed on this page should be useful for rapid reference purposes. To have given a more comprehensive list would have defeated its purpose.

The signal generator may have special SW output arrangements associated with the output leads. If not, it is to be advised that a 400-ohm non-inductive resistance be connected in series with the high-potential output lead from the generator.

With the output indicator connected to the receiver all should now be ready for the actual work to start on the SW circuits. At this point it should perhaps be mentioned that most of the various operations enumerated below take far less time to carry out than to describe. Some of them need only occupy a matter of seconds.

Recommended Procedure

Apply the trimming signal, adjust the main tuning control of the receiver to bring in the signal. It may be necessary to trim up the signal-frequency circuits (quite roughly at this stage). Now run the oscillator trimming through its full variation, noting the number of signal peaks that are obtained. If multiple peaks are found reduce the output of the signal generator in the endeavour to get the alternative oscillator trimmer settings to no more than two. A choice of peak setting must now be made, and if only two are obtainable choose the one involving the lesser trimmer capacity. If there are several residual peaks some will probably be noticeably weaker than others, and in this case pick on one of the smaller capacity ones, taking a stronger in preference to a weaker one.



The short-wave trimmers of a small superheterodyne are shown here.

The receiver tuning should be set as accurately as possible to the calibrated marking for the trimming frequency, and the oscillator trimming adjusted for exact optimum on the chosen trimmer peak setting. Next, trim up the signal frequency circuits, taking care over "pulling" as previously described.

The next move is that of tracking adjustment, assuming that the receiver has variable tracking, and the signal generator tuning and the receiver tuning should be set at the tracking frequency points. Adjust the tracking control for maximum peak output, at the same time slightly rocking the ganged condenser for optimum results. A return to the trimming frequency should then be made and any necessary readjustments carried out.

Wavelength-frequency Relationships

Metres		Mc/sec.	Metres
13	23.08	20	15
15	20	19	15.79
17	17.65	18	16.67
19	15.79	17	17.65
25	12	15	20
27	11.1	13	23.08
31	9.68	12	25
33	9	11	27.27
40	7.5	10	30
49	6.12	9	33
50	6	8	37.5
70	4.3	7	42.9
75	4	6	50
100	3	4	75

Short-wave Adjustments—

Sometimes it may be necessary to make tracking and trimming corrections yet once again.

If all seems to have gone off well, check up on a few signals at frequencies spread over the tuning range, particularly noting if the receiver's calibration holds good, and if the sensitivity keeps up (or at least does not drop abnormally) over the range. If this check gives satisfactory results the job is done.

If it so happens that the work has been carried out starting from the wrong trimming peak, trouble will, of course, be experienced. Any difficulty over tracking should make one immediately suspicious in this respect, and the accuracy of the receiver's calibration is a good telltale. Either the second-channel test previously described can be applied to settle the right or wrong peak question or a fresh start made on another peak setting as a trial. Circumstances will indicate which is likely to be the quicker method.

If the receiver has fixed tracking it may sometimes be found that, although the correct trimming setting has definitely been chosen, yet the calibration still remains a little out. If the error is small it is generally legitimate to adopt a little compromise of oscillator trimming. The trimming capacity should be slightly increased or decreased with the object of reducing the average error over the scale and, of course, the signal frequency trimming should be correspondingly touched up again.

Minor Readjustment

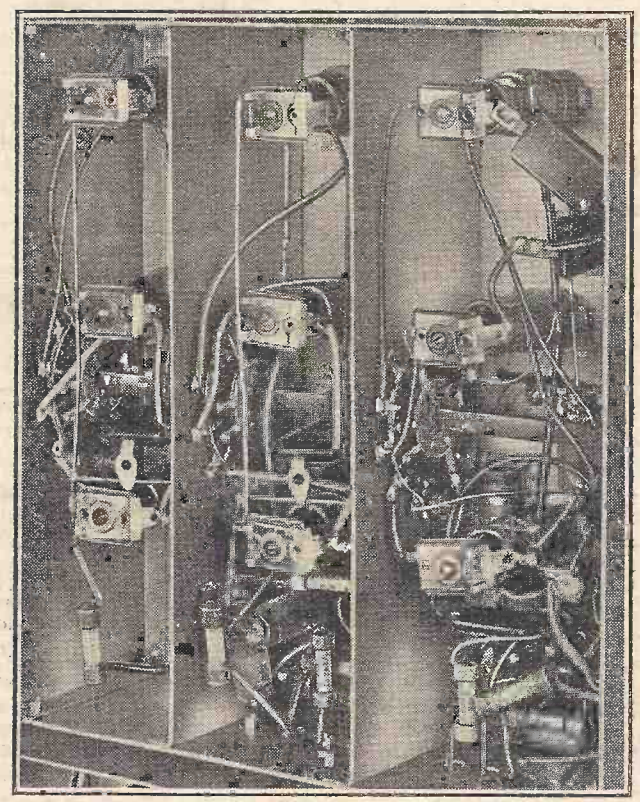
Let us now consider case (2), i.e., the common example of the receiver with SW performance down, but a case where very possibly only slight readjustment may be necessary.

The first move should be to decide whether or not the oscillator circuit adjustments need attention. This is easy to decide by making a test of the receiver's calibration over the scale. If the calibration holds good then the oscillator circuit should be left severely alone and attention concentrated on the signal-frequency circuits. If it does turn out that the oscillator is evidently not tracking properly the oscillator adjustments will have to be tested, and in this case one might as well settle down to the complete job of SW lining-up.

If the receiver is lacking in sensitivity on SW, but there is no sign of calibration errors, it will often happen that a slight readjustment of signal-frequency trimming will work wonders. Some receivers in particular respond to a very marked degree to a touch-up on the input circuit trimmer, and where the "last ounce" is required it will often pay to try the input trimming on outside signals and using the actual aerial with which the receiver is normally used.

If such difficulty is experienced with the SW adjustments that it seems impossible to get them right, the question will arise as to whether there are faults present or whether the adjustments have not been carried out correctly (alternatively, has any one of the available adjustments been overlooked?).

It is hoped that enough has already been said about the possibility of working on the wrong oscillator beat to render it impossible for any reader to be caught in that snag without realising what is the matter. If the receiver seems resolutely to fight against coming into correct calibration, and there is no doubt about the correctness of the oscillator beat, the following points may be worth considering:—(1) Has the receiver been assumed to have fixed tracking when actually there is a variable adjustment in the oscillator circuit? (2) Is the IF correct? (3) Has the wiring of the oscillator circuit been displaced, accidentally or otherwise?



The underside of a typical modern receiver is illustrated here. The set includes one short-wave band in addition to medium and long waves.

As regards (3) it is to be mentioned that quite small displacement of wiring can have marked results. A fact that it might be important to know is that the designers of some receivers have arranged that the deliberate bending of connecting wires shall be part of the SW adjusting (which might lead to an awkward situation if one did not realise this, so it might prove worth while to try a little judicious experimenting with the aid of a prod of insulation material—but proceed very carefully). Incidentally, any lead wire or loop adjustments should always be carried out near the longest wavelength end of the range.

When the receiver's calibration shows up correctly over the range but the sensitivity falls off badly towards one end and signal-frequency trimming does not cure the trouble, it should be suspected that the signal-frequency tuning is not tracking properly with the actual signal frequency. It must be remembered that if the signal-frequency circuits and the oscillator circuit are not together tracking properly the act of tuning in a signal tends to set the oscillator circuit to the correct tuning. That is why we have emphasised so much the importance of watching the receiver's calibration as a check on the oscillator circuit.

When all attempts at adjustment fail to make the SW side of the receiver behave itself, the position, of course, deteriorates into one of fault tracing. The subject of fault tracing, as regards component faults, is outside the scope of this article, but the writer cannot resist giving the hint that whenever it becomes a matter of fault tracing the eye of suspicion should always be directed to any fixed condensers that may be associated with any of the tuned SW circuits.

To conclude these notes the question must now be considered as to what can be done in the absence of a signal generator. In the writer's opinion it is most unwise to attempt complete SW lining-up unless the receiver is of the simplest type or there happens to be no option in the matter. If the job must be tackled the trimming and tracking must, of course, be carried out on outside signals. Added to such difficulties as have already been mentioned there are now additional possibilities of complication such as uncertainty as to the frequency of a chosen signal and lack of a signal just where it is wanted.

The oscillator circuit should not be touched unless results on reception show definitely that it requires attention.

If it is merely a matter of trimming up the signal-frequency circuits this can be done quite easily and satisfactorily on outside signals and any signal well down towards the shortest wavelength end of the range can be used.

New G.E.C. Public Address Equipment

THE principal item in the new programme of PA apparatus announced by the G.E.C. is a 20-watt amplifier with separate bass and treble "uplift" tone controls and automatic gain control. Two separate valves are included for the latter purpose and the introduction of this form of acoustic AVC is of benefit not only in overcoming difficulties with speakers who are unskilled in microphone technique, but also in reducing microphonic feed-back. KT66 tetrodes in class A push-pull are used in the output stage and the price of the amplifier is £28 10s.

A moving-coil microphone specially designed for PA work has been introduced for use with this amplifier. It is mounted in a quickly adjustable socket which may be set at any desider angle, and the price is £6 5s.

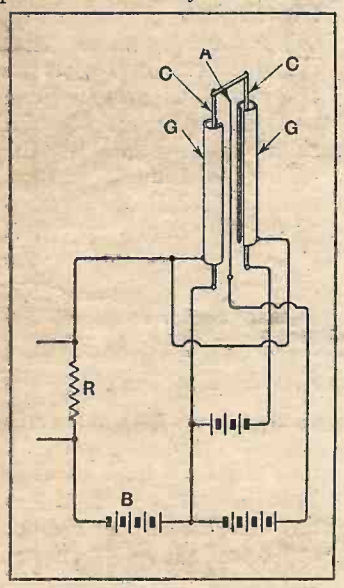
Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

VISUAL TUNING INDICATORS

THE figure illustrates the construction of an electron-discharge tube for use as a visual tuning indicator. The parallel legs of the cathode C are enclosed by two cylindrical "grids" G, each with a slit which faces inwards towards a straight-wire anode A mounted parallel to the cathode legs. With this arrangement a change of two volts on the grid is sufficient to make the anode glow brightly under bombardment by the electron stream.

Normally the grids are negatively biased by a battery B to cut-off point, so that the wire is dark. Voltage applied from a resistance R, preferably forming part of the AVC system, tends to



Valve-type tuning indicator.

make the grids more positive, and renders the anode A white-hot when the associated tuning circuit is adjusted to the point of resonance. The glowing wire is easily visible from the side of the tube.

Marconi's Wireless Telegraph Co., Ltd. (communicated by Radio Corporation of America). Application date, September 14th, 1937. No. 502181.

o o o o

SCANNING SYSTEM

INCOMING television signals are applied to a detector which is shunted by a resistance in series with a biasing voltage. Both the picture signals and the synchronising impulses produce voltage variations across the shunt resistance, but these, even when added to the steady bias, fail to trigger an oscillator valve until such time as the carrier wave drops below the "black" level at which the synchronising impulse is sent.

In this way the picture and synchronising signals are separated from each other. On the receipt of a synchronising impulse, the oscillator valve is triggered into action, and generates a pulse of current which is used to synchronise the saw-toothed scanning valve. These pulses are of constant amplitude, irrespective of the strength or duration of the triggering voltage applied. They cease when the passage of the synchronising signal reverses the direction of the triggering voltage.

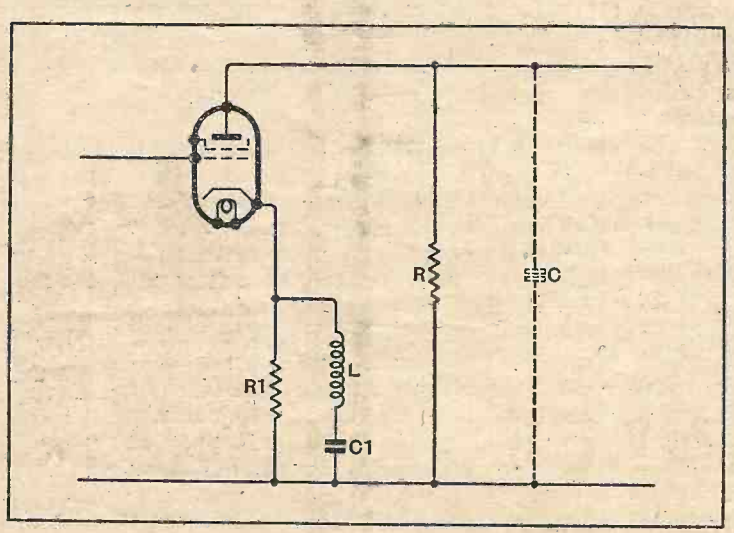
F. W. Cackett (communicated by Telefunken Ges für Drahtlose Telegraphie m.b.H.). Application date August 13th, 1937. No. 500876.

o o o o

TELEVISION AMPLIFIERS

RELATES to a wide-band amplifier for handling television signals, in which negative feedback is used to reduce amplitude distortion by making the amplification less dependent upon changes in the operating voltages or in the characteristics of the valves employed. In such amplifiers it is found that stray capacities associated with the output circuit still cause a falling off in the amplification of the higher frequencies, and it is the object of the invention to avoid this.

The output impedance of the valve is represented in the figure as a resistance R shunted by a capacity C. The negative feedback takes place across the cathode resistance R1. To some extent, the object aimed at has previously been achieved by shunting this cathode resistance by a condenser of such value that their time constant is the same as that of R and C. But, in practice, it is found that the impedance of this condenser falls too low to operate in the desired way for the high frequencies encountered in television work. Accordingly the cathode resistance is now usually shunted, as shown in the figure, by a condenser C1 in series with



Counteracting stray capacity effects.

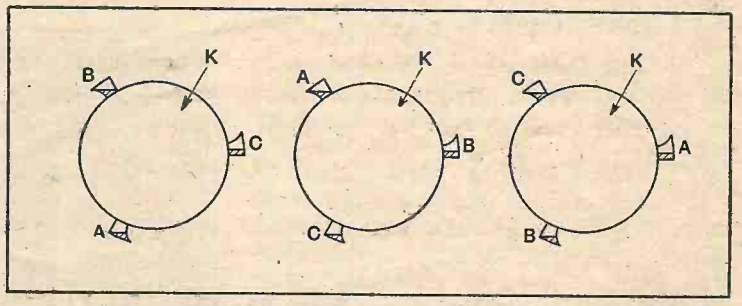
an inductance L, the value of which is determined by a mathematical analysis of the circuit conditions.

E. L. C. White and M. G. Harker. Application date October 22nd, 1937. No. 502578.

PRE-SET TUNING ARRANGEMENTS

THE figure shows how mercury switches, A, B and C, can be used for changing the tuning of a wireless receiver or transmitter. The mercury partly fills the triangular chambers, which are mounted on the periphery of a rotatable cylinder K. Different contacts in the chambers are closed according to the position the mercury takes up, under the effect of gravity, as the cylinder is rotated.

In the first position, for instance, the mercury in the chamber A will bridge contacts arranged near the "pointed" end of that chamber, whereas in the other two figures (which show the cylinder rotated through angles of 120 deg. and 240 deg. respectively), those two contact points are open-circuited, and other pairs of contacts are closed. By arranging the contacts at different points in each chamber, any desired sequence of tuning can be effected by bringing selected condensers or inductances in or out of circuit, as the cylinder K is rotated.



Mercury switches for pre-set tuning.

W. A. Beatty. Application date September 4th, 1937. No. 505170.

CATHODE-RAY TUBES

A CATHODE-RAY tube has been developed in which several electron beams are produced simultaneously, each being controlled independently of the others, for the purpose of what is called "multiple spot" scanning.

The invention relates to a tube of this kind, and provides a cathode structure in which a number of mutually insulated strips (which act as electron emitters) are strung over the outside of a hollow rod, along the axis of which runs a heating element. Each of the emitting strips is connected by a separate lead to its own section of a potentiometer or delay network, so that each is controlled in the sequence required for multiple-spot scanning.

J. D. McGee. Application date August 23rd, 1937. No. 502796.

o o o o

PREVENTING "NIGHT EFFECT"

ONE method of avoiding the so-called night effect, when taking bearings on a distant transmitter, is to work on short "impulse" signals which are repeated at a rapid rate. The DF receiver is then arranged so that it accepts the first impulse to arrive, i.e., the one that travels along the ground, but is made inoperative before the space-wave impulse can reach it, after reflection from the Heaviside layer. This necessitates that the receiver be cut out at intervals which synchronise with the frequency of the transmitted impulses.

The specification describes an aircraft installation of this kind adapted to be used for "homing," where it is also necessary to reverse the frame aerial input, at a fairly rapid rate, in order to indicate to the pilot whether or not he is keeping on a straight-line course.

Telefunken Ges für Drahtlose Telegraphie m.b.h. Convention date (Germany), February 4th, 1937. No. 504060.

"Radio Data Charts," A Series of Abacs. Post free 4/10.

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GUTHMAN McMurdo Silver Communication Receiver.

WE are Sole Distributors for the United Kingdom of Above Product.

CIRCUIT Superhet., with double regeneration obtained at signal frequency and also at intermediate frequency. As a result, very high sensitivity and selectivity are obtained.

CONTROLS.—R. meter, silencer, tone, aerial trimmer, A.F. gain selectivity, beat oscillator, receiver-send, A.V.C. B.O., on/off; assembled with valves but unwired, £17; wired and aerial tested, £18/18.

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RECEIVERS, with valves; £7/7.

FOR One Month Only.—Chassis with valves, £5/7/6.

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MODEL R.F.96 —— 8-STAGE ALL-WAVE RADIOGRAM CHASSIS

Incorporating R.F. AMPLIFIER, 3-Stages of A.V.C. and corrected 3½ watts output. Complete with Matched M.C. Speaker.

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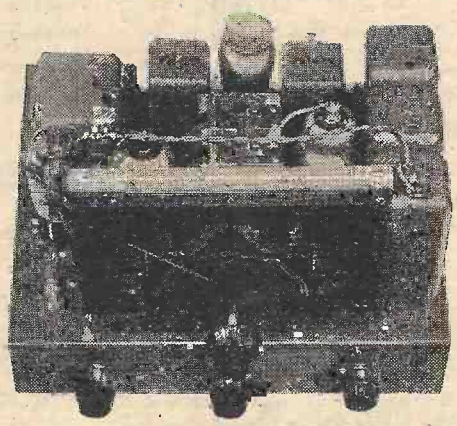

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McMURDO

BRITISH McMurdo Silver Model 15-17, new 1938 chassis, with speaker, listed 43 gns., unused; £22/10 cash.—A.C.S. Radio, 16, Gray's Inn Rd., W.C.1. [0640

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1939 Midwest 15-valve A.C.-D.C. 200-50, 6 wavebands, 5 to 1,500 metres, in beautiful walnut console cabinet, list £45, price £20; 16-valve A.C. 200-50 American Midwest, 5 wavebands, in walnut console cabinet, £14.

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R.G.D.

R.G.D.—Latest Console all-wave superhet, listed 23 gns.; bargain, £12/10.—Bray, 763c, Finchley Rd., N.W.11. Speedwell 9633. [8704

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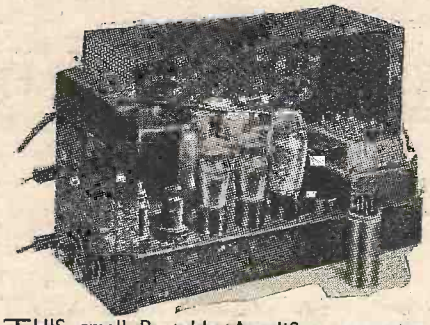
Type CP20 AC and 12-VOLT DC AMPLIFIER



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Or in Rexine Case with Collaro Motor, Piezo P.U. and Mike Transformer..... **£17 17 0**

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Gauze Case for either chassis 12/6 extra.

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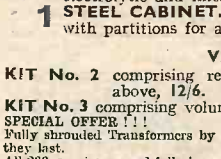

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This Service Kit comprises:

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72 RESISTORS. Assorted, colour coded resistors, ½ to 3 watts.

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VALUE £4 for **17/6**

KIT No. 2 comprising resistors and condensers only, as above, **12/6.**

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60 m/A., 15 Hy., 250 ohms	1/11

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INSPECTION Invited; photos loaned to country customers.

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CLEARANCE Sale!! — Radiogram and television cabinets, prices slashed! 10 gns. worth for 50/-! 5 gns. worth for 20/-!—Write, wire, 'phone or call, Cameo Co., 23, Denmark St., W.C.2 (Tem. 5900.) [8527

DEGALLIER'S for the Finest Obtainable American Cabinets, Table, Console and Radio Grams; also Record Changers, 5 gns. Send 1½d. stamp for reprints from actual photographs.—Degallier's, 31, Craven Terrace, Lancaster Gate, London, W.2. Paddington 6492. [8553

DYNAMOS, MOTORS, ETC.

ALL Types of Rotary Converters, electric motors, battery chargers, petrol-electric generator sets, etc., in stock, new and second-hand.

A.C.-D.C. Conversion Units for Operating D.C. Receivers from A.C. Mains, 100 watts output, £2/10; 150 watts output, £3/10.

WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0518

ROTAX Converter, type E, 100 to 300 volts D.C., 120 m.a., new 1935, list price £19/10; accept £6. Box 405, c/o *The Wireless World*. [8684

ELECTRADIX Rotary Converters for A.C. Radios on D.C. Mains; alternators 50 to 500 cycles; mains motors and motor generators for 1 to 600 cells; petrol engines and switchgear.—218, Upper Thames St., London, E.C.4. [0619

RECORDING EQUIPMENT

ALL Recording Discs and Materials in Stock, tracker units, £4/7/6; recording motors, £3/17/6.—Write for further details, Will Day, Ltd., 19, Lisle St., W.C.2. [0595

VALVES

ALL Types of American Tubes in Stock of Impex and Arcturus makes at competitive prices.

WE Can Also Supply a Full Range of Guaranteed Replacement Valves for Any British non-ring. American or Continental type at an appreciably lower price.

SEND for Lists of These, and also electrolytic condensers, line cords, resistances, etc.

CHAS. F. WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0452

AMERICAN 2/9; 1,000 non-ring British, from 1/9; bargains galore; lists free.—Shippers, 18, Corporation St., Manchester. [0607

METROPOLITAN RADIO SERVICE.—Special offer. American valves, in makers' cartons, 3/- each, Octals 3/6 each; American valves, first grade, in all types; trade supplied.—1021, Finchley Rd., N.W.11. Speedwell 3000. [0436

ELECTRICAL EQUIPMENT

1- and 3-phase Motors, ¼ to 5 h.p., surplus stock, first class condition.—Tel.: Reliance 1693. Easco Electrical Service, 18, Brixton Rd., S.W.9. [0642

COMPONENTS

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

PREMIER SUPPLY STORES.

PLEASE See Our Displayed Advertisement on page 5. [0488

GARRARD A.C. Record-changers, Model R.C.4a, plays eight 10- or 12-inch records, brand new; £5/5.

HENRY'S, 72, Wellington Av., Stamford Hill, N.15. Stamford Hill 2907. [8699

RYALLS RADIO, 280, High Holborn, London, W.C.1, offer new goods, post free.

ELLIPTICAL Speakers, Celestion, suitable Ekco replacements, 750 and 1,250 ohms, less transformers, speech 25 ohms, new, handle 8 watts, carry up to 120 m.a.; 5/6 each.

AMPLIFIERS, A.C. 200-250v. output 16 watts A.C. from pair 6L6 push pull, 3 stage, ample volume for driving extra speakers available. Complete with valves, and pair of elliptical speakers, wired up ready for use; 72/6, carriage paid.

SPEAKERS, pairs, brand new, elliptical cone speakers, made by first class firm, quality of reproduction outstanding, push-pull pentode transformer, fields 325 ohm for smoothing choke, 8,600 as bleeder, circuit available, handle 10-15w.; 14/- pair.—Ryalls Radio, see above. [8374

ROTHERMEL £4/4 Pick-up, 30/-; A.F.7, O.P.M.1, Varley D.P.14, 10/- each.—55, Clovelly Rd., Bexleyheath. [8693

"Radio Laboratory Handbook." Price 8s. 6d. net. Post free 9s.

COMPONENTS—SECOND-HAND CLEARANCE, SURPLUS, ETC.

R.

RADIO CLEARANCE, Ltd.,

63, High Holborn, W.C.1. 'Phone: Holborn 4631.

SPECIAL Offer During July.

ROTHERMEL Piezo High Fidelity Speakers.

MODEL R.95, 7in. cone, will handle 5 watts; 9/11.

MODEL R.105, 10½in. cone, will handle 6 watts; 11/6.

ABOVE Can be Used in Conjunction with Existing Moving Coil Speaker, connect across primary of speech transformer; to use independently a choke must be connected between the receiver or amplifier output; in the event of push-pull, connect to the 2 anode terminals of output transformer, ignoring C.T.

T.C.C. 8 mfd. 450-volt Working Wet Electrolytics, can type, one-hole fixing; 1/6 each.

POLAR ½ and ⅓ Resistances, good selection; 4/6 a gross.

PHILCO American Mains Transformers, 200-250 volt, 6.3 volt 3 amp., 5 volt 2 amp.; 7/6 each.

POLAR N.S.F. Tubular Condensers, our selection; 4/6 gross.

PLESSEY 8 Mfd. Can Electrolytics, 350 volt working, 7d. each; 6 mfd. Can Electrolytics, 450 volt working, 8d. each.

GRAHAM Farish 0.001 and 0.002 Mica Condensers; 8d. dozen.

GRAHAM Farish Short Wave Valve-holders, ceramic type, 4-pin; 3d. each.

GRAHAM Farish Grid Leak Holders, 6d. dozen; pot dividers, wound on glass, 150 and 350 ohm., 3d. each; pilot bulbs, 6.3 volt 0.3 amp., 3d. each.

BULGIN Grid Caps, screened, 4d. each; Bulgin S.P.S.T. twist switches, 6d. each; Bulgin D.P.D.T. twist switches, 9d. each.

9-WAY Group Boards, 4d. each; 5-pin reversible valve-holders, base board or chassis, 3d. each.

BRADLEY Ohm Volume Controls, with switch, 600,000 ohms; 8d. each.

B.I. 25 Mfd. 25-volt Tubulars, 4d. each; B.I. 4 mfd., 200-volt tubulars, 5d. each; 2-piece valve cans., 6d. each; rubber grommets, small, 3d. dozen.

BULGIN 30-watt Mains Resistances, tapped, 195-250 volt; 2/- each.

ALL Orders Over 5/- Carriage Free; under this amount sufficient postage must be included with order.

ALL Enquiries Must Enclose 1½d. Stamp.

RADIO CLEARANCE, Ltd., 63, High Holborn, London, W.C.1. Telephone: Holborn 4631. [8681

RADIO SUPPLIES, the cheapest mail order house in the country, score again with another spectacular purchase.

THE Latest 1939-40 Crossley 10-valve Receiver, five wavebands, covering 7 to 2,000 metres, including television sound, 10-watt beam power push-pull output stage, seven push buttons for automatic tuning, large slide-rule type dial calibrated with boldly printed station names in colour, illuminated waveband indicators, slow motion manual tuning, full A.V.C., band pass I.F.s, 10in. auditorium speaker, cathode ray tuning indicator, a beautiful, massively built cabinet finished in selected veneers, to harmonise with every modern furnishing scheme, all in sealed carton; £8 each.

1939 Emerson Midgets, five-valve superhets, long and medium wave, A.C./D.C., 100-250 volt working, very powerful, all in sealed carton; £3/5 each.

1939 "Automatic" 5-valve Car Radio, fits any car, easily installed, 6-volt operation (medium wave), £3/15/6; medium and long wave, £4/10/6.

1939 "Trav-ler" 6-valve Car Radio, 6-volt operation, push buttons (medium wave), £4/10; (medium and long wave), £5.

JUST a Few Brand New "Weston" 5-valve Car Radios, 2 wavebands, push buttons, 6-volt operation; £4/5 each.

ANY of the Above Car Radios, for 12-volt operation, 3/6 extra.

"COLLARO" Automatic Record Changers, brand new, sealed carton; £4/15.

ROLA G12 P.M.s, with multi-ratio output transformers, sealed carton. £2/12/6; Rola 8in. P.M.s, with matching transformer, 8/- each.

DECCA Mains Transformers, 200-250 volt input, 350-0-350v., 120 m.a. secondary, 4v. 2.5 amp, 4v. 7 amp, 13v. 2 amp., brand new; 3/- each.

BRAND New Midget 4 m.f.d. Condensers, 350-volt working, cardboard case; 3/- doz.

RADIO Record H.F. Pentodes, equivalent to Mazda, A.C.V.P.I, boxed, 3/- each; Belmont 80s, 1st grade, boxed, 2/3.

OUTPUT Transformers, Magnavox and Blue Spot, 1/9 each; Centralab pots, long spindle, 10,000, 50,000, and ½ meg., less switch, 1/- each.

3 Only.—Ever Ready 4-valve all-wave A.C. Receivers; £1/17/6 each.

2 G.E.C. 1938 Model 5-valve Superhets, all-wave, A.C., a snip, £3/5; 2 Ultra 115 1938 model 4-valve superhets, A.C., all-wave, £3/5.

1 Philco 471 1937 Model 4-valve Superhet, A.C., all-wave, £2/12/6; 1 Philips 794A 1937 model 5-valve Superhet, A.C., all-wave, shop soiled cabinet, £3.

ALL the Above-mentioned Sets are Complete with Valves, and in cabinet in perfect working order.

ORDER Early and Save Being Disappointed; a suitable amount must be included to cover postage, etc.

RADIO SUPPLIES, 22, Faraday Ave., Manchester. 8. Tel.: Col. 1261. [8695

ELECTRADIX

MORE SPECIAL CLEARANCE BARGAINS

45 gau. Eureka 10 m.a. enamelled Res. Wire, 108 ohms per yd., ¼ lb approx., 300,000 ohms, 3/- for ¼ lb. reel; 36 gau. enam. ditto, 100 m.a., ¼ lb. approx., 8,000 ohms, 1/-; 33 gau. enam. ditto, ¼ amp., 1/- per ¼ lb. reel; 29 gau. enam. ditto, 1/- per ¼ lb. reel; 27 gau. enam. ditto, ½ amp., 10d.

BARE Res. Wire, 48 gau. Nickel Chrome Wire, 700 ohms per yd., 6/- per ounce; only 4 lb. left. 5 lb. of Heating Strip, chrome, ½ × 16 thou., 2/6 per ¼ lb.

SLIDER RES. KIT, for Home Rheo Constructors, 250 watt size, porcelained steel tube, 2¼in. × 6in., two cast end brackets, slider-rodb rush and guide-handle, nuts, etc., ready for assembly, all new, 5/-. Oxydised Resistance Wire, 4,800 ohms of 100 m.a., 5/-, or any of six other gauges up to 110 ohms for 2 amps., 5/- reel.

METER MOVEMENTS. Full size, moving coil, P.M., for adapting home-made multi-range testers. For 3in. or 4in. dials, 5/-, post 1/-.

G.P.O. TYPE B TELEGRAPH RELAYS, with platinum points, 7/6. Silvertown Horizontal Galvos., two jewels, 5/-, post 6d. Vertical needle G.P.O. teleg. Galvos., 4/6. Weston 2in. dial centre-zero ammeters, read 1 amp. to 15 amps., 5/-.

3/9 Post Free.

MILLIAMMETERS. 8 m.a. back of panel illuminated milliammeters. Skeleton type, 970 ohms D.C. with plain scale and 1in. needle with mica panel, back lamp and bracket. Great bargain at 3/9 post free. Bulgin Midgets, 8 m.a., 6/-. Sifam, 1¼in., 10 m.a., 8/6.

H.F. AERIAL RADIATION METERS. Flat panel, 2¼in. dial, Hot wire, 0-500 m.a., 7/6; 0 to 2 amps., 12/6; 3in. dial ditto, 0-4 amps., 21/-. Panel 4in. dial, 3 amps., £1/10/-; 7in. dial, 2 to 15 amps., £1/15/-.

A.R.P. POCKET HEADPHONES, W.D., all leather headband, strap and cords, 2/6 pair. 120 ohms, with aluminium headbands, 2/9. 4,000 ohms, 4/6. House and Office Telephones, wall and table, 10/- and 15/- each. Unbreakable Telephone Wire, 15/- per ¼ mile.

SPARK OR IGNITION COILS. Remy Plain 4, 6 or 12 v. for spark, 3/6.

ONE HUNDRED 10-watt Moving Coil Magnets by Darwin. New 4-claw 4¼ lb. weight, 4/- each, post 1/-.

5,000 RESISTORS, ¼ and 1 watt, .01, .025, .03, .1, .5 and 1 meg. Glass vacuum, wire ends, worth 1/- each, at 1/- per doz., or 9/- gross.

400 VARIABLE CONDENSERS, single .005 mfd. Tekade, 1/3. .005 S/W Formo, 2/-. 2-gang, 2/6. 3-gang, 3/6.

FIXED CONDENSERS for odd smoothing jobs, 5,000 Mansbridge 1 mfd. Condensers to clear at 2/- doz., 20/- gross.

200 EARTH ground spikes for radio or telephones, 8d. each, post 6d., or 6/- doz., carr. fwd.

60 NEW 3-VALVE unwired Battery Sets with oak cabinet, aluminium panel, lettered, fitted 2 varia. condensers 13 × 7 × 6. Suitable A.R.P. valve or crystal set, 10/-. 2/- post and packing.

TRANSMITTERS. Aircraft 2-valve, old type, R.A.F., with valves, 17/6. Field Transmitters, old Army type, 1 and 2 valve, portable, totally enclosed with Valves, folding key and aerial meter, 40/-. Sullivan variable R.F. inductances, 7/6. A.C. Hand Generators, P.M., geared drive, 80 volts, 20 m.a., 5/-.

100 ELECTRIC DRILL STANDS. Massive Wolf Geared rise and fall with counterweight. Suitable large or small machines, 7/6, carr. fwd.

200 TRUE-TWIN CAMERASCOPES, 2 lens viewers, 1/- post free.

MORSE PRACTICE SETS, No. 3, with key buzzer and lamp for sound and visual, line plug, etc., 7/-. Sound Type, 1A type key and buzzer, 3/-. Visual Type 2A, key and lamp, 2/-.

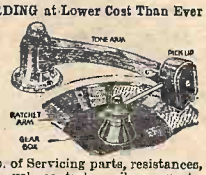
ALUMINIUM PANELS for Transmitters and Receivers, substage or front. Heavy gauge flat and true, enamelled one side, black or brown. 18 gauge, 12in. × 12in., 3/-; 16 gauge, 3/10; 18 gauge, 12in. × 18in., 4/6; 16 gauge, 5/9; 18 gauge, 18in. × 18in., 5/6; 16 gauge, 6/4. Black Paxolin and Ebonite Panels, all sizes from 24 × 24in. Tubing and formers.

MICRO-AMMETERS for small current Valve Voltmeters, etc. Sensitivity, 0 to 50 microamps full scale, moving coil, panel type, 2¼in. dial. Reads direct your signal strength on a crystal set. 1,000 ohmores, 50 mV. def. Cheap. 40/-.

DIX MIPANTAS METER, 19/6. **VALVE ANALYSERS**, AC/DC, £5. Cossor Ganging Oscillator, £12/10/-. Earl Webber Oscillator, £9/10/-. Baldwin Henlog Inductance Bridge, £6/10/-. Baldwin Mufer, £8. Logohm, 70/-. **VALVES** for Transmitters; 40-watt AT40, 4/6.

MORSE or MUSIC. HOME SOUND RECORDING at Lower Cost Than Ever

The **FEIGHT RECORDER** fits any Radiogram, positive drive, worm gear and rack. Complete ready for use, only 37/6. Super Feigh Fidelity Set, 42/6. Tracking Gear only 21/-. Either 3/3 doz. metal blanks can be used or the glass-coated simplets, 10in., 3/- each.



Have you got our NEW SALE LIST? FREE for stamped addressed envelope.

GREAT BARGAIN in 5/- PARCELS. 10 lb. of Servicing parts, resistances, tubulars, micas, variables, wire, sleeving, vol. controls, coils, magnets, chokes, switches, terminals, mouldings, etc.

ELECTRADIX RADIOS

218, UPPER THAMES STREET, LONDON, E.C.4

Telephone: Central 4611

GET 2 YEARS FREEDOM FROM NEEDLE-CHANGING with the

Walco GENUINE Sapphire GRAMOPHONE NEEDLES

More than 2,000 playings from one needle, a minimum of record wear, and greatly improved reproduction are obtained from the new Walco Needle—price **12/-**. Order now or write for FREE BOOKLET **"SOUND REPRODUCTION"** from

R. A. Rothermel LTD

(Dept. G),

Canterbury Road, High Road, Kilburn, N.W.6

COMPONENTS—SECOND-HAND CLEARANCE, SURPLUS, ETC.

VAUXHALL.—Hivac valves, all types. Flat sheet aluminium. 12in.×12in. 3/-, 18in×18in. 5/6.

VAUXHALL.—T.C.C. dry, 8 mfd., 2/6; 600v. aluminium containers; T.C.C. 600v. dry, cardboard containers, 8 mfd., 1/9.

VAUXHALL UTILITIES, 163a, Strand, W.C.2.—Ask for free list; metal rectifiers, HT10 10/-, HT9 9/-. [8677

MAINS RADIO DEVELOPMENT Co. Offer Immediate Delivery, carriage paid, call mornings; telephone Tudor 4046; stamp for list 227A.

DUBILIER Mica Tag Condensers, 0.00005, 0.0001, 0.0002, 0.0003, 0.0005 p.f., 3d., 2/6 dozen.

ERIE 1-watt Colour Coded Unused Resistors, any size, 50 ohms to 5 megohms, your selection; 3d., 2/6 dozen; 2-watt, 6d.

CENTRALAB Latest Potentiometers, long standard spindle, unused, all sizes, 5,000 ohms-2 megohms; 2/-, with mains switch 2/3.

TUBULAR Condensers, 400-volt working, wire ends, best make, 0.0001-0.05 mfd., 4d.; 0.1 mfd., 4d.; 0.25, 0.5 mfd., 6d.

CLIX Unused Chassis Valveholders, 5-pin, 7-pin, 3d. each; all American sizes, 6d. each; best sleeving, 1½d yard.

FIFTY Unused N.S.F. ¼-, 1-, 2-watt Resistors, wire ends, marked, colour coded, 20 different useful sizes in each parcel; 50 for 2/6 only.

MAINS RADIO DEVELOPMENT Co., 4-6, Muswell Hill Rd., London, N.6. Tudor 4046. [8569

SOUTHERN RADIO, 46, Lisle St., London, W.C. Gerrard 6653.—Stocks of receivers and replacement components, as previously advertised. [8548

BELLING-LEE Di-pole, reflector, masthead fitting (slightly damaged), 120ft. special cable; cost 4½ gns., 35/-.—Highcliffe, Bloomfield Rd., Bath. [8690

3 WAVE-BAND Tuning Packs for British Valves, aligned and tested; 3-gang H.F., F.C., battery or mains, 32/6 only; 465 K/C IFTs, for above, 2/6 each.—S. A. Radio, 293, Norwood Rd., S.E.24. [8694

REPAIRS AND SERVICE

"SERVICE with a Smile."

AMERICAN Valves, spares, linecords, rewinds; repairers of all types of American and British receivers.—F.R.I., Ltd., 22, Howland St., W.1. Museum 5675. [0434

LOUD-SPEAKER Repairs, British, American, any make, 24-hours service; moderate prices.—Sinclair Speakers, Alma Grove, Copenhagen St., N.1. [0590

GUARANTEED Repairs, Any Transformers, choke, motor armature, converter, dynamo, etc.; keenest prices, immediate quotation, prompt, dependable service. —See below.

L.T.P. (LONDON TRANSFORMER PRODUCTS, Ltd.), Willesden, N.W.10. Willesden 6486 (3 lines). [6892

MAINS Transformer Service, Repairs, rewinds, or construction to specification of any type, competitive prices and prompt service.—Sturdy Electric Co., Dipton, Newcastle-on-Tyne. [0516

METROPOLITAN RADIO SERVICE.—Guaranteed repairs to American and British receivers; American valves, service parts and rewinds; trade supplied.—1021, Finchley Rd., N.W.1. Speedwell 3000. [0435

DEGALLIER'S "Reliable Service With a Written Guarantee." First class workmanship, lowest prices; all British and American receivers; let American specialists do the job. 48-hour service. Degallier's Ltd., 31, Craven Terrace, London, W.2. Pad. 6492. [8552

REPAIRS to Moving Coil Speakers a Speciality; cones and coils fitted, fields altered; prices, including eliminators quoted; loud speakers, 4/-; L.F. and output transformers, 4/-, post free; guaranteed satisfaction; trade invited, estimates free; prompt service.—Loud-Speaker Repair Works, 5, Balham Grove, London. Battersea 1321. [0394

SITUATIONS VACANT

AIR MINISTRY.

DIRECTORATE of Technical Development.

APPLICATIONS are Invited for an Appointment as Designer at the Royal Aircraft Establishment, South Farnborough, Hants, to take charge of a section of a drawing office engaged in the design of aircraft and ground communication systems; candidates should have had a good general education and technical training in electrical and mechanical engineering; candidates should also have had good workshops experience, including radio design for production, and possess a knowedge of aircraft communication equipment.

SALARY Scale: £350 a year, rising by annual increments of £18 to £500 a year.

PROMOTION to Higher Posts is Governed by Merit as and When Vacancies arise; the appointment will be non-pensionable, but the entrant will be eligible for consideration for appointment to a pensionable post in the event of a vacancy arising on the permanent establishment.

REQUESTS for the Necessary Application Form Should be Made (quoting Ref. No. A3361) to the Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants, enclosing stamped addressed envelope; the closing date for the receipt of forms is 28th July. [8702

EXPERIENCED Final Tester Required.—Reply, stating age, experience and salary required, Baird Television, Ltd., Crystal Palace, Anerley Hill, S.E.19. [8689

WANTED, sales-service engineer, with established retailer, carrying leading agencies; state experience, salary expected.—Ewell Court Electrical, Ltd., 197, Kingston Rd., Ewell, Surrey. [8696

EXPERIENCED Television Servicemen Required for Indoor and Outdoor Work, only written applications considered; state age, education, previous trade, experience and if owner driver.—G.E.C. Service Depot, Greycoat St., Westminster, S.W.1. [8687

SITUATIONS VACANT

AIR MINISTRY.

AERONAUTICAL INSPECTION DIRECTORATE.

VACANCIES exist for unestablished appointments as Examiners in the W/T and Instrument Branches.

QUALIFICATIONS.

APPLICANTS for vacancies in Instrument Branch must have good general education, theoretical knowledge of physics and training in light engineering or instrument making. Candidates should be able to read drawings, understand specifications and use micrometers and other types of measuring instruments. If necessary, preference will be given to candidates having a good knowledge of thermometry and optical and pressure measuring instruments.

APPLICANTS for vacancies in W/T Branch having the following qualifications will receive preference: good general education, sound technical knowledge of high frequency engineering equal to City and Guilds final examination in Radio Communications, practical knowledge of modern W/T and electrical equipment. Candidates should be able to read drawings, understand specifications and use micrometers and other measuring instruments.

APPLICATIONS from candidates previously declared unsuccessful will be considered, provided the necessary additional experience has been gained.

SUCCESSFUL candidates will be given a period of training in inspection as applied to these subjects, not exceeding three months.

DURING training candidates will be regarded as on probation and paid at the rate of £3/10 weekly. On satisfactory completion of the training course they will be appointed as Examiner and paid at £246 a year, rising by increments of £12 if service satisfactory to £337, except that the starting salary for entrants below the age of 24 years will be reduced by £12 for each year below that age, payable monthly in arrear.

SUBSISTENCE allowance at the rate of £1/5 weekly is payable whilst under training to married men (and others with certain dependants) who normally reside outside the training centre.

CANDIDATES must be prepared to serve in any part of the United Kingdom and be willing to fly as observers in connection with their duties.

NORMAL age limits 21-50 years. Candidates between 50-55 years will be considered if they have had previous inspection experience.

CANDIDATES who on interview fail to qualify for the Examiner Grade may be considered for:—

ASSISTANT Examiner. Salary scale £184-£10-£246.

ASSISTANT Examiners do not undergo training, but are appointed direct to an A.I.D. station. They may later become eligible for promotion to Examiner on attaining the requisite standard of efficiency, provided they are willing to undertake the obligations required of examiners as above.

APPLICATION must be made on Form 786, copies of which can be obtained on application (by postcard only) to:—The Under-Secretary of State, Air Ministry (I.C.S./Rec.42), Berkeley Square House, Berkeley Square, W.1. [8703

AIR MINISTRY.

A NUMBER of Vacancies Exist for Technical Officers and Assistants II and III at Various Royal Air Force Stations for Work in Connection with the Development, Installation and Maintenance of Wireless Equipment.

THE Qualifications Required are:—

(A) EDUCATION to Degree Standard or Equivalent in Physics or Electrical Engineering, or a sound technical training.

(B) WORKSHOP or Laboratory Experience in the Development of Radio Communication Equipment.

A KNOWLEDGE of the Operation and Maintenance of Royal Air Force Wireless Equipment Would be an Advantage.

SALARY Scales are:—

B.210—Technical Officers—£275×£18—£455×£25—£580 (men); £275×£12—£347×£18—£464 (×£25—£580 in exceptional cases) (women).

B.211—Assistants II—£315×£12—£385 (men); £265×£12—£315 (women).

B.212—Assistants III—£130×£12—£214 (efficiency bar); ×£12—£310 (men); £130×£12—£214 (efficiency bar); ×£12—£260 (women).

COMMENCING Salaries up to £455 (Men) and £347 (Women) for Technical Officer Appointment, and up to £214 or above in exceptional cases for Assistants III according to qualifications and experience.

THE Appointments Will be Non-pensionable in the First Instance.

REQUESTS for the Necessary Form of Application Should be Addressed to the Under Secretary of State, Air Ministry (S.2.A/B.8019), Berkeley Square House. Berkeley Square, quoting the appropriate reference number and enclosing a stamped addressed envelope. [8701.

RADIO Valve Development Engineer Required; applicants must have degree in physics or electrical engineering, or previous experience; aptitude for design and development work, and interest in mass production methods.—Write, giving full particulars, to Cosmos Mfg. Co., Ltd., Brimsdown, Enfield. [8669

SITUATIONS VACANT

CIVILIAN Wireless Instructors Required at Royal Air Force Volunteer Reserve Centres.

INITIAL Rate of Pay £4 per Week, rising to £4/5 a week after a satisfactory probationary period, and thereafter by annual increments of 2/6 per week to a maximum of £4/12/6 per week; candidates must have a sound knowledge of electrical principles and their application to radio and low-power electrical engineering, and be capable of lecturing; suitable candidates will be interviewed, tested and medically examined.

CANDIDATES May be Required to Undergo a Short Course of Instruction at No. 1 Electrical and Wireless School, Royal Air Force, Cranwell, Sleaford, Lincs, before taking up duty, and during this period the rate of pay would be 65/- a week.

APPLICATION Should be Addressed to the Air Officer Commanding, Headquarters, Reserve Command, R.A.F. Hendon, the Hyde, N.W.9, giving full particulars as to previous experience, age, etc. [0638

JUNIOR and Senior Inspectors and Testers Required for Transmission Equipment Operating in the Voice and Carrier Frequency Ranges; applications from radio service engineers invited.—Write fully, stating age, experience and salary required, to Box 5825, A.K. Advg., 4, Talbot Mansions, Museum St., W.C.1. [8688

ELECTRIC DRY SHAVERS

REMINGTON, Rand, Shavemaster, Packard, Casco, Rabaldo.—Trade enquiries to Leonard Heys, 36, Henry St., Blackpool. [0633

MISCELLANEOUS

CHEAP Printing.—1,000 billheads, 3/6; sample free.—Cheteway Press, 18, Buxted, Sussex. [8180

EVERY Radio Dealer Who is Not a Regular Reader of "The Wireless and Electrical Trader" should send his trade card at once for a specimen copy and full details of the "Trader" Services. "The Wireless and Electrical Trader" has the widest influence, the largest weekly circulation, and is read by all the leading manufacturers and traders. Trade only, 15/- per annum, post free.—Published at Dorset House, Stamford St., London, S.E.1. [0615

PATENTS

"PRACTICAL Hints on Patents," free on application.—The Imperial Patent Service, First Avenue House, High Holborn, W.C.1. Preliminary consultation free. [0481

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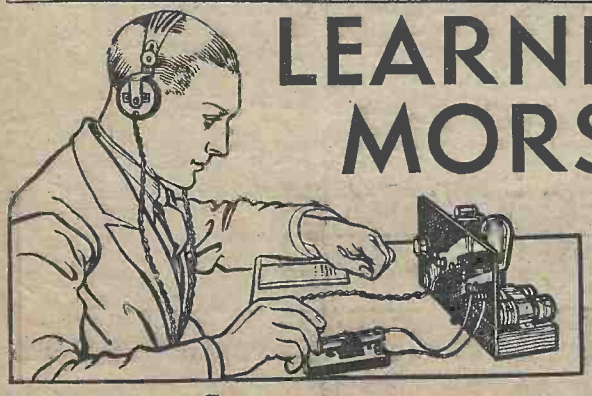

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