

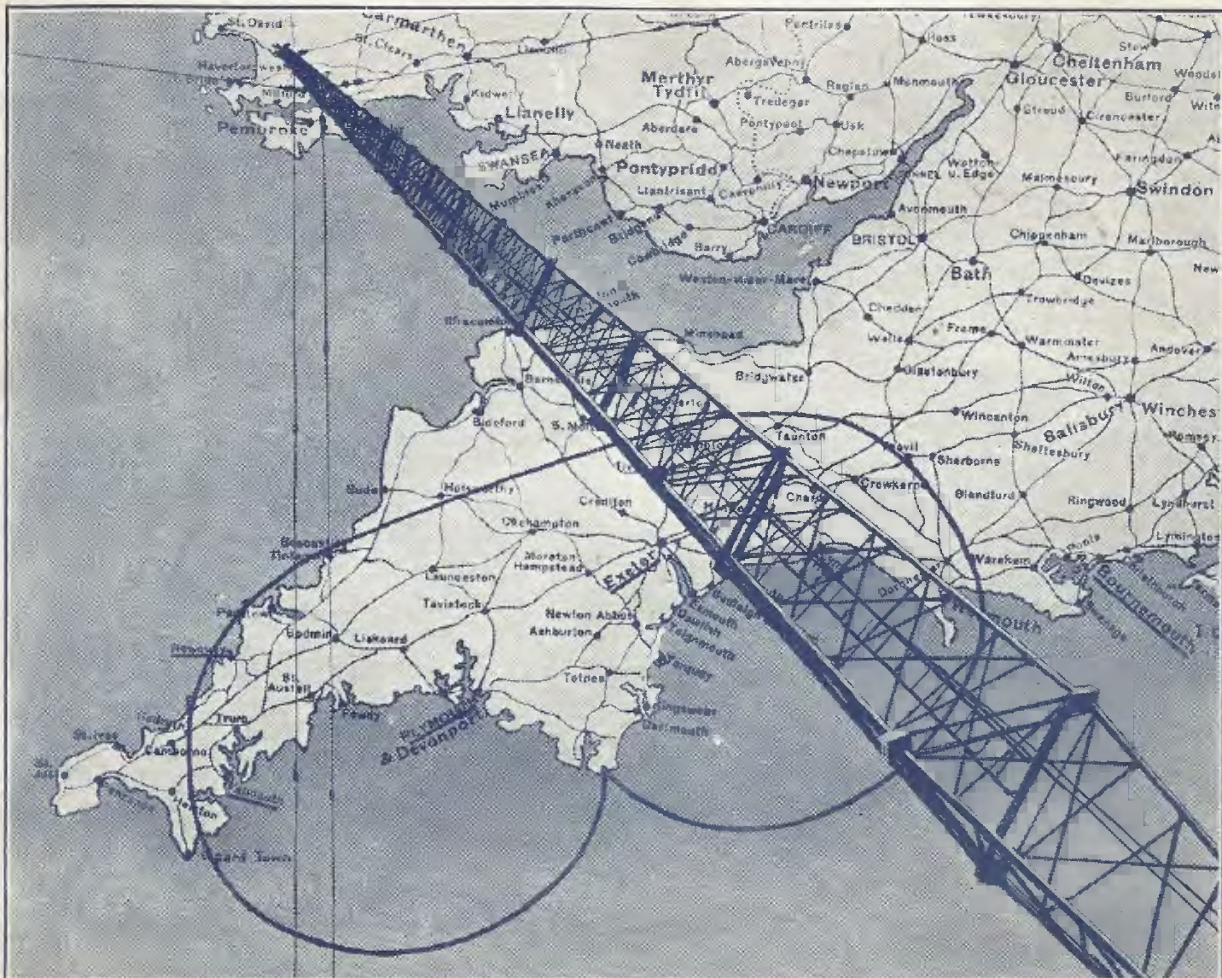
HIGH-TENSION BATTERY ECONOMY

The **Wireless World**

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JANUARY, 1941



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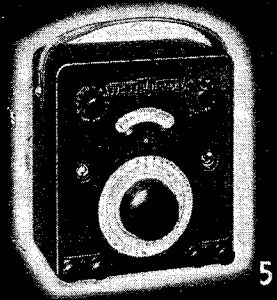
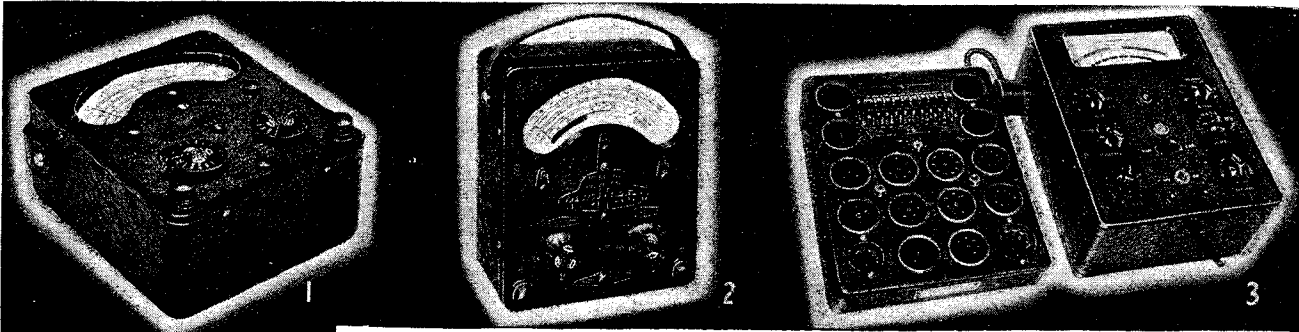
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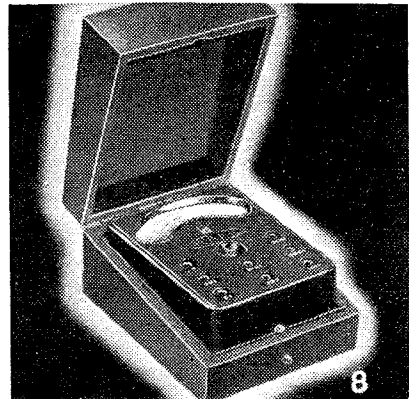
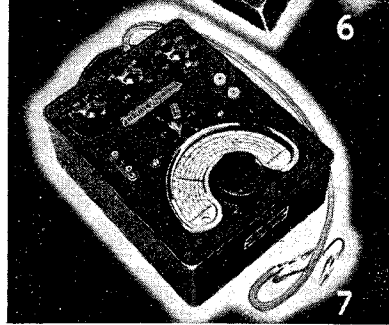
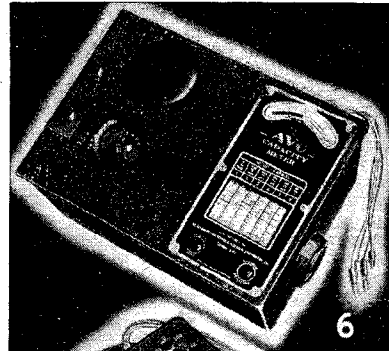


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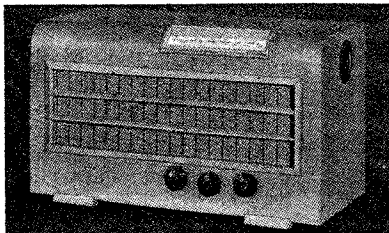
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- ☛ Six Wave Bands 10 to 565 metres continuously.
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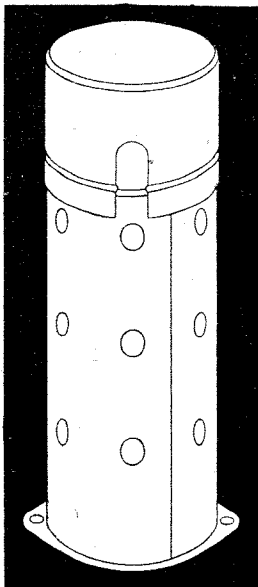


Illustration shows Tinplate Valve Shield supplied by Reads.

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announce a further selection of their bargains in high-class RADIO AND ELECTRICAL EQUIPMENT. As always, satisfaction is assured.

TUNING MOTORS, 15/30 v. A.C. operation. Finest model imported from U.S.A. Spindle 60 r.p.m., reversible, with automatic 2-pole make switch. High torque, suitable for many other purposes, 8/6.

PANEL METERS of guaranteed accuracy, A.C. or D.C., 2 1/2 in. flush panel mount, finished black. Amps.: 0/3, 7/9. Amps.: 0/10, 8/6. Milliamps.: 0/20, 0/50, either 9/6. Volts: 0/10, 9/6. Get these good instruments while supplies are available!

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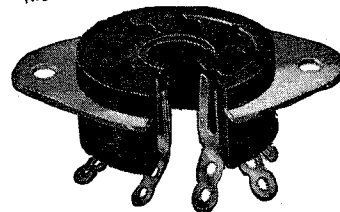
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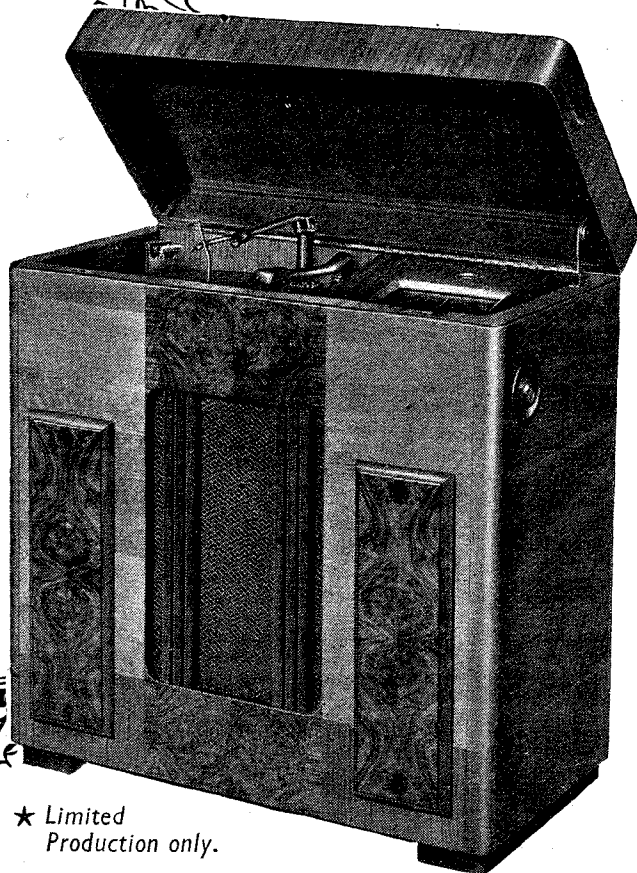
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Our vast organisation is now devoting the bulk of its productive forces to the great National effort that will, as speedily as possible, restore to us the time when Christmas will again be a season of festivity and COSSOR Quality RADIO be available for every home.



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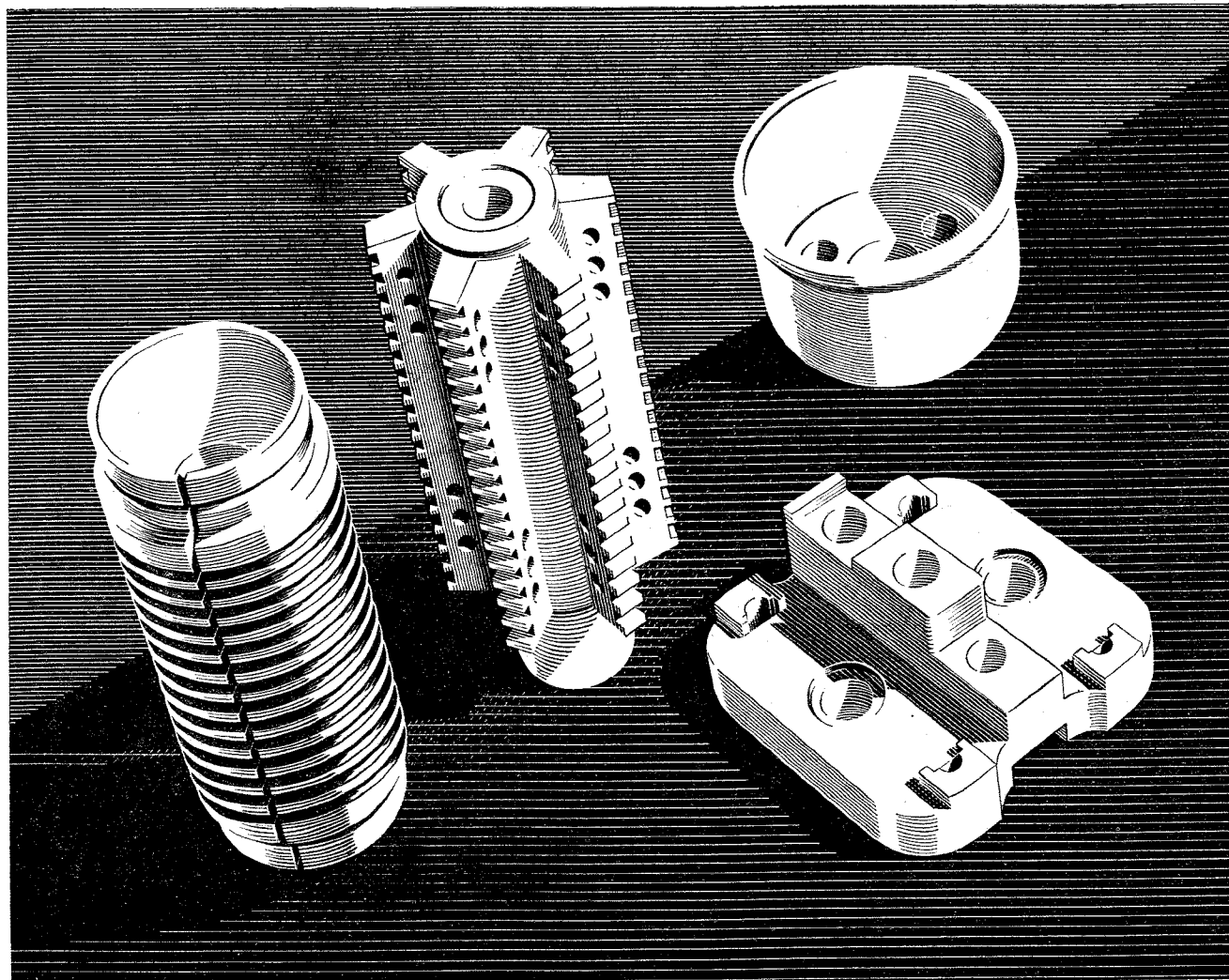
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A 5-valve Superhet, covering 12-2,000 metres in 5 wave bands.

- Beat Frequency Oscillator.
- 2-spread Band-Spread Control.
- A.V.C. Switch.
- Illuminated Band-Spread Dial.
- Send-Receive Switch.
- Iron-Cored I.F.s.
- Phone Jack.
- Over 4 Watts Output.

Built into Black Crackle Steel case providing complete screening. 10in. Moving Coil Speaker in separat. steel cabinet to match. Receiver, complete with all tubes and Speaker... **£9.9.0**

PREMIER 1941 HIGH FIDELITY AMPLIFIER KITS

Each Kit is complete with ready drilled chassis, selected components, specially matched valves and full diagrams and instructions.

	Kit of Parts with Valves	Completely Wired and Tested
4-watt A.C. Amplifier	£2 14 0	£3 11 6
4-watt A.C./D.C.	3 0 0	3 17 6
6-watt A.C.	6 16 6	7 13 6
8-10 watt A.C./D.C.	6 11 6	7 9 0
15-watt A.C.	7 18 9	9 8 0

Black Crackle Steel Cabinet, 17/6 extra.

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Wire-ends. All L.T. Windings Centre-Tapped

SP 250	250-0-250 v. 60 ma., 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 2-3 a.	11/9
SP 300	300-0-300 v. 60 ma., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a.	11/9
SP 301	300-300 v. 150 ma., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 1 a., 4 v. 1 a.	15/-
SP 350A	350-350 v. 100 ma., 5 v. 2 a. (not C.T.), 6.3 v. 2-3 a.	14/-
SP 350B	350-350 v. 100 ma., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a.	14/-
SP 351	350-350 v. 150 ma., 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 3-4 a.	15/-
SP 352	350-350 v. 150 ma., 5 v. 2 a., 6.3 v. 2 a., 6.3 v. 2 a.	15/9

Auto Transformers. Step up or down. 100-125 v. to 200, 230 or 250 v. A.C., 60 watts, 9/11; 125 watts, 13/6; 250 watts, 18/6.

L.T. Transformers, all C.T.
4 v. 2-3 a. ... 9/11 6.3 v. 2-3 a. ... 9/11
2.5 v. 5 a. ... 9/11 7.5 v. 3 a. ... 9/11
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Push-Pull Driver Transformers, 3:1 ... 6/6
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Will match any output valves to any speaker impedance.
1:1 ratios from 13:1 to 80:1, 5-7 watts, 15/9.
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Premier Morse Key, Bakelite Base and Brass Movement	3/3
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3 Henry Chokes	7/6
Complete Kit of Parts for Valve Oscillator as described in W.W. "Learning Morse"	25/-

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Incorporating the Premier 3-Band S.W. Coil, 11-86 Metres without coil changing. Each Kit is complete with all components, diagrams and 2-volt valves. 3-Band S.W. 1 Valve Kit, 14/9. 3-Band S.W. 2 Valve Kit, 22/6.

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1-V. S.W. A.C. Superhet Converter Kit	26/3
2-V. S.W. Receiver Kit	29/-

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Short-Wave Coils, 4- and 6-pin types, 13-26, 22-47, 41-94, 78-170 metres, 2/- each, with circuit.

Premier 3-Band S.W. Coil, 11-25, 19-43, 38-86 metres. Suitable any type circuit, 2/11.
4-pin or 6-pin Coil Formers. Plain or Threaded, 1/2 each.

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Lissen Dual Range Screened Coils. Medium and Long Waves, 2/9 each.

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Trolitul insulation. Certified superior to ceramic. All-brass construction. Easily ganged.

15 m.mfd.	1/9	100 m.mfd.	2/3
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Moving Coil Mike. Permanent magnet model requiring no energising. Response 90-5,200 cycles. Output .25 volt average. Excellent reproduction of speech and music, 49/-.

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for ALL SETS

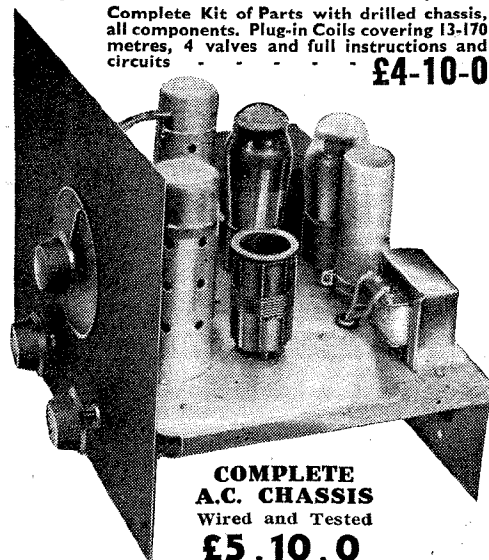
Europa Mains Valves. 4 v. A.C. Types, A.C./H.L., A.C./L., A.C./S.G., A.C./V.M.S.G., A.C./H.P., A.C./V.H.P., A.C.P., all 5/6 each. A.C./H.P., A.C./V.H.P., 7-pin, 8/6. A.C./Pens. I.H., 8/6; A.C./P.X. 4, 9/-; Oct. Freq. Changers 9/6; Double Diode Triodes, 7/6; 2 1/2-watt D.H. Triodes, 12/-; 350 v. F.W. Rect., 5/6; 500 v. 8/9. 13 v. 2 amp. Gen. Purpose Triodes, 5/6; H.F. Pens. and Var-Mu H.F. Pen., Double Diode Triodes Oct. Freq. Changers, 8/6 each. Full and Half wave Rectifiers, 6/6 each.

NEW PREMIER S.W. A.C. RECEIVER

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COMPLETE CHASSIS wired and Tested £3 18 6

EXTRA COILS 9-15, 200-2000m. also supplied

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"very much impressed"

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Send for full details

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for A.C. MAINS

Westinghouse Rectification complete and ready for use

To Charge:	6 volts at 1 amp.	22/6
2 volts at 1/2 amp.	12 volts at 1 amp.	24/6
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Greetings to all our Friends

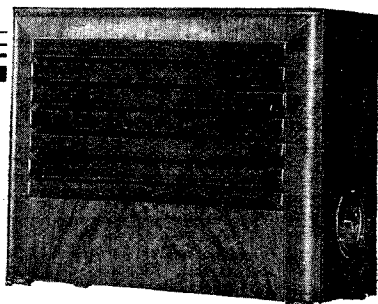
Wherever you may be, whatever duty you may be performing in to-day's fight for liberty and decency, we send to you sincere

Hearty Greetings and Good Wishes

May the Best of Luck attend you in the months to come.

THE DIRECTORS AND STAFF

McMichael Radio Ltd.



Size of Cabinet 15" x 12" x 6½"

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Prices from 24/-
List on application

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Less Transformer 65/- With Transformer 73/6

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32 RANGE UNIVERSAL TAYLOR-METER

(Sensitivity 1,000 ohms per volt
A.C. and D.C.)

The set testing functions of this precision instrument covers all ranges essential for carrying out accurate electrical measurements for Radio and General test work.

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4½" square type Taylor moving coil meter. Sensitivity of 900 microamps.

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The large dial has 3 clearly engraved scales for measurements of Resistance, A.C. and D.C. volts, A.C. volts and amps.

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 - (6) Output Volts 0-2.5 up to 1,000.
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 - (4) Ohms from 1 to 10 megohms.
 - (4) A.C. Current 0-1 mA. up to 2.5 amps.

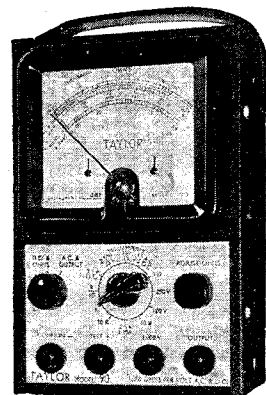
SOCKETS

There are 4 on the front panel, "Common," "Test," "1,000v" and "Output."

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A high degree of accuracy is assured as every instrument is carefully checked against our standard.

A fully descriptive technical Brochure of this instrument, free on request.



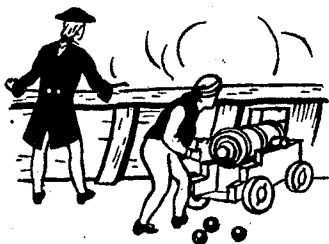
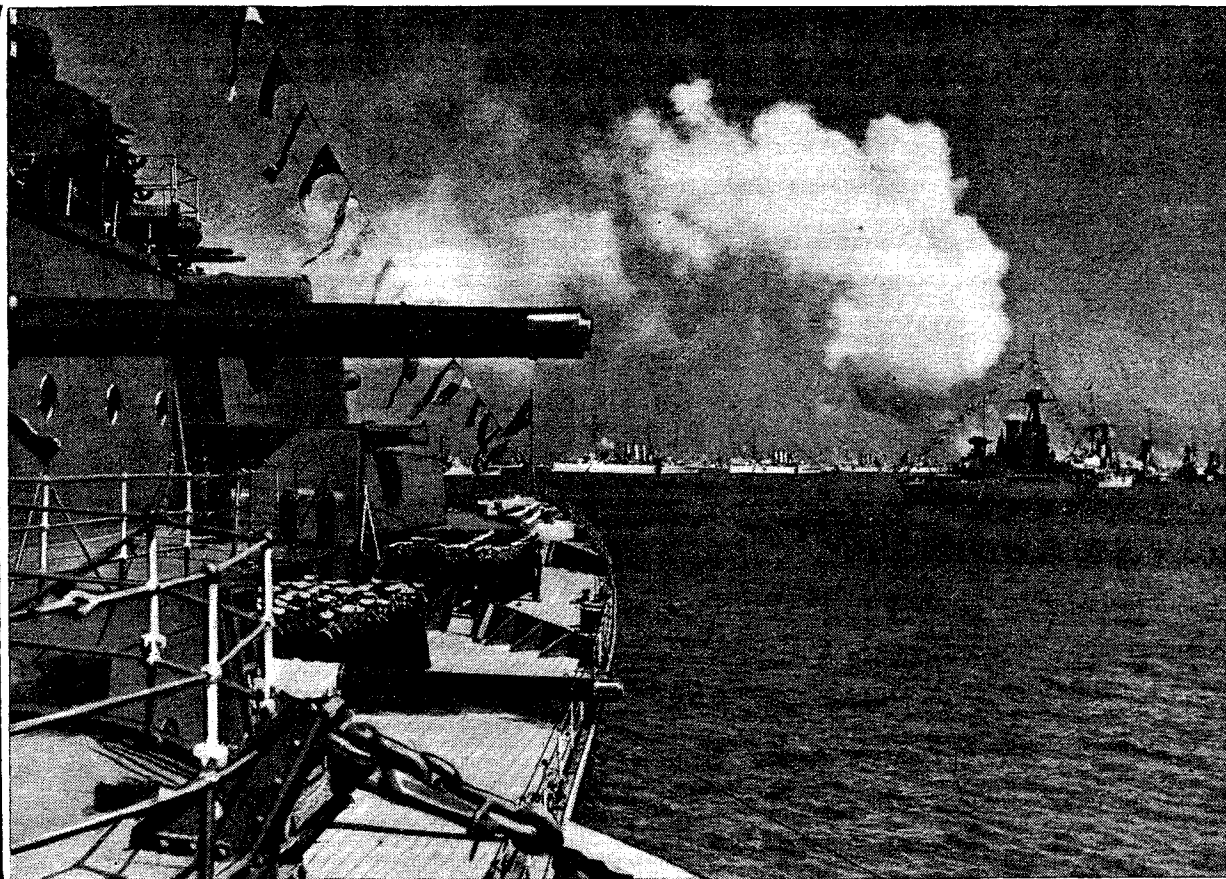
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We've had our squalls and we've had our battles ; we've had our salvos and we've had our broadsides ; but in spite of all we've carried on. And now, in this greatest trial of all, we are still riding the troubled waters calmly, and still, if we may say so, doing our job just that little bit better than anyone else.

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CHRISTMAS 1940



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to all
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The Marconiphone
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and wishes for an early
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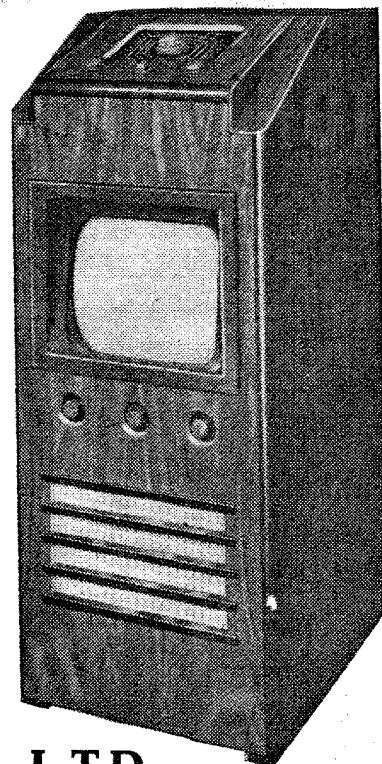
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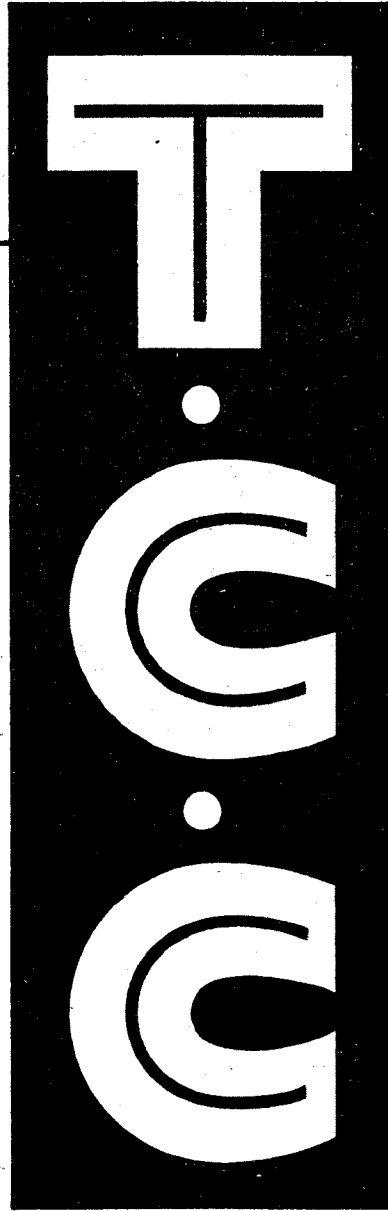
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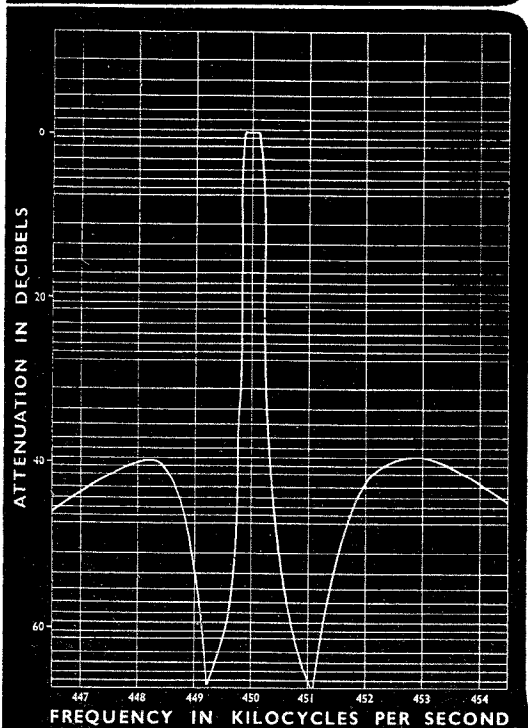
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JANUARY, 1941

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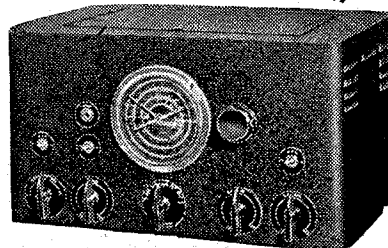
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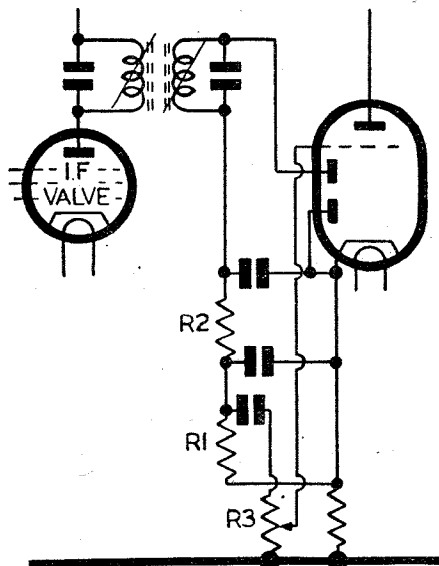
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Obviously, a widened tolerance may have an effect on many aspects of the performance of the set. Let us take an example. In the diagram,



which shows part of the circuit of a straightforward mains set, R_1 ($0.47\text{ M}\Omega$) is the diode load; R_2 ($0.1\text{ M}\Omega$) the I.F. decoupling resistance; and R_3 ($1.0\text{ M}\Omega$) the volume control. Before the war R_1 and R_2 had a standard tolerance of $\pm 10\%$, while R_3 was $\pm 20\%$. We have now increased the tolerance of all three

to $\pm 20\%$, and this change has an effect on the gain, selectivity and quality of the receiver. The question which had to be answered before the change could be made was whether or not the effect would be serious enough to be noticeable in use.

With a diode load right on the low limit, the Q of the secondary of the second I.F. transformer is 4% worse than with the pre-war low limit, while on the high side it is 4% better. This means that the Q of the coupled pair swings approximately $\pm 2\%$ beyond the old limits, and the gain changes rather more than this because some change of coupling occurs with change of Q . But it is fortunate that the first I.F. transformer is less damped and has a higher Q than the second, so that the overall effect on selectivity and on sideband cutting is quite small.

Some change of gain also occurs because of the change in the potentiometer ratio given by R_2 feeding R_1 and R_3 in parallel. The gain is least when R_1 and R_3 are a minimum and R_2 a maximum, and it is greatest when the reverse is true. With a tolerance of $\pm 10\%$ the change of gain from this cause was about $\pm 0.50\text{ dB}$, while for $\pm 20\%$ tolerance on all values the change of gain is $\pm 0.81\text{ dB}$. Such a variation of gain would really require a side-by-side change-over test to appreciate it, and under to-day's conditions can be ignored.

The AC/DC load ratio of the diode is also affected by these tolerance changes. The AC/DC load ratio is given by:—

$$a = \frac{R_1 R_3}{R_1 + R_3} + R_2$$

Inspection of this fraction will show that the value of a is a minimum when R_1 is a maximum, and R_2 , R_3 are at their minimum values. So that with the old tolerances the worst value was:—

$$a = \frac{517 \times 800}{1317} + 90 = 0.67$$

while with the new values:—

$$a = \frac{564 \times 800}{1364} + 80 = 0.64$$

Here, as in the other cases, we are a little worse off, but the effect is not serious.

Similar tolerance changes have been necessary in all parts of the receiver, and the overall effect is to produce variations in performance, which, while obvious on measurement and greater than we should like in peacetime, have little effect on the general utility of the receiver and none on its reliability.

It should also be borne in mind (apropos the case we are discussing) that only a small proportion of the resistors used is actually on the limit of tolerance; and sets in which all three resistors are right over to one limit are quite rare. The great majority of sets will still lie close to the mean performance.

And remember, too, that these small changes in the performance of the receiver make all the difference between being able to produce a set and not being able to produce it—the difference between somebody's getting the news and not getting it—and we believe that radio news and radio entertainment are needed to "do their bit" in keeping us cheerful.

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JANUARY, 1941

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Editorial Comment

A Year of Wartime Wireless

WRITING in this journal a day or two after the outbreak of war, we said "there is one thing that we can face with the most serene confidence. The wireless service, though young in years, has already established a tradition of steadfast devotion to duty of which we are all justifiably proud . . . the various branches of the service may meet with difficulties that none of us can yet foresee, but . . . communication will be maintained." As we approach the end of the first full year of war, it is opportune to enquire how far that expectation has been fulfilled.

Wireless communication, in the widest possible sense of the term, *has* been maintained. Paradoxically, wireless is one of the most silent of services, but, although countless stories of devotion to duty will never be made public, enough is already known to prove conclusively that it has not been found wanting.

It is perhaps natural that the Royal Air Force have been most in the public eye, and the kind of cool courage that the wireless man is often called upon to show is well exemplified by the conduct of Sergeant Davidson, who was recently awarded the D.F.M. When the bomber in which he was acting as operator was hit by enemy fire, Davidson, in spite of the fact that he was dazed and temporarily blinded, continued to work his apparatus, though his burned fingers had to be guided to the controls by another member of the crew.

Much of what has been done by wireless personnel of the Navy must be left to the imagination, but we can rest assured that their task has been no enviable

one. The casualty lists published after the battle of the River Plate included a high proportion of telegraphist ratings. Similarly, official reticence has cast a veil over the doings of Army wireless men, but enough has filtered through to show that they played a vital part in maintaining communication during the retreat on the Channel ports. Among the fighting Services must now be included the men of the Merchant Navy, who are now bearing the brunt of the intensified German submarine and aerial attacks against our shipping.

Another important link in the communication system of this beleaguered fortress is the B.B.C., which, as all listeners know, has maintained its service, sometimes under "front-line" conditions. The matter broadcast still does not meet with wide approval—it never did and probably never will—and it seems certain that a greater measure of Government control will be imposed on the Corporation's Overseas Service, which, it is good to hear, is to be extended.

In spite of shortage of staff and material, the supply of broadcast receivers has so far been adequately maintained by the wireless industry, which has also provided sinews of war, in the shape of foreign exchange, by its successful attempts to extend the export market. In addition, the industry is supplying vast quantities of equipment to the fighting Services. Altogether, wireless has no reason to be ashamed of itself, and we are confident that, when the history of the present war comes to be written, the contributions made by wireless will be admitted to have been even greater than they were in 1914-1918.

Greetings to Our Readers

IT is not inconsistent with the spirit that should prevail in a beleaguered fortress—especially in one that is so cheerfully and successfully resisting all attacks—to offer the usual Christmas Greetings to our readers. To all members of the big and more-than-ever united family of wireless, whether in the fortress or outside it, in the Services or on the civilian front, the Editor and staff of *The Wireless World* tender their sincere good wishes for Christmas and the New Year.

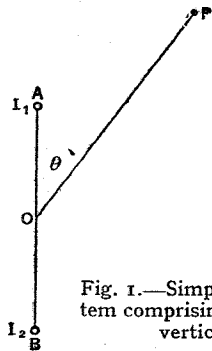
Directional Broadcasting

REDUCING WASTED RADIATION

FOR many years directional aerials have been used for short-wave wireless services. In such cases the area which it is desired to serve generally subtends a small angle at the transmitter, and it is therefore possible to concentrate the energy into a narrow beam, thus increasing the field strength in the desired direction without increasing the transmitter power.

The use of directional aerial systems for medium-wave broadcasting is much more recent, and the need for these is not at first sight obvious. Generally speaking, a broadcast transmitter is placed at the centre of the area it is required to serve, and a circular horizontal polar diagram, as given by a single vertical aerial, is required.

Fig. 1.—Simple directional system comprising a pair of spaced vertical aerials.



In special cases, however, it is desirable to be able to control the shape of the horizontal polar diagram by means of a directional system. The contour of the area to be served may not be circular, or, if circular, there may be advantages in not placing the transmitter at the centre.

In serving a region having a long coast line, for instance, it may be better to take advantage of transmission over sea, over which the attenuation is low.

In addition, although theoretically a single aerial gives a circular horizontal polar diagram, in practice this may be far from the case, due to unequal ground attenuation in different directions. As a result of this, if a field strength contour (that is, a line joining points of equal field strength) is measured in the immediate vicinity of the aerial, it will be the same shape as the polar

diagram of the aerial; but, as the distance is increased, ground attenuation begins to have an effect, and the shape of the contour changes, generally settling down to a fixed shape at a distance of a few miles. It is thus advantageous to concentrate the radiated energy in the directions in which the attenuation is high in order to improve the coverage of the transmitter.

Again, the use of directional aerials may be desirable on the score of reducing radiation in a certain direction with the object of protecting the service area of a distant transmitter which has to share the same wavelength. The new Montreux wave plan (which but for the war would now be in force) provides for the use of directional aerials for a number of transmitters with this end in view—and, indeed, without this protection it is probable that the plan would not have been accepted by several of the signatory countries.

Simple Aerial Systems

Directional aerial systems for medium-wave broadcasting differ greatly from those for short-wave services, inasmuch as the polar diagram must not be sharply directional. Simple types of aerial systems will, therefore, give the desired control of the polar diagram shape.

Two spaced vertical aerials, A B, as shown in Fig. 1, are generally used, the relative phase and amplitude of the currents in the aerials being controlled by appropriate impedance networks. Mast radiators, or aerials suspended between masts, may be used. The polar diagram of such an arrangement will, of course, be symmetrical about the line of the aerials. Both aerials may be driven—that is, excited directly from the transmitter—or one aerial may be driven and the other excited by radiation from the driven aerial. Such an undriven aerial is sometimes referred to as a parasitic reflector,

The use of directional transmitting aerials—as opposed to “all-round” radiating systems—represents a relatively new and growing trend in the planning of M-W broadcasting services. Means of obtaining directional effects, and examples of their application, are described in this article

and the spacing and termination are chosen to give the required phase and amplitude relationships.

If I_1 , the current in A, lags I_2 , the current in B, by an angle ϕ , and if the spacing and wavelength are d and λ respectively, the shape of the polar diagram is controlled by the ratio of I_1 to I_2 , d , and ϕ . It is obvious that, because of the space and time-phase relationships of the fields due to A and B, in certain directions addition of the separate fields will occur, and in other directions partial or complete cancellation.

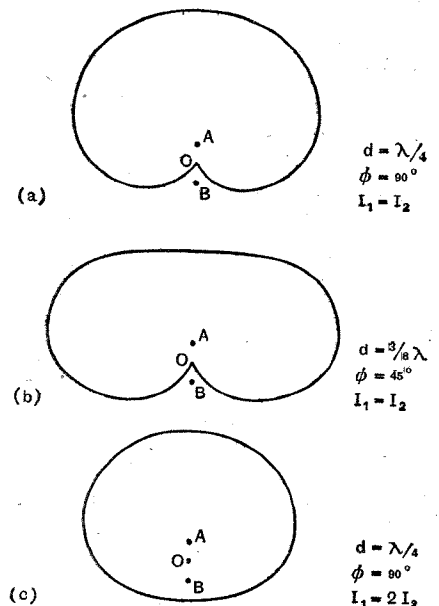


Fig. 2.—Typical polar diagrams obtainable from an aerial system as shown in Fig. 1.

Directional Broadcasting—

In general, the field in a direction OP, at an angle θ to the line of aeri- als, may be found by the vector addition of the fields due to A and B separately. This is proportional to:

$$\sqrt{(I_1 + I_2)^2 \cos^2 \left\{ \frac{\pi d \cos \theta}{\lambda} - \phi \right\} + (I_1 - I_2)^2 \sin^2 \left\{ \frac{\pi d \cos \theta}{\lambda} - \phi \right\}}$$

which is equal to:

$$\sqrt{I_1^2 + I_2^2 + 2I_1I_2 \cos \left\{ \frac{2\pi d \cos \theta}{\lambda} - \phi \right\}}$$

reducing interference in specified directions. The fact that the field has been reduced in certain directions necessarily means that it is increased in other directions for the same radiated power.

Radiation Characteristics

Typical polar diagrams are shown in Fig. 2. In these O represents the centre of the system, and AB the line of aeri- als. The field strength in any direction is proportional to the distance from O to the point on the

polar diagram. This corresponds approximately to the case of a tuned parasitic reflector spaced $\frac{\lambda}{4}$ from the driven aerial.

Although some of the diagrams shown indicate zero values, these are never attained in practice; small amplitude and phase errors, and the effect of surrounding objects result in small minima instead of zeros, but this does not impair the efficiency of the system appreciably.

Practical Examples

The usefulness of the polar diagrams discussed will be more evident by considering specific cases of directional aerial systems installed and used by the British Broadcasting Corporation before the war.

Fig. 3 shows the service area of the Midland Regional transmitter. This transmitter was designed to serve the Midland counties from Gloucestershire in one direction to Nottinghamshire in the other. It was obviously inefficient to transmit as much energy in the direction of the Severn estuary as in the direction of Nottingham; in addition, the attenuation of the ground in the former direction is low, and this provided a further reason for concentrating the energy in the north-

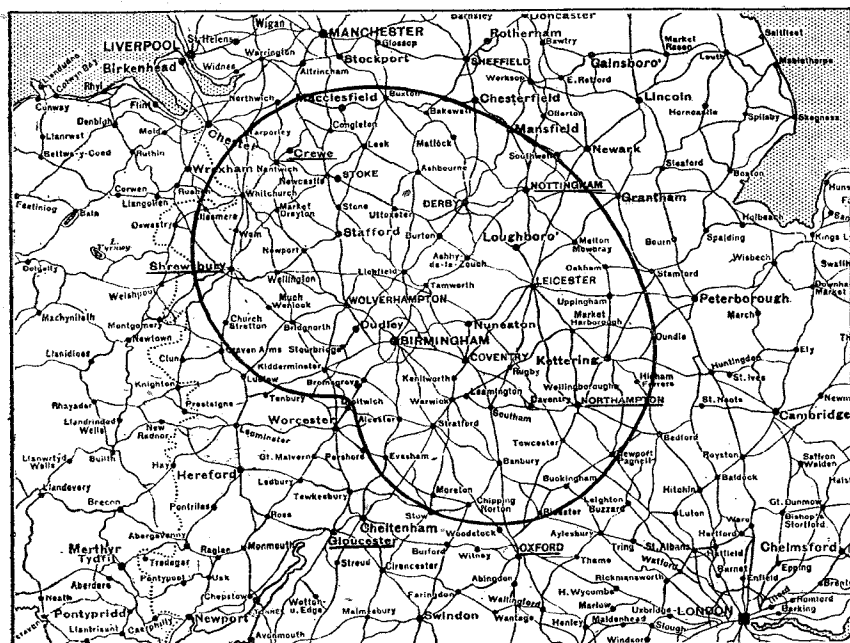


Fig. 3.—Designed service area of the B.B.C.'s Midland Regional transmitter.

In these expressions the angles are in radians, 2π radians being equal to 360 degrees.

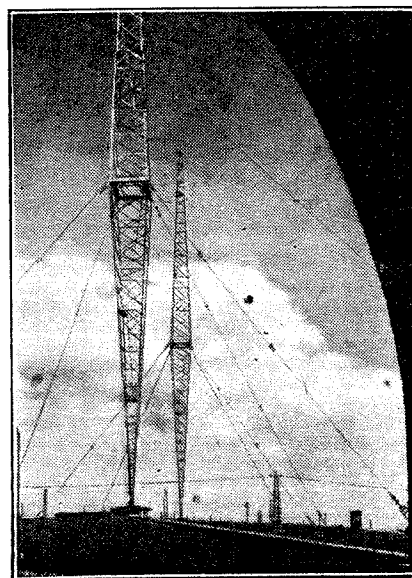
If, therefore, I_1 is equal to I_2 , it is possible, by suitably choosing d and ϕ , to obtain either one zero, or two zeros equally displaced about AB. The position of the maxima can also be controlled in the same way. If, however, I_1 is not equal to I_2 , no zeros are obtained, but either one or two minima, equally displaced about AB.

By choosing the ratio of I_1 to I_2 , and the values of d and ϕ , it is thus possible to obtain a polar diagram in which the maxima and the minima are in desired directions, the former giving an increase in field strength in the service area, and the latter

curve in that direction. Fig. 2a corresponds to a spacing of $\frac{\lambda}{4}$ and a lag of 90 deg., giving the well-known cardioid diagram; the radiation is reduced over a comparatively narrow sector, and the maximum increase in radiation occurs in the direction BA.

Fig. 2b corresponds to a spacing of $\frac{3}{4}\lambda$ and a lag of 45 deg.; the radiation is reduced over approximately the same sector, and the maximum increase is in a direction perpendicular to the line of aeri- als. In this direction the increase is equivalent to doubling the transmitter power.

Fig. 2c is similar to Fig. 2a, except that I_1 is equal to $2I_2$, giving a much smaller deformation of the



Radiator and reflector masts at the Vienna station: an early example of directional broadcasting on medium waves.

Directional Broadcasting—
east direction. A cardioid polar diagram, as illustrated in Fig. 2a, was used at this station, but with

omnidirectional aerial, radiating the same total power, were used. The combination of a directional aerial system and unequal attenuations in

coupled to the two aerials. A final check can then be made by means of local field strength measurements.

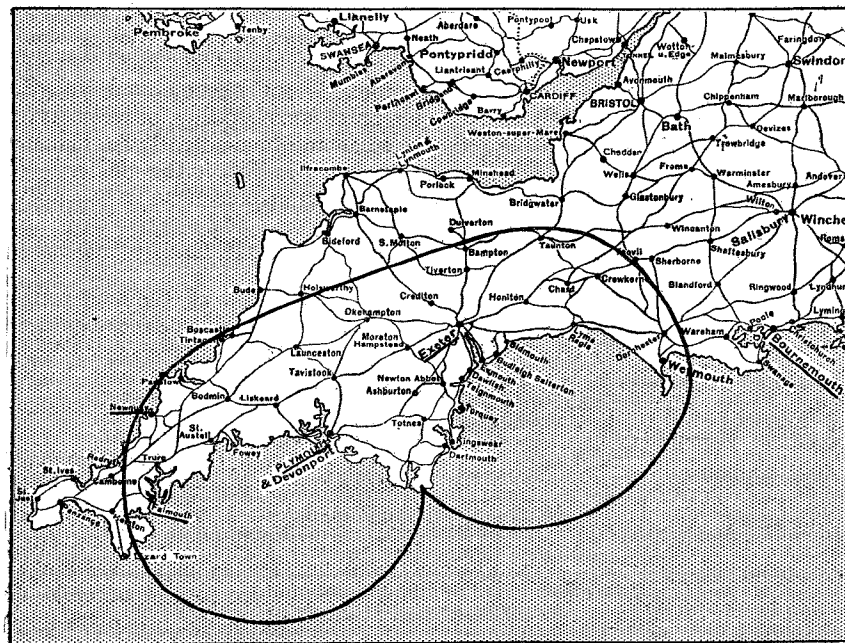


Fig. 4.—A good example of the modern tendency to reduce wasteful radiation by using a directional aerial was provided by the design of the Start Point station.

the relative amplitude adjusted to give a small amount of radiation in the direction AB; the line of aeriols was chosen to give maximum increase of field strength in the direction of Nottingham.

Start Point

A more sharply directional polar diagram was aimed at for the newer Start Point transmitter, shown in Fig. 4. The service area in this case is southern Cornwall and Devon, and also a large part of the south coast. Advantage was taken of low attenuation over the sea by locating the transmitter on the coast line, on a headland which projects into the sea; in order further to increase the range along the coast, the directional aerial system shown in Fig. 2b was used, the line of aeriols being arranged to give maximum increase in field strength in the desired direction. The amount of energy radiated out to sea was thus reduced considerably, whilst even in the least favoured direction, to the north, the field strength was as high as if an

different directions thus gave an elongated polar diagram especially suitable for this service area. It is of interest to note that the field strengths from this transmitter in Plymouth, Falmouth and Portsmouth were roughly the same.

Even though the currents in the two aeriols are equal, it is not necessarily true that the impedance and powers are the same. The working impedance of each aerial is dependent on the amplitude and phase of the current flowing in the other aerial. It is thus necessary to measure, in addition to the impedance of the separate aeriols, the mutual impedance between them. The impedance and power in each aerial can thus be calculated, and impedance matching and phasing networks added to give the correct power and phase relationships. In the case of Fig. 2b, for instance, the power in aerial A is approximately two-thirds of the total power. The correct amplitude adjustment can be checked by means of meters, and the phase by means of a cathode-ray tube, or similar device, suitably

Book Review

Radio-Frequency Measurements by Bridge and Resonance Methods. By L. Hartshorn, D.Sc. Pp. 265 + IV, with 99 figures. Chapman & Hall, Ltd., 11, Henrietta Street, London, W.C.2. Price 21s.

THE thing that impresses one about this book is the sound and thorough way the author has done what he set out to do. There is an enormous literature on radio-frequency measurements—comparatively little of it in book form—and an attempt to cover the whole field in a book of reasonable size would have resulted in each aspect being too superficially treated to warn the reader of the many sources of error and indefiniteness. The author confines himself to the measurement of quantities such as impedance, resistance, capacity, phase, etc., excluding current, voltage and frequency; and deals with the two methods indicated in the title. Of these, the treatment of radio-frequency bridge methods is particularly valuable because of the absence of comprehensive information elsewhere; and resonance methods have been very usefully extended to include the transmission line "circuits" that are necessary to cope with the growingly important frequencies above 200 Mc/s.

The book is divided into three parts—principles, apparatus, and methods. In the first, the equations relating to impedance, resonance and screening are derived, for use later on. Thoroughness in getting down to basic principles is, however, not abandoned at the end of the first section but continues throughout. In this field, quick "ready-to-wear" rules are apt to lead the worker astray by not sufficiently exactly defining what it is that is being measured; but the present author, as befits a Principal Scientific Officer at the N.P.L., deals precisely and quantitatively with all the minor complications, such as the inductance of variable condensers and leads, that are too often dismissed in general terms. Nevertheless, he is human enough to include the ARRL Radio Amateurs' Handbook among the thirteen books recommended, and to advise the modern "communication" receiver, rather than a special amplifier, as a bridge detector.

The volume is an authoritative and clear exposition of the subject.

M. G. S.

Series or Parallel?

ALTERNATIVE FEED CIRCUITS FOR AVC SYSTEMS

By W. T. COCKING, A.M.I.E.E.

The functioning and relative merits of the two available methods of feeding AVC voltages to the grids of controlled valves are discussed, and it is shown that the parallel method, though not widely used, has certain advantages for short-wave and all-wave receivers

are necessary for the maintenance of accurate ganging even if they are not required for AVC purposes. Thus, take the case of a super-heterodyne with one RF stage. AVC will normally be applied to the RF valve, but not always to the frequency changer. Whether or not it is applied to this valve, however, its tuned grid circuit should include a condenser of the same value as that in the tuned grid circuit of the RF stage. The oscillator, too, should have the same capacity included within its tuned circuit, but this does not usually necessitate the use of an extra component, but merely an appropriate reduction in the value of the padding capacity.

The inclusion of C_1 reduces the efficiency of the tuned circuit somewhat because of the losses in the condenser—it thus reduces selectivity and sensitivity in some degree. The importance of this depends upon the magnitude of the effective series resistance of the condenser in relation to the effective series resistance of the tuned circuit as a whole before the insertion of C_1 . It may be quite important when low-loss circuits are used, but in the average case of only moderately efficient components the loss introduced by C_1 is not very serious.

On short and ultra-short waves where the coil inductance L is small

It comes in series with the tuning condenser C and so reduces the total maximum circuit capacity. This can be made as small as desired by the simple expedient of making C_1 very large compared with the maximum capacity of C . For instance, if the latter has the common value of $0.0005 \mu\text{F}$, and we are willing to sacrifice $10 \mu\mu\text{F}$ total capacity, we have $0.00049 = 0.0005 C_1 / (0.0005 + C_1)$ or $C_1 = 0.0245 \mu\text{F}$. In practice, a capacity of $0.1 \mu\text{F}$ is commonly used and this reduces a capacity of $0.0005 \mu\text{F}$ for the tuning condenser to an effective value of $0.0004975 \mu\text{F}$; the reduction is $2.5 \mu\mu\text{F}$.

Effect on Ganging

It is at once obvious that if there are several circuits with ganged tuning controls the accuracy of ganging may be affected even if C_1 is large enough not to restrict the tuning range appreciably. A reduction of 10 kc/s or so in the tuning range may be unimportant in itself, but if one or two circuits are so restricted and others are not, the effect on sensitivity and selectivity of the ganging errors may be very serious.

It is important, therefore, to insert such condensers in all the tuned circuits which are ganged together, and the condensers must all have the same capacity. They

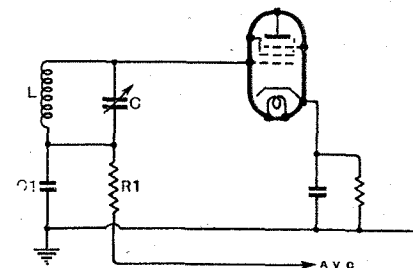


Fig. 2.—This series-feed circuit is practicable when the tuning condenser rotor may be isolated.

the inductance L_1 of the condenser may be highly important. Its chief effect is likely to be in causing inaccurate ganging, and this can be

It is not always realised that, in the application of AVC bias to a controlled valve, alternative methods usually exist. Wherever alternative methods are available a designer necessarily has to choose between them, and it is consequently important for him to know the characteristics of each.

Probably the commonest AVC feed circuit is the series type shown in Fig. 1. The tuning coil L is not returned directly to the earth line but through a condenser C_1 , and the AVC line is connected to the junction of L and C_1 through a resistance R_1 . This particular arrangement of series feed is necessary because the frame of the condenser C must be earthed in most cases. If it need not be earthed a modified form of the circuit, shown in Fig. 2, has certain advantages which will be dealt with later.

The first thing to notice about the circuit of Fig. 1 is that C_1 is included within the tuned circuit. The condenser has a capacity C_1 , but it has also inevitably an internal inductance L_1 and resistance R_1 ; it is, in fact, on its own a series resonant circuit. The total inductance, capacity and resistance of the tuned circuit as a whole are thus no longer L , C and R , but become $L + L_1$, $CC_1 / (C + C_1)$ and $R + R_1$.

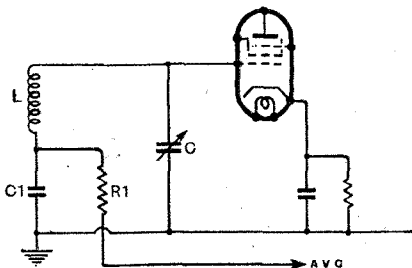


Fig. 1.—The series-feed circuit, as applied to the majority of receivers having a ganged tuning condenser with an earthed rotor.

The insertion of C_1 thus affects the tuning and efficiency of the circuit.

First of all, let us consider the effect of the capacity of C_1 alone.

Series or Parallel?—

minimised by including identical condensers in all the circuits ganged together, just in the way that the inclusion of such condensers is advisable to prevent ganging errors due to capacity variations. In this case, however, it is not sufficient merely that the condensers should be of the same capacity; they should also be of the same make and type. Unless they are of the same construction it is improbable that their inductances will be even roughly of the same value.

These considerations do not apply to the circuit of Fig. 2, for here C_1 is not a part of the tuned circuit LC. This circuit is nowadays usually adopted in IF amplifiers, and there is usually no objection to the use of different capacities for C_1 , or even different types of condensers, in the various stages. It is only with the arrangement of Fig. 1 that care must be taken.

As an alternative to the series-feed circuit the parallel-feed arrangement of Fig. 3 can be, and often is, used.

In this case the tuned circuit LC is complete in itself, and the valve is fed from it through the condenser C_1 , AVC bias being applied to it directly through R_1 .

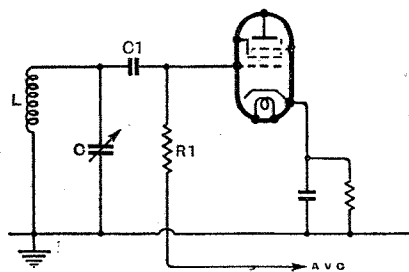


Fig. 3.—In the parallel system, controlling voltages are fed to the grid through a resistance R_1 ; condenser C_1 acts as a "stopper."

Provided that the reactance of C_1 is small compared with the input impedance of the valve, the presence of C_1 will have little or no effect on the tuning of LC. Consequently C_1 need be inserted only in those circuits which need it for AVC purposes, and the condensers used in different circuits need not be of the same capacity nor of the same type.

On medium and long waves the input impedance of the valve is substantially the reactance of the grid-

cathode capacity, so that it is only necessary for C_1 to be large compared with this capacity. This rarely exceeds $10 \mu\mu\text{F}$, so that C_1 need not exceed $1,000 \mu\mu\text{F}$ for its effect to be negligible. Smaller values down to $100 \mu\mu\text{F}$ are often used.

The resistance R_1 appears in shunt with LC when C_1 is fairly large as indicated above. It consequently damps the tuned circuit and reduces sensitivity and selectivity. The extent to which this damping action is important depends upon the value of R_1 in relation to the effective dynamic resistance of the tuned circuit.

The latter will rarely exceed $0.1 \text{ M}\Omega$ on the medium waveband and is likely to be considerably less on short waves. If R_1 is made ten times as great— $1 \text{ M}\Omega$ —the effective total dynamic resistance will be approximately 90,000 ohms, so that the drop in selectivity and stage gain will be about 10 per cent. If R_1 were much higher, say $10 \text{ M}\Omega$, the performance would be affected to a negligible degree, but there are reasons why this resistance cannot be more than a very few megohms.

Grid Resistance Limits

Valve makers often place a maximum limit of about $2 \text{ M}\Omega$ to the DC resistance included in the grid circuit of any one valve. There must be other resistances in the AVC circuit for filtering purposes which are common to more than one valve, and these count as though their value were multiplied by the number of valves to which they are common. Consequently, it is usually difficult to make R_1 more than $1 \text{ M}\Omega$ and remain within the valve maker's limitation.

With good quality condensers it is probable that the losses introduced with the series circuit are lower than those caused by the resistances of the parallel circuit at moderate to low radio frequencies. Much depends on the components used, but the odds are that on medium and long waves the series circuit will be slightly the better of the two.

At high frequencies, however, the position is rather different. In the first place, the dynamic resistance of the tuned circuit is likely to be con-

siderably lower, and in the second the valve itself has an appreciable input resistance. At really high frequencies this may be a few thousand ohms only, but over the usual short-wave bands it is generally to be measured in tens of thousands of ohms. The result is that a value of $1 \text{ M}\Omega$ for R_1 in the parallel circuit is likely to increase the losses by a negligible amount.

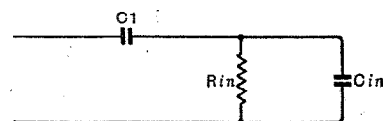


Fig. 4.—Explaining how the parallel-feed method may be used for impedance matching.

On the other hand, the resistance introduced by C_1 in the series circuit will normally tend to increase with frequency, and so this circuit will have relatively higher losses on short waves than on medium and long. When the undesirable effects of inductance in C_1 are also considered it can be seen that the advantage lies definitely with the parallel-feed system with a short-wave or all-wave receiver, but with the series-feed circuit for a set designed primarily for the medium and long wavebands.

There are, however, certain practical matters to take into account. In the parallel circuit, C_1 is at a high radio-frequency potential, and must consequently be screened at least as carefully as the valve and its grid lead. The condenser, moreover, must have a low capacity to earth, otherwise the stray capacity across the tuned circuit will be excessive. With "top-grid" valves the disposition of this condenser and the resistance R_1 is sometimes a nuisance. With the parallel-feed circuit, however, both condenser and resistance are at a low potential to earth and need little or no screening; neither is their capacity to earth important.

One point in connection with the parallel-feed circuit which deserves mention is the possibility of obtaining impedance matching between the valve and the tuned circuit in cases where the input resistance of the former is smaller than the dynamic resistance of the latter. As shown in Fig. 4, the input impedance of the

Series or Parallel?—

valve can be represented by a capacity C_{in} in parallel with a resistance R_{in} . The impedance of the combination of the two with C_r is equivalent to a capacity and resistance in parallel, but the former is smaller and the latter of larger value than C_{in} and R_{in} . By a suitable choice of value for C_r , R_{in} can be matched to the tuned circuit and maximum efficiency is thus easily secured.

Provided that R_{in} is much larger than the reactance of C_{in} and C_r in parallel, the optimum value of C_r is $C / \left[\sqrt{\frac{R_D}{R_{in}}} - 1 \right]$ where R_D is the dynamic resistance of the tuned circuit. Thus, if the input resistance of the valve is one-quarter of the

dynamic resistance of the tuned circuit, C_r should be about equal to C_{in} . As C_{in} is commonly 5-10 $\mu\mu\text{F}$, the value for C_r is much smaller than that often used.

Such small values will normally be required only on short waves where the valve input impedance is low. Before a detector or AVC rectifier, however, a small capacity may be advantageous even at low frequencies. Thus, suppose we have an IF circuit with a dynamic resistance of 0.2 $\text{M}\Omega$ and we are feeding an AVC diode from it through a capacity, the diode having an input resistance of 0.1 $\text{M}\Omega$ with a capacity of 5 $\mu\mu\text{F}$. Then for optimum efficiency the feed condenser should have a value of $5 / [\sqrt{2} - 1] = 5 / 0.414 = 12 \mu\mu\text{F}$.

Index for "The Wireless World"

OUR Publishers announce that the index for Volume XLVI of *The Wireless World* (November, 1939, to December, 1940) is now ready. Copies are obtainable for 7½d. each, post free, or, with cloth binding case, for 3s. 10d., post free. Our Publishers will bind readers' copies in cloth for 8s., plus 9d. for return postage of the completed volume.

Export Enquiry

THE firm of Meher Radio Company, Mehta Road, Bombay, India, requests us by telegram to invite British manufacturers of high-grade broadcast receivers to get into touch with them immediately with a view to arranging an all-India agency. Full particulars of products and prices should be sent.

In What Direction ?

A GRAPHICAL METHOD OF WORKING OUT THE BEARING OF A DISTANT TRANSMITTER

MOST radio aerials are directional, that is to say, the currents induced by a signal depend not only on the field strength but also on the direction of the waves. The directional property of the aerial is due partly to the layout of the aerial wires and

By T. S. E. THOMAS, B.Sc., Ph.D.

Many types of aerial, at any rate those used for short-wave reception, have marked directional properties, and it is an advantage when the best possible results are required from, say, the American Continent, to be able to set up the aerial on a bearing which will ensure the maximum "pick-up."

be caused by the directional property of the aerial and, if so, how it can be remedied.

To find the direction of a distant station B at the observer's station A it is sufficient for short distances to join AB on the map with a straight line and measure the angle or bearing it makes with the North-South line or meridian at A. This procedure will not give a correct result when the other station is in, say, America or Australia, for the path of the waves is the "bee-line" along the earth's surface between A and B. This line

(see Fig. 1) is called the Great Circle arc between A and B. The angle α which this line makes with the meridian at A could be found by measurements on a large globe, but the usual method is to use one of the formulæ of spherical trigonometry for which it is necessary to know the latitudes of A and B and the difference in their longitudes.

If only an approximate result, correct to the nearest degree or so,

Fig. 2. Illustrating the method of using the nomogram shown in Fig. 3.

is required the arithmetic can be avoided by the use of a nomogram devised by Weir which is reproduced in Fig. 3. In order to understand the use of this nomogram it will first be necessary to dissect it into its component scales with the aid of the

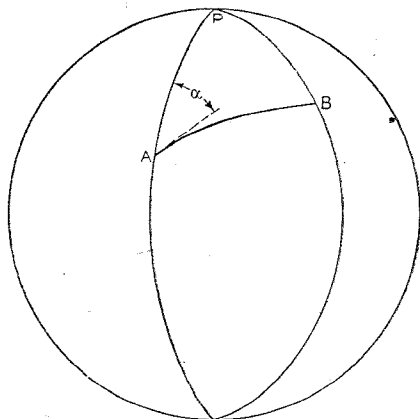
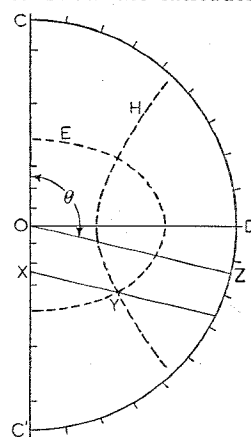


Fig. 1. Showing the true bearing of a station in relation to the Great Circle path of the wave from B to A.

partly to the screening effect of obstacles such as buildings. When consistently bad reception of certain stations is experienced it is useful to be able to ascertain whether this could



In What Direction?—

illustrative diagram in Fig. 2. On examination it will be found to consist of:—

1. A rectilinear scale COC' with graduations corresponding to the observer's latitude.
2. A uniformly graduated circular scale CDC' on which the bearing of B at A is measured.
3. A set of intersecting curves.

It will be seen that there are two types of curves: latitude curves such as E and longitude difference curves such as H. Each latitude curve corresponds to a definite value of the latitude of B, and each longitude difference curve to two values of the longitude difference between A and B. If we take the North and South latitude curves as distinct curves, then the intersection of a latitude curve and a longitude difference curve fixes a point Y on the nomogram. Curves for intermediate values can be sketched in when necessary.

Procedure

The rules for the use of the nomogram can now be set out as follows:

1. Find X the point on the latitude scale corresponding to the observer's latitude.
2. Find Y the point of intersection of the station latitude curve and the longitude difference curve.
3. Join XY and through O the centre of the circular scale draw a line OZ meeting the scale at Z where the angle θ may be read off (the parallel line can be drawn with the aid of a ruler and set square).
4. If A and B are on the same side of the equator the Great Circle bearing α of B at A is equal to θ .
5. If A and B are on opposite sides of the equator then the bearing α of B at A is equal to $180^\circ - \theta$.

It is important to note that the apparent reversal of the North and South latitude scales is not accidental.

The above set of rules may appear rather complicated, but if the working in the examples given below is repeated on the nomogram it will be found that the difficulties are not great.

Example 1.—At a receiving station in the Potteries Lat. 53° N. Long. 2° W. it is desired to find the bearing of a radio transmitter in California, Lat. 40° N., Long. 122° W.

In this case Long. Diff. is $122 - 2 = 120^\circ$.

The point X on the nomogram is the 53° division on the North Lat. scale. The point Y is located at the intersection of the 40° N. Lat. curve and the 120° Long. Diff. curve. A line OZ is now drawn through O

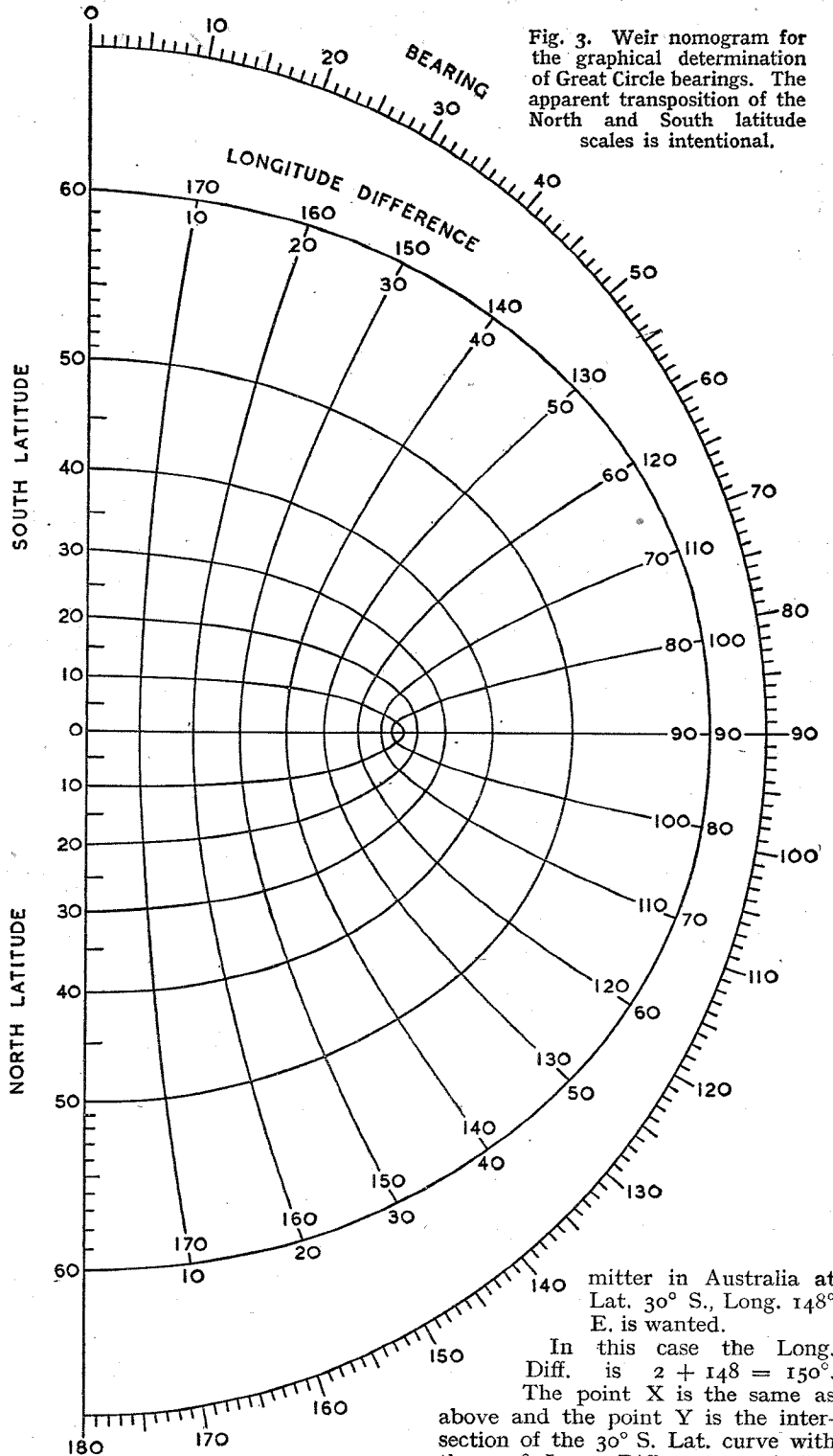


Fig. 3. Weir nomogram for the graphical determination of Great Circle bearings. The apparent transposition of the North and South latitude scales is intentional.

parallel to XY and cuts the circular scale at the 51° graduation. Hence in this example the bearing is (Rule 4) 51° West of North.

Example 2.—At the same station in the Potteries the bearing of a trans-

mitter in Australia at Lat. 30° S., Long. 148° E. is wanted.

In this case the Long. Diff. is $2 + 148 = 150^\circ$.

The point X is the same as above and the point Y is the intersection of the 30° S. Lat. curve with the 150° Long. Diff. curve. A line OZ is drawn through O parallel to XY and the circular scale reading is 17.5° . Since A and B are in this case on opposite sides of the equator the bearing is (Rule 5) $180 - 17.5 = 162.5^\circ$ East of North.

HT Battery Economy

SOME WARTIME EXPEDIENTS

By "SERVICE"

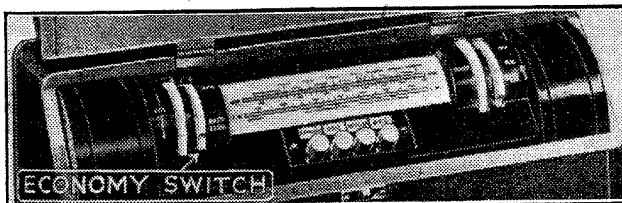
BATTERY receiver users this winter will be well advised to make their HT batteries last as long as possible. Not only has the money-saving aspect to be considered, but supplies of battery ingredients must be conserved and battery distribution made as wide as possible. Stocks have accumulated during the summer months, but they are feeling the onslaught of the increased winter demand, and retailers may not soon be able to supply all types immediately upon demand. To be without radio these days is unpleasant to contemplate, so battery users should all do what they can to ease the manufacturing situation by economising in radio "consumable items" as much as possible.

Like many other forms of saving a great deal can be accomplished by voluntary economy. It should hardly be necessary to point out that the peacetime practice of leaving the set running for most of the day as a background to normal domestic activities should be discontinued.

Turning to the possibilities of effecting economies by technical

to these details will affect battery economy is that in the majority of modern battery receivers AVC is provided, and this means that the bigger the signal transferred from the aerial and earth system to the receiver, the greater will be the bias applied to the controlled valves by the AVC circuit. The increase in bias automatically reduces the anode

The economy switch of the Marconiphone 895 is mounted on the control panel; in the H.M.V. 1404 it is at the back of the receiver.



current, and in the writer's experience a reduction of 1.5 mA can be effected. This may not sound a great deal, but, spread over a long period, it helps to increase the life of the battery appreciably.

A number of commercial receivers employ battery economising devices, and two typical examples of the simpler kind will serve to illustrate

phone Model 895, 5-valve battery portable receiver. The economy switch is shown connected across the economising resistance R which has a value of 10,000 ohms. It will be noted that in this position the switch and resistance will only reduce the HT current taken by the mixer and IF valves. Even so the total HT current from the HT battery drops from 9mA to approximately 5 mA, which is a considerable saving in

battery consumption over long periods.

In this particular receiver the output stage comprises two valves in push pull with a fixed bias. It is not practicable, therefore, to cut the HT down on these valves without also altering the bias, and the economy effected does not warrant any further complications, which would entail double switching.

The effect of this particular arrangement of battery economiser is to limit the sensitivity of the receiver but still to allow good local-station reception. The quality and power of reproduction of local stations is practically unaffected by the use of the economiser switch.

All Stages Affected

The second example is the His Master's Voice Model 1404, 4-valve battery superhet. Reference to Fig. 2 will show that in this case the economiser switch and resistance reduce the HT current taken by all stages of the receiver. The output stage is automatically biased, and, therefore, any reduction in the anode volts will bring about a corresponding decrease in the anode current with a consequent reduction in bias due to the smaller current flow-

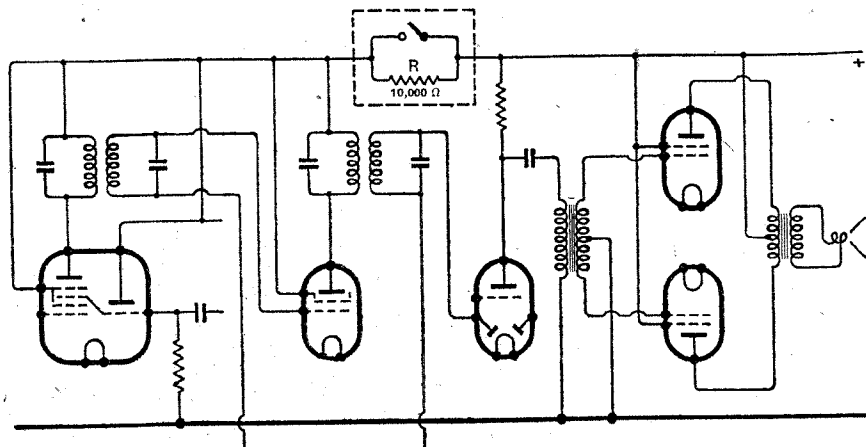


Fig. 1.—The battery economy device (shown within the dotted lines) of the Marconiphone 895 portable. It consists of a current-reducing resistance (with short-circuiting switch) in the common feed circuit of the frequency-changer and IF valves.

means, a start can be made by ensuring that the aerial and earth system is the very best that can be provided. The reason why attention

how various types of receivers may be dealt with.

Fig. 1 represents the HT and valve anode circuits of the Marconi-

HT Battery Economy—

ing through the automatic biasing resistance.

In this receiver the maximum HT current is 10 mA, but with the economiser resistance in circuit it

they have been modified for battery economy, will operate only at a lower volume of output before distortion sets in will probably be appreciated

announcements from official sources. These people have often used their new receivers as a second instrument in the house, and are rather surprised at the apparent short life of the HT battery. Being used to operating a mains model most of the day they are inclined to use the battery receiver in a similar way.

Of course, an HT battery can be run down after only a very short life by leakage from a faulty cell. The electrolyte escaping from the cell will creep over the bottom of the battery and make a short-circuit path for all the cells except the last one, which is generally referred to as the positive cell.

This cell can never be discharged by internal short-circuits, whereas all the others can, as will be appreciated by a glance at the accompanying illustration. At A, cell 5 is shown discharging through the zinc of the cell and the electrolyte which has "crept" over all the bottom of the battery. At B, cell 7 (the positive cell) has no connection from its positive cell terminal, and therefore cannot discharge itself. By testing this cell, therefore, by means of a sharp prod which will penetrate the cardboard container of the battery and make contact with its zinc can and using this connection to take a quick voltage test across a 10-ohm load it can be ascertained whether the battery has been run down by internal or external conditions.

If the voltage of the cell is about 1.4V, then this indicates a faulty battery; but if the cell shows a much lower voltage, then it is proved that the whole battery of cells, including

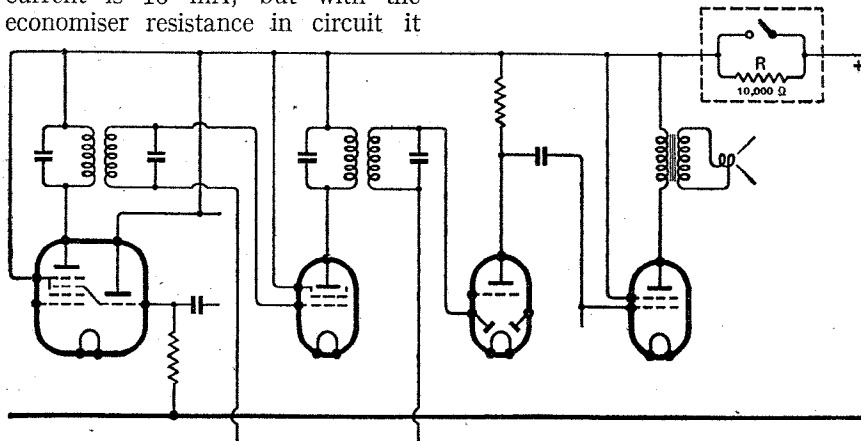


Fig 2.—In the H.M.V. 1404 superhet the economising resistance reduces the HT supply to all valves; it may be short-circuited by means of a switch mounted at the back of the set.

drops to 5mA. As would be expected the overall performance of the receiver is inevitably affected when this method of battery economising is put into operation.

Economy by Over-biasing

Where a permanent reduction in HT battery consumption is tolerable straightforward output stages may have their bias values altered to bring about a reduction in anode current. For example, in one receiver brought to the notice of the writer a reduction of 2.5 mA was achieved by replacing a 330-ohm bias resistor by one of 560 ohms. The quality of reproduction was quite satisfactory if the volume control was used sympathetically so that the output stage was not overloaded. The maximum volume obtainable before distortion set in was adequate for a normal living room.

With any particular receiver a slightly different value of bias may be necessary to effect a satisfactory compromise between battery economy and volume of output. A variable resistance of about 1,000 ohms or so will prove useful in determining the exact value of bias resistance required, and can be either left in circuit when satisfactory results have been achieved or a fixed resistance of the desired value put in its place.

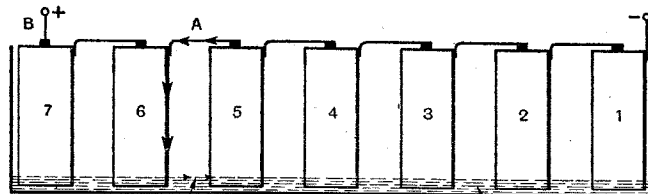
The fact that most receivers, after

by neighbours, especially under wartime conditions of living. Readers of *The Wireless World* will be doing good work if they can persuade battery receiver users to apply the modifications described in this article.

There is one point to note when carrying out the modifications, and that is, instability due to the possible coupling of circuits by a common resistance in the HT feed. If, through insufficient decoupling in the receiver, this trouble shows itself, connect a low-voltage high-capacity electrolytic condenser across the added resistance. This will cure the fault.

There is another way in which technical readers can help people

Showing how the positive end-cell of an HT battery remains unaffected by internal short-circuits. Mere dampness of the cardboard base of the container may cause trouble.



SHORT CIRCUIT PATH THROUGH ELECTROLYTE

ELECTROLYTE FROM FAULTY CELL

who are coming into contact with battery receivers for the first time. There are many who have never previously owned a battery receiver, but who have bought them as stand-by sets in case of a major failure in the electricity supply service which will prevent them hearing important

the positive cell, has been run down normally.

If all the above points are considered and the appropriate ones put into operation, a really worth-while saving in running costs and in the number of batteries used during the winter months will be effected.

Improving QPP Quality

By S. W. AMOS, B.Sc.

THE USE OF NEGATIVE FEEDBACK

IF good quality and a fair output are needed, the design of the output stage of a battery-driven receiver presents several problems not met with in mains-driven apparatus. The rival merits of a single triode and quiescent push-pull have been discussed at length in the columns of *The Wireless World* before, the chief factors to be considered being that whilst QPP gives large power output, the triode undoubtedly gives superior quality and

are added in a push-pull stage, and as pentodes introduce more such distortion than triodes, and as odd harmonics are very noisy, these are undoubtedly the source of the objectionable shrillness or harshness characteristic of pentode outputs.

Any factor tending to reduce odd harmonic distortion in QPP quality, even at the expense of some amplification, is a very desirable thing, for the ideal battery output valve is one embodying the quality of a triode

with the power output and economy in HT current of the quiescent system. Such a factor is inverse feedback.

Now inverse feedback cannot eliminate any distortion completely, but it can reduce it to such small dimensions that the ear, which is notoriously

obliging in such matters, will overlook it entirely. We cannot hope, therefore, even with the aid of inverse

feedback, to get from a QPP stage quality which is really identical with that given by a triode, though it might be possible to get results which are aurally indistinguishable.

Let us consider some methods of applying feedback, taking an average QPP valve, fully loaded. It delivers about one watt of audio-frequency power to the speaker, which, we will assume, has an impedance of 2 ohms.

The RMS voltage across the loud speaker is given by the formula:— $V = \sqrt{RW}$ in which V = RMS voltage, R = loudspeaker impedance and W = audio-frequency power. In this case, therefore, the RMS voltage is $\sqrt{2}$, and the peak voltage is hence 2, making the peak-to-peak voltage 4.

Applying Feedback

The average QPP valve requires a grid bias of the order of 9 volts, so that, when the valve is fully loaded, the peak grid-to-grid swing is 18 volts. This is supplied by a centre-tapped AF transformer having the rather high ratio of about 7:1. Hence the peak AC volts across the primary of the transformer is about 2.5. If, then, the EMF from the secondary side of the output transformer be applied to the primary of the intervalve transformer so that the two EMFs are in opposite phase, we shall achieve a measure of nega-

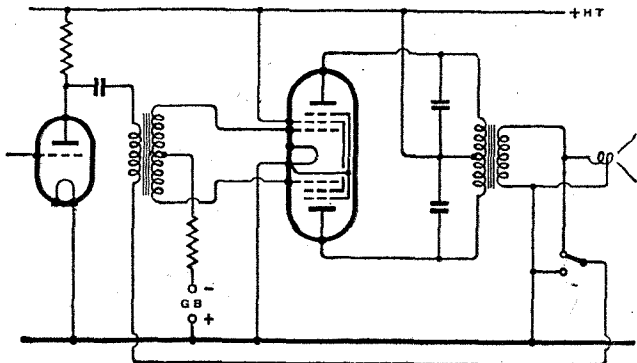


Fig. 1.—Application of negative feedback to a typical QPP amplifier.

is less prone to give distortion when the high-tension battery develops some internal resistance. It is also less particular about the aural effects of mismatching the valve impedance to the load impedance. For these reasons many people prefer triodes to the more complex quiescent systems.

Odd-number Harmonics

Distortion, in general, consists of spurious notes introduced by valves during the process of amplification. They have frequencies which are multiples of those forming the true signal. Even-number multiples, or harmonics, are automatically cancelled out in a well-designed push-pull stage, so that the output of a QPP valve should show little evidence of even harmonic distortion, if the two halves of the valve are well matched. Odd harmonics, however,

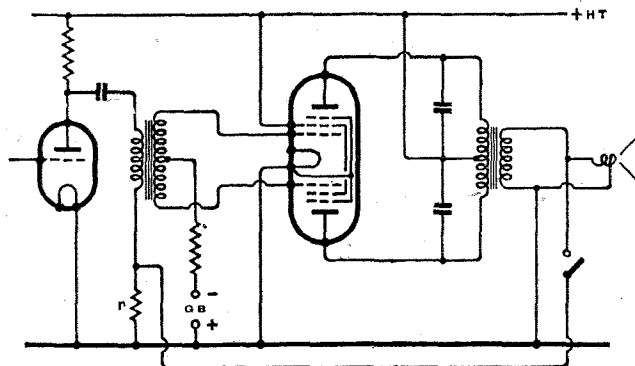


Fig. 2.—Another method of switching over from negative feedback to plain QPP amplification.

tive feedback. The primary of the transformer now has to supply 6.5 volts to give the same output which 2.5 volts formerly gave. This is

Improving QPP Quality—

therefore equivalent to a loss in volume of: $20 \text{ Log}_{10} \frac{6.5}{2.5} = 8$ decibels, which represents a noticeable, though not a serious, diminution of volume, but it is accompanied by a reduction of distortion and a straightening of the response curve. With such a small degree of feedback

triode, to amplify about 20 times—a reasonable amount—the peak volts at its grid will be: $\frac{2.5}{20} = 0.125$ volt. In this case, therefore, the loss in volume will be: $20 \text{ Log}_{10} \frac{4.125}{0.125} = 20 \text{ Log}_{10} 33 = 30$ decibels, a much more serious loss than before, and one which cannot be tolerated, ex-

of zero feedback, there became evident a highly unpleasant form of distortion which can only be described as a grunt accompanying every burst of volume, and every note below a certain frequency. This horrible travesty of the original performance, with which some readers are no doubt only too familiar, is caused by the loss in HT volts across the resistor, which becomes serious whenever the anode current rises in sympathy with an orchestral crash or a bass note. By turning on the feedback it was observed that this distortion was reduced, although no elimination of it was possible. A large condenser of 4 mfd. capacity was connected between HT negative and the receiver end of the resistor, and this contributed something towards this reduction of the distortion.

Remembering the unfortunate fact that HT batteries can develop sufficient internal resistance to mar QPP quality before their useful life is over, it is possible to say that the addition of inverse feedback to the receiver will prolong the useful life of the cells, and this, combined with the reduction of third harmonic distortion and the straightening of the response curve, makes the addition of inverse feedback to QPP stages well worth while.

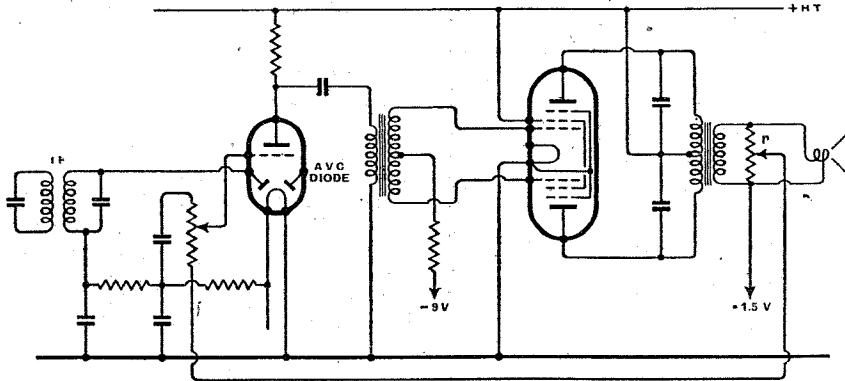


Fig. 3.—A more drastic negative feedback system, applicable to sets with an intermediate AF stage.

there is no point in making it variable; one either wants it all or none at all, so that a simple change-over switch can be included in the circuit to apply the feedback when it is needed. This is illustrated in Fig. 1. A simple on-off switch can also be employed instead as shown in Fig. 2. Here the value of the resistance r is somewhat critical, for it has to satisfy two conditions, namely:— (a) It must not be too great or it will behave as one half of a potentiometer, the primary of the transformer being the other half. Losses will therefore result. (b) On the other hand, it must not be too small, or else it will absorb appreciable power from the output transformer secondary, and thus also introduce losses.

In practice, therefore, as is so often needed in radio, a compromise is needed, and 50 ohms, with a 2-ohm speech coil, works well.

The scheme described above is very suitable for QPP stages, which immediately follow a leaky grid detector. Where there is an AF stage preceding the QPP valve, as in the majority of superhets, a more ambitious scheme can be used, for the feedback voltage can be applied to the grid of the penultimate amplifier. Supposing this valve, usually the triode section of a double-diode-

cept on the strongest signals. Such feedback as this, then, should be variable, and it can conveniently be arranged as illustrated in Fig. 3. The value of the potentiometer r is not critical; 10,000 ohms works well.

In using such an arrangement, the greatest possible feedback should be used, consistent with reasonable volume. In practice this simply means that the feedback potentiometer is used as a volume control, the true volume control remaining permanently at maximum.

When a fair degree of feedback is used, the quality obtained in practice approaches very closely that given by a triode. The objectionable "screechiness" of the pentode is quite eliminated. One's first impression, on listening to a QPP stage with feedback, is that there has been a distinct loss of "top," but if comparisons are made with a triode output it is realised that this loss is nothing more serious than a flattening-out of the response curve at the higher audio frequencies.

To simulate the conditions prevailing when a partially exhausted high-tension battery is in use, a 1,000-ohm resistor was included in the main HT positive lead of a QPP stage with variable feedback. With the feedback control in the position

A Valuable Index

THROUGHOUT 1940 our sister journal, *The Wireless Engineer*, published abstracts from, and references to, more than 4,500 articles on wireless and allied subjects which have appeared in the journals of the world. The value of these abstracts is greatly enhanced by the publication of an index, occupying 43 pages, in the December issue of the journal. The type of index is unusual in that, instead of each title being alphabetically arranged, the keyword in the title is set in heavier type, and the title then appears alphabetically under this word in the index.

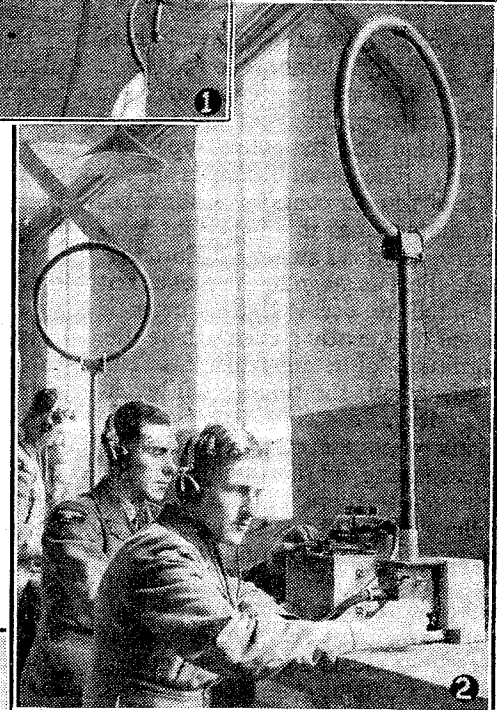
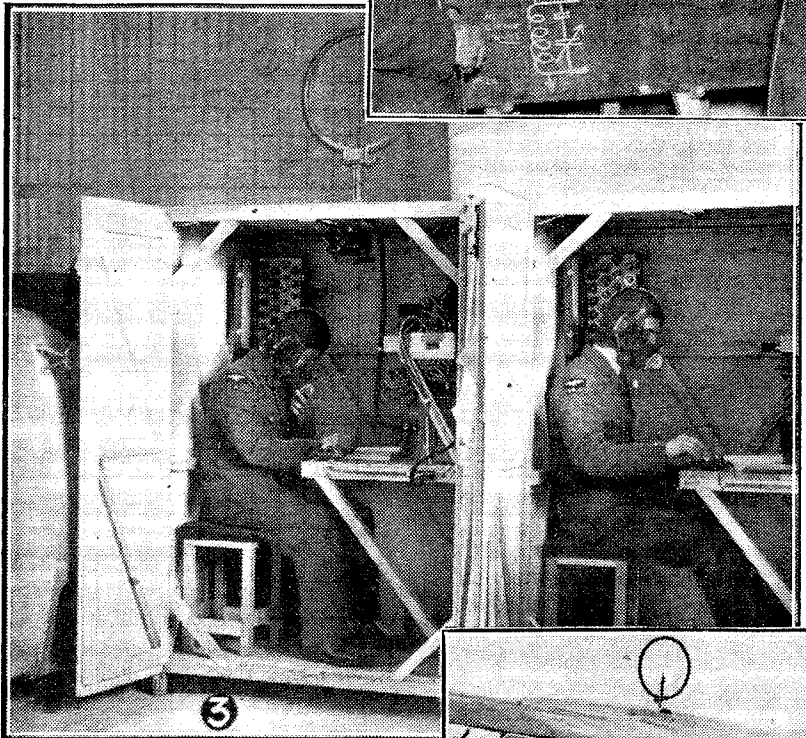
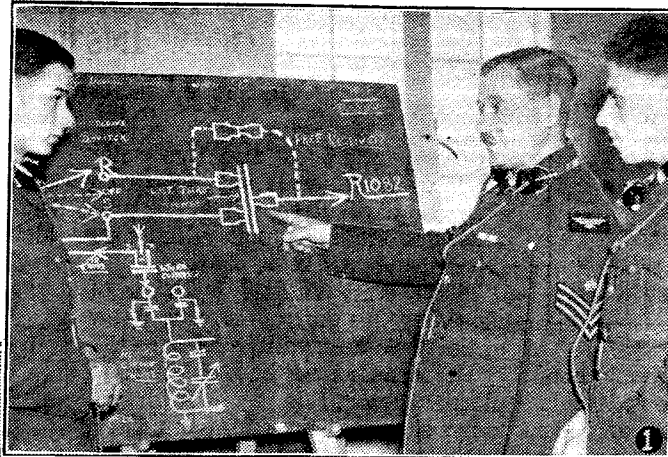
In addition to the above index and the index to articles published in *The Wireless Engineer* throughout the year, the December issue, which was on sale on the first of the month, contains articles on the circuit design of commutator inverters, the effect of screening cans on the effective inductance and resistance of coils, and phase focusing in velocity-modulated beams.

Copies of *The Wireless Engineer* are obtainable to order through newsagents or direct from our Publishers at Dorset House, Stamford Street, London, S.E.1, at 2s. 8d. post free.

Training R.A.F. Operators

AFTER the prospective R.A.F. wireless operator has attained the necessary standard of knowledge in general theory, he begins to undergo instruction in the actual circuit details of Service equipment (1). Direction-finding forms an important part of the operator's work; entrants are given the opportunity of practising on the ground (2) before being called upon to take bearings in the air. As begin-

GLIMPSES OF SOME OF THE LATER STAGES OF INSTRUCTION.



ners soon find out, sending and receiving at, say, the qualifying speed of 20 w.p.m. under ideal conditions in the class-room is vastly easier than in an aircraft. The transition is made more gradual by giving operating instruction in its later stages under conditions simulating those obtaining in flight (3). Sometimes the learner is accommodated during the "ground" stage in the fuselage of an obsolete aeroplane. In photograph No. 4, which shows a group returning from a training flight, the operators under instruction are approaching the stage where they will be ready for a short final course of operational training under Service conditions and then for the real thing.



Automatic Meter Protection

DEVICE FOR SAFEGUARDING SMALL MOVING COIL INSTRUMENTS

By T. J. REHFISCH, B.Sc. (Eng.)

Methods of overload protection used in heavy electrical engineering are not easily applicable to meters with full scale deflections of less than a milliampere. The author reviews the alternatives available for instruments used in testing and laboratory work

METER manufacturers normally claim a considerable overload capacity for their products, depending on the rate of application and the actual type concerned. The usual rating is of the order of 100 per cent. for continuous, and many times this figure for temporary, overload currents. However, mechanical damage to the movement is bound to occur if the meter is abused frequently; even where the magnitude of a repeated overload is only small, the pointer will eventually fracture owing to fatigue.

This weakness can be prevented by arranging for the pointer of the meter not to travel beyond the stops or the ends of the scale under such constantly recurring conditions as an open or short circuit of the input and/or output terminals, as the particular case may be. Further, there sometimes exists some other critical but less frequent condition, such as, for instance, a maximum input voltage in the case of a valve voltmeter; this should lead to an overload not

of these conditions and the meter used, while the scale shape may be affected, particularly where the protection is obtained by an addition to the instrument circuit proper.

There exist various methods of providing this protection; only a few of the basic ones will be described.

The simplest method of all is to place a resistor in series with the meter such that the maximum EMF in the meter branch divided by the total resistance in the branch is equal to the current for full-scale deflection of the meter. This arrangement is much used in insulation test sets and ohmmeters. Fig. 1 illustrates the law of a 1000-volt insulation test set fitted with a 50 μ A meter. Curve A represents the scale law without a protecting resistor, the internal resistance of the instrument being regarded as negligible against 20 M Ω , while curve B applies to the same instrument protected by 20 M Ω . It will be noticed that the original range (curve A) of 500 to 20 M Ω has now been changed to 480 to 0 M Ω , i.e., the scale has been opened out somewhat; readings are affected by less than -20 per cent. below 10 μ A.

A meter can be protected by a device having a negative (resistance-current or voltage) characteristic. The multiplying power of such a shunt increases with load, i.e., it

(mionic) worked at the bottom of their characteristic, and the new ceramic material "Metrosil" developed by Metropolitan Vickers.

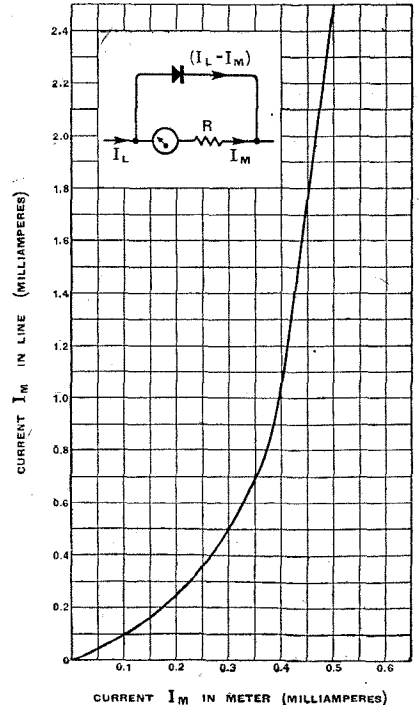


Fig. 2.—Law of meter protected by rectifier-type shunt. I_L (max.) = 2.5 mA, I_M (max.) = 0.5 mA, R = 400 Ω .

As an example, consider a 0.5 mA. movement which is to be safeguarded against frequent maxima of line current amounting to 2.5 mA. The arrangement of Fig. 2 is a solution of this problem. The resistance R is adjusted until the full-scale deflection of the meter corresponds to 2.5 mA. in the line, i.e., the shunting rectifier—actually an inexpensive Westinghouse element type Hr—then takes a current of 2.5 - 0.5 mA. = 2 mA, while for smaller values the shunting effect is less than $\frac{2.5}{0.5} = 5$.

Care must be taken to eliminate AC from the line, as rectification of this component by the "shunt" would result in erroneous readings.

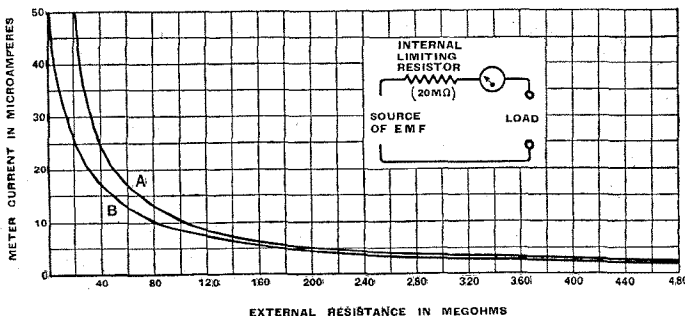


Fig. 1.—Curves showing effect of limiting resistance in an insulation test set; A, meter unprotected; B, with internal resistance of 20 M Ω .

exceeding 50 to 100 per cent. for safe, continuous working.

The solution of any particular problem depends on the exact nature

takes a progressively increasing share of the total or line current as the latter rises. Concrete examples are rectifiers (whether oxide or ther-

Automatic Meter Protection—

It is well known that the anode current of a valve can only vary between the limits of zero (at "cut off") and some value corresponding to the flow of positive grid current, or saturation (complete emission) in the case of diodes. Thus, the valve circuit of Fig. 3 is a "backed off" meter or bridge circuit in which the standing anode current has been eliminated from the meter branch. For maximum sensitivity, expressed as the ratio "change in meter current divided by change in grid volts," experiment and theory indicate the condition $R_1=R_2=R_3=$ impedance of the valve at its operating point. This maximum sensitivity is roughly equal to one-third of the normal valve slope.

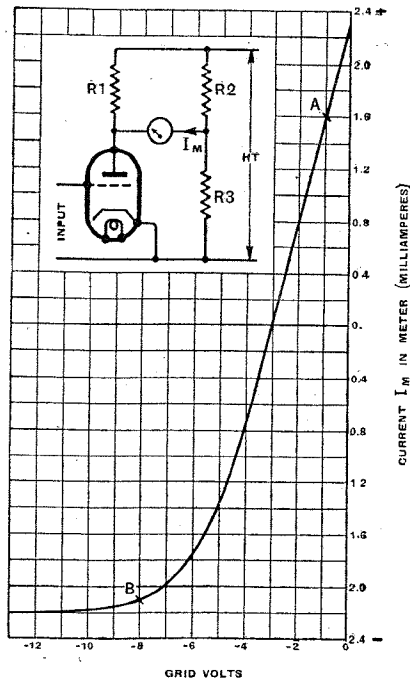


Fig. 3.—Illustrating the use of a valve as a current-limiting device. $R_1=R_2=R_3=15,000\Omega$. The curve is for an HL/41/DD valve with 250 volts HT.

The circuit of Fig. 3 may be used in a number of ways. When the input is a DC voltage, one would arrange for this to be negative only and work the valve from a point such as A; the maximum change in the meter current is then about 3.8 mA, and the current-voltage law linear over the major portion of the scale.

Where the input is alternating the

valve is preferably used as a leaky grid rectifier. With the necessary filter in the anode circuit, the result is similar to that of the preceding case.

It is sometimes necessary to employ square-law detection, e.g., in the measurement of complex wave forms; or an open input circuit may be required. These requirements postulate anode bend rectification, and the valve would be worked at a point such as B (Fig. 3). Even then the DC voltage developed across the grid cannot pass zero far into the positive direction because of the flow of grid current within the valve, assuming a high DC impedance for the source. The total change of meter current will then be substantially the same as in the other two cases. However, as for small inputs, square-law rectification is less sensitive than its linear counterpart, a more delicate meter may have to be used in the anode bend detection circuit and protection will be less complete.

If any of these valve bridges are mains-operated a considerable overload current will pass through the meter when switching on, even where a slow-heating rectifier is used. To prevent this, R_3 (Fig. 3) is replaced by a ballast valve of the same type as the control valve. This, incidentally, has the added advantage of reducing meter current fluctuations due to variations in the supply, particularly if the two cathodes use the same self-bias resistor; in the latter case, also, sensitivity is increased.

Further methods of restricting grid-voltage excursions are borrowed from wireless set technique, such as a diode limiter acting in a way similar to a noise suppressor, or a triode arranged as an AVC element.

Easily resettable "cut-outs" of a simple and rugged design are available for breaking currents from a few milliamps upwards. These consist of an iron-cored coil and a contact armature, the armature being pulled away from the contact stop and opening the circuit when the current exceeds a certain pre-set limit. To be of practical use the armature should be easily replaced against the stop, e.g., by a push-button.

Circuit breakers marketed for use with electric toy trains are very satisfactory for the small currents con-

sidered, and can be set over a wide range of "break-currents" by adjustments to the mechanical parts and the value of the shunt resistance

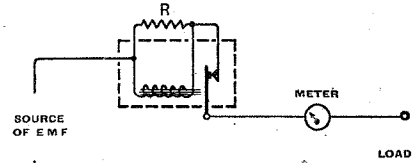


Fig. 4.—Basic circuit of electro-magnetic circuit-breaker for meter protection.

R (Fig. 4). When this is properly done, the value of the break-current is found to be constant for an indefinite period of time. R also serves the purpose of by-passing switching-on transients which would otherwise cause an unwanted break. To guard against this further, it is essential that the load should not be too capacitive. Any smoothing condensers must therefore be connected in the supply side of the circuit-breaker and should be sufficiently large to prevent ripple from causing chattering of the armature in the case of an AC mains-derived supply.

This review will have served its purpose if the reader will appreciate that there is scope for ingenuity in designing a self-protecting meter circuit. It is left to the judgment of the designer to choose, modify or combine any of the methods outlined above to suit his particular case. As the meter quite often represents the most costly component in the instrument, it is well worth the trouble to ensure that once fitted it may require no further attention.

Collins' Wireless Diary

IN addition to the usual diary section and general information, this publication devotes some 100 pages to data and formulæ of wireless application; in this total is included log and anti-log tables, algebraic formulæ, etc.

In some cases the subjects are treated at considerable length; for example, in sections headed Capacity, Inductance, Wireless Installations, Oscillating Circuits, several pages are given to each topic. There is, in addition, much tabular data and a glossary of technical terms. *Collins' Wireless Diary* costs from 1s. 9d. to 8s. 6d., depending on the style of binding, and is published by William Collins, Sons and Company, Ltd., 144, Cathedral Street, Glasgow, C.4.

Current Topics

RECENT EVENTS IN THE WORLD OF WIRELESS

WAVELENGTH CHECKING CENTRE

Brussels Bureau Reopens at Geneva

THE task of checking and reporting on the wavelengths of European broadcasting stations, which has for many years been carried on at Brussels by the Union Internationale de Radio-diffusion, was abruptly terminated by the German invasion of the Low Countries on May 10th. M. Raymond Brailard, the director of the Brussels checking centre, was faced with the task of evacuating the apparatus as the military authorities signified their intention of doing so or destroying it.

We now learn from the Bulletin of the U.I.R. that the task of evacuation was successfully accomplished. On May 16th it was removed from Brussels and eventually, after many vicissitudes, it arrived safely at Geneva, the headquarters of the Union. Thanks to the great precautions taken during the journey, when it was under constant supervision, the equipment did not suffer in the slightest degree, and it was found possible to put it very speedily into service again. Some of the expert staff of the Brussels centre were able to resume their observations, and reports have been sent out to all members of the U.I.R. and to the various Administrations through the intermediary of the International Telecommunications Union at Berne.

Although the installation at Geneva is on a temporary basis only, it is interesting to learn that measurements are fully up to standard.



R.A.F. OPERATOR'S ENDURANCE

Blinded but Continued Operating

THE story of the safe return of a British bomber which was severely damaged over Germany is one of astounding persistence and courage. Fragments of an anti-aircraft shell hit the plane and touched off an outside in flares. The observer and the wireless operator were both injured, and a ten-foot hole was torn in the fuselage.

When giving the account of the flight the pilot said, "The explosions had hurled the control column out of my hands and the cabin filled with dense black smoke. Very soon the smoke cleared a little and I looked round and saw the wireless operator coming through the door with flames licking his flying suit. He was on fire himself. The bomb-aimer dashed up to him and beat the flames out with his hands. Then he disappeared down the fuselage again.

"Then the second pilot came forward and reported that the fire seemed to be under control. During this time, the wireless operator and I were alone in the cabin. He had collapsed on the floor and said, 'I'm going blind, sir.' His face was burned completely black, and it looked as though blood was streaming from his eyes. As soon as his burns had been attended to he explained the settings of the dials to the rear gunner, and when everything was ready he had his hand guided to the key. For forty minutes he stood like that, tapping out his message, but the aerial had been shot away, and nothing got through.

"It took us five hours to get home—there was an 80-mile wind against us. All those hours the wireless operator made no moan or complaint although he was suffering from the intense cold as well as from his burns.

"It was a crew to be proud of, not one of them showed even the slightest trace of fear or doubt about our ability to get through."

The captain of the aircraft, Pilot Officer G. L. Cheshire, and the wireless operator, Sgt. H. Davidson, have been decorated with the D.S.O. and the D.F.M. respectively for their gallantry.

U.S.A.'s BIGGEST AND BEST

Wireless Equipment of the America

DETAILS of the extremely comprehensive wireless installation of the 35,000-ton *America*, the largest and fastest liner built in the United States, are published in the latest issue of the *RCA Review*. In addition to the four main transmitters, which cover long-, intermediate- and short-wave telegraphy and short-wave telephony, there is emergency equipment operated from a 12-volt accumulator battery, an auxiliary low-power radio-telephone for communicating with tugs and coastal stations in narrow waters, and two lifeboat sets.

Each of the main transmitters provides between five and ten crystal-controlled frequencies and in the case of the short-wave telegraphy set there is provision for extension up to a maximum of 30, with an aerial power of 1 kW. The elaborate aerial system fed by these transmitters comprises a main "flat top" aerial between the masts divided into two sections; the sections may be used separately or in parallel. For short-wave reception there are five dipoles mounted between the funnels and dimensioned for various frequencies between 4 and 22 Mc/s. Another aerial, in the form of a horizontal "V," may be used either for the emergency transmitter or for the main short-wave transmitter.

The main receiving equipment, operated from a neatly arranged "console," comprises three separate sets, designed for both headphone and loud-speaker reception and for switching time-signals to a speaker on the bridge. The radio-telephone receiver, with the switching arrangements for

ENEMY AGENTS' PORTABLE TRANSMITTER.

This equipment was found in the possession of two spies who were executed in London on December 10th. The telegraphic transmitter, weighing about 1 lb., is housed in one case; in another are the dry batteries from which it is fed. The aerial, seen coiled up, is clearly intended to be erected on extemporised supports, such as trees, etc.

N.B.C. TELEVISION NETWORK

Washington's First Station

THE capital of the United States is to have its first television station. The National Broadcasting Company has announced plans to establish a television centre in the Wardman Park Hotel, Washington, at a cost of approximately \$50,000. This will be the N.B.C.'s second television station, and is expected to become the key transmitter of a proposed network.

INDIAN SHORT-WAVE STATIONS

Overcoming Skip Distance

SINCE November 1st the short-wave stations of All-India Radio at Delhi, Bombay, Calcutta and Madras, which had previously been transmitting the evening programme in the 60-metre band, have been operating for the latter part of the evening in the 90-metre band.

This change became necessary due

AMATEUR TELEVISION

An American Move Criticised

THE fact that an effort is apparently being made in America to interest amateurs in television transmission in the 112-Mc/s band is deprecated by the Editor of the *T. & R. Bulletin*.

"We should be the last to criticise any move aimed at advancing the technique of television," he writes, "but we contend that the restricted amateur bands, as internationally agreed, are not the place for such experiments. Television must remain a selfish service—'eating up kilocycles'—until some new epoch-making method of transmission is evolved. For that reason we argue that those who wish to link up amateur television with amateur telephony should be given a separate part of the spectrum in which to out-jam one another! To permit television in the 112-Mc/s band is to restrict seriously all normal amateur telegraphy and telephony.

"It may perhaps be argued that television, being a new science (or is it an art?), should be given preference over the old-fashioned telephonic and telegraphic methods of communication, but somehow we think that very few of the ordinary hams of America will appreciate having to contend with even 120-line television transmissions within their bands."

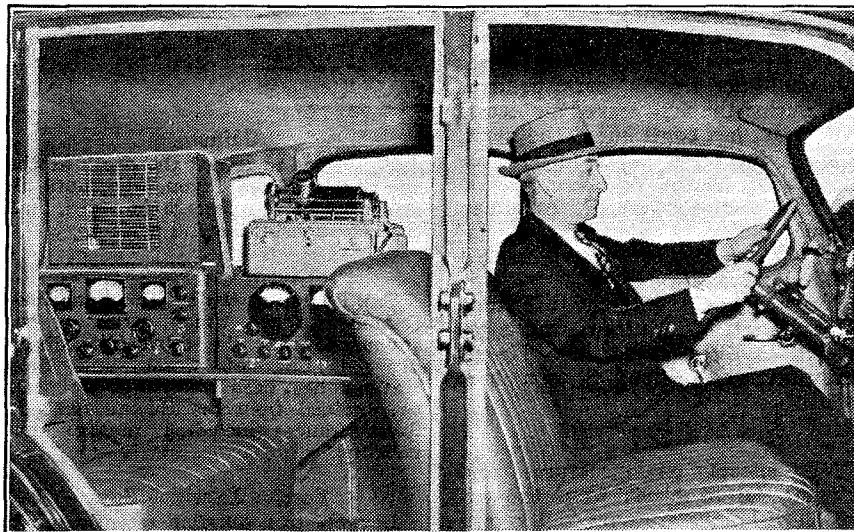
It may be remembered that some years ago British amateurs were given an allocation just outside the 28-Mc/s band for television experiments, and it is suggested by the writer that if, after the war, this latest development "catches on" in Great Britain, our authorities would be well advised to place amateur television stations in a "world apart."

NEWS IN MORSE

FOR the convenience of readers who are anxious for opportunities of practising morse reception, we publish below the times (BST) of the transmissions of official British news bulletins in morse from the Post Office stations, GIA, 15.27 m; GAI2, 16.03 m; GIM, 23.13 m; GAY, 33.67 m; GIJ, 42.95 m; and GBR, 18.750 m.

00.30 GBR, GAY, GIM, GIJ
13.00 GBR, GAI2, GIA, GIM
17.02 GBR, GAI2, GIA, GIM
20.48 GBR, GAY, GIA, GIM

The transmitter GIA has its aerial directed towards South America.



AMERICA ON THE ALERT. One of the new F.C.C. monitoring cars equipped with apparatus for the location of illicit transmitters. Suspicious transmissions can be recorded on phonograph cylinders.

The new station, W3XNB, will operate with a power of 1 kW for both vision and sound.

The new site has all the advantages of a ready built studio building, for the hotel includes the Wardman Park Theatre, which seats 500.

It is proposed to link the new station with the existing station W2XBS in New York by means of a special automatic television relay system developed by R.C.A.

PIONEER'S RETIREMENT

MR. WALTER WITT BURNHAM, manager of the Radio Division of Ediswan, has now retired, and also relinquishes the chairmanships of the R.M.A. and B.R.V.M.A. Mr. Burnham, whose association with wireless dates back to the days before broadcasting, founded the firm of Burnham and Co., of Deptford, from which grew the original Burndept concern.

The chairmanship of the B.R.V.M.A. passes to Mr. G. A. Marriott, of the G.E.C. Osram Valve Department.

to the movement towards the period of minimum sunspot activity in the 11-year cycle. A.I.R. engineers state that during the winter of 1938-39 skip distance was scarcely in evidence even at the end of the evening transmissions in January, but that in January, 1940, it was making its presence felt.

During this winter a noticeable reduction in average ionisation levels is apparent, and therefore to avoid unsatisfactory reception within a radius of several hundred miles of the transmitter the change to the 90-metre band has been made.

LIMITING RADIO SUPPLIES

AN amendment to the Limitation of Supplies Order recently announced by the President of the Board of Trade reduces the supplies of certain goods for the wireless industry in order that production may be devoted to an even greater extent to the war effort. During the six months from December 1st the quota for the home trade will be reduced to 25 per cent. of the sup-

Wireless World

Current Topics—

plies for the same period from December 1st, 1939. Although radiogramophones and accessories are scheduled, wireless receivers, sound amplifiers and loud speakers are excluded.

It is pointed out that there is no shortage but that the object of the Order is to conserve present stocks.

C.B.S. LONDON REPRESENTATIVE HONOURED

MR. EDWARD R. MURROW, chief of the European staff of the Columbia Broadcasting System, who is in charge of the London office, was elected by New York's Overseas Press Club as "the foreign correspondent who, during the first year of the second world war, has contributed the most, as a result of his work, toward the information of the American people and the formulation of American national policy in international relations." Mr. Murrow was presented with a typewriter.

Prior to his appointment to Europe in May, 1937, Mr. Murrow, who is 36, was C.B.S. director of talks. He recently returned to the U.S. on a short visit.

BLAST

THE effects on structures and material of blasts from the explosion of bombs are now well known in those localities that have suffered severe bombing air raids. In some of these areas radio shops have been damaged, and reports reveal that often glass-enclosed valves and other components in radio sets are unharmed, but almost always the equipment refuses to function because of ruined cones and speech-coils in the loud speakers. Presumably the nature of the blast wave is such that the effect is particularly destructive to present-day loud speakers. As an emergency protective measure for the speakers of broadcast sets, the placing of cushions against the front and back of the cabinet is suggested.

PA ENGINEERS' NATIONAL SERVICE

AT the annual general meeting of the Institute of Public Address Engineers, Mr. N. Partridge, the chairman, in presenting his annual report for the past year's working, said that the Institute's activity had increased, and its membership expanded. It was recalled that whilst many of the festive occasions with which PA had become associated had necessarily ceased, new applications had arisen.

Mr. Partridge recalled that when attempting to satisfy the demands for PA gear created by the "Music While

You Work" campaign, a scarcity of record changers was revealed. When it was learned from the Ministry of Supply that, owing to manufacturers being engaged upon work of greater national importance, the shortage would continue, the Council of the Institute opened a register of second-hand gear. The invaluable aid rendered by PA vans towards minimising the disorganisation of food supplies resulting from the calamity which recently befell Coventry was voiced by the chairman.

FROM ALL QUARTERS

Obituary

WE regret to record the death at the age of 69 of Lord Tryon, who, until his elevation to the peerage in April, had been Postmaster-General since 1935.

List of Coast and Ship Stations

THE Bureau of the International Telecommunications Union, Berne, has announced that the thirteenth edition of the List of Coast and Ship Stations has been published. It can be obtained from the Bureau for 4.80 Swiss francs (including postage and packing).

Surplus Television Sets

IN reply to a question recently raised in the House of Commons, Mr. Harcourt Johnstone, Secretary for Overseas Trade, stated that surplus television receivers in this country cannot be exported to the United States as they incorporate certain American patents which British manufacturers are not permitted to exploit in the U.S.

FM Network

IT is expected that the new rules governing frequency-modulated broadcasting, recently announced by the Federal Communications Commission, will accelerate the introduction of this form of transmission in America. Mr. Paul A. de Mars, vice-president of the Yankee Network, speaking recently on "Some Observations on Frequency Modulation Broadcasting," said that within a year a new national network of FM stations should be under way.

Duplex Facsimile

FACSIMILE equipment providing for simultaneous transmission and reception of written messages by wireless or wire was recently demonstrated by Finch Telecommunications, Inc., at the company's works in Passaic, N.J. The apparatus, which, with its power supply unit, weighs less than 50 lb., measures approximately 15 x 14 x 13 in. The advantage of this portable unit is that it can be used for visual communication between mobile points which hitherto have been confined to aural methods.

Inter-ship Radiotelephone Communication

IN order to relieve the congestion now existing on the present inter-ship frequency of 2,738 kc/s, the U.S. Federal Communications Commission has permitted the use of 2,638 kc/s for telephone communication between vessels. To avoid interference between the aeronautical and inter-ship communication services, which share the 2,634—2,642-kc/s band, the use of the newly allocated inter-ship frequency is banned on the inland waterways of the U.S., including the Great Lakes.

U.S.-Finland Radiotelegraphic Link

THE first direct radiotelegraphic circuit between the United States and Finland was opened by R.C.A. Communications, Inc., on October 16th. The terminal points are New York and Helsinki. It has, hitherto, been necessary to link the two countries via Stockholm, Sweden.

American Amateurs

THE fact that the Federal Communications Commission has gone to the trouble and expense of obtaining finger prints and details of citizenship of all American amateurs is taken by *QST* as an indication that there is no intention of shutting down their stations for reasons of national defence.

U.S. Foreign Language Censorship?

WHILST the Federal Communications Commission is powerless under existing law to censor programmes, it has sent a questionnaire to all stations requesting details of broadcasts in languages other than English in an endeavour to formulate a definite policy regarding foreign language transmissions from the United States.

The Voice of India

ALL-INDIA RADIO is to have a new 100-kW broadcasting station. A sum of £135,000 has been sanctioned by the Indian Legislature for the erection of the station, which is intended for transmissions to Europe, Africa, the Far East and the Middle East.

B.B.C.'s Red Cross Radio Competition

A NEW departure in B.B.C. programmes was introduced on December 7th and 11th, when a radio competition organised to raise money for the Red Cross Penny-a-week Fund was broadcast.

Canadian News

WHEN 73 of Canada's 86 medium-wave stations change their frequencies in accordance with the North American Regional Broadcasting Agreement on March 29th, many of them will have exchanged their frequency-control crystals with other stations. This exchange is being made to overcome the difficulty caused by the embargo placed on crystals by the United States, where most of the Canadian stations obtain them.

It may not generally be known that the Canadian Broadcasting Corporation

Wireless World

has two mobile recording units in England. Each of these is manned by two engineers and there is a staff of four Canadian announcers.

The Canadian Broadcasting Corporation has a new 7.5-kW short-wave transmitter at Quebec with which it is proposed to radiate programmes to North

and South America and Europe. The new transmitter, which, it is reported, will be ready for operation early in the New Year, is costing some £15,000.

The Montreal Light, Heat and Power Consolidated employs 38 wireless equipped service repair cars with which communication is maintained through

the Company's headquarters short-wave station, CY5Y.

There appears to be no slackening in the demand for receivers in Montreal in spite of the additional receiving licence fee of \$2.00 imposed on its citizens since July 1st. The general licence fee throughout the Dominion is \$2.50.

NEWS IN ENGLISH FROM ABROAD

REGULAR SHORT-WAVE TRANSMISSIONS

Country : Station	Mc/s	Metres	Daily Bulletins (B.S.T.)	Country : Station	Mc/s	Metres	Daily Bulletins (B.S.T.)
America				Manchukuo			
WNBI (Bound Brook)	17.780	16.87	4.0‡, 6.0.	MTCY (Hsinking)	11.775	25.48	8.0 a.m., 10.5.
WCAB (Philadelphia)	6.060	49.50	} 12.45 a.m.‡, 1.0 a.m.†.	Nova Scotia			
WCAB	9.590	31.28		CHNX (Halifax)			
WBOS (Millis)	9.370	31.35	11.45.	6.130	48.94	10.45.	
WCBX (Wayne)	17.830	16.83	2.0, 3.0†, 4.0†, 4.15‡‡, 5.0‡†, 7.0, 8.30†.	Newfoundland			
WGEO (Schenectady)	9.530	31.48	8.30†, 9.55‡‡, 11.25‡.	VONG (St. John's)	5.970	50.25	11.15.
WGEA (Schenectady)	15.330	19.57	1.0, 2.0‡, 6.0, 7.45, 9.55‡‡.	Rumania			
WPIT (Pittsburgh)	15.210	19.72	6.0.	Bucharest	9.280	32.33	10.40‡.
WRUL (Boston)	6.040	49.67	1.0 a.m.§.	Spain			
WRUL	11.790	25.45	10.45.	FET1 (Valladolid)	7.070	42.43	8.50.
WRUL	15.250	19.67	1.0 a.m., 10.45.	EAJ7 (Madrid)	9.860	30.43	12.30 a.m.
Australia				Sweden			
VLQ (Sydney)	9.615	31.20	8.0 a.m., 8.0.	SBO (Motala)	6.065	49.46	10.15.
VLQ5	9.680	30.99	1.30, 4.30, 10.30.	Thailand			
VLQ2	11.870	25.27	6.0.	HSP6 (Bangkok)	11.715	25.61	2.45.
VLQ7	11.880	25.25	8.0 a.m., 3.0, 8.0, 11.0.	Turkey			
VLQ8	17.800	16.85	7.0 a.m.	TAP (Ankara)	9.465	31.70	8.15.
China				TAQ	15.195	19.74	1.15.
XGOY (Chungking)	11.900	25.21	11.30 a.m., 12.10, 9.30, 10.30.	U.S.S.R.			
Finland				— (Moscow)	7.545	39.76	10.30, 11.30.
OFD (Lahti)	6.120	49.02	} 8.55 a.m., 7.15, 10.15, 11.15.	RWV96	9.520	31.51	7.30, 9.0, 10.30, 11.30.
OFD	9.500	31.58		RAI	9.600	31.25	1.0 a.m.
OFE	11.780	25.47		—	10.724	29.59	11.15.
OFE	15.190	19.75		—	11.499	26.09	12.0 noon.
Hungary				—	11.710	25.62	10.30.
HAT4 (Budapest)	9.125	32.88	1.30 a.m.§.	—	11.830	25.36	7.33 a.m., 7.30, 11.30.
HAT5	9.625	31.17	12.15 a.m.‡, 12.30 a.m.†.	—	12.000	25.00	1.0 a.m., 9.0†, 10.30.
HAS3	15.370	19.52	3.55†.	—	14.720	20.38	12.0 noon, 5.0.
India				RNE	12.000	25.00	1.0 a.m.
VUD2/3 (Delhi)	9.590	31.28	9.0 a.m., 1.30, 4.50.	—	15.040	19.95	1.0 a.m.
VUD4	11.830	25.36	9.0 a.m., 1.30, 4.50, 6.15.	RKI	15.180	19.76	1.0 a.m., 7.33 a.m., 9.0, 10.30.
VUD3	15.290	19.62	9.0 a.m.	—	15.715	19.09	12.0 noon.
Iran				—	18.540	16.18	12.0 noon.
EQB (Teheran)	6.155	48.74	7.30.	Vatican City			
Japan				HVJ	6.190	48.47	8.15.
JZJ (Tokio)	11.800	25.42	9.5.	Yugoslavia			
JZK	15.160	19.79	9.5.	YUA (Belgrade)	6.100	49.18	10.25.

It should be noted that at this time of the year changes of wavelength are frequently made and readers are, therefore, advised to try alternative wavelengths.

REGULAR LONG- AND MEDIUM-WAVE TRANSMISSIONS

Country : Station	kc/s	Metres	Daily Bulletins (B.S.T.)	Country : Station	kc/s	Metres	Daily Bulletins (B.S.T.)
Bulgaria				Rumania			
Sofia	850	352.9	9.55 (Th. and Sat.).	Radio-Romania	160	1,875	10.40‡.
Hungary				Bucharest	823	364.5	10.40‡.
Budapest	546	549.5	11.10.	Spain			
Ireland				Radio-Coruna	968	309.9	1.10 a.m.
Radio-Eireann	565	531	6.45‡, 10.5†, 10.10‡.	Sweden			
Latvia				Motala	216	1,389	} 10.15.
Madona	583	514.6	10.0 (Tu. and Fri.).	Stockholm	704	426.1	
Kuldiga	1,104	271.7	10.0 (Tu. and Fri.).	Goteborg	941	318.8	
				Falun	1,086	276.2	
				U.S.S.R.			
				Moscow 1.	172	1,744	11.30.

All times are p.m. unless otherwise stated. * Saturdays only. § Saturdays excepted. † Sundays only. ‡ Sundays excepted.

Wireless World

Station	Call Sign	Mc/s	Metres	kW	Station	Call Sign	Mc/s	Metres	kW
Motala (Sweden)	SBT	15.155	19.80	12	British Oversea Service	GSV	17.810	16.84	10-50
Tokio (Japan)	JZK	15.160	19.79	50	Wayne (U.S.A.)	WCBX	17.830	16.83	10
Moscow (U.S.S.R.)	RW96	15.180	19.76	20-100	Tokio (Japan)	JLS2	17.845	16.81	50
British Oversea Service	GSO	15.180	19.76	10-50	Moscow (U.S.S.R.)	—	17.910	16.75	20-100
Lahti (Finland)	OIE	15.190	19.75	1	Radio Nations (Switzerland)	HBF	18.450	16.26	20
Ankara (Turkey)	TAQ	15.195	19.74	20	Moscow (U.S.S.R.)	—	18.540	16.18	20-100
Chungking (China)	XGOX	15.200	19.74	35	Bangkok (Thailand)	HS6PJ	19.020	15.77	10
Pittsburgh (U.S.A.)	WPIT	15.210	19.72	40	13-Metre Band (21.450-21.750 Mc/s)				
Lisbon (Portugal)	CSW4	15.215	19.72	10	Boston (U.S.A.)	WRUL	21.460	14.00	20
Belgrade (Yugoslavia)	YUG	15.240	19.68	10	British Oversea Service	GSH	21.470	13.97	10-50
Boston (U.S.A.)	WRUL	15.250	19.67	20	Schenectady (U.S.A.)	WGEA	21.500	13.95	25
British Oversea Service	GSI	15.260	19.66	10-50	Philadelphia (U.S.A.)	WCAB	21.520	13.94	10
Wayne (U.S.A.)	WCBX	15.270	19.65	10	British Oversea Service	GSJ	21.530	13.93	10-50
Delhi (India)	VUD3	15.290	19.62	10	Pittsburgh (U.S.A.)	WPIT	21.540	13.93	40
Buenos Aires (Argentine)	LRU	15.290	19.62	7	British Oversea Service	GST	21.550	13.92	10-50
British Oversea Service	GSP	15.310	19.60	10-50	Wayne (U.S.A.)	WCBX	21.570	13.91	10
Sydney (Australia)	VLQ3	15.315	19.59	—	Schenectady (U.S.A.)	WGEA/O	21.590	13.89	25-100
Schenectady (U.S.A.)	WGEA/O	15.330	19.57	25-100	British Oversea Service	GRZ	21.640	13.86	10-50
Treasure Island (U.S.A.)	KGEI	15.330	19.57	20	11-Metre Band (25.600-26.600 Mc/s)				
Budapest (Hungary)	HAS3	15.370	19.52	5	Boston (U.S.A.)	WRUW	25.600	11.70	—
Moscow (U.S.S.R.)	—	15.715	19.09	20-100	St. Louis (U.S.A.)	W9XPD	25.900	11.58	—
16-Metre Band (17.750-17.850 Mc/s)					Cincinnati (U.S.A.)	W8XNU	25.950	11.56	—
Pittsburgh (U.S.A.)	WPIT	17.780	16.87	40	South Bend (U.S.A.)	W9XH	26.050	11.52	—
Bound Brook (U.S.A.)	WNBI	17.780	16.87	25	Superior (U.S.A.)	W9XJL	26.100	11.49	—
British Oversea Service	GSG	17.790	16.86	10-50	Nashville (U.S.A.)	W4XA	26.150	11.47	—
Chungking (China)	XGOX	17.800	16.85	35					
Sydney (Australia)	VLQ3	17.800	16.85	—					

Stations of which the names are "indented" are working outside the regular broadcasting bands.

Short-wave Receiving Conditions

PROSPECTS FOR JANUARY

(COMMUNICATED BY THE ENGINEERING DEPARTMENT OF CABLE AND WIRELESS, LTD.)

RECEPTION during the month of November was somewhat more erratic than of recent months, consecutive days of favourable conditions being relatively few in number.

Ionosphere storm conditions were reported to be in evidence on November 1st, 4th, 5th, 9th, 12th, 13th, 14th, and 20th to 30th inclusive (but excluding 24th and 27th).

The occurrence of a large group of storms between the 20th and 30th was not entirely unexpected; the probability of such was, in fact, referred to in the November issue of this journal, published on October 20th, as some readers may recollect.

Recovery to more normal conditions during the last day or two of the month, the possibility of which was suggested in that issue, did not, however, materialise.

A sudden ionosphere disturbance of the "Dellinger" type occurred on November 15th at 0835; its effects, which were observed for about forty minutes, were confined mainly to routes to the Eastward and Southward of this country. The last reported disturbance of this type occurred on August 15th at 1435. (This and other times given in this report are GMT on the 24-hour clock notation.)

Particulars of the broadcast bands which, it is considered, should prove most reliable during January under

normal conditions of propagation at the times stated for five selected routes, are given below; these may serve as a guide when considering the possibilities of reception from places not too remote from those specified.

Attention is drawn to the fact that a number of factors, for example (a) transmitter power, (b) efficiency of aerials at both the transmitting and receiving end, and (c) ionosphere abnormalities, may often result in better reception being obtained on wavebands other than those quoted.

Montreal: Midt, 41 or 49 m; 0300, 49 m; 0700, 41 or 49 m; 1000, 31 or 41 m; 1200, 19 or 25 m; 1400, 16, 19 or 25 m; 1700, 25 or 31 m; 2000, 31 or 41 m.

Apart from the effects of ionosphere storms which may be detrimental to reception from time to time, particularly during the hours of darkness, difficulties may be experienced on occasions between 0700 and 1100. In general, the most favourable period for reception on this route is likely to be between 1400 and 1800.

Tokio: Midt, 31 or 41 m; 0700, 19 or 25 m; 0900, 16, 19 or 25 m; 1100, 19 or 25 m; 1300, 25 or 31 m; 1600, 31 or 41 m; 1800, 41 or 49 m; 2200, 49 m.

Little, if any, reception is to be anticipated over this route between 0100 and 0500, and such signals as

may be audible for an hour or two prior and subsequent to this period are not expected to be of any great value except under the most favourable conditions.

Buenos Aires: Midt, 31 or 41 m; 0300, 31, 41 or 49 m; 0600, 41 or 49 m; 0900, 25 or 31 m; 1200, 16 or 19 m; 1500, 16 m; 1800, 16 or 19 m; 2100, 25 or 31 m.

During adverse conditions the periods 0700 to 1000 and 1800 to 2100 are likely to present the greatest difficulties.

Cairo: Midt, 41 or 49 m; 0300, 49 m; 0600, 25 or 31 m; 0900, 19 or 25 m; 1300, 19 m; 1600, 19 or 25 m; 1800, 25 or 31 m; 2100, 31 or 41 m.

Capetown: Midt, 31 or 41 m; 0300, 41 or 49 m; 0700, 25 or 31 m; 0900, 16 or 19 m; 1200, 16 m; 1500, 16 or 19 m; 1800, 25 or 31 m; 2100, 31 m.

In general, conditions on the Cairo and Cape Town routes should be favourable throughout the 24 hours, except, possibly, between 0400 and 0700.

With regard to reception during January, while there are no indications at the time of writing this report of a large number of consecutive days of "peak" conditions, it would seem probable that signals during the latter part of the second week and early part of the third week may prove to be

Letters to the Editor

THE EDITOR DOES NOT NECESSARILY ENDORSE
THE OPINIONS OF HIS CORRESPONDENTS

Short-wave Receiving Conditions—

subnormal compared, for example, with those during the first or last few days of the month.

Most readers are no doubt aware that the area and number of spots on the sun varies from day to day and that the annual means (called Wolf numbers) follow a roughly periodical variation, the period being about 11 years from one maximum (or minimum) to the next, the complete variation from minimum through maximum and back to minimum being termed the solar or sunspot cycle.

The last maximum occurred in 1937, the Wolf number for which was 114 as compared with 79 for the previous maximum, i.e., that of 1928.

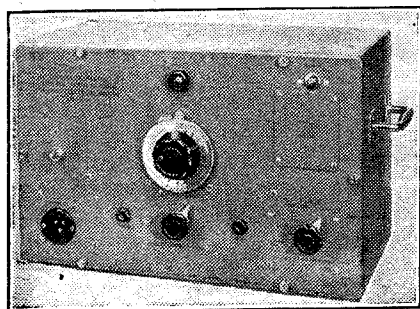
Since 1937 the numbers as shown in the brackets below have progressively decreased; for example, 1938 (109), 1939 (89).

With regard to the year 1940, although the Wolf number is unlikely to be published from Zurich before next March, it would seem from purely radio data that it will be about 60.

Salford Crystal Calibrator

STANDARD FREQUENCIES FOR
LABORATORY AND PRODUCTION WORK

DESIGNED for the calibration of radio receivers this new product of Salford Electrical Instruments, Ltd., Silk Street, Salford, 3, Lancs, consists of a quartz crystal-controlled oscillator with a low temperature coefficient operating at either 100 kc/s, 1 Mc/s or 5 Mc/s. An auxiliary oscillator working at either 25 or 50 Mc/s can be set from the main oscillator, and by the use of harmonics, frequencies up to 300 Mc/s can be calibrated with an accuracy better than 0.1 per cent.



Portable crystal calibrator unit, Type BW200, made by Salford Electrical Instruments.

The unknown frequency is combined with the calibrated oscillation in a mixing stage, and the beat is observed by means of phones.

High-Quality Gramophone Recordings

MAY I express my appreciation for the additional list of gramophone records given by Mr. G. R. Ginns in *The Wireless World* for December. Will others please help to expand this list of records which must pass an average test for (a) freedom from amplitude and frequency distortion, (b) reasonably low surface scratch, and (c) contrast and substantial quality. The type of record we leave to the individual's taste.

Without the help of readers it is a hit-or-miss business buying gramophone records for several reasons, such as the time wasted in wading through far too many bad recordings, or the absence of a faithful reproducer in the dealer's shop. Quite frankly I give up unless a particularly good recording is heard by broadcast or a friend's house, so for this reason an exchange of lists is most helpful.

"Schon Rosmarin." Liebesfreud. Col. FB 1410. Saxophone solos.
"Evensong." Solemn Melody. H.M.V. BD 670. Concert organ.
"Finlandia," Parts 1 and 2. H.M.V. BD 665. Concert organ.
"Plymouth Hoe," Parts 1 and 2. H.M.V. B 9036. Light Sym. Orch.
"God Save The King"; "Rule, Britannia!" H.M.V. B 8553. B.B.C. Sym. Orch.

HAMILTON H. TAIT.

Edinburgh, 10.

I WAS very pleased to see that this topic was revived by your correspondent G. R. Ginns in the December issue. Under present wartime conditions many readers of *The Wireless World* will no doubt have turned to the electric gramophone as their main "wireless" interest. The scope of this interest, although it does not involve a consideration of radio frequencies, is very great, for it includes all the aspects of audio frequency amplification, pick-up and loud-speaker design, tone control in the widest sense ("electrical cooking"), the mounting of speakers and the acoustics of rooms, the plotting of partial and overall response curves, and finally the whole subject of direct recording. *The Wireless World* has always catered excellently for its readers who are interested in these topics, and many like myself must have felt very grateful for the first-class articles by Mr. Voigt, Mr. Scroggie, and others. I feel sure

that if even more of your columns were devoted to this subject, many readers would be greatly indebted to you.

The following short list is my selection of "high-quality" recordings:

Overture, "Carnival" (Dvorák); Talich and Czech Philharmonic Orchestra. H.M.V. C 2842.

Rhapsody, "España" (Chabrier); Sir Thomas Beecham and London Philharmonic Orchestra. Columbia LX 880. (There appears to be little volume compression in this recording.)

Variations on a Theme by Haydn (Brahms); Weingartner and London Philharmonic Orchestra. Columbia LX 744-745.

Incidental Music to "The Tempest" (Sibelius); Sir Thomas Beecham and London Philharmonic Orchestra. Part of the Sibelius Society Album, Vol. V, H.M.V.

Overture, "Die Fledermaus" (J. Strauss); Marek Weber and his Orchestra. H.M.V. C 2646. (There is possibly a little too much reverberation in this recording, though this very fact may make it appeal to many when it is reproduced in the average room.)

Ballet Music, "Coppelia" (Delibes); Walter Goehr and London Ballet Orchestra. Columbia DX 899.

Letter Scene and Waltz from "Rosenkavalier" (R. Strauss); Kipnis and Ruziczka (duet), with Berlin State Opera Orchestra. H.M.V. DB 1543.

Flower Song from "Carmen," and Your Tiny Hand is Frozen from "Bohème"; Webster Booth (tenor) and London Philharmonic Orchestra. H.M.V. C 3030.

Iago's Creed from "Otello" (Verdi); Denis Noble (baritone) with Orchestra. H.M.V. C 3753.

The best recorded speech I have heard is "The Birth of Radio," a Columbia record (Ref. No. R.O.67) presented with a commercial radio-gram about five years ago.

C. H. EDLIN

(B.Sc., A.Inst.P.)

Woolaton, Nottingham.

MY own best records have been in previous lists given by readers, but I have two which, although not perhaps of the highest quality, are certainly not bad. They are both violin solos with accompaniment, apparently a difficult subject for recording. Here they are:—

"Poem" and "Le Cygne," Wolf. Col. DB 1058.

"Serenade" and "Song of Paradise," Campoli and Foort. H.M.V. BD 484.

Perhaps I should mention that I use a Cosmocord Series III crystal pick-up with a resistance-capacity correcting network to give an approximately level frequency response, followed by an amplifier resembling Mr. Scroggie's (*The Wireless World*, May 11th, 1939).

E. F. GOOD.
Sheffield, 7.

Wireless World

MR. G. R. GINNS' letter interested me greatly, and I quite agree that it would be very helpful to know which are the best recordings. The trouble is that it is essential to know what sort of apparatus is being used by the critic before one is prepared to accept his opinion. Personally I use a Lowther straight set with a Voigt speaker and Voigt pick-up. Here is a list of really outstanding recordings:

"England, My England." H.M.V.
 "Lullaby" (Scott), sung by Flagstad. H.M.V.
 "Eccossaises," Brailowsky. H.M.V.
 Handel's "Largo," Gigli. H.M.V.
 "Don Juan," Strauss. H.M.V.
 Walton's "Façade." H.M.V.
 "Scenes from Shadow Play," 1 and 2. (Coward.) H.M.V.
 "I Got Rhythm." Parlophone.
 "If All the World Were Mine." H.M.V.
 "Walt Disney Selections," Parts 1 and 2. Columbia.

It must be borne in mind that late prints of records are not as good as early prints—also that a record deteriorates very rapidly at the beginning of its playing career. In my opinion, after four or five playings a record is no longer anything like as good as when it was new, although it will not get any worse for another hundred or more playings.

MAURICE ELLINGER.

London, W.2.

GRAMOPHONE records seem to be the order of the day and I would like to take this opportunity of adding my voice to that of Mr. Ginns in a request for readers to send in lists of high quality recordings.

My selection is set out below:

"Frasquita Serenade" (organ), Parlophone F843.
 Rachmaninoff's "Prelude in C Sharp Minor," H.M.V. DB3011.
 "Nellie Dean" (Joe Daniels' Dance Band), Parlophone P1558.
 The whole of the latest H.M.V. recording of "The Mikado" is good—i.e., DB4038-48 or auto-coupling 8105-15, but especially DB4039, "Wandering Minstrel"; 4040, "Our Great Mikado"; 4041, "Behold the Lord High Executioner" and "Comes a Train of Little Ladies."
 Walsall. A. A. COTTERELL.

Book Review

How to Make Good Recordings. Pp. 127. Published by Audio Devices, Inc., 1600, Broadway, New York City, N.Y., U.S.A. Price (in U.S.A.): \$1.25.

DIRECT disc recording by amateurs is rapidly growing in popularity as a hobby throughout America, and laymen with more enthusiasm than knowledge and experience seek enlightenment. To meet this demand the manufacturers of Audiodisc blanks and other recording products have prepared this beautifully printed new

book to help the budding recordist.

Admittedly a limited exposition on a complex subject, this publication succeeds in collecting, under too sections indexed for quick reference, a great amount of hitherto scattered information which the novice would find invaluable and the more seasoned recordist will find useful for checking his routine procedure. The latter may also profit by a study of the chapter on common recording difficulties and their remedies.

In dealing with the various aspects of the work plentiful references to the relative Audio company's products are made and, although advice on choosing the best recorder is given, it is presumed that a complete apparatus will be acquired, as no circuits for amplifiers or details of matching technique, etc., are included.

The excellence of the many self-explanatory diagrams on such topics as microphone placing and the clarity of the illustrations depicting record cutting defects deserve special mention. A useful glossary of technical terms employed in the text concludes this recommended handbook.

D. W. A.

"Radio Designer's Handbook"

A COMPLETE REFERENCE MANUAL OF CIRCUITS AND FORMULAE

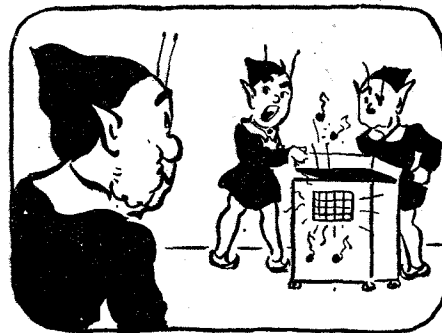
THOSE engaged in the design of receivers, whether from a professional or amateur point of view, will find in this new work every formula required for the evaluation of circuit constants and a wealth of information on modern receiver developments, including negative feedback, volume expansion, automatic frequency control, etc.

Explanatory matter is brief and to the point, and a good index enables the reader to reach the essential information required in the shortest possible time.

There are chapters on the design of tone controls, AVC circuits and frequency changers (including formulæ for oscillator tracking), and the treatment of audio amplifiers and output stages is unusually complete. Tests and measurements, including valve voltmeter design, have a chapter to themselves, and there is a section dealing with wireless mathematics.

The handbook is edited by F. Langford Smith, B.Sc., A.M.I.E.E., and is available from our Publishing Department, bound in cloth, priced 7s. 6d., or by post, 8s. 1d.

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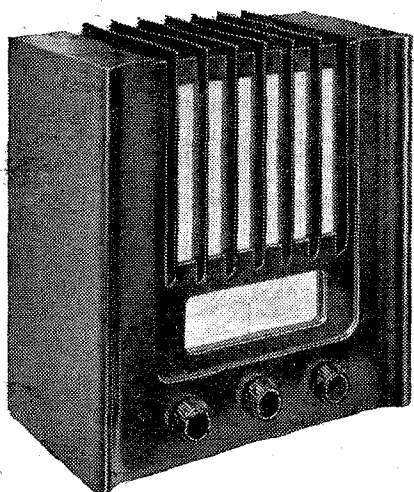
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Murphy Model AD94

A COMPACT AND EFFICIENT RECEIVER DESIGNED TO MEET WARTIME REQUIREMENTS. PRICE £9 10s.



IN designing this receiver, Murphy Radio have taken into account wartime changes in listening habits, the present and possible future restrictions on the supply of certain raw materials, and last, but by no means least, the necessity of keeping the price within reasonable limits. The result is a most attractive little receiver of good appearance and lively performance, which should safely carry the good name of the firm through the war period.

In these days, a long-wave range is more or less redundant, so the designers have concentrated on two waveranges only—short and medium—with a consequent saving in coils and switching complications. Other circuit economies have been made by

omitting the tone control and also the external loud speaker switch, but the main components are of standard Murphy quality and no compromise with reliability and essential performance has been allowed.

The set bridges the gap between the so-called "midget" receiver and the full-sized table model, and combines the light weight and small size of the former with the better range, selectivity and quality of the latter.

The moulded bakelite cabinet is an innovation as far as Murphy sets are concerned, but the designers seem to be quite as successful as they have been with veneered woods in the past.

Circuit.—The valve sequence follows the usual arrangement in four-valve superheterodyne receivers. A triode-heptode is used for frequency changing, a variable-mu pentode for IF amplification, a diode-triode for signal and AVC rectification and first stage AF amplification, and a beam tetrode for power output.

Iron cored inductances are used throughout, and circuit alignment is carried out by adjusting the core positions. No variable padding condensers are provided, and correct tracking is effected by inductance

variation at the low-frequency end and trimmer adjustment at the high-frequency end of each waveband. There are sockets for an aerial filter unit to reduce local station interference in situations where this is troublesome.

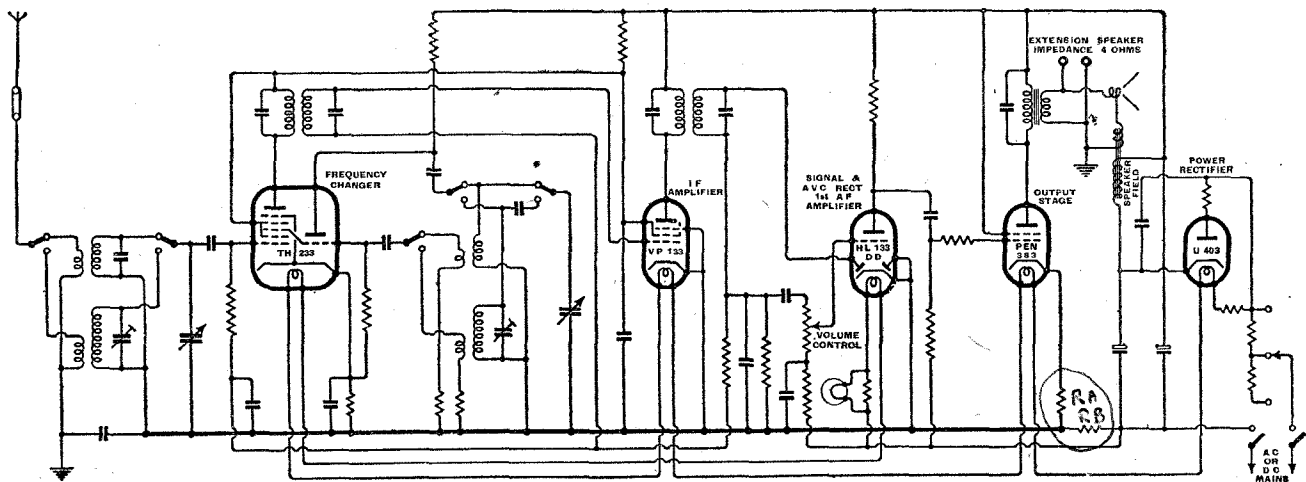
The simplest form of single diode rectifier circuit is employed, and the redundant diode is tied down to cathode. AVC is applied to both preceding valves. A measure of negative feedback is introduced by the economy of omitting the by-pass condenser on the bias resistance of the output valve. Bias for the first

WAVERANGES

Short .. 16.7 to 50 metres
Medium 200 to 550 metres

AF stage is taken from a tapping on the same resistance and is, of course, decoupled.

Performance.—The general liveliness and good signal-to-noise ratio on the short-wave band are remarkable in view of the fact that no RF stage is employed. There is a dead silent background between stations which serves to emphasise the clear



Circuit diagram of the Murphy AD94 receiver. The mains voltage adjusting resistance is included in the HT as well as the heater circuit, and maintains constant current in the loud speaker field.

Murphy Model AD94—

cut quality with which each successive station is received. Second-channel interference is not obtrusive on stations of moderate or low field strength, and the sensitivity over the whole range is remarkably uniform. The AD94 would be well worth buying as an auxiliary short-wave receiver to an existing standard medium- and long-wave set.

Selectivity on the medium-wave band is good, and when tuning through a station, the IF circuits sound sharp. The loud speaker has a good top response, and this removes any suggestion of dullness due to side-band cut when the station is accurately tuned. Quality of reproduction is in fact much superior to that of the average small set. There is enough low frequency response for the ear to be able to follow the double bass parts in a full orchestra without erring on the side of artificial resonance. So good is the response that one tends to ask for more volume than the set is capable of giving, and a wary hand must be kept on the volume control.

Constructional Features.—The new bakelite cabinet is a well thought-out design, from the point of view of both appearance and mechanical strength. The walls are for the most part little more than $\frac{1}{2}$ in. thick, but the reinforcement provided by the ribbed exterior grille and the internal lugs for supporting the chassis gives strength and rigidity without adding unduly to the weight. Actually, the complete receiver turns the scales at only 13 lbs.

The chassis, which is coated with a durable blue enamel, is in the form of a channel section, which serves to strengthen still further the whole assembly. Components are laid out in the conventional Murphy fashion, with the main tuning condenser offset. The chassis is only 4 in. wide, and the electrolytic tuning condenser projects through a hole at the front, where it is clamped. One of the IF transformer cans is skewed slightly to give easy access to the cores for trimming.

In most Murphy DC/AC sets, a thermal delay is provided to protect the pilot lamp during the warming up period, but in this case an economy has been effected by using a lamp

running at a lower temperature. This does not illuminate the whole dial, but gives a spot of light at the side to show when the mains are switched on.

From every point of view, the AD94 is a skilful compromise, and is just the right type of set to hold the "home front" until more liberal times.

Book Review

Getting Acquainted with Radio. By Alfred Morgan. Pp. 279+XI; 130 drawings and diagrams. Published by D. Appleton-Century Company, 34, Bedford Street, Strand, London, W.C.2. Price 12s. 6d.

GOOD books of the wireless-without-tears type are few and far between. Perhaps the subject does not readily lend itself to such treatment; be that as it may, many of the popular "simplified" expositions are likely to make the reader abandon wireless altogether—or, if he is really keen, to get down to first principles without waste of time.

Here is a book that is an exception to the general rule. The author seldom tries to simplify those things that cannot be simplified, but he finds so much to explain adequately that the type of reader for whom he is writing will gain a sufficient understanding of fundamentals on which to build a deeper knowledge by subsequent heavier reading.

In the opening chapter the pill of history is gilded under the heading of "Adventures in Space." Here, incidentally, the main initial contribution of Marconi—the addition of a radiating aerial-earth system to the Hertz oscillator—is ignored, but the slightly dramatised story of the beginnings of wireless is very readable. The author then proceeds to the explanatory part of his book, starting with wave propagation and proceeding to basic principles, valves, receivers, etc. The chapter headed "Taking the Mystery out of Tuning" should be especially helpful to many readers.

After the theory section come several chapters showing how the reader can put his knowledge into practice by building simple receivers and, as this book was originally published in America, where present restrictions do not apply, transmitters as well. The fact that American practice is exemplified does not greatly impair the value of the book to the reader in this country. H. F. S.

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However, some supplies of components are still available for Radio Servicing, but should delays occur we know our friends will appreciate the difficulties which at present arise from day to day.

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Random Radiations

By "DIALLIST"

FM Broadcast Service

BY now the regular frequency-modulation programmes originating in the Schenectady studios should be in full swing, for they were due to start on November 20th. The service is to be one of seven hours a day to begin with. It will consist of general entertainment programmes of the kind with which all DX listeners to America are familiar, with the one difference that more time than normal is to be given to news broadcasts. The transmitter is actually in the Helderberg Hills, a dozen or so miles from the city and the studios. FM does not lend itself, of course, to transmission over telephone lines, so the link will be a wireless one, using a very short wavelength. The frequency of W2XOY, the Helderberg station, is 43.2 megacycles. If anyone has an adaptor (a "translator" the Americans call it) enabling an amplitude-modulation receiver to deal with FM, he should be able to pick up these transmissions when conditions are favourable. I only wish that I had the chance of having a try for them: FM is claimed to be much less affected by atmospherics than AM and it would be vastly interesting to see how reception of W2XOY goes at times when AM stations are suffering severely from crackle.

A Combination Receiver

The American G.E.C. are, I note, bringing out a set which will receive either AM or FM transmissions, the change-over from one method to the other being made by the mere turning of a switch. A smart idea that, from many points of view. Few people, for instance, would want to buy a receiver that could be used on one station only, no matter how good its programmes were. Again, if FM is all that it's cracked up to be in the way of fine quality and freedom from atmospheric interference, such a receiver will be the best possible advertisement for the system, since it will enable the user to make direct comparisons without any trouble at all. If he finds that FM gives him better quality with fewer unwanted noises he's likely to become a convert without further ado. The Federal Communications Commission, by the way, has reserved 7 channels in the neighbourhood of 43 megacycles for frequency-modulation trans-

missions. One deduces that the F.C.C. regards FM as something promising and that W2XOY soon won't be the only station transmitting regularly by this method.

No Inter-station Interference ?

It is claimed that FM does away with interference by one station with another. I read, in fact, that it is impossible for one station to jam another, for no two stations, even though both are working on exactly the same frequency, can be heard simultaneously. This is a big claim; but it is said to be amply supported by experimental results. For example, transmissions of different programmes on the same frequency were made from two experimental stations—call them A and B—in different parts of Schenectady. A car provided with a FM receiver was driven from the neighbourhood of A towards B. At the start A came in without a trace of B. Then, as the half-way mark was passed, A disappeared quite suddenly and there was B just as suddenly in its place. At the half-way line it was found, when the car was driven very slowly, the critical point, so to speak, was sharply marked. Here you were receiving A; a yard or so more and B's programme came from the loud speaker. Nowhere was there a duel between A and B, or even a back-

ground of one station on the other's programme. It was also found that with the car stationary near the mid-point a slight rotation in one direction or the other of the aerial would eliminate A and bring in B—or vice versa. Food for thought there; don't you agree?

Possibilities

Mind you, I've had no chance of getting any first-hand information about the results of FM, and nearly all that I've read about it has been written by folk responsible for its development or more or less closely connected with those that were. One knows only too well how enthusiasm for one's own products can blind the eyes to their shortcomings. But the accounts of results achieved by FM ring true, and I can't think that a concern like the American G.E.C. would spend a mint of money on developing it—with no immediate prospect of a return—if they hadn't convincing proof that it would live up to expectations. If it does there's a big future for it. One of the big problems of pre-war days was that of interference with broadcast reception. It's an important problem, for wireless has become an integral part of human life to-day. And it's going to be even more pressing after we've settled this spot of bother and got back to our normal lives again. Is FM going to show us how to eliminate the effects of interference, man-made and natural? Is it going to give us a means of avoiding the jamming, the heterodyning and the side-band splash that have so far defied all the efforts of those who do noble work in prepar-

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Wireless World

ing wavelength "plans"—and still nobler and more strenuous work in persuading the many countries concerned to adopt them and to carry them out faithfully? If it does these things it will prove to be one of the most brilliant of radio inventions. If it doesn't it will, anyhow, have been a praiseworthy attempt to solve some of our greatest difficulties. And should it not furnish the complete answer to these problems, it may well point the way to something that does. Here's hoping, anyhow!

Sets for the Troops

BOTH the War Office and the Nuffield Fund are providing wireless receivers in large quantities for the troops in this country. But I'm sure that there are not a few units that could do with more than they receive from either of these sources. Having lived rough and more or less at the back of beyond myself since the war began I know how essential a wireless set is as a bringer of news and dispeller of boredom. If the papers come late the seven o'clock and eight o'clock bulletins appease the pangs of morning news hunger. We alternate between periods when we're so busy that we get little rest or sleep and others when time hangs heavy on our hands because there is next to nothing to do. During those slack periods we want wireless badly. Troops particularly likely to be glad of an extra receiver or two are anti-aircraft artillery and searchlight units. If you have an old one (it doesn't matter how old so long as it works: we're not unduly critical), you can probably find recipients who will welcome it. Should you not be in touch with such units the Welfare Officer (name and address at any post office) will tell you which would be glad of a present of this kind. You haven't an old set no longer in use? Then possibly you could rig up something from the contents of your junk box. Remember that a set that gets only the local station won't be sneezed at. Battery sets are always in demand; but many units have mains supplies of current, so that there are plenty of ready recipients of mains receivers. 'Tis a worthy cause. Will you do what you can?

Don't Waste Batteries

GOOD work, the strict control imposed on the prices of torch batteries. Last year, if you remember, there were some evil ramps and too often the only thing that limited the price asked was the amount that the customer was willing to pay. It was,

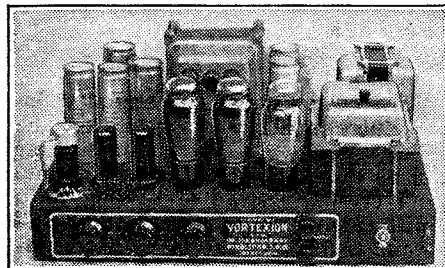
I suppose, to be expected, for we were caught short of supplies—at any rate of supplies big enough to meet the demands of the black-out. But this year there has been plenty of time to make plans for the winter, and so far as one can see there's no difficulty about obtaining flashlamp refills. But don't be extravagant with your torch batteries just because there seem to be enough available. There are enough, if we're reasonably careful; but there won't be sufficient to go round if people waste them. I have a torch with both a sliding switch, which stays "on" once you've pushed the slide forward until you pull it back again, and a spring button which keeps the juice turned on only so long as you press it with your finger. I'm trying to remember never to use the slide, but always the button. And here's why—it's a tip that others may find useful. With the glass covered by the prescribed thickness of newspaper you may not notice that your torch is still on when you come into a lighted room after the darkness outside. I was caught that way the other day when using the slide; didn't, in fact, discover that the battery was doing useless work until it was all but run down. You can't do that sort of thing if you use the button only, for directly you put the torch down out it goes. And here's another tip that I've found a great economy. If you have a two-cell or a three-cell tubular torch, renew only *one* cell at a time. It's easy to find by substitution which is the worst of the old cells. Chuck it into the nearest battery salvage bin and put in the new one. Mark the old one (or ones) and when next your glim becomes dim you'll know where the discard is to be made. You'll find that the suggested combination of new and tired cells gives quite enough light and means much more economical working.

Book Received

Photograms of the Year, 1941. Edited by F. J. Mortimer, Hon. F.R.P.S., Editor of *The Amateur Photographer*. In spite of wartime difficulties, this well-known annual publication, which has just made its forty-sixth appearance, shows no falling-off in interest. Over 80 exhibition pictures, together with critical comments, are included. Among the various articles contained within its pages may be mentioned a review of the year's photographic work, both in this country and abroad. A directory of British Photographic Societies, nearly 500 in number, is also given. Published by Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1. Price 6s. (paper cover); 8s. (cloth bound), postage 7d.

VORTEXION

50w. AMPLIFIER CHASSIS



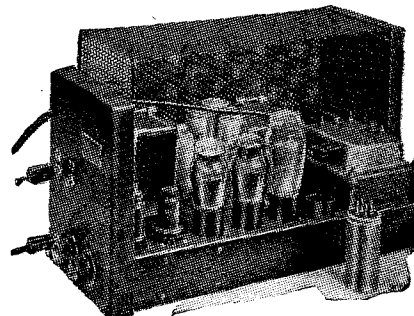
A pair of matched 6L6's with 10 per cent. negative feed-back is fitted in the output stage and the separate HT supplies to the anode and screen have better than 4 per cent. regulation, while separate rectifier provides bias. The 6L6's are driven by a 6F6 triode connected through a driver transformer incorporating feed-back. This is preceded by a 6N7, electronic mixing for pick-up and microphone. The additional 6F5 operating as first stage on microphone only is suitable for any microphone. A tone control is fitted, and the large eight-section output transformer is available in three types—2-8-15-30 ohms; 4-15-30-60 ohms or 15-60-125-250 ohms. These output lines can be matched using all sections of windings and will deliver the full response (40-18,000 c/s) to the loud speakers with extremely low overall harmonic distortion.

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TYPE CP20

This small Portable Amplifier operating either from AC mains or 12-volt battery, was tested by "THE WIRELESS WORLD," October 1st, 1937, and has proved so popular that at Customers' demand it remains unaltered except that the output has been increased to 17.2 watts and the battery consumption lowered to 6 amperes. Read what "The Wireless World" said—

"During tests an output of 14.7 watts was obtained without any trace of distortion so that the rating of 15 watts is quite justified. The measured response shows an upper limit of 18,000 c/s and a lower of 30 c/s. Its performance is exceptionally good. Another outstanding feature is its exceptionally low hum level when AC operated even without an earth connection. In order to obtain the maximum undistorted output, an input to the microphone jack of 0.037 volt was required. The two independent volume controls enable one to adjust the gain of the amplifier for the same power output from both sources, as well as superimpose one on the other, or fade out one and bring the other up to full volume. The secondary of the output transformer is tapped for loud speakers or line impedances of 4, 7.5 and 15 ohms." Prices: Plus 10% war increase.

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Unbiased

By FREE GRID

Into the Future

IT is customary at this season to indulge in a few prophecies for the New Year. In these times more of us than ever before are gazing into our crystals instead of tickling them with cats whiskers, as naturally we all want to know what is in store for Adolf in the ensuing twelve months. I may say that I have been in consultation with the aged Eastern seer, to whom, as I told you a month or two back, I was able to be of great service on one occasion.

He rather disappointed me by merely prophesying the obvious for this year, namely, that in April *The Wireless World* would be celebrating its 30th birthday, and entering on its fourth decade of existence. However, I speedily found out that I had, through an oversight, omitted to send the necessary baksheesh, and when this omission had been remedied I got better results. He repeated even more emphatically than before that in 1941 we shall be using our television sets again.

Talking of television reminds me



Gazing into our crystals

that the Yanks have just decided to fall into line with certain other countries and adopt 441 lines as a television standard, so it looks as though we might eventually find ourselves in "splendid isolation" with our 405 lines, as we are with our antique monetary system, and a few other things like that. Now I hold no brief for 441 lines, and don't believe for a moment that definition is appreciably

better than with our own 405 lines, but I do want to be able, when long-distance television comes, to use my domestic television set to pick up American and Continental programmes. My point is that if we are ever going to accept the 441 line standard, or any other figure, that may be internationally agreed upon, now is the time to make the change when television is in abeyance, and the minimum of trouble would be caused thereby.

If a change is going to be made, and it is left until after television is resumed, everybody will be clamouring for their sets to be adjusted overnight, so as not to miss a programme, and the makers' factories will be choked up with work, with the result that there will be general ill-feeling all round. If it were done now it could be carried out in a leisurely manner over a period of weeks. Therefore, if it is going to be done, better do it now or never at all.

A Serious Menace

I SUPPOSE that most of you have noticed the enormous increase in oscillation which has been taking place everywhere, but more especially in the London area, since the *blitzkrieg* began. On some evenings the noise has been truly dreadful, and it has at times been difficult to differentiate between the whistles emanating from the loud speaker and those due to falling bombs, and on several occasions diplomatic relations between Mrs. Free Grid and myself have been strained to breaking point, due to my dragging her unceremoniously under the table with me when a particularly realistic whistle came from the loud speaker.

It is, of course, quite obvious to me what is really happening. We hear many tales of mysterious light signals flashed to enemy aircraft by fifth columnists in our midst, but I long ago realised that Adolf was not quite so old-fashioned in his methods as that. A fifth columnist need run no risk of watchful warden or Home Guard seeing him flashing his torch; he can sit comfortably in his shelter posing as an innocent citizen, searching for the elusive B.B.C. with his old-fashioned swinging-coil set, for, after all, a nice wireless whistle on which an enemy plane can take a DF bearing



A heavy hand fell upon my shoulder

is far better than any flashing light, and far less obtrusive.

In order to put my theories to the test I equipped myself with a very good portable DF outfit made up from a circuit published in *The Wireless World* many years back, when wireless was wireless, and very speedily found that my worst suspicions were confirmed, namely, that the loudest and most persistent howls were emanating from houses adjoining important military targets. There was one particularly bad case in which a steady howl came from a row of modest suburban villas "situate," as the house agents say, hard by a locality which only the necessity of absolute secrecy prevents my revealing to you.

Having identified the actual house by means of careful work with my *Wireless World* Diary DF gear, I was investigating the matter further by peering through a chink in the black-out curtains when a heavy hand fell upon my shoulder, and I was confronted by a large limb of the law, or, to be exact, two limbs, in the shape of a very large policeman and a very small warden.

It is, I think, better not to dwell on the events of the next few hours; suffice to say that had it not been for the active intervention of the Editor, who is very well known to the police, things might have gone very ill with me indeed. The nightly howling on the ether still remains, and if any of you have neighbours who are more than ordinarily addicted to it, I will leave you to draw your own conclusions.

Apart from any question of fifth column activities, do not forget that when the enemy passes over an area from which a welter of whistles is emanating he is at once informed that he is over a town, and not over the countryside.

Recent Inventions

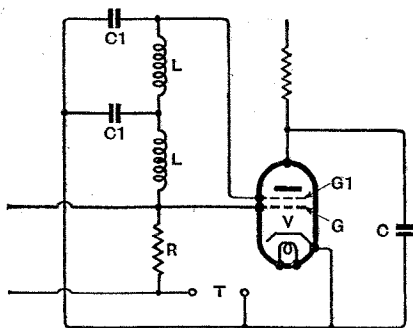
Brief descriptions of the more interesting radio devices and developments disclosed in Patent

Specifications will be included in these columns

TIME-BASE CIRCUITS

THE frame and line synchronising signals are separated in a television receiver by applying them both to a "delay" circuit having a time constant which is greater than the "line" and less than the "frame" impulse.

The Figure shows a gas-filled valve V which generates a saw-toothed voltage when the condenser C is discharged. It is provided with two grids, one connected directly to the input and the other through a network of inductances L and capacities C₁, forming a delay circuit.



Method of separating "line" and "frame" impulses.

Both sets of synchronising signals are applied to the terminals T. A short "line" impulse develops a voltage across the resistance R which is applied to the inner grid G, though its effect disappears before the same impulse can reach the second grid G₁ through the delay circuit. Since the valve will only discharge when both grids are affected, the line impulses are thus cut out. The longer "frame" impulse, however, has time to get through to both of the grids, and so "trigger" the valve, to discharge the condenser C and generate a frame scanning-oscillation.

Murphy Radio, Ltd., and K. S. Davies. Application date December 14th, 1938. No. 522737.

WIRED-WIRELESS SYSTEMS

WHEN a number of receivers are fed with different programmes from a common transmission line, it is desirable that each receiving set should present a high impedance to the line, so as to avoid disturbing the line voltage as the sets are switched into or out of circuit. The voltage is, however, not uniform along the line, being usually higher at points near the sending end. Also variations in voltage may arise owing to reflection at various branch points. Accordingly it is advantageous to be able to provide independent means for adjusting the signal strength at each receiver so as to make it substantially the

same for each of the available carrier frequencies.

With this object in view, each receiver input is shunted by a fixed resistance in series with a variable resistance, which is also in series with a band-pass filter capable of passing the modulation frequencies from the line. The variable resistance can be adjusted up to a value ten times the fixed resistance, whilst the latter is sufficiently high to keep the response of the band-pass filter uniform over the whole band of signal frequencies.

P. P. Eckersley and R. E. H. Carpenter. Application date October 18th, 1938. No. 522889.

VISUAL TUNING INDICATORS

THE fluorescent screen of a visual tuning indicator of the cathode-ray or "magic-eye" type is divided into, say, three segments, each producing a different colour under the impact of the electron stream. For each position of the wave-change switch of the set, a corresponding segment is automatically brought into circuit with the anode of the indicator tube, so that the tuning point of a long-wave station is shown, for instance, in red, whilst the medium and short-wave indications appear in other colours.

Vereingte Glühlampen und Elektrizitäts Akt. Convention date (Germany) May 28th, 1938. No. 519921.

PUSH-BUTTON AND MANUAL TUNING

IN a motor-controlled push-button set, it is usual to provide for manual tuning as an alternative to automatic station selection. The invention consists in using the motor normally employed for automatic tuning, so that it also plays a useful part in manual tuning.

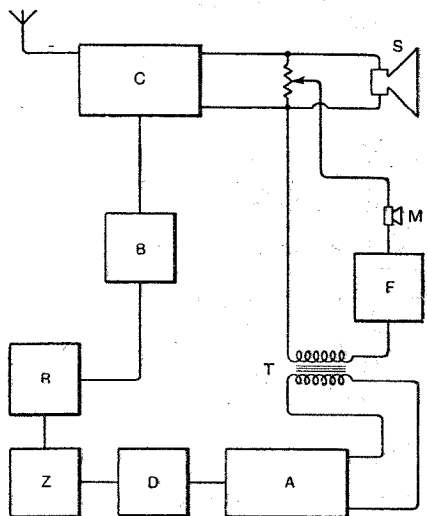
Suppose the tuning indicator-needle happens to be positioned towards the right-hand side of the station scale, and that it is desired to tune the set, by hand, to a station located towards the opposite end of the scale. The listener will then press the manual-control knob towards the left. This first brings the muting switch into action, so as to "silence" the set, and then brings the motor into gear to drive the needle towards the required end of the scale. When the needle has been brought close

to the desired tuning-point in this way, the lateral pressure on the control knob is released. The muting switch then becomes inoperative, the motor drive is broken, and the tuning operation is completed by hand-control in the ordinary way.

Kolster-Brandes, Ltd., and W. A. Beatty. Application date October 7th, 1938. No. 519905.

WHEN THE AUDIENCE TALKS

WHEN the casual conversation of the audience in a cinema theatre threatens to drown out the speech from the film, it is possible to use the noise of such "chatter" to produce an automatic volume control voltage, which serves to boost-up the film dialogue. The present invention deals with the same problem in another, and possibly more effective, way, because matters are so arranged that any extraneous noise acts automatically to cut down the volume of the film speech or music, so that the audience is forced to be quiet if it wishes to hear what is coming from the stage. Similarly, the invention can be used to silence an ordinary wireless



Volume regulation by voice control

set when a conversation is started between people who have been listening to a broadcast programme.

As shown, an auxiliary microphone M is "balanced" across the loud speaker S so that it is not affected by the normal output from the latter. Any extraneous noise, however, produces an unbalanced microphone current, which passes through a 200-400-cycle filter F and a transformer T to an auxiliary amplifier A. The output from A is rectified at D and passed through a time-delay circuit Z to operate a relay R. This auto-

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2., price 1/- each.

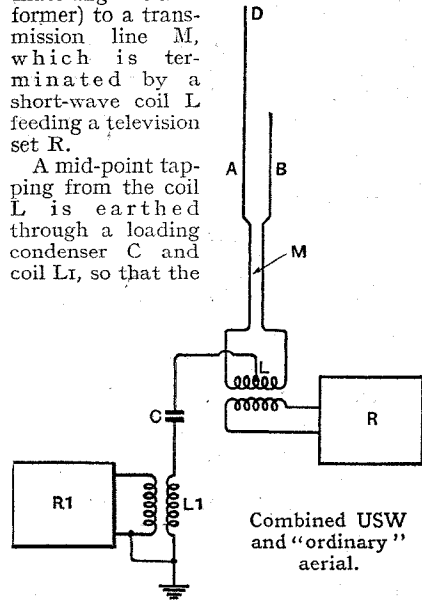
Recent Inventions—

matically applies a cut-off or volume-reducing bias to the main receiver C, through a special biasing network at B. *Kolster-Brandes, Ltd., and C. N. Smyth. Application date November 4th, 1938. No. 520915.*

"ALL-WAVE" AERIALS

THE Figure shows an aerial arrangement suitable for receiving both television and ordinary broadcast programmes. The upper dipole D, which is tuned to the television waves, is coupled through two suitably spaced conductors A, B (forming an impedance-matching transformer) to a transmission line M, which is terminated by a short-wave coil L feeding a television set R.

A mid-point tapping from the coil L is earthed through a loading condenser C and coil L₁, so that the



whole of the upper system acts as an aerial for the longer waves, which are fed to the receiver R₁. Since the dipole aerial is "balanced" for the television waves, there will be very little "leakage" into the lower earthed lead, though a high-frequency choke may be inserted in series with the coil L₁ if necessary.

Kolster-Brandes, Ltd.; W. A. Beatty; and P. K. Chatterjee. Application date December 23rd, 1938. No. 523074.

REMOTE VOLUME AND TONE CONTROL

IN order to control the output of a wireless set from a remote point through leads which do not carry power current, and which do not require shielding, a potentiometer resistance is shunted across the secondary winding of the loud speaker transformer. A variable tapping from this resistance is then connected in series with the cathode resistance of the distant amplifier, so as to apply negative reaction, and to give a control circuit of low impedance to the chassis of the set. A condenser for high-frequency discrimination is included in the feed-back connection, or any other required form of tone control may be incorporated.

The remote control may be used in ad-

dition to the ordinary volume control provided on the set. The latter then serves to determine the general level of volume suitable to the circumstances in which the set is being used, whilst the remote control allows a fine adjustment to be made to suit individual tastes, having regard to the particular type of music that is being reproduced.

Murphy Radio, Ltd.; D. N. Truscott; and G. D. Reynolds. Application date September 13th, 1938. No. 520128.

AERIALS

A DIPOLE and reflector unit, as normally used for receiving television signals, is further adapted to receive ordinary broadcast signals. For television work, the dipole is assisted only by the re-radiation effect of the reflector, and is connected to the set by the usual coaxial or two-wire line.

For receiving the medium- or long-wave broadcast programmes, a separate screened down-lead is used. This is coupled through a matching transformer to the whole aerial unit, so that the capacity of the reflector, as well as that of the spacing bar between it and the dipole, both help to "load" the system, so that it can be tuned to the longer wavelengths.

Alternatively, the television dipole is directly connected to the reflector through a centre tapping on a coil having a high impedance to the television frequencies, and a low impedance to the longer waves. In this arrangement, the same down-lead is used for both types of programme.

Belling and Lee, Ltd., and F. R. W. Strafford. Application date September 24th, 1938. No. 520628.

CAPACITY EFFECTS

IF a piece of metal foil is placed against a slab of agate or polished stone, and a voltage is applied across the surface of contact, the foil will adhere quite

agate are placed together, and two pieces of metal foil are cemented over the two outer surfaces. If a varying voltage is now applied across the two pieces of foil, it is found that the capacity between them changes with the voltage. The reason is obscure, but is believed to depend upon molecular changes in the thin dielectric film between the foil and the agate surface.

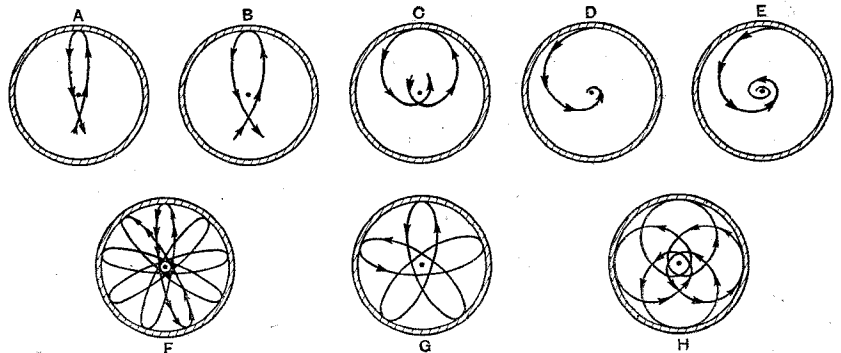
The arrangement can be used for applying automatic frequency control to a wireless receiver.

Marconi's Wireless Telegraph Co., Ltd.; N. M. Rust; J. D. Brailsford; and A. L. Oliver. Application date November 12th, 1938. No. 522476.

MAGNETRON GENERATORS

A single or "split" cylindrical anode enclosing a straight cathode, the space between the two electrodes being subjected to the action of an external magnetic field. The field controls the electrons emitted from the cathode, and forces them to follow a more or less curved path, as they move towards the anode. The frequency of the oscillation generated is thus determined by the curvature of the electron path, or, in other words, by the time taken for the electrons to travel from cathode to anode. In ordinary practice the applied magnetic field is of uniform intensity.

According to the invention, the magnetic flux is not kept uniform but is deliberately concentrated either near the anode or in the region of the cathode. This concentration is effected by placing elements of high magnetic permeability inside the tube near the electrodes in question. In the Figure, A, B, C, D, E represent different orbital paths which the electrons can be forced to take according as the magnetic control field is concentrated near the anode or near the cathode. F shows a cycle of nine electronic oscillations of the form shown in A, each rotating counter-clockwise;



Electron orbits in a magnetron.

strongly to the stone. This phenomenon is known as the Johnsen Rahbek effect, and has already found various applications in wireless practice.

The effect is used in the present invention to convert a varying voltage into a corresponding variation of capacity. The polished surfaces of two pieces of

G represents a five-cycle sequence of the oscillations in B; whilst H shows, by contrast, the path taken by the electrons in a uniform magnetic field.

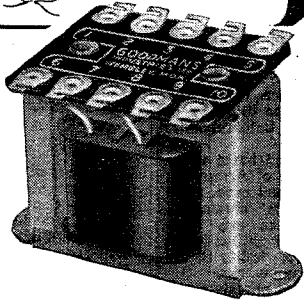
Marconi's Wireless Telegraph Co., Ltd. (assignees of E. G. Linder). Convention date (U.S.A.) December 30th, 1937. No. 523329.

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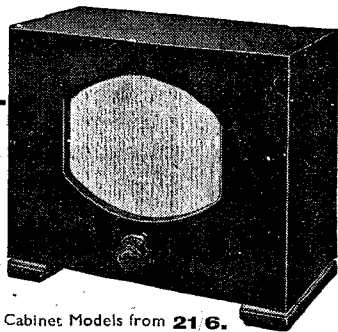
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RECEIVERS AND AMPLIFIERS SECOND-HAND, CLEARANCE, SURPLUS, ETC.

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HOWARD, Model 460, super receiver, 10 valve, with frequency monitor and speaker, as new; £20.—Dawson, Jeweller, Halesworth. [9367]

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Wanted

MURPHY A50 and Peak Preselector.—2, Cliff Rd., Gardens, Leeds, 6. [9324]

MCCLOURE A.F.C.4 Feeder Unit or Similar, in perfect working order.—Hubble, 70, Aldermanbury, E.C.2. [9342]

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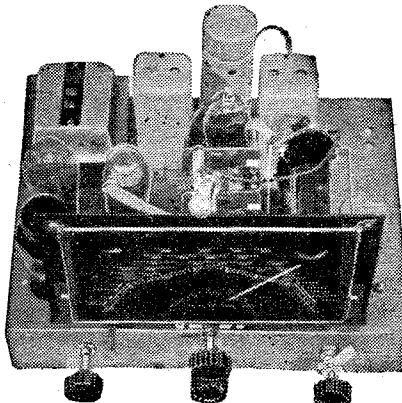
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(13-160m. continuous & normal Broadcast bands)
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WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0518

Wanted

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Wanted

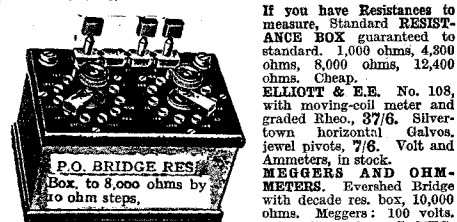
RECORD Changers, radiogram units, pick-ups, etc., new or second-hand; units also requiring repair also purchased; state condition and make.—Box 2557, c/o *The Wireless World*. [9361

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DIX-MIFANTA VEST POCKET TESTER, Moving-iron multi-range meter for A.C. or D.C. No projecting terminals. THREE ranges of volts: 0-7.5, 0-150, 0-300. In black bakelite case. 2 1/2 in. by 2 1/2 in., 1/6.

7 in. **OSCILLOGRAPH TUBES**, Ediswan, £3/10/-.

OSCILLATORS, McLachlan Het. W/M, 20 to 5,000 metres, £4. Sullivan Screened Het. to 16,000 metres, 65/-.

TESTERS FOR RADIO SERVICE, Inductance Bridge, Baldwin Henlog, 20 micro-H. to 20,000, £5/10/-, Inductance Micrometer, Cambridge, Universal Model L, unipivot 0-120 meter shunts and A.C. gen., £8/10/-, Capacitor Analyser, Hunts, 1 mfd. to 70 mfd., 50 ohms to 2 meg. and power factor, cheap. Cap.-Res. Radiometers, 9,001 mfd. to 25 mfd., 20 ohms to 4 megs., £9/10/-, Cap.-Ohmmeter, range .001 mfd. to 10 mfd., 0.1 to 1 meg., need adjust.

5K. GENS. AND OSCILLATORS, Radials Ev. Edgcombe Modulated E.F. 3-price Oscillator, 5 ranges 103,000 metres, DHO, Type P, 175 to 3,000 sigs. as new, Triumph Sig. Gen., 100 to 3,000 kc. and 3 to 75 megacycles, £7/10/-, Chicago Oscillator, Webster, 20 kc. to 60 mc., as new, £12. Trimeasy Pye Oscillator, 12 to 3,000 metres, in 5 ranges, Ganging Oscillator, Cosmor, 10 kc. to 20 mc., as new, £11.

VALVE ANALYSERS, Etc. Weston Selective, Model E665, D.C./A.C. volts 5/1,000 v. m/a. 4 to 600 at 1,000 c.p.v., for 4, 5, 7 and 9 pin valves, £13 for twenty-guinea set. Ev. Edgcombe D.C. Multi, 5 m/a to 500 amps, 150 m/v to 600 volts, portable, £8. Emicol 3-meter Valve Tester, volts, m/a and ohms, valve bases, etc., needs repair, cheap. Met-Vick A.C. Watt-Hr. Meter, 250/500 v., 1 to 100 amps, 120 r.p.m., integrating, 60/-, Huntington Telescope £5/-.

SUPREME PORTABLE VALVE ANALYSER KIT, with 2-scale moving coil meter, with rectifier for A.C., drilled and fitted panel in case, range switch, etc. 45/-, makes an 8-guinea set.

D.C. to A.C. ROTARY CONVERTERS, For A.C. Radio on D.C. mains, 230 v. A.C. output with filter, in silence cabinet, 12 volts, 100 volts, 230 volts in stock at bargain prices, as illus. Other sizes in stock: 50 watts, 150 watts and 440 watts, all in new condition.

Midget A.C. Rotary Converters for small 50 cycle 230 v. output from D.C. 230 v. mains, 7 watt P.M. model, 27/6 only. Specially compact lightweight 15 watt D.C./A.C. 230 v. Cheap, 55/-.

D.C./D.C. PORTABLE MOTOR GENS. for L.P.T.V. 6 v. input 500 v. 25/30 m/a. output, 57/6. 6 v. to 400 v. 75 m/a, 62/6. 12 v. to 1,000 v. 75 m/a, 65/-, 25 v. to 1,400 v. 1/2 amp., £5/10/-, 2 kWh Set, 200 v. D.C. coupled to 5,000 volt 1/2 amp. D.C. Gen., £15.

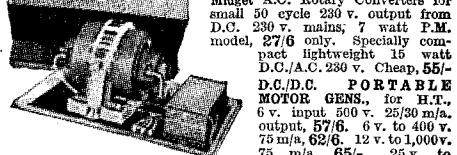
DYNAMO BARGAIN, 100 volts 1 amp. D.C. shunt, ball-B, "Croydon", 15 lb., 6 in. x 5 in., 12/6 curr. free.

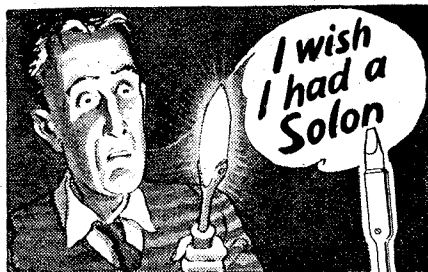
INVERTERS, Crypto 440 watt M.G. input 230 v. 50 cycles to D.C. 220 v. 2 amps. Starter and Volt Regulator, £8/15/-, Smaller set, A.C. 220 v. to D.C. 100 v. 1 amp., 60/-, Sets for Battery Charging, Big set for 200 cells and 8 car batteries on 230 v. A.C. complete £15. Cost double. 21 kW, set for 500 cells, £55.

MOTOR GENERATORS, D.C./D.C. 220 v. D.C. to 24 v. 30 amps, £9. 220 v. to 16 v. 5 a., £5. Many other sizes in stock.

Send 2d. stamp for latest Bargains List "W." Stamped envelope must be sent for all answers to enquiries.

ELECTRADIX RADIOS
218, Upper Thames Street, London, E.C.4
Telephone: Central 4611





No overheating with Solon Electric Soldering

Overheated irons need filing and retinning; a laborious or troublesome job—cut it out by using a SOLON. With Solon Electric Soldering, in 4 minutes, the bit gets to the correct heat and stays there!—just as long as you need it; 15 hours' use takes only 1 unit. No flame—no dirt. The constant heat, at the point, makes the solder run sweetly; sweats it right into the joint; gives you a strong neat job.



Made for following standard voltages:—200/220 230/250.



Handyman model supplied complete with Resin-Cored Solder, Flex and Lamp Adaptor **9/4**

Solon Resin-Cored Sol-**6D.** per reel.

W. T. HENLEY'S TELEGRAPH WORKS CO. LTD. (Dept. 24/E), Engineering Sales Dept., Milton Court, WESTCOTT, DORKING, SURREY.

Joining the R.A.F.?

If you intend to join any section of the Services in which a knowledge of the Morse Code is required you can become a skilled W/T Operator by taking a

CANDLER CODE COURSE

There are courses for beginners and also for those who desire to considerably increase their w.p.m. speeds.

In the "BOOK OF FACTS," which will be sent FREE on request, full information is given concerning the subjects covered by all Candler Courses.

There's no royal road to learning—but there IS a quick, sure way to genuine CODE skill. Thousands of Candler Trained Operators, including many in the Services, have proved the value of this truly remarkable system of Code instruction.

J. Clarricoats, Sec., Radio Society of Great Britain—says: "I regard the Candler System as being the most important system of its kind and already large numbers of Members of the Radio Society of Great Britain have intimated to me that they are studying the course of instruction with a view to preparing themselves for service in one branch or another of H.M. Forces."

Courses supplied on cash or monthly payment terms.

COUPON

Please send me a Free Copy of Candler "Book of Facts"

NAME

ADDRESS

Post in 1d. unsealed envelope to London Manager
CANDLER SYSTEM CO. (Room 55W.), 121, Kingsway, London, W.C.2.

Candler System Co., Asheville, North Carolina, U.S.A.

RECORDING EQUIPMENT

Wanted

V.G., Saja and other makes of recording equipment of studio standard required; highest price paid. —Box 2555, c/o The Wireless World. [9357]

VALVES

METROPOLITAN RADIO SERVICE—American Valves, in all types, trade supplied.—1021, Finchley Rd., N.W.11. Speedwell 3000. [0436]

ACCUMULATORS

50 Radio Accumulators at Half Price! Slightly used but in perfect condition; £6.—Box 2554, c/o The Wireless World. [9352]

METERS, ETC.

Wanted

FERRANTI 2 1/2 in. Flmh 1 m.a. Moving Coil Meter, or any other good make.—5, Bank Rd., Biggleswade, Beds. [9366]

TEST EQUIPMENT

Wanted

EVERETT EDGCUMBE 1940 All Purpose Tester, No. 40.—71, Windsor Lane, Burnham, Bucks. [9337]

REPAIRS AND SERVICE

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). [9227]

EPOCH—Diaphragms for all models, guaranteed 12 months, as supplied to G.P.O., Gaumont-British, etc.—"R.E.C.S.," Crown St., Reading. Phone: 2796, day or night. [9354]

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]

"SERVICE with a Smile."—Repairs of all types of British and American receivers; coil rewinds; American valves, spares, line cords.—F.R.I., Ltd., 22, Howland St., W.1. Museum 5675. [8934]

METROPOLITAN RADIO SERVICE—Guaranteed repairs to American and British receivers; American valves, condensers, volume controls, linecord resistances, Majestic I.F. transformers, and rewinds, trade supplied.—1021, Finchley Rd., N.W.11. Speedwell 3000. [0435]

PATENTS FOR SALE

THE Proprietor of British Patent No. 290,642, relating to "Improvements in radio telephone signalling," is desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the invention either by the sale of the Patent Rights or by the grant of Licences on reasonable terms. Interested parties who desire further particulars should apply to Albert L. Mond and Thiemann, of 14-18, Holborn, London, E.C.1. [9325]

THE Owner of British Patent No. 469,498, relating to "Improvements in or relating to Phonographs," is desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the invention either by the sale of the Patent Rights or by the grant of Licences on reasonable terms.—Interested parties who desire further particulars should apply to Albert L. Mond and Thiemann, of 14-18, Holborn, London, E.C.1. [9326]

COMPONENTS

SECOND-HAND CLEARANCE, SURPLUS, ETC.,

PREMIER RADIO.

PLEASE See Our Displayed Advertisement on page 5. [0488]

SOUTHERN RADIO'S Wireless Bargains.

ALL Goods Previously Advertised Still Available.

SOUTHERN RADIO, 46, Lisle St., London, W.C. Gerrard 6653. [9238]

FERRANTI A.F.5C., definitely as new; 16/6, post free.—43, Albert Rd., Levenshulme. [9343]

TROPHY Three, complete set coils, guaranteed perfect; £2/17/6.—Hobley, 109, Drive, Wellingborough. [9347]

Masteradio —MALLORY

VIBRAPACKS

PERFECT PORTABLE POWER

British-made Vibrator Power Supply Units employing the **WORLD-FAMOUS "MALLORY" VIBRATORS**

OUTPUTS of up to 30 watts from either 6 volt or 12 volt battery supply.

EFFICIENCY as high as 70% including rectification.

LIFE. Masteradio-Mallory Vibrators mean longer life. Longer life means **LOWEST COST PER HOUR ACTUAL USE.**

DEPENDABILITY. In Masteradio-Mallory Vibrapacks the Vibrator is working under ideal conditions, thus ensuring utmost dependability.

Used by the War Office, Air Ministry, G.P.O.

Let our Technical Dept. solve your portable power problems. Write for details:

MASTERADIO Ltd.
(Dept. W. W.) Vibrant Works,
RICKMANSWORTH ROAD,
WATFORD, HERTS.

*Grams: Mastiola, Watford. *Phone: Watford 9885.

GREENWOOD

WARD

AC/DC ROTARY CONVERTERS

for operating P.A. Amplifiers, Radio Receivers, etc.

WE ALSO MANUFACTURE
DC/DC ROTARY TRANSFORMERS, SMALL ALTERNATORS, SMALL DC MOTORS, H.T. GENERATORS, MAINS TRANSFORMERS up to 10 k.v.a. PETROL ELECTRIC generator sets up to 50 k.v.a. **BATTERY CHARGERS** for private and industrial use, and are fully equipped for general small engineering work.

Full details of any of the above upon request. Export enquiries invited.

CHAS. F. WARD
46, FARRINGTON ST., LONDON, E.C.4
Telephone: Holborn 9703. Works: Bow, E.

**COMPONENTS—SECOND-HAND,
CLEARANCE, SURPLUS, ETC.**

RADIO CLEARANCE, Ltd.—Owing to bomb damage we have taken new premises at 95, High Holborn, W.C.1, where all orders will be executed with our usual promptness.

ALL-WAVE Superhet Chassis, 5-valve A.C., latest Mullard valves, T.H.4B, V.P.4B, T.D.D.4, Pen. A.4, L.W. 4/350v. Ranges: short-wave, 16-48 metres; medium-wave, 200-500 metres; long-wave, 800-2,000 metres. Size of chassis, 14½in. long, 7½in. deep; height overall, 8½in. Controls: Tuning at side, volume on/off at side, wavechange, provision for pick-up. Complete with valves, £4/7/6 each.

SPECIAL Offer—Ready in 7 days, 200 only, 5-valve A.C./D.C. sets, 3 wave-bands, complete in attractive cabinet, size 14in. x 8in. x 6in., ready to plug in; list price £8/8, our price £4/9/6 each.

2V. Output Pentode Valves, 5- or 4-pin, side terminal, unboxed; 2/11 each.

LISSEN 2V. Screen-grid Valves, S.G.2V.; 4/6 each.

LISSEN 2V. Battery Pentodes, 4-pin, side terminals, P.T.2A.; 4/11 each.

LISSEN Rectifier Valve U650; 2/11 each.

ULTRA Short and Short-wave Choke, Lissen Hi-Q., inductance 100 microhenries, boxed; list 2/- each, our price 1/- each.

ULTRA Short and Short-wave Double Wound Low-resistance Choke, Lissen Hi-Q., resistance less than 0.05 ohms, boxed; list 2/6 each, our price 1/3 each.

LOW-LOSS Ceramic Valve Holders, Lissen Hi-Q., baseboard and chassis 7-pin; 1/- each.

MANSBRIDGE Type Condensers, Lissen Hi-Q., 250 D.C. working, moulded cast with feet, 1 mfd.; 1/- each.

LOW-LOSS Short-wave Variable Condensers, Ceramic insulation, brass vanes, Lissen Hi-Q., minimum capacity, 5 microfarads, two types, boxed, with knobs, 600 mfd., list 7/6 each, our price 3/- each; 200 mfd., list 5/6, our price 2/6 each.

ROTARY Coil Units, Lissen Hi-Q., 4-band from 4.8-91 metres, can be selected by turn of knob, with circuit, boxed; list 15/6, our price 6/11 each.

PUSH-PULL Switches, Lissen 2 point, 4d. each; 3 point, 6d. each.

YAXLEY Type Switches, 4-pole, 3-way, 9d. each; Yaxley type switches, 4 bank, 2/6 each.

AMERICAN Line Cords, with fittings, 3/6 each; 3-way American line cords, 450 ohms resistance, 1/6 each.

ROLA P.M. Speakers, latest model, 7½in. cone, with power and pentode transformer, boxed; 15/- each.

MAGNAVOX 10in. Energised Speaker, field resistance 3,000 ohms, with transformer; 12/6 each.

CLOCK-FACED Dials, 5in. x 3½in., with printed 3-wave scale and escutcheon; 2/6 each.

STRAIGHT Line 3 Waveband Dials; 1/11 each.

MAINS Transformers, G.E.C. American windings, 350-0-350v., 65 m.a., 6.3v., 2.5 amps., suitable for replacements in G.E.C. models; 6/6 each.

MAINS Transformers, Wearite, R.C.1 250-0-250v., 80 m.a., 4v. 2.5 amps., 4v. 4 amps., 9/11 each; R.C.2, 350-0-350v., 120 m.a., 4v. 2.5 amps., 4v. 4 amps., 2/6 each; R.C.3, 350-0-350v., 150 m.a., 4v. 2.5 amps., 4v. 2.5 amps., 4v. 5 amps., 15/- each; R.C.4, 500-0-500v., 150 m.a., 4v. 2.5 amps., 4v. 2.5 amps., 4v. 2.5 amps., v. 5.6 amps., 21/- each; R.C.5 100 watt auto transformer, 100-110v., 200-250v. reversible, 12/6 each; R.C.6 above transformers 200-250v. tapped primaries; R.C.D. drop through type capped, 350-350v. 100 m.a., v. 2 amps., 6.3v. 5 amps., 10/6 each.

CHASSIS Mounting Valve Holders, American 4-5-6-7-pin, 4d. each; Octal, 6d. each; Loctal, 10d. each.

VALVE Holders, Celestion, 5- and 7-pin chassis type, 4d. each; baseboard type, 5-pin, 2d. each.

VOLUME Controls, Centralab, spindles, length 2½in., with switch, 100,000, 250,000, 500,000 and 1 meg., 2/11 each; Centralab 1 meg. volume controls, with switch, 1½in. spindle, 2/- each.

VOLUME Controls, C.T.S., wire wound, 5 watt, 500, 1,000 and 10,000 ohms; 2/6 each.

ROTHERMEL Junior Pick-up, Piezo electric model, with rest, brand new, boxed; 21/- each.

DRESS-BUTTON Units—Size of unit, 6in. x 6in. x 2in., complete with six press buttons and capacitors; 4/11 each.

2-WAY Push-button Switches, 1/6 each; 11-way push-button switches, 1/6 each; 6-way push-button switches, 1/- each.

SPEAKER Cabinets, suitable for 8in. speaker; 4/6 each.

(This advertisement continued in column three.)

GALPINS

ELECTRICAL STORES

**75, LEE HIGH ROAD, LEWISHAM,
LONDON, S.E.13**

Telephone: LEE GREEN 5240

Terms: Cash with Order

ELECTRIC LIGHT CHECK METERS, small, late type, well-known makers, in good condition, electrically guaranteed for 200/250 volts 50 cy. 1 phase A.C. mains. 5 amp. type, 6/-; 10 amp., 7/6; 20 amp. 9/- each. Post 1/- on all types.

"CRYPTO" SHUNT WOUND DYNAMO, 30 volts 10 amps., 1,900 r.p.m., in good condition, 65/-, carriage forward.

"CROSSLEY" APPROX. 1 H.P. GAS ENGINE, tube ignition, in good condition, 65/-, carriage forward.

D.C. ELECTRIC LIGHT CHECK METERS, 200/250 volts 5 and 10 amps., 4/6 each, post 1/- (in new condition).

PHILIPS HIGH VOLTAGE CONDENSERS. Infid. at 4,000 volt working, 5/6 each, carriage paid.

REGULATORS, STARTERS AND LARGE DIMMER RESISTANCES. Stud Switch-arm type. State wants.

SWITCHBOARD VOLT AND AMPMETERS MOVING COIL AND MOVING IRON. All first-class makers. Please state requirements.

TEN LINE CORDLESS TELEPHONE PORTABLE EXCHANGE BOARD, complete with calling generator in new condition, £6/10/-, carriage forward.

EX R.A.F. GLASS ACCUMULATOR TANKS, 5 x 5 x 8in., new and unused, 3/6 each, post 1/-.

EX R.A.F. SWITCH PANEL, with case (new), fitted 6 small knife switches, leads, cords and cleats, complete in wood case, 2/6 each, post 6d.

EX R.A.F. NEW NEGOTIATOR MOTOR BLOWER, 100 volt motor, shunt wound, 1,800 r.p.m., ball bearing, fitted to Cyclone fan, 4½in. inlet 5in. outlet, massive aluminium casing 11in. dia., new and unused, 55/- each, carriage 4/-.

SMALL ELECTRIC ROTARY CONVERTOR, 110 volts D.C. input, 10 volts at 30 amps. output. Useful for garage charging, 55/-, carriage forward.

D.C. MOTOR BLOWERS, 2in. inlet and outlet. Aluminium body, laminated field, ideal for dug-out ventilation. 100 volt, 25/-.

X-RAY TUBES by well-known makers, 7in. bulb Tungsten Targets, 15/- each, carriage forward.

HIGH-VOLTAGE TRANSFORMERS useful for all test work, or television. Input 200/240 volts, output 5,000 and 7,000 volts, 6/6 each, post 1/-.

VOLTAGE CHANGING TRANSFORMERS (Auto Wound), 100/110 to 200/240 v., or vice versa, fully guaranteed, 1,000 watts, 60/-; 2,500 watts, 110/-.

DUG-OUT LAMPS, Ex R.A.F., solid brass construction, glass dome, complete with 12-volt bulb (any bulb can be fitted), wall fitting, 3/- each, post 6d.; Ditto, wing type, as new, 2/6, post 6d.

DUG-OUT LAMPS, Ex R.A.F., porthole type, or can be bracket fitted, glass dome, three colour fitting, white, red or green, solid brass construction, 6in. dia., complete with bulb; any size bulb can be fitted. Price 5/-, post 6d.

1 KW. TRANSFORMER, 100 v. input at 100 cycles, output 10,000 volts centre tapped, price 30/-, carriage forward.

EX R.A.F. AUTOMATIC CHARGING CUT OUTS AND VOLTAGE REGULATORS, to suit any dynamo up to 20 volts at 15 amps., fully adjustable, wiring instructions, complete in metal case. Price 3/6, post 6d.

DOUGLAS ENGINE, 2½ h.p., special air cooling, twin, on allii bedplate, portable, complete with petrol tanks and in perfect working order, suitable for pumping, lighting, etc., price £10.

B.T.H. LIGHTWEIGHT HEADPHONES, 4,000 ohms, headbands damaged, phones guaranteed, 5/- per pair. Post free.

DYNAMOS, all shunt wound and fully guaranteed, 50/75 v.-15 a., £6/10/-; 50/75 v.-25 a., £8/10/-; 50-volt-30 a., £8/10/-, all carriage forward.

8-10 WATT AMPLIFIER for public address work, 110/240v. mains, Mo valves, using 2 P x 4's in push-pull, 35/- each, carriage 2/-.

LARGE D.C. CIRCUIT BREAKER, as new, 4-pole, 100 amps. price £5, carriage forward.

SWITCHBOARD, lightweight, suitable for portable set, fitted a pair of meters, Everett Edcumbe, flush fitting, 3½in. dia., reading 0-150 v. and 0-50 a., moving coil, 5 double-pole knife switches, etc., £5, carriage forward.

25-VOLT D.C. MOTOR, maker "Crompton", ½ h.p., ball bearing, in perfect order, £3, carriage forward.

DITTO, on iron bedplate, but fitted with large reduction gear and rope drum, £5, carriage forward.

110-VOLT D.C. MOTOR, totally enclosed, rated at 8 amps., ball bearing, in new condition, make good slow-speed dynamo, £2/5/-, carriage forward.

MANGIN REFLECTING MIRRORS for spotlight work, price 5/-, post 6d.

CROMPTON MILLIAMPMETER, 8in. dia., 7½in. scale, moving coil reading 0-15 m.a., as new, £3/10/-.

BAKER 20-WATT MOVING-COIL SPEAKER, complete with metal rectifier and universal transformer, £2/10/-, carriage forward.

GUNMETAL PULLEYS, 7in. diameter, to take 1in. dia. rope, complete with rope guard and hook, 7/6 each, post 1/-.

**COMPONENTS—SECOND-HAND,
CLEARANCE, SURPLUS, ETC.**

(This advertisement continued from first column.)

SET Cabinets, various sizes; callers only, 4/- each.

RESISTANCES, ½ watt, ¼-½ and 1 meg. only; 1/6 dozen.

DROPPING Resistances, for all purposes, total resistance 535 ohms, 5 taps in steps of 50 ohms, standard for Pye, Lissen, Ever-Ready, etc.; 3/- each.

PUSH-BACK Connecting Wire; 1d. per yard.

10 FT. Coils Connecting Wire, glazed; 4d. each.

DUAL Capacitors, 300x600; 4d. each.

I.F. Transformers, 465 k.c. in 1½in. cans; 2/6 each.

COIL Kit, for superhet circuit, including 2-gang straight condenser, aerial coil assembly, oscillator coil assembly and 2 465 k.c. I.F. transformers, with circuit diagram; 8/11 each.

PILOT Lamps, 6.3, 0.3 amp.; 6d. each.

PLESSEY Single Gang 0.0005 Variable Condensers; 1/11 each.

T.C.C. 8 mfd. 150v. Tubular Electrolytics; 1/6 each.

T.C.C. 16x8 mfd. 350v. Wkg. Tubular Electrolytics; 2/6 each.

B.I. Wire-end Bias Electrolytics, 50 mfd., 12v.; 1/6 each.

TUBULARS, wire-end, non-inductive paper condensers, all sizes up to 0.1; 5d. each, 4/9 per dozen.

B.I. 8x8 mfd., 440v. working, cardboard electrolytics, 3/6 each; ditto, 16x8 mfd., 4/6 each; ditto, 8 mfd. tubulars, 2/- each; ditto, 4 mfd. tubulars, 1/9 each; ditto, 2 mfd. tubulars, 1/3 each; ditto, 8 mfd. cans., 2/11 each.

HUNTS Cardboard Wire-end 8 mfd. x 8 mfd. x 8 mfd., 450v. wkg., 2 negatives; 3/11 each.

CONDENSERS—0.0005 twin, 1/3 each; triple, 1/9 each.

LISSEN Mica Condensers, our assortment; 2/- dozen.

RAYTHEON Valves, first grade, largest stockists, all types stocked, including glass series, glass octal series, metal series, bantam series, single-ended metal series and resistance tubes, all at most competitive prices; send for lists.

AL Orders Must Include Sufficient Postage to Cover Hours of business: Week-days 9-4, Saturdays 9-1 p.m. Please write your name and address in block letters. We cannot undertake to answer enquiries unless full postage included (2½d.).

RADIO CLEARANCE, Ltd., 95, High Holborn, London, W.C.1. [9368]

COMPONENTS at Scrap Prices; state needs.—A.A. Agency, Bridge of Allan, Scotland. [9360]

VAUXHALL—Rola 8in. P.M. speakers, 14/9; 8in. energised 1,500 ohm, 12/6, with transformers.

VAUXHALL—Ironcored tuning coils on base, terminals, switch, 3-gang handpans, 19/6; volume controls, 2/3, with switch 3/-.

VAUXHALL—Electrolytic condensers, 8 mfd. 500v. 2/-, 8 mfd. 500v. 3/6; Niclet 3½-1 L.F. transformers, 5/9.

VAUXHALL UTILITIES, 163a, Strand, London, W.C.2. Postage extra orders under 3/-; 1d. stamp for list. [9356]

L.T. Metal Rectifiers, 12v. 1 ampere, with circuit, 4/6; transformers for same, 10/6; crystal microphones, famous maker, a beautiful mike, £2/12/6; tubes, firsts, sealed boxes, 75, 42, 80, 4/3.—(Hampton, 42, Howitt Rd., London, N.W.3. [9365]

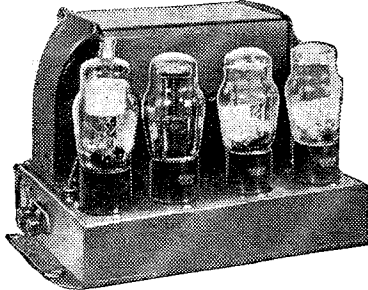
HAYNES 2 H.F. Tuner, 1937 model, recently revalved, 130/-; mains transformers, Partridge, 350-120, new, 21/-; Rich and Burdy 350-0-350 120 m.a., 4v. 2.5a. 4v. 6a. 4v. 1a. 35/-; chokes, Sound Sales, 10H. 118 ohms, 270 ma., 10/-; Varley 20H 500 ohms, 100ma. 6/6; Varley 14-28H 260 ohms, 115 ma, 17/6; Ferranti speaker, M.L. P.M., 37/6.—Williamson, 30, Malvern Avenue, Flixton, Lancs. [9364]

COULPHONE Radio, New Longton, Preston.—Prompt personal attention. All goods brand new. Tungram valves; guaranteed American valves, 5/9; Octal, 6/9; Cosmocord crystal pickups, 22/6; Rola G12 2,500 ohms, with transformer, 57/6; 10in. Rola P.M., with transformer, 22/6; 8in. Rola P.M., 15/6; Goodmans 8in. P.M. Universal transformer, 16/6; Plessey 8+8 mfd. aluminium can, 525 volt, 3/3; Armaster 8-valve 4-waveband, push-pull chassis, with speaker, £10/10. Stamp for 1941 list just printed. [9339]

A NEW YEAR'S OPPORTUNITY !

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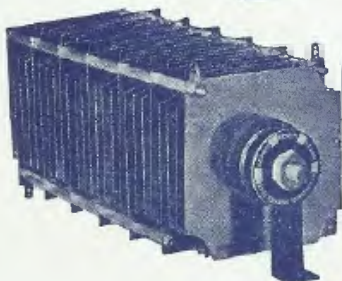
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