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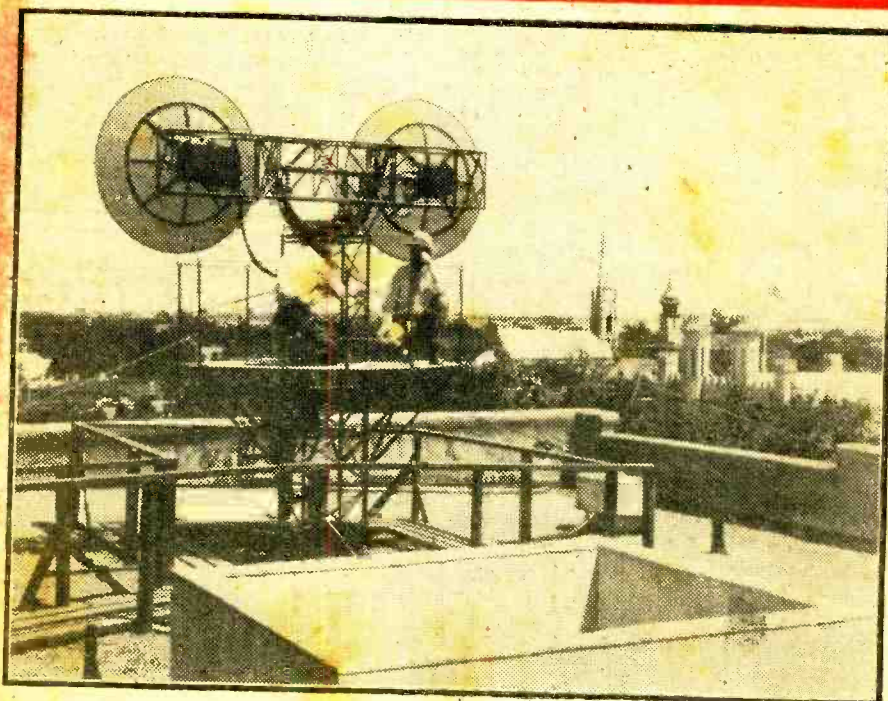
Practical Wireless

9^D
EVERY
MONTH

Vol. 24 No. 500. ||

Editor: F. J. C. CAMM ||

MARCH, 1948

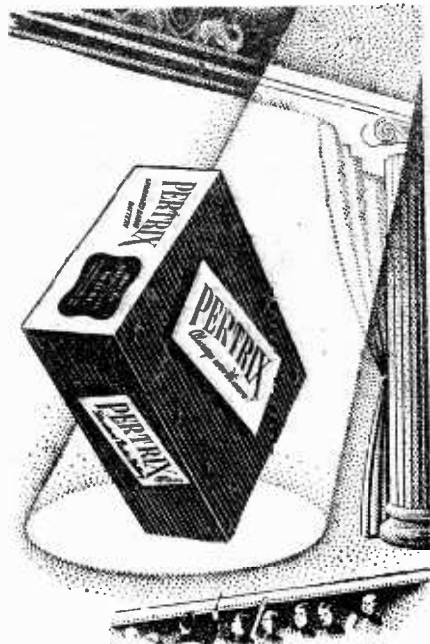


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Long Waves on Wartime Utility Receiver
Television Test Pattern Generator
Transmitter Technicalities
A C.R. and L. Chart

Test Instrument Design
Novel Battery Circuits
The C.P.S. Emitron
A High-tension Unit



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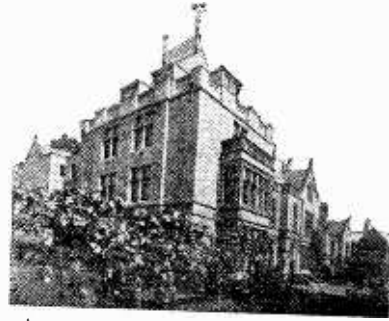
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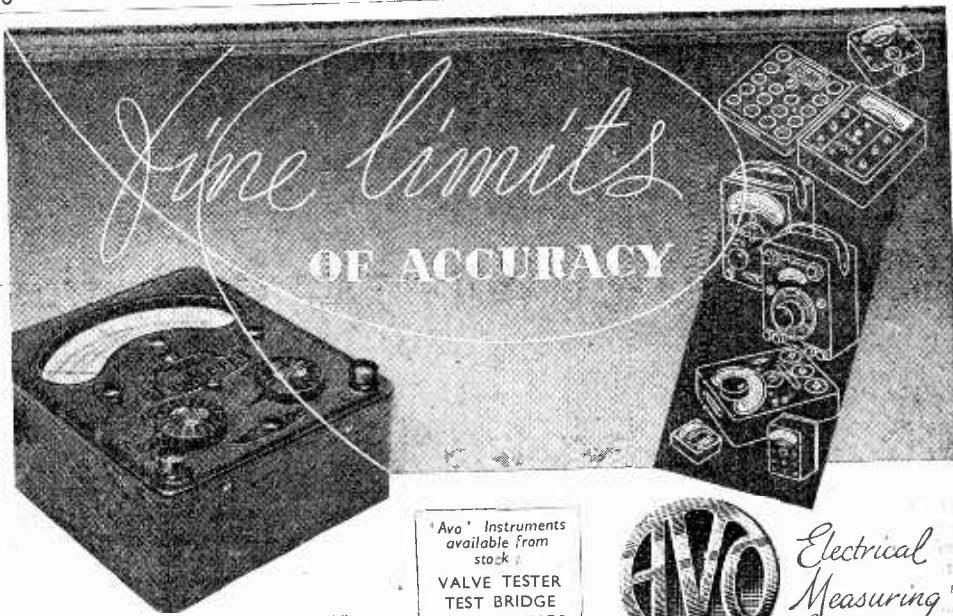
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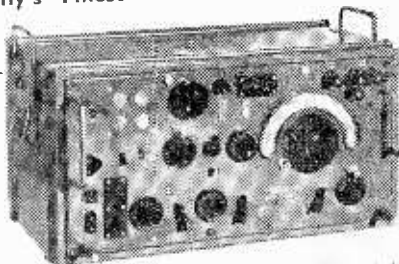
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Range	Ext. Diam.	Res.	Fitting Proj.	Type	Price
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40 v.	2in.	8K	Flush	M.C.D.C.	7/6
2 1/2 a.	2in.	—	Flush	Thermo H.F.	7/6
4 a.	2in.	—	Port	H.W. H.F.	3/6
20 a.	2in.	—	Flush	M.C. D.C.	7/6
40 a.	2in.	—	Flush	M.C. D.C.	7/6
25 a.	3 1/2in.	—	Proj.	M.C. D.C.	7/6
25 a.	3 1/2in.	—	Flush	M.C. D.C.	7/6
25 a.	3 1/2in.	—	Flush	M.C. D.C.	7/6
500 µc.	2 1/2in.	500Ω	Flush	M.C. D.C.	10/-
5 ma.	2 1/2in.	—	Flush	M.C. D.C.	20/-
1 ma.	3 1/2in.	—	Flush	M.C. D.C.	25/-
500 µc.	2 1/2in.	—	Flush	M.C. D.C.	7/6
20 v.	3 1/2in.	—	Flush	M.I.A.G. D.C.	12/6
15 v.	3 1/2in.	—	Flush	M.C. D.C.	7/6
150 ma.	2 1/2in.	—	Flush	M.C. D.C.	12/6
200 ma.	3 1/2in.	—	Flush	Electrostatic	65/-
5,000 v.	4 1/2in.	—	—	—	—

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Practical Wireless

16th YEAR
OF ISSUE

EVERY MONTH
VOL. XXIV. No. 500. MARCH, 1948.

and PRACTICAL TELEVISION

Editor E.J. CANN

COMMENTS OF THE MONTH

BY THE EDITOR

Wanted—A Commercial Broadcasting Station

THERE are rumours that the B.B.C. is considering an increase in the Wireless Licence, which at present is £1, with an additional £1 if a television receiver is operated. Whilst most other commodities and services have increased in price by over 100 per cent., the B.B.C. was the very last to increase the licence fee, from 10s. to £1. We do not think that the licence fees drawn from television pay for the television service by many tens of thousands of pounds, and that service has therefore to be bolstered up by sums drawn from the normal licence fees and other B.B.C. revenue, such as publications. As far as television is concerned, that position must remain whilst it continues as a local and at present largely experimental service. When the market is expanded by the opening up of new television transmitting stations throughout the country this service will probably become self-supporting and profit-making.

We do not think that anyone has just cause for complaint in the cost to the public of our broadcasting service; for the comparatively small sum of £1 a year the listener gets 365 days of programmes designed to cater for every listener—not every listener all the time, but for every listener some of the time.

Notwithstanding the millions of listeners, the B.B.C. state that they are considering an increase, suggested in many quarters of 10s., in the licence fee. We suggest that this increase in revenue can be raised without increasing the licence fee at all.

In the first place there should be a thorough investigation into the financial administration of the B.B.C. to see whether there is justification for the criticism that it is over-weighted with personnel not fully employed, and with administrative charges which are unnecessary.

Bearing in mind that the B.B.C. draws most of its programme material from outside sources, the cost of the programmes in relation to the cost of administration exhibits a great disparity. Artists complain of the B.B.C. fees. It may well be that an investigation would show a considerable saving could be effected as well as an improvement in efficiency by a judicious pruning of the staff, by greater concentration of the

remaining staff and by the introduction of a greater degree of cohesion between the various departments, and a more personal relationship between the heads of departments and the B.B.C. personnel as a whole. That would effect, in our view, a considerable saving.

Our second point is that the time is ripe for the B.B.C. to drop its outmoded belief that publicity is an unclean thing, and to remove its ban on commercial broadcasting in this country. In other words, it should erect as soon as possible another station purely for the transmission of sponsored commercial programmes in which the sponsor has a reasonable chance of getting his money back, or of advertising his particular goods. In saying this we do not suggest that such a station need go to the publicity extremes adopted in America. At the same time, it cannot be expected that firms will spend large sums of money sponsoring a programme in return for a bald statement at the beginning or end of the programme coupling its name with it.

In the early days of broadcasting in this country commercial programmes were tried for an experimental period, but they ceased because firms were not anxious to repeat the experiment. It did not pay because of the niggardly attitude of the B.B.C. in the matter of "mentions." The announcer merely said that the programme came to you by courtesy of Messrs. So-and-So.

It is even more necessary to have such a station in these days, not so much from the point of view of revenue but from the point of view of enhancing the reputation of British goods and of competing in the export markets with other countries, who use every publicity medium to push their wares in foreign markets. Great Britain should drop the pedagogic idea that broadcasting is only an instrument of uplift and entertainment. Other nations have demonstrated that it is a powerful salesman which sets a radio hallmark upon goods.

We are certain that Sir Stafford Cripps, the arch-priest of export, will support our plea for a British commercial broadcasting station to enhance the prestige of British goods and to act as a counterblast to the thinly veiled propaganda pumped into the ether by other nations with an eye to business.

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ROUND THE WORLD OF WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate number of licences issued during the year ended November 30th, 1947.

Region	Number
London Postal	2,062,000
Home Counties	1,440,000
Midland	1,562,000
North Eastern	1,697,000
North Western	1,441,000
South Western	938,000
Welsh and Border	633,000
Total England and Wales	9,773,000
Scotland	1,046,000
Northern Ireland	173,000
GRAND TOTAL ..	10,992,000

One Greetings Message Every Second

RE-ORGANISATION of Cable and Wireless Central Telegraph Station led to 14 per cent. improvement in average handling time of Christmas and New Year Greetings messages this year. Up till late on New Year's Eve, Greetings telegrams were being transmitted overseas at an average rate of almost one per second.

During the 48 hours preceding Christmas 170,000 messages were handled—20,000 more than in 1946; 697,000 messages (including 147,000 Greetings) were handled in the Station from December 19th to 29th.

Delivery by Air

FOR some time past R. M. Electric, Ltd., have been doing their utmost to develop the overseas markets, and in order to fulfil an urgent demand for their receivers in all parts of Ireland have for several weeks chartered special Aerovans.

These aircraft have been flown from the local aerodrome, Wolsington, thus enabling the equipment to be delivered in Ireland the same day as leaving the factory, instead of taking up to fourteen days for conventional methods of transport.

R.I.C. Press Officer

ANDREW REID, who handled the Press arrangements for Radiolympia, 1947, has been appointed Press Officer to the Radio Industry Council and commenced his new duties on January 1st, working from his own chambers at 11, Garrick Street, W.C.2.

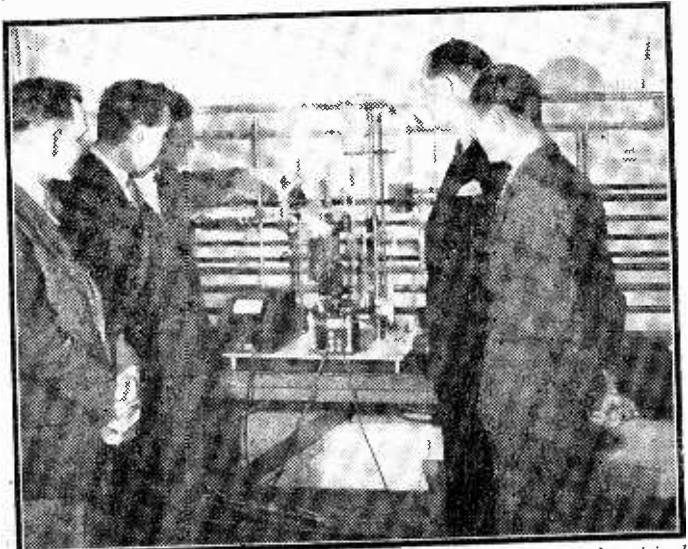
The Battery at Zero

HOW to keep warm these days is a national problem, if only for comfort's sake. Motorists are even more concerned about keeping the car warm to facilitate a quick start. In their efforts in this direction there is a tendency to concentrate on the engine and radiator, overlooking that hard worked component, the battery.

An interesting experiment in the Research Laboratory of The Chloride Electrical Storage Co., Ltd., at Clifton Junction, near Manchester, established the definite relation between temperature and battery output. A 100-ampere-hour Exide battery was maintained at 0 deg. F. (32 degrees of frost) for a considerable period and was then subjected, without pre-heating, to a discharge of 300 amps. It maintained this for 4 minutes 42 seconds before the voltage had fallen to 1 volt per cell. The recuperating effect on open circuit was then demonstrated by switching off the discharge and repeating the discharge once per hour. With these intermittent recuperating breaks of one hour, the discharge was repeated four times without any re-charging.

B.B.C. Plays in U.S.A.

AS a result of an agreement reached between the B.B.C. and the American authorities a number of B.B.C. feature plays have been recorded and are to be heard over American networks. This work is carried out by the B.B.C. Transcription Service.



A Party of Naval Officers from the Electrical Branch, recently visited the Mullard Valve factory at Mitcham. They are seen here watching special apparatus designed for the measurement of absorption of gas at low pressures by zirconium.

Increase in Television Viewers

THE number of television licences in force at the end of November, 1947, was 31,250, an increase of 3,400 on the October figure. In six months the total has risen by 12,515 (over 66 per cent.).

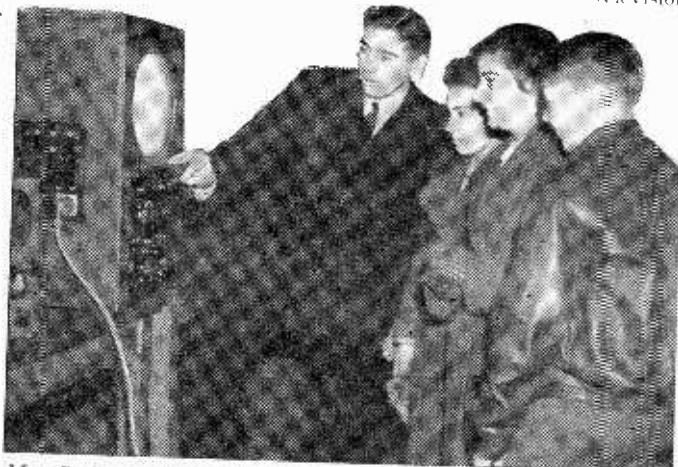
1947	Television licences	Increase	
		Number	Percentage
May ..	18,735	—	—
June ..	20,114	1,379	7.4
July ..	21,074	960	4.8
August ..	23,076	2,002	9.5
September ..	25,062	1,986	8.6
October ..	27,850	2,788	11.1
November..	31,250	3,400	12.2
Total ..		12,515	66.8

New E.M.I. Factory

ELECTRIC AND MUSICAL INDUSTRIES, LTD., announce that they have arranged to purchase a modern factory at Pegrivale from Radio and Television Trust, Ltd. As already announced in these pages, manufactures at this factory are being transferred to other factories in their group and elsewhere. The main factory of the E.M.I. Group is at Hayes, some three miles distant. The group also has a substantial factory at Treorchy in South Wales. These three establishments will be operated largely for extension of the group's export trade. During the 12 months ended June, 1947, the E.M.I. group, operating factories in Great Britain and abroad, earned some two million pounds for the British foreign exchange pool in various currencies, including United States dollars and South American currencies.

Emergency Call

INSTEAD of "Raiders Overhead," the current warning is "Power Consumption Too High." Mullard use the time-honoured "three pips" call to announce this to the employees in their factory at Mitcham.



Mr. G. Parr, A.M.I.E.E., lectured recently on Television at the South Kensington Museum.

The method of operation is manual. In the power control room a man watches the dial registering kilowatt consumption. When the needle swings to 1,560 kW. or over he depresses a switch which connects with the amplifier system throughout the factory and sounds the warning.



The popular Eddystone "640" Communications Receiver being shipped to U.S.A. to cover orders received.

Television in School in U.S.A.

THE Nutley (N.J.) High School has recently had added as part of the regular general school programme. A receiver was specially adapted for classroom use and was presented by a local manufacturer. It incorporates a large-screen direct-viewing receiver, tube and speaker being set up on a platform which may be rolled out on to the auditorium stage when required.

Television Publicity

A DISCUSSION on architecture was recently given over the television system and was part of the centenary celebration of the Architectural Association. Delegates and guests from all parts of the country, attending a banquet which was part of the celebration, were able to follow the discussion on television receivers of the table and floor type which were installed by Ferranti especially for the purpose.

Modifying the Wartime A.C. Utility Receiver

In This Article Instructions are Given to Enable Long-waves to be Received
By C. L. ORSBORNE

MANY people possessing the Wartime Utility receiver, experience difficulty in receiving the Light programme after sunset on the 261.1 metre transmission. The following description gives details for adding long-wave coils for a sum of about 16s. Apart from being able always to receive the Light programme without fading or distortion, the transmissions from Luxemburg are now very entertaining.

It is surprising what liberties can be taken with this receiver. The wiring to the separate coils need not be screened from the rest of the circuit, nor between aerial and oscillator wiring. It is advisable, however, to keep the aerial and oscillator wiring reasonably separate, as shown in Fig. 3. The coils and padding condensers can be suspended in the wiring, but are better fixed to the chassis by bolts. The circuit before modification is shown in Fig. 1, and Fig. 2 shows the circuit with the wavechange switch and the long-wave coils added.

Oscillator Section

It will be noticed that the 500 pF grid condenser and 47,000 ohm grid leak are moved to the grid end of the oscillator coil to make padding adjust-

ments easier. The medium-wave coils differ slightly in different makes of set, some requiring more padding than others. The padding should be sufficient to make North Regional appear at about 450 on the dial.

The oscillator coils are switched at one end only, the H.T. + side is common to both. It is important to connect the feed-back coil the correct way round or no oscillation will result. When disconnecting the medium-wave coil mark the designation of each tag, in pencil, on the chassis. For example, trace the oscillator grid wire and mark this "G." The wire going to the grid condenser and leak from the oscillator coil is marked "E." Similarly the tag connected to the oscillator anode is marked "A." The remaining H.T. tag is left untouched. The above lettering is marked on the diagrams and ensures that the coil is rewired correctly.

Aerial Section

The "earthy" ends of these coils are common and go to the A.V.C. line: this is a black wire and need not be removed. A short, thickish piece of wire is soldered to the bottom tag of the medium-wave aerial coil and is used to support the long-

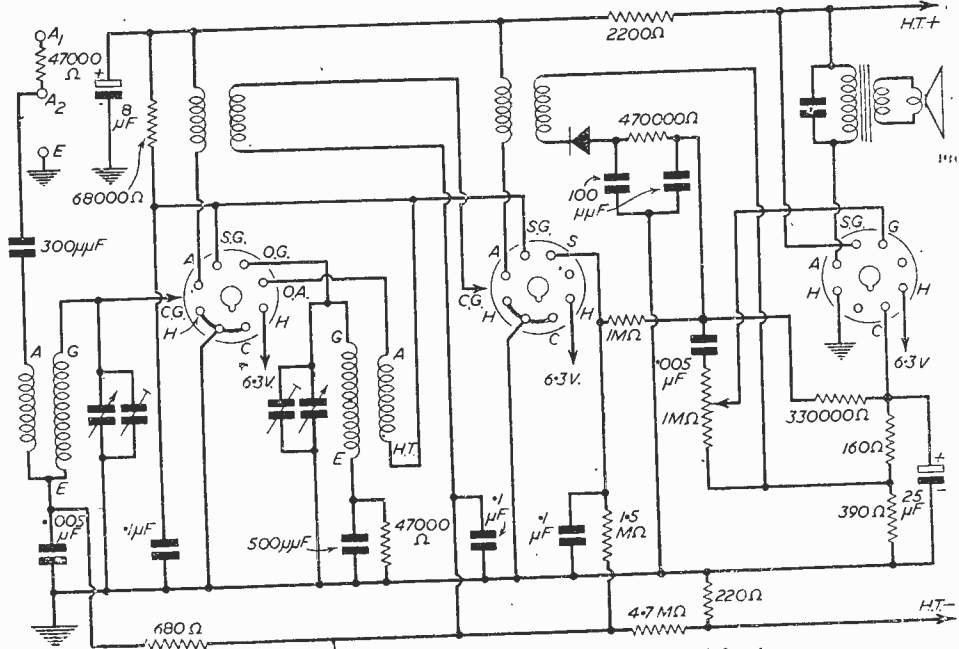


Fig. 1.—Circuit of the "Utility" receiver before modification.

wave aerial coil and connect it to A.V.C. The long-wave coil can be mounted on a bracket, of course, but this is not necessary because the coil is so light. It will be found that no hum is picked up whether the axis of the coil is parallel or at right angles to that of the mains transformer.

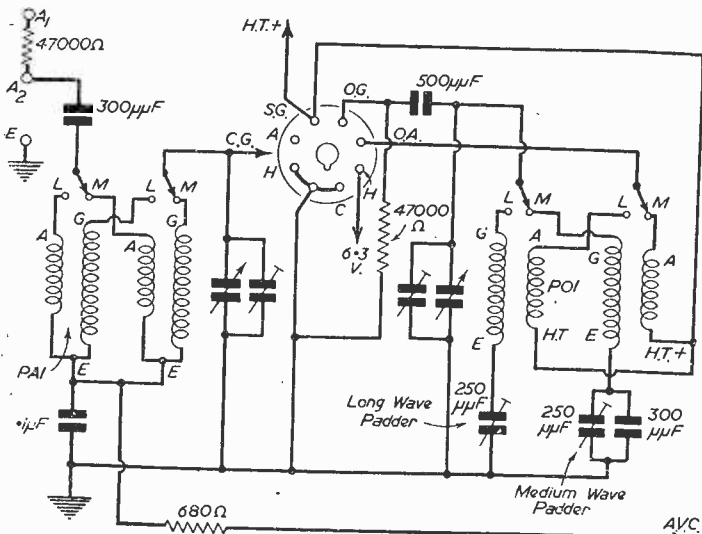


Fig. 2.—The frequency-changer with long-waves added.

Trimmers

No trimmers additional to those on the tuning condensers are used. Trimming on the medium-waves is necessary, but has never been found to be so on the long-wave band, especially as no stations exist at the high-frequency end.

Mounting and Wiring

A convenient hole, ready drilled, for the wavechange switch, will be found in the centre of the chassis. It is then only necessary to drill a 1/16 in. hole in the cabinet. Having removed all the wires except the H.T.+ from the medium-wave oscillator coil (do not remove the coil), next unsolder and separate the grid leak and condenser. Now rest the wavechange switch spindle through the hole in the chassis indicated above. Do not fix it permanently just yet, because it will be difficult to get the soldering iron to the back tags. Solder the grid condenser, and wire from the fixed plates of the oscillator tuning condenser to the appropriate tags at the back

of the wavechange switch. Unsolder the wire from the top of the medium-wave aerial coil. This goes to the fixed plates of the aerial tuning condenser. Pull it through the hole in the chassis just underneath its tag, and solder to the correct tag at the back of the wavechange switch (Fig. 3). Solder wires of an appropriate length to the remaining tags at the back of the wavechange switch, which can then be fixed in position.

A convenient hole with which the long-wave coil can be bolted in position will be found just underneath the strengthening bar. This bar can be drilled to hold the padding condensers or they can be suspended in the wiring if it is sufficiently strong to prevent them moving about and touching adjacent connections. The 47,000 ohm grid leak is wired direct from the oscillator grid to the earthed cathode tag. The "earthly" side of the padding condensers also goes to this tag. The rest of the oscillator wiring is now completed.

Aerial Circuit

The wires from the wavechange switch to the aerial coils are run through the brass eyelets in the chassis. Two tags of the long-wave coil (Fig. 4) are soldered together and to the short stiff wire mentioned previously. The wiring of the aerial coils can then be completed.

Adjustments

Turn the wavechange switch to the medium-wave position. Make sure that the trimmers are not

Next month we shall describe how to modify the Utility receiver for all-wave reception.

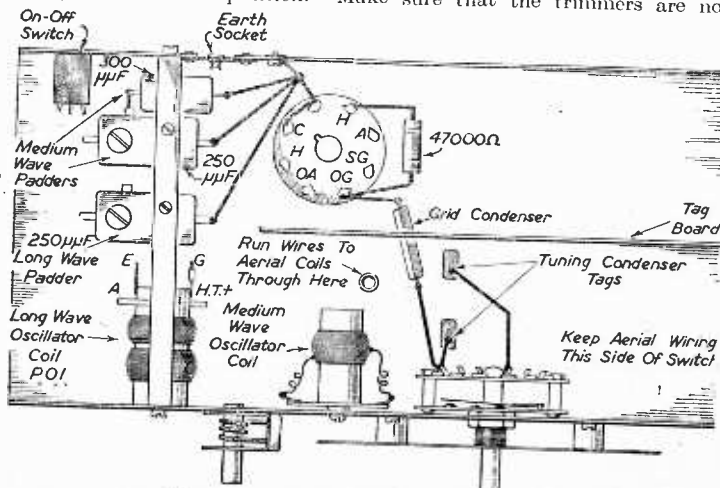


Fig. 3.—Layout of the oscillator section.

tight down. Turn the dial to 450 and adjust the medium-wave paddler to bring the North Regional to maximum volume. Make sure that it is North Regional; if the dial is turned to about 420 the Dutch station Hilversum will be heard at good strength. London Regional will come in at about 350 on the dial. Now turn the dial to 260 and adjust

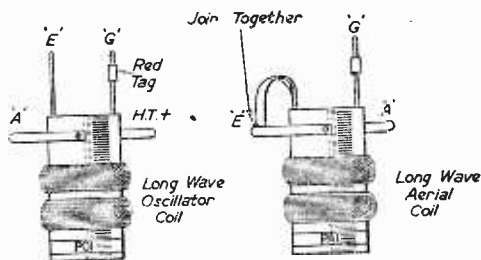


Fig. 4.—Connections to the long-wave coils.

the oscillator trimmer until the Light programme is heard. It may be necessary to move the dial slightly. Adjust the trimmer until the Light programme is heard at maximum volume. Now go back to 450 and readjust the paddler to bring North Regional to maximum again. Then return to 260 and re-check the trimmer on the Light programme.

COMPONENTS REQUIRED

- One Wearite "P" coil, type PA1.
- One Wearite "P" coil, type PO1.
- One 4-pole 2-way switch (spindle 1½ in.).
- Two 250pF padding condensers.
- One 300pF mica condenser.

The trimmer on the aerial section is adjusted so that interference is not experienced from adjacent stations. If this is done at the H.F. end, say on Midland Regional or the Light programme, it will be satisfactory at other points.

Finally, switch to the long-waves and turn the dial pointer to 450. Adjust the long-wave paddler until Droitwich comes in at maximum volume. Luxembourg will be found at about 360 and Airmet at about 340 on the dial.

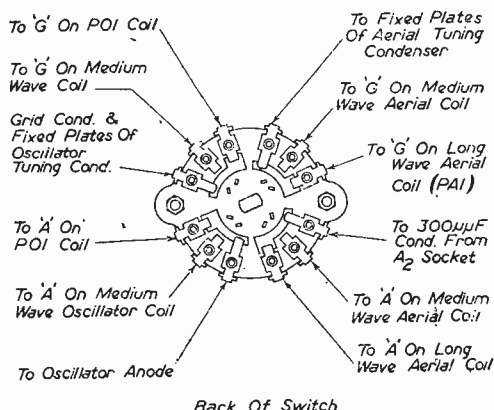


Fig. 5.—Connections to the wavechange switch.

If a signal generator is available so much the better, but if the above adjustments are done carefully the results will be found to be just as satisfactory. No other adjustments are necessary. If desired the dial can be sign-written in Indian ink.

Television in U.S.A.

EXTRA charges for electric power where television sets are connected to the line have been made in Connecticut.

The action of two Connecticut cities, Wallingford and Norwich, was cited by L. C. F. Horle, chief engineer of the Association, who reported that the Public Utilities Commission of Connecticut had permitted the Borough Electric Works of Wallingford to charge \$2.50 extra a month for electric power where a television receiver is installed, on the assumption that added power was required.

Earlier it had been reported that owners of sets in Norwich have been required to pay \$1.26 extra on their monthly bills, not as a direct charge for electricity, but for having the set connected to the line.

Mr. Horle said that a survey of fifteen sets showed that power demand "contrasts not at all with the demand and power factor of many domestic appliances whose wide usage at normal power rates effectively destroys any sound basis for distinctive rates for television receivers."

The feeling among the radio officials was that the power companies were defeating their own best interests by discouraging the use of sets.

Compound Viewing Screen

The viewing screen of a projection type television receiver may be a complex affair, RCA engineer I. G. Maloff told the Optical Society of America at their recent Cincinnati meeting. One such screen is a sandwich of two transparent plastic lenses and a sheet of plastic with a silica opacifier in it.

Two 15 x 20 inch lenses, used for the front and back of the screen, concentrate the light in the desired viewing field. The rear piece is a "Fresnel" field lens—a thin Plexiglass sheet moulded with a series of fine, concentric, circular ridges, somewhat like the surface of a phonograph record. The front of the screen is a multiple-element lens of narrow vertical cylinders moulded in Plexiglass. Laminated between these is a thin Vinylite sheet containing enough silica opacifier to render "moire" effects unobjectionable and to disperse the light so that no "hot-spot" is formed.

The screen provides a brightness gain of 7.5 and, in combination with large aperture reflective optics, provides a 15 x 20 inch picture having highlights with a brightness of more than 50-foot-lamberts, which compares favourably with direct-viewing kinescopes and more than satisfies the recommendations for good motion picture theatre practice.

The screen is used in the new RCA Model 648 PTK television receiver. (Radiocraft.)

Test Pattern Generator

A Servicing Aid for Television Receivers.

By EDWIN N. BRADLEY

A PRESSING need which is sooner or later felt by every service engineer engaged in the repair of television receivers, and perhaps to an even greater extent by experimenters who, though living outside the range of the present transmitters are preparing for the extension of the television service, is for a simple television Test Pattern Generator. Television set repairs, and the design and development of a television receiver, must be carried out as time permits, yet final tests must always be made on a transmission, which inevitably means delays. Television signal generators are available commercially, but their cost puts them out of reach of the small service establishment and certainly far out of reach of the home experimenter. The circuit to be described was designed to be at

produced by modulations of the line. The time of a single line scan in the present television signal, including sync. and blackout pulses, corresponds to a frequency of 10,125 scans per second, so that were the test carrier to be modulated by a 10,125 c.p.s. note (which actually would require to be a square wave rather than a sinusoidal tone) a single vertical bar could be produced down the screen, the width of the bar depending on the duration of the modulation through each complete cycle of modulation. If the modulation were as shown in Fig. 1A, then the left-hand side of the picture would be bright and the right-hand side dark with a gradual transition from light to dark across the screen, whilst if a sharply pulsed or peaked modulation were employed, as in Fig. 1B, a single bright bar down the picture would result, the position of the bar depending, obviously, on the positioning of the pulse along the base line representing time.

The receiver, nevertheless, would be free-running; that is, it would be supplied with synchronising pulses. Accordingly the line timebase would very quickly lock in on the pulse of Fig. 1B and the bright bar would appear at the extreme right-hand side of the picture. The receiver would also endeavour to lock in on the waveform modulation of Fig. 1A, but the locking would be less definite and there would in all probability be shift and flicker of the (admittedly useless) shading of light and dark across the screen.

If the modulation of Fig. 1B were now to be changed to the form shown in Fig. 2, the second or extreme right-hand pulse would serve to synchronise the line timebase, whilst the first or central pulse would cause a bright bar to appear in the centre of the picture. The modulation frequency would now be twice 10,125, or 20,250, cycles per second. Each cycle of modulation, moreover, is a short duration pulse.

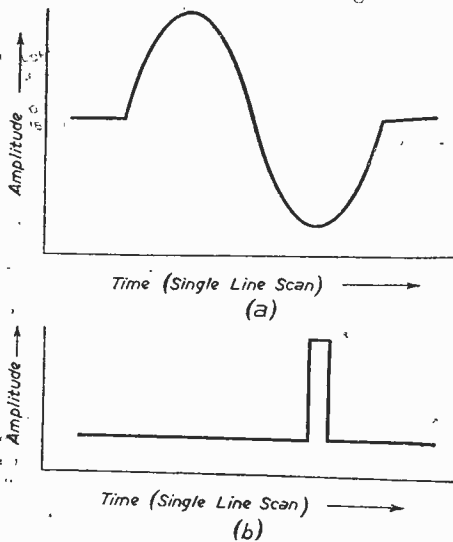


Fig. 1.—(a) A modulated or sine-waveform and (b) a pulse of the "square-topped" type.

once cheap to produce, to utilise easily available parts and valves and, above all, to be flexible in operation and as useful as possible.

The requirements of a television test signal first need some consideration. Whatever modulation is used it must be impressed on a broad carrier in order that the flat-tuned R.F. and I.F. stages of the receiver shall pass a band of frequencies rather than a sharp central frequency, and the modulation itself must be of such a nature that to be of greatest value the signal may refer to, or test, vertical patterns only, horizontal patterns only and vertical and horizontal patterns combined.

Obviously something more than the 400-cycle note of the ordinary signal generator is needed.

Required Pattern

Vertical patterns, which might well be a set of bars running from top to bottom of the screen, are

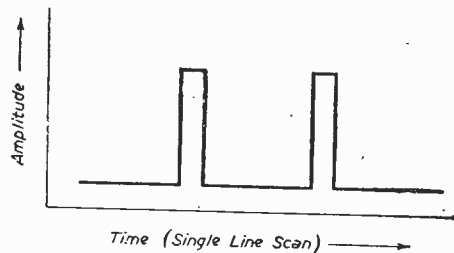


Fig. 2.—Two pulses which could cause time-base triggering as explained above.

Synchronising

At this point it is necessary to stress the fact that the pulse being used for synchronising is actually in the wrong sense. This pulse should be negative, just as a true sync. pulse on the television signal consists of a sharp drop from 30 per cent. to zero signal, but in actual fact it is found that all the receivers tested lock in very well on a positive

pulse. The locking appears to occur on the trailing edge of the pulse as it drops in amplitude, thus stimulating the sync. separator and passing sync. signals to the time base in the usual manner.

To obtain a vertical pattern of bars, therefore, it is necessary to modulate a broad carrier with a series of pulses of short duration with regularly timed intervals, when synchronising will be automatic. A square wave or pulse generator might be used, but it is found that all these requirements are met very well indeed by the simple super-regenerative receiver for the very high frequencies. The quench frequency on such a circuit consists of short pulses and whilst the shape of the pulses is not so regular as that shown in the diagrams, such a circuit can produce an excellent vertical pattern on the television screen.

Horizontal Pattern

It still remains to produce a horizontal pattern. Once again sharp pulses on the carrier are needed, although in this case the pulse frequency must be much slower. The speed of the frame time base is 50 scans per second, interlaced, to produce 25 complete pictures per second, so that a frequency of 50 pulses per second would again cause a single bright bar to appear horizontally across the screen. Here again, however, this bar would be used by the receiver in lieu of a synchronising pulse and the bar would appear at the bottom of the picture. A modulation frequency of 100 pulses per second would, however, provide both synchronising of the frame and a bright bar across the centre of the picture, and a frequency of, say, 200 pulses per second would give three horizontal bars and a bright bottom band.

Some experimenters, accustomed to the vagaries of the less definite frame-locking characteristics of a television receiver, may doubt whether the horizontal pattern would lock on a single positive going pulse. Nevertheless, perfectly satisfactory results and rock-steady patterns have been obtained by this method.

To produce these slow-pulsed modulations on the super-regenerative receiver which is doing duty as a line modulator and carrier generator, a blocking oscillator of the simplest type may be used. The receiver quenching is stopped so that a pure carrier is radiated, then the blocking oscillator is used to modulate this carrier at any desired frequency within the circuit limits.

Thus, both a vertical and horizontal pattern may be obtained separately. To produce an overall pattern, it is necessary only to switch in the quench once more, still modulating the carrier with the slow pulses. The bars combine into what may be termed a finely graduated and divided "herring-bone" pattern, which gives an excellent test of overall screen focus, overall brilliance, and locking on quite a complicated signal.

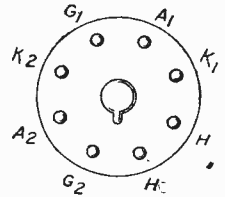
The final generator circuit is shown in Fig. 3. To broaden the carrier the oscillator (the first section of the double triode V1) is untuned so far as a normal tuning capacitor is concerned, L1 being tuned merely by its own capacitance combined with the input capacitance of the valve.

As in the ordinary self-quenching super-regenerator, the quench frequency is produced by, and depends on, the grid-leak R1, R2, combined with the capacitor C2. Since R1, R2 is variable

between 10,000 and 500,000 ohms, the quenching frequency can be varied over a very wide range. Thus, the number of vertical bars on the screen can also be varied from one or two up to twelve or so. At the same time, the bars will be regularly spaced and quite upright and straight. Any irregularities in the pattern as shown on the screen can be traced to the line timebase.

To produce a horizontal pattern, C2 is switched out of circuit by S1a, and the second section of V1 is supplied with H.T. through S1b, the H.T. being drawn through the common feed resistor R4. The second section of V1 is a blocking oscillator, using an ordinary intervalve transformer as the oscillating inductances. Oscillation proceeds so powerfully that the grid of the triode becomes highly negative, and the valve is blocked until the charge leaks off through the combination of C3, R5. This combination has a

Fig. 4.—Details of connection of the electrodes of the 6SN7 valve as seen from below.



variable time constant, so that by varying R5 the leak may be slow or fairly rapid. Immediately the valve can conduct the oscillation recommences until once more the grid is blocked. The triode thus produces pulses at an audio rate, these pulses modulating the anode supply to the oscillator and thereby the plain carrier which the first section of the valve is radiating. By varying R1, R2 in this instance, the conditions under which the oscillator is working can be varied, the oscillator load being changed by variation in the grid current and thus the self bias of the valve, so that R2 can be used as a control to give the best carrier conditions for modulation by the horizontal pattern.

Throwing the switch S1a, S1b to its third position brings the quenching capacitor C2 back into circuit. The oscillator again becomes a super-regenerator, but the blocking oscillator is still adding its modulation to the restored line modulation, and whilst the controls R2 and R5 become a little less effective, wide control may still be exercised over the pattern which now covers the whole screen.

Construction

Unlike the majority of very-high-frequency equipment there appears to be no critical layout for the test pattern generator, and the only requirement is that the choke, R.F.C., is a good component. If, for any reason, the oscillator refuses to work, or quenching is poor, it is probably because the R.F. choke has been badly wound, but failure on this score is, in any event, extremely unlikely. The layout may therefore suit any chassis or case that is to hand.

The high-frequency circuits should, of course, be neatly made and wired. C1 is mounted direct on the grid pin of the valve-holder (G1 in the basing diagram, Fig. 4) and L1 should be mounted directly from C1 to the anode pin, A1. The lead to R1, R2 should be as short and direct as possible. L2 is mounted on the output sockets and posi-

tioned so that it is beside and in line with the mode end of L1, spaced from L1 by roughly 1/4 in. L2 is, of course, the pick-up or output coil from which the receiver under test is fed.

It will be noted that no smoothing capacitor is used in the power pack. This allows a 100 cycles ripple to reach the generator to which the blocking oscillator locks so that there is no likelihood of irregularity in this circuit.

Testing, Calibrating and Using the Generator

The generator can be used immediately it is built but for best results it may be calibrated against a television receiver known to be in good working order.

Couple the generator to the television aerial sockets by a short length of ordinary twisted flex. Often no coupling is needed, and the stray field round the generator is sufficient if it is placed beside the receiver. If direct coupling is used the flex should, of course, be plugged into the sockets connected with L2.

Switch on both generator and receiver, and when operating temperatures are reached inspect the screen. S1 should be in position 1 to produce vertical bars.

Vary L1 by opening the turns or squeezing them together, to produce the best picture. (This corresponds to tuning an ordinary circuit.)

(Continued on page 119.)

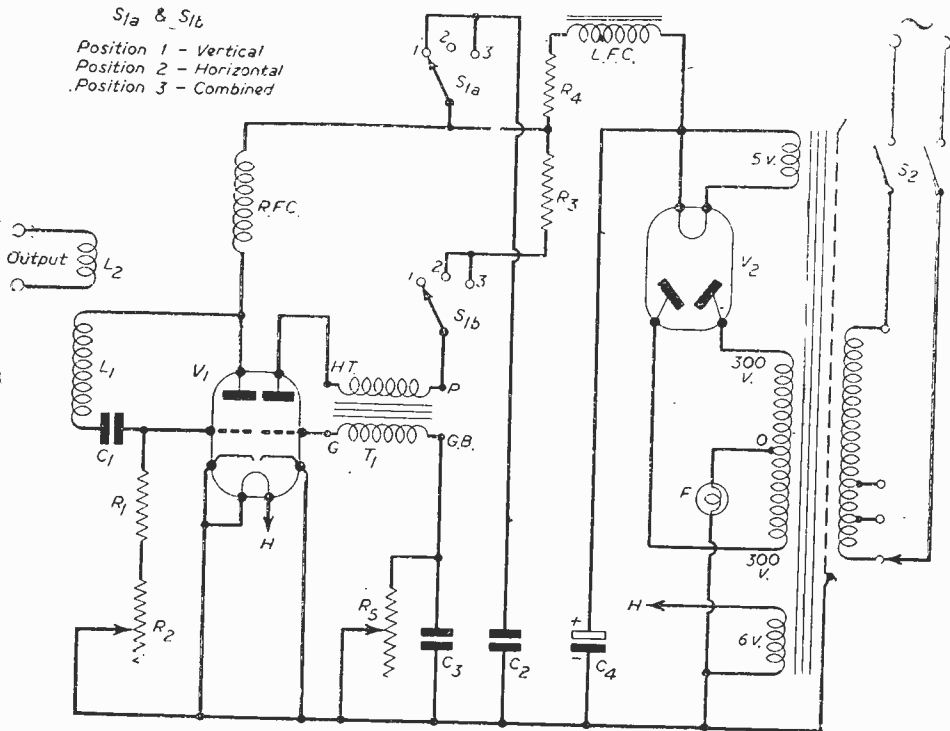


Fig. 3.—Circuit of the complete pattern generator.

LIST OF COMPONENTS

- L1—23 turns 18 s.w.g. D.C.C. and enamelled, close-wound, 1/4 in. diameter.
- L2—Two turns 18 s.w.g. D.C.C. and enamelled, 1/4 in. diameter.
- C1—0.0003 μ F mica.
- C2—0.006 μ F mica.
- C3—0.001 μ F mica.
- C4—8 μ F 450 volts working, electrolytic.
- R1—10,000 ohms, 1/2 watt.
- R2—0.5 megohm variable, line frequency control.
- R3—4,700 ohms, 1/2 watt.
- R4—33,000 ohms, 1 watt.
- R5—50,000 ohms variable, frame (horizontal), frequency-control.
- T1—3 \pm 1 intervalve transformer.
- T2—300-0-300v. 60 mA. H.T., 5v. 2A., 6.3v. 1A., primary, 200-250 volts.

- L.F.C.—10 or 20 henrys.
- F—Fuse bulb with holder, 2.5 volts flash bulb suitable.
- V1—6SN7.
- V2—5Y3G.
- Two International octal chassis-mounting valve-holders.
- R.F.C.—75 turns 30 s.w.g., enamelled, close-wound on 1/4 in. diameter rod; a ceramic 1 megohm resistor serves for a former.
- S1a, b—Two-pole 3-way selector switch.
- S2—Two-pole on-off switch.
- Small chassis, with metal case if possible.
- Output sockets for L2.
- Three control knobs for R2, R5, S1.

Transmitter Technicalities-1

In This Article DYNATRON Deals with a Load Impedance Conundrum

THE question which we are about to discuss in this article is one which gave rise to a great deal of argument in certain technical circles. Often, it is a thankless job to offer solutions to problems made terribly abstruse by successive discussions. After involved answers have been given, an elementary one is apt to infuriate people who always seem to be looking for the hard explanation where a simple one will do!

As is usual, some still hint that the point is not settled—that it is really a matter of opinion,

Because each valve, when working in Class B, functions for "half the time" (of a full A.C. cycle), it is easy to prove that *Energy/Time (=Power)* over this half-cycle period gives exactly the same answer as if the average was worked for a full cycle period. In other words: the *rate of expenditure* of energy (power) is the same for a half-cycle as for a full cycle.

There is no getting away from that line of argument. It is perfectly correct. But those who know anything whatever about A.C. averages will not be deceived for one second into thinking it signifies the power output of a Class B amplifier—where the output voltage is *sinusoidal*—can mean anything other than an average taken over a full cycle.

This point was covered in some detail in my article on A.C. power problems, where we took an example of a Class B push-pull amplifier delivering a total A.C. output of 20 watts, i.e., average output. Then, the average output per valve is obviously 10 watts. But the peak instantaneous (or "maximum") power on each side is 20 watts—a very different figure from an average.

We shall again consider briefly some aspects of Class B working in the present article. Many "hot" arguments raged over this pulse/power question—no doubt, partly because peak instantaneous power values (so many "megawatts") are employed in pulse techniques, such as radar.

But, bound up with the power problem was another big question which, in fact, helped to support the fallacy that each valve was in some sense supplying the full power output.

I had read hints of this before in various text-books and articles, where it was suggested—without explanation—that the load impedance in Class B is generally *less* than the A.C. resistance of the valve. Probably many readers may have come across this somewhat odd statement.

One-quarter Anode-to-anode Load ?

One or two text-books, such as the ones given as references at the end of the present series, are more explicit about the matter. In fact, it is believed that all the difficulties originally started from what these writers had put in print. Without any very clear explanation, they give equations for Class B audio-frequency push-pull which say that the "load resistance" in the anode circuit of each valve is *one-quarter* of the total anode-to-anode load resistance—and not *one-half*, as in ordinary Class A push-pull!

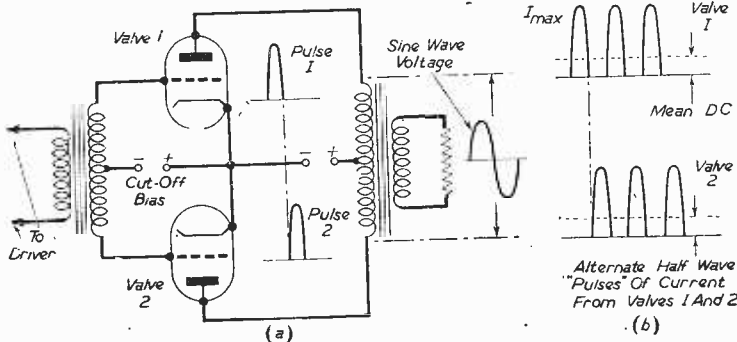


Fig. 1.—Class B, illustrating "intermittent" current conduction, but substantially a sine-wave voltage, i.e., no "pulsating voltage" exists anywhere across the output load, therefore "pulse power" is non-existent.

conventions (blessed word!) and points of view. "Who is right?" some still ask who do not care to admit that I, Dynatron, should make so light of a question debated by superior technicians!

Fortunately, I have some pretty able technical readers of these columns who are perfectly capable of judging for themselves, e.g., whether we are talking about *facts* or conventions. The correspondence columns are always open to any valid criticism worthy of serious attention.

The Controversy

What was this controversy which has not hitherto appeared in the technical press? One aspect of it was discussed some time ago in an article entitled, "Some A.C. Power Problems." There I referred to a curious—but nevertheless serious—line of argument suggesting "the part can be equal to the whole"—that each valve in a Class B push-pull amplifier is supplying as much power as two!

It may seem strange that many who argued failed to see anything fundamentally silly about such a proposition! Misguided to some extent by "higher opinions," it was naturally assumed that there *must* be some profound logic in support of the doctrine. . . .

There were also some very ingenious and plausible arguments.

At the time when the "argument" arose, many people took this figure for granted. "There can be no question about the matter," they would say, though they could offer no very sound reasons why the thing should be so "obvious." What reasons were given were fundamentally fallacious.

It is not suggested the text-books are "wrong." They are perfectly correct in asserting that the load seen by the individual valves is actually and truly one-quarter of the anode-to-anode load.

To illustrate: Suppose the anode-to-anode load resistance in Fig. 1 is 2,000 ohms. In any ordinary push-pull amplifier we would say each valve sees a load resistance of $\frac{1}{4}Ra = 1,000$ ohms. But in Class B push-pull each valve will see $\frac{1}{4}Ra = 500$ ohms, and this will be the figure represented by a load line! (Our figures are somewhat on the low side for any amplifier, but will do for illustration.)

That is a statement of fact. We are not questioning the figure. But what on earth does it mean? Why one-quarter? Is it the "real" load, or a sort of trick in manipulating formulae?

Taking figures for granted is all very well in its way. Difficulties often start when we set about using them, for example, in calculating the power output of an amplifier. Let us examine the question a little more closely.

An Erroneous Result

If we reckon upon an A.C. load of one-quarter the total, and assume that each valve develops one-half the total output voltage across half of the primary (a fact readily demonstrable), we shall inevitably conclude each valve is supplying as much A.C. power as two!

There is nothing odd about that. Power (watts) = V^2/R . If, for one valve of a pair in push-pull, we take $\frac{1}{2}V$ but $\frac{1}{4}R$, the power will still work out to V^2/R —the same as if we considered two valves!

The principle is true of a good many things besides valves. A transformer of 1/2 voltage-ratio has a 4/1 impedance (or load) ratio, the power being the same on primary and secondary sides: for a given "wattage," a lamp or a heater designed for half a given voltage must have one-quarter the resistance, and so on.

Since the voltage across half the primary of the output transformer must be one-half the total voltage across the whole primary, it follows there must be something ridiculous about this quarter figure for the load resistance when used for reckoning power output.

If we employ two valves in push-pull in order to get 20W. output, there must be something "screwy" about a load resistance value which tells us each valve is also supplying 20W.!

But, as mentioned in my previous article, efforts were made to try to justify this silly figure by abstruse (and quite erroneous) arguments concerning "power averaged over a half-cycle period."

Somehow, each valve is supplying 20W., yet it is not "useful output"! We have seen what it really signifies, but before proceeding farther with the load question a few words on Class B may not be amiss.

Class B

Better known perhaps as *Quiescent Push-pull* (Q.P.P.), Class B is a pulse method of using two valves in push-pull—for A.F. work push-pull must be employed, but it is possible to use single valves in Class B for radio-frequency purposes.

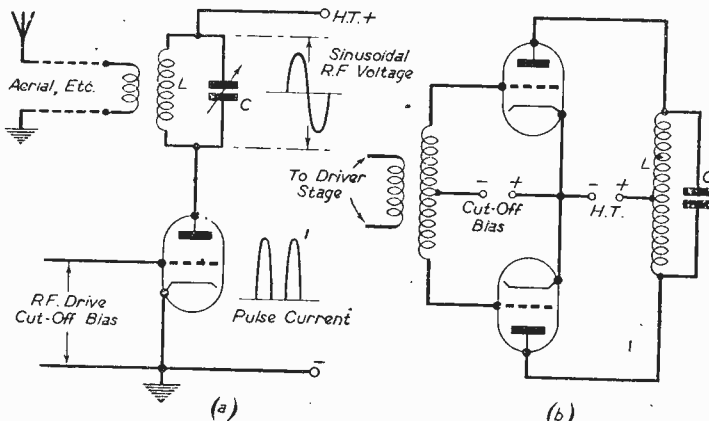


Fig. 2.—(a) Shows a single-valve in Class B (or even Class C) used as an R.F. power amplifier in a transmitter; because a resonant "tank circuit" is used, the output voltage will still be sinusoidal. (b) shows a push-pull version of the circuit.

You will probably know the mechanism of Class A push-pull. A current increase takes place in one valve (and one half of the transformer winding) at the same time as a current decrease in the opposite half; the grid of one valve receives a potential change in a "positive" sense, when the opposite grid is running "negative."

Provided the valves are working with minimum distortion, and the push-pull amplifier reasonably well balanced, the net effect of these current variations will be to induce a sine-wave voltage in primary and secondary of the output transformer.

In Class B the same result (sine-wave output voltage) is accomplished rather differently, leading to economy of standing H.T. power and thus improved D.C./A.C. conversion efficiency in high-power stages. A disadvantage is that adjustments are much more critical than Class A to get a close approximation to a sine-wave voltage.

In the first place each valve is biased almost to current cut-off. When alternating "drive" is applied to the grids each valve supplies alternate half-cycles of current, as in Fig. 1(b). At any given time only one half of the output transformer primary is carrying pulses of current, and this current will be a half-wave "pulse," very similar to the current output of a half-wave rectifier, Fig. 1(b).

Observe that we have emphasised the fact that only one side of the amplifier is functioning over a

given interval. In Class A both halves of the output transformer carry a true alternating current *all the time*, i.e., an increase in one half, and a decrease in the opposite half.

In Class B first one valve supplies a half-wave pulse, then the other. Both valves are never conducting at one and the same time, hence the terms *intermittent conduction*, etc. When one half of the primary is in action the other half is idle, and so on.

Now, provided certain conditions are realised, pulsing each half of the primary *alternately*, in this way, can bring about the same result as in Class A—a nearly sine-wave output voltage.

It is of importance to realise this. The valves are supplying a pulsating (rectified) current, but the output voltage is a sine-wave. *No pulsating voltage of the same wave-shape as the current exists in the output circuit.* Most of the futile arguments and fallacies concerning "pulse power," and so forth, arise through failure to understand this elementary fact.

A Class B amplifier can be adjusted to deliver a nearly true A.C. (sine-wave) output, comparable to Class A, though, as stated, these adjustments are critical whilst negative feedback is employed nowadays to ensure best results.

Single-ended Class B

So far we have been talking of "push-pull." For Class B audio amplification there is no alternative—push-pull must be used to get anything approaching a sine-wave voltage. With untuned transformer output, a single-valve in Class B would give a highly-distorted voltage-wave. There would be no possibility whatever to get an approach to sinusoidal ("distortionless") output.

But in transmitters it is quite possible to employ single-ended Class B in *radio-frequency stages*, i.e., with a tuned circuit, or resonant load, as in Fig. 2(a). A push-pull version is shown schematically in Fig. 2(b).

Here a sine-wave current is maintained oscillating in the closed L.C. circuit, which, in turn, gives a sine-wave voltage across the resonant combination. Again, the valve itself supplies a half-wave pulsating current.

This single-valve R.F. case will come in very useful for demonstrating that the quarter impedance in Class B is not a peculiarity of push-pull, as such. What we shall term a *pulse load* has to be considered, even in the single-valve case.

Fallacious Arguments

From this outline of push-pull action let us turn to one or two wrong reasons which were adduced to explain the quarter figure.

One is transparently obvious—it seems incredible that it was actually put forward as an explanation! If A.C. measuring gear were employed to find the load resistance existing across each half of the transformer, the value shown would be one-quarter of the resistance across the whole primary!

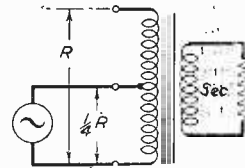
Perfectly true, of course. But as an explanation of Class B, it falls wide of the mark. For A.C. measuring gear would show exactly the same quarter ratio in Class A push-pull, or, for that matter, across the halves of any isolated transformer or tuned circuit. This explains exactly nothing of the quarter-figure in Class B.

If you "tap" any transformer or coil to give an auto-transformer of half voltage ratio (or if you take an ordinary half transformer) the impedance-ratio is the *square* of the voltage or turns ratio, i.e., if a load resistance R exists across the whole winding; then, to get the same power at half the voltage, the equivalent load across one half of the winding will be $(1/2)^2 \cdot R = 1/4 \cdot R$.

The quarter resistance which each valve in Class B sees cannot be measured by A.C. test gear and, moreover, is not a result of impedance-transformation arising from transformer taps. As will be seen presently, it is a curious quantity of an entirely different kind.

Let us look at another plausible argument. If you take out one of the valves in Class B push-pull, abnormal conditions will arise because the A.C. load on the remaining single valve will be found to be actually one-quarter of the original anode-to-anode A.C. load! Of course, it will—and in Class A, too, though the practical results will not be as serious.

Fig. 3.—If an alternator is tapped across half the primary, as indicated, it will see only one-quarter of the total primary load resistance R . Is intermittent valve operation in Class B an analogous case?



What we have said about the rules of impedance-transformation should show why. The A.C. load on the remaining valve *becomes* one-quarter if the other valve is made inoperative. Note carefully what is said. The A.C. load. Actually, there would be other complications, such as non-sinusoidal waveforms in A.F. push-pull. For the moment the essential point is that loading conditions will be entirely different with one valve out of action, and this is *not* the answer to our quarter riddle.

A third line of argument which follows from the above, and probably sounds the most convincing, is this: because the valves operate intermittently—only one supplying power at a time—it follows that we are virtually using half the transformer winding, and, therefore, by impedance-transformation principles the load on that one valve must be one-quarter of the resistance across the whole winding.

It sounds most plausible because conditions might seem identical to a case where an A.C. supply is connected across half a winding, as in Fig. 3—the "A.C. generator" being each Class B valve during the half-cycle it is in action. But are the two cases identical? Remember that the valves are supplying a *pulsating* current, whilst the sinusoidal alternating voltage is a result of the push-pull action of two valves.

(To be continued.)

OUR COVER SUBJECT

THE illustration on our cover this month shows some of the Bell System Equipment, mounted on a telephone building in Hollywood, California, which was used for an extended series of experiments in television transmission. In this location the signals were beamed to a station on Mt. Wilson where they were broadcast to television sets in the Los Angeles area.



ON YOUR WAVELENGTH

By THERMION

Disc Recording and Processing

THERE can be no doubt that present commercial conditions confine the disc record to the speed, diameters, and groove spacing at present standardised. This raises the interesting question as to whether the future of the disc record is to be limited by playing time, frequency range, dynamic range, and also whether it should always be destined to run at an excessive range of linear speed. Non-commercial records, of course, have long since departed from the methods adopted in the domestic gramophone disc.

In a discussion before a meeting of the Radio Section of the Institution of Electrical Engineers, following a lecture on "Commercial Disc Recording and Processing," some interesting viewpoints emerged. The lecture was given by Mr. B. E. G. Mittell, who thought there existed a serious degree of divergence owing largely to two causes—namely, the ease with which departures could be made from the classic frequency characteristics, and the use of reproducing points which being of a permanent or semi-permanent nature did not adapt themselves to the shape of the individual record groove.

In the discussion it was agreed that there was no fundamental disagreement with the proposals for standardisation of groove, stylus and recording characteristics put forward by the lecturer. It was further thought that a preliminary committee on which the principal British record pioneers were represented would have no difficulty in reaching tentative agreement nor in finding the basis of a British standard. I suggest that the British Standards Institution be asked to form such a committee.

The standard recording speed in this country is 78 r.p.m. The proposed speed put forward by the N.A.B. of America is essentially a 33½ r.p.m standard, but it has by no means found universal acceptance in the U.S.A. Most of the speakers thought that some degree of pre-emphasis of high frequencies was desirable with present recording materials, and that the amount proposed by the N.A.B. was excessive and would lead to tracking distortion at the modulation levels usually recorded on commercial discs. A rise of 3 decibels from 300 c/s to 6,000 c/s and a further 3 decibels from 6,000 c/s to 12,000 c/s was suggested by one speaker as a suitable compromise. It was also thought that an extended high frequency was worth while provided that distortion components in both recording and reproducing systems could be reduced to a satisfactory low level.

Even when the response of the reproducer or of the ear of the listener was restricted, it was possible to detect a subtle improvement resulting from the recording of high and even ultra-sonic frequencies.

The peaking of the high-frequency response to give a spurious brilliance was deplored. Some speakers thought that the proper approach would

be to reduce noise at its source by research into alternative materials for the record. Vinyl plastics had been extensively tested and had shown considerable promise, although they are more expensive.

Experience in America seemed to indicate that the public does not yet regard the improvement as worth the extra cost. The absence of abrasive means that more care has to be taken to ensure a correct needle point, and specially-designed pick-up movements might be needed owing to the reduced elasticity of the grooved wall.

There is also the question of the limitations of the present manufacturing processes. Several speakers ask for information on the change of groove shape during the various stages of manufacture, and it was stated that change of shape between the original wax and the final stamper was compensated by modifications in the shape of the recording cutter.

Groove wear during playing time was discussed, and it was stated that sapphire points did not necessarily damage the grooved walls. A record which had been played one thousand times did not audibly indicate any damage to the grooves.

It is my view that we have a long way to go before an ideal material is found for gramophone discs, and I believe that within the next 20 years the disc system will be abolished in favour of photo-electric-cell recordings. The problem of recording television programmes, at present an unsolved problem, may by its solution provide the answer to the problems of recording sound only.

Television Breakdowns

I wonder if anyone can invent some method whereby the B.B.C. can let viewers know when they have broken down to avoid a general rush to the controls of their television receivers? At the moment, when the sound channel breaks down a simple notice is sometimes transmitted, asking viewers to stand by whilst the fault is rectified. When the vision channel breaks down a record of Bow Bells or some other interval type of music is played. But very often some fault in synchronising or framing arises (mainly, it appears on O.B. transmissions), and one does not know whether it is due to some fault in the receiver or the transmitter. If it is the latter, how can the information be suitably conveyed to the viewers before they have started adjusting their receivers? And how long should one wait before starting to make adjustments? These points need solving and, no doubt, the B.B.C. would welcome ideas on the subject.

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Let us remember wisdom of the ancient well-proved rune, that he who pays the piper should rightly call the tune.

"Totum"

C, R and L Chart

A Graphical Aid in Selecting Capacitors, Resistors or Inductors.

By M. WEINWURM

THIS chart has been constructed to provide a rapid means of solution to problems involving 2 resistors or inductors in parallel or 2 capacitors in series.

For reasons of brevity the following explanations refer to a parallel combination of two resistors only.

Procedure

The ordinates *a* and *b* represent the respective values of the two components forming the parallel combination, the value of which will be found on the point of intersection of the lines R and *c* (connecting *a* and *b*).

On the other hand, to find the value of resistor (*b*) which must be shunted across an existing one (*a*) to give a certain total value (R), connect the given values on R and *a* by means of a straight line, and the required additional value will be found at the point of intersection on *b*.

Power Rating

Since the power dissipated in a resistor is inversely proportional to its resistance the power rating for *Ra* is read on *b*, and for *Rb* on *a*, as can readily be seen from the chart.

If, in the example given, *Ra* were of the 3 watt, and *Rb* of the 5 watt type, they would both be equally loaded. These would be the minimum required ratings for a combined power dissipation of 8 watts.

Should the total power consumption be different shift line *c* until the sum of the values *a* and *b* is equal to the power dissipated in the combination, and read the rating for *Ra* on *b*, and *Rb* on *a*.

Example

An E.M.F. of 30 volts is connected across 300 ohms and 500 ohms in parallel. From the chart the value of this combination is found on R=187.5 ohms, and the total power dissipation is calculated (30² : 187.5) with 4.8 watts.

After shifting line *c* until the values *a* and *b* total 4.8 the individual power ratings can be read, for *Ra* on *b* with 1.8 watts, and for *Rb* on *a* with 3 watts.

Proof

$$c = \sqrt{a^2 + b^2}$$

$$\sin \rho = \frac{b}{c}; \cos \rho = \frac{a}{c}$$

$$a = 180 - 45 - \rho = 135 - \rho$$

$$\sin 45 = \cos 45 = \frac{1}{\sqrt{2}}$$

$$\frac{R}{\sin \rho} = \frac{a}{\sin a}; R = \frac{a \sin \rho}{\sin a}$$

$$\sin a = \sin 135 \cdot \cos \rho - \cos 135 \cdot \sin \rho =$$

$$\frac{1}{\sqrt{2}} \cdot \frac{a}{c} + \frac{1}{\sqrt{2}} \cdot \frac{b}{c}$$

$$= \frac{\frac{1}{\sqrt{2}}(a+b)}{c}$$

$$R = \frac{a \cdot \frac{b}{c}}{\frac{\frac{1}{\sqrt{2}}(a+b)}{c}} = \frac{ab \sqrt{2}}{a+b}$$

In order to read the correct result $\frac{ab}{a+b}$ directly on the R line it is merely necessary to make unit distance on the R line $\sqrt{2}$ times one unit on the *a* or *b* line.

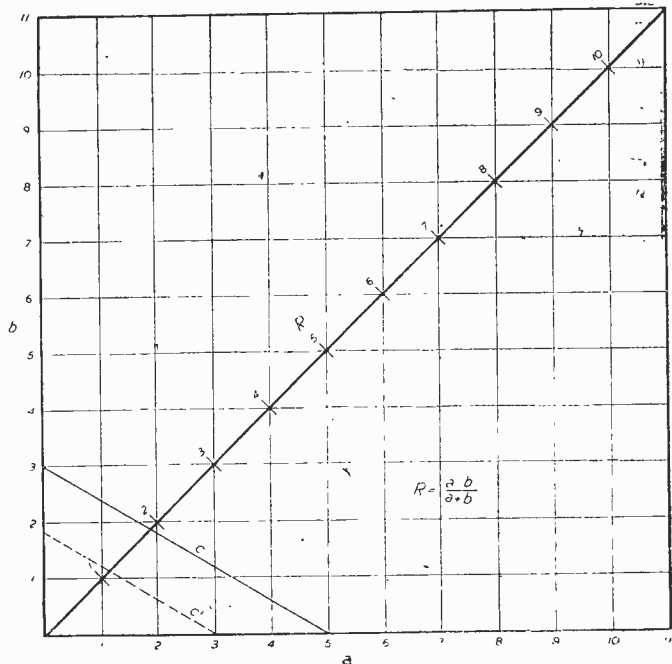
The angle $\hat{a}R$ being 45°, $R+a\sqrt{2}$.

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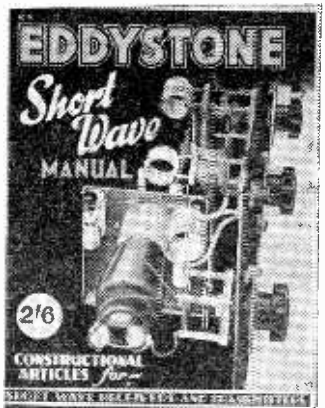
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Test Instrument Design-3

The Multi-vibrator and Sub-standard Oscillators

By P. E. TOOKE

IN the field of sub-standard frequency checking the one indispensable instrument is the multi-vibrator and its associated circuits. A multi-vibrator is a two-stage R.C. coupled amplifier with its output fed back to the input. Otherwise known as a "relaxation" oscillator, it is a Franklin circuit using, instead of a tuned resonant circuit, a resistance-capacity arrangement.

The action of this type of circuit can be understood by the fact that each tube produces a phase

ing frequencies are required, as the harmonics will carry on from a fundamental of, say, 10 kc/s. to anywhere up to 200 or 300 kc/s in 10 kc/s steps. Also, sub-harmonics can be generated by locking the multi-vibrator with an oscillator of a frequency higher than the fundamental. That is to say, if the vibrator oscillator has a frequency of 1/10 of the fundamental locking frequency it will produce harmonics of exactly 1/10, 2/10, 3/10, etc., or sub-harmonics.

So in a multi-vibrator we have the best means of calibrating that is possible. Fig. 1 shows the circuit of a relaxation oscillator. The locking voltage can be injected at the point marked, or on the screening grids if the tubes used are pentodes. In either case some means of controlling the amplitude of the locking oscillator should be fitted, as this considerably affects the locking.

Crystal Oscillator

A suitable crystal-controlled oscillator for locking a multi-vibrator is described in the first article of this series (January issue). This should have a buffer stage, for which R.C. coupling is normally used, and the amplitude gain should be fitted on the buffer circuit.

A very useful piece of apparatus for the home laboratory can be constructed in this way—a multi-vibrator of, say, 10 kc/s locked with a crystal oscillator of the same frequency. For checking the frequencies of other oscillators a mixer stage and demodulator should be incorporated, then all that is necessary is to mix the known and unknown frequencies until zero beat is

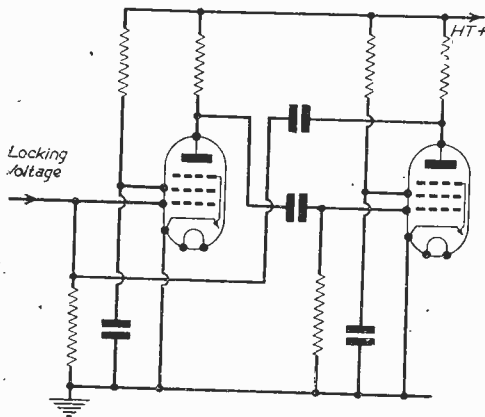


Fig. 1.—A multi-vibrator or relaxation oscillator using pentode valves.

shift of 180 deg.; and the voltage fed from the output to the input of the first tube is the right phase to carry on oscillation. The frequency is determined by the grid leak resistance and grid condenser capacity, but is influenced by tube and the remaining circuit to some extent.

Multi-vibrators can be adjusted to oscillate from a few cycles to anywhere up to about 100 kc/s. The chief asset of the instrument is that the frequency is very rich in harmonics, and by injecting a voltage from an oscillator resonating at about the fundamental it can be "locked," and the frequency is as accurate as the locking voltage.

Such an arrangement is invaluable where calibrat-

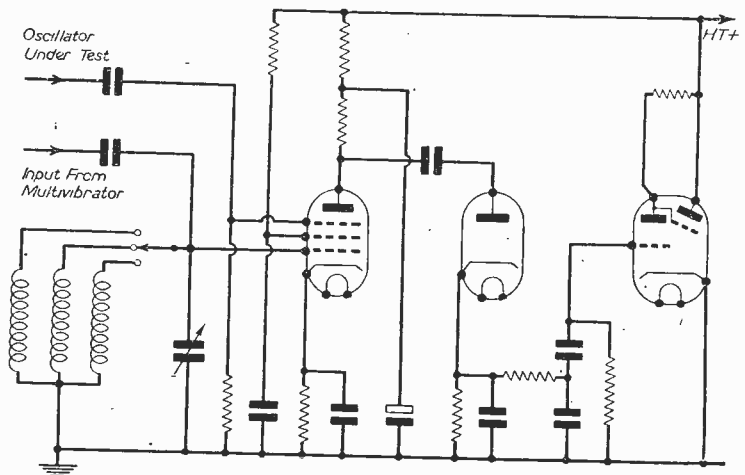


Fig. 2.—Tuned mixer and diode demodulator stages with a cathode-ray indicator for checking zero beat.

found; the unknown oscillator frequency is then exactly the same as the harmonic with which it beats.

Of course, the mixer stage should be tuned; otherwise it will not be known with which harmonic you are beating. A cathode-ray indicator can be used for checking the beats or, if you really want to do the thing properly, an oscilloscope. For all ordinary purposes, however, the cathode-ray indicator will suffice. The mixer and demodulation stages of such a set up are shown in Fig. 2.

This means of checking frequency is much more accurate than the conventional wave-meter method, although it entails more apparatus.

Sub-standard Oscillator

The construction of a really sub-standard oscillator is rather beyond the means of the average "ham," although he very rarely needs such a standard of accuracy. Some idea of the extreme care which is taken to insure that the frequency is dead stable may be gained from the following specification for a commercial instrument: First take a crystal oscillator. The crystal is normally contained in an "oven" in which the temperature is thermostatically controlled. Means of ventilation are provided for the associated circuits, and the plate circuits fixed tuned to the fundamental frequency of the crystal. A buffer stage is pre-tuned and sometimes even two buffer stages are used. A network of stabilizer resistances and tubes is used to control the plate voltage, and special circuits are used to control any fluctuations in the heater voltage. As already pointed out, such refinements are barred to the amateur, who is quite content with a frequency stability of one part in ten thousand, and often even less.

Quite good stable oscillators for locking the multi-vibrator previously described can be constructed with the E.C.O. or Franklin circuit, if special care is taken with wiring and layout. Such circuits should be fixed tuned, and the tuned

circuit kept well ventilated and away from the heat of the tube, as this is the most frequent cause of "frequency shift" when the apparatus, as a whole, warms up. In all cases heavy screening should be used for resonant circuits. Stray pick-up and capacity can easily upset the delicate tuning.

These same precautions also refer to any mixer buffer and demodulator stages used for frequency checking. Although obviously not as important as the oscillator, they can, if badly designed, have an effect on the accuracy of the resultant test or check.

It therefore pays to make a good job of not only the oscillator, but also the associated stages. Plenty of decoupling should be used (in the right places, of course) to prevent any stray R.F. finding its way into the H.T. supply, and if high frequencies are being used, chokes are almost an essential in the heater leads of buffer stages, etc.

Copper is the best material to use for chassis and screening cans, if it can be obtained. Failing this, a plated chassis should be used. On no account rely on a painted chassis unless special care can be taken of earthing, etc., and even then be wary of it.

Resistances are ideal if wirewound and have a high tolerance; likewise, condensers should be of a good mica or ceramic type for the smaller capacities, and high voltage paper for the larger. All components should be of at least 100 per cent. higher rating than at which it is to be used, as this will prevent excessive heating and keep the instrument cool.

The power pack is best mounted on a separate chassis to prevent any stray mains pick-up and heat, which is unavoidable in a power unit. If these precautions are taken, there should be no reason why a very high standard of stability should not be obtained, even with the use of standard components.

(To be continued)

Six-metre Licences

REPORTS which have appeared elsewhere of amateur activities on the six-metre band have led to inquiries concerning a licence for such work, as the band is not authorised under the standard Amateur Licence. We understand from the R.S.G.B. that the G.P.O. have now arranged to grant a special permit to all U.K. amateurs to use the six-metre (50-54 Mc/s) band provided it is stated in the application that the facility is required for the purpose of conducting technical investigations. The permits will remain valid only until April 30th next.

It had been anticipated that the G.P.O. would accept from the R.S.G.B. a preliminary list of names, addresses and call signs of those requiring the facility, but the G.P.O. were unable to agree to this arrangement. All who wish to obtain the facility must, therefore, make direct application to the Engineer in Chief, Radio Branch, W5/5, Brent Buildings, North Circular Road, London, N.W.2.

Regulations

Among the regulations governing the permit are the following:

Stations may only operate during the following hours: 12 noon to 2 p.m. and 10.30 p.m. to 10 a.m. within 50 miles of London, but at any time outside that area.

No transmission may take place within ± 50 kc/s of the following frequencies: 50.5 Mc/s, 51.2 Mc/s, 51.9 Mc/s, 52.6 Mc/s and 53.25 Mc/s.

The 42 amateurs who were granted permission last November to operate on six metres have had their permits extended.

The G.P.O. will make a charge of 10s. for each permit issued in order to cover their expenses, and this fee should be sent with the application.

Car Radio Licences

READERS are reminded that if they have a car radio licence and their car has been laid up due to the withdrawal of the basic petrol ration they may obtain a refund on the licence at the rate of 1s. 8d. per month on the unexpired portion of the licence.

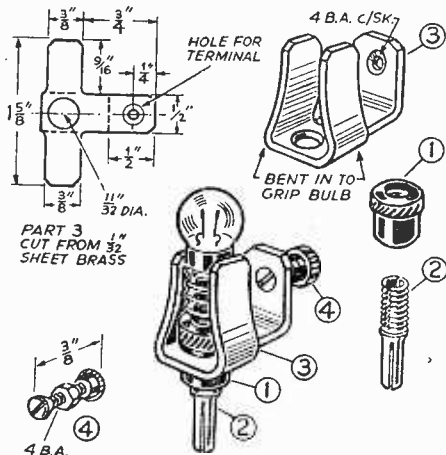
Application should be made to the nearest head postmaster, enclosing a formal signed notification stating that the car has been withdrawn from service.

Practical Hints

Battery Safety Fuse-plug.

THE novelty of the home-made fuse-plug illustrated lies in the simplicity of its construction and the readily-procurable wander plug used as a basis for the design. This is a standard type having two bottom lock nuts, which are easily removable, leaving a plain shank. The two parts used are shown as parts 1 and 2 respectively in the drawing.

The simple T-shaped strip, part 3, is cut from 1/32in. sheet brass. A 11/32in. diameter hole is drilled in the centre of the three arms as shown. This is to take the plastic top of the wander plug, which should be a tight fit in the hole. The other hole is for the small terminal which can be either



THE FINISHED FUSE PLUG

A novel method of making a fuse-plug.

4 B.A. or 8 B.A. as preferred. The T strip is bent to bracket form as shown, and the plastic top 1 pushed in. The two arms should be bent to afford a firm grip to the screwed metal shank of the flash lamp bulb. The pip of the bulb contacts the shank of the plug, which is itself insulated from the bracket by the plastic top 1 now acting as bushing. With the 1/32in. gauge brass specified the bulb is gripped sufficiently hard to obviate the necessity of a binding of insulating tape, which might be necessary if a thinner gauge were used. It was found necessary to cut off a small slice from the bottom of the plastic top 1 so that the metal shank 2 would effectively contact the "pip" of the bulb, when the former was screwed up.—R. L. GRAPER (Chelmsford).

Concealed Wave-change Switch

IT was desired to convert a midget (medium wave only) receiver to operate on medium and long waves. Since there was no space on the front of the set for the usual wave-change knob,

THAT DODGE OF YOURS!

Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay half-a-guinea for every hint published on this page. Turn that idea of yours to account by sending it in to an address to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be original. Mark envelopes "Practical Hints."

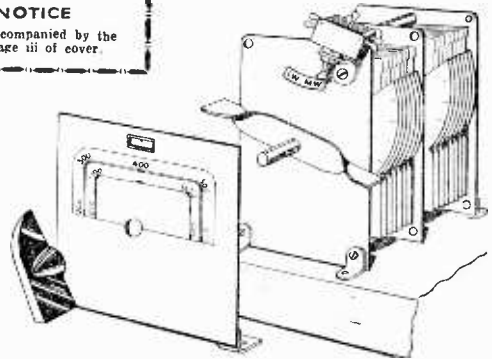
SPECIAL NOTICE

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

the method shown in the sketch was adopted.

A double-ended arm is mounted behind the dial on the tuning condenser spindle and operates the switch (a small toggle switch), mounted on a bracket on the tuning condenser frame.

Clockwise operation of the tuning knob at the end of its travel clicks over the switch to



Adding a wave-change switch to a variable condenser.

change from medium wave to long wave: similarly anti-clockwise motion changes from long wave to medium wave.

This method makes reception difficult over a small portion of the band at around 550 metres (whilst the arm is actually pushing over the wave-change knob). However, reception is very poor on the usual midget at around 550 metres, so little is lost. Similarly, a small portion of the long-wave band around 800 metres will be "lost." Here there are no stations. The effect can be minimised by making the arm as long as practicable.

A small brass plate may be soldered to the knob of the switch and marked M.W. and L.W. to show through a small window in the dial, giving indication of band in use.

The new long-wave scale was printed alongside the medium-wave scale.—H. J. R. TOWNSEND (Newport, Mon).

REFRESHER COURSE IN MATHEMATICS

By F. J. CAMM

8/6, by post 9/-

FROM

GEORGE NEWNES, LTD.,

Tower House, Southampton Street, Strand, W.C.2

Portable

A Self-contained Battery Receiver

By F. BE

THIS set is the result of many experiments; it has three unsuccessful predecessors. An economical receiver with a performance satisfactory in any part of the country had to be found and then fitted in to the smallest possible space compatible with first rate results.

L.T. arrangements are simple. A frame aerial is fitted but it does not need accurate winding, and its performance is very good; Radio Netherlands will fully load the output valve during daylight whilst after dark A.F.N., Eire, and Frankfurt are all easily receivable. Further, the set is not a box of whistles, not one heterodyne being found anywhere round the dial.

None of the parts is critical and only patience and careful construction are necessary for success. The set has been going for six months and has been a great success on hikes, at a Youth Centre and for reproducing gramophone records for dancing. During the power cut last year it was invaluable.

The Circuit

The circuit is that of a straightforward super, with an untuned R.F. stage. Only one point need be noted—the wiring of the filaments. This is not just any series arrangement; it is the only one which is completely satisfactory from the point of view of accidental short circuits, etc. Other arrangements, though possibly easier in construction, might mean a continuous bill for burnt-out valves. As shown, accidental shorting of either positive to chassis will only short the batteries, the valves will be unharmed. As no delay can be imposed upon the A.V.C. line, A.V.C. is only applied to the I.F. stage.

The set will not go into the space detailed unless the plan of construction is adhered to throughout. One word about the components; size is important, so insist on the smallest obtainable. Quarter watt resistors are used throughout, and all .01 μ F condensers are Metalmite, being just 1in. long

and about 3in. in diameter. Coils are Wearite "P" type and all valves are of the G.T. series. The British equivalents could be used, but the width of the case would have to be correspondingly increased. The whole set is designed around the Celestion 5in. midget type speaker and no other should be considered. The set could have been made a great deal smaller by using smaller batteries, speaker, and so on, however, but such reductions seriously affect volume, tone, and running costs, the last item being of very real interest, for the set costs less than a penny an hour to run. A midget of the shoulder bag type using a No. 26 H.F. battery might easily cost 5d. or 6d. an hour!

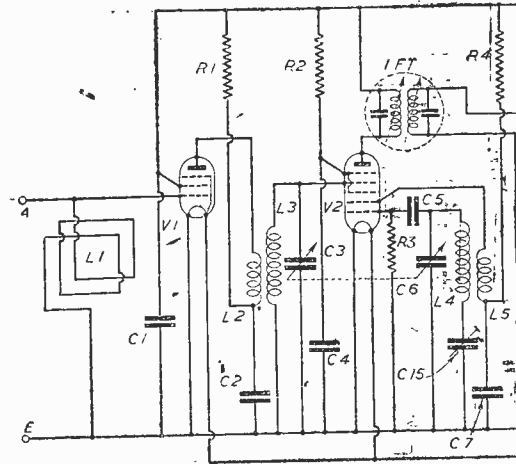


Fig. 1.—Theoretical circuit

COMPONENTS

- L1—Frame aerial.
- L2, L3—Wearite P.H.F.2 coil.
- L4, L5—Wearite P.O.2 coil.
- I.F.T.1, I.F.T.2—I.F. transformers, Wearite, type M.400.
- T1—Output transformer, Wharfedale O.P.3.
- C3, C6—.0005 μ F (two-gang, Polar small type).
- C1—1 μ F.
- C2, C4, C7, C8—.01 μ F.
- C5, C9, C10—.0001 μ F.
- C11, C12—.03 μ F.
- C14—.005 μ F.
- C13—25 μ F, electrolytic, 12 volt D.C. working.
- C15—Padder 950 pf max.
- R1—2,000 ohms.
- R2—80,000 ohms.
- R3—200,000 ohms.
- R4, R5, R12—50,000 ohms.
- R7—3.5 megohms.
- R8, R9—1 megohm.

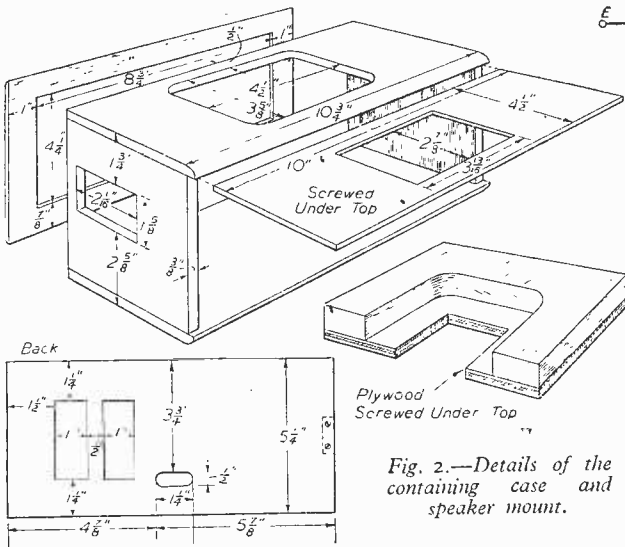


Fig. 2.—Details of the containing case and speaker mount.

Four

with Novel Frame Aerial
WITH

The battery used here is a B.117 layer-built. The L.T., an 800 cycle lamp battery, will still do good service on a cycle long after it has resigned its commission in the radio.

Construction

The chassis is bent up out of sheet metal, such as tin plate (easily obtained) or aluminium (difficult to obtain, but easy to work). In the original model duralumin was used; it proved entirely satisfactory.

Mark out as shown, cut to shape and then bend up the small platform, making sure this is done in the right direction. Some readers may foresee

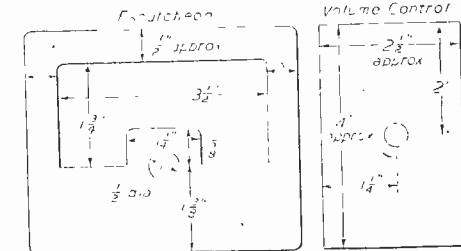
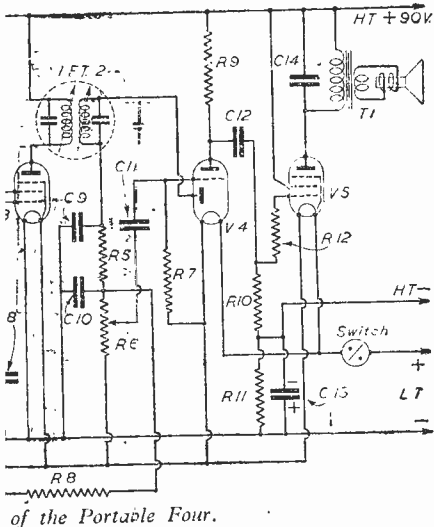


Fig. 3.—Escutcheon and volume control mounting details.

difficulty in cutting as shown. The outside can be done with tin snips. The interior division can be made with tension file or even an old chisel. (The last method may seem crude but it is very sound!) Valveholder holes may now be punched or cut. Drilling should also be completed at this stage. Next mount the components, including brackets for the coil (P.O.2) and volume control. These may be made from the sheet metal. The tuning condenser is mounted by nuts and bolts through the back plate and platform of the chassis; 3/16in. spacers are used between condenser and chassis. The condenser spindle should fall 4 1/4 in. from the end of the chassis and 1/4 in. in front of it when seen with the two-gang condenser at the top right. The centre of the spindle is taken for these measurements.

One of the Wearite I.F. transformers must be modified. Remove it from its can by undoing the nut at the top. Cut off the tags as short as possible and solder on wires instead. We now have a wire-ended component instead of one with soldering tags. This is necessary because of the lack of space beneath the chassis—immediately above the volume control. (Denco I.F. transformers, although rather



of the Portable Four.

LIST

- R10—2 megohms.
- R11—550 ohms.
- R6—5 megohms pot. with switch.
- Speaker—Celestion, 5in., Model P.5.Q.O.

Sundries

- Valveholders—5, Octal.
- Trimmers—2, 50 pf max.
- Aerial and earth bracket, etc.

Valves (G.T. Series)

- V1—1N5.
- V2—1A7.
- V3—1N5.
- V4—1H5.
- V5—1C5.

Batteries

- H.T.—B.117, Ever Ready.
- L.T.—800, Ever Ready.

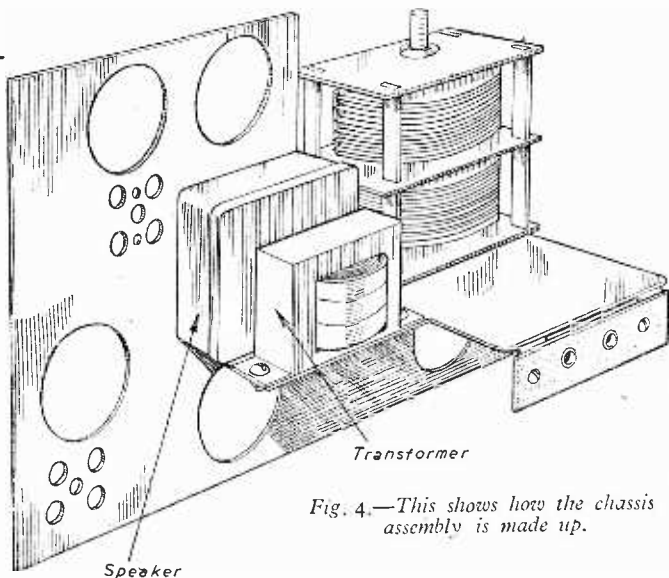


Fig. 4.—This shows how the chassis assembly is made up.

larger, are already wire ended and have been used with success.) Mount the output transformer on the "platform" as shown, also the A.E. strip, etc.

Wiring Up

Commence with the filaments, then complete the various coil connections and finally complete the audio stages. Ignore the frame aerial as yet. Note the particular situation of certain components, e.g., bias resistor and condenser, and trimmers. When all the wiring is complete try the chassis in position over the speaker to ensure that nothing is shorting against its metal frame. All components and wiring should be well clear but if any difficulty is experienced through the use of alternative parts then some insulating material should be pasted on to the speaker, e.g., thick brown paper coated with shellac, etc. The space between the chassis and the speaker baffle is $1\frac{9}{16}$ in. Brackets should now be cut to mount the chassis on the speaker baffle. (To have bent ends on to the chassis for this purpose would have been too difficult for anyone without a vice.) The baffle, it will be seen, is a piece of three-ply. As soon as the frame aerial is in place assembly can be begun.

The Frame Aerial

Wind this with approximately 34 s.w.g. D.C.C. wire. As the frame is untuned it is an excellent idea to wind it so that its natural resonance falls somewhere about 400 metres, .75 Mc/s. This can

best be achieved by winding 95 turns on to a former 22 in. in perimeter; the shape does not matter. In other words, the former could conveniently be rectangular, 4 in. \times 6 $\frac{1}{2}$ in., or round, 7 in. in diameter. The latter is the shape to aim at eventually. Proceed as follows:

First wind round the former a couple of turns of stiff paper about 2 $\frac{1}{2}$ in. wide. Secure it in place and then wind on the 95 turns. The winding should now be thoroughly impregnated with thick shellac or thin glue. Leave it to dry and then tear away paper and remove the winding. Ease out any corners caused by formers other than round ones and mark any point on one side of the winding. Place a ruler across the frame at this point so that it forms an angle of 45 deg. with the turns. Fold the frame so that this corner lies flat. Measure off 5 in. from the original starting point in the same direction as the fold. At this second point fold again, though this time the ruler must lie at 90 deg. to its original position and not in the same line. From the second point mark off 6 in. still in the same direction (i.e., 11 in. from original point). At this new point repeat the above folding, etc., in this other half of the frame. The result should be a flat frame aerial, 5 in. \times 10 in. approximately, with its corners missing. Cut from a sheet of stiff card such a piece as will fit into the pocket, at one end of the frame and extend to about half way along it. Assemble as shown. This card is important for more than obvious reasons and should not be

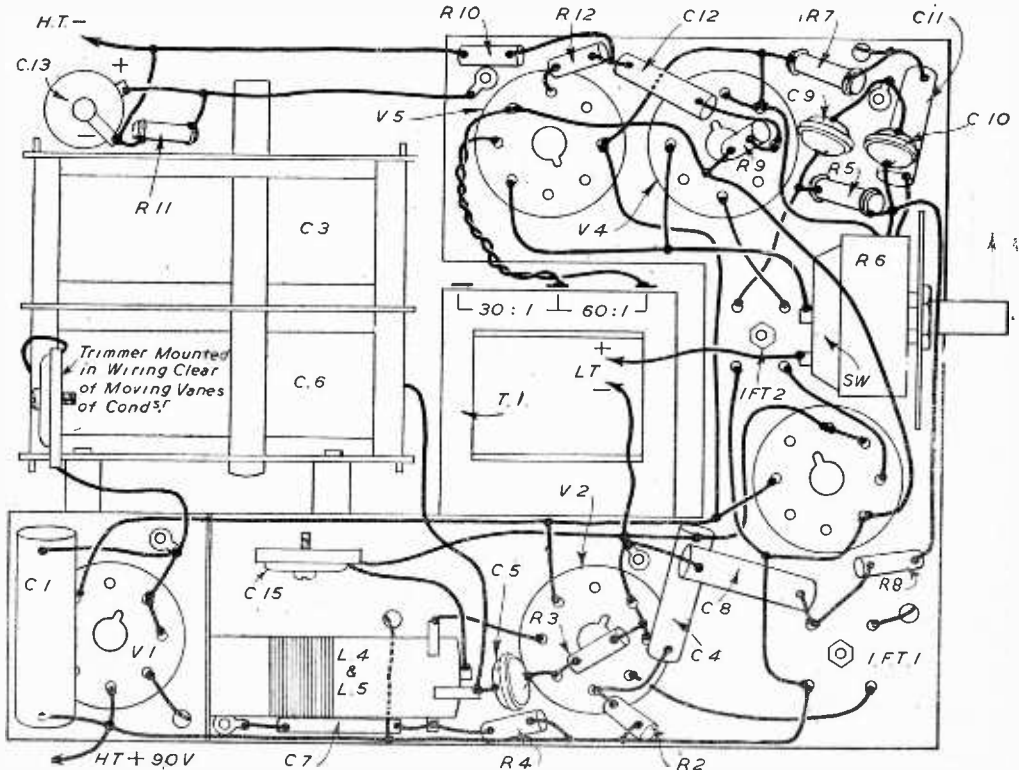


Fig. 5.—Wiring diagram of the receiver, showing battery leads.

omitted. The turns covering the loudspeaker opening may be separated in order not to reduce its efficiency. The nuts and bolts holding the card on to the baffle board may also carry double-ended soldering tags, thus allowing anchoring of the ends of the frame.

Temporary connections should now be made to the speaker and frame aerial and the set tried out. When the batteries have been connected without the valves in place connect a torch bulb across the filament of the output valve and short across the filament of the frequency changer. The bulb should light when the set is switched on; if it burns out on no account insert the valves until the fault has been rectified.

With the valves now in place the local stations should come in quite well. This assumes that the adjustable cores on the I.F. transformers have not been meddled with as yet. If no signals are heard resist the temptation to adjust the cores; instead, check over the connections, especially those to the oscillator coil. Reversal of these would cause the valve to fail to oscillate and result in absence of signals. Once the local signals

are heard adjust the I.F. transformers for maximum volume. Begin with the diode and work back to the frequency changer.

Tracking

Commence with all trimmers unscrewed. Perform the following operations:

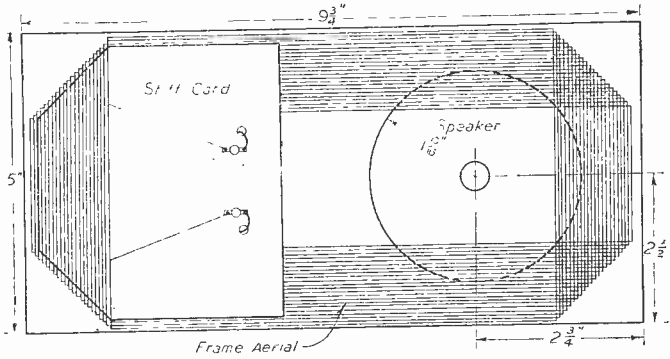
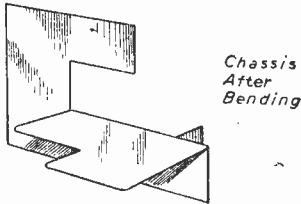


Fig. 6.—Details of the frame aerial.



1. Tune to the lowest frequency receivable (i.e., about 500 metres), say, the Third Programme. Adjust the padder for maximum volume, returning each time an adjustment is made. The padder will require to be nearly tight.

2. Tune in the highest frequency receivable and adjust the trimmers. If adjustment of the one on the H.F. transformer brings about a peak volume set it at maximum and do not touch the other trimmer. There is no need to re-tune whilst adjusting the H.F. coil trimmer. If this does not work out, i.e., the H.F. transformer trimmer produces no improvement, then the trimmer on the oscillator needs adjusting. This time re-tuning will be necessary.

These two operations complete, tune to a weak signal and make a final check on the I.F. transformers. Set the cores in wax and assemble the chassis on the baffle board.

Now repeat operation 1 and 2 above until no further improvement results. Finally set all trimmers in wax.

Those with signal generators will not need the above instructions, but assurance may now be given that in actual fact it was found possible to achieve every bit as good results by the method described above. The only difference is in the time taken.

The electrical construction is now complete, only the case remains to be executed.

The Case

The diagrams are self-explanatory, but assembly should be made in this order.

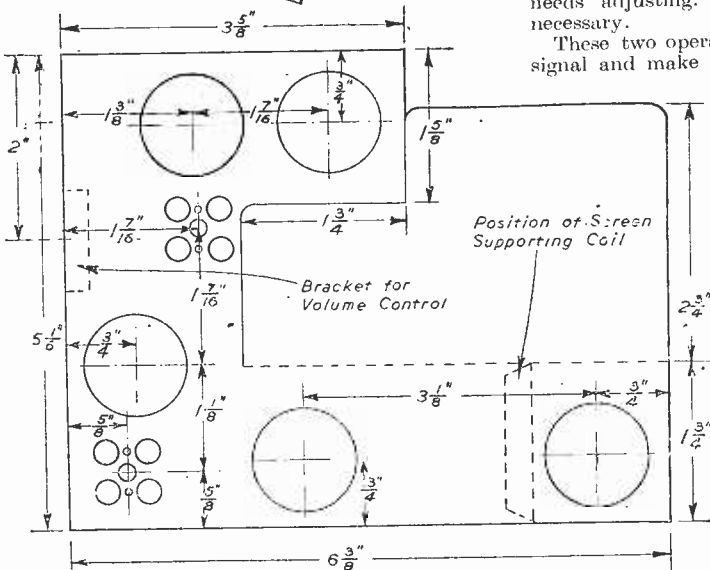


Fig. 7.—Chassis drilling, cutting and bending details.

Make the outside, nail and glue all butted joints. Fix on the ply front in similar manner and round all edges along the length. Secure in place the dial support, cover with leather cloth. One piece of leather is wrapped round the front and top and turned over the ends. Cut out the speaker opening and save this to cover the lower edge of the back. Cover the ends overlapping the turnover from the front and top. Turn in round the dial hole and volume control recess. Face up with odd scraps (Note: Indian ink or black paint should first be applied to all corners which may not be adequately covered). Cover the back in a like manner. Glue the silk in place in the case and on the back. Cover the inside of the back with black paper to give a neat finish. Take a length of beading, mitre the corners in cutting to length and assemble to fit the speaker opening. Assemble by glueing only, paint and when dry glue in place in the case. The back is hinged at one end and fixed with a single screw at the other.

One-millimetre ply is used rather than metal for the escutcheon and for the back plate for the volume control. (This material can be obtained from model aeroplane shops, as can coloured dope, most suitable for all the painting detailed above and below.) Cut the ply to the shape and size of the opening in the top of the case; fret an opening in it as shown and drill for the spindle. This escutcheon must fit tightly into the case. Paint it and when dry glue a piece of celluloid on to the back. A piece of card can be marked up for the actual dial. The

colour scheme of the original was navy blue leather cloth, cream paint and an orange dial face. The back plate for the volume control is merely a piece of this ply cut and drilled, painted and then slipped over the control spindle. Another piece of this ply is fixed to the feet of the two-gang to form the partition between the set and the H.T. battery. Prepare the epicyclic drive by making a pointer and painting it and then attaching it.

Take the chassis with partition and volume control back plate in place and slide it into the case, volume control end first. When in place drop the epicyclic drive in through the top on to its spindle and tighten up. Next, slide inside the card dial and fix in place with a drawing-pin if necessary. Drop the escutcheon over the epicyclic spindle and push down. Fit the knobs. Clips for the batteries can be purchased or made out of piano wire (again try the model aeroplane shop).

Fix the strap with four screws to the end with the volume control. Carrying it thus, it takes up less room and is most comfortably balanced; further, the dial is not obscured. Stick four small squares of felt on to the bottom that has not been covered so that polished tables do not suffer from contact.

The original model was made with no other tools than a pair of pliers, a fret saw, two screwdrivers, two ordinary files, a spanner, a drill, a soldering iron and a hammer and an old chisel. No instruments were used other than a voltmeter.

News from the Clubs

OSWESTRY AND DISTRICT RADIO SOCIETY

Hon. Sec.: A. D. Narraway, G2APW, "Lamorna," Pant., Oswestry, Salop.

At a recent meeting, Mr. Trotter, G3AFI—a member of the Society—gave a practical demonstration of Lecher Wire Technique to a crowded room in the Technical Institute, King Street, Oswestry. Mr. E. D. Power, G3ASC, vice-chairman of the Society, presided, and proposed a hearty vote of thanks to G3AFI for his lucid demonstrations and answers to the many and varied questions which followed the demonstration. Mr. A. D. Narraway, G2APW, hon. sec., seconded the motion, and invited all members to come forward with further demonstrations, especially those connected with receiver design and similar interests; he also thanked all members who had donated spare radio gear for a local School for the Blind. Forthcoming talks on television and suitable receiver design were being arranged. Informal ham chats in connection with ex-Service gear and its modification were announced. All new members for 1948 are heartily welcomed.

SUTTON AND CHEAM RADIO SOCIETY

At the last meeting a representative of Messrs. Belling Lee addressed the Society on "Radio Interference, Its Cause and Its Cure." The lecturer dealt with all aspects of those "clicks and buzzes which spoil radio reception," and his remarks were most illuminating.

WORTHING AND DISTRICT GROUP—RSGB

Hon. Sec.: G. W. Morton, 42, Southfarm Road, Worthing, Sussex.

At the meeting held on Thursday, January 1st, 1948, at Oliver's Café, Southfarm Road, Mr. W. J. Allen, M.B.E., G2VJ, the representative for Region 8, presented the National Field Day Trophy to the Group for their effort in obtaining the highest score on the 1.7 and 3.5 mcs bands. The Trophy was presented to Mr. English, the town's representative, in the absence of Mr. Bowers, the owner of the call sign of the station GANY/P. Certificates produced by the secretary were presented to the members who built and operated the station.

After the presentation of the Trophy and certificates, Mr. Allen gave a very interesting and absorbing lecture on the construction and design of an amateur short wave transmitter. The talk and discussions which followed produced useful hints from the working out of tank circuits to making chassis.

Although no official news has been received from the Worthing Council regarding the site for field operation it was decided, in the light of published reports in the local press, to apply for a club licence to operate a portable station from High Salvington.

It is hoped to get the station into operation at Easter and to hold a session every week-end throughout the summer.

THE BIRMINGHAM AND DISTRICT SHORT WAVE SOCIETY

Hon. Sec.: N. Shirley, 14, Manor Road, Steelford, Birmingham, 9.

At the meeting held on January 5th the subscription rates were revised and are now fixed at 15s. per annum. An 0-v-1, built around a 1LN5 and a 1C5 was brought along for members to handle. The treasurer's report was read and showed a slight credit balance.

READING AND DISTRICT AMATEUR RADIO SOCIETY

President: Dr. Lemon, G2GL, 23, Oakley Road, Caversham, Reading.

A RECENT meeting gave members a new subject for experiment, when Mr. Hunt demonstrated the Synchronode, amazing all with its simplicity and its capabilities as a high quality receiver with also high selectivity.

U.I.F. reception technique was also dealt with very thoroughly by G8RS. Circuits and mode of operation of various frequency changing systems; grounded grid amplifiers; and antenna matching systems such as the "Arminer" were discussed, particular attention being given to the noise level associated with each.

On January 10th there was a special general meeting, at which the proposed new rules of the Society were discussed, and finally passed. This was followed by a demonstration on the use of the oscilloscope by Dr. Lemon. In particular, its application to the reception side of amateur radio. Methods of using the instrument as an "S" meter, panoramic viewer, and modulation percentage meter for received signals being demonstrated.

Meetings of the Society continue to be held on the second and last Saturday of each month, at 6.30 p.m., in Palmer Hall, West Street.

OVER 6,000,000

With reference to a statement in our February issue, the B.R.C. ask us to state that the circulation of *The Radio Times* is, in fact, over 6,000,000 copies a week.

The C.P.S. Emitron

Interesting Details of the B.B.C.'s New High-sensitivity Television Camera

THE C.P.S. Emitron is an electronic television pick-up tube which has been developed since the end of the war in the E.M.I. Research Laboratories, and gives promise of extending the scope and quality of the B.B.C. television service. Preliminary trials of this new camera tube, such as the Royal Wedding and the "Itma" programme on the occasion of the visit of the King and Queen to Broadcasting House, have been very encouraging.

The Emitron and Super-Emitron, which were developed before the war and are still in use by the B.B.C., gave very good quality television pictures and a very reasonable variety of programmes. However, they have several limitations. Firstly, it is necessary to have quite good illumination for transmission of a good quality picture. Studio illumination at A.P. is uncomfortably intense; the stage illumination for broadcasts direct from theatres has to be increased to such a degree that it spoils the show for the audience, and frequently outside broadcasts are of poor quality because the light is bad. Secondly, undesirable shading appears in the pictures, even when the light is quite adequate, which must be continually corrected by the operating engineers. When the light is poor this shading of the picture ("tilt" and "bend") becomes uncontrollable.

How it Operates

The C.P.S. Emitron overcomes these defects by applying a method known as cathode potential stabilisation (hence the name, C.P.S. Emitron), which was invented by E.M.I. Research engineers in 1934. As is well known the Emitron operates as follows: A lens forms an image of the scene to be transmitted on a mosaic of photo-sensitive elements. The light of the image liberates photo-electrons from these minute particles and as these photo-electrons are lost positive charges are built up on the mosaic which correspond to the light distribution in the image. The mosaic is then scanned by a high-velocity beam of electrons which discharges these positive charges in succession. As each is discharged an electrical pulse is imparted to a common electrode known as the signal plate, which passes these pulses on to the amplifier. Unfortunately, besides discharging the mosaic elements, these high-speed electrons also knock out of the mosaic a large number of secondary electrons which spread across the mosaic and result in reduced efficiency and the spurious signals referred to above.

In the C.P.S. Emitron the mosaic is stabilised at the potential of the cathode from which the beam electrons come, and hence they fall on it

with very small energy; so small that they cannot knock secondary electrons from surface. In this way the undesirable shading and other spurious signals are eliminated and much higher efficiency attained. A further post-war E.M.I. invention has enabled the sensitivity of the photo-electric mosaic to be very greatly increased, and the fidelity of reproduction of colours to be improved.

Better Depths of Focus

Intensive work on these methods (all television research was stopped during the war) has culminated in the C.P.S. Emitron. This tube is capable of transmitting satisfactory pictures, quite free from shading effects, with normal lighting—such as is required for comfortable working, reading, writing, and considerably less than is normally used on a theatre stage. This is something like 50 times



This view of the new camera—taken at the Regal, Edmonton, during the first theatre broadcast with it—shows its general appearance.

less light than is required by an Emitron and one-tenth that required by the Super Emitron. Moreover, with quite moderate lighting the aperture of the camera lens can be stopped down to such an extent that great depth of focus can be obtained in the picture. Since shading signals are entirely absent the camera can be turned from one scene to another without the picture being upset by these troublesome effects, which can be very irritating even with very expert operation.

The C.P.S. Emitron will enable a great saving in electric power required to illuminate indoor scenes as well as improving the comfort of the actors, and outdoor broadcasts will be possible until dusk. Certainly the poor light would have stopped play in most games before the picture would have become unsatisfactory.

A High-tension Unit

Constructional Data of a Simple A.C. Power Pack to Enable Battery Receivers to be Operated from the Mains

By F. G. WYER

WHERE a battery-operated receiver is in use and A.C. mains are available, it is possible to add a unit which replaces the high-tension battery. Its cost is less than that of two new batteries, and it will last indefinitely. The current taken from the mains is so slight that it can be ignored. In consequence the construction of such a piece of apparatus can be well worth while.

The unit described will operate any ordinary two, three, four or five valve set. Modern receivers with automatic bias and only two H.T. connections are most suitable for it, although provision is made for an intermediate H.T. tapping. In some receivers additional H.T. tappings may be required. If this is so, they may be added as will be described.

The Components

None of the parts is in any way critical, although they must be in sound condition. The metal rectifier may be one designed for ordinary use or voltage-doubling; in the latter case the unrequired contact is ignored. Such rectifiers may be obtained new or secondhand and last almost for ever. It is scarcely possible that any ordinary receiver will overload the rectifier, so any high tension rectifier is suitable. If alternatives are available, one giving

from 20 to 40 milliamps (maximum) for 250 or more volts is the type to look for.

Similarly, the smoothing choke will not require to pass much current. A 40 milliamp model is large enough. 20 Henries is a suitable inductance. A larger inductance will increase smoothing.

The condensers may be paper or electrolytic. In the latter case the polarity must be observed as shown in the diagram. The two smoothing condensers may be from 4 to 8 μF . For a small receiver, 2 μF . condensers will function quite well.

Constructing the Chassis

This is 9in. by 6in. by 2in. deep, and is made from wood. A strip of ebonite 9in. by 2in. may be used for the front to provide better insulation. $\frac{1}{2}$ in. or $\frac{3}{4}$ in. wood may be used for the side runners, with thinner wood for the top and back. Screws will hold the pieces together. A ready-made chassis may be employed, but it is best to avoid using a metal one. If a metal chassis is used, insulated terminal mounts should be employed. Care should be taken that no leads can fray and short to the chassis, and the rectifier should be examined to determine that its fixing bolt is not internally connected to the element.

The parts are screwed down in the position shown in Fig. 1. Some smoothing condensers may be in circular cans, when they will be held in position by clips. Cardboard-cased condensers with flexible wires for connections should be held in place by a band screwed over them. If leads or tags are marked red and black, red will be positive.

Fig. 2 shows the underneath connections, for which insulated wire is recommended. The switch should be a type intended for mains use.

Wiring in Words

Mains lead to switch. Switch to rectifier. Rectifier to smoothing condenser, and to choke. Choke to smoothing condenser and to H.T.2 terminal. H.T.2 terminal to resistor. Resistor to 1-2 μF . condenser, and to H.T.1 terminal. Minus terminals of all condensers and H.T. minus terminal to other mains lead.

A proper plug or adapter on a length of twin flex is used for the mains connection.

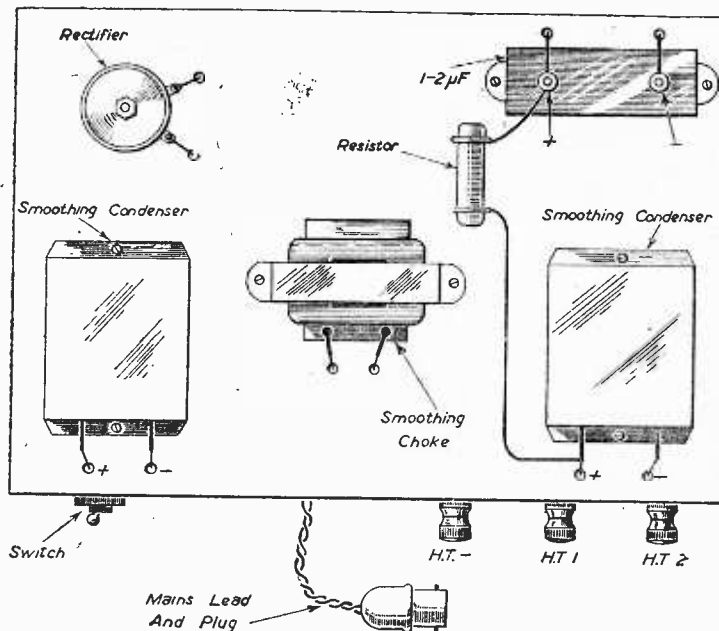


Fig. 1.—Above chassis layout and wiring of the unit.

If the rectifier is not marked with plus and minus signs the leads to it may need reversing to obtain the proper polarity in the output. If electrolytic condensers are used and there is any doubt about this, test with a voltmeter before connecting the condensers, as if the wrong polarity is applied to them they may be damaged.

may be reduced to 20,000 or 30,000 ohms or so. Violent oscillation would show a higher value were needed.

The output may be measured with a high-resistance voltmeter, with the unit connected to the receiver and working.

RESISTOR (OHMS)	CURRENT FLOWING	VOLTAGE DROP
20,000	1mA.	20
30,000	1mA.	30
40,000	1mA.	40
	etc.	
20,000	2mA.	40
30,000	2mA.	60
40,000	2mA.	80
	etc.	
5,000	4mA.	20
10,000	4mA.	40
20,000	4mA.	80
	etc.	
1,000	10mA.	10
5,000	10mA.	50
10,000	10mA.	100
	etc.	

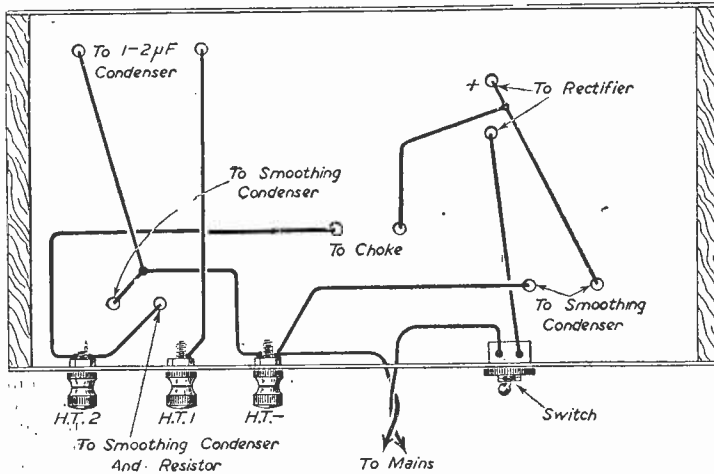


Fig. 2.—Under chassis layout and wiring.

Additional Tappings

These are added by including a further resistor of appropriate value, with a condenser of about 1 or 2 μ F. connected

Containing Case

Fig. 3 clearly shows how this may be made. If cut to the dimensions shown it will fit over the apparatus so that the ebonite panel fills the gap below the 9in. by 4in. front piece. Two screws each side will hold the unit in place, and a bottom about 10½in. by 6½in. may be screwed on afterwards.

A number of small holes may be drilled round the case to give ventilation.

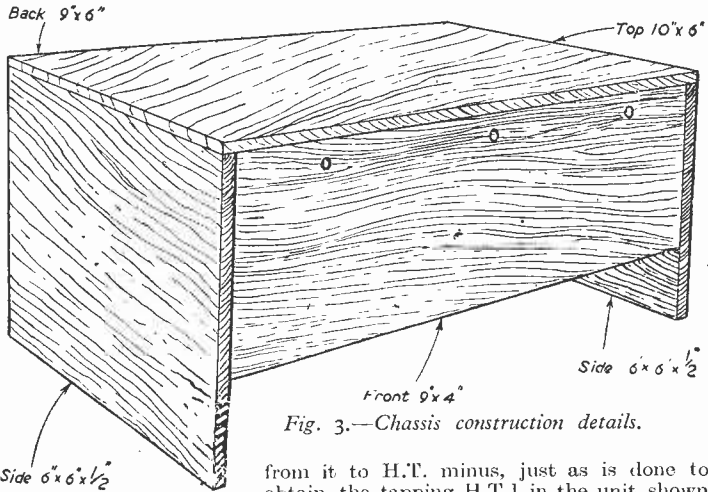


Fig. 3.—Chassis construction details.

Obtaining the Correct Voltages

The output of the unit will depend on the voltage drop in the choke and rectifier, and on the mains voltage. The drop mentioned will depend on the current taken. Fortunately, the voltage is not generally critical, anything up to 150 volts being permissible for H.T.2.

The resistor may be of any value, depending upon the voltage required at H.T.1. The drop this resistor causes will depend upon its value and the current flowing, as shown in the next column.

From this it should be possible to choose a suitable resistor. The current consumption may be found by means of a meter, or by consulting the data of the valves used. Actually the matter is not critical, and a value of about 50,000 ohms will do for the majority of receivers. If this is used, and results are somewhat weak, the resistor

from it to H.T. minus, just as is done to obtain the tapping H.T.1 in the unit shown here. (See Figs. 1 and 2.)

Important

The unit should be disconnected from the mains before any alterations are made, to avoid the possibility of shocks. It will be seen that H.T. minus must be connected directly to one mains lead. Because of this a condenser of about .1 μ F. should be added in series with the earth lead if this is used. This is to avoid connecting one mains lead to earth. For the same reason, it is best to avoid touching metal parts in the receiver when it is connected to the mains.

Novel Battery Circuits-2

Conclusion of the Data on Receivers of Unusual Design

By C. SUMMERFORD

Using Two-volt Valves

IN each of the circuits so far discussed 1.4-volt valves have been used. but, although the only alteration that need be made so that they may be used with a 2-volt L.T. supply is a resistor in one of the L.T. leads, there may be those who have preference for 2-volt valves. To satisfy this need, therefore, the circuit of Fig. 4 has been evolved, and as will be seen this utilises British valves that are easily obtainable. V1, a Mazda TP22, is a triode-pentode frequency changer having two entirely independent sections. Due to this independence and the absence of electronic coupling associated circuits can be designed for optimum operating conditions.

Instead of allowing the valve to perform its normal function, i.e., that of frequency changer, the variable- μ pentode section is used as a R.F. amplifier, and the triode section as a separate reactor valve. The latter is not, however, used for applying regeneration to the R.F. stage, but to the diode detector circuit. By so doing, diode quality is obtained with leaky grid sensitivity and better selectivity than would be obtained either from a normal leaky grid or a diode detector.

Separate diodes are used for detection and A.V.C., so that the latter may have a small delay bias, which is applied by the 1.5-volt battery B2. The delay could be obtained by taking the earth return of R7 to a suitable tapping on R9, but if this

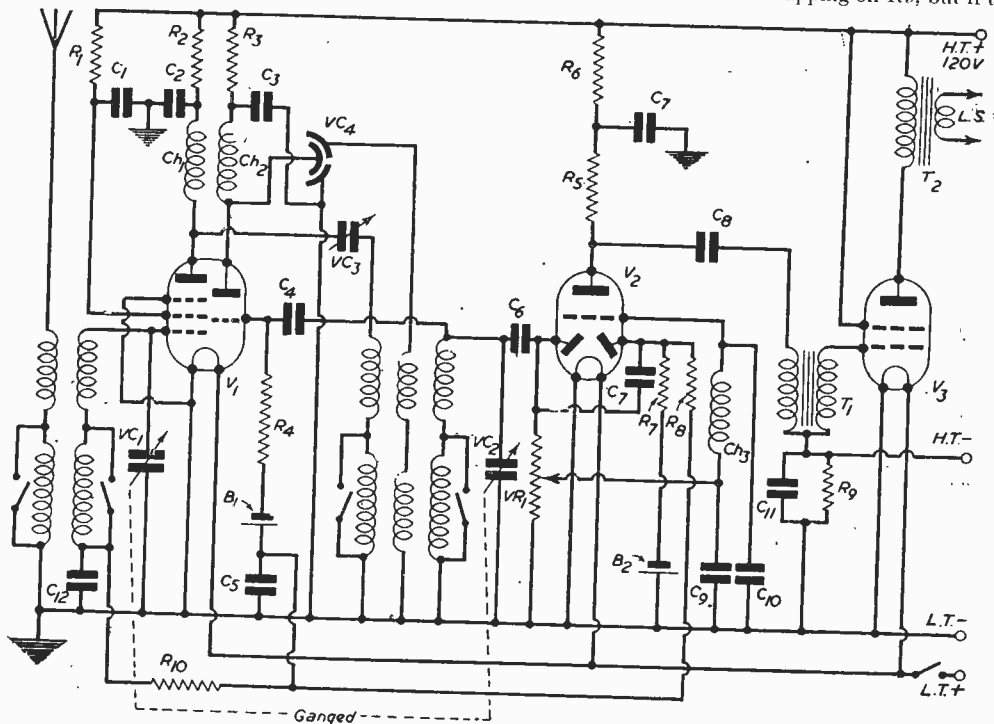


Fig. 4.—Circuit of a superhet with ordinary 2-volt valves.

V1—Mazda TP22.
 V2—Mazda HL23DD.
 V3—Cossor 220 OT.
 VC1, VC2—.0005 μ F two-gang.
 VC3—.0003 μ F preset.
 VC4—.0003 μ F mica variable.
 C1, C2, C8—.1 μ F.
 C3—1 μ F.
 C4, C6, C9—.0001 μ F.

COMPONENTS REQUIRED

C5, C12—.05 μ F.
 C10—.0005 μ F.
 C7—2 μ F.
 C11—10 μ F elec.
 B1, B2—1.5-volt G.B. battery.
 R1—150,000 ohms.
 R2—5,000 ohms.
 R3—30,000 ohms.
 R4—1 meg.

R5—40,000 ohms.
 R6—20,000 ohms.
 R7—1 meg.
 R8— $\frac{1}{2}$ meg.
 R9—500 ohms.
 R10— $\frac{1}{2}$ meg.
 T1—1 : 4 parafeed transformer.
 T2—To suit speaker.
 All resistors $\frac{1}{2}$ watt type.

is done R9 will have to be either a low resistance potentiometer or split up into two separate resistors.

Both sections of V1 are controlled by A.V.C. and in addition the reactor section has a fixed bias of 1.5 volts. Regeneration will be found to be much smoother with a small fixed bias on the reactor, which will also take less current under these conditions. A.V.C. efficiency is again largely governed by the setting of the regeneration control and in this circuit entails the use of a panel-mounted variable condenser for VC4.

It may cause some surprise that no grid condenser and leak are used for the triode section of V2. But as both V2 and V3 are high gain valves and as,

also, they are transformer coupled, the A.F. signal input required at the grid of V2 in order to give full loading of V3 is so small as to warrant the extra components unnecessary. Direct coupling between diode and triode, as shown, will give a small bias to the triode, which will be dependent on the setting of VR1. Those who do not like this system may, of course, insert the normal condenser and leak.

The total A.T. current taken by the circuit of Fig. 4 is slightly higher than in the other three circuits and works out at .45 amps. while H.T. current consumption is 7.5 milliamps. V3 gives approximately 400 milliwatts output, with 120 volts on anode and screen.

Radio and Television at "Ideal Home"

At the latest refinements in radio, including models not yet on the market, will be seen at the 1948 Daily Mail Ideal Home Exhibition, which celebrates its Silver Jubilee at Olympia from March 2nd.

H.M.V. will be showing their brand-new Model 1901, a combined automatic radiogram and television receiver, with a 15in. cathode ray tube. Orders can be placed for it at the exhibition.

Another new radiogram will be seen on the Goblin stand. Designed by the experts responsible for the acoustic equipment of Brompton Oratory, it has separate treble and bass controls to allow "mixing" without affecting volume, and a 36in. by 3½in. tuning scale. As a gramophone it will play eight mixed records. On the same stand Goblin will be showing their "Time-Spot" radio.

Television Parlour

FOR television enthusiasts, Messrs. John Logie Baird will be staging demonstrations throughout the day on two of their television-radio models, the "Garrick" in walnut Jacobean oak, and the "Lyric" in bird's-eye maple with walnut surround. Their stand will take the form of a furnished room with alcoves in which several sets will work simultaneously. Baird's are promising delivery of up to two months for orders placed at the exhibition.

A special feature of Messrs. Amplion's exhibit will be their mains converter. This unit will transform a battery set—table or portable model—into an all-mains receiver. This stand will also show a new range of lightweight pick-ups and the latest Amplion five-valve table receiver. Orders for this will be taken at the exhibition and passed on to the purchaser's local retailer, through whom delivery will be effected.

The exhibition will be open to the public at 5 p.m. on March 2nd. After that from 9.30 a.m. to 9.30 p.m. every weekday until March 25th. Admission (tax inc.): 2s. 9d.; children, 1s. 9d.

Test Pattern Generator

(Continued from page 99.)

Rotate R2. The bars on the screen will successively lock, dissolve, relock with an extra bar, dissolve, relock with another extra bar, and so on. R2 should be calibrated with the bar numbers by marking the positions of the switch with 1, 2, 3, 4, etc., for then the generator can be used with a faulty receiver, R2 set to produce, say, 10 bars, and the receiver line timebase corrected for frequency.

Switch S1 to position 2 for horizontal patterns. Rotate R2 to produce the best possible picture, and then rotate R5, watching the change in horizontal bar numbers. Fewer bars result, but R5 can also be calibrated as 1, 2, 3, 4, etc., and used to correct faulty frame timebases.

Finally, switch S1 to position 3 to produce the overall pattern. Positions of both R2 and R5 will be found where the picture locks and becomes clear, a jumble of lines and bars occurring at other points. If desired, these control positions may also be marked.

One circuit detail alone may require some readjustment to suit the constructor's components: the value of C3. Different transformers used for T1 in the blocking oscillator will give different frequencies of operation, and should the frequency change with rotation of R5 be found insufficient, or should the frequency be unduly low, it is only necessary to experiment with different values for C3, a decrease in capacitance generally being found satisfactory.

WARNING

The generator is built round a super-regenerative circuit and it is therefore a prolific source of interference. It should never be used during television transmission times and, of course, no type of aerial must ever be connected to the output sockets.

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Impressions on the Wax

Review of the Latest Gramophone Records

THE Columbia issue of Richard Strauss's First Horn Concerto (DX1397-98), to synchronise with the composer's recent notable visit to this country, is now followed by the release of his Oboe Concerto, featuring Leon Goossens (oboe), accompanied by the Philharmonic Orchestra, conducted by Alceo Galliera, on *Columbia DX1444-46*. Leon Goossens was the soloist in its first performance in England at a Promenade Concert in London. The scoring of the three movements has an economy characteristic of Richard Strauss's latest style. The accompanying orchestra is scored for two flutes, cor anglais, two clarinets, two bassoons, two horns and strings.

Of interest in the latest recordings is Debussy's "Printemps"—Symphonic Suite, played by the Royal Philharmonic Orchestra under the able baton of Sir Thomas Beecham, Bart., on *H.M.V. DB6549-50*. The suite consists of two main sections headed by a brief but important prelude which provides material for the whole design. The end of the prelude is marked by a pause, whereupon Debussy repeats his chief theme on the violins at the opening of the first section. Its treatment is notable for vivid contrasts, though the theme itself and derivatives from it are woven into a highly-organised pattern. In these records Sir Thomas Beecham has secured a performance full of the true Debussy atmosphere.

Chopin's "Ballade No. 2 in F, Op. 38," played by Benno Moiseiwitch, on *H.M.V. C3685*, is the second Ballade of the set of four which Chopin composed and dedicated to his contemporary, Robert Schumann, and was published in 1840. Of the four Ballades this one has, perhaps, its greatest share of fantasy; certainly it is regarded as one of the gems of pianoforte music. Concert-goers will have heard Moiseiwitch play the Ballades—sometimes all four in one evening—and will know with what beauty of phrasing he invests them.

The playing of Albert Sandler and his Palm Court Orchestra has a recognisable quality of its own, judging from the very many letters of appreciation that are received by Mr. Sandler. He once said: "My policy has always been to play light music in pure form, from the printed copy, and without fancy arrangements." His latest recording, "Waltz Memories," on *Columbia DB2364*, introduces "Paradise," "Diane," "Charmaine," "Poem" and "Just for a While."

Variety

For the past 20 years—virtually, in fact, since he launched out as a solo artist—Columbia recordings by Turner Layton have been in unwavering demand by those who favour romantic songs, sung in an intimate and entirely appealing manner. His latest recording is "I Wonder Who's Kissing Her Now," from the film of that name, and "And Mimi," a French-style café song, which is America's number one hit. The number of the record is *Columbia DB2367*.

Peggy Reid who has recorded "The Stars Will Remember" and "Song of Yesterday," on

Columbia FB3366, owes her rise to stardom on the air to Joy Russell-Smith, who engaged her for "Variety Band-Box" after only a single hearing. Since then she has been topping the bills in British music-halls and making a series of recordings that has established this young artist as a natural vocalist.

Three records released recently introduce favourite names among Scottish record buyers—Ian Macpherson, baritone, sings "A Dream o'Home" and "My Ain Folk," on *Parlophone F3372*; the Smith Brothers—actually five Northumbrian brothers—who have made a big name for themselves broadcasting on Scottish and English wavelengths, have recorded "Eileen O'Grady" and "I'll Take You Home Again, Kathleen," on *Parlophone F3377*; and Jimmy Shand, who plays the traditional dances of his country in the most exciting way with the aid of two accordions, a fiddle, piano and drum has made a record of Scottish Country Dances in strict tempo on *Parlophone F3378*.

Dance Music

For the past 17 years Oscar Rabin's has been one of the featured bands chosen to play for the Ballroom Dancing Championships sponsored by the *Star* newspaper. Thus the advent of Oscar Rabin's "Dancing Time" series has already met with great success. His latest recording in this series is "Mighty Lak' a Rose" (waltz) and "I'll See You in My Dreams" (quick-step), on *Parlophone F2265*.

This month Harry Davidson forsakes his old-time dances for a Gilbert and Sullivan Selection on *Columbia DX1450*: Victor Silvester's Strings for Dancing play "Vienna In Springtime" and "Fioretta" on *Columbia FB3365*; and Geraldo and his Orchestra have recorded "The Coffee Song" and "Serenade of the Bells" on *Parlophone F2264*.

MGM. Records

I have received some new records this month under the above title, and as one might guess from the initials they are American recordings, featuring American artists. The well-known "Holiday For Strings" coupled with "Laura" is played by David Rose and his Orchestra, on *MGM.103* and the coloured singer, Lena Horne, who recently made a B.B.C. broadcast, sings "Deed I Do" and "I Feel So Smoochie," on *MGM.111*. Other dance band numbers include "A Sunday Kind of Love" and "Pots and Pans," by Jimmy Dorsey and his Orchestra on *MGM.105*; "Peg o' My Heart" and "Sleepy Time Gal," by Art Lund with Orchestra, conducted by Johnny Thompson, on *MGM.106*; "Slow Burn" and "Hey Daddy-O," by Sy Oliver and his Orchestra, on *MGM.104*; "Chi-Baba Chi-Baba" and "Oh, My Aching Heart," on *MGM.108*; "Tip Light" and "Arabian Boogie," by Slim Gaillard and his Trio, on *MGM.107*; and "Three Little Words" and "And the Angels Sing," by Ziggy Elman and his Orchestra, on *MGM.101*.

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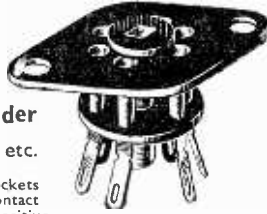
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M/COIL SPEAKERS.—Page 5 in. PM, 15 -; Rola 5 in. PM, 21 6 (Energ. 1,000 ohms with Trans., 29 6); Rola 8 in. PM, 24 -; with Trans., 30 - (Energ. 1,500 ohms, 31 6; 2,000 ohms with Trans., 33 6); Goodmans, 10 in. PM, 35 -; Ro'la 10 in. PM, 32 6 (Energ. 1,500 ohms with Trans., 36 6).

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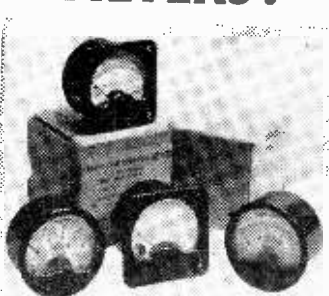
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Underneath the Dipole

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

"LOCAL boy makes good" is one of the most successful basic themes of literature, the theatre and films. Its universal appeal is probably due to the psychological fact that it is one of the four or five fundamental plots in which everyone can imagine themselves playing a principal part. By exploiting it, Victorian poets made undying reputations and Hollywood producers made (before the recent *ad valorem* tax) millions.

Within recent years there has been a growing demand for news items of "local boys making good," and the film talent scout can always be assured of plenty of free publicity in the Press the moment he promises that the face of some unknown individual is "photogenic." This type of Press-story has been overdone to such a large extent that it has now become something of a bromide. Nevertheless, certain types of faces are photogenic—that is to say, they do not provide the photographer with undue lighting problems. Long noses, sunken eyes, crooked teeth and hollow cheeks are physical defects which may be an advantage for stage work, giving character or individuality; but they can become a positive nightmare to the cinema cameraman when he takes portrait close-ups. Unlike the still photographer, who is able to have his negatives retouched by hand, the cine cameraman has to achieve his "retouching" by the expert manipulation of lights in the first place.

Telegenic Faces

The television lighting cameraman has an even more difficult problem. Not only has he to cope with the varying deficiencies of human faces—he has to arrange lighting suitable for the large variety of long shots, medium shots and close-ups which succeed one another during the course of an evening's performance, and even to make certain lighting changes, silently, during its progress. His camera operators and the engineers in charge of the complicated picture amplifier rackwork have tricky jobs, too. The former, his eye glued to the viewfinder of the Emitron camera, panoramas and tilts his camera to obtain the desired pictorial composition, and the latter, watching the images on the monitor tubes, grades and shades the resultant picture by adjusting the brilliance and contrast of each separate pick-up. This is where the "touching-up" is done in television. In addition, all of these people have to bear in mind certain frailties which may exist at the receiving end, in thousands of homes: sides and corners of pictures on curved tubes, non-linear scanning or weak reception. Performers, heads, for instance, have to be kept well away from the top of the frame, otherwise they might be partially decapitated or distorted on receivers which are slightly out of adjustment. Similarly, when four or five actors are grouped together, the outside persons should not be too near the sides of the picture. With all these things on their minds, the engineers naturally prefer actors who are not so fat as to make the "knob twiddlers"

reach for the slimming effect of the line amplitude control, nor so tall that they make a grab at the frame amplitude knob! With a receiver adjusted to high contrast, hollow cheeks look positively ghastly, and platinum blondes in full-head close-ups are likely to upset frame synchronism when they open their mouths. The Alexandra Palace boys must yearn for a nice line in standard humans, not too fat and not too thin, not too tall and not too short, clothed in half-tones and served in front of pastel-shaded backings! The television research departments may (ahem!) be sending their talent scouts out looking for perfectly linear, photogenic faces. On the other hand, they may prefer to put up with the devastatingly lovely and decidedly non-linear faces of the mannequins in Bettie Macpherson's "Fashions Round the World!"

Television Comedians

The peculiarities of the television medium are kind to some comedians and cruel to others. Three star comedians who are completely at home in front of the Emitron cameras are Leslie Henson, Richard Hearn and Claude Hulbert. Leslie has always been a favourite comic of mine—on the stage. I liked him on the films, too, but it was obvious that the mechanics of film production and its lack of continuity limited the brilliant spontaneous quality of his clowning. On the other hand, television throws into relief those very qualities which already shone on the stage—the amazing face with a million expressions and the perfect timing of "gags," which on the films passes out of the control of the comedian into the hands of the film editor. A head close-up of Leslie Henson reacting to someone else's dialogue, is a story in itself. Add to that his fruity reply, also in close-up, and you may rest assured that about a hundred thousand viewers (representing four viewers per receiving set) in the London area, are rocking with mirth. Claude Hulbert's mastery of television is best known in several amusing revue sketches, while Richard Hearn's household repair hints have more than a touch of genius about them. These three men seem to *know* television and their appearances are eagerly anticipated.

Pioneer Days

Television is now passing through the stage of development which is equivalent to the sound radio days when it was an exciting thing to broadcast from strange new places. In the carefree days of long ago, Capt. Eckersley's original band of enthusiasts used to tackle an unbelievable variety of jobs in addition to their normal technical and development work. Broadcasting the Savoy Havana Band from an airliner or the Flying Scotsman, or the nightingale from the Surrey woods were extras added to the normal daily work of research on artificial echo, multiple mixing devices (later known as "Dramatic Control Panel")

or microphone pressure-response curves. This, by the way, was an aspect of broadcasting not remembered on either sound radio or television during the B.B.C.'s Jubilee programme. Important pioneers of radio telephony such as H. J. Round, P. P. Eckersley, A. G. D. West and H. L. Kirke were barely mentioned. I will admit that I am inclined to become a little nostalgic about such matters, for I was one of "Eckersley's Boys" in the earliest days of 2LO, and assisted one or other of these brilliant men in an extraordinary variety of original work. When I think of the difficulties of the first relays of American broadcasting, when we had Beveridge aerials a mile long and tuning

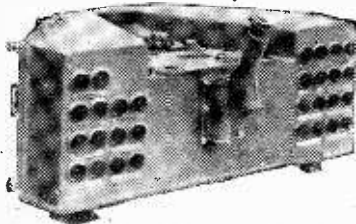
knob handles a yard long, I realise the tremendous progress that has been made. Television is now passing through the same exciting phase, and, in due course, I suppose, will settle down to a steady machine-made, mass-produced output of visual entertainment. In the mean time, the twenty-nine thousand television licence holders in the London area are privileged to observe the miracles nightly performed at the Alexandra Palace, where the 1948 band of B.B.C. enthusiasts are making history. And coupled with the engineers are the names of large numbers of artistes who have absorbed the new technique under the guidance of George More O'Ferrall and his fellow producers.

New Developments in the Recording of Oscillograph Traces

IT is well known that high-speed mechanical or electrical variations can be translated by a standard commercial oscillograph into visible traces on a fluorescent screen. The impermanence of the traces, however, makes difficult any accurate study of the inter-relationship of several phenomena and makes impossible any subsequent checking; and attempts have been made with varying success to photograph these traces by standard cameras.

Traces Recorded Side by Side

During the late war Messrs. Avimo Ltd. designed special cameras which gave much more satisfactory results and recorded, side by side, on continuous film or paper, traces from any standard type of oscillograph. The number of traces which could be so recorded was, however, limited in practice by the fact that the space between the screens necessitated moving the camera back so far that the traces were reduced eventually to an impracticable scale. To provide a record on a practical scale where a number of traces are required to be shown side by side Avimo now have in production a series of recording cameras with built-in cathode-ray tubes—the latter so arranged that their traces are photographed through a mirror. In this way as many as 15 traces, plus a timing interval, may be recorded.



One of the Avimo instruments referred to in the accompanying notes.

Specially Designed Equipment

A camera of this type has been incorporated in a photo acoustic recording unit, which has been designed and made to the special requirements of the British Ministry of Supply.

The apparatus consists essentially of an Avimo 6-channel camera with built-in cathode-ray tubes, and six photo-cell microphone pick-ups—the latter being suitably placed round a target within a radius of 2,000 feet. The camera, with electronic amplifiers and control equipment, is housed in a van and is connected to the pick-ups by cables.

Each pick-up transmits, in the form of electrical energy, both the light intensity throughout the duration of the flash and the sound of the flash—thus enabling, for example, the distance of the flash to be determined.

How the Photo Acoustic Recording Unit Works

The reactions of the pick-ups are recorded in the form of linear traces on the six 1½ in. cathode-ray tubes (VCR.522), which are built into the camera. The maximum length of trace on each tube screen is 1 in., which is reduced to 10 mm. on the film. Provision is made for the use of standard 70 mm. perforated film or paper in 100ft. lengths, wound on metal spools, and a microscope is provided which permits the viewing of the traces whilst recording is in progress. The cathode-ray tubes are each mounted in a mu-metal shield, so arranged that the light from the tube heaters has a minimum effect on the film, and it is possible, by an adjustment which is not affected by normal vibration and handling, so to orientate each tube in its mounting that the traces lie on one straight line on the record, at right angles to the direction of film travel. A range of six film speeds is obtainable, approx. 1, 2½, 5, 10, 25 and 50 inches per second.

The Pick-up Unit

The photo-cell microphone pick-up may be thus briefly described:

The door carries a 1/16 in. opal glass screen mounted in front of a glass colour filter cell which contains a suitably coloured solution to serve as a correction filter for the photo-cell spectral response.

The pick-up is mounted on an anti-vibration chassis with telescopic legs, so that the height of the unit may be varied.

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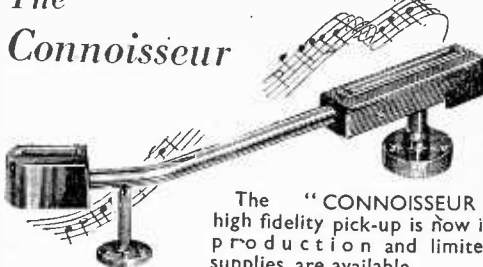
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Programme Pointers

In This Article MAURICE REEVE Reviews Another Musical Book

I MAKE no apology for returning once more to the review of a book. After all, literature is the handmaid of everyone in turn. No subject in the wide creation would be possible, and certainly it would not be worth having if we couldn't criticise it, discuss it, browse over it and ponder generally upon its past achievements and future prospects. Any subject which, metaphorically speaking, didn't want us to do that, which took up an attitude towards us that was as much as to say it considered itself above, beyond, or beneath our notice, or that didn't contain sufficient matter within itself to warrant our noticing it at all, then that subject would certainly not be meet (meat) for this journal's readers.

Fortunately, music is a subject which owns a literature that is an integral part of the art itself. The study of music and the lives of the people who make it is only second in fascination to the music itself.

Our distinguished contemporary, *The Musical Times*, was founded by J. Alfred Novello, in 1844, when he took over Muzner's *Musical Times*, born two years earlier. It has long ranked as one of our chief "highbrow" papers, covering the whole range of serious music, with special emphasis on the vocal, teaching and competition festival sides of the art. The book referred to at the head of this article is "The Mirror of Music" 1844-1944, a century of musical life in Britain as reflected in the pages of *The Musical Times*. It has been compiled by that accomplished and indefatigable musicologist, Percy A. Scholes (author of "The Oxford Companion to Music," recently reviewed in these pages), and published by Novello & Co. in conjunction with the Oxford University Press, in two most handsome and well-produced volumes at 52s. 6d.

Historic Performances

This is a fascinating work, and to turn over its pages is to turn back the leaves of one's own musical experiences. Everything seems to be there that happened in the musical life of England during that lengthy period. "What did *The Musical Times* say of this, that or the other?" Well, it is all here, carefully annotated, sorted and indexed. Historic performances of the major masterpieces, including the original production of many of them, the visits to these shores of every conceivable personality, great and small, all the famous festivals, concert series, competitions, operas, recitals, composers, performers, schools, academies; everything, in fact, as *The Musical Times* saw it. The whole is charmingly linked together by Dr. Scholes, and his writing is a major feature of the work.

The pages are punctuated with innumerable humorous stories of the peccadillos, fads and idiosyncracies of the great ones of music. Of Jenny Lind it is quoted (1850) from America that the fortunate proprietor of one of her old gloves is letting it out to be kissed, at the rate of one shilling an outside and two shillings an inside kiss. Of

Paclunann, when an encore was demanded, he told the audience, "No, I will not give an encore, but as I played that piece very badly I will play it again." And of its advice to a reader (1905): "G. G. M.—This is a free country and no one is barred from entering pupils for exams." Why not keep on with your trade of boiler-plating and continue your 'little teaching in the evening,' instead of 'thinking of taking up teaching music as a profession.'" Hundreds of these make delightful reading.

A hundred and eighteen plates of illustrations would form an absorbing volume of their own, though I suppose it is inevitable that some of them get duplicated in various works of music, especially when brought out by the same publishers.

The index reveals that the widest range of musical activities were covered by the paper's critics, by the inclusion in it of such diverse headings as Christy Minstrels, Cinema Vandalism, Charlie Chaplin and Music, Music Hall, Musical Piracy, etc., etc., etc. A curious and interesting case of selective indexing, or sub-indexing, occurs under "Violinists." Whereas "Pianists" are subdivided amongst other categories, into "British," pp. 309-312, and "Foreign," pp. 312-320, violinists are of three distinct labels, e.g., British, pp. 341-4, foreign, 344-55, and women, 342, 373. Our lady pianists are, I feel, fortunate, though I cannot for the life of me think why their sisters wielding the bow have been thus singled out.

Modern Piano Playing

Regarding modern methods of piano technique and the pianists they have bred, Mr. Scholes has this to say of "The New Royal Academy Group" (or the Matthay Group, as we may call them, from the source of their training): "... this group has certain characteristics in common (the names of its chief members are enumerated). Unlike their elder colleagues who had gone abroad and studied under the Liszt or Leschetizky influence they are more intent on tone, phrasing and general refinement than on the display of power, and herein they have effected something that we may call a twentieth century reform in British piano playing."

Reform, yes; but a good one? I doubt it very much. High as is the standard of native pianists to-day, I venture to say that none can yet claim to enter the select hierarchy, or dynasty, formed by the Continental masters of the instrument. These are fewer to-day than they were, by many; but this is not to be wondered at when we review the conditions prevailing in Europe during the greater part of the last thirty years. The greatness of any artist must always be in his ability to tug at our heartstrings and to stir up our emotions and bring us right out of ourselves. That is why Liszt, Rubinstein and Paderewski, and those who have succeeded in following in their footsteps as closely as in them lies, will forever hold up the mirrors for others to see themselves reflected in.

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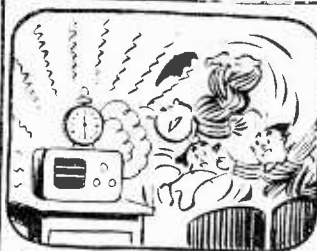
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Open to Discussion

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).

Ex-R.A.F. Equipment

SIR,—The letter of Mr. B. E. Harris, under "Ex-R.A.F. Equipment" certainly puts the cat among the pigeons. From personal experience I know this sort of thing has been happening. On the other hand, I have dealt with firms who are satisfied with a fair profit. I am also fully aware of the fact that much of this material is sold by weight to contractors.

Mr. Harris appears sure of his facts, but perhaps some of the traders concerned in disposal might care to comment on the matter. Taking the figures as outlined, they offer the opportunity to have the matter raised in the House of Commons. I suggest Mr. Harris lets his local M.P. have the facts. If only in fairness to fair-dealing firms.

While on the subject of ex-Government equipment, never let it be said that Britain cannot make radios. In such equipment one finds some of the finest examples of compact design and neat wiring to be found anywhere. I note that the 116A Rx is a favourite. Harmonics and image effects appear to be common. Nobody has suggested the use of a wave trap. The idea is simple and worth considering. My experience with this set is that providing one listens on the right frequency at the right time, the station tuned for is usually there. It should not be overlooked that the fitting of new valves, the hexodes in particular, will upset the calibration. After trial these should be interchanged and the difference noted.—A. W. MANN (Middlesboro')

Test Instrument Design

SIR,—In the article by Mr. P. E. Tooke, in the January issue of PRACTICAL WIRELESS, I find a very misleading description of a "conventional" crystal oscillator.

It will be seen from his Fig. 3 (a) that the anode load is purely resistive, thus making the conditions for self-maintained oscillations impossible. To produce oscillation condition the anode load should be inductive, so that the impulses fed back from the anode to grid (via the grid to anode inter-electrode capacity) shall be of the correct phase.

Later Mr. P. E. Tooke describes what he calls an improved type of crystal oscillator with a tuned anode circuit; now this is really the conventional type. With a tuned circuit in the anode it is, of course, possible to produce the required inductive anode load by making the resonance frequency of the anode circuit slightly higher than the crystal frequency.

It may be of interest to mention here that if the crystal be connected between the grid and anode a resistor in the anode may be used, if shunted by a small capacitor, as this arrangement requires a capacitive load to produce oscillation condition.—L. B. COPSTICK (New Malden).

Mr. Tooke makes the following observations on the foregoing criticism:

SIR,—I wish to point out that although the addition of a R.F. choke or tuned plate in the circuit of a crystal oscillator is desirable, not only for stability but also for a better waveform, it will not stop oscillating if there is only a resistive load in the plate. If the value of the load is made about .25 or .5 megohm enough feedback is obtained via the plate-grid inter-electrode capacity to sustain oscillations.

This is due chiefly to the high stage gain obtained which "triggers" the crystal into oscillations.

Mr. Copstick also mentions an arrangement by which the crystal is connected between grid and plate. The plate resistor being shunted by a small condenser. This, he says, will produce oscillations, owing to a capacitive load.

I would rather like to know how a capacity can be a load: resistive or inductive!—but surely not capacitive.

Cathode-ray Tube Data

SIR,—With reference to your article on Service C.R. Tubes. In January, 1948, L. J. Avery (page 41) says that the VCR 97 has no afterglow, but in February, 1948 (page 57) you state that it has a long afterglow.

In a letter from the makers (G.E.C.), they give the commercial equivalent as E-9504-B-16, the only difference being that the final voltage of the service tube is 2.5 kv. (max.).

The afterglow of the E4504-B-16 is negligible. The G.E.C. have a leaflet (OV 9695) which may be obtained on request. Readers who have purchased VCR97 may like to obtain one of the leaflets, as it contains operating conditions, description, ratings, base connections, and a circuit, etc.—R. D. LUBBOCK (Leicester).

Readers' Thanks

SIR,—I wish to thank, through the PRACTICAL WIRELESS, all readers who kindly sent information about the S.D.2, especially the one who sent a Triotron catalogue.—R. E. TURNER (Burton-on-Trent).

SIR,—Please accept my very best thanks for publishing my letter regarding the No. 18 Mk. III ex-Government receiver in your January issue.

Since the appearance of the letter I have been swamped with letters from all parts of the country, from amateurs eager to help, and thanks to them I have now got the set working very well indeed.

I offer my very best thanks to all those who wrote, since the number of letters was too large to attempt to answer individually. Those who sent instruction books and circuits I will, of course, write to personally and return the papers.

May I say in conclusion that I was very agreeably surprised at the large number of enthusiasts who

answered my call. I had no idea that such a fine spirit of friendliness and eagerness to help one another existed among radio enthusiasts. It is very pleasing indeed to know that such a friendly spirit does indeed exist in "ham" radio.

Again with many thanks for your help, Sir, in the first instance.—JOHN A. BROCKIE (Aberdeen).

Ex-Service Gear—A Warning

SIR,—I recently bought a No. 18 Mark III, 6.9 megacycles, receiver with which was supplied a circuit diagram.

On checking up on the plug connections, I found that although they went to their appropriate places on the diagram, the pins were shown in the wrong order.

The pin diagram gave:

- No. 1 pin—Aerial
- No. 2 pin—G.B.
- No. 3 pin—L.T.+
- No. 4 pin—H.T.+
- No. 5 pin—L.T.— and H.T.—

After the check-up they were found to be as follows:—

- No. 1 pin—H.T.+
- No. 2 pin—Aerial
- No. 3 pin—G.B.
- No. 4 pin—L.T.+
- No. 5 pin—As before

If, of course, the plug had been wired as shown on the diagram, the H.T.+ would have been on the L.T.+ , with disastrous results to the valves. I hope this information will save someone from a set of burnt-out valves.—R. E. BROWN (Oakengates).

"Radiolympia Afterthoughts"

SIR,—What a pity the Marquis of Donegal did not pause for "Second Thoughts" before publishing his "Afterthoughts" on Radiolympia.

Concerning one device of which, unfortunately, I do not know, he writes, *inter alia*: "there is a limit to what modern science should do for the fool. When you get a set that incorporates an electric clock for the absent-minded listener, switches on the programme he has pre-selected and shuts itself off at the end of the programme in case he forgets to do so—well, I think we've about had it!"

I should like to place on record that just over twenty years ago I liked to listen to the radio in bed until the transmitter closed down. I therefore had a phone lead to my bedroom and made myself a clockwork switch to turn off the set at the correct time. This saved me getting out of bed to walk about fifteen yards along a cold passage and negotiate a flight of stairs. Perhaps the Marquis would let me know whether this was "foolish" or "absent-minded."—H. RIMOUT (Hayes).

U.S. Receiver BC.348R

SIR,—I have noted of late an increasing number of ex-U.S. Air Force receivers BC.348R advertised in your magazine. Some advertisers claim that this set can easily be adapted to work from a mains power pack from normal mains voltages in place of the 28-volt dynamotor, which is easily removed. This statement is erroneous. In addition to removing the dynamotor, all the filament leads in the set must be rewired, particular attention being paid to the earthing; also, when

using anything over about 250 volts D.C., output on the H.T. line (normal H.T. volts is about 220-224 according to type of dynamotor), one of the voltage-dropping resistors in the circuit must be replaced by a higher wattage resistor, otherwise it will burn out. As I have now disposed of my BC.348R I cannot say which resistance this is, but I found that I could let the resistance burn out, then replace it without damaging the remainder of the set. Attention must be paid to the dial lamp wiring (at present in *series* with filaments of some of the valves).

In your February, 1948, issue under "Cathode-ray Tube Data," page 56, Fig. 2, the cathode of tube 3BP1 should be taken to the top of the .5M Ω , 1M Ω resistor and .1 μ F 600 volt network, shown to the right of the cathode. Otherwise, it is at a "floating" potential in relation to the grid of the 3BP1.

This article was of great interest to me, and I trust you will continue to give as much data as possible on as many kinds of equipment as you can find space for.—J. D. SPARKE (Stockton-on-Tees).

Receiver 1147B

SIR,—I must thank you for publishing my letter in your excellent magazine. I have nearly two dozen letters from other holders of the Rx1147B. I have the following data which may be of use to other owners of the Rx.

The valves are:

- VR136 = RL7 (single-ended S.W. H.F. pentode).
- VR91 = EF50 (single-ended S.W. H.F. pentode).
- VR56 = EF36 (R.F. pentode).
- VR137 = RL16 (single-ended S.W. triode).
- VR55 = EBC33 (double-diode-triode).

These valves are all 6.3 volt heaters and require 250 volts H.T. The power plug is numbered with pins 1 to 6.

- Pin 1 .. — (L.T.) (Earth).
- " 2 .. H.T.— (not directly connected);
- " 3 .. —
- " 4 .. H.T.+.
- " 5 .. Heater+ve (other heater earthed to chassis).
- " 6 .. —

If the Rx is to be used in its present condition, the R.F. pentode should be replaced by a suitable output valve (e.g., 6V6, etc.). The present range is 180 to 220 kc/s.

The signals are modulated at a supersonic frequency (20 kc/s). These are detected by the EBC33, amplified by V6 (EF36), the anode circuit of which contains a tuned transformer. The signal is heterodyned by the B.F.O. (triode part of EBC33) and is again detected by this valve. The signal is amplified by V7 (EF36) and passed to output transformer which can take high/low headphones. The I.F. is 25 Mc/s, and it has a band width of 500 kc/s. There is no A.V.C. The volume control operates V.M. bias on the I.F. stages only.

The remote control plug must be altered. Join pins 1 and 2 together (2 is the earth pin and 1 is the automatic bias resistor). The switch does not switch on the set. This is used when the C.U. is added, and is used to operate a relay: I am thanking Mr. Norman Dean who supplied some of this information and who also sent me a blueprint circuit and component values. Congratulating you once again on such a fine "newsy" magazine.—P. SMITH (Sudbury).

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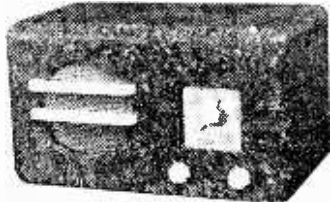
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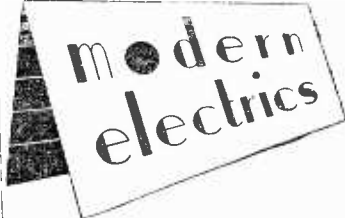
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MISCELLANEOUS

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Listener's 3-watt A.C. Amplifier (3-)) — WM392*
Radio Unit (2v.) for WM392 (2-)) — WM398*
Harris Electrogram Battery Amplifier (2-)) RC, Trans) — WM399*
De Luxe Concert A.C. Electrogram (2-)) — WM403*
New Style Short-wave Adapter (2-)) — WM394*
R.T.D.L.C. Short-wave Converter (2-)) — WM405*
Wilson Tone Master (2-)) — WM406*
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Cannes Midget Three (D, 2 LF (Trans)) .. — PW51*
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Battery All-Wave Three (D, 2 LF (RC)) .. — PW55*
The Monitor (HF Pen, D, Pen) .. — PW61*

The "Colt" All-Wave Three (D, 2 LF (RC & Trans)) .. — PW72*
The "Rapid" Straight 3 (D, 2 LF (SG & Trans)) .. — PW82*
F. J. Cannon's Oracle All-Wave Three (HF, Det, Pen) .. — PW78
1933 "Triband" All-Wave Three (HF, Pen, D, Pen) .. — PW84*
P. J. Cannon's "Sprite" Three (HF, Pen, D, Det) .. — PW87*
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Four-valve : Blueprints, 2s. each.
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Nucleon Class B Four (SG, D (SG), LF, Cl, B) .. — PW34B*
Pury Four Super (SG, SG, D, Pen) .. — PW34C*
Battery Hall-Mark 4 (HF, Pen, D, Push-Pull) .. — PW46*
"Acme" All-Wave 3 (HF Pen, D (Pen), LF, Cl, B) .. — PW33*
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC)) .. — PW90*

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Three-valve : Blueprints, 2s. each.
Rondie Triode-Triode Three (HF Pen, DDT, D, Pen) .. — PW35*
D.C. Ace (SG, D, Pen) .. — PW29
A.C. Three (SG, D, Pen) .. — PW35C*
A.C. Leader (HF Pen, D, Pow) .. — PW35B*
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Mains Record All-Wave 3 (HF Pen, D, Pen) .. — PW70*
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MISCELLANEOUS

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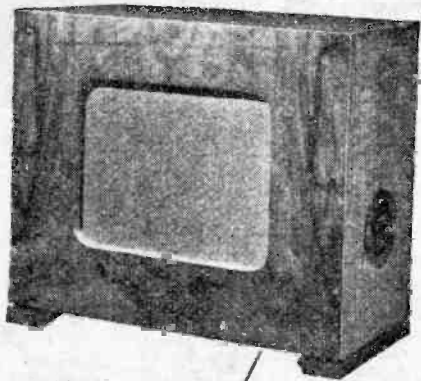
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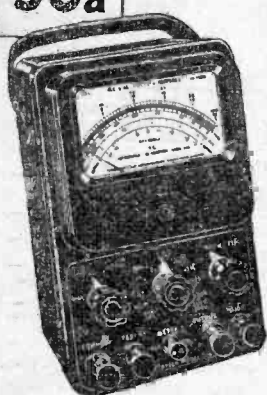
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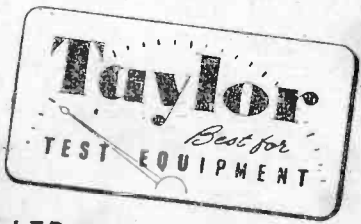


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