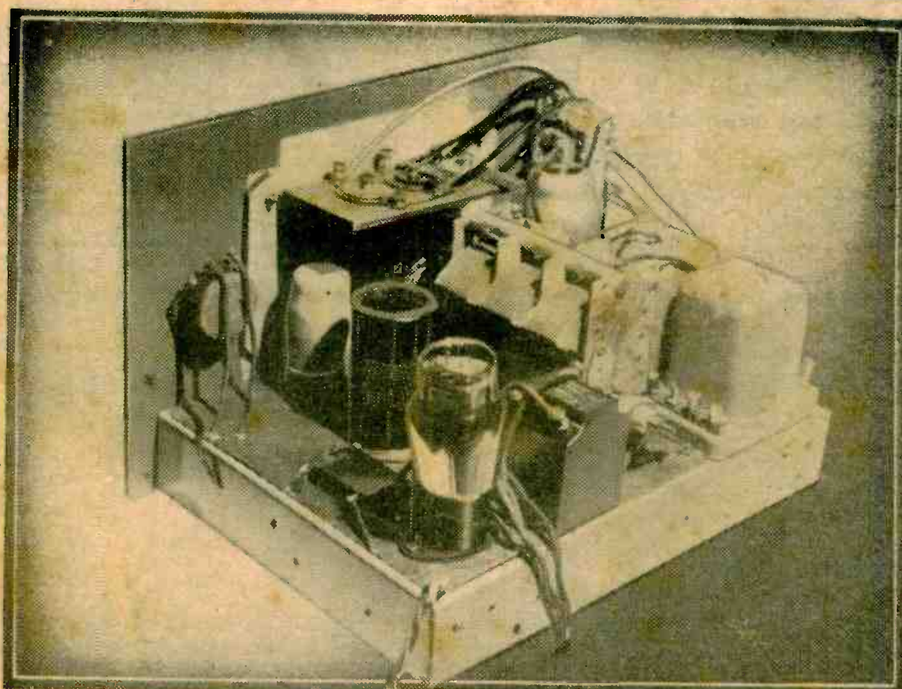
DUAL SPEAKER NETWORKS

Practical Wireless

9D. EVERY MONTH

Vol. 23. No. 493. || Editor: F. J. CAMM || AUGUST, 1947



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15th YEAR OF ISSUE

EVERY MONTH
VOL. XXIII. No. 493. AUGUST, 1947.

Editor F. J. CAMM

COMMENTS OF THE MONTH BY THE EDITOR

Radiolympia

THE first post-war Radiolympia takes place from October 1st to October 11th, 1947, both dates inclusive. Applications for space greatly exceeded the space available in the original plan, necessitating rearrangement of stand sizes and the creation of some new stands in the National Hall Gallery.

The first ballot, which was for the Wholesalers and the Trade Press, was for the wall stands in the annexe to the Grand Hall. The heavy demand for space, however, made it necessary to throw open part of the annexe to manufacturers, and the wholesalers were therefore limited in their choice to wall stands in the annexe. Wholesalers naturally protested against this, and one very large firm withdrew from the ballot.

The manufacturers' ballots did not give satisfaction, and there was criticism among smaller firms, who naturally asked for smaller spaces than large firms. In some cases blocks of the smaller stands were booked by the larger firms, thus restricting the choice, except for the newly created balcony stands, to firms in the latter ballots. An effort was made to remove these difficulties by splitting up some of the large stands remaining into smaller ones.

The stands will be arranged as follows:

Grand Hall: Radio manufacturers, including nearly all of the well-known set manufacturers; component manufacturers; battery manufacturers; makers of instruments; material and part suppliers; wholesalers; and the Trade Press.

In the National Hall will be found electronic apparatus manufacturers with some overflow of exhibitors from other sections; in the Grand Hall Gallery will be found the manufacturers' offices, and in the National Hall Gallery small manufacturers, publishers and associations.

A total of 175 firms have taken space at the time of going to press.

Thus Radiolympia this year will not be arranged on the lines which had become stabilised in 1939. Do not look in the old familiar places for the old familiar firms. Even this journal, which has been in every Radio Show since its inception, may not be in its old familiar spot where it had become the Mecca for all those interested in the technical side of radio.

We may be relegated to an obscure stand in the gallery. Little consideration seems to have been shown to the technical press, for we understand that our contemporaries in common with ourselves have been relegated to some obscure portion of the exhibition, as if the technical press were of no importance! Perhaps we shall be able to report better news in our next issue, for we are certain that after a hiatus of eight years readers are as anxious to renew their acquaintance with us as we are with them.

A great deal has taken place in those eight years. It is not generally known by the public that the manufacture of wireless communications equipment began in Britain 50 years ago; regular broadcasting was begun for the first time in the history of the world in this country 25 years ago; Britain began television 10 years ago and is still the only country providing a regular television service. That the British radio industry is in a healthy position is shown by the fact that in 1946, the first full post-war year, exports of all types of British radio equipment totalled £8,000,000, as compared with £2,000,000 in 1938. It has, of course, greatly increased since 1946. The exports included 345,000 broadcast receivers (four times the 1938 figure); transmitting equipment to the value of £1,000,000; 5½ million valves; 100,000 amplifiers; 100,000 loudspeakers and over £1,000,000 worth of other components.

Exports were made to over 80 countries. The radio industry was, of course as a result of wartime development, in a better position than other industries to start exporting on a large scale immediately the war was over. To-day there are over 100,000 people employed in the manufacture of radio equipment in this country.

We shall have an opportunity of seeing, if not of purchasing, what the industry has done when Radiolympia once again opens its door to the public on October 1st. Unfortunately, owing to the paper shortage we shall not be able to produce the weekly issues so much looked forward to by our readers before the war, and which gave such full reports of the Show. But our next issue will contain a full report of the exhibits and other articles apropos to the exhibition.

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The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Wireless." Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor, "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

ROUND THE WORLD OF WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ended April 30th, 1947:

Region	Number
London Postal	2,031,000
Home Counties	1,433,000
Midland	1,537,000
North Eastern	1,655,000
North Western	1,427,000
South Western	922,000
Welsh and Border	616,000
Total England and Wales	9,621,000
Scotland	1,035,000
Northern Ireland	155,000
Grand total	10,811,000

London-Kabul Link

CABLE and Wireless, in co-operation with the Afghan Administration, opened on June 1st a 3,500 miles direct wireless telegraph beam between London and Kabul.

The rate for ordinary telegrams from Great Britain is reduced from 1s. 7d. to 1s. 5d. per word. Code telegrams are available at 10½d. per word, but at present deferred telegrams and letter telegrams are not accepted to Afghanistan.

Something New

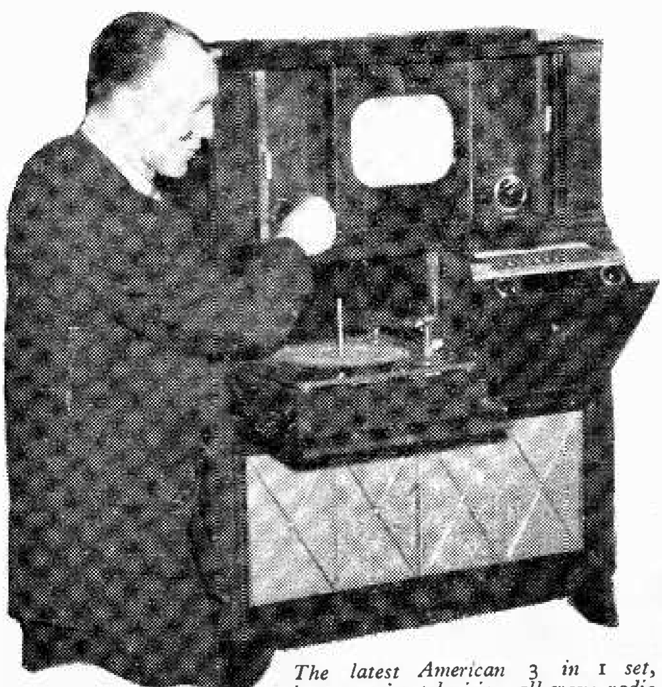
THE Ekco Radiotime—recently announced—was featured by the B.B.C. in their Television Programme "Kaleidscope," presented recently. Introduced and presented by the Council of Industrial Design, this radio-cum-clock-cum-alarm is full of novel features and attractive styling points which the council looks for from British factories.

G.P.O. Licence Warning

THERE are now approximately 10,810,550 broadcast receiving licences in force in Great Britain and Northern Ireland. Of these 16,600 are television licences.

The Post Office have reason to believe that, despite the steady increase in the number of licences, there is still a considerable number of unlicensed sets in use, and during April, 1947, there were 222 prosecutions.

Each separate family or household using wireless receiving apparatus in a house, part of a house or flat should have a wireless licence.



The latest American 3 in 1 set, incorporating television, all-wave radio and auto-change gramophone. This set is now being mass-produced by the R.C.A.

Ultra Set at Greenwich

WE understand that the Royal Observatory Greenwich have recently purchased an ultra model U.405 receiver for receiving B.B.C. time signals.

Two Ekco Service Announcements

E. K. COLE announce the appointment of Mr. H. R. Denne as television outside-service engineer, operating from their main service department, Somerton Works, Southend-on-Sea. Mr. Denne will be available to dealers throughout the entire television area on application to the main service department.

Ekco also announce a change of address for their Scottish service depot previously at Cadogan Street, Glasgow. This is now moved to a section of the company's Scottish works and should be officially addressed as follows: Scottish Service Depot, Ekco Works, Duchess Road, Rutherglen, Lanarkshire. The telephone number is Rutherglen 2240-3.

Amateur Record

C. G. ALLEN, sales manager of McMichael Radio, Ltd., the well-known amateur radio G8IG, recently received the American WAS certificate. This is awarded when stations have been worked in all 48 states of the U.S.A. and is a further achievement in Mr. Allen's long list of amateur activities.

Relay Service for Watford

WE understand that the Watford Corporation are negotiating for the installation of a relay service capable of supplying four programmes to subscribers in the borough. It is stated that if the concession were granted 5,000 subscribers would be served after three to five years' service, and that the corporation would derive revenue to the extent of about £350 per annum for each thousand subscribers.

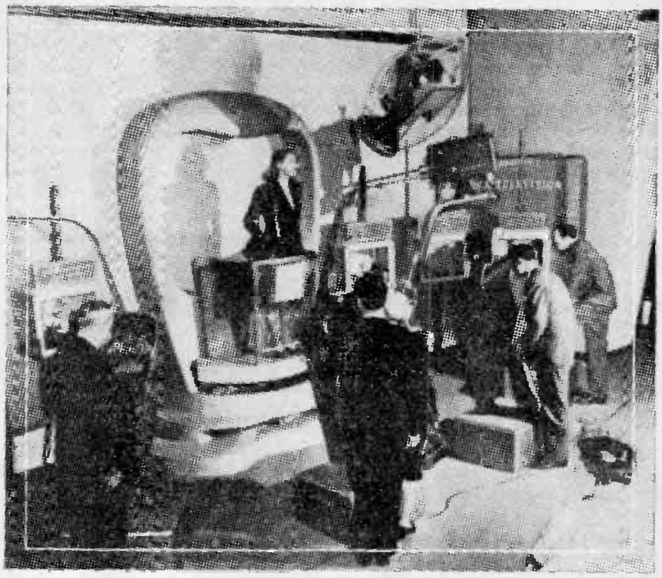
Sir Malcolm Campbell's Bluebird II

THE starter batteries which provide the initial impulse to the DH Goblin II gas-turbine jet-propelled engine of Bluebird II, for Sir Malcolm Campbell's attempts to raise his own world's water speed record, are *not* to be housed on the boat.

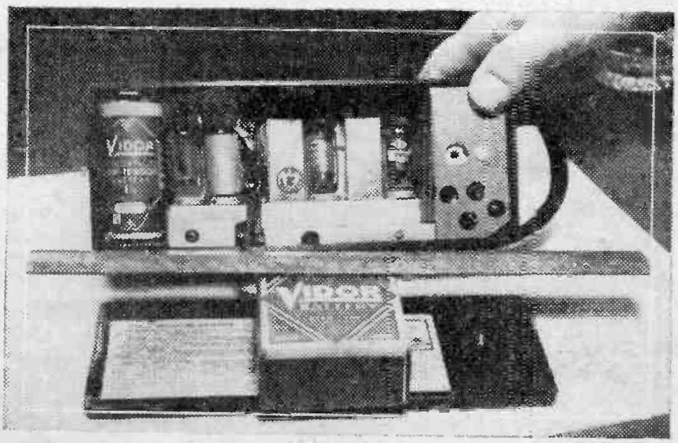
A standard Exide battery has been fitted to each of the two starting launches. The battery in the first launch will be used to start the engine on the outward run, whilst its counterpart will take over the job before the return lap. This is necessary because Sir Malcolm may have to switch off his engine at the end of the first lap in order to effect a turn—otherwise the momentum might be too great to allow him to bring his boat around with safety, even at the minimum throttle. Thus Sir Malcolm will once again be relying on Exide to get him off the mark on yet another attempt of his to smash an existing world speed record.

U.H.F. Television Links

FOUR U.H.F. relay stations, working on about 30 c.m., are to be erected to link London with Birmingham for the proposed television transmitter. 80ft. towers will carry directional aerial arrays, and the relays will be entirely automatic in action, requiring no resident staff. In the event of a breakdown, a standby set is automatically switched into circuit. It is stated that the relay stations will not be completed until 1948, and that they are being built by the G.E.C.



Beryl Davis recently appeared on television in the U.S.A. Whilst broadcasting she was able to see her televised picture on the set suspended in front of her. The small sets in the foreground enabled direct comparisons to be made between the actual and the televised image.



A new portable in the miniature field—measuring 9in. by 4in. by 4in. Medium and long waves are available.

American Wire-recorders

FIRST wire-recorders, plus radiogram equipment for home use, were recently placed on the market in Chicago at $170. The combination included a straight record player (less autochange equipment) and a superhet circuit.

Free Hearing Aids

WE understand that Messrs. Kolster-Brandes have received a contract from the Ministry of Supply for a large quantity of lightweight hearing aids which will be made available without charge to deaf persons under the new National Health Service. They will not be available until about the middle of next year, by which time a chain of about 300 clinics should be established at which deaf persons can be examined and, if found necessary, fitted with the aids.

A Short-wave Four—2

This Month We Describe the AC/DC Version of a T.R.F. Set for all Short-wave Ranges

THE layout of the chassis is shown in Fig. 8. There is no H.T. fuse bulb as in the battery set. Additional are the mains dropper, located at the extreme back of the chassis, and the 8 mfd. smoothing condenser between the detector coil and rectifier. This should have the case (negative) in contact with the chassis. The positive tag passes through a hole about ¼in. in diameter.

As the caps of the R.F. and detector valves are the grid connections, a lead is taken from one to the tuning condenser. The grid leak and grid condenser are soldered together and supported in the lead to the detector grid (see Fig. 8). Rubber-covered, solid wire of about 20 s.w.g. should be used for these leads.

Under-chassis wiring is shown in Fig. 6. The more important leads should be soldered on first, and subsequent leads kept well clear of them. The heater wires may be run right against the chassis and should not run near grid or anode leads.

Note that in this case the earth terminal is insulated from the chassis, the .1 mfd. condenser isolating the main from direct earth connection.

The second smoothing condenser is fixed to the side of the chassis with a clip. This, and the position and wiring of all the other components, may be seen in Fig. 6. An insulating tag is again used to support the condenser coupling the L.F. transformer.

When wiring the mains-dropper resistor, particular care should be taken, and reference to Fig. 4, made to avoid error. The lead from the switch is taken to the top of the dropper. The centre clip is taken to the rectifier anodes, and the bottom clip to the rectifier heater. The circuit to the other mains connection is via the valve heaters, the detector heater being directly connected to the chassis.

The V.M. potentiometer or variable resistor may have its spindle in contact with the chassis. A small fixed resistor is added so that bias cannot be reduced to zero.

Insulator "X" should be connected to the detector coil grid winding as before.

A 500 ohm resistor may be used for biasing the output valve if the 440 ohm value is difficult to obtain.

As the rectifier has two anodes and cathodes these are wired in parallel (see Fig. 6).

U.X. Valve Types

As similar valve types are available with U.X. bases, the connections for these are shown in Fig. 5. The 43 is an output pentode, and 6C6 or 6D6 may be used for R.F. and detection. If the valves are obtained with a plain glass envelope, valve screening cans may be erected round the R.F. and detector valves. Failure to do this will result in some tendency towards instability.

Circuit Alignment

If the trimmer were connected to the detector coil it would upset tuning. A small fixed capacity is, therefore, introduced across the detector coil, so that trimming may be achieved by adding capacity to the R.F. coil. It is then only necessary

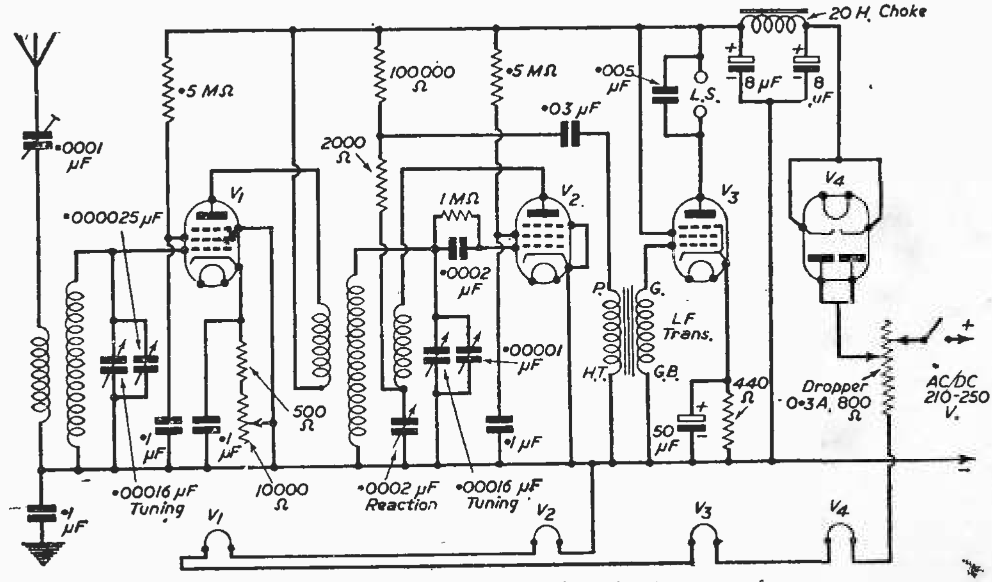


Fig. 4.—Theoretical circuit of the A.C./D.C. short-wave four.

to turn the panel trimmer for maximum sensitivity and volume when listening.

Figure 7 shows the insulator marked "X" in Figs. 3 and 6. It supports a metal plate about ½in. by 2in., bent so that it is near the chassis. This gives additional capacitance with low losses. It should be bent into such a position that the R.F.

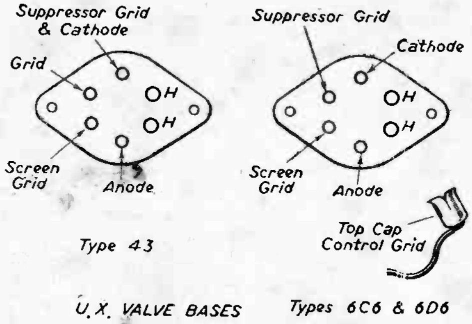


Fig. 5.—U.X. valve base connections for the 6C6 and 6D6 valves.

trimmer may be peaked for maximum results with any pair of coils, and with the tuning condenser in any position. This is not very critical.

Operating the Receivers

A pair of similar coils should be inserted, and the valves, as mentioned in the Component List. With a 120 volt H.T. battery, about 1.5 volts bias will be required at G.B.1, and 4.5 volts at G.B.2. G.B.2 may be increased to six volts for economy in running, or reduced to three volts for maximum volume.

The screen potentiometer should be about halfway, and may be turned down to decrease volume. It will be found that by increasing the screen voltage above a certain value the volume decreases again, so the potentiometer may be set to the most

COMPONENT LIST. MAINS-OPERATED RECEIVER

- **4- and 6-pin coils (with holders) for ranges desired.**
- **2-gang, .00016 mfd. tuning condenser, with reduction gear drive and dial.**
- **.0002 mfd. reaction condenser, with reduction gear drive and knob.**
- **.000025 mfd. panel trimmer with knob.**
- **.0001 mfd. pre-set condenser.**
- **.0002 mfd., .005 mfd., .03 mfd., and four .1 mfd. fixed condensers. 50 mfd. 50 volts-working bias condenser. Two 8 mfd. 250 volts-working smoothing condensers.**
- **10,000 ohm variable resistor.**
- **440 ohm, 500 ohm, 2,000 ohm, 100,000 ohm, two .5 megohm and 1 megohm fixed resistors.**
- **800 ohm, .3 amp mains dropper with three clips.**
- **Transformer for indirect feed.**
- **On-off switch for mains.**
- **20 henry, 60 mA smoothing choke.**
- **Aerial insulator, insulated earth terminal, and speaker terminals with block.**
- **Three octal holders, and U.X. 6-pin holder.**
- **Mains plug.**
- **Valves: 6K7 for R.F. and Detector. 25A6 for Output. 25Y5 for Rectifier. (U.X. types: 6C6 or 6D6 for R.F. and Detector. 43 for Output. 25Y5 for Rectifier.)**

suitable point when maximum sensitivity is required.

With the mains receiver, about 30 seconds must elapse for the valves to heat up. The dropper clips should be set so that the correct current is flowing through the heaters. This may be done by connecting an A.C. meter to the heaters to check the voltage, or by including in circuit a .3 amp dial lamp, and adjusting the heater clip until this lamp lights at normal

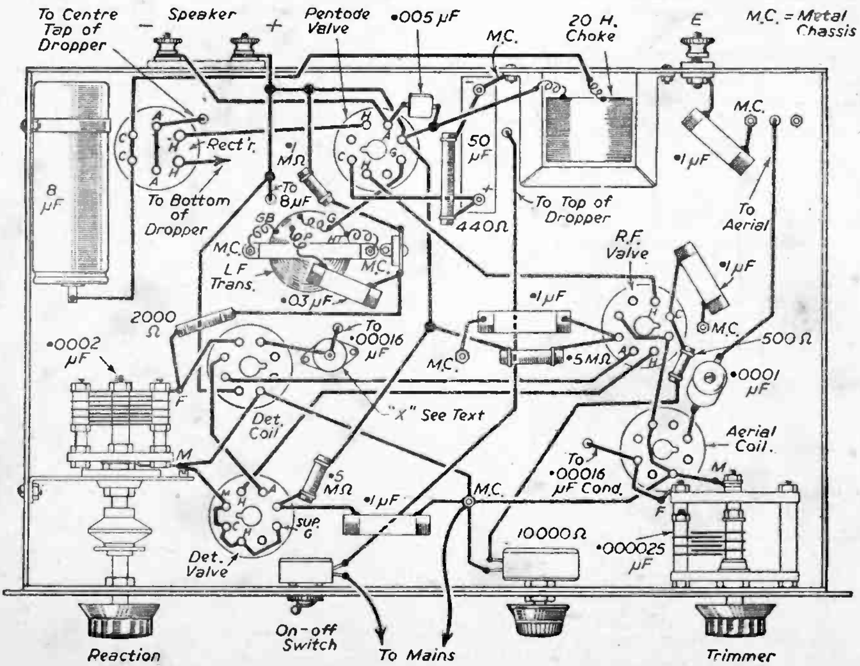


Fig. 6.—Under-chassis view and wiring of the receiver.

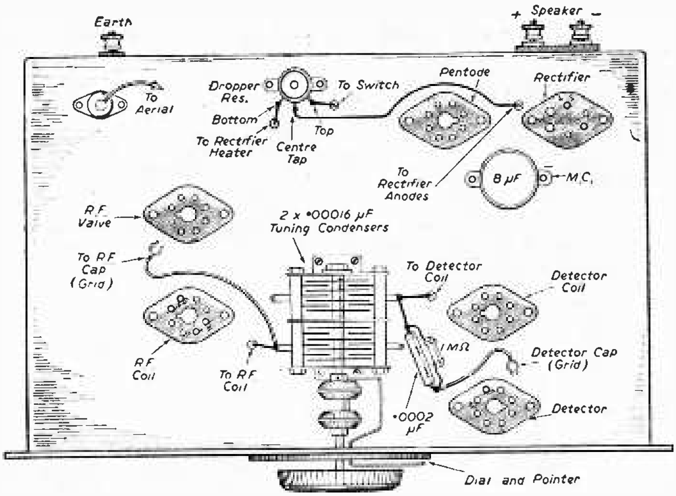


Fig. 8.—Top of chassis layout.

brilliance. Actually the voltage is not unduly critical. The mains plug should be withdrawn before making adjustments.

The centre clip can be adjusted, the H.T. voltage being measured by a high-resistance meter connected to the receiver end of the smoothing choke. With the valve types given, there is little point in increasing it above 135 volts. If no meter is available, a position about one third down the resistor is suitable.

With both receivers the reaction condenser should be advanced to increase sensitivity, and the panel trimmer adjusted initially for maximum volume. The .0001 mfd. aerial pre-set may be set to about half-capacitance with a normal aerial. If the capacity is too great, the R.F. tuned circuit will tune rather flatly.

When the mains receiver is fixed in a cabinet, ample ventilation must be left at the back, as the mains-dropper becomes hot in use. The battery receiver requires no ventilation.

The aerial lead, in common with all leads in the receiver carrying signals, should not be close to the mains leads, speaker leads, or other wiring.

If the mains-operated receiver is to be used with DC, it may be necessary to reverse the plug in the power socket to obtain the correct polarity.

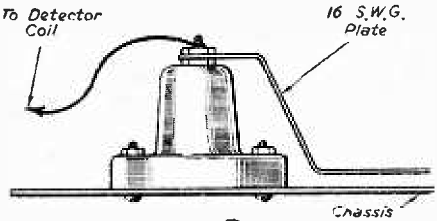


Fig. 7.—Details of the insulator "X" of Figs. 3 and 6.

Dual Speaker Networks

Full Electrical Details of a Simple System for Feeding Low- and High-frequency Speakers from a Single Output.

By K. KEMSEY-BOURNE

MANY readers will have noticed during visits to large theatres or halls in which sound-reinforcement systems are used that the speaker baffles, from which sound is fed into the auditorium, often consist of large rectangular cabinets each containing two speakers, one of which is mounted behind a plain circular aperture, while the other feeds a cellular-horn arrangement having six or eight openings, each opening being flared out to dissipate sound over the required angle. A large diameter speaker behind the circular aperture is fed from the amplifier with bass frequencies only, and the higher frequencies, which are more directional in effect, are fed to the second, smaller speaker unit behind the cellular horns; the horns ensure adequate dispersion. (One model of this type, the Vitavox, was illustrated in our April issue.)

This type of dual-speaker system has several advantages over the use of a single speaker for all frequencies, and is particularly useful for reproducing music at high quality where the power output is more than a very few watts. Similar systems

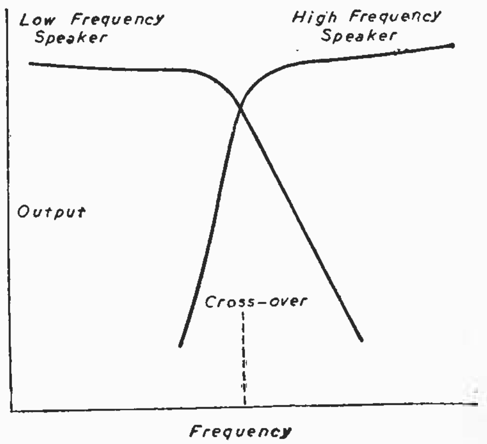


Fig. 1.—Frequency characteristic of a dual-speaker system.

are used for cinema reproduction, where the speakers are of a high-efficiency horn type mounted behind the screen. For the benefit of quality enthusiasts who wish to construct dual-speaker systems of their own, we give here design data and figures for the dividing networks necessary to feed separate high and low frequencies to two speakers without upsetting the matching to the output stage of the amplifier.

Cross-over Frequency

The first step necessary is to decide at what frequency the change-over from one speaker to the other shall take place; the bass speaker will handle all below this cross-over frequency, and the top speaker will take nothing below but everything above this frequency. In commercial practice there is some variation in the choice of cross-over; the Western Electric Mirrophonic sound-film system changes over at 300 c.p.s., and the Vitavox Bitone system adopts 1,000 c.p.s.

Whatever the cross-over frequency adopted, the over-all response of the network must be so designed that the output to each speaker is as indicated by Fig. 1. The attenuation on either side of the cross-over should be not less than 10 decibels per octave for good results; that is, if the cross-over is fixed at 1,000 c.p.s., then the output to the bass or low-frequency speaker is down 10 decibels at 2,000 c.p.s., and the output to the high-frequency speaker is down 10 decibels at 500 c.p.s., relative to the level at 1,000 c.p.s. A 12-decibel cut at these points would be even better, corresponding to a voltage or current ratio of 1/4.

Since 1,000 c.p.s. is a suitable cross-over point for domestic use, as well as for P.A., this figure will be taken for the following calculations. Cinema systems usually have a very much higher power output at extreme bass frequencies (down to 25 c.p.s.) than domestic or P.A. apparatus, and a lower cross-over is suited to "woofer" speakers fed from 250-ohm feeder lines.

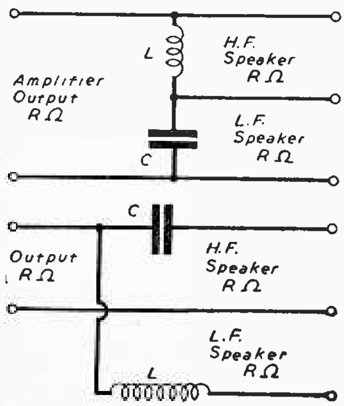


Fig. 2.—Simple systems giving attenuation of 6db per octave beyond cross-over

Formulae and Calculations

The formulae given can, of course, be used to work out network values for any desired cross-over frequency, but for normal purposes 1,000 c.p.s. is recommended.

Fig. 2 illustrates the simplest possible systems for feeding high and low frequencies to separate speakers. These two circuits have an attenuation of about only 6 decibels per octave on either side of cross-over, which is less than desirable. They are accordingly not used in practice, but the values calculated for them are the first steps for the practical networks of Fig. 3.

Values for the circuits of Fig. 2 are given by

$$L=\frac{R}{2\pi F} \quad \text{and} \quad C=\frac{1}{2\pi FR}$$

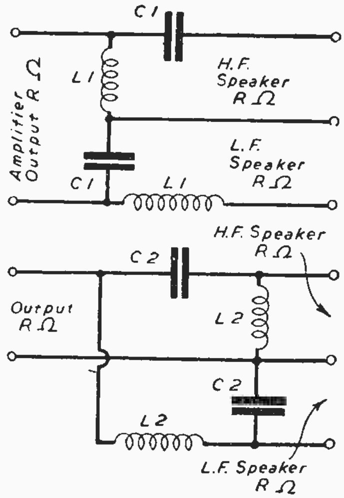


Fig. 3.—Practical systems giving constant input resistance and good attenuation.

where L is inductance in henries.
C is capacitance in farads.
F is cross-over frequency in cycles/second.
R is impedance of the amplifier output and of both speakers in ohms.

The networks as used in practice are shown in Fig. 3. The values here are given by

$$L_1=\frac{L}{\sqrt{2}} \quad \text{and} \quad L_2=\sqrt{2}L$$

$$C_1=\sqrt{2}C \quad \text{and} \quad C_2=\frac{C}{\sqrt{2}}$$

These networks give a constant input resistance, and have an attentuation of approximately 12 decibels per octave past cross-over.

It will be noted that R is the output impedance of the amplifier, and also of both the speakers; this system does not require unorthodox matching arrangements, but is correctly matched all the time. The most common values of speech-coil impedance are 3 and 15 ohms, and so, from the design data above, suitable circuit values for these impedances have been calculated for cross-over at 1,000 c.p.s. The results are given in the following table:

	L	L_1	L_2	C	C_1	C_2
R 3 ohms	480	340	680	53	75	37.5
R 15 ohms	2,400	1,700	3,400	11	15.6	7.75

The values for capacitance, originally calculated in farads, have been corrected to microfarads; similarly, inductances are in microhenries. For a cross-over at 500 c.p.s. all given values should be doubled, and so on.

There should be no difficulty for constructors to obtain the required capacitance; for 15-ohm impedances, for example, C_1 could be taken as 16 mfd., and C_2 as 8 mfd. Paper condensers should be used, not electrolytics; 100 volt working is adequate. To obtain other values remember that the capacitance of a number of condensers in parallel is the sum of their individual capacitances; inductances in series are additive, provided that there is no mutual inductance.

The inductance coils must be of the lowest resistance possible, and they must be wound of wire sufficiently large to carry the speech currents of the full output. The following table gives winding details for single-wound air-cored inductances:

Inductance Microhenries	Dia. of winding	Length of winding	Number of turns/inch
	ins.	ins.	
340	2	4	30
680	2	4	45
1,700	3	6	35
3,400	3	6	55

If commercial coils of suitable inductances are to be used they must be of a sufficiently low resistance type (not more than about 20 ohms).

Construction

The mechanical details of the unit will be left to individual choice or experiment, but there are several points of acoustic importance that must be observed. The cabinet containing the two speakers must be large enough to ensure a good bass response, and it should be made of heavy wood. The back should not be enclosed unless the speakers, particularly that fed with the low frequencies, have been designed for operation under such conditions. Box-resonance is to be avoided; a highly absorbent lining will help. The bass speaker should be a heavy-duty type 10in. or 12in. diameter; if a horn speaker for high frequencies is not available then a good 8in. or 10in. unit should be mounted above the bass speaker, both speakers having appropriate plain circular apertures.

Phasing

Care must be taken to see that the phasing of the speaker cones is correct, both speech coils being connected in similar polarity; if speakers are run in opposite phases then dead spots may be noticeable in the room or auditorium. To check the phase of a speaker, connect a 4-volt battery across the speech coil temporarily and note which way the coil moves, in or out. Then mark the terminals of each speaker plus and minus for movement in one direction. If you suspect that two speakers are in opposite phase this can be easily checked by reversing the connections to one of them.

New Mobile Radio Telephone

Details of a New Unit-built Transceiver by Plessey

A NEW mobile V.H.F. radio telephone transmitter-receiver developed by the Plessey Co., Ltd., is remarkably small in size and due to the employment of unit construction is particularly easy to service.

The equipment incorporates, in one case, transmitter, receiver, power supply and send-receive switching units, measures only 8ins. high by 7¾ins. wide by 9¾ins. deep and weighs 16¾lbs.

The set will operate from a normal 12- or 6-volt heavy duty battery and takes a current drain of 5 amps. on "Receive" with the transmitter heaters "On" and 10 amps on "Send."

Servicing Facilities

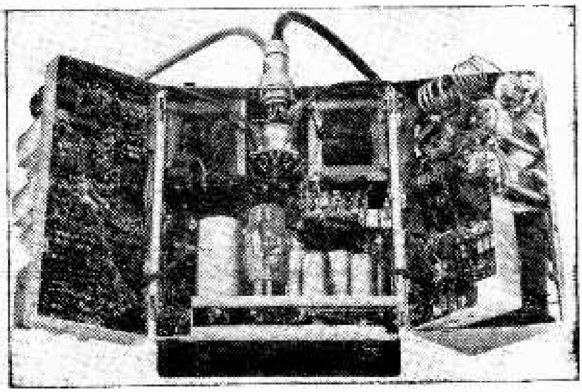
Special attention in the design has been paid to the provision of servicing facilities. A unique form of unit construction is employed; the transmitter, receiver and power supply units being separate chassis, attached to each other by easy detachable half-hinges. Transmitter and receiver "fold over" and are mounted on top of the centre chassis. When servicing the set, the three chassis can be simultaneously exposed and in this "open" position the set still operates.

Provision can be made for either A. M. or F. M. working by the interchange of detachable units.

The Circuit

The set can be designed to operate on any limited frequency in the V.H.F. band and the operating frequencies of transmitter and receiver need not be the same. The receiver is crystal controlled.

The transmitter comprises a cathode coupled oscillator using a miniature pentode valve E.L.91, with its anode circuit tuned to the third harmonic of the oscillator frequency. This is followed by an E.L.91 trebler and two R.L.16 valves in a parallel/push-pull doubler circuit, which also acts as an amplifier.



This view of the apparatus clearly shows the separate units.

Electronic Musical Instruments—2

Details of an Electro-mechanical Organ Mechanism

By F. C. BLAKE

INSTEAD of using valve oscillators, or valve oscillators coupled to divider circuits as mentioned last month, there are a number of electro-mechanical and electro-optical methods used commercially in electronic organs, most of which have to be built with such a high state of precision that, unless the experimenter has access to a machine shop, they are not suitable for home construction. There is, however, one instrument of this type which can be constructed with very little trouble.

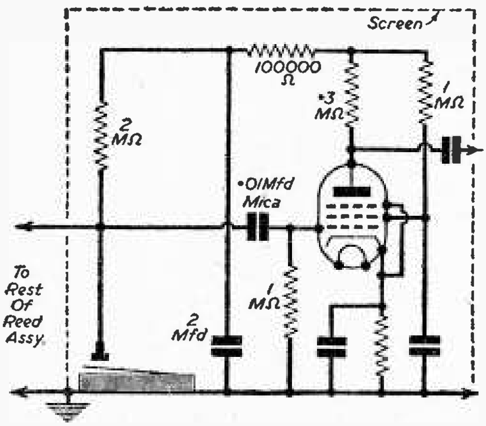


Fig. 1.—Electrostatic pickup circuit.

The commercial counterpart of the experimental instrument I am about to describe is known as the "Orgatron" and is marketed in this country by Messrs. Selmer, Ltd.

The Orgatron utilises vibrating reeds similar to those used in the familiar "American" organ, each of which forms one plate of a minute variable condenser, the other plate being in the form of an adjustable screw or screws situated over each reed.

The total capacity of these small condensers is coupled to a high gain amplifier, as shown in Fig. 1.

I have experimented with this method, using an old American organ as a foundation, and found it difficult to obtain sufficient amplification of signal compared with mains hum pickup. If it had been possible entirely to screen the reeds and pickup screws, the hum could have been eliminated, but this is rather difficult to do owing to the key mechanism being so close to the reeds.

Frequency Modulation

If, however, we use the variable capacity of the reeds and electrodes to alter the frequency of a R.F. oscillator—in other words produce frequency modulation—and subsequently demodulate the resultant output with a discriminator, we get an extremely high signal/noise ratio output, which will require very little extra L.F. amplification.

The actual fundamental frequency of the R.F. oscillator is not critical, of course, but it is advisable to keep clear of amateur and commercial bands to prevent any possibility of interference being either received or transmitted. The oscillator output must be kept as low as possible, and the organ case should be coated with metal foil to keep R.F. radiation to a minimum.

The American organ operates by suction as distinct from the harmonium, which is pressure operated, and either of these instruments may be used quite successfully, although the writer carried out the described experiment with an American organ. The keyboard of this instrument is usually fixed in position by means of woodscrews at the extreme edges, removal of which will display the wooden push rods passing through the windchest to the pallets beneath. The swell shutters should next be carefully removed, revealing the reeds in their individual wooden cells. As we have to bore out the tops of the cells to accommodate the electrodes we must next remove the reeds for safety. It will be noticed that they are marked C, C#, D, etc., which will be a guide when re-assembling.

Finally, before we can start cutting, the top board of the windchest must be unscrewed so that any wood chippings that get under the pallets can be removed.

Mounting the Electrode Screws

The method of mounting the electrode screws is shown in Fig. 2. The wooden cells are carefully drilled out sufficiently to clear the screw heads; strips of ebonite are then prepared, drilled and tapped to take the screws, taking care both in boring the wood cells and setting out the electrode

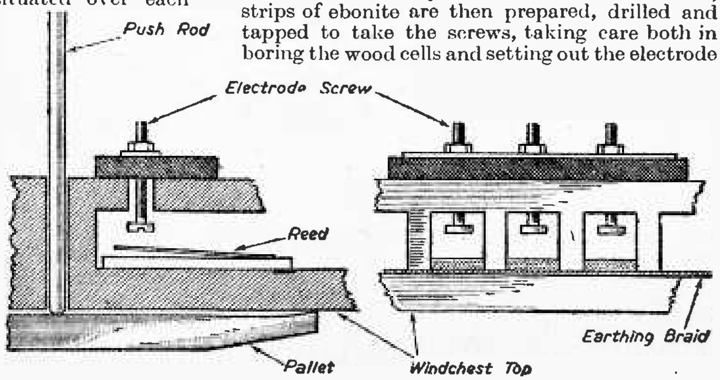


Fig. 2.—Details of the electrode assembly.

positions so that each screwhead is situated near the tip of each reed. After mounting the electrode strips in their appropriate positions a little beeswax should be run around the edges of the strips to prevent any extra air from getting through, which might render the draw stops inoperable.

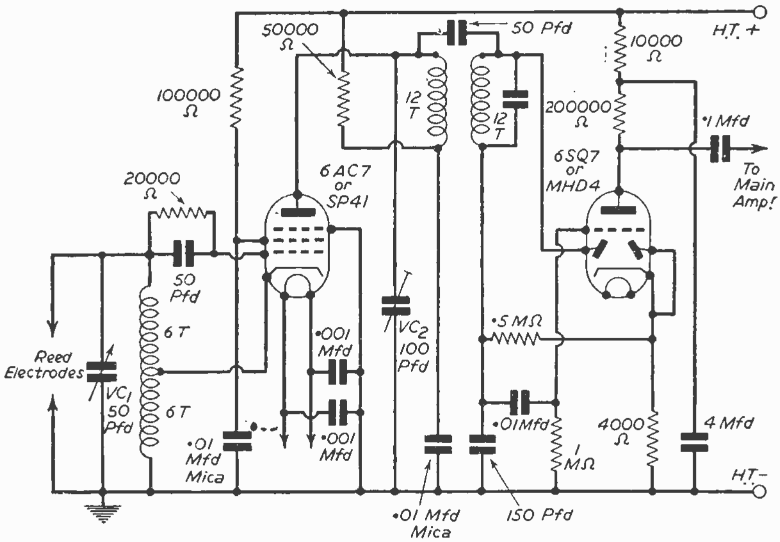


Fig. 3.—F.M. pickup unit.

The reeds may now be replaced. As they must all be bonded and earthed, a length of screened tinned copper braiding—the outer covering of single screened flexible wire—can be fixed under the protruding edge of each reed, making sure that when the reed is slid into its cell it makes good electrical contact.

After making sure that there are no chippings or dirt in the cells the windchest top is refixed. Each electrode is then adjusted with the reed vibrating so that the electrode screw is in close proximity, but not touching the vibrating reed. To make the reeds "speak" it is necessary gently to depress its associated push rod, but care must be taken not to push it down more than is absolutely necessary or else the pallet underneath may be dislodged, necessitating removal of the windchest top again.

The mechanical side of our instrument is now ready for its associated electronic part.

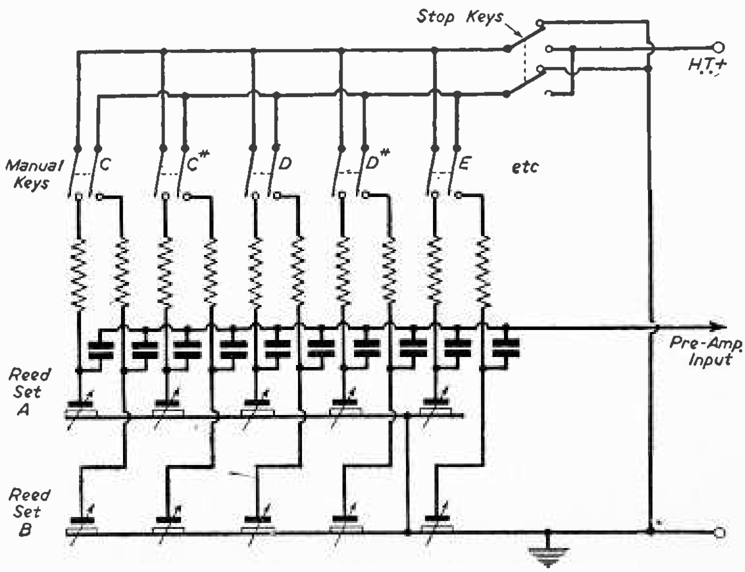


Fig. 4.—Electrostatic pickup with "maintained" reeds.

The Electronic Side

We shall need a small chassis to take two valves, and it should be wired as shown in Fig. 3. The filament and H.T. supplies may be taken from the main amplifier or, if desired, the chassis can accommodate its own power supply.

When ready for testing the F.M. unit is coupled to its power supply, amplifier input and electrode assembly.

After switching on the unit rotate the variable condenser VC1 slowly, when a strong carrier should be heard. If a reed is now set in vibration an amplified note should be obtained; a slight adjustment of VC1 may be necessary to get the maximum output.

Each reed is now tested in turn and a tonal balance effected by unscrewing the electrode screws of any tones that give a larger output than the rest. A frequent check with VC1 should be made to compensate for the effect caused by the capacitance change as the screws are moved.

When satisfied that a balance has been found the swell shutters are refixed and the keyboard remounted.

The knee swell device should be disconnected and the shutters screwed down. The mechanical sound output should be deadened as much as possible by means of felt. The swell lever may be used to operate the main amplifier volume control, by the use of a little ingenuity.

If so desired an electric blower can be fitted to the windchest; a vacuum cleaner mounted in a sound-proof box makes quite an efficient unit and it can usually be used either as a suction or pressure forming device.

Results

If care has been taken in the construction of this instrument, some very pleasing results will be obtained and the amplification and improvement in tone will please the most critical musician.

A suggested line for further experiments would be as follows. Mount all the reeds and their associated electrodes in a sound-proof chamber, allowing them to vibrate continuously, and then, by the keys, operating contacts to select the notes as required. By this means, the slow action of the reeds starting to vibrate could be eliminated, enabling fast staccato passages to be played with ease. With this system the reed electrodes could easily be entirely screened, so that the electrostatic method of pickup could be used.

To select different sets of reeds, instead of using stops which operate shutters, the stops could be in the form of switches which bring the H.T. polarising voltage to the reed sets selected (Fig. 4.). One pair of contacts would be needed for each set of reeds.

By including a time constant circuit in each electrode polarising circuit, the sound envelope could be modified to give various effects.

The Carbon Microphone

Experimental Resistance Coupling Circuit for the Amateur Transmitter.

By R. H. ROLLING (G6WM)

THE carbon microphone, which converts sound waves into electrical energy, usually consists of a tightly stretched diaphragm that exerts mechanical pressure on a number of carbon granules. Normally the natural mechanical resonance period of the diaphragm falls within the voice range, and it is very sensitive near the resonant frequency. The effect results in a distorted output with a peaky response and poor quality.

The essentials of a good microphone are: That it must respond equally to all speech frequencies, it must be sufficiently sensitive to eliminate the need for excessive audio amplification, and not introduce noise, such as hiss, cord noise, etc.

For voice transmission, wide-frequency-response audio equipment is not required, a uniform frequency response from 200 to 3,000 cps. being adequate. In any case, the high R.F. selectivity in modern communication receivers cuts off the higher frequencies, and modulated frequencies above 3,000 cps. are wasted.

It was decided to explore the possibilities of using the ordinary carbon microphone, attempt to fulfil the foregoing requirements, and endeavour to obtain a response approaching the more expensive types. Such a microphone was purchased as ex-government surplus, and examination showed that it consisted of the usual carbon back, housed in a bakelite case, with a press-to-talk switch in the handle. It was particularly noticed that the diaphragm was slightly concave, and the whole job looked very promising.

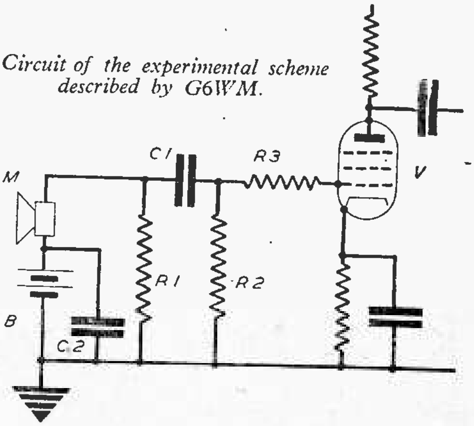
The microphone was initially set up with transformer coupling to the input circuit of the modulator equipment. On test it possessed the inherent features of its type: tendency to blasting on its diaphragm frequency, background noise, and rustled badly when given mechanical shock. No doubt the general response could have been improved by the fitting of a well-designed transformer, but such a transformer is fairly expensive, and, in any case, this was not available.

It was thereupon decided to resistance couple the microphone to the input circuit, thus securing all the advantages of this form of coupling. The circuit shown was subsequently evolved.

The Circuit

The valve V is the usual high-mu pentode, which is resistance coupled to the next stage, which in this case was the actual modulator. The resistance R3 is a grid stopper and has a value of 5,000 ohms, and R2 is a 500,000 ohms grid resistor. The microphone input circuit consists of C1, the audio coupling condenser (·1 mfd.), and the resistance R1, the microphone load resistor, which is equal to the resistance of the microphone. In this case the value is 200 ohms. M, of course, is the microphone and B a 3-volt battery, which has a .5 mfd. condenser connected across it.

Circuit of the experimental scheme described by G6WM.



The action of the circuit is as follows: Directly sound waves impinge on the microphone the diaphragm vibrates and the microphone current is varied in a manner determined by speech sounds. Speech variations of microphone current cause an alternating PD to be developed across the resistor R1. This alternating PD is applied to the grid of the valve via condenser C1 and subsequently amplified by the following circuits.

The results obtained by this method of coupling were very gratifying.

Some A.C. Power Problems—1

Ambiguities About "Mean" and "R.M.S." Values

By "DYNATRON"

MOST students seem to have considerable difficulty in grasping the idea of *effective* current or voltage in an A.C. circuit.

If in an examination paper the term "R.M.S." is used, the majority will be able to write some sort of definition, such as "the square root of the sum of the squares," 0.707 of the maximum, etc.

But substitute the word *effective*, or *virtual* value, and the question will be skipped in nine cases out of ten ! Or, if R.M.S. value is dealt with at all, the explanation will be along well-worn lines, leaving much to be desired in the way of complete understanding.

For example, how many can say offhand what is the R.M.S. value of a half-wave current, Fig. 1(b), compared with the value of the full sine-wave (a) ? What is the *mean* value in the two cases ?

Mean value lends itself to much confusion. It simply means, of course, *arithmetical average*: the "mean" between 5 and 3 is $\frac{1}{2}$ (5+3)=4. The average marks obtained by a class is the sum total of all the marks, divided by the number of students sitting an examination. It would sound somewhat pedantic to refer to "mean value" in such a case, though it is exactly what is signified by "average."

While all this is extremely simple, a term like "average" seems to assume a frightful aspect when applied to alternating or pulsating quantities. One great difficulty is to understand clearly the distinction between a mean current, or a mean voltage, and the *mean power* in an A.C. circuit. Unless the vast difference in meaning is clearly understood, it is easy to fall into such traps as to write :

Average Power in an A.C. Circuit=(Average Current)$^2\times$Resistance, etc.

Or to feel hopelessly confused when a teacher is explaining these things.

Mean Current

As long as we are talking about current, or voltage, the average value of any purely *alternating* wave, such as Fig. 1 (a), is zero.

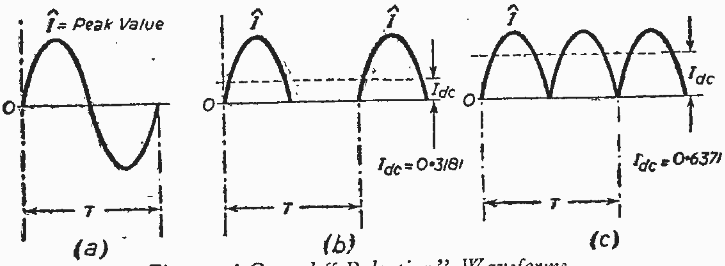


Fig 1.—A.C. and "Pulsating" Waveforms.

The best way to realise this is to connect an ordinary moving-coil voltmeter (not a rectifier instrument) across an A.C. supply. The pointer will simply vibrate rapidly at the frequency of the supply, about the "zero" as a datum line.

A moving coil is an average-current (or average-voltage) instrument. Because the movement reverses on reversed current, the pointer moves in opposite directions during successive positive and negative half-cycles of an alternating current, and so takes up zero as a mean position.

But even here there is ground for confusion. For instance, why is it sometimes said that the average value of a sine-wave current is, not zero, but 0.637 of the maximum peak value ?

Actually, the statement is meaningless as long as we are dealing with a pure *alternating* current of zero average value.

Thus, if we average over a full *alternating cycle* the answer is zero—that implies, of course, that we are dealing with a *reversing* (or *alternating*) current. The 0.637 refers to an average *D.C. value*, which we would get if the wave was fully *rectified* as in Fig. 1(c)—*full-wave* rectification gives rise to a mean D.C. component indicated by the dotted line.

This is because the current is now *unidirectional*, not purely alternating—it varies, or "pulsates" only *on one side of zero*. Obviously, the mean current will then be some value above zero. If the successive half-waves retain a sine-shape, I_{dc}= 0.637 of the peak instantaneous current Î.

Similarly, with *half-wave* rectification, Fig. 1(b), the average D.C. will be one-half of what it is in Fig. 1(c)=$\frac{1}{2}$ of 0.637.Î=0.318.Î.

We may bring this discussion down to practical terms by considering the results obtained in charging accumulators by the rectified currents shown in (b) and (c).

Suppose the peak current in each case is Î=10A. Then a moving-coil ammeter would indicate a charging current of 0.637×10=6.37A in (c), but only 0.318×10=3.18A in (b). Evidently, for a given peak current, charging would take twice as long if we used half-wave rectification.

Averaging Over "Half" and "Full" Cycle

Now we ought to be quite clear as to what an "average" implies in such cases.

Students are often mystified by statements referring to the average "over a half-cycle," or, "over a full cycle." Bald statements of the kind convey but little if, as is generally the case, not a word of explanation is given.

The real point, of course, is that an "average" must take account of *intervals of time when no current is passing*—intervals of a half-cycle in Fig. 1(b). If we denote the time-period of one cycle by T, we get two pulses in time T in (c), but only one pulse in (b). In (b), current passes for only half the time T, therefore, *over time T*. the average must be one-half what it is in (c).

Read this carefully: observe that we are *averaging over a full-cycle period of time T in each case*; over this time-period the mean current is 0.6371 in (c). but 0.3181 in (b). Is this perfectly clear? Of course, we are not bound to take a full-cycle period. We might take, say, a multiple of T—the time occupied by several cycles—but the averages would work out just the same.

Many textbooks, however, will tell you that the 0.637 is "an average taken over a *half-cycle*." To be unambiguous, it should say: the average of a *half-wave* current taken over a *half-cycle* period; for, if we average (a *half-wave* current) over a *full-cycle* period, the answer is $\frac{1}{2} \times 0.637 = 0.318$, as above. But, the average of a *full-wave* current over a *full-cycle* period is 0.637—exactly the same as the average of a half-wave current over a half-cycle period.

All this may sound like using a lot of words to emphasise the obvious. But my experience indicates that it is just these things which are not "obvious," and, without mathematics, I know of no other way to avoid ambiguities.

Incidentally, there is another practical point about that experiment of using a moving-coil ammeter in a half-wave or full-wave charging circuit.

You would probably find—if you knew the peak current $\hat{I}$—that the ratio of I_{dc} $\hat{I}$ will seldom work out to exactly 0.318, or 0.637. Never forget that these are "ideal" factors, true only upon the assumption that the current pulses retain a *sine-shape*. If the voltage is sinusoidal, this would be nearly true of a charging circuit, or one comprising pure resistances, but paper assumptions never work out exactly in any real A.C./D.C. circuit.

We might go on to consider other shapes of waves or pulses. But not in this article. We shall keep to our idealised waveforms in order to illustrate important principles which may readily be applied to other cases.

When dealing with a "pulse"—of any shape—it may be important in certain radio applications to calculate an average value over the *pulse period* itself. Such cases are often discussed in articles, e.g., rectangular pulses, and so forth, which are important in television or radar techniques.

For present purposes, the main idea to get hold of is the mean value of a current of short duration, *when averaged over a full-cycle period T*. That is the current which will be indicated by a mean-current instrument, and the half- and full-wave cases may be taken as simple illustrative examples.

Mean Power

Note carefully, too, that, so far, we have been discussing the mean values of *currents*—not *power*.

Having found the mean current, it is easy to fall into the trap of saying that the power, in *watts*, developed in a given resistance R, is:

$$W = (\text{Mean Current})^2 \times \text{Resistance} = I^2_{dc}R.$$

If this were true, no pure alternating current such as Fig. 1 (a) would develop power in any resistance—its mean value being zero! Yet we know the current would have a certain *effective* heating value, equivalent to a certain steady D.C. Though the *average current* is zero, an A.C. is quite capable of developing an *average power* in a resistance, represented, for example, by the white heat developed in a 100-watt lamp filament. A moving-coil meter in circuit with that lamp would register zero mean current, but the *mean power* is nevertheless 100 watts.

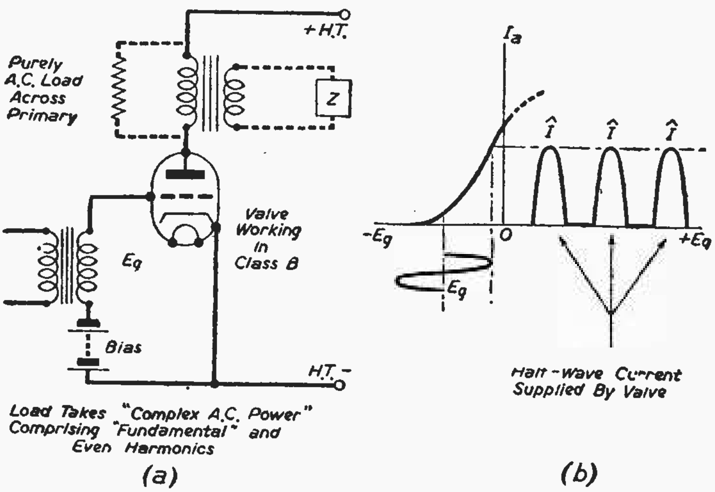


Fig. 2.—Single-valve in Class B, with Untuned, *Aperiodic Load.*

Again, if the pulsating-currents of Fig. 1 (b) and (c) were passed through a resistance, the amount of heat produced would be greater than could be accounted for from the indication of a moving-coil ammeter or voltmeter. Never confuse mean current, or mean voltage, with mean *power*.

What, then, is an *average* A.C. power? First, take the pure sine-wave current of Fig. 1 (a). Since the current has different values at every instant of time, the watts developed in a resistance will vary accordingly, reaching a maximum at the instant when the current is at its *peak* value $\hat{I}$.

But this peak is itself only a fleeting "instant" in the cycle—a "point," if you like, of less duration than one ten-millionth of a second! The corresponding power is a *peak instantaneous* value. It has no more claim to our attention than the infinite number of other "points" in a cycle.

All such "instants" are too evanescent to be considered in heating a resistance, or, rather, we must *average over the whole cycle the heating effects* ($\propto$ *power*) *produced at all instants*. When we have done so, the equivalent power will be some power-value less than the maximum. We may call it the *effective power*, generating heat, as if the current had some steady D.C. value less than the maximum.

The precise term is *average power = mean power*.

The corresponding *effective current*, *virtual current*, or R.M.S. value, is, for a sine-wave, 0.707 of the maximum current. If a D.C. of this steady value were passed through the resistance, the steady heat developed would be exactly equal to the average heat developed by the alternating current—the D.C. power would be equal to the mean A.C. power.

In fact, it is quite easy to see how this 0.707 is arrived at, without any abstruse reasoning. Or, at least, we can take it as proved—in almost every textbook—that *the average power developed in a resistance by a sine-wave alternating current is one-half* (50 *per cent.*) *of the peak* (*maximum*) *power.*

This being so, it follows that the current—the *effective current*—is $\sqrt{\frac{1}{2}}=0.707$ of the maximum peak current:

$$\text{Power} \propto (\text{Current})^2,$$

or, $$\text{Current} \propto \sqrt{\text{Power}}.$$

The same reasoning, of course, applies to voltage.

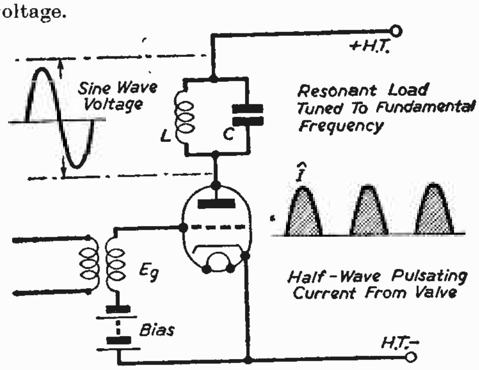


Fig. 3.—*Single-valve in Class B, with* Tuned *Load.*

It will be useful to remember this definition of R.M.S. value: that it is *that value of current or voltage which is equivalent to the mean power developed by an alternating current.*

These sine-wave principles are true of lamps, heaters, cables, A.F. and R.F. oscillators and power amplifiers, feeders, transmitting aerials, etc., etc. If a peak current, or a peak voltage, is known, there is no need to find the R.M.S. value first in order to calculate the A.C. power: using the R.M.S. value comes to exactly the same thing as taking ½ (peak power).

As a particular case, consider a push-pull amplifier (A.F. or R.F.) which supplies a total power output of 20 watts—from two valves. That is the average A.C. power, which is what we understand by A.C. "power."

No matter whether this push-pull amplifier is functioning in Class A or Class B, handling a frequency of 100 or 1,000 c/s., or as a Class C radio-frequency type handling 10-100 Mc/s., the *average* output of each valve is ½ of 20W.=10W.

By the general A.C. principles we have outlined, this 10W. is ½ (peak instantaneous power). So it is true to say that *each valve* of the push-pull pair is supplying a *peak power* of 20W. for an evanescent instant—the same as the mean power from the two valves. But as we are never concerned with peak instantaneous powers, the point is hardly worth mentioning. It is equally true to say that a 100W. lamp takes a momentary peak power of 200W.—but who worries about that? For every practical purpose the mean power is 100W.

The matter is mentioned here because I have come across certain teachings which would have us believe that each valve in that amplifier, if in Class B, is actually supplying an *average* power of 20W.! I am going to deal with this interesting fallacy in a future article. It has a certain degree of technical plausibility, and, as I have shown in previous writings, many fallacious teachings are made plausible by giving the impression that different "conventions," or "points of view" are permissible. In this case, we are told the "pulse" point of view, in Class B, leads to this result, contradicting straightforward A.C. ideas.

Now, from a standpoint of strict logic, "a thing cannot be true, and not true." It is no "convention" that each valve in our push-pull amplifier is delivering 20W. of peak instantaneous power. That is a *fact*—true of Class A, Class B, or Class C. Therefore, by no stretch of the imagination, or of technical terminology, can each be said at the same time to be delivering an *average* of 20W.! If 20W. is a peak instantaneous power, it cannot possibly be an "average."

We might as well say that if a train is running at a maximum speed of 60 m.p.h. at a given "instant," or a short interval of time, it also has an average speed of 60 m.p.h. over a longer interval which takes into account velocities less than 60 m.p.h.!

So if you should come across this "point of view" in connection with Class B, bear in mind the "fundamentals" of A.C. power. It will save you chasing many red herrings in discussions of power averages, etc., whilst you will not be led up the garden by "conventions."

Pulse Power

But to return now to a consideration of Fig. 1 (b) and (c).

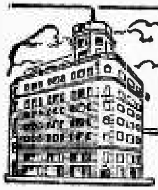
The power produced in a resistance by the full-wave current (c) will be exactly the same as with the corresponding full sine-wave of the same amplitude (a), i.e. ½ (peak power). It follows that the R.M.S. value of (c) is 0.7071, exactly the same as (a).

Taking 10A peak, as before: a moving-coil ammeter would indicate 6.37A, but an R.M.S. instrument (hot-wire, moving-iron, thermo-couple, etc.) would show $0.707\times10=7.07$A. For battery-charging the average current of 6.37A would be the important value, but from the standpoint of heat produced in a resistance 7.07A is the effective value.

The ratio R.M.S./Mean is called the *form-factor*, and it is $7.07/6.37=1.11$ for a sine-wave, or rather a *fully-rectified* sine-wave. Thus, with Fig. 1 (c), an R.M.S. ammeter will read 11 per cent. high, compared with a moving-coil type. If the wave-form is distorted, the *form-factor* will be different from 1.11. Hence the reason why rectifier types of A.C. meters have a "form-factor error" when the scale is calibrated to read R.M.S. values upon a sine-wave basis.

Next month we will see how to find the R.M.S. value of a series of half waves and go into some other facts about rectified waveforms.

(To be continued)



ON YOUR WAVELENGTH

By THERMION

Car Radio Tax Imbroglio

THE Treasury recently issued a statement to the effect that Purchase Tax is to be imposed on car radios. This has caused confusion as well as concern in the motor trade, and certainly to those motorists who have already paid the tax. Discussing the matter with one of the leading manufacturers of car radio the other day I was told that as long ago as July last they had challenged the imposition of Purchase Tax on car radio. The official reply then given was that wireless sets designed for receiving public broadcast entertainment and adapted for use in motor vehicles are regarded as chargeable with Purchase Tax.

The legality of this ruling by the Department of Customs and Excise was immediately contested by the trade and recently the Society of Motor Manufacturers and Traders passed on to its members official notification that the existing law does not provide for Purchase Tax to be charged on radio sets exclusively designed for use in cars.

A representative of Radiomobile, Ltd., stated: "Our position in this matter, in common with other companies, is, of course, simply that of a collector of taxes. Since receiving this new official notification, however, we have ceased to charge Purchase Tax on car radios. We are making a claim for the return of tax already collected and if successful we shall make reimbursements to all those who have paid it."

It is possible that the ruling to charge tax on car radios in the near future may be contested in the Courts.

The London-Birmingham Radio Relay Link

WARTIME experiences in radar have contributed greatly to our knowledge of wide-band systems and ultra-short-wave technique, and this knowledge was enhanced by the availability in this country of advanced television technique. The research laboratories of the G.E.C., I learn, are intensifying their experiments on radio links for ultra-high-definition for colour television. Attention has also been given to the requirements of high directivity radio links to provide multi-channel telephone facilities in this country or abroad.

At the end of 1946 the G.P.O. issued a comprehensive performance specification for a radio linkage between London and Birmingham, which is required at the earliest moment to provide the first extension of the B.B.C. 405 line system to the provinces.

This link, which is to be designed by the G.E.C., is intended for the transmission of television signals having the waveform of the present 405 line 50 frames per second signals transmitted by the B.B.C. from Alexandra Palace. When completed it will permit television signals to be relayed simultaneously from London to Birmingham and from Birmingham to London, though in order to establish a link between the two cities as early as possible a single reversible channel will first be installed.

Transmission is to take place between a radio terminal near London and one near Birmingham. The radio frequencies used will be of the order of 1,000 mc/s, and the system has been designed for operation over optical paths between stations up to 40 miles apart.

Two intermediate stations will be used to relay the signals between the radio terminals, and because of the nature of the terrain one path will be about 20 miles in length and the other two will be about 40 miles.

At each station there will be an 80ft. lattice steel tower which will carry a cabin 9ft. square, containing the radio frequency and signal channel equipment. Outside will be the transmitting and receiving systems. The power supply units will be at the foot.

Radiolympia

I AM keenly looking forward to the first post-war radio show. Where our stand will be situated is in the lap of the gods at the moment, because at the time of going to press a certain amount of reshuffling is taking place.

It seems such a long time since those fateful days in 1939 when the imminence of war and the gloom which spread over the country caused the exhibition to close before it had run its allotted span. I wonder how many of the old faces I shall see there? Even the personnel of firms has changed; there are many new firms whose goods I want to see. I know that a few were shown at the Britain-Can-Make-It Exhibition, but they were by no means representative of what has been done during the past eight years.

"Listening-in to Adam and Eve"

[It has been stated that a sound once created goes on travelling through space for ever, and that some day we will have instruments delicate enough to pick up the words of all the mighty dead for us to listen to through our loudspeakers.]

O! What a frightful prospect this,
Let's hope it is not so;
Who wants to hear the spate of words
Uttered so long ago?
Oh! how Romance might suffer
And History hang her head;
How many idols be cast down
Through silly things they said,
If we could hear them once again
By pressing on a button,
Whilst none of us could answer back
To speakers dead as mutton.
The B.B.C., of course, might smile
And clap its hands in joy
If they with "Pastographic Mike"
No artists need employ.
The B.B.C. "No fees incurred"
To its enormous gain.
Invention such as this might hail
To bring past back again;
But, weighing all things up, let's hope
This story is not right,
Lest listening-in for Adam's voice
Put sanity to flight.—"TORCH."

Underneath the Dipole

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

SLOWLY but surely the development of colour television progresses. It is a slow and laborious process which is proceeding behind "locked doors" where the back-room boys retain full control of the high scanning rates necessary. The high scanning rate is, of course, one of the chief snags of two- or three-colour television, each colour component of which requires scanning just as many times per frame per second as the present black-and-white pictures.

Mechanical Electronic Systems

Several systems have been evolved and some of them have been demonstrated. It has been generally agreed that in colour kinematography or photography, or, in fact, in any process of colour picture reproduction, that the minimum number of basic colours which may be combined to give satisfactory results is three. Quite pleasing renderings in colour kinematography have been obtained with two basic colours, but the range of colour shades is then strictly limited. In *Kinemacolour*, a two-colour process evolved about thirty years ago by Charles Urban, successive cine frames were photographed alternately through orange and green filters. The positive print was, of course, in black and white, but small dots at the side of the orange-filtered frames enabled the film to be synchronised with the orange segment of the shutter blades of the projector; a green segment was synchronised with a frame not having this dot. The speed of the projector was 32 frames per second—twice the then normal speed for projecting black-and-white films, and the quite pleasing results were in no small measure due to the fine precision workmanship of Messrs. Ernest F. Moy, the Camden Town engineering firm.

How we marvelled at the pictures of a red, friendly-looking cow grazing in a realistic green field! But if the projectionist carelessly threaded up his machine with the "orange" dotted frame opposite the "green" segment of his projector shutter, then the cows obligingly turned a sickly green and the fields went red!

Colour Milestones

Through the years which followed, long before television, various film colour systems waxed and waned, and the names of these were almost as florid as the colours until, at last, satisfactory three-colour processes were evolved by Technicolor, Agfacolor and Dufaycolour. These systems all have actual colour-prints and no longer require the use of a colour-segmented shutter on the projector.

Nevertheless, the most successful colour television systems to date have relied upon a return to the mechanical colour-segmented shutter in some form or other. Based upon the same principles as Kinemacolour, a system has been developed in which a shutter having three colour segments is mechanically rotated in front of the television camera, and similar rotating filters are passed in front of a single cathode-ray tube at the receiving end—the transmitting and receiving shutters being maintained in exact synchronisation. This system requires the transmission of about 150 frames per second in order to avoid the possibility of colour fringing or flicker. The problems of synchronising the filters running at such a high rate are great, but when demonstrated on "closed circuit" in a laboratory, results were promising but hardly "commercial." The shutters took the form of a conical drum containing red, green and blue segments.

Coloured Mosaics

Additive television colour systems which resemble the Dufaycolour process of photography have been evolved in which both transmitting and receiving ends make use of a uniform mosaic having red, green and blue components, or, alternatively have red, green and blue lines on the screens. These additive systems appear to have possibilities, but the complication of filtering out the component colours and ensuring accurate synchronisation at the receiving end is far from simple. It seems to be almost impossible, for instance, to guarantee that a green element signal will always register exactly upon the corresponding green element component on the receiver.

Multiple Tube Receivers

Yet another system, which hardly seems to be intended for the home, makes use of three projection-type tubes, used simultaneously and projecting through the appropriate colour filters on to one single screen, the three pictures being superimposed. This system, which was demonstrated some time ago by Baird, also requires great accuracy in order to achieve an exact superimposition of the images. Variations of all these methods are being continually tested, tried and improved, but I think it is doubtful that a commercial stage will be reached for many years. Big screen colour television in cinemas would seem to have greater possibilities than home reception, especially if the big cinema circuits are allowed to erect transmitters, are allocated wavelengths—or are permitted to use special Post Office line links.

Square and Flat Tubes

Before the war, Great Britain was well ahead in the development of most television component parts. But it may be remembered by some readers that favourable reports were received of German cathode-ray tubes with square or rectangular ends instead of the usual circular shape, and with a flat face. This was claimed to be a big improvement upon the usual rounded type with a convex end. If a tube of this type is short, then there is the possibility of loss of focus near the edges. Still, I have seen similar tubes at the research laboratories of two or three of our big radio manufacturers, and so I anticipate further improvements on these lines will be available here soon.

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The instrument is self-contained for resistance measurements up to 20,000 ohms, and, by using an external source of voltage, the resistance ranges can be extended up to 10 megohms. The ohms compensator for incorrect voltage works on all ranges. The instrument is suitable for use as an output meter when the A.C. voltage ranges are being used.

Supplied complete with leads, testing prods, crocodile clips, and instruction booklet.

D.C. Voltage	A.C. Voltage
0—75 millivolts	0—5 volts
0—5 volts	0—25 "
0—25 "	0—100 "
0—100 "	0—250 "
0—250 "	0—500 "
0—500 "	

D.C. Current	Resistance
0—2.5 milliamps	0—20,000 ohms
0—5 "	0—100,000 "
0—25 "	0—500,000 "
0—100 "	0—2 megohms
0—500 "	0—5 "
	0—10 "

Size: 4⅝" × 3⅝" × 1⅝" *Nett Weight:* 18 ozs.

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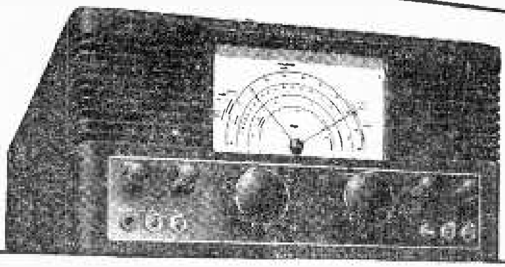

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Making a Valve Tester

How to Make a Simple Emergency or a Multi-purpose Servicing Instrument

By W. J. DELANEY (G2FMY)

MANY constructors have a number of spare valves in their spares box and are doubtful about their condition. On the market at the present time are many ex-Government valves, some of which are from used equipment, and some of which are guaranteed unused. Before using such types of valve it is very nice to be able to test them, and although most keen constructors test all other items used in the construction of transmitters and receivers, the valves are often taken for granted owing to the apparent difficulty of making other

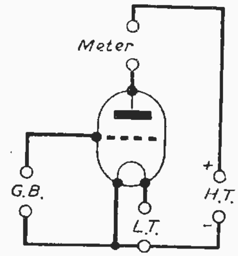


Fig. 1.—This circuit indicates the basic principle of the valve tester. Various voltages may be applied at the terminal points.

than a "substitution" test. This is, of course, the simplest way of testing a valve, and consists, as its name implies, merely in plugging the doubtful valve in place of one of more or less similar type in a working piece of apparatus and comparing the results. But the really keen amateur possesses, as a rule, a number of test instruments, and these are available in various types and most of them cost a sum which can reasonably be afforded. The valve-tester, however, is generally a more elaborate piece of equipment and is not often found in the den of the wireless amateur, but rather in the workshop of the service engineer or the laboratory of a firm. Furthermore, it is not called into use so often and is therefore considered to be unworthy of its expense. However, it is possible to make up quite a satisfactory tester, either of a type which can be used at odd moments when the condition of a valve is in doubt, or as a complete piece of apparatus suitable for the service man who is engaged in trade as such.

Basic Principles

There are really only two things which matter in the testing of a valve—apart from the fact as to whether or not it is completely broken down. Assuming that the filament or heater is intact, all that one wishes to know is whether the electrode insulation is satisfactory and what is its "goodness." As its name implies the latter is the "quality" of the valve, and fortunately it is measured by a standard term. This is generally known as the "mutual conductance" and is measured in milliamps per volt. It is the ratio of the change in anode current to change in grid voltage. With an ordinary triode, when a certain value of H.T. and G.B. is applied, there will be a steady anode current. If now either the H.T. or the G.B. is modified the current will show a change. To carry out a test of the valve and plot its conductance, the most satisfactory plan is to apply a steady value of H.T. and vary the applied G.B. From this it will be seen that all that is needed for a very simple tester is a simple H.T. unit (or dry battery if a battery instrument is required), a suitable valveholder, and a source of biasing voltage. As this is generally quite low an ordinary battery may be used, although it is possible to use part of the mains supply by taking suitable precautions.

The essential part of the tester is, of course, a milliammeter, and if it is not desired to make up a complete test instrument, two terminals may be provided to which an ordinary milliammeter may be connected. The meter should, of course, be capable of giving a full-scale reading slightly higher than the maximum current taken by the valve under test.

Using the Instrument

All that is necessary to test a valve now is to apply approximately 100 volts H.T., the maximum G.B. given by the valve makers for the valve under test, and note the anode current. Checking this with the maker's published curves will show whether or not the valve is up to standard. If the anode current is much lower than given in the published lists, then the valve should be replaced. If it is desired to produce your own set of characteristic curves, the H.T. may be left constant and varying grid voltages applied and the current readings noted. The readings are plotted on some squared paper and will give a curve from which much valuable data may be deduced.

Modifications of the above basic idea may now present themselves. Firstly, as described, only

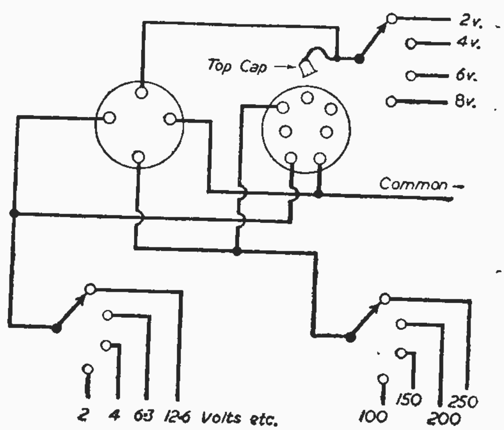


Fig. 2.—The principle of the multi-valve tester is shown here. Any number of different valve holders may be joined together as shown.

one type of valve will be usable, but as valves are to-day obtainable which have several different pin and base arrangements, it is obviously necessary to arrange for all of these to be accommodated, so in place of the single valveholder a complete range will have to be provided. Before the war it was possible to buy adapters which plugged into a standard valveholder and had at the other end sockets to take various types of valve, and, although it is possible to make up such adapters at home, it is preferable to mount one of each kind of holder likely to be required on the panel of the tester and wire them in parallel. That is, all the heater sockets should be connected together, all the anode sockets and so on. Arranged in this way no switching would be required, but if the instrument is to be made up for servicing purposes, then some provision should be made for varying the applied voltages without external modification. For this, the filament, anode, screen and other sockets should be taken to multi-point switches, such as the rotary wafer-types now readily available. These should be labelled according to the electrodes to which they are joined, and the wiper or moving contact of the switches taken to the appropriate supply source. Alternatively, one wafer or multi-point switch may be taken to the filament circuits only and the contacts on it taken to the supply voltages most generally required, i.e., 2, 4, 6.3 volts, etc. The anodes may all be joined to one wiper, and the surrounding contacts taken to various H.T. voltages, and so on. Much depends upon the type of testing which is to be carried out, and the main principle is to provide a supply source (which may be A.C.) means for varying the applied voltages to any electrodes, and means for easily plugging in any type of valve.

Cathode Insulation

The cathode-insulation test is a little more complicated, and a circuit which has proved very successful in practice is shown in Fig. 3. A standard "magic-eye" tuning indicator is employed, and approximately 100 volts is applied, through approximately 1 megohm, across the heater-cathode circuit. The

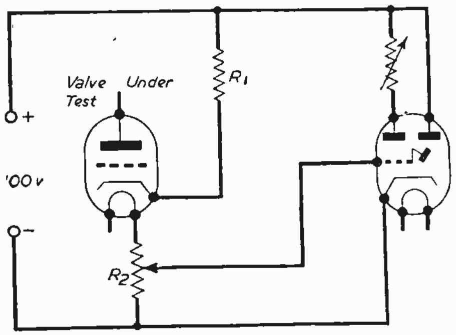


Fig. 3.—Cathode insulation may be tested by this type of circuit.

D.C. flowing through the resistance in the heater circuit is applied to the grid of the tuning indicator. A variable resistance in the anode circuit of the indicator, and a suitable meter, will enable adjustments to be made for various types and conditions of valve. In the commercial model, the meter is marked zero to indicate a complete cathode-heater short-circuit. By calibrating the dial or control-knob of resistance R2 according to the grid voltage applied, taking as the basis the resistance of R1 (which will be the maximum circuit resistance with a cathode-heater short-circuit), it is possible to have a scale showing in ohms the cathode-heater resistance. The control in question is, of course, adjusted so as just to close the "magic-eye."

Valve Types & Prices

A CORRESPONDENT, Mr. E. I. R. Bellas, of Penrith, says: "I have been in the habit of reading 'On Your Wavelength' since early AMATEUR WIRELESS days, usually with considerable enjoyment, but in some recent remarks on 'Valve Prices,' Thermion makes several dogmatic statements that cannot be allowed to pass unchallenged. He says that British valve manufacturers or, rather, set designers, favour dual-purpose valves; there is usually only one dual-purpose valve, a double-diode pentode or triode in a set, the remainder being ordinary screen-grid, screen-pentode, or F.C. valves. Americans make similar types, but possibly not a D.D. pen or D.D.T., but they make a pen-diode (output + half-wave rectifier). We produce (so Thermion asserts) valves to very close limits. Maybe, but every manufacturer makes his valves different from those of every other; some are interchangeable without any circuit alteration, the majority are not, yet every 6K7, for example, no matter by whom made, is interchangeable, and what is more, is as satisfactory, so it would appear that the U.S.A. makers work to fairly close limits and all to the same specification, which is better than we can or do. Another point in the Americans' favour is their coding, from the type number one understands immediately the voltage, position and type of tube. To know anything of a British valve by the British system (?) one needs a table. Why do our makers still have to make antique 4-volt valves, consuming 1 amp. each or 16-volt valves, consuming .25 amp.? The 4-volt series consume more than twice the power of the American 6.3-volt .3A. series, and they cannot be used in conjunction with the 16-volt types conveniently, whereas the American 6.3-volt class and 12.6-volt class can. Regarding length of service, I know of a set bought eight years ago for 30s. in a public-house, that has never had a valve changed and is as good as ever on two short and medium bands for both tone and volume and sensitivity, and it has been in use for approximately four hours a day throughout.

"I am not anti-British, and I believe we *can* produce the best.

"One last question, why does one maker of octal valves have to be different from the international octal and space the two pins adjacent to the key 2mm. farther apart than the others so that a special socket is necessary?"

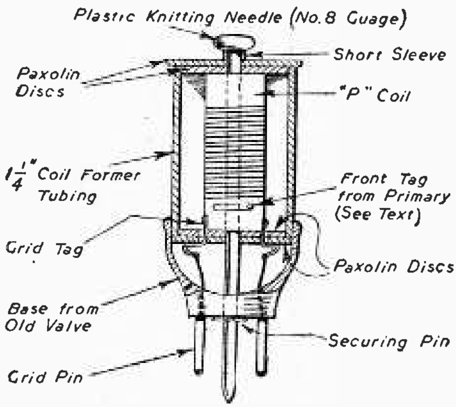
Practical Hints

Plug-in Coils

REQUIRING a set of small and efficient plug-in coils, I devised the following method of using Wearite midget " P " coils.

The accompanying sketch is self explanatory, and it is only necessary to point out that the two side (primary) tags should be bent over to clear the inside of tube cover, thin wires being soldered to these tags and taken through two small holes drilled through bottom paxolin discs and thence to the heater pins. (Not shown in sketch.)

The socket to receive these coils should be a five-pin type, with the cathode or centre socket removed or drilled out to take the locating pin.



A novel and practical idea for making up plug-in coils—using " P " type coils.

In assembling press the tube down well into valve base and mark for drilling small hole to take small securing pin as shown. A washer can be inserted at top if necessary to take up any slackness.—G. W. HARDY (N.W.10).

Supply Adapters

THE following dodge should be of interest to readers who do P.A. work and wish to run their amplifiers from either the mains or a car battery.

An Octal valveholder is fitted to the chassis and connected as shown. Note the series parallel arrangement of the heaters (the resistance R is to equalise the current).

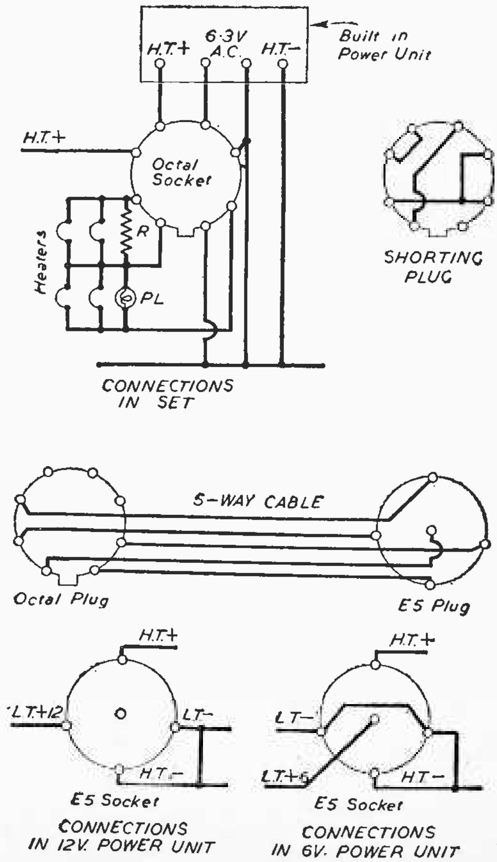
Next, make a shorting plug from an old Octal valve base. Connect pins 3 and 4 together, pins 1 and 5 together, and pins 2, 6 and 7 together. Next, another Octal plug and a 5-pin English plug are required. These also are made from old valve bases and joined by a 5-way cable as shown. Fit an English 5-pin valveholder to the 12 volt rotary transformer and connect as shown.

For mains operation the shorting plug is inserted in the Octal socket, and connects the mains transformer, rectifier and heater winding. The heaters are now in parallel.

To run from the battery, remove the shorting plug and connect up the cable to the set and the power unit.

The mains transformer is now out of circuit and the H.T. and L.T. are drawn from the external supply, the heaters being in series parallel.

Connections are also given for use with a 6 volt unit.



Servicemen will find this adapter idea very valuable for P.A. work.

This dodge could be used to run a car radio set from A.C. mains or to use a small A.C. set in a car.—NORMAN DEAN (Manchester, 14).

Push-button Al

A Four-band Receiver for Battery Operatior

By F. G.

THIS useful receiver tunes two short-wave bands in addition to long and medium waves, so that all the more popular frequencies can be covered. The ranges are selected by switching, but one coil is a plug-in type, enabling other ranges to be tuned when desired if a suitable coil is inserted. Push-buttons are provided to give immediate and correct tuning for three local stations, and this refinement is well worth adding and will rapidly prove its usefulness.

None of the components is critical. Suitable push-button switches and other parts will be found advertised in these pages.

The Circuit

From Fig. 1 it will be seen that the various switches form the only complication. However, no difficulty should arise in this direction if the diagrams are followed.

As the only type of push switch generally obtainable provides a single-pole change-over action for each button, it is necessary that the R.F. stage should be untuned when receiving either of the three local stations. Only three pre-sets are required, and these are mounted immediately behind the tuning dial. The three lower buttons are used in conjunction with these for the reception of two medium-wave and one long-wave stations. If the Third Programme, local Home Service, and Light Programmes are selected, volume will be ample without the R.F. stage.

When manual operation is selected, both R.F. and detector stages are tuned by the gang condenser. On either of the short-wave bands the R.F. stage is untuned, the grid circuit being completed through the .25 megohm leak. This is quite satisfactory and avoids ganging difficulties on those wavebands. As the detector section of the gang condenser requires to be switched in and out of circuit by means of the push switch this introduces long wiring

COMPONENT LIST

- .0005 mf . 3-gang tuning condenser with reduction drive.
- .0003 mfd. reaction condenser.
- Fixed condensers: two .0002 mfd.; .01 mfd.; 1 mfd.
- Resistors : 30,000 ohm ; .25 megohm ; 2 megohm.
- .5 megohm potentiometer. 25,000 ohm variable resistor.
- L.F. transformer for direct feed, ratio 1 : 3.
- All-wave H.F. choke.
- .0001 mfd. pre-set. Two .0005 mfd. pre-sets. One .0003 pre-set. (Trimmers 1, 3 and 2 respectively in text.)
- 6-pole 3-way rotary switch.
- 5-way push-button switch, single-pole double-throw action.
- 4-pole switch.
- On-off switch.
- Fuse and holder (60 mA). Component bracket.
- Extension spindle and coupling. Stand-off insulator.
- Plug-in coils and holder (3-winding types). One 4-pin, one 5-pin, and one-octal valveholders.
- Valves : Screen grid or H.F. pentode for R.F. Mazda HL23 for detector. Low consumption pentode or tetrode for output.

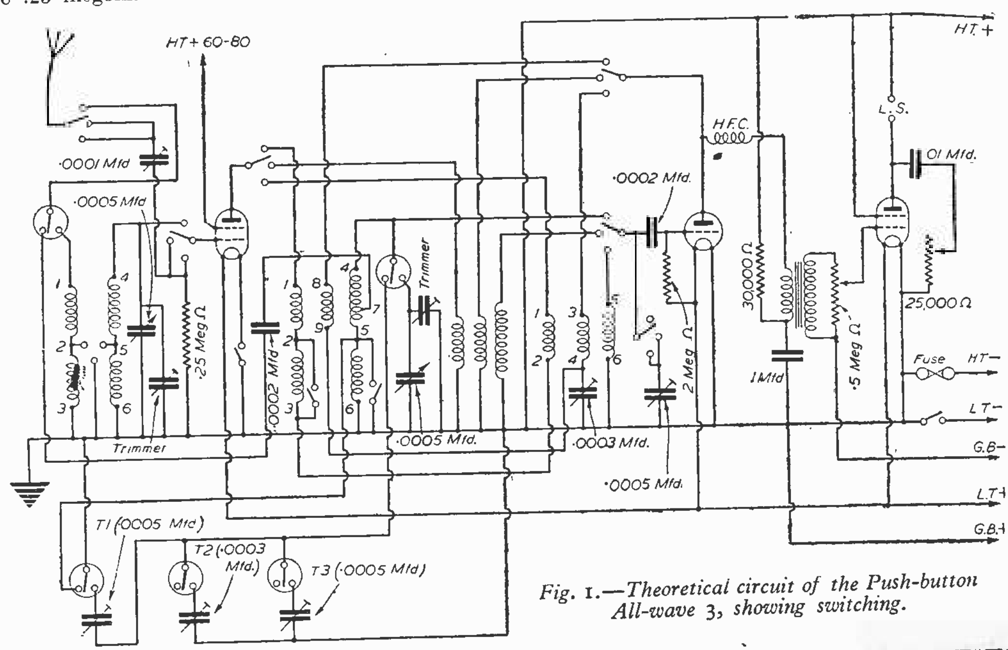


Fig. 1.—Theoretical circuit of the Push-button All-wave 3, showing switching.

·wave Three

·vith Manual and Automatic Tuning.

YER

which would be unsuitable for short-wave reception. Because of this a three-gang condenser is used, one section being retained for tuning the short-wave coils. This avoids any losses associated with the push switch (which would become serious on short waves). It will be found that the receiver will operate quite efficiently on wavelengths below

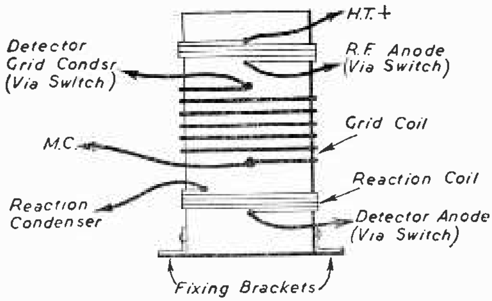


Fig. 3.—Details of the fixed short-wave coil.

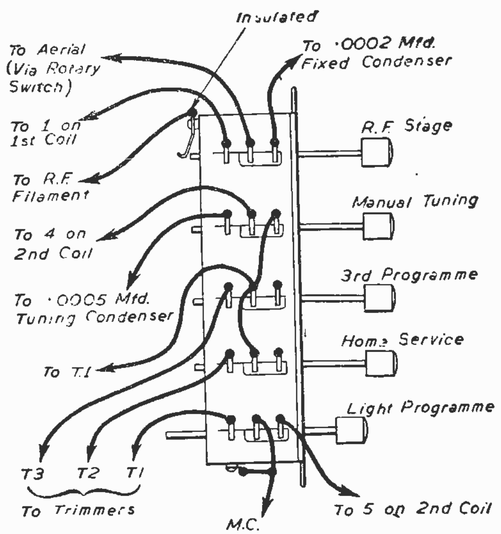


Fig. 2.—Details of the push-button switch unit and wiring.

10 metres, provided that wiring to the short-wave coils is no longer than necessary.

An output tetrode with potentiometer volume control completes the circuit, a 25,000 ohm variable resistance and .01 mfd. condenser being added for tone control.

Chassis and Panel

A metal chassis, 11in. by 9in., and 2in. deep, is required. A panel, 12in. by 7in. is secured to this by the bushes of the controls mounted below the chassis. Fig. 7 shows the panel layout. A really good quality tuning drive is necessary to make short-wave tuning easy and four scales are required upon the tuning dial so that stations may be indicated for each waveband.

The push switch should be bolted to the left of the panel, and suitable knobs fitted to the other controls. The necessary holes for components and wiring should be drilled on the chassis, taking care not to place the R.F. valve so near the push switch that operation of the latter is impossible.

Positions of the components upon the top of the chassis will be seen in Fig. 6. The three pre-sets are secured to a small panel which is fixed behind the tuning dial by brackets. A small insulator near the rear of the chassis is used for an aerial connection.

Wiring the Receiver

To avoid errors wiring may be done in three stages. First, carry out all the filament and other wiring not associated with the switches. From the sub-chassis plan, shown in Fig. 5, it will be seen that this is not great. The push-button switch and pre-sets can then be connected, following with the six-pole three-way rotary switch.

Connections to the push switch are illustrated in Fig. 2. All the leads are marked, and the operation is as follows: Pressing the lower button connects trimmer 1 and sets the second tuning coil for long-

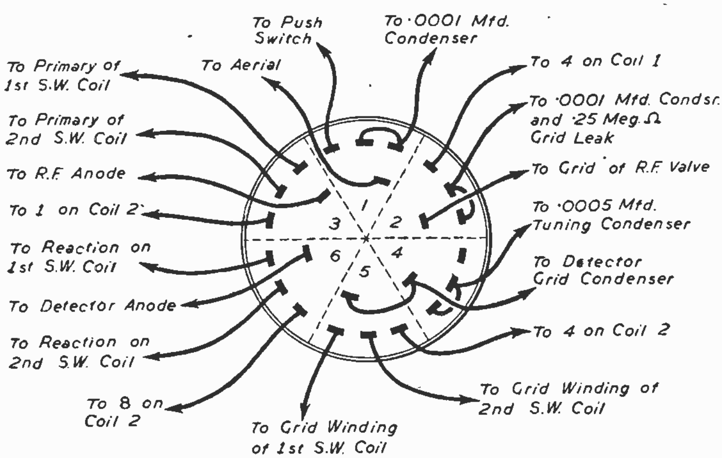


Fig. 4.—Connections for the rotary switch unit.

wave reception (for the Light Programme). When either the second or third button is pressed the lower button will spring out, switching the coil to medium-wave reception. In addition, suitable pre-sets are connected for the Home or Third Programmes. Depressing the button marked Manual Tuning connects the .0005 mfd. tuning condenser. For reception of any but the more powerful stations the top button should also be pressed in, this bringing the R.F. stage into operation, tuned by the rear section of the gang condenser. The reaction condenser may be used to increase the volume of weak stations in each case.

The Rotary Switch

Each connection to this is marked in Fig. 4. All difficulties should be avoided if each section is wired individually.

Section 1 switches the aerial. Sections 2 and 3 switch the grid and anode circuits of the R.F. stage. Section 4 connects the section of the tuning condenser required for short-wave reception. Section 5 controls the grid circuit of the detector, and Section 6 the reaction circuit.

Switch positions are as follows: Position 1—first short-wave range (9 to 15 metres, or 19 to 35 metres, as will be mentioned later). Position 2—second short-wave range obtained with plug-in coil for either 19 to 50 metres or 25 to 60 metres (or any other range as desired). Position 3—long and medium waves, selection being by means of the four-pole switch associated with the long- and medium-wave coils. The switch must also be in this position for push-button operation.

All wiring associated with the short-wave coils and detector must be as short as possible. Other connections should not be unduly long, and wiring to each section of the switch should be kept clear of that going to the other sections. Failure to attend to this may introduce instability in the R.F. stage. There is no need to screen the R.F. anode lead, and this should be avoided as causing short-wave losses. However, the portion of the anode connection between the switch and long- and medium-wave coils should be screened. No wires associated with the short-wave coils require screening.

The S.W. Coils

Most of the higher frequencies will be covered by the plug-in coil. A single coil will cover from approximately 25 to 75 metres, but sensitivity begins to drop off slightly near the low-frequency end of the band, due to the large tuning condenser capacity.

Winding details of the fixed short-wave coil (mounted below the chassis) will be seen in Fig. 3. If it is desired to tune the 10-metre band, five turns of 18 S.W.G. wire on a 1in. diameter former may be used for the grid winding. Two turns are suitable for the coupling winding, with four for reaction. For these latter windings 26 S.W.G. wire, close wound, is suitable.

Nine turns of 22 S.W.G. wire, on a 1¼in. former, may be used to tune from approximately 19 metres upwards. Five turns will be required for R.F. coupling, with seven for reaction. If the maximum waverange is required, this coil will tune up to 35 metres, and a suitable plug-in coil may be used which will embrace the 80-metre band. A range of 19 to 50 metres is obtainable with one coil,

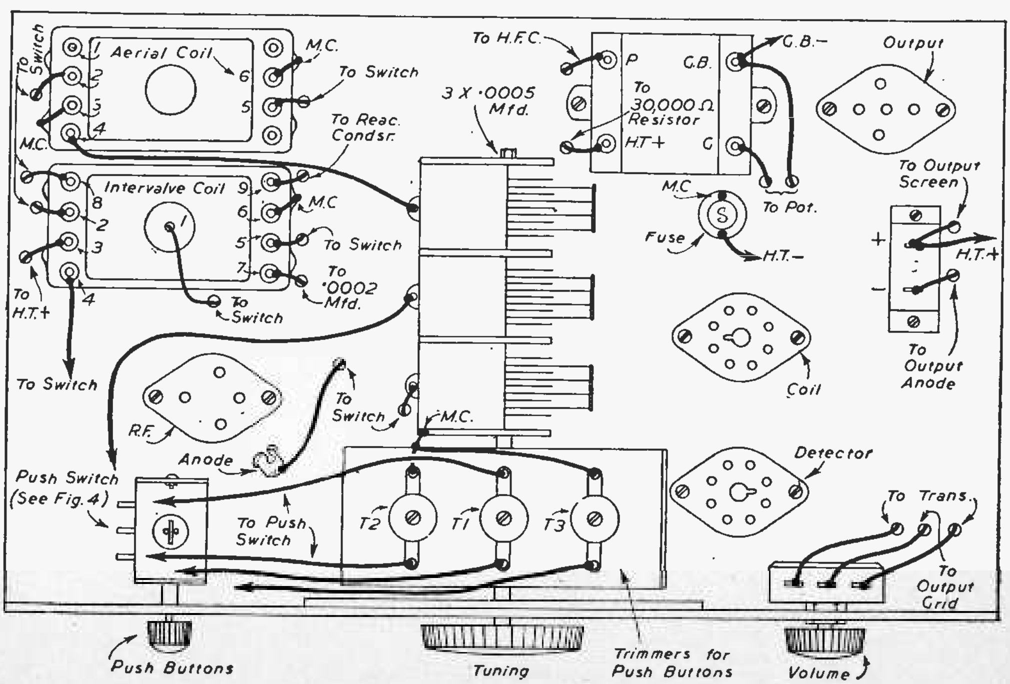


Fig. 5.—Above chassis wiring details.

but this is worth avoiding if possible when more than one short-wave range is provided.

Adjusting Trimmers and Pre-sets

The trimmer on the section of the gang condenser used for short-wave tuning should be removed or fully opened. Nothing further is required for these bands.

To trim on long and medium waves, set the switches for medium-wave reception and depress the two top buttons. The trimmers on the central and rear sections of the gang condenser can now be adjusted for maximum volume. This is best done near the high-frequency end of the medium-wave band, and adjustment should be suitable for long-wave reception also.

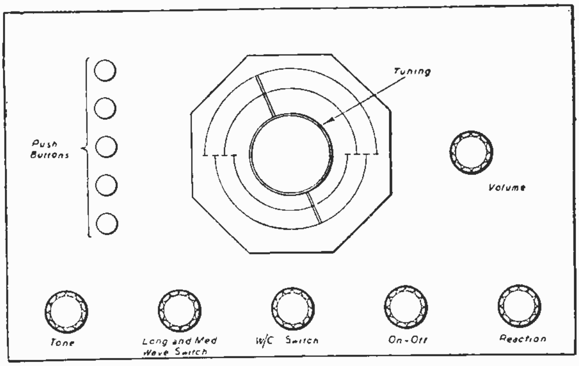


Fig. 7.—Panel layout of the Push-button A.-w. Three.

In the event of instability arising as ganging is accomplished, attention should be paid to the wiring associated with the two coils. If leads are well separated no extra screening should be needed; if it is, it should only be added to leads which do not connect to the short-wave coils.

If it is not possible to reach the lowest short-wave range desired, and leads connected to the front section of the tuning condenser and switch are well clear of the chassis, then a turn or two must be removed from the grid winding of the short-wave coil, or a coil with less turns inserted in the holder. The receiver is not suitable for operation on wavelengths below nine metres.

For push-button operation the wavechange switches should be left at the long-wave position. Push in the lower button and adjust the centre trimmer (T.1 in Fig. 6) for maximum volume on the Light Programme. Trimmer T.2 should be adjusted with the second button depressed, and trimmer T.3 with the centre button depressed. The third trimmer will require screwing nearly right down to receive the Third Programme on 514.6 metres.

As shown in Fig. 2, a brass contact is added to the push switch to complete the R.F. filament circuit, *via* the plunger, when the top button is depressed. This is necessary because the limited number of contacts prevents the R.F. stage being tuned to the desired stations by additional pre-sets adjusted to match those used in the detector stage.

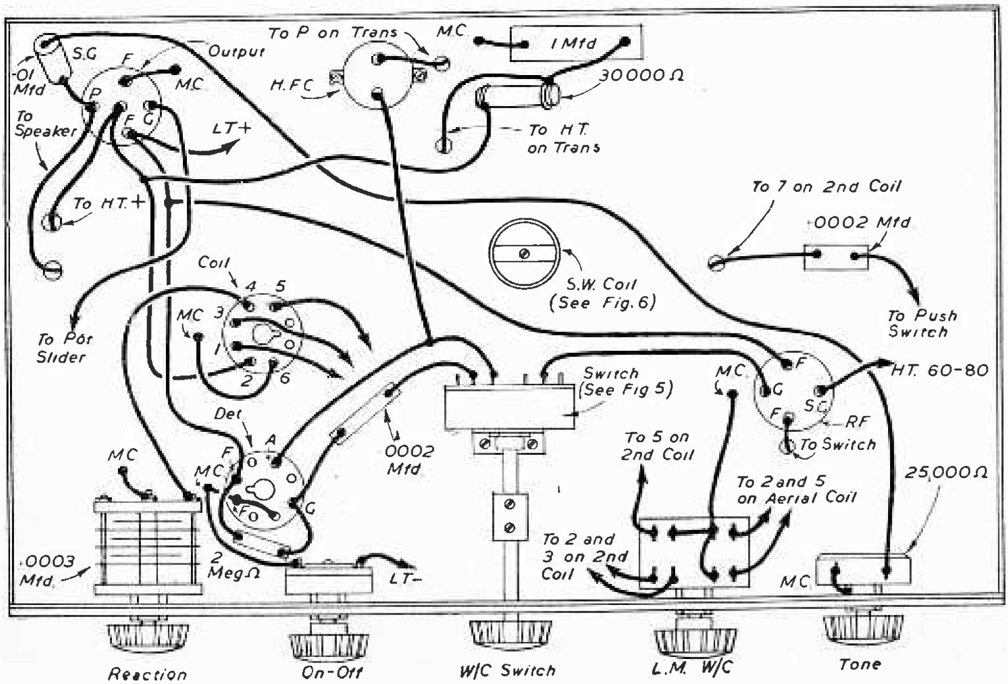


Fig. 6.—Under-chassis wiring details.

The Three-four Portable

Instructions for Making and Winding the Frame Aerial, and Testing This New Receiver

THE construction of the plywood former for the aerial is quite simple, and consists of eight pieces of 3/16in. plywood, four pieces being 7¾in. × 2½in. and four smaller ones for the corners being 2½in. × 2½in. The ends of all eight pieces are chamfered slightly and glued together to the shape shown in Fig. 7 last month. This will be best done by making a cardboard or paper plan and mounting the glued pieces on the template, using temporary wood blocks as supports and leaving overnight until quite firm. A few panel pins might be used also, but too many are not advised. The small corner pieces, and inner block supports shown, make for a very strong frame. The framework should be finally sand-papered quite smooth and finished with a coat of shellac varnish. A smaller view of the frame former and front panel has been given with overall sizes, as made by the author. It will be noticed the front panel is not quite square. Care should be taken when fixing the Perspex spacers, but when the frame aerial winding is wound on tightly, the whole job will be found perfectly rigid. The frame winding consists of 17 turns, soldered at each end to the soldering tags, to which also are soldered the short lengths of flex for connection to the tags on receiver. The tapping, which may be a few turns from earthy end, should be carefully soldered, taking care not to sever any of the aerial strands by so connecting.

The speaker panel is cut out of the front frame panel with a good strong fretsaw, and is made 9½in. diameter. A very small half circle might be included when cutting out this panel, for ease of replacing the speaker after external use. This can be seen in both Fig. 1 and Fig. 7. However, it will be found that a circular cut is rarely dead true, and the panel will generally be found to fit the front panel only in the position from which it was cut. Small wooden stop pieces glued to the rear, and four simple brass turnbuttons screwed to the front, complete the simple detachable arrangement. The ⅜in. diameter holes drilled in this circular panel can, of course, be replaced by a more fanciful design and covered at the back by suitable dust-excluding material before screwing on the speaker.

The Coil

This is shown in detail in Fig. 9. The former used was an eight-ribbed one of 1½in. diameter, having four pins. The grid winding consists of 80 turns of 30 s.s.c. wire, close wound, the top and bottom of this winding going to pins 1 and 2 respectively. It will be found essential, however, to test this winding together with the frame aerial, as the two have to match in inductance. It is therefore a good plan to wind on about 85-90 turns and then remove single turns, when trying out the set, until the correct matching is arrived at. The reaction winding is positioned inside the grid winding and consists of about 40 turns of 40 s.w.g. s.s.c. wire on a 1in. diameter cardboard or paxolin tube. The top and bottom ends of this winding go to pins 3 and 4 respectively. Actually, these 40 turns for the reaction will be less in width than as shown in the illustration but should be wound from the lower end. Both windings should go in the same direction. Small wedges of wood, or pieces of sleeving, can be used to keep the inner reaction tubing securely in place.

Matching the Circuits

The correct matching of frame aerial and coil will have to be finally arrived at by trial, and to do so it is best to arrange the set and batteries, and L.F. transformer unit, outside the case and as near as possible to the positions they will finally occupy. This will allow the coil to be removed easily for alteration. Adjusting the coil will be preferable to amending the frame aerial. The two trimmers on the ganged tuning condenser should be adjusted until stations at both top and bottom ends of the band are received at their best volume. The trimmer of C1 section should preferably be almost unscrewed, whilst that for C2 should only need to be slightly screwed in. The reaction control should be also advanced slowly during these ganging adjustments, whilst the screen control should be just past midway position. More accuracy, too, will be obtained by using the 'phones for these ganging adjustments. Care should be taken to switch the set off, or remove the H.T.— plug, before removing or making alterations to the coil. The hole in the plywood cover panel for H.T. lead was included for those who prefer to disconnect H.T. entirely

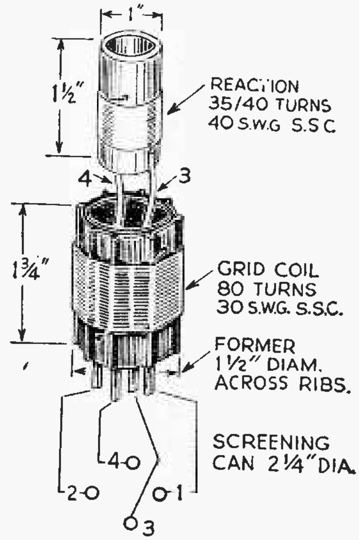


Fig. 9.—Details of the coil.

during periods of inactivity, although as has already been explained, any drain from screen resistance network has been obviated by the switching arrangement.

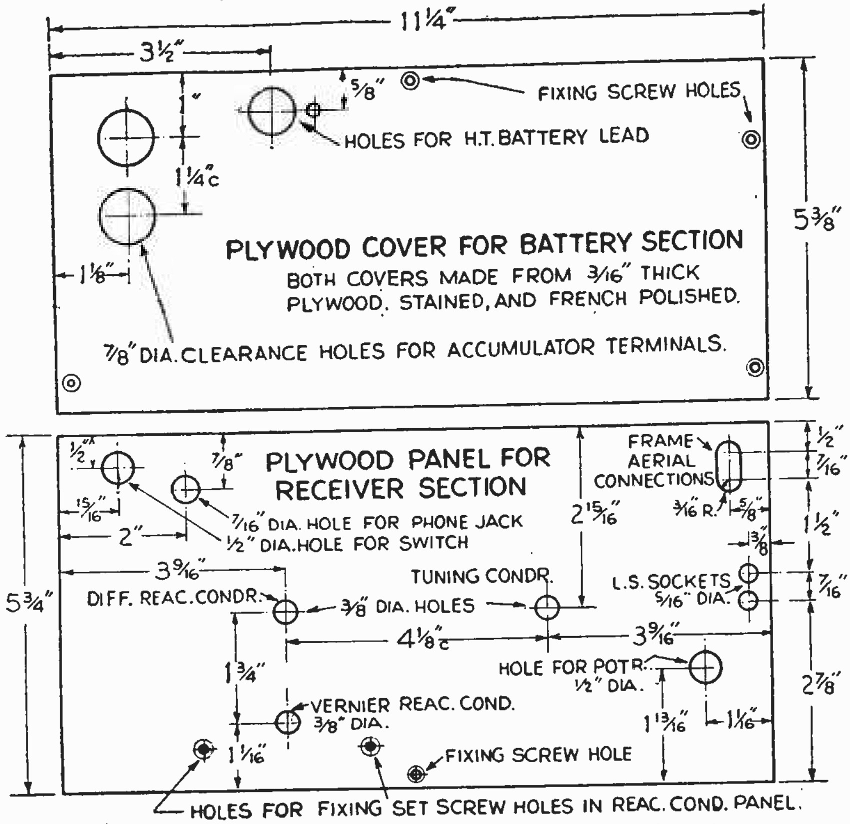


Fig. 10.—Details of the wooden covers for receiver and batteries.

Results

With reaction control at minimum and screen potential control also at minimum, the Home and Light programmes come through at comfortable speaker volume, whilst the Third programme is received at its appropriate times near the top end of the scale with reaction in use. Quite a sprinkling of the more powerful continentals come in, a few also with reaction at minimum. Naturally, care should be exercised in any use of this reaction, but the set will be found sufficiently sensitive without taking the controls too near oscillation point. Slight overloading on the home stations can quickly be obviated by turning the portable as previously explained.

Using a Mullard PM.1LF for V3, and a PM.202 for V4, with 4.5 volts and 6 volts bias respectively, consumption was found to be 10/12 milliamps., and on phones this was reduced to 5 milliamps. Using a PM.22A pentode output, with 3 volts bias, consumption remained about 10 m/A, with a slight increase in volume, although results were not so good for quality.

Although only one make of valve has been specified, other British equivalents can, of course, be used, and in this respect a shorter valve for V1 might avoid the necessity of drilling the side clearance hole in the case, although the anode does not project far into this and the hole itself is covered by a piece of black fabric.

Miniature Loudspeakers

MEASURING only $2\frac{3}{8}$in. square by $1\frac{5}{8}$in. deep, and each weighing $2\frac{1}{4}$ozs., two miniature moving-coil loudspeakers presented recently to Mr. A. H. Whiteley, founder of the Whiteley Electrical Radio Co., of Mansfield, Notts, are believed to be the tiniest in the world.

British Design

They have been designed by Mr. R. T. Lakin, the company's research engineer, and Mr. D. James (production manager). All the parts have been made by the Whiteley group of companies, the magnets by a Sheffield subsidiary company. They were presented to Mr. Whiteley to commemorate the "coming of age" of the firm.

Small Cone

Mounted on a solid walnut stand, they employ a $1\frac{1}{4}$in. diameter loudspeaker unit with $1\frac{1}{4}$in. chassis and a 1in. effective diameter cone. The speech coil, which is wound on paper, is $\frac{5}{16}$in. in diameter and works in a .030in. gap. The speaker is of the permanent magnet type, has a flux density of 5,000 gauss, and is completely dustproof. The cone is of moulded pulp, .005in. thick. Volume control of a potentiometer type identical to that used in the firm's "WB Stentorian" loudspeaker is fitted. The loudspeakers respond to frequencies from 30 to 1,600 cycles per second.

P.W. List of S.W. Broadcast Stations

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THE following list of broadcast stations is given in order of frequencies, but the B.B.C. have pointed out that the Conference sitting, at the time of going to press, in Atlantic City, may decide on a re-allocation of the frequency bands.

Freq. Kc/s	Wave-length	Call-sign	Location
26,550	11.30	GSS	Daventry
26,400	11.36	GSR	Daventry
26,100	11.49	GSK	Daventry
25,750	11.65	GSQ	Daventry
21,750	13.79	GVT	Daventry
21,710	13.82	GVS	Daventry
21,680	13.84	VLC10	Shepparton, Australia
21,675	13.84	GVR	Daventry
21,650	13.86	WLWS1	Cincinnati, U.S.A.
21,640	13.86	GRZ	Daventry
21,610	13.88	WNRX	New York
		KNBA	Dixon, California
21,600	13.89	VLA9	Shepparton, Australia
		VLB8	Shepparton, Australia
21,590	13.90	WGEA	Schnectady, U.S.A.
21,570	13.91	WCRC	New York
21,550	13.92	GST	Daventry
21,540	13.93	VL5B	Shepparton, Australia
21,530	13.93	GSJ	Daventry
21,500	13.95	WOOW	New York
21,470	13.97	—	Colombo, Ceylon
		GSH	Daventry
18,160	16.52	WNRA	New York
18,130	16.55	GRP	Daventry
18,080	16.59	GVO	Daventry
18,025	16.64	GRQ	Daventry
17,955	16.71	WLWL1/2	Cincinnati, U.S.A.
17,850	16.81	PRL9	Rio de Janeiro, Brazi
		KCBF	Delano, California
17,840	16.82	VLC9	Shepparton, Australia
		HVJ	Vatican City
17,830	16.83	VUD10	Delhi. India
		WCBX	New York
17,820	16.84	CKNC	Sackville, Canada
17,810	16.85	—	Moscow
		GSV	Daventry
17,800	16.85	KRHO	Honolulu, Hawaii
		WLWK	Cincinnati, U.S.A.
17,790	16.86	GSG	Daventry
17,780	16.87	KNBI	Dixon, California
		WNBI	New York
17,775	16.88	PHI	Huizen, Holland
17,770	16.88	OTC5	Leopoldville, Belgian Congo
		KNBI	Delano, California
17,765	16.89	TPC3	Paris
17,760	16.90	VUD3	Delhi, India
17,750	16.90	WRUW	Boston, U.S.A.
17,745	16.91	OTM6	Leopoldville, Belgian Congo
17,730	16.92	GVQ	Daventry
17,720	16.93	LRA5	Buenos Aires
17,715	16.93	GRA	Daventry
17,700	16.95	GVP	Daventry
17,527	17.11	—	Brazzaville, F.E.A.
17,445	17.11	HVJ	Vatican City
16,670	18.00	CNR	Rabat, French Morocco
15,960	18.79	PLG	Bandoeng, Java
15,875	18.89	HEK3	Berne, Switzerland
15,750	19.05	RRRD	Moscow
15.595	19.23	FZI	Brazzaville, F.E.A
15,515	19.33	HCJB	Quito, Ecuador
15.450	19.42	GRD	Daventry
15,435	19.44	GWE	Daventry
15,410	19.46	—	Moscow
15,385	19.50	FGA7	Dakar, West Africa
15,360	19.53	—	Moscow
15,350	19.54	WLWO	Cincinnati, U.S.A.
		VUD8	Delhi, India
		WRUW	Boston, U.S.A.
15,345	19.55	CXA9	Montevideo, Uruguay
15,340	19.56	KNBX	Dixon. California
		—	Moscow
15,330	19.57	WGEO	Schnectady, U.S.A.
15,320	19.59	CKCS	Sackville, Canada
		VLC4	Shepparton, Australia
		—	Moscow
15,310	19.60	GSP	Daventry
15,300	19.61	GWR	Daventry
15,290	19.62	WRUL	Boston, U.S.A.
		KWIX	San Francisco, California
15,290	19.62	VUD11	Delhi, India
15,280	19.63	WNRE	New York
		—	Moscow
15,275	19.64	—	Singapore
15,270	19.65	RW96	Moscow
		WCBN	New York
15,260	19.66	GSI	Daventry
15,250	19.67	WLWR1	Cincinnati, U.S.A.
		KNBX	Dixon, California
15,240	19.68	TPA2/5	Paris
15,230	19.69	VLG6	Lyndhurst, Australia
		KCBA	Delano, California
15,220	19.71	PCJ2	Huizen, Holland
15,210	19.72	WBOS	Boston, U.S.A.
		OQ2AA	Leopoldville, Belgian Congo
		VLC11	Shepparton, Australia
15,200	19.74	VLA6/ VLB6	Shepparton, Australia
		WOOC	New York
15,195	19.75	TAQ	Ankara, Turkey
15,190	19.75	VUD5	Delhi, India
		CKCX	Sackville, Canada
15,180	19.76	GSO	Daventry
15,165	19.78	OTC4	Leopdville, Belgian Congo
15,160	19.79	VUD7	Delhi, India
		VLG7	Lyndhurst, Australia
15,155	19.80	SBT	Motala, Sweden
15,150	19.80	WRCA	New York
		WNBI	New York
15,140	19.82	GSF	Daventry
15,130	19.83	WRUS	Boston, U.S.A.
15,120	19.85	HVJ	Vatican City
		—	Colombo, Ceylon
15,110	19.85	GWG	Daventry
15,100	19.87	EPB	Teheran, Iran
		HOXA	Panama City
15,074	19.88	ETA	Addis Ababa
15,070	19.91	GWC	Daventry
14,840	20.21	LSP6	Argentine
14,690	20.42	PSF	Rio de Janeiro
13.610	22.05	—	Moscow
13.325	22.53	—	Khartoum, Sudan
13,050	22.99	WNRI	New York
13,020	23.05	—	Moscow
12,450	24.09	HCJB	Quito, Ecuador
12,235	24.51	TFJ	Reykjavik, Iceland
12,120	24.75	—	Algiers
12,095	24.80	GRF	Daventry
12.080	24.83	PST	Rio de Janeiro
12.040	24.92	GRV	Daventry
12,000	25.00	CSX	Lisbon, Portugal
11,970	25.06	FZI	Brazzaville, F.E.A.
11,965	25.08	HEK4	Berne, Switzerland
11,955	25.09	GVY	Daventry
11,945	25.12	ZPA5	Asuncion, Paraguay
11,930	25.15	GVX	Daventry
11,925	25.15	LRR	Rosario, Argentine
11,915	25.18	XGOY	Chungking, China
11,900	25.21	VLG9	Lyndhurst, Australia
		OQ2AB	Elizabethvil'e, Belgian Congo
11,885	25.23	TPB7	Paris
11,880	25.25	VLG5	Lyndhurst, Australia
11.870	25.27	VUD9	Delhi, India
		WOOC	New York
		WOOW	New York
11,860	25.30	GSE	Daventry
11,850	25.32	ORY	Belgium
		VUD3	Delhi, India
11,840	25.35	VLC7	Shepparton, Australia
		VLG4	Lyndhurst, Australia
		GWQ	Daventry
		—	Rangoon, Burma
11.835	25.35	CXA19	Montevideo, Uruguay
11,830	25.36	—	Moscow
11.820	25.38	GSN	Daventry
11,810	25.40	KCBR	Delano, California
		WOOW	New York
		HOXB	Panama City
		VLB4	Shepparton, Australia

Freq. Kc/s	Wave-length	Call-sign	Location
11,800	25.42	CE1180	Santiago, Chile
		GWH	Daventry
11,790	25.45	WRUA	Boston, U.S.A.
11,784	25.45	—	Saigon, Fr. Indo China
11,780	25.45	RW96	Moscow
11,770	25.49	VLA4	Shepparton, Australia
		VLB3	Shepparton, Australia
		GVU	Daventry
11,760	25.51	VLA8	Shepparton, Australia
		VLG10	Lyndhurst, Australia
		VUD11	Delhi, India
		CKRA	Sackvillé, Canada
11,750	25.53	GSD	Daventry
11,740	25.55	HVJ	Vatican City
		—	Moscow
		CE1174	Santiago, Chile
11,735	25.56	—	Singapore
		LKQ	Oslo, Norway
11,730	25.58	PHI	Huizen, Holland
		GVV	Daventry
11,720	25.60	OTM4	Leopoldville, Belgian Congo
		PRL8	Rio de Janeiro
11,710	25.62	VLG3	Lyndhurst, Australia
		WLWS2	Cincinnati, U.S.A.
		WLWO	Cincinnati, U.S.A.
11,705	25.63	SBP	Motala, Sweden
11,700	25.64	—	Paris, France
		GVW	Daventry
11,685	25.67	HVJ	Vatican City
11,680	25.68	GRG	Daventry
11,615	25.82	EPC	Teheran, Iran
11,090	27.05	—	Ponta Delgada, Azores
11,040	27.17	CSW6	Lisbon, Portugal
11,000	27.27	YHN	Java, Dutch E. Indies
10.780	27.83	SDB2	Motala, Sweden
10.730	27.95	VQ7LO	Nairobi, Kenya
10,410	28.78	HED4	Berne, Switzerland
10,350	28.98	LQA5	Argentine
10,220	29.35	PSH	Rio de Janeiro
10,065	29.80	PLY	Batavia, Dutch E. Indies
9,980	30.06	FZI	Brazzaville, F.E.A.
9,958	30.13	HCJB	Quito, Ecuador
9,940	30.18	HNF	Baghdad, Iraq
9,925	30.22	XDY	Mexico City
9,915	30.26	GRU	Daventry
9,860	30.42	—	Moscow
9,825	30.53	GRH	Daventry
9,810	30.58	—	Vienna
9,790	30.64	TGWA	Guatemala City
9,750	30.76	WNRX	New York
9,748	30.77	OTC2	Leopoldville, Belgian Congo
9,740	30.80	CSW7	Lisbon, Portugal
		XGOA	Chungking, China
9,720	30.86	PRL7	Rio de Jeneiro
9,710	30.89	KZTI	Manila, Phillipine Islands
9,705	30.91	FZF6	Fort-de-France, Martinique
9,700	30.92	KCBR	Delano, California
		WLWR1	Cincinnati, U.S.A.
9,690	30.96	LRA1	Buenos Aires
		GRX	Daventry
9,680	30.99	VLA3	Shepparton, Australia
		VLB2	" "
		VLC2	" "
		EQC	Teheran, Iran
9,675	31.01	GWT	Daventry
9,670	31.02	VUD4	Delhi, India
9,660	31.05	LRX	Buenos Aires
		HVJ	Vatican City
		VLQ3	Brisbane, Australia
		GWP	Daventry
9,650	31.09	KRHO	Honolulu, Hawaii
		VUD5	Delhi, India
9,640	31.12	YVKC	Caracas, Venezuela
		GVZ	Daventry
9,635	31.14	XGOY	Chungking, China
9,630	31.15	VUB2	Bombay, India
		VUD7	Delhi, India
		CKLO	Sackville, Canada
		KZRH	Manila, Phillipine Island
9,625	31.17	XEBT	Mexico City
		XGNC	Kalgan, China
		GWO	Daventry
9,620	31.18	TPB24	Paris, France
9,618	31.19	TIPG	San Jose, Costa Rica
9,615	31.20	VLB9	Shepparton, Australia
9,610	31.21	—	Moscow
		—	Algiers
		—	Rio de Janeiro
9,605	31.23	—	Capetown, South Africa

Freq. Kc/s.	Wave-length	Call-sign	Location
9,600	31.25	HOXC	Panama City
		—	Khartoum
		GRY	Daventry
9,590	31.28	VUD2	Delhi, India
		PCJ	Huizen, Holland
		WLWK	Cincinnati, U.S.A.
9,585	31.30	CE960	Santiago, Chile
9,580	31.31	VLG	Lyndhurst, Australia
		VLH3	Australia
		GSC	Daventry
9,565	31.36	VUM2	Madras, India
9,560	31.38	VUD5	Delhi, India
		—	Paris, France
9,555	31.49	—	Singapore
9,550	31.41	OLR3A	Prague, Czechoslovakia
		WRUW	Boston, U.S.A.
		KGEI	San Francisco, California
		HVJ	Vatican City
		GWB	Daventry
9,545	31.43	—	Colombo, Ceylon
9.540	31.44	VLB	Shepparton, Australia
		VLC5	" "
		LKJ	Oslo, Norway
		—	Rangoon, Burma
9,535	31.46	—	Berne, Switzerland
		SBU	Motala, Sweden
9,530	31.48	VUC2	Calcutta, India
9,525	31.50	ZBW3	Hong Kong
		GWJ	Daventry
9,523	31.50	—	Johannesburg, South Africa
9,520	31.51	VLW7	Perth, Australia
		—	Colombo, Ceylon
9,518	31.52	OXF	Denmark
9,510	31.55	GSB	Daventry
9,505	31.56	YUC	Belgrade, Yugoslavia
9,500	31.57	OIX2	Pori, Finland
		XEWW	Mexico City
9,490	31.61	KNBI	Dixon, California
		WOOW	New York
9,480	31.64	XGOA	Chungking, China
		—	Moscow
9,479	31.64	ORY	Belgium
9,470	31.67	CR6RA/C	Luanda, Angola
9,465	31.69	TAP	Ankara, Turkey
9,445	31.76	LRY	Buenos Aires
9,442	31.78	SDT	Motala, Sweden
9,440	31.78	FZI	Brazzaville, F.E.A.
9,437	31.78	—	Warsaw
		COCH	Havanna, Cuba
9,425	31.80	—	Belgrade, Yugoslavia
9,410	31.88	GRI	Daventry
9,380	31.98	OTM2	Leopoldville, Belgian Congo
9,370	32.01	—	Madrid, Spain
9,362	32.05	COBC	Havana, Cuba
9,350	32.08	OTM	Leopoldville, Belgian Congo
9.345	32.10	—	Sofia, Bulgaria
		FZF6	Fort-de-France, Martinique
		HBL	Geneva, Switzerland
9,315	32.20	LRS	Buenos Aires
9,285	32.29	CR8AS	Macao
9,275	32.34	COCX	Havana, Cuba
9,253	32.42	—	Bucharest, Rumania
9.250	32.43	YSF	San Salvador, El Salvador
9,235	32.48	COBQ	Havana, Cuba
9,230	32.50	CR8AA	Macao
9,165	32.73	CR6RB	Benguela, Angola
9,105	32.94	PJC1	Curaçao
9,082	33.04	CNR3	Rabat, French Morocco
9,026	33.23	COBZ	Havana. Cuba
8,940	33.55	—	Moscow
8,910	33.67	—	Moscow
8,830	33.97	XRRA	Peiping, China
8,825	33.99	COCQ	Havana, Cuba
8,700	34.48	COCO	Havana, Cuba
8,110	36.99	XRSA	Sichang, China
8,036	37.33	FXE	Beirut, Syria
8,020	37.40	ODE	Beirut, Syria
7,995	37.52	PMD	Batavia, Dutch East Indies
7,940	37.78	PSL	Rio de Janeiro
7,863	38.17	SUX	Cairo
7,852	38.21	ZAA	Tirana, Albania
7,660	39.16	LZB	Sofia, Bulgaria
7,650	39.21	—	Moscow
7,560	39.68	—	Moscow
7,510	39.94	—	Moscow
7,445	40.29	FG8AH	Guadeloupe, W. Indies
7,410	40.48	—	Moscow
7,360	40.76	RWG	Moscow
		—	Berne, Switzerland

Freq. Kc/s	Wave-length	Call-sign	Location
7,340	40.87	XMNG	Nanking, China
7,320	40.98	GRJ	Daventry
7,300	41.09	—	Moscow
7,295	41.12	—	Athens, Greece
7,290	41.15	—	Munich 1
		VUD2	Delhi, India
		VUD3	Delhi, India
		VUD5	Delhi, India
		VUD11	Delhi, India
7,283	41.19	ZQP	Lusaka, N. Rhodesia
7,280	41.21	VLC8	Shepparton, Australia
		VLA	Shepparton, Australia
		GWN	Daventry
7,270	41.26	—	Moscow
7,260	41.32	VUM2	Madras, India
		GSU	Daventry
7,250	41.37	PJC1	Curaçao
		GWI	Daventry
7,240	41.43	VLQ	Brisbane, Australia
		VUB2	Bombay, India
7,230	414.9	GSW	Daventry
7,225	41.52	KOFA	Salzburg, Austria
7,220	41.55	JCKW	Palestine
7,215	41.58	VLQ2	Brisbane, Australia
7,210	41.61	VUC2	Calcutta, India
		VUD8	Delhi, India
		VUD10	Delhi, India
		LLF	Oslo, Norway
		GWL	Daventry
7,200	41.66	RW96	Moscow
7,185	41.75	—	Colombo, Ceylon
		GRK	Daventry
7,177	41.80	—	Moscow
7,165	41.87	—	Moscow
7,150	41.95	XGOY	Chungking, China
		GRT	Daventry
7,126	42.09	—	Hargeisa, British Somaliland
7,120	42.13	GRM	Daventry
7,100	42.25	EAJ7	Madrid, Spain
7,085	42.34	YI5KG	Baghdad, Iraq
7,075	42.40	GRS	Daventry
7,055	42.52	OQ2AB	Elizabethville, Belgian Congo
7,026	42.70	—	Malaga, Spain
7,010	42.79	XPSA	Kweiyang, China
7,005	42.8	—	Valladolid, Spain
6,980	42.98	FO8AA	Papeeti, Tahiti
6,920	43.35	—	Moscow
6,917	43.37	FGA	Dakar, Senegal
6,820	43.98	SUP2	Cairo, Egypt
6,786	44.21	HI2A	Dominican Republic
6,780	44.24	HNF	Baghdad, Iraq
6,770	44.31	—	Singapore
6,700	44.77	—	Moscow
6,675	44.94	HBQ	Switzerland
6,635	45.21	HIT	Trujillo City, Dominican Rep,
6,600	45.45	—	Moscow
6,548	45.80	YNBH	Managua, Nicaragua
6,540	45.87	TGWB	Guatemala City, Guatemala
6,525	45.97	—	Ljubljana, Yugoslavia
6,485	46.22	HI2T	Dominican Republic
6,450	46.51	COHI	Cuba
6,430	46.65	HI1R	San Cristobal, Dom. Republic
6,390	46.94	HI9B	Santiago de los Caballeros, Dom Republic
6,385	46.98	HI1X	Trujillo City, Dominican Republic
6,370	47.09	CSX	Lisbon, Portugal
6,368	47.09	OAX4H	Lima, Peru
6,345	47.28	HEI2	Berne, Switzerland
6,335	47.36	OAX6E	Arequipa, Peru
6,330	47.40	COCW	Havana, Cuba
6,320	47.46	EQB	Teheran, Iran
6,315	47.50	—	Baden-Baden, Germany
6,312	47.54	HI1Z	Trujillo City, Dominican Rep.
6,295	47.65	OTM1	Leopoldville, Belgian Congo
6,275	47.80	ZPA1	Asuncion, Paraguay
6,273	47.81	HIL	Trujillo City, Dominican Rep.
6,270	47.85	YSR	San Salvador
6,255	47.96	TGRA	Guatemala City, Guatemala
		YSU	San Salvador
6,245	48.03	HI1N	Trujillo City, Dominican Rep.
6,220	48.23	HJFB	Manizales, Colombia
		OAX4M	Lima, Peru
6,210	48.30	HC1AC	Quito, Ecuador
6,205	48.34	YV6RD	Bolivar, Venezuela
		—	Tangiers
6,200	48.38	HJCT	Bogota, Colombia
6,195	48.42	HI1A	Santiago de los Caballeros, Dom. Rep.

Freq. Kc/s	Wave-length	Call-sign	Location
6,195	48.42	GRN	Daventry
6,190	48.46	HVJ	Vatican City
		VUD2	Delhi, India
		VUD7	Delhi, India
		WNRX	New York
6,185	48.50	LLI	Oslo, Norway
6,180	48.54	LRM	Mendoza, Argentine
		GRO	Daventry
6,175	48.58	XEXA	Mexico City
6,165	48.66	HHCM	Port-au-Prince, Haiti
		HER3	Berne, Switzerland
		GWK	Daventry
6,160	48.70	—	Moscow
		—	Rome, A.F.N.
6,155	48.74	EQB	Teheran, Iran
		CE615	Santiago, Chile
6,150	48.78	VLR2	Melbourne, Australia
		VUB2	Bombay, India
		TIRH	San Jose, Costa Rica
		GRW	Daventry
6,145	48.83	XGOY	Chungking, China
6,140	48.86	—	Moscow
6,130	48.93	COCD	Havana, Cuba
		CHNX	Halifax, Nova Scotia
6,125	48.98	GWA	Daventry
6,12	49.02	LRX1	Buenos Aires
		OIX1	Helsinki, Finland
6,110	49.10	GSL	Daventry
6,105	49.15	WLKS	A.F.N., Kure, Japan
6,100	49.18	VUD10	Delhi, India
		—	Poland
6,095	49.22	—	Johannesburg
			Belgrade, Yugoslavia
6,090	49.26	LRY1	Buenos Aires
		ZNS2	Nassau, Bahamas
		—	Luxembourg
		—	Moscow
		GWM	Daventry
6,085	49.30	VUM2	Madras, India
		ZAA	Tirana, Albania
6,080	49.34	—	A.F.N., Munich
6,070	49.42	GRR	Daventry
6,065	49.46	SBO	Motala, Sweden
6,063	49.48	FIQA	Madagascar
6,060	49.50	VQ7LO	Nairobi, Kenya
		—	Sackville, Canada
		VUD11	Delhi, India
		—	Moscow
6,050	49.59	GSA	Daventry
6,040	49.66	COBF	Havana, Cuba
		—	Algiers
6,035	49.71	—	Rangoon, Burma
		GWS	Daventry
6,030	49.76	—	Moscow
		OLR2B	Prague, Czechoslovakia
		IRF	Rome, Italy
6,026	49.81	PCJ	Huizen, Holland
6,025	49.81	—	Brazzaville, F.E.A.
6,015	49.87	PRA8	Pernambuco, Brazil
		XEOI	Mexico City
6,010	49.91	RW96	Moscow
		CJCX	Nova Scotia
		OLR2A	Prague, Czechoslovakia
		VUC2	Calcutta, India
		VUD3	Delhi, India
		GRB	Daventry
6,005	49.95	—	Johannesburg, South Africa
6,000	50.00	ZFY	Georgetown, Bt. Guiana
		XEBT	Mexico City
		PRI3	Bello Horizonte, Brazil
5,995	50.05	—	Andorra la Vieja, Andorra
5,990	50.08	LRS1	Buenos Aires
5,970	50.25	HVJ	Vatican City
		VONH	St. John's, Newfoundland
5,950	50.42	HH2S	Port-au-Prince, Haiti
5,945	50.46	OAX4V	Lima, Peru
6,940	50.50	RV15	Kharbarovsk, U.S.S.R.
5,935	50.54	PJC1	Curaçao
5,920	50.67	—	Moscow
		XGOA	Chungking, China
5,890	50.93	OAX4Z	Lima, Peru
5,880	51.02	—	Capetown, South Africa
5,875	51.05	HRN	Tegucigalpa, Honduras
5,845	51.32	—	Paramaribo, Surinam, Dutch Guiana
5,810	51.63	—	Moscow
5,732	52.33	SBU	Motala, Sweden
5,620	53.38	OAX2A	Trujillo, Peru
5,302	56.58	—	Munich

Freq. Kc/s	Wave-length	Call-sign	Location
4,990	60.12	YV3RN	Barquisimeto, Venezuela
4,978	60.26	YVKO	Caracas, Venezuela
4,970	60.36	YV5RM	Caracas, Venezuela
4,965	60.44	HJAE	Cartagena, Colombia
4,955	60.54	HJCQ	Bogota, Colombia
4,950	60.60	VQ7LO	Nairobi, Kenya
4,945	60.66	HJCW	Bogota, Colombia
4,930	60.85	HJAP	Cartagena. Colombia
4,925	60.91	CR7BU	Lourenço Marques, Mozambique
4,915	61.04	YV5RN	Caracas, Venezuela
		ZOY	Accra, Gold Coast
4,900	61.22	—	Colombo. Ceylon
4,895	61.28	HJCH	Bogota, Colombia
		—	Johannesburg, South Africa
4,890	61.34	VQ7LO	Nairobi, Kenya
4,885	61.40	HJDP	Medellin, Colombia
4,880	61.47	VUB2	Bombay, India
4,875	61.55	HJFH	Armenia, Colombia
4,865	61.66	HJEX	Cali, Colombia
4,860	61.72	YV5RU	Caracas, Venezuela
4,855	61.72	HJCA	Bogota, Colombia
4,850	61.85	HJGF	Bucaramanga, Colombia
		ERA	Ponte Delgada, Azores
4,840	61.98	YV1RZ	Venezuela
4,830	62.11	YV2RN	San Cristobal, Venezuela
4,825	62.17	HJED	Cali, Colombia
4,820	62.24	—	Singapore
4,815	62.30	HJBB	Cucuta, Colombia

Freq. Kc/s	Wave-length	Call-sign	Location
4.810	62.37	YV1RL	Maracaibo, Venezuela
4.805	62.43	HJDU	Medellin. Colombia
4.800	62.50	YV1RX	Maracaibo. Venezuela
4,795	62.56	EQD	Teheran. Iran
		HJDX	Medellin, Colómbia
4.790	62.63	YV6RU	Bolivar City. Venezuela
4,785	62.69	HJAB	Barranquilla. Colombia
4,780	62.76	YV4RO	Valencia, Venezuela
		—	Singapore
4,775	62.82	HJGB	Bucaramanga, Colombia
4,770	62.89	YV1RY	Coro, Venezuela
4,700	62.89	ZQ1	Kingston, Jamaica
4,650	64.51	HC2AK	Guayaquil, Ecuador
4.170	73.04	HCJB	Quito. Ecuador
3,930	76.33	HC5EH	Cuenca City, Ecuador
3,726	80.50	ZQP	Lusaka, N. Rhodesia
3,720	80.64	ZEB	Bulawayo, S. Rhodesia
3,658	81 95	ZEA	Salisbury, S. Rhodesia
3,580	83.79	YV3RS	Barquisimeto, Venezuela
3.505	85.59	YV5RX	Caracas, Venezuela
3,495	85.83	VUD2	Delhi. India
3,490	85.96	CR7AB	Lourenço Marques, Mozambique
3,470	86.45	YV7RB	Cumana, Venezuela
3,450	86.95	—	Johannesburg, S. Africa
3,430	87.46	LRS	Buenos Aires
3,380	88.75	YV5RY	Caracas. Venezuela
3,335	89.95	VUD3	Delhi, India
3,305	90.77	VUC2	Calcutta, India

On the Amateur Bands

A Monthly Report of Results and Conditions Experienced on the Short Waves.

By "KAYAK"

OVER the period under review, conditions on all the amateur high-frequency bands have continued good. Three major DX contests, the B.E.R.U., R.E.F. and the American-Canadian QSO party have provided much in the way of interesting DX.

28 Mc/s Band

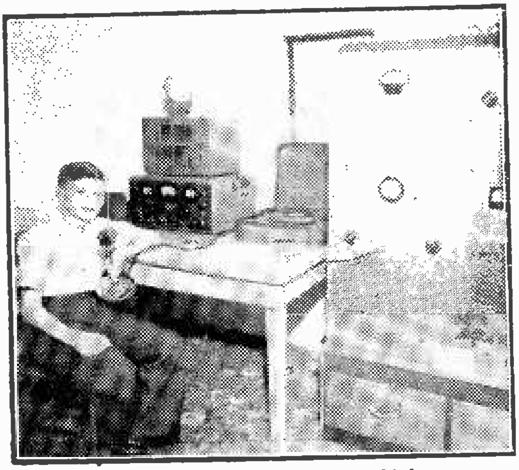
D. L. McLean reports over 100 good DX 'phones received. He remarks upon strange conditions which have resulted in South Americans being audible until 23.15 G.M.T., Pacific-coast Americans coming through until 22.30, and stranger still, Australian and New Zealand signals being received up to 22.45.

Extracted from his log: Chilean CE1AH, CE3BA, CE3EE; CR9AG in Macaro; Liberian EL2A, EL5A; HH5PA Haiti; HI60, Dominican Republic; HK3AB, Colombia: KV4AD, Virgin Islands; KZ5AB, Canal Zone; OQ5AR and OQ5CE Belgian Congo; PZ1D, PZ1M, Surinam; VP4TE, VP4TZ, Trinidad and Tobago Islands: VP6FO, Barbados: VQ3EOD, Tanganyika; VQ4ERR, VQ4JBC, Kenya; YN3DG, Nicaragua; YV1AN, Venezuela; and ZE1JB, ZE1JM, Southern Rhodesia. "Mobile maritimes" listed include W1PPH/MM, W2LDH/MM, W2QIC/MM and W5BSY/MM. Interesting ones from the Middle East are MD5AFA and MD5KH (QTHs in current DX list at end). Receiver used by Mr. McLean is Sky Champion S20 with V.H.F. converter. Antenna is a 58 Mc/s coaxial-fed dipole, 8½ft. long and 40ft. high. From his good report this month it would appear that the offending radar station which has caused him intense QRM on this band has been removed.

Dennis Tyler lists W6ONT/KW6, Wake Island; XZ2DN, Burma; VS9AB, Aden; TI2OEC, Costa Rica; VP9F, Bermuda; W3JRF/KG6, Guam; XU6GRL, Nanking; NY4FC,(QTH ?); VP2MY, Monserrat Island; ZC6FP, Palestine: CN8BB, French Morocco; and numerous Pacific-Coast Americans.

G3FT reports many good DX QSOs from his temporary beam antenna which is only 8ft. above ground.

Effective as from April 1st, amateur operation on the 28 Mc/s band in Canada was authorised



Amateur station W5LVZ, El Reno, Oklahoma, operated by Donald Choice, who claims to be the world's youngest operator. He is 10 years of age.

as follows: 28,200 to 29,700 kc/s for A.M. 'phone; 29,500 to 29,700 for narrow band F.M.; 28,000 to 29,700 kc/s for CW. As a result of this sub-division of the band the first 200 kc/s will be kept clear for CW operation.

14 Mc/s Band

This frequency continues to provide the rare DX catches. On most days the band is now "open" for 24 hours at a time.

BSWL 804 informs us of CT2AB, Azores; EA9AI, Spanish Morocco; HK1DZ, Colombia; Japanese J2AAG; KH6GF, Hawaii; LI2BO, Libia; MD5PC, Kabrit, MEF; OA4AI, Peru; TI2OA, Costa Rica; TR1P, Tripoli; VP2LA, Leeward and Windward Islands; VQ4JBC, Kenya; W2MMO/MM (on Newfoundland-Bremen run); YI6C, Iraq; ZC6DD, Palestine; and a host of W5s, W6s and W7s. Many Australian calls are listed, the most interesting being VK7NC and VK7TR, both in Tasmania. Antenna used by BSWL 804 on this frequency is a 33ft. vertical.

John Brooks, North London, records the following CW stations: OX3BF, Greenland; ZM6AC, Western Samoa (a very consistent DX station on this frequency); CT2LL, Azores; VO2G, Newfoundland; KZ5GD, KZ5AD, both in Bilbao, Canal Zone; LB4UD (QTH ?); ZD1KR, Sierra Leone; NY4AE, Guantanomo Bay, Cuba; K7JDA/KP4, Puerto Rico; PK2RK, Java; and LJ2F, Bergen. 'Phones listed are: EA1D, Madrid; CX2AX, Montevideo; W6ONT/KW6, Wake Island; TI2RC, Costa Rica; CO8NP, Cuba; YV5ACX, Venezuela; and LI2BO, Libia.

On CW our contribution is: ZM6AC, Western Samoa; KL7BA, Alaska; ZD1KR, Sierro Leone; YI2AM, Baghdad; EP1AL, Iran; NY4AE, Cuba; OA4Q, Peru; EK1AS, Tangiers; ST2AM, Sudan; VS9AN, Aden; PK6HA, Celebes; KH6JW Hawaii. "Best of the month" was KS4AC, Swan Island, West Indies, who was heard several mornings in succession around 06.00 G.M.T., working American stations at the rate of one a minute. Our 'phone log shows YV5AB, Caracas; HK3BI, Bogata; XACP, Sardinia; HZ4DO, Mekka; PR1AB (QTH ?); HH5PA, Haiti; XABU, Rhodes; and W2MMO/MM. A few American stations, 'phones and CW, have been heard using the new "K" prefix. This prefix is being used as and when the "W" series in each district is completed.

'Phones reported by Denis Tyler list VK4NK, New Guinea; W3KDD/MM; CT2WX, Azores; PA1OY, Surinam; ZB1AD, Luqa; Malta; VR2AE, Fiji; ZD1KR, Sierra Leone; KUFRA (QTH Libia ?); CR4HT, Cape Verde Islands; VK4NK, New Guinea; KP6AA, Palmyra Island; LI2BO, Libia. On CW there is HK4AF, Colombia; PK6EE, Celebes; CP1AP, Bolivia; OI2KAA, Helsinki; ET3Y, Ethiopia; VQ8IL, Mauritius; KZ5AD, Bilbao; D5FF (Germany ?); XE3C, Mexico; I6USA, Eritrea; LB9O (portable) Trondheim; EA7AV, Madrid; and VS6AA, Hong Kong.

From the A.R.R.L. we learn that Lawrence De Wolfe Kelsey, operator of the Ronne Antarctic Expedition, now operates from Marguerite Bay on 14 Mc/s, using the call W3LYK/Antarctica. The hours 04.00-08.00 G.M.T. are suggested as the best for contact with the expedition. The expedition is also "on the air" from the Motor Vessel Port of Beaumont, using call-sign AYZH. The frequency is 8,330 kc/s (answering calls to be made in the 7 Mc/s band) and scheduled time for amateur contacts is around 04.30 G.M.T. every third day (June 4th, 7th, 10th, etc.).

7 Mc/s Band

Conditions on this band remain the same, DX catches being there for those with the patience to wade through the heavy European QRM. Our own log shows VE4AN; VP9E, Bermuda; XE1R, Mexico; FB8AG, Madagascar; K7JDA; KP4EN, Puerto Rico; Cuban CO6AV, CM2CZ and CM8GA; HK4AF, Colombia; and CX1DB, Uruguay. All these were heard around 01.00 G.M.T. on various days.

Dennis Tyler lists VP4TS, Trinidad; XE1A, Mexico; CN8MZ, French Morocco; KV4AA, Virgin Islands; South African ZS6AD; ST2AM, Sudan; and innumerable East Coast Americans.

Shorts

The Kon-Tiki expedition left Callo, Peru, on April 29th, on its 4,000 mile trip across the Southern Pacific to the Polynesia group. The Kon-Tiki is a raft 50ft. long by 20ft. wide, consisting of logs of balsa wood and bamboo lashed together with rope. The expedition carries a low-power transmitter, which operates in the 14, 28 and 50 Mc/s band, using call-sign LI2B. Beam aerials are in use for the 28 and 50 Mc/s bands, and the power input is 15 watts.... "KZ5" call-signs are now being issued to civilians in the Panama Canal Zone. Formerly call signs were issued to military personnel only.... Cards for unlisted Japanese stations may be sent to Major Lloyd D. Colvin, J2AHI, H.Q., 71 Sig. Service Btn., A.P.O., c/o Postmaster, San Francisco.... Temporary power restrictions in Hawaii and vicinity on the band 3,500-4,000 kc/s have now been removed, and amateurs in the area may now use 1-kilowatt input on this band.... Canadian amateurs in the 8th district (North-West Territories) receive mail only twice a year, hence their delay in answering reports.... American amateurs, upholding their great tradition, cleared much distress traffic during the recent Texas holocaust.... The American 11-metre band has been shifted 25 kc/s lower in frequency and is henceforth 27,160 to 27,430 kc/s.

Current DX QTH List

NY4AE, Guantanamo Bay, Cuba.

OX3BF, Earl Baker, R.M.3/C, Navy 1,503, c/o F.P.O., N.Y.C.

OI2KAA, Box 250, Helsinki.

CR9AG, John Alvarez, c/o G.P.O., Macao, via Hong Kong.

CX1DB, c/o American Embassy, Montevideo.

KP4CU, P.O. Box 307, Juncos, Porto Rico.

KV4AD, P.O. Box 136, Fredericksted, St. Croix, U.S. Virgin Islands.

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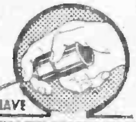

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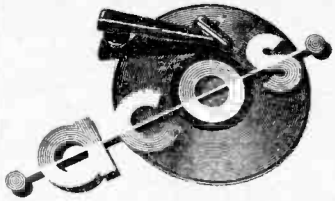

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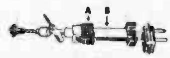

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ELECTRIC LIGHT CHECK METERS, for 200/250 volt 50 cyc. 1 phase, ideal for subletting, etc., guaranteed electrically 2½ amp. load 12/6, 5 amp. 12/6, 15 amp. 20/-, 20 amp. 25/-, 30 amp. 30/-, 40 amp. 35/-, 50 amp. 45/-. 100 amp. 50/- each, plus 1/6 carriage extra.

EX-G.P.O. VERTICAL TYPE GALVANOMETERS, centre zero reading 30/0/30. 7/6 each, post 1/-. Mallory 12 volt. vibrators, new and unused. 7/6 each. Electrolytic condensers, 80 mf. 350 volt wkg. 5/6 each, post 9d.

METERS. All first grade moving coil instruments, new, boxed, ex-Govt., 0 to 40 volts, with series resistance removed. 5 m/a. 15/- each. 0 to 10 amps. 15/-, 0 to 1 m/a. 21/-. All 2in. scale and by well-known makers.

EX-R.A.F. MICROPHONE TESTERS. These consist of a Ferranti 2½in. m/coil 0 to 1 m/a. meter with Westinghouse Rectifier incorporated, calibrated at present 0 to 10 volts, microphone transformer, jacks, etc., all contained in polished teak case, size 6½in. x 5¼in. x 5in. Condition as new. Price 37/6 each.

EX-G.P.O. (AMERICAN) VIBRATOR PACKS. Type M222, 4 volts D.C. input, output 100/120 volts A.C. 20/30 m/a. New and unused, 27/6 each, carriage 2/6.

VOLTAGE CHANGER TRANSFORMERS. Ex-Govt., auto wound, Tapped 0, 10, 20, 25, 90, 130, 150, 190, 210, 230 volts, 1,000 watts, all tapping at 1,000 watts. New and unused £5/10/- each, carriage 5/-.

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EX-R.A.F. AERIAL COUPLING UNITS, absorption type. Range from 1.2 to 5.3 m/cycles, 10/- each, post 1/-.

EX-R.A.F. I.F.F. UNIT (Model) 3002 complete with 10 valves types 3X70E, 1EF50, 4VR65, 2XYT61A, and rotary converter 12 volts input 450 volts 40 m/a. output. These units are as new. Price complete, £3/10/- carriage paid. Ditto Model 3009, 24 volt input, £3, carriage paid.

EX-R.A.F. RADAR IMPULSE TRANSFORMERS (new, boxed). We have no actual data on these, but believe them to have an output of 15,000 volts at 3 kW. for a micro second. A bargain for the experimenter at 10/6 each. P.F.

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News from the Clubs

DUBLIN RADIO CLUB
Hon. Sec.: 8, New Ireland Road, Rialto.

THE Dublin Radio Club (formerly Practical Amateur Radio Constructors Club) have elected the following Officers and Committee members:

President: T. Keogh.
Vice-President: R. Plunkett.
Hon. Sec.: W. C. Rothwell.
Ass. Sec.: H. Duncan.
Treasurer: C. O'Mara.
Ass. Treasurer: F. Murtagh.
Committee: J. Keane, W. Traynor, E. Murphy.

The Club has been reorganised, and a Technical Library opened. Members who wish to donate books can get in touch with the Librarian, Mr. C. O'Mara, on meeting nights.

Members attending the Morse classes for the last two months have made excellent progress, classes being held on Wednesday and Friday, 8 p.m. to 9 p.m. Many members have constructed sets with good results; these sets ranged from simple O-V-O's to a five-valve T.R.F.

Meetings are held in the Foresters Hall (Room 6), 41, Parnell Sq., Wednesdays and Fridays, 8 to 10.30 p.m.

SLADE RADIO
Hon. Sec.: L. A. Griffiths, "Tresco," 34, Florence Road, Sutton Coldfield.

ON Friday, May 16th, Slade conducted a most unusual meeting by means of 5-metre transmission and reception.

The normal formalities were completed, and the evening was filled by 2AK and 5LJ giving a description of their respective outfits and, later, 2ATK/P left Broomfield Road and travelled to Pilkington Avenue, transmitting the while, also in the 5-metre band. The maximum distance between these two points is approx. 3¼ miles and, but for flutter due to obstructions, the signal was 100 per cent. and readable the whole time.

Reports were received from Handsworth Wood and Elmdon; in both cases reception was 100 per cent. and contact was kept with all three stations. The schedule started at 8.10 p.m. and terminated at 9.50 p.m.

The evening proved a great success, and is one worthy of other clubs' consideration.

THE STOURBRIDGE AND DISTRICT RADIO SOCIETY
Hon. Sec.: D. Rock, Flat 1, Block 1, Worcester Road, Summerfield, Nr. Kidderminster.

AT the General Meeting of the above Society, held on May 6th, 1947, the large number of members who attended heard a lecture on "Radio Aids to Navigation." This interesting subject was discussed by Flight Lieutenant G. W. Adam, R.A.F., and was much appreciated by all.

Future meetings, it is hoped, will include talks on Variable Frequency Oscillators, Transformer Designs, etc. Plans for the operation of two portable stations at Kidderminster and Clent during the National Field Day in June are well in hand.

Any person interested in radio or allied subjects is invited to attend the meetings, held monthly at King Edward's Grammar School, Stourbridge, on the first Tuesday of each month.

PROPOSED LURGAN AND DISTRICT RADIO CLUB

IN view of the increased number of radio enthusiasts in the district, it is felt that a Club would be appreciated. Details of this proposed Club may be obtained from W. J. Galloway, Moygannon, Donacloney, Co. Down, N.I.

CLACTON RADIO CLUB
Hon. Sec.: A. P. Kerford-Byrnes (G6AB), "Haywire," 44, Preston Road, Holland-on-Sea, Essex.

THIS newly-formed Radio Club has meetings every fortnight. The G.P.O. have granted a Transmitting Licence, and the Club Transmitter has been on the air with the call sign G3CRC.

Slow Morse classes are held for the benefit of members, and a series of lectures on the fundamentals of radio is being given by Mr. D. W. Heightman (G6DH).

Anyone interested in radio is invited to attend, and full particulars can be obtained from the Hon. Sec. as above. New members would be welcomed.

WIRRAL AMATEUR RADIO SOCIETY
Hon. Sec.: B. O'Brien, G2AMV, 26, Coombe Road, Irby, Heswall, Cheshire.

THIS Society continues activity with over sixty members, two meetings per month being held in the Y.M.C.A., Whetstone Lane, Birkenhead. June meetings will be on Wednesdays, the 11th and 25th, at 7.30 p.m. Programmes to be announced later.

Recent meetings have included very successful junk sales and a talk by G2FNI on the TR 1196.

Full details of the society from the Sec.

YEOVIL AMATEUR RADIO CLUB
Sec.: D. Hover, 16, Richmond Road, Yeovil, Somerset.

THE Yeovil Amateur Radio Club now meets on Wednesdays at 7.30 p.m. in the Technical School, Kingston, Yeovil. Now a permanent headquarters has been secured it is proposed to build a club station and to apply for a club licence. Morse classes are held at each meeting. Any prospective member should contact the Secretary.

KYNOCH RADIO AND TELEVISION SOCIETY
Assist. Sec.: G. E. Nicholls, Kynoch Works, Witton, Birmingham, 6.

THE above Society has been formed in connection with employees of I.C.I. (Metals), Ltd., Kynoch Works, Witton, Birmingham.

The Society's activities will cover interests in Quality Reproduction, Recording, Short-Wave Reception and Transmission, and the various applications of Electronics, and it is hoped eventually to establish its own station and laboratory.

An interesting programme of lectures, visits and demonstrations is being arranged.

WORCESTER AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: D. Higley, 1, York Place, Worcester.

THE above club has just been formed in Worcester. Meetings are held once a month, on the first Thursday, at the Victoria Institute.

THE BIRMINGHAM AND DISTRICT SHORT WAVE SOCIETY
Hon. Sec.: N. Shirley, 14, Manor Road, Stechford, Birmingham, 9.

MEETINGS of the above society continue to be held on the first Monday of each month (the August meeting will be held on August 14th). Efforts are being made to organise fortnightly meetings, if sufficient interest is forthcoming. At the June meeting the May Log given by two of the members included some very good DX, and showed what straight receivers can do. There was also a quiz contest which provided some amusement and, it is hoped, some useful information.

Programme Pointers

This Month MAURICE REEVE Looks at the June Anniversaries

IT becomes increasingly difficult to depend on the advertised wireless programmes. Like the farmer who never knows whether his autumn sowings will lie under 10 feet of spring floods, or the lady who will be fortunate if she can use her clothing coupons for a winter outfit when she expected to adorn herself with a summer creation on them; so is it difficult for the reviewer of coming features to write about what may never take place.

But the hours devoted to "good" music, and related subjects, are really so generous that we should not grumble too much when something we were looking forward to cannot be given us.

June Anniversaries

Perhaps a résumé of the chief musical anniversaries of June will be of interest; there are quite a few.

Elgar was born on the 2nd, in 1857; Stravinsky on the 5th, in 1882; Schumann on the 8th, in 1810; Wagner's "Tristan and Isolde" was first performed in Munich on the 10th, 1865, with the faithful and much-wronged Hans von Bülow conducting. Richard Strauss was born in 1864 on the 11th; Grieg on the 15th, in 1843; Gounod on the 17th, 1818. Elgar's most lovely and haunting work, the "Enigma Variations," was first played on the 19th, in 1899. Offenbach was born on the 20th, in 1819; Wagner's "Die Meistersingers" was produced on the 21st, in 1868, and his "Valkyrie" on the 25th, in 1870. Last but not least, Beethoven's "Missa Solemnis" was heard for the first time in its entirety on the 29th, in 1830, three years after the composer's death, and 80 years after and 30 years before, Bach's "B Minor Mass" was written and first performed, respectively.

The claims of Elgar to be our greatest national musical genius are only likely to be challenged by Purcell champions of past days and by Delius fans of his own times. With what success I will not commit myself to saying. Sufficient to say here, that he was the centre of the great musical renaissance in England, and that he bequeathed us undoubted masterpieces in the said "Variations," "Gerontius," "Falstaff," "Cockaigne," the "Violin Concerto," etc. His two symphonies, if fine works, are not, in the writer's opinion, in the same rank as the great German symphonic dynasty.

Robert Schumann, who died at the early age of 46, was, in many ways, the most ineffable of all the romantic 19th century masters. He left an imperishable legacy, with a special enrichment of piano literature. About to become a first-class pianist, he cut that part of his career short by permanently injuring his fingers in a mistaken and misguided effort to develop his technique by means of impossible exercises performed with the aid of a contraption of his own devising. But by marrying the devoted and subsequently famous Clara Wieck, he was not only able to hear his own piano works adequately performed, but to become the father of eight children as well. After his death, Clara devoted her life to playing Robert's works and became a very distinguished pianist in the process. All honour to her; her life could scarcely have ever known a dull moment.

Who has ever been unaffected by that sweet, lovely work, "Carnival"? The apotheosis of the 19th century romantic movement, it challenges even Chopin in some of its pages, one of which bears the greatest of the romantics' name for its title. A master of most musical forms, he made outstanding contributions to vocal, chamber and symphonic literature. His symphonies are strong candidates for a high place in the symphonic hierarchy. He dedicated his "Fantasie," that work of "sweet, heavenly length," to Liszt, his great romantic contemporary, who returned the compliment by inscribing Robert's name at the head of his own greatest contribution to the romantic movement, the "B minor Sonata."

Strauss's Contribution

Richard Strauss, like Sibelius, is a veteran of over 80, whose contribution to music is both completed and secured for posterity. The musical grandson of Richard Wagner, he is perhaps less popularly known than most composers. But his brilliant and dazzling symphonic poems, fashioned on Liszt's prototype of 50 years earlier, together with some excerpts from his operas, "Rosenkavalier," "Salome," etc., are permanent features of the repertory. The latter rank with modern Italian opera as classics of the genre.

Grieg, the grandson of a Scots emigrant, is probably far more widely known, and maybe liked, than either Schumann or Strauss, but he must take a far lower seat on Parnassus than either. A master of the smaller forms, with a gift for melody that is frequently marred by the constantly recurring descent of a, usually, minor third to its cadence; Debussy's delineation of his music as "bonbons stuffed with snow," remains a classic of its kind.

Unlike operatic masters who wrote their own operas, Grieg has relied on someone else to write one based on a raking and sifting of his music for "likely" bits and pieces. The current production, "Song of Norway," frequently distorts the original much more than it deserves. His piano concerto, a glittering work abounding in the above figure, and one of the most popular in the repertory, is his finest work.

Of Beethoven's and Wagner's contributions to the month's births, left to the last, Wagner's is absolutely outstanding in the history of music. Opera never reached such heights, either before or since. And it is pretty safe to say that, like Beethoven with the symphony and related works, Wagner has said the definitive word on operatic lore. Seeing that he was also his own librettist, he and Beethoven—Bayreuth and Bonn are not far apart, anyway—must surely be sharing the throne on Mount Parnassus. The two together embrace the whole musical cosmos; neither has left anything for their successors to do but imitate and emulate when and where they can.

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MULLARD Loctal 9 pin valve holders' 6/- per doz.

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announcing following additions to their List of Valves, British and American, from 5/10 as given in July issue of "Practical Wireless," page 298. These may be added to the many hundreds of types : CBL1, CBL31, DET25, HP4106, KT33C, U403, VR105/30, VR150/30, X41C, 1E7, 6AB7/1853, 6AC7/1852, 6C4, 7Q7, 12SG7. Order C.O.D. Please enquire for any valve you require, even if not listed. We may have it. Old and new types are arriving daily.

Here is a non-classified selection of new items in order of their day-by-day arrival :—

Electro Plating Home Outfit Kit enables you to nickel-plate any article which is electroplatable ; operates from 1.5 volt dry battery, complete, **£1 9s. 6d.** **Stripper** for Wire and Cable, capacity 1.044-5 036 VIR and flexibles, Micro blade setting; 18% Tungsten H.S. cutter, quick change bed, **15s.** **Eric Steel Tray Box** with swing lid, containing 96 ½-watt Resistors, assorted values from 12 ohms to 10 megohms ; not only colour coded but actually marked. Will carry 100% overload. Same as above but 48½-watt 15 ohms, 10 megohms, **£1 4s.** **Pocket Level**, all metal, long life, accurate, spirit filled, **5s.** **Magnifying Lens**, 2in. diameter, with frame and handle, **10s.** **Lexington Moving Coil Pick-up**, scientifically engineered, **£6 6s.** **Motor**, Elec. working model kit, operates from 4.5 torch batt., **9s. 11d.** **Heater-Cooker**, electric, convertible unit, **£3 19s. 6d.** **Mice Traps**, electric, hygienic (no wattage), **12s. 6d.** **Thermostatic Soldering Irons** for fine work, 70 watts, 12 ozs., **£1 4s.** **Therm Elec. Gaslighters**, complete with battery, ready to use, **11s. 3d.** **Midget Radio Kit**, "Black Rhapsody," modern in appearance and construction, complete from cabinet, black plastic to the last screw. Perfect natural tone value 4 valves, medium and long waves A.C./D.C., assembled in 3 hours, **£11 9s. 7d.** **Collaro Motor and Pick-up Unit** in leatherette carrying case, **£11 5s.** **Pocket Radio MCR1**, for battery and mains, on all waves, **£12 4s. 6d.** **Multicore Ersin 3-core Solder** in new window cartons 16 SWG **5s. 3d.** 13 SWG **4s. 10d.** **Taylor Valve-tester**, 47A, portable, **£25.** **Hunts Capacitor**, analyser and resistance bridge, C.R.B., **£18 18s.** **Midget Condensers**, 25 x 25 mfd., 200 v., **7s. 6d.** **Taylor 120A**, **£8 10s.** **Transformers**, multi ratio (12 ratios), **9s. 9d.** **Stick-thread**, insulating material for neat jobs, **1s.** **Ball Drive**, smooth epicyclic friction drive, ratio 6 to 1¼in. shaft, **3s. 3d.** **Hand Drill**, precision instrument, smooth handle action, **£1 4s.** **Sentinel**, the new no-mast all-copper Aerial, 8 s.w. 9, hand drawn, **6s. 6d.** **Wonder Crystal Set**, complete with headphones to match, **£1 2s. 6d.** **Avo All-wave Oscillator**, battery operated, with 2 dummy aerials, **£12.** **Trimmer Tool Kits**, complete outfit for set aligning, **£1 12s. 6d.** ; Super kit, **£1 17s. 6d.** **Glass Dials**, 5 x 8in., all wave multicolour stations, **3s. 6d.** **Solon Pencil Bit Solder Irons**, 230-250 v., **18s. 9d.** **Speaker Fabric**, modern weave, coupon free, square foot **2s. 6d.** **Sunray Lamp** "Collaro," complete with goggles, **£5 15s. 10d.** **Cement Tin**, **6s.** **Metal Engraving Pen**, electric, **10s. 6d.** **Hydrometers**, non-break model, all plastic, **7s. 6d.** **Telsen Electric Immersion Heater**, 200-230 v. 400 watts, **16s.** **Moving Coil Microphone and Headphone Assembly** (approx. impedance of each unit 48 ohms). Microphone has "Press to talk" switch (worth £8), complete, only **17s. 6d.** **Trusthold**, wood plastic, **1s.** **Therm Gaslighter Elements**, 1.5 v., **9d.** **Therm Gaslighter Extensions** off torch, **1s. 3d.** **Milliammeter**, 0-5, 2¼in., **£2 5s.** **Milliammeter**, 0.1, 2¼in. moving coil, **£2 11s. 6d.** **Lead-in Wire**, 4 mm. rubber insulated, per yard, **1s.** **Service Sheets**, British or American, per doz. **10s. 6d.**

J. BULL & SONS, (P.W.), 246, High St., Harlesden, N.W.10.

Impressions on the Wax

Review of the Latest Gramophone Records

THROUGHOUT Gigli's recent successful tour in this country the wish was repeatedly expressed by his admirers that the great tenor should be heard in some English songs. In response, Gigli has recorded two—"Parted" and "I'll Walk Beside You"—on *H.M.V. DA*1870. We do not support his choice.

Familiar though Liszt's "Hungarian Rhapsody No. 2" may be to almost everyone, the spectacular new version by Alexandra Brailowsky on *H.M.V. DB*6414 should find a warm welcome. The restrained tempo of the first part is treated with consummate care by the soloist, while the spirited second section provides a glorious opportunity for this fine artiste to demonstrate his remarkable ability in playing complicated passages demanding an impeccable sense of rhythm.

Another well-known favourite that makes its reappearance this month is Richard Strauss' "Der Rosenkavalier" Suite, which has been recorded by The Halle Orchestra, conducted by John Barbirolli, on *H.M.V. C*3556-58. It is an entirely new orchestration by the composer and will be popular with all music lovers. On the reverse side of *H.M.V. C*3558 is recorded, by the same orchestra, Wagner's "Lohengrin" Prelude to Act 3.

It was in 1929 that Ernst Lubitsch started Jeannette Macdonald on the long series of films that has made her famous. Among the best known of them was "Firefly," a large scale operetta dealing with the adventures of a beautiful spy during the Peninsular War. The music Rudolph Friml wrote for it is still fresh and appealing, especially "Giannina Mia," which Jeannette Macdonald sings on *H.M.V. B*9550, coupled with "Romany Life" on the reverse side. Miss Macdonald is said to have decided upon a reduction of her screen activities in favour of a recording career, a policy which will be heartily applauded by collectors of her records.

Cecile Chaminade was already a composer at the age of eight, when Bizet heard some of her compositions and prophesied a brilliant career for her. She developed into a fine concert pianist and wrote a great many songs and piano pieces which became very popular. They still remain outstanding examples of tuneful light music, very pleasant to hear or play. George Melachrino's full orchestra is heard to great advantage in this composer's "Autumn," and "First Rhapsody" is a composition by Melachrino himself; both these are played on *H.M.V. C*3570. The name of Melachrino is now among the most popular in present day entertainment, largely through his excellent radio programmes and the very attractive recorded items he makes from time to time.

Music from "Nicholas Nickleby"

FOLLOWING on the success of "Great Expectations," a second Dickens novel has reached the screen. The Ealing Studios production of "Nicholas Nickleby" has been supplied with incidental music by Lord Berners. The incidental music gives a series of cameos which will be appreciated by both Dickensians and admirers of Lord Berners. The Philharmonic Orchestra, under Ernest Irving, are in charge of Lord Berners' incidental music in the film itself, so that this record—*Columbia DX*1362—carries the stamp of authenticity.

The "Morning Song," which is featured on *Columbia DX*1361, was specially written by Sir Arnold Bax, who is Master of the King's Musick, to commemorate the twenty-first birthday of H.R.H. Princess Elizabeth. The first performance took place towards the end of last year at a Sir Robert Meyer concert, at which Harriet Cohen was the soloist. The attractive subtitle, "Maytime in Sussex," calls up visions of early summer in perhaps one of the loveliest of English counties, and Bax's skill in suggesting atmosphere by means of delicate touches makes this new composition a characteristic example of his style. Harriet Cohen is the soloist for this record, as she was for the first performance.

Variety

THE new C. B. Cochran production, "Bless the Bride," by A. P. Herbert and Vivian Ellis, now running merrily at the Adelphi Theatre, London, introduces a new singer to this country in the person of Georges Guétary. Guétary, who is one of the most popular singers in France and recently topped the poll of radio listeners, has a style that is particularly his own. He is of Greek stock, and has lived in France about 14 years. Columbia are recording him exclusively, and with him, in duets, is the leading lady of "Bless the Bride," Lizbeth Webb. He makes his debut on two records—*Columbia DB*2301-2—and sings four of the popular hit tunes from the show.

All who have heard the Radio Revellers on the air in "Desert Island Discs" will be delighted to know that they have an exclusive arrangement to record for Columbia. Their first record is fully up to expectations and, whether they are dealing with the unfortunate stop-out-late who forgets his key and beseeches Richard to "open the door," or telling how the zebra, camel and pig acquired their spots, hump and curly tail, their comedy is original and first-class. Their recording of "Open the Door, Richard" and "Uncle Remus Said" is on *Columbia FB*3301.

Other radio favourites who have made new recordings are Turner Layton, who sings at the piano "Good Night (You Little Rascal You)" and "Souvenirs," on *Columbia FB*3299; Rita Williams, with orchestra conducted by Eric Robinson, who has recorded "Out of My Dreams" and "People Will Say We're In Love," on *Columbia FB*3296, and Steve Conway, who sings "May I Call You Sweetheart?" and "Show Me the Way," on *Columbia FB*3287.

Geraldo fans will be pleased with his two latest discs of "Open the Door, Richard" and "Anniversary Song," on *Parlophone F*2214 and "That's the Beginning of the End" and "Among My Souvenirs," on *Parlophone F*2217. All the Geraldo songsters, Denny Vaughn, Archie Lewis and Carole Carr are on parade in these records.

Open to Discussion

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

Peculiar Faults

SIR,—After reading Mr. Guy's letter in the May-June issue of PRACTICAL WIRELESS I can call to mind two similar experiences that I have had recently.

The first involves a broadcast receiver fitted with an extension speaker, which, although the fixed speaker is switched off, still gives out a fair signal corresponding to that in the extension. This, I think, is due to the proximity of a matching transformer whose field cuts the moving coil of the resident loudspeaker, thus inducing a varying current which actuates the diaphragm.

The second case involves a short-waver, the basic output stage being parallel-fed 'phones and speaker direct fed. The separate switches are actuated by a multi-contact jack in the 'phones line. When the 'phones are in circuit the laminations of the output transformer vibrate in resonance with the output signal, so that a continual chatter emanates from under the chassis. I have tried absorbing the surplus energy in the secondary by shunting it with a low resistance, but this appears to have a large damping effect on the whole circuit.

I should like to point out that in desperation I have since dismantled the complete set.—J. L. JAMES, BRS 14,270 (London, N.14).

Crystal or V.F.O.?

SIR,—With reference to the article entitled "Crystal or V.F.O.?" in the May-June issue, perhaps the following idea of mine will be of interest. The V.F.O. circuit was sent me by GI5HU, of Belfast, but I devised the idea of fitting a crystal and change-over switch, so that I can have either E.C.O. or C.O. The switch is of ceramic insulation and silver contacts for low resistance, and the 15 pfd. bandspread condenser gives a tuning range of about 100 kc/s.

In use, the C.O. is tuned up (in my case my crystal frequency is 7,103 kc/s), the bandspread is then set at 90 deg. and the E.C.O. switched in. The grid condenser is then tuned until I get the same dip in the plate current meter as I did with crystal. The V.F.O. can then be tuned approx. 50 kc/s either side of the crystal frequency. I have had this in use some time now, and find it is very useful when there is a lot of QRM on my crystal frequency, though I personally prefer crystal when possible, but the E.C.O. is very stable, and I have had T9 reports when using it.—H. MILLS, G3AJB (Whitby, Yorks).

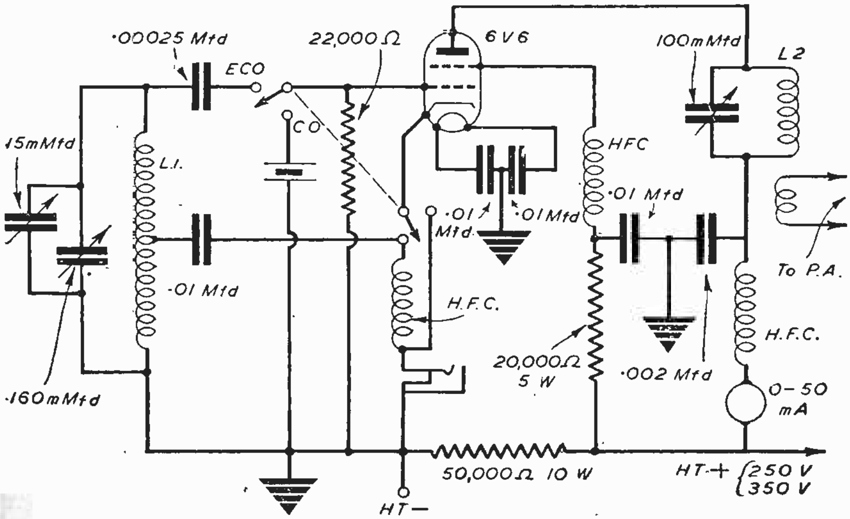
Amateur Station FF8FT

SIR,—Reference your article in May-June issue, "On the Amateur Bands," and the list of 'phone stations submitted by John Roscoe, of Bedford, station FF8FT is given as Lagos, F.W. Africa. This must be a mistake, as Lagos is the capital of Nigeria, *British* W. Africa. I should imagine it is far more likely to be Dakar, but I cannot say definitely, as I do not know Dakar's call sign. Perhaps some other correspondent can enlighten us as to whom the call sign FF8FT has been allotted.—C. F. M. GAY (N. Finchley).

Tx and Rx Details Wanted

SIR,—I have recently acquired some United States Navy radio equipment, which is being sold here in Ceylon. I have the following receivers and transmitters: BC—625A, BC—624A, R—3/ARR—2x, TN—8/APX—1, RT—22/APX—1.

Can any of your readers help me by giving me details about any one of the above? I would be interested to know in what capacity they are used, their operating frequencies, and their circuit diagrams, if possible. Thanking you for a very absorbing journal.—W. P. GUNASEKERA (Pitipane, Homagama, Ceylon).

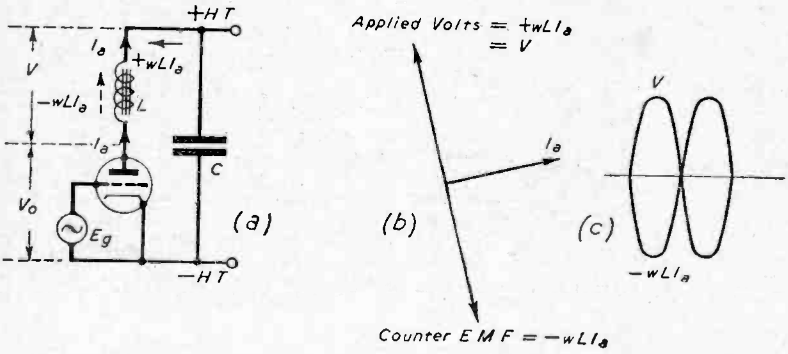


The 6V6 C.O./E.C.O. scheme as used at G3AJB.

"The Vector Problem"

SIR,—In a recent issue I noticed a letter from Mr. Griffiths, Wrexham, raising a query with me which I always regard as of fundamental importance.

Mr. Griffiths wants to know how I arrive at the voltage V at 180 deg. to V_o. I have dealt with the question frequently and shall probably have to mention it again in any basic discussion of valve vectors. I consider that—as long as we are dealing with a series circuit—failure to emphasise the *supply* (or *applied*) voltage V is the root cause of numerous confusions, such as postulating two *currents* 180 deg. out of phase in the anode circuit.



Some fundamental A.C. relationships for a purely inductive load. Is Vo in-phase with the E.M.F. of self-induction, −wLIa, or the applied E.M.F. +wLIa? These two equal and opposite components must obviously exist to sustain the current-change Ia. The pure resistance case lends itself to similar argument, where "internal p.d." is the load reaction.

Perhaps it will save me a lot of argument if we consider a purely inductive load of L *henries* in the anode circuit (neglecting any shunting effects of the valve, etc.) (Fig. 1a).

An alternating component Ia flows in L, at a frequency w/2π. Therefore, we have: (a) a counter E.M.F. of self-induction, −L.di/dt. (or R.M.S. value −wLIa) in the turns of the coil, and (b) *a component of the H.T.* (the "applied voltage") equal and opposite to the back E.M.F. and thus expressed by +L.di/dt, or simply wLIa.

It is beyond any possible dispute, I think, that these two voltages exist, and are mutually 180 deg. out of phase. The current change Ia cannot be sustained by a "back E.M.F." without some equivalent of a "supply voltage" opposing it. Obviously, the latter is wLIa, derived from the H.T. source.

Now, if we take a connection off the *anode* end of L, we have an "output voltage" Vo, numerically the same as wLIa. If the load were a pure resistance R, we would give Vo a *negative* sign. What sign should it be given in this case where the load is a pure inductance? If of the same sign as (a), then it must be of opposite phase to (b). Which is it? We cannot have it both ways.

I will leave Mr. Griffiths to decide. Because one end of the load impedance is tied to the *fixed* potential of +HT, I reason that Vo always takes the negative sign of the *load reaction*—in this case, a tangible "back E.M.F." This gives the negative sign the accepted meaning used in electrical engineering, i.e., denoting a *back E.M.F.*, or −L.di/dt.

Well, what about a pure resistance? Here there is no tangible "counter E.M.F.," though there must be some equivalent of an "applied voltage." I do not know if Mr. Griffiths will agree that the internal *potential-difference* in a resistance has a negative sign relative to the applied E.M.F., and that, therefore, once again, Vo takes a negative sign relative to the *positive*-phased component V, which *must* exist across R. V=IaR simply, whilst Vo = −IaR = −V, the sign of the *internal potential-difference.* This is because of the fixed, steady potential of HT+, as before. I trust this will make my viewpoint clear, and demonstrate that no simple A.C. equivalent can adequately show the true conditions existing in a valve circuit—as I see it, we are bound to consider D.C. potentials.—"DYNATRON."

Radio KUFRA

SIR,—I would be grateful if, through the medium of your paper, you will convey to all those Hams who were good enough to work with radio KUFRA that I have now left Kufra Oasis, and am afraid, therefore, that my little station is not liable to be heard again for a considerable time. I am on my way to England, and in spite of innumerable difficulties you may assure those interested that just as soon as is possible I will send cards to QSL my various contacts.—JOHN W. OLIVER (Fayid).

Radio VS6DY

SIR,—I was very interested to read in the July issue of PRACTICAL WIRELESS about the amateur station VS6DY on the 14Mc/s band, but I cannot understand why the working is from s.s. *Anglo African*.

As far as I am aware this station was started towards the end of 1945 by three members of the wireless staff on board H.M.S. *Duke of York*. They first opened whilst they were in Hong Kong, and the last letters, DY, stood for the ship. Whether this was done officially or not I cannot say, but that it was done I know for a fact.

They continued operating whilst out in the Pacific and for a time on the return voyage to England. What happened after their arrival home I don't know, and wonder if you can throw any light upon it now the call sign is being used again.

I cannot remember the details of their equipment except that they made their transmitter from spare parts of various old types.

Hoping you may be able to give further information.—R. DENNIS (Wragby, Lincoln).

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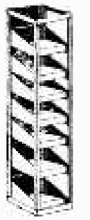

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