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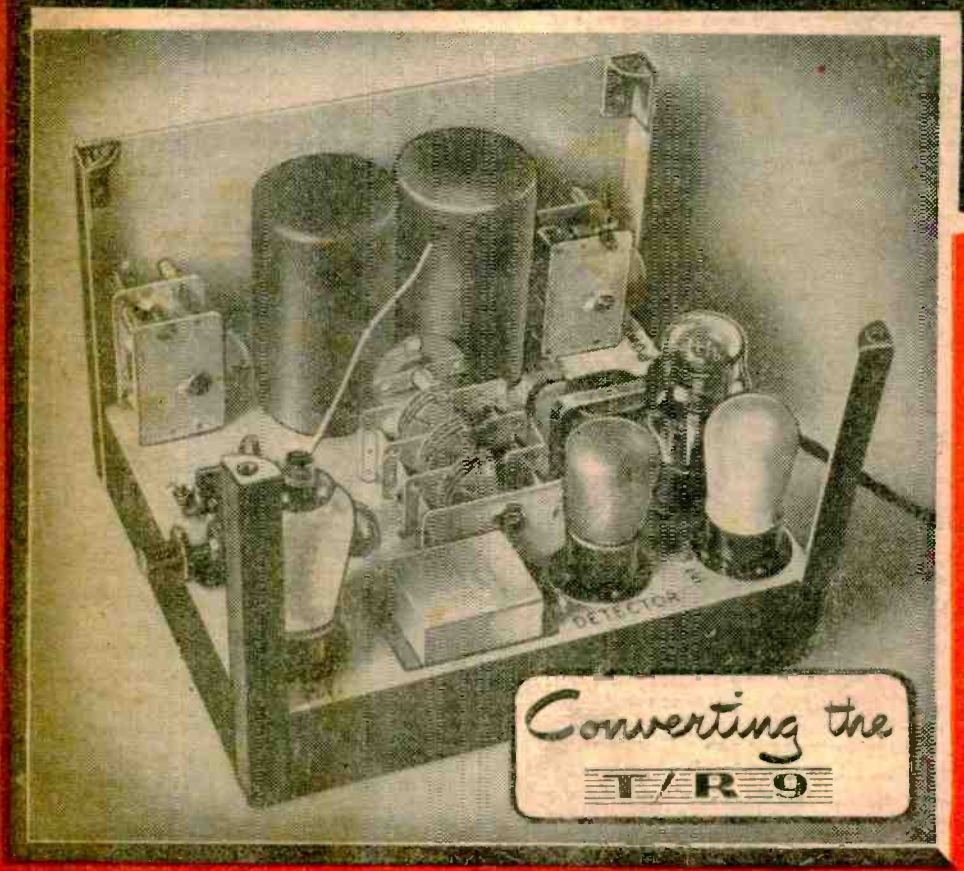
EDITOR:
F.J.CAMM

PRACTICAL WIRELESS



Converting the T/R 9

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Practical Wireless
19th YEAR OF ISSUE
EVERY MONTH.
VOL. XXVII. No. 534. APRIL, 1951
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COMMENTS OF THE MONTH — BY THE EDITOR

Beveridge and the B.B.C.

AT the moment of going to press there has been no Parliamentary debate on the Beveridge Report, but inquiries show that the B.B.C. has heeded the criticisms and the recommendations made in the Report, the chief of which were reviewed in last month's issue. That there was room for a considerable shake-up in the B.B.C. is quite apparent from the evidence given before the Committee.

The plain truth is that the B.B.C. started off on the wrong foot; in its early days it was staffed by people unqualified to found such a gigantic and important organisation, and it has proceeded year by year on the lines of a patchwork quilt.

And as it has expanded, so has it become over-departmentalised and now consists of a large number of watertight cells, which have given rise to interdepartmental jealousies, and in some cases have restrained progress.

Let us be sure that radio has developed the B.B.C. The B.B.C. did not develop radio on its own. It has merely used a highly scientific instrument invented and improved by private enterprise. No one at the B.B.C. in its early days foresaw what it was to become. As programme time increased and the variety of the programmes became more diversified so fresh departments were started which were not co-ordinated to the older departments.

To-day there is a feeling among the staff of remoteness from the B.B.C. hierarchy, and a feeling, in the absence of competition, they are compelled to hang on to their jobs because there is nowhere else to go. A high percentage of the staff commenced with the B.B.C. at an early age, and they have no other training.

In view of the disclosures in the Report, the B.B.C. has received unfair praise in the past, the public confusing the quality of the programmes with the organisation itself. Anyone can play a gramophone record and almost anyone can produce a programme. The method of selecting programme material and artistes for the programme is open to severe criticism. The authority has been vested in the wrong type of people. The attitude has been, as was once said at a B.B.C. conference, that the public viewpoint does not matter; it is the B.B.C. viewpoint only which matters, and they proceeded to give the public not what it wanted but what, until a few years ago, Lord Reith thought it ought to have.

It became an Empire which disliked criticism, and would suffer no interference from the Government or the industry.

The Report, therefore, although too bulky to be easily digested by members of the public, has performed a valuable service in making known all the opposing views of those who wish to set the B.B.C. on an even keel. It may be that in the process of reorganisation some of the recommendations will be overlooked or forgotten, since they range over such a vast field, from trade union representation to high-frequency broadcasting, finance, selection of programmes, and so on.

The B.B.C. thinks so, too, for we understand that it is already instituting certain changes recommended in the Report of its own volition.

We must remember, however, that it *is* only a report, and that the recommendations are not binding on the B.B.C. Indeed, when the Report comes up for Parliamentary debate many of the recommendations may be rejected.

P.E. Data Sheets

Commencing with issue dated February 23rd, our companion journal, *Practical Engineering* (4d. every Friday) is presenting each week eight free Data Sheets on the subject of mechanical movements. The series will continue for at least 13 weeks, and will cover practically every known mechanical movement, both in elemental and combined form. An index will be included, and so that readers may preserve them in permanent form a loose leaf binder is available for a purely nominal sum.

When complete the series will comprise a valuable textbook on a subject on which information is very scarce; a textbook which, in the ordinary way, would cost at least one guinea. There must be many readers in the radio industry who will find this information of great value.

Those wishing to collect this unique series of Data Sheets should place a regular order with their newsagents for *Practical Engineering* to be delivered each week. —F.J.C.

ROUND the WORLD of WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ended December 31st, 1950:

Region	Number
London Postal	2,341,000
Home Counties	1,632,000
Midland	1,734,000
North Eastern	1,885,000
North Western	1,597,000
South Western	1,055,000
Welsh and Border Counties ..	726,000
Total England and Wales ..	10,970,000
Scotland	1,119,000
Northern Ireland	206,000
Grand Total	12,295,000

The total includes 586,100 television licences.

Larger B.I.F.

THE thirtieth British Industries Fair, to be held at London and Birmingham from April 30th to May 11th, promises to be larger than last year. Applications for space for the London section have totalled 642,000 sq. ft., compared with only 549,634 sq. ft. for the 1950 Show.

Power Cut Warnings

THE Northampton Wireless Relay Company have now included in their service warnings of impending power cuts. When a cut is probable, the radio programmes are cut and a warning whistle from the East Midlands Electricity Board is transmitted to subscribers, who thus know that a cut is possible within the next two minutes.

Radio Courtship

IT is reported from America that a marriage is shortly to take place between W9CQQ (Samuel Jamieson) and W5NXH (Myrtle Thomey) in New York. They have conducted their courtship over the air between their two homes in Texas and Indiana.

Television Servicing Certificate Examination

THE Radio Trades Examination Board announce that arrangements have been made for the examination of candidates who live outside the range of a B.B.C. television transmitter. These candidates will be accepted for the written papers only on the understanding that they will sit the practical examination within 12 months of the opening of a television transmitter in their area. The certificate will not be issued until the completion of the examination.

In view of this, arrangements are being made for candidates from Scotland to sit the written papers of the May, 1951, examination.

Monte Carlo Rally Organisation

AFTER travelling almost non-stop from Glasgow to London, on the first "leg" of this year's Monte Carlo Rally, the radio-equipped Humber Hawk team and their helpers demonstrated their fine organisation at a Lewisham garage.

Before the first car was due to arrive, a radio station had been set up in one of the garage offices and Marconi engineers, together with a team of automobile engineers, listened for a call to warn them when to expect the first car.

A radio call was immediately made to check the position of the second car and the first car passed to the hydraulic lift for a swift, but thorough, overhaul. While on the lift a Marconi engineer checked the V.H.F. transmitter-receiver.

A few minutes later the second car came in and was filled with petrol before going on to the lift. During petrol filling, the second car driver, Mr. H. Pilmore-Bedford, made a radio call to the third car and a mechanic removed the aerial preparatory to the car going on to the lift.

New Radio Industry Council

THE Radio Industry Council, reconstituted under a plan adopted by the old Council last year, held its first meeting on Thursday, January 25th, when Mr. J. W. Ridgeway, O.B.E., was elected chairman, and Mr. G. Darnley Smith, vice-chairman.

The new council consists of 16 members, four being nominated by each of the constituent associations (B.R.E.M.A., R.C.E.E.A., R.E.C.M.F., and B.R.V.M.A.), and nominations are for one year only.

Among other innovations under the new constitution are an executive committee consisting of eight members, two being nominated by each constituent, and a committee of secretaries of the R.I.C. and constituent associations with the director, R.I.C., as chairman.

Stereophonic Stage Amplification

THE Regent Theatre, King's Cross, has recently been installed with a Stereophonic Stage Amplification System. By reason of the completely separate channels employed, one for each side of the stage, far greater microphone sensitivity can be obtained from footlight microphones used in this way, than from the conventional form of stage amplification. The whole of the stage is brought into the effective orbit of amplification, rendering the use of floorstand microphones almost superfluous except for special effects.

An ingenious method of balancing of the two separate channels, including microphones, amplifiers and loudspeakers, brings about a wonderful illusion of direction. From the audience's point of view the sound appears to come from that part of the stage from whence it actually originated. From

the producer's point of view it has the effect of *broadening the stage*, and thus heightening the theatrical effect, apart from ensuring that *all* the sounds on the stage are heard effectively in all parts of the "house."

The system is proving an outstanding success. The installation was carried out by the ELA Amplifier Department, of Philips Electrical, Ltd., London, under the supervision of Mr. R. D. Carter-Pedlar, B.A., who also designed the special type of loudspeakers necessary for this new departure in amplification systems. Otherwise quite standard types of Philips ribbon microphones, amplifiers, electronic mixers and loudspeaker units have been employed throughout.

Obituary—A. W. Lay

THE Marconi Companies regret to announce the death of Arthur William Lay, B.Sc., M.Inst.E., A.M.I.E.E., F.Inst.P., at the age of 58, at his home "Beresford," Galleywood Road, Chelmsford, on Saturday, February 3rd, 1951.

Mr. Lay was well known for his work in medical physics and electronic instrumentation, research, design and development and enjoyed a world-wide reputation for his work in electro-medical metering.

He was a consultant to many hospitals, had attended over 1,000 major operations, and was a friend of many leading specialists in the medical world. At the time of his death he was planning to extend his laboratory and intended to work in atomic physics as applied to medicine and industry in collaboration with the Marconi Companies.

B.I.R.E.

THE following meetings of the Institution will be held in March, 1951:

LONDON SECTION.—Thursday, March 29th: Commencing at 6.30 p.m. London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1. "Nuclear Scintillation Counters," by J. B. Birks, B.A., Ph.D.

SCOTTISH SECTION.—Wednesday, March 7th: Commencing at 7 p.m. National Philosophy Department, The University, Drummond St., Edinburgh. "High Fidelity Sound Reproduction," by D. T. N. Williamson.

Thursday, March 22nd: Commencing at 7 p.m. Institution of Engineers and Shipbuilders, Glasgow. "Magnetic Amplifiers," by H. M. Cole, B.Sc.

SOUTH MIDLANDS SECTION.—Wednesday, March 14th: Commencing at 7.15 p.m. Exhibition Gallery, Public Library, Rugby. "A Transmitter for an Experimental Eight-channel Carrier Wire-broadcasting System," by R. G. Kitchenn, B.Sc., A.M.Brit.I.R.E.

NORTH-EASTERN SECTION.—Wednesday, March 14th: Commencing at 6 p.m. Neville Hall, Westgate Road, Newcastle-on-Tyne. "Acoustics," by E. G. Richardson, B.A., Ph.D., B.Sc.

WEST MIDLANDS SECTION.—Wednesday, March 28th: Commencing at 7 p.m. Wolverhampton and Staffordshire Technical College, Wolverhampton. "Engineering Aspects of Industrial Electronic Equipment," by R. J. F. Howard.

Loudspeakers in Station Refreshment Rooms

THE railway and hotels executives announce that loudspeakers, connected to the station broadcasting systems, are to be installed experimentally in the refreshment rooms at Edinburgh (Waverley), Crewe, Preston, Swindon and Bristol stations, as soon as the equipment can be obtained. The object is to ascertain whether train announcements can be broadcast to the refreshment rooms without causing too much disturbance to passengers taking meals.

The team of three Humber Hawks which won the Silver Cup for the best radio installation at the Monte Carlo Rally were Marconi-equipped. Bill Whitehouse, a famous international driver, is here seen using the Marconi equipment.

Police Radio Patrol Arrest

A LONDON police radio motor-cycle patrol, one of those which recently went into action for the first time, chased four bandits in a saloon car after a raid on a jeweller's shop at Clapham Common. The car was abandoned during the chase and one man ran into Clapham North Underground station. The patrolman dismounted and ran down the escalator, and detained the man as he was boarding a train.

V.H.F. Converter

A Self-contained Unit to Cover Down to 2 Metres

By T. W. DRESSER

SOME time ago an article appeared in PRACTICAL WIRELESS on the conversion of an item of surplus equipment to 2-metre (144 Mc/s) reception and while this unit would undoubtedly appeal to some readers there must be quite a large number, possessors of R1155 or other communication receivers, to whom a converter covering 10 down to 2 metres, or lower, would be preferable as it enables use to be made of the receiver's gain and selectivity by combining the two instruments into a double superhet. Additionally, the cost of such a converter is hardly likely to exceed that of the altered ex-Service equipment and most certainly will not involve as much work.

That there is need for some such unit is obvious from the fact that few communication receivers cover even the 10-metre band and several well-known manufacturers have had on the market for some time separate units, generally working in a super-regenerative circuit, to cover these lower wavebands, a notable example being the National 5-10 metre receiver. The increasing popularity of 144 Mc/s among British amateurs and the possibility that freak reception conditions may bring in some of the 6-metre signals from American amateurs active on this band—and remember that TV signals from Alexandra Palace were picked up in South Africa 18 months ago—makes such a unit a necessity to the keen short-wave enthusiast.

Circuit

The unit to be described was designed for use with a home-built communication receiver, but has also been in use with a Hallicrafter and several other makes. The circuit is quite straightforward and its performance is primarily due to quality parts and the layout. As is customary in ultra-short-wave receivers the latter has been so arranged that the shortest possible leads are used, and, of course, one earthing point only for each valve. It is good practice, if it is possible, so to arrange the components, coils, resistors and condensers in particular, that little or no additional wiring is required.

The R.F. amplifier, an EF50—an EF54 can be used without any change—is so orientated that the small shield usually used across its base and soldered to pins 5, 8, and the spigot earthing tag is now extended right across the chassis, effectively screening all the input circuit from that of the anode. At the same time the grid coil and tuning condenser are mounted close enough to the grid pin to need no more than 1in. or so of wire for connection purposes. The 6SA7 mixer and 6J5 oscillator are mounted in close proximity to each other on the chassis with their components centred around the 15 mm. bandspread condenser, which, of course, is one of the front panel controls. Ceramic valveholders are used throughout as well as ceramic

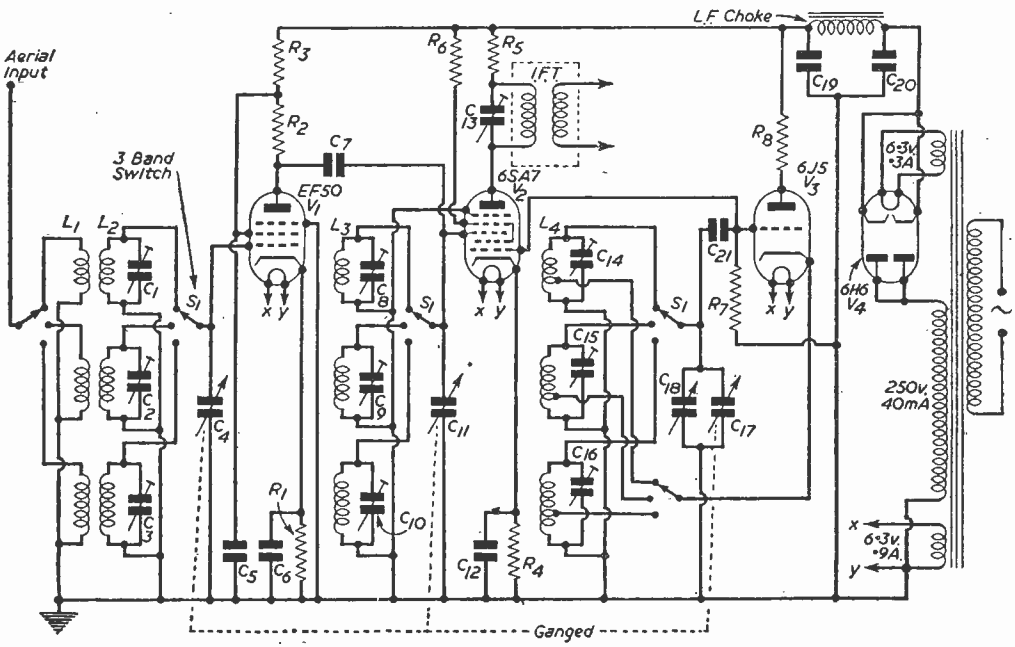


Fig. 1.—Theoretical circuit of the converter.

feed-through insulators, of the type used in radar equipment, where wires have to be passed through the chassis, and the tuning gang condenser is also ceramic insulated.

Coil Data

The coil data for 10, 6 and 2 metres is given in Table I, together with wire gauges, spacing and tapping point details. All coils, incidentally, are wound on ¾in. formers and should preferably be

TABLE I

10 Metres

Coil	Wire gauge	Turns	Spacing	Osc. coil tap point
L1	18 s.w.g. enamel	6	Closewound	—
L2	Ditto	6½	To cover ½in.	—
L3	Ditto	6½	To cover ½in.	—
L4	Ditto	6½	To cover ½in.	2½ turns*

* From earthy end.

6 Metres

Coil	Wire gauge	Turns	Spacing	Osc. coil tap point
L1	16 s.w.g. enamel	3	Closewound	—
L2	Ditto	3	To cover ⅜in.	—
L3	Ditto	3	To cover ⅜in.	—
L4	Ditto	3	To cover ⅜in.	1½ turns

2 Metres

Coil	Wire gauge	Turns	Spacing	Osc. coil tap point
L1	16 s.w.g. enamel	1½	Closewound	—
L2	Ditto	1½	To cover 3/16 in.	—
L3	Ditto	1½	To cover 3/16 in.	—
L4	Ditto	1½	To cover 3/16 in.	¾ turn

of the ribbed ceramic type obtainable at any good components shop for about threepence each. The coils have been calculated for an intermediate frequency of 1,500 kc/s, but to get as near perfect tracking as possible and also to secure the required coverage it may be advisable to adjust the coils by squeezing or expanding the turns or by slight alteration to the number of turns. Probably the first is the better way.

All components in the circuit (Fig. 1) have been keyed for simplicity and are given overleaf with their values, while Fig. 2 indicates the chassis dimensions and layout both below and above deck.

Power Supply

The unit is intended to operate from a power supply of 250 volts H.T. and 6.3 volts 1 amp. L.T., which may be drawn from that of the main receiver or from an integral power pack. Fig. 1 shows the built-in power pack which was used with the original unit and it will be noticed that that faithful standby, the 6H6, has been pressed into service again as the rectifier. It is not called upon to deliver much in the way of current and therefore fulfils the function quite satisfactorily.

TABLE II

80/75 Metres †

Coil	Wire gauge	Turns	Spacing	Osc. coil tap point
L1	26 s.w.g. enamel	14	Closewound	—
L2	28 s.w.g.	52	To cover 1¼in.	—
L3	Ditto	52	To cover 1¼in.	—
L4	Ditto	38	To cover 1in.	13 turns*

† Use with .005 pad trimmer.
* From earthy end.

40 Metres

Coil	Wire gauge	Turns	Spacing	Osc. coil tap point
L1	26 s.w.g. enamel	9	Closewound	—
L2	Ditto	36	To cover 1in.	—
L3	Ditto	36	To cover 1in.	—
L4	Ditto	27	To cover ¾in.	10 turns*

* From earthy end.

30 Metres

Coil	Wire gauge	Turns	Spacing	Osc. coil tap point
L1	24 s.w.g. enamel	7	Closewound	—
L2	Ditto	28	To cover ¾in.	—
L3	Ditto	28	To cover ¾in.	—
L4	Ditto	21	To cover ⅝in.	7 turns*

* From earthy end.

20 Metres

Coil	Wire gauge	Turns	Spacing	Osc. coil tap point
L1	22 s.w.g. enamel	6	Closewound	—
L2	Ditto	11	To cover ½in.	—
L3	Ditto	11	To cover ½in.	—
L4	Ditto	10	To cover ½in.	3 turns*

* From earthy end.

Other Receivers

It is possible that some readers desirous of short-wave listening will not possess a communications receiver, but that need be no deterrent provided they have a broadcast receiver going down to 200 metres. In fact, by extending the coil ranges and, of course, using a switch with more contacts the converter can be made to function as a highly-efficient double-superhet for all bands. To help such readers coil data for 80-, 40-, 30- and 20-metre bands are given separately in Table 2. The addition of these coils also means that the switch should be changed to a 2-pole 7-way 3-bank unit to enable the new bands to be switched.

When the unit is completed, in either form, it can be tested in a simple manner. Couple it up to the aerial and earth terminals of the receiver with which it is to be used and tune the latter to 200 metres (1,500 kc/s). Short circuit the grid of the 6J5 to chassis and swing the tuning of the main receiver through the 200-metre point, say 5 metres each side, to check that the peak noise level is on 200 metres. Finally, adjust the trimmer on the primary of the output transformer until the peak noise is reached, then remove the short-circuit from the grid of the oscillator and unit is ready for duty.

In conclusion the converter will be found to fulfil amply the purpose for which it was devised, and with a little care in construction will give a signal much superior to that obtainable from apparatus functioning on an I.F. of 465 kc/s, or from much of the ex-Service equipment on the market, because it has been built solely for the purpose for which it is going to be used.

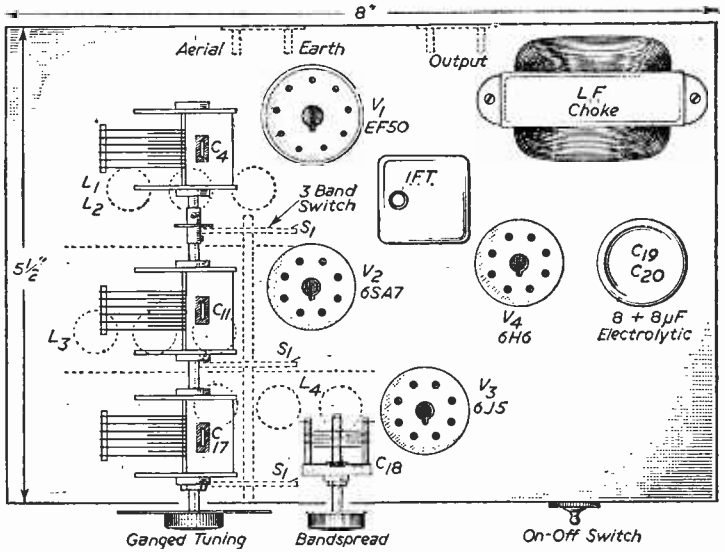


Fig. 2.—Chassis dimensions and layout.

Alternatives

To forestall any queries which may arise concerning the use of alternative parts we must point out that we are unable to give details for using valves, coils or other components differing from those specified, and any instrument such as this which is designed for a specific purpose must be constructed to the original design. Problems of lay-out, etc., are combined with the choice of components, and the particular use to which the apparatus is to be put, and therefore the circuit and valves should be adopted in their entirety.

LIST OF COMPONENTS

C1, C2, C3, C8, C9, C10, C13, C14, C15, C16 = 3.30 pF trimmer.	C18 = 15 pF variable condenser.
C4, C11, C17 = (tuning) 3-gang 25 pF condenser.	C19, C20 = 8+8 μF electrolytic condenser.
C5, C6, C12 = .001μF tubular.	R1 = 200Ω ½ watt.
C7, C21 = 100 pF silver mica.	R2 = 4.7 kΩ. ½ "
	R3 = 3.3 kΩ. ½ "
	R4 = 400 Ω. ½ "
	R5 = 5 kΩ. ½ "
	R6 = 20 kΩ. ½ "
	R7 = 50 kΩ. ½ "
	R8 = 7.7 kΩ. ½ "

3 International octal holders (ceramic).
1 International octal holder (bakelite).
1 2-pole 3-way 3-bank wafer switch (ceramic).
1 mains transformer, as indicated.
1 L.F. choke to carry 40 mA.
1 1,500 kc/s I.F. transformer or two-winding medium-wave coil.

Icelandic Communications

AN experimental radio telephone link installed between the Icelandic capital, Reykjavik, and the lonely Westmann Islands—a distance of 75 kilometres—has proved so successful, and the existence of reliable communication facilities has led to such an increase of traffic, that the system is to be replaced by a Marconi V.H.F. multi-channel link. This new link will provide eight telephone channels (by means of frequency divisions), permitting eight simultaneous conversations.

The extremely severe climate of Iceland makes such a link a necessity. Gales and heavy seas make sea communications difficult at all seasons, and impossible in the winter.

Multi-channel Links

It is only since the end of the war that the value of V.H.F. multi-channel radio links has been universally recognised, though such systems were previously used in many parts of the world. Now there is an increasing demand for these facilities in the many territories where line systems are inadequate or impossible on account of the terrain.

The equipment is designed to give equally faithful service under all climatic conditions, ranging from tropical to arctic.

Wrotham V.H.F. Station

Details of the B.B.C. Experimental F.M. Transmitter

DURING 1945 the B.B.C. Engineering Research Department began a series of tests in order to get first-hand information on the possibilities of broadcasting on very high frequencies (V.H.F.). Though comprehensive, these tests did not show conclusively whether amplitude modulation (A.M.) or frequency modulation (F.M.) would be superior for this purpose, and so it was decided, as a long-term project, to carry out comparative tests at high power. To this end a new transmitting station was built near London, and this station has been making experimental transmissions for the past few months.

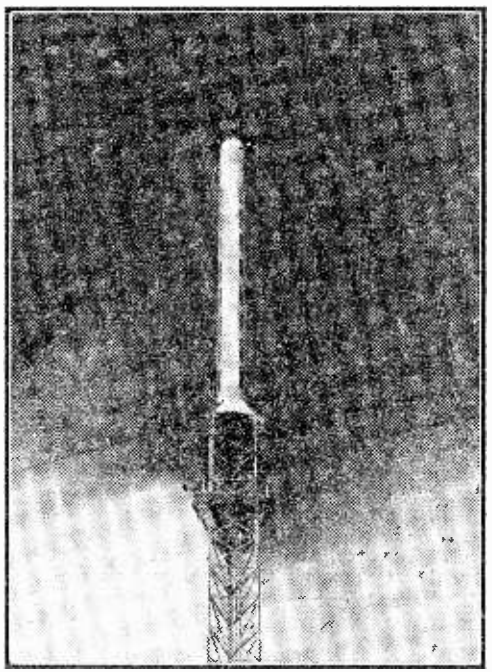
The station is on Wrotham Hill, one of the highest points in Kent, just off the main London-Folkestone road, about 20 miles south-east of London (National Grid Reference 51/594604). It consists of a single-storey brick building and a 470-ft. mast, the base of which is 730ft. above sea level. The building, which is similar to that of the Sutton Coldfield Television Station, has two wings, in one of which are the A.M. and F.M. transmitters, a control room, and auxiliary equipment and in the other a quality-checking room, offices and canteen. The elevations are to designs by London architects, Messrs. Wimperis, Simpson, Guthrie and Fyffe, FF.R.I.B.A.

Transmitter

The F.M. transmitter, manufactured by Marconi's Wireless Telegraph Co., Ltd., has a power of 25 kW. and operates on a mean carrier frequency of 91.4 Mc/s (3.28 metres) with a maximum deviation of ±75 kc/s. It incorporates the Marconi "F.M.Q." system of frequency modulation, in which a quartz crystal oscillator is connected through a quarter-wave network to a balanced modulator, the susceptance of which varies with the modulating signal, and in turn varies the frequency generated by the crystal oscillator. The crystal is specially cut so that it does not produce spurious harmonics within the operating range. The chief advantage claimed for this system of frequency modulation is that the circuits are much simpler than those of other systems, and therefore more reliable and easier to maintain.

The output of the crystal oscillator is passed through three frequency doubling stages and one tripling stage to produce the carrier frequency of 91.4 Mc/s. There then follow six stages of amplification. The first two are conventional push-pull stages, and the remaining four are single-ended earthed-grid stages with coaxial-line tuning elements. The output stage consists of two BR128 valves in parallel, giving an output of 25 kW. Supplies at 6 kV. and 3kV. for the valve anodes are obtained from hot-cathode mercury-vapour rectifiers in the power-conversion plant, which is installed behind the transmitter. The filaments of all the valves are A.C. heated.

The A.M. transmitter, also manufactured by Marconi, has an unmodulated power of 18 kW. and operates on a carrier frequency of 93.8 Mc/s (3.20 metres). The drive equipment and the radio-frequency amplifiers are like those in the F.M. transmitter, except that the balanced modulator in the "F.M.Q." drive is made inoperative. The audio-frequency modulator has four stages, the final stage consisting of two ACT14 valves operating in class B push-pull, which modulate the output stage of the transmitter. Supplies at 9 kV., 4.5 kV. and 3 kV. are obtained from hot-cathode mercury-vapour rectifiers in the power-conversion equipment behind the transmitter.



The cylindrical upper portion of the 360ft. mast at Wrotham. This section is 110ft. long and 6½ft. in diameter, and forms the V.H.F. aerial proper.

Control

Both transmitters are controlled and monitored in a single kiosk. The kiosk has windows looking out on the transmitter hall, so that the engineer on duty gets a clear view of the transmitters he is controlling. On each control desk are switches controlling the supplies to the various stages of the transmitters and meters indicating the voltages and currents to them. Special monitoring equipment is installed for measuring the frequency deviation due to modulation and for checking any shift in the mean carrier frequency.

Air-blast cooling is used throughout in both transmitters. The air can either be circulated round a

closed system, in order that it may attain its working temperature quickly, or be drawn in from outside the building. During cold weather the air can be discharged into the transmitter hall in order to warm it. Motor-driven dampers operated by thermostats control the circulation of the air automatically.

A concentric feeder connects the output of each transmitter to a change-over switch via a filter for minimising harmonic radiation. By means of the change-over switches the transmitter outputs can be connected either to the feeders leading to the aerial or to test loads. The test loads, which are identical, consist of short lengths of concentric feeder through which water is circulated. The power is dissipated in the water, which is obtained from a supply unit where its temperature is quickly raised to a predetermined value and then kept at that value in order to prevent variations in the impedance of the load.

From the change-over switches the transmitter outputs are connected by concentric feeders, having an impedance of 51 ohms to a combining filter, which prevents power from being fed from one transmitter to the other. This filter, which is outside the transmitter building, consists of sections of concentric line. The F.M. and A.M. signals from the filter are carried up the mast to the slot aerial system by a single concentric feeder.

Aerial

The mast is some 50 yards from the transmitter building. It consists of a lattice steel support mast 360 ft. high, on top of which is a cylindrical section 110 ft. long and 6½ ft. in diameter, which with the slots in its surface forms the V.H.F. aerial system. The support mast has a triangular cross-section, each face being 9ft. across, and rests on a ball joint which permits some angular movement under wind pressure. The dead weight of the mast is 60 tons, and the maximum thrust at the base is 200 tons. Nine stays, attached in sets of three at 160ft., 360ft. and 470ft. above the ground, hold the mast erect. The mast was designed and built by British Insulated Callender's Construction Co., Ltd.

The aerial system, which is common to both transmitters and radiates horizontally polarised waves, consists of 32 slots in the surface of the cylindrical section, arranged in eight tiers, each tier have four slots spaced at 90 deg. intervals round the surface. Each slot is 8ft. high and 1ft. wide, and is screened by backing it with a series of horizontal bars placed one above the other at one-foot intervals. In the centre of one half of each slot and parallel to the edge is a rod, approximately half a wavelength long, one end of which is connected to the surface of the cylindrical mast, and the other to the driving feeder. Each slot operates as a folded slot. This arrangement reduces the input impedance of the slot from approximately 600 to 150 ohms, a value which is more convenient for feeding by coaxial cable. All the slots are fed with currents of the same amplitude and phase.

The aerial was designed in the B.B.C.'s Engineering Research Department. The associated feeder system was developed and manufactured by Marconi's. The aerial is suitable for any frequency within the band 87.5 Mc/s to 95 Mc/s, and has a mean power gain of approximately eight decibels, which does not deviate by more than ± one decibel in any horizontal direction.

Power Supply

The station is supplied with power at 11 kV., three-phase, 50 c/s, by duplicate feeders, which terminate on switchgear in a sub-station near the transmitter building. This supply is transformed down to 415 volts and distributed from the low-voltage switchroom in the transmitter building to the transmitters and auxiliary equipment. A 50-volt supply for the transmitter control circuits is obtained from metal rectifiers, and there is a 240-volt battery for emergency lighting.

Manufacturers' Announcements

ACE RADIO, LTD., Tower Works, Tower Road, N.W.10.

DUE to increases in material and labour costs, the following increases became effective as from February 19th, 1951:

	List Price	Plus P.T.	
Minnigram A.C.	£40. 9. 0	£17. 6.0	—55 gns.
,, D.C.	43. 7.10	18.11.2	—58 ,,
,, 3-speed	44. 2. 6	18.17.6	—60 ,,
Mayfair 1-speed	52.19. 0	22.13.0	—72 ,,
,, 3 ,,	56.12. 6	24. 4.6	—77 ,,

Three new models are also announced.

PHILIPS ELECTRICAL, Century House, Shaftesbury Avenue, London, W.C.2.

PHILIPS ELECTRICAL also announce the following increase in retail prices of current models, as from February 1st, 1951:

603A Radiogram—from 69 gns. (Tax paid) to 75 gns. (Tax paid).

1502U 12in. Table Television—from 59 gns. (Tax paid) to 62 gns. (Tax paid).

1800A Projection Television—(Picture size 13¾in. by 10¼in.)—from 92 gns. (Tax paid) to 96 gns. (Tax paid).

704A Projection Television—(Picture size 18in. by 13½in.)—from 130 gns. (Tax paid) to 136 gns. (Tax paid).

MULLARD ELECTRONIC PRODUCTS, LTD., Century House, Shaftesbury Avenue, London, W.C.2.

TO assist dealers in estimating and ordering their stocks of maintenance valves for television receivers, the Valve Sales Department of Mullard Electronic Products, Ltd., has recently compiled a list of the most popular Mullard valves used in the vision sections of television receivers. The sound sections of the receivers are already adequately covered by the well-known Mullard "94" and "36" lists.

The new list is being circulated to all Mullard valve dealers with the regular monthly mailing. The demand for certain maintenance types is greater than for others and will, of course, vary for different television areas. A number of stars have accordingly been placed against each type in the list denoting its popularity from the point of view of estimated maintenance sales during 1951 for the London, Birmingham and Northern television areas respectively.

On your Wavelength

by THERMION

L.P.R.

I HAVE received a welter of correspondence from readers wishing to set me right on the subject of L.P.R. and to guide my erring footsteps into the paths of rectitude from which they think I have in my technical juvenescence strayed. I am grateful to them all. The letters published in this issue summarise the points made by most of my correspondents, and so I am looking into the matter again and will issue progress reports from time to time.

The general view seems to be that L.P.R. is wanted, that it is inevitable, and that some of the larger companies are deliberately holding back this scientific development because of vested interests.

On the contrary I believe they are protecting the best interests of their gramophone-using public because it will take many years to re-record all of the titles in the gramophone catalogue, in other words, whilst L.P.R. may be a good thing, the moment is not ripe for its general introduction.

It is my own view that in the distant future we shall not use wax records at all, but a strip of celluloid with a sound track on it, a photo-electric cell and the usual amplifier—in other words, something similar to the sound track on a talkie. Such a machine was actually marketed many years ago, styled, I believe, the Cellophone, but its sponsors were bought out and the idea killed.

One spool of film occupying about the same space as an ordinary gramophone record would contain a recording of a complete opera, which could be played non-stop without the inconvenience of frequent change of record and needle.

Automatic record changers do not entirely eliminate the difficulty.

The gramophone needle is a destructive tool, and it cannot be said that the life of an ordinary wax disc is long, notwithstanding the multitudinous needles which have been produced. They may improve quality, but they do not improve the life of the record.

The gramophone of to-day with a pick-up or sound box will be as out of date 50 years hence as Edison's wax cylinder.

At the same time I want to make it quite clear that the pro-L.P.R. and the anti-L.P.R. must not play battledore and shuttlecock with me over this matter.

Recording Telefilms

I LEARN that the B.B.C. claims to have perfected its system of recording Telefilms; new apparatus has been developed at its research station and will be in full operation by October. The B.B.C. then proposes to telefilm suitable productions and sell them to sponsors in America. Equity I am also informed have discussed recording payments to actors at the rate of 100 per cent. additional fees for two reproductions and a percentage of revenue thereafter.

The B.B.C. probably quotes as a precedent for these projected arrangements the system of transcription radio programmes which has been in operation for some years. Needless to say I am filled with dismay at the prospect arising from any system such as this. It means that we voluntarily surrender ourselves to the domination of the dollar at the cost of our artistic integrity. Very few of the plays now transmitted are ideal for the American market. They are made for Englishmen. The time may come when if a choice has to be made between a play suitable for this country and one with Transatlantic possibilities, the Americans will have it every time.

Moreover, we in this country will be made to submit to American requirements and accustom ourselves to a play of 56 minutes duration. More trouble lies ahead with the actors. They will rightly demand higher fees if they know that their efforts will help to advertise somebody's medicine in 20,000,000 American homes. Cost of production will rise all round. Every play for America will have to be glossier than the home product and include star names.

Canada and Australia may be operating before the year is out. By all means let us sell them recorded plays—but English plays made for English audiences.

The B.B.C. may argue that with a greater revenue it will be possible to spend more money and so secure better results, to which I reply, that overnight the Government could sequestrate all of the B.B.C. profits above a certain figure, if a national emergency arose. We have just arrived at the time when, thanks to more studio space and extra equipment, it is possible to provide longer rehearsal times. If the telefilm system is so good, then a play can be made like an ordinary film, shot by shot, and assembled later.

More money probably spells bigger and more luxurious sets. This, however, takes little account of the medium which still remains a comparatively small area of tube as the theatre stage. Unfortunately there is no evidence that the B.B.C. has the commercial ability to extract good terms from hard bargains.

It is my profound hope that this scheme will not go ahead. It is not in the best interests of television nor broadcasting.

The Practical Television Receiver

I have just commenced construction of the *Practical Television* Receiver described in the 3s. 6d. booklet (by post 3s. 9d.) published from the offices of this Journal. I like the performance of the prototype so much that I do not think it can be beaten by the best commercial receiver. In many ways it is superior.

Radio Amateurs' Examinations

The 1950 Test Paper and a Report on the Results

IN order that prospective transmitting amateurs may gain some idea of the standard required by the G.P.O. Examinations, we again give the full Test Paper set in May last. The City and Guilds of London Institute have reported on this Examination and their report follows the paper:

All questions should be attempted. Use should be made of diagrams where applicable. The maximum possible marks obtainable is affixed to each question.

1. With the aid of a diagram, describe the essential features of a crystal-controlled radio transmitter suitable for the 14 Mc/s frequency band and indicate the method of keying. (15 *marks.*)

2. Describe a superheterodyne receiver suitable for the reception of C.W. signals over the frequency range 1 to 20 Mc/s. Illustrate your answer with a block diagram. (15 *marks.*)

3. State what requirements have to be met under the non-interference conditions of "The Postmaster-General's Licence to Establish An Amateur Wireless Station." (15 *marks.*)

4. Describe a heterodyne frequency meter and explain how it is used to measure the frequency of a transmitter. (15 *marks.*)

5. What is understood by "radiation characteristics"?

With the aid of diagrams, describe the radiation characteristics of a horizontal dipole with and without reflector. (10 *marks.*)

6. Explain—

either (*a*) the meaning of class A, class B and class C amplification,

or (*b*) the method of neutralising a power amplifier. (10 *marks.*)

7. Two inductors of 10 and 20 microhenrys are connected in series; two others of 30 and 40 microhenrys are also connected in series. What is the equivalent inductance if these series combinations are connected in parallel? Assume that there is no mutual induction. (10 *marks.*)

8. (*a*) What is the relation between the frequency and the wavelength of a radio wave?

(*b*) What are the frequencies corresponding to wavelengths 30 km., 150 m., and 10 cm.?

(*c*) Why are wavelengths shorter than 5 metres generally unsuitable for long-distance communication? (10 *marks.*)

Report on the Papers

The following general report is given on the papers as a whole and is not necessarily applicable to the work from individual schools.

Year	Number of Candidates	Number of Passes	Number of Failures	Percentage of Failures
1950	Home 823	653	170	20.6
	Overseas 10	7	3	30
1949	Home 885	628	257	29
	Overseas 13	8	5	38.5

The number of entries for the 1950 Radio Amateurs' Examination showed a slight decrease as compared with former years. The general standard of candidates' work in the 1950 examination, both technically and in the method of approach to the questions, was fairly high. Practically all questions were attempted by the candidates. A report on each question follows:

Question 1 (*Transmitter*): Well done by most candidates. A small number of the candidates in their diagrams of single-ended power amplifier stages indicated incorrectly the method of neutralisation by showing the neutralising condenser connected directly between the anode end of the coil and the grid and the high tension supply connected to the end of the anode coil.

Question 2 (*Receiver*): Very well done by practically all candidates.

Question 3 (*Non-interference condition of Licence*): Well done by most candidates.

Question 4 (*Heterodyne frequency meter*): Fairly well done by most candidates.

Question 5 (*Aerial radiation*): Well done by practically all candidates.

Question 6 ((*a*) *Classes of amplification or alternatively* (*b*) *neutralisation*): About 75 per cent. of the candidates chose the first alternative, which practically all answered very satisfactorily. The remainder of the candidates who chose (*b*) satisfactorily described the procedure for neutralising a power amplifier, but a fair number of the candidates showed incorrectly in their diagrams the position of the neutralising condenser and the high tension lead (see report on Question 1).

Question 7 (*Calculation*): Well done by practically all candidates.

Question 8 (*Frequency, wavelength and propagation*): Well done by practically all candidates.

Largest Valve-driven H.F. Generator in Europe

PHILIPS ELECTRICAL LIMITED announce the completion of their latest High-frequency Induction Heating Generator, Type F280, which has a maximum output of 150 kW. (continuous) and 200 kW. (intermittent). This equipment, which has recently been installed at the De Havilland Propellers Ltd., Hatfield, for hardening purposes, represents the most powerful and up-to-dato valve-driven high frequency generator in Europe.

The F280 is designed for operation on a mains supply voltage of 380-440 v., 3 phase, 50 cycles, and requires a maximum mains power input of 280 k.V.A.

The valve complement consists of one oscillator valve, one grid bias valve, and six rectifier valves. Two spare valves are housed in the generator. The filament voltage of the oscillator valve is maintained constant by an automatic, motor-driven regulator.

A wide choice of automatic operating-time ranges is effected by the fitting of two synchronous motor timers.

The equipment measures approximately 7ft. in height, 4½ft. in width and 12ft. in depth, and weighs 3 tons. For ease of transport the heavy component are readily removable and the framework of the whole equipment divides into two sections.

Converting the T/R9

Adapting a Popular "Surplus" Receiver

By F. G. RAYER

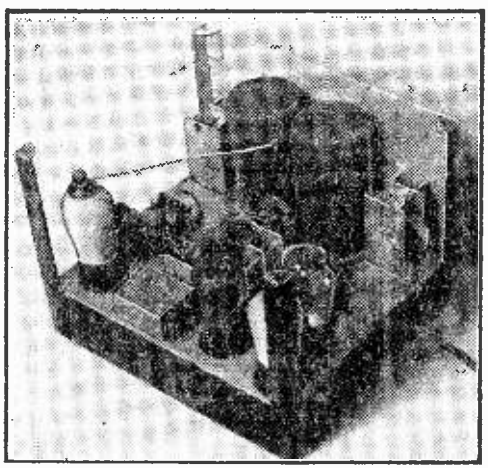
AN examination of the pages of PRACTICAL WIRELESS will show that T/R9 receivers are offered by various advertisers at prices ranging from 12s. 6d. upwards, complete with valves. As these receivers stand they are not very suitable for ordinary purposes; some controls are awkwardly situated on top, the gang condenser is intended to be operated by means of a remote-control arrangement to be attached at the side, and the waveband does not allow the most popular frequencies to be tuned.

These difficulties can be overcome by rebuilding in more conventional form; construction is easy because the chassis is ready drilled, and the blank aluminium sheet, flanged and already riveted to the chassis, can become the panel. At the same time the unrequired, untuned R.F. stage can be omitted, together with one L.F. stage (making a 4-valve circuit), and the coils rewound. The final circuit is shown in Fig. 1. Ganged bandspread tuning is employed; the bandsetting condensers are not ganged, and this enables the R.F. stage to be aligned with the detector throughout the tuning range without difficulty, maintaining an excellent degree of efficiency.

A .5 megohm volume control with switch, tuning dial for the bandspreading condenser, and .0002 μF. reaction condenser will need to be obtained separately. All other parts, including coil formers, fixed and variable condensers, resistors, valve-holdes, screening cans, flexible coupler, H.F. and L.F. chokes, bolts, spacing pillars, etc., will be found in the T/R9 set.

Dismantling and Construction

The receiver should be dismantled by cutting all leads and unscrewing all bolts. The metal brackets holding the variable condensers vertically above the centre of the chassis are not further



A view of the modified receiver.

required. All resistors and condensers, where affixed to tag boards, are numbered. These numberings have been shown in Fig. 1 to facilitate reconstruction. If these numbers are followed, and the colour coding of the resistors not read, take care R6 and R9 (1 megohm and 0.1 megohm respectively) are not confused.

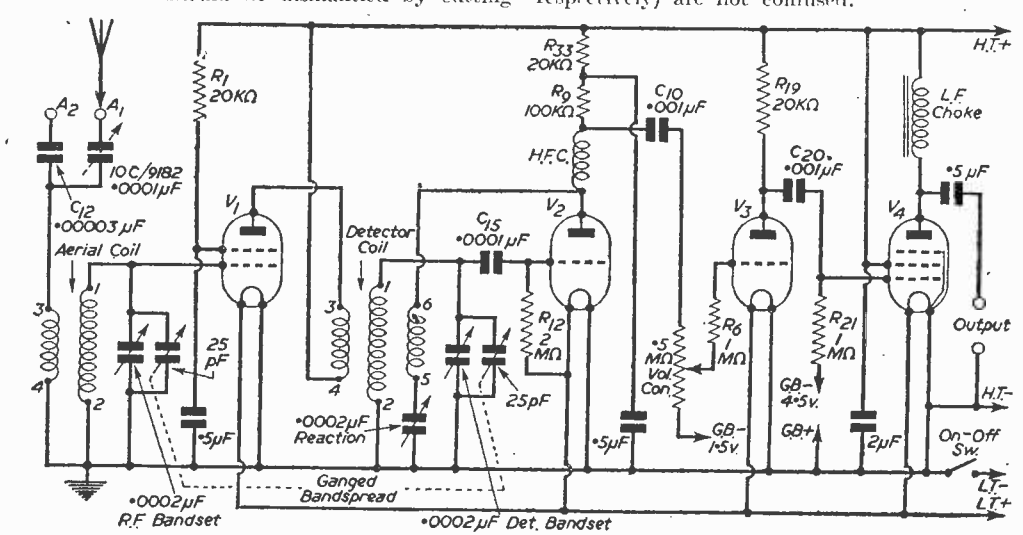


Fig. 1.—Theoretical circuit of the receiver with components numbered as in the T/R9.

As the nuts are varnished, pliers should be used to hold them while the screw driver is used. In a few difficult instances it may be necessary to apply methylated spirit to the shellac to soften it. As the T/R9 set has only two tuned circuits the third set of plates on the bandspreading condenser is omitted in some models; if they are present, ignore them when wiring.

If necessary, clean up the chassis and varnish the surface which will now become the panel.

Two valveholder holes will now be unused. One is concealed by the 2 μF. condenser; the other comes below the left-hand bandset condenser, and the parts are bolted down in the positions shown in Fig. 3.

The gang condenser is bolted from below, the flexible coupler and rod being used to extend the drive from the tuning dial. The two single-gang condensers each have 0-180 deg. dials, with reduction drives, and these should be mounted on the panel, the spacing pillars attached to the condensers being left in position. The variable condenser, previously wired between the anodes of the R.F. valves, now becomes the aerial-series condenser, and when set to the best value, will not need readjusting. The metal brackets of this component are not in contact with either moving or fixed plates, so it may be mounted on the chassis. C12, providing an optional aerial connection, is mounted on one of the small tag boards which have been removed from the receiver.

20 S.W.G. tinned copper wire can be used for connections, in conjunction with insulating sleeving, with lengths of flex for battery leads. The suitably-marked G.B. plugs can be used, but H.T. and L.T. connectors will have to be purchased separately.

All components and wiring below chassis will be seen from Fig. 4. The pieces extending from front to rear, dividing the chassis into four compartments, are left in position. Leads pass through the holes in them where necessary. All points marked "M.C." are taken to the chassis itself. It is suggested that the tuning coils be left until last, all the other wiring being done. The finished coils will be mounted above the two large holes near the panel. Each coil and screening can has three fixing feet, and the chassis is ready drilled for these. The lead from the centre tag of the volume control is taken through screened braiding.

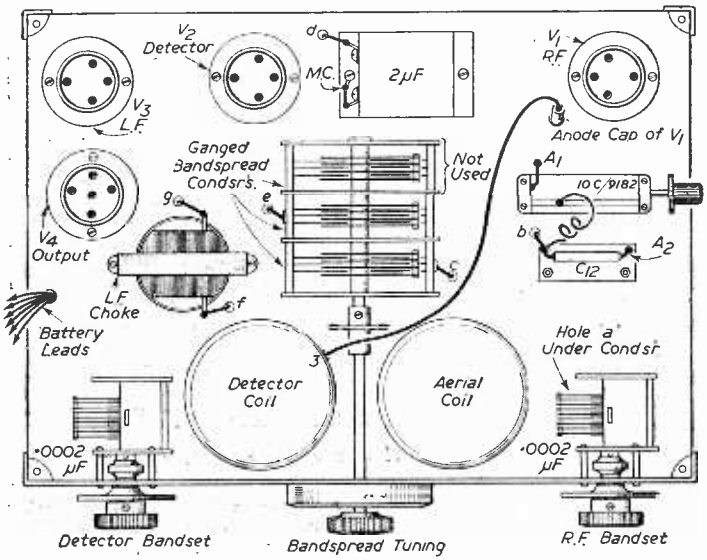


Fig. 3.—Above chassis layout and wiring details.

Modifying the Coils

As removed from the receiver, the coils each have a single winding of 13 turns, the former being threaded and 1¼in. in diameter. Remove these windings, replacing the wire (20 S.W.G. tinned-copper) so as to obtain 7 turns, double-spaced (e.g., leave one blank "thread" between each turn).

This is the winding shown on each coil in Fig. 2 between points 1 and 2.

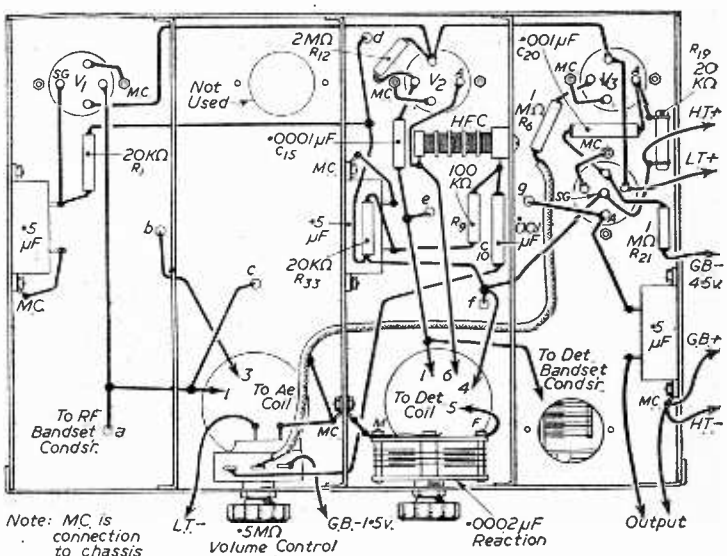


Fig. 4.—Below chassis wiring details.

Now interwind three turns of 30 D.C.C. or similar wire in the unoccupied threads as shown between points 3 and 4. These windings are for aerial and R.F. coupling.

Leave a ¼in. space below the windings on one coil

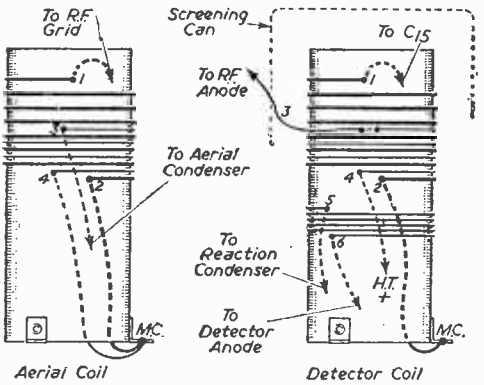


Fig. 2.—Coil wiring details.

and put on five turns, side by side, of 30 D.C.C. or similar wire, for reaction. (Points 5 and 6.)

All the ends go down inside the coils, except for end 3 on the detector coil. This is passed through a hole in the screening can, and taken to the R.F. valve anode cap.

Bolt the coils in position and wire them up. Then place the cans in position and secure them with nuts. A very slight dent or cut with a file will be necessary where the extension spindle passes from the flexible coupler, so that this may turn without friction, insufficient space existing between the cans as they stand.

Coils wound in this way will tune from approximately 18 to 24 metres, thus enabling the most popular and satisfactory short wave bands to be covered. The threaded formers ensure the coils will match satisfactorily and their performance seems to be superior to midget type coils.

Operational Adjustments

Four of the original valves of appropriate type are inserted. If an earth is used, take it to H.T. negative or chassis. Excellent speaker results will be obtainable, though phones can be used for weak, long-distance stations, and a change-over switch can be fitted. The choke output circuit enables the phones to be earthed, avoids current through them, and prevents the possibility of an open anode circuit. The desired band is selected by means of the bandset condensers, the R.F. control being peaked for maximum volume. The centre control is then used for tuning, giving accurate alignment over a narrow band and also "spreading out" the dial readings of crowded amateur or other transmitters.

If the small dials on the two single-gang condensers are set accurately to zero their readings will coincide closely throughout the tuning range.

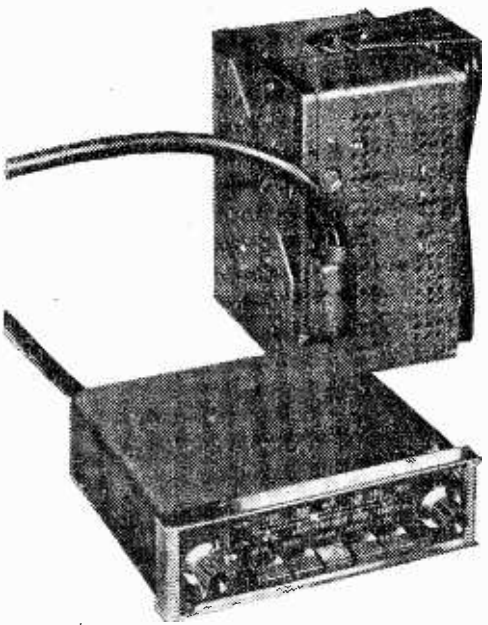
If necessary the pre-set aerial condenser can be adjusted; reducing capacity here will increase selectivity, but slightly reduce volume.

The reaction control will not be very critical on many of the more powerful stations, but should be used carefully to hold the detector in a sensitive condition when searching for weak signals.

If more economical H.T. consumption is desired, the grid bias voltages may be increased to 3 and 6 respectively.

Radiomobile Car Radio

THE Model 100 receiver which was illustrated in our issue dated February has now been superseded, and is replaced by the Model 4200



The new Radiomobile Car Radio Model 4200 receiver and its power pack.

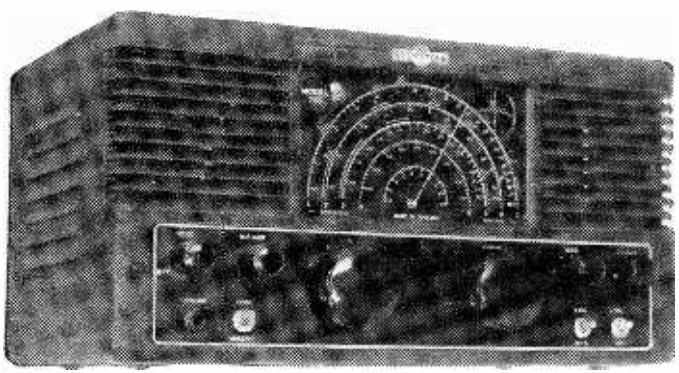
illustrated above, price 20 gns. plus P.T. This is an 8-valve receiver covering both medium and long waves and has a performance equal to the standard home receiver. There are five push-buttons, as well as manual tuning, and each button is easily adjustable to a variety of stations. Another refinement to be found on this receiver is a four-position tone control. It is claimed that the output is sufficient to operate two of the larger size loudspeakers. We should also like to take this opportunity of pointing out that the name of the company has been changed to S. Smith & Sons (Radiomobile) Ltd.

TEST REPORT

Eddystone Model "740"

A Modern Communications Type Receiver

THIS is an eight-valve general purpose communications type receiver, designed for the amateur or professional. The circuit employed consists of an R.F. stage followed by a frequency-changer, I.F. stage, diode demodulator, L.F. amplifier and pentode output stage. In addition there is a beat-frequency oscillator, noise limiter, and mains rectifier. As may be seen from the illustration below, the main control panel is provided with the main tuning knob and range selector switch, and, in addition, a tone control (with which is combined the on/off switch), R.F. gain control, A.F. gain control, B.F.O. control, a socket for 'phones, and three on/off switches. The latter provide for send/receive adjustment, A.V.C. or B.F.O. and noise limiter in or out. The centre dial is of the wide vision type and has the various scales additionally marked to indicate amateur bands, etc. Finally, a scale at the bottom, in conjunction with a small dial in the upper right-hand corner of the main dial provides vernier setting by means of which quick resetting of any given tuning point may be obtained.



The Model "740" Eddystone Receiver.

The Circuit

A built-in multi-coil unit is controlled by a multi-contact switch to provide tuning on the following bands:

1—30.6 Mc/s to 10.5 Mc/s.
2—10.6 Mc/s to 3.7 Mc/s.
3— 3.8 Mc/s to 1.4 Mc/s.
4—205 metres to 620 metres.

The dial calibration for these ranges is calibrated to a high standard of accuracy (better than .5 per cent.). Round the scales the amateur bands are marked off in blue, and the short-wave broadcast bands in red, the dial being illuminated in such a manner that these stand out most clearly.

Power Supply

The receiver is primarily for A.C. mains operation, but may be used with a vibratory power pack in conjunction with a 6-volt accumulator by the simple removal of an octal plug at the back of the chassis. Under these conditions the total load on the accumulator is between 5 and 6 amps.

Results

We have had one of these receivers under test for the past few months and find it most satisfactory in every way. On the broadcast bands selectivity is adequate and the reproduction of quite a high standard. We used the receiver with a properly boxed and baffled speaker, and the quality was equal to any standard commercial broadcast receiver. On the short waves the performance is, of course, what one would expect from the communications type of set. Selectivity is adequate for all normal purposes and is almost as good as that on our standard AR88, which is, of course, a much more elaborate and expensive receiver. The amateur bands are sufficiently well spread to enable the receiver to be used by the amateur transmitter, and the B.F.O. arrangement works perfectly satisfactorily. A number of different aerials were tried and quite a small arrangement enabled a very wide selection of short-wave broadcast stations to be well received. A.V.C. is very effective and counters all normal fading, whilst the noise limiter was fully up to what one would expect from the arrangement employed. As with most receivers which employ both A.F. and R.F. gain controls, some experience is called for to obtain a suitable balance between these to obtain a suitable signal-noise ratio.

There is only one small criticism which we would make and this does not concern the performance. (Incidentally, it may also be due to the particular model we have been testing being in the need of adjustment.) We refer to the vernier tuning device. In our model when the pointer was set to zero the vernier did not come to zero, and did not line up at any of the indicator points. Although a given setting can always be found exactly, we would have preferred to have found the zero on the vernier dial at the unit indicators on the main dial. The receiver costs £32 10s. complete.

Loudspeaker Mounting

Improved Performance without Special Cabinets, and with a Minimum of Labour

By W. J. DELANEY (G2FMY)

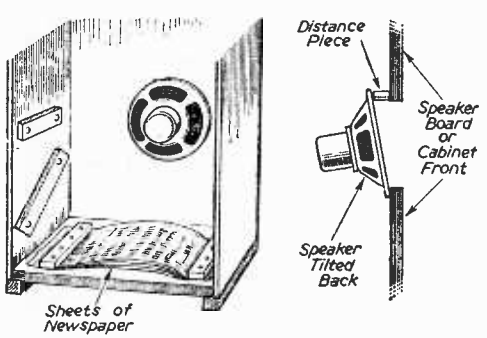
CORRESPONDENCE shows that there is one very important point connected with the average listener's quest for quality. Designs have been given from time to time, and advertisements often appear, for special loudspeaker cabinets designed to give a very high standard of reproduction from different makes of speaker. But where a listener already has an existing console (or even a table model which stands upon its own small table or stand) the extra cabinet may take up room which cannot be spared owing to the remaining furniture in the room. Another very important point concerned with the separate loudspeaker is that if a television receiver is employed with a common amplifier the loudspeaker, situated even at only a short distance from the viewing screen, gives rise to psychological effects—the sound and picture being separated and thus unrelated. What, therefore, can the average constructor with a small room do to improve reproduction with existing material and without using one of these separate special cabinets?

Mounting Important

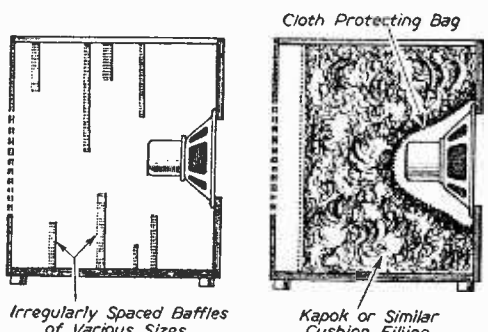
There are, fortunately, quite a number of ideas which can be carried out, some without incurring any additional expense, the exact procedure depending upon the space available in the existing cabinet and the type of equipment which is in use. First of all, let us take the standard type of console—either radio alone or radiogram. The receiver will be housed in the upper part of the cabinet, and the speaker will be situated in the centre of the lower portion. Usually there is no apparatus near the speaker, except, perhaps, the power pack in the case of a mains receiver. The speaker will be bolted or screwed to the front of the cabinet, which will probably be plywood of about ⅜in. thickness. When a back is fitted to such a cabinet the reproduction is, in many cases, inclined to be "boxy," and the receiver or amplifier is probably made deliberately deficient in bass to avoid heavy resonance. There are several things which may be done in such a case. To improve bass without introducing boom the wood of the cabinet must be reinforced to prevent it vibrating (like a drumhead). To assist in preventing both bass resonance and perhaps microphonic troubles, the air column in the cabinet must be broken up. To improve top (either alone or after bass has been improved) the speaker may be mounted in an alternative manner. Each of these ideas (or all of them, if desired) may be carried out without in any way interfering with the cabinet work, at a minimum of expense, and with a commercial receiver as well as with a home-made one.

Cabinet Resonance

First of all, take the case of a console cabinet of standard, medium-price, commercial design. This will consist of medium thickness plywood glued and screwed, with, perhaps, two runners for a shelf to carry the receiver or gramophone motor board. Thus, fairly large pieces of thin ply will be in existence, and if the inside of such a cabinet is tapped with the finger-tips fairly firmly it will be found that there is quite a noticeable drumming. There should, however, be no "note" at all from the cabinet, and to prevent the sides (and perhaps the front) from giving off this note the wood must be damped in some way. Battens of 1½in. or 2in. by ⅜in. wood (ordinary unplaned timber is very suitable), cut into odd lengths and screwed in various positions irregularly on the sides, will deaden them effectively. Obviously, the screws chosen for fixing should be of such a length that the points do not reach the veneered surface, and thus the cabinet will remain undamaged. Another idea which I recommended many years ago, and which proves very effective indeed, is to line the cabinet sides and bottom with a thick layer of newspapers. Save all your papers for a few weeks and then lay upwards



Figs. 1 and 2.—Cabinet resonance may be modified or reduced, as shown here.



Figs. 3 and 4.—Alternative ideas for reducing cabinet resonance or "boom."

of a dozen on the bottom of the cabinet neatly one on top of the other. Do not press them flat, but just lay them so that a certain amount of air is left between adjacent sheets. A thin strip of wood (ordinary trellis lath about $\frac{3}{4}$in. by $\frac{1}{4}$in.) is then screwed across each end, leaving the centre free. It will bulge up slightly and acts as a sort of air cushion, damping not only the wood but also helping to damp the internal air column. The paper need not fill exactly the side or bottom of the cabinet, but the ends should be clamped tightly so that there is a springiness in the centre which can be felt with the hand.

Finally, if one can afford it, the cabinet may be lined with two or three thicknesses of ordinary carpet underfelt. These two latter ideas both have the additional advantage of damping the air column and this should be dealt with next.

Air Resonance

The air in the cabinet, especially when "imprisoned" by a back—even if it has holes in it—will tend to resonate at some frequency relative to the area of the cabinet interior and the natural resonance of the speaker. This air column must, therefore, be broken up or prevented from vibrating as a whole, and the cushioned sides or felt will tend to damp such vibrations as soon as they occur. Where it is bad (due, perhaps, to improved bass response in a set or amplifier), the simplest way of breaking up the air column is to stretch pieces of felt or even stout cloth across the cabinet at different points. If ordinary open type cloth (such as old lace curtains, cheese-cloth, muslin, etc.) is employed, it may simply be tacked at suitable positions, irregularity being the main point to watch. If, however, a very close woven material is used, such as underfelt or heavy discarded clothing material, holes should be cut in the centre. If expense is not important the space surrounding the speaker may be filled with kapok or similar cushion-filling material, first enclosing the speaker in a linen bag to keep out fluff from the gap, etc.

Speaker Position

Either one or all of the above ideas may be applied to any individual cabinet and will markedly affect the reproduction. The position of the speaker must next be considered. In some cabinets the speaker is mounted on a separate board, and the front of the cabinet is covered over its entire width by some type of material. If the speaker mounting board is attached inside the cabinet by screws, an improvement which is sometimes very effective is to remove the mounting board and replace it by a similar size and shape of the same type of wood (usually ply), but with the hole for the speaker cut right over to one side instead of in the centre. Putting the speaker out of centre in this way assists in preventing a regular air-column resonance and in some cases may remove the need for filling a cabinet or using the air-column damping just referred to. Another point in the mounting of the speaker is not to screw it flat on the inside of the cabinet or mounting board. It may be mounted in a tipped-back position, again without any difficult work, simply by loosening the screws or clamping nuts and slipping a strip of wood down between the speaker and the mounting board and then screwing up the screws or tightening the nuts. This will give a reduction in the bass response and improve 'top,' and, if greater improvement is required in the high-note response, the speaker may be removed, spacing pieces slipped over the bolts or screws and then replaced so that there is $\frac{3}{4}$in. or more space all round the speaker.

The above notes give some idea of the lines upon which the reader can work to improve reproduction without tampering in any way with a good commercial receiver, and no special skill is called for. At the same time, of course, the builder of an amplifier or receiver who is making his own cabinet may incorporate each or all of the ideas mentioned in the final design to obtain results which, whilst obviously not equal to those obtained from a mathematically designed vented cabinet, will give vastly improved results from the ordinary type of domestic cabinet.

Hearing Aids

THE subject of hearing aids has hitherto received little attention from the radio engineer, in spite of the fact that many of the techniques of miniaturisation were first developed for this branch of engineering. It was therefore breaking new ground when a symposium on Hearing Aids was held by the British Institution of Radio Engineers in London, on Wednesday, January 10th, 1951.

The symposium, under the Chairmanship of Mr. J. R. Hughes (M.Brit.I.R.E.), who was responsible for the arrangements, consisted of three Papers. These dealt with the subject in logical order, first considering the medical aspect, then specifying the type of aid and, finally, discussing the design of hearing aids.

The opening Paper by Mr. E. R. Garnett Passe, F.R.C.S., a well-known otologist, dealt with the clinical aspects of deafness.

Mr. E. Aspinall, B.Sc., then described the Master Hearing Aid which had been constructed at the Post Office Research Station. This instrument had been set up as part of the research carried out by the G.P.O. in connection with the design of the "Medresco," which is the national hearing aid distributed free under the National Health Scheme.

The third speaker was Mr. J. P. Ashton, B.Sc. (Eng.), of Amplivox, Ltd., who described in some detail and with the aid of many diagrams and photographs the general practice in the design and manufacture of commercial hearing aids. He outlined the facilities which these instruments could offer and described the principal component parts which they employed. With all these components, perhaps the main interest was their very small size and it was this which largely distinguished them from the more familiar parts used generally in radio practice.

Mr. Ashton outlined the performance level commonly attained and showed frequency characteristics of complete instruments, of microphones and of receivers as well as performance data for the very small subminiature valves. He referred to one or two special problems, such as the importance of reducing "case noise," a requirement which called for very smooth contours on the case of the instrument, and, in some instances, special finishes as well.

The three Papers were followed by a lively and interesting discussion.

Top Band Receivers

Short-wave Equipment and All-band Listening

By A. W. MANN

ALTHOUGH there is a certain amount of activity on the 160-metre band, such activity by no means equals that of pre-war days. For a variety of reasons, this band is comparatively little used by amateurs. One reason is of particular interest to the listener and transmitter alike.

In a 40-metre phone discussion heard by the writer, one operator remarked that his receiver was good on all bands, apart from 160 metres. The receiver, by the way, was an A.C.-operated communications superhet.

It is many years since the writer first listened on this band. At first, simple regenerative detector type receivers were used. These were battery operated. At a later date various types of mains receivers including superheterodynes were tried out. From these early experiments, definite ideas were formed, which to date still appear to be fully justified, so far as my location is concerned.

Noise Ratio

Compared with the other amateur bands, the 160-metre band is noisy. This applies even under average receiving conditions. When powerful multi-valve receivers of high sensitivity are used, the background noise is amplified. We are not concerned with inherent receiver noise, because not all superheterodynes, or TRF receivers are noisy.

Suitable Receivers

While it is admitted that there are some modern communication A.C. powered receivers which are in large measure satisfactory on this band, the writer prefers the battery type for 160 metre reception. A six-valve, battery-operated superhet has been found to be more satisfactory for loud-speaker reception than an A.C.-powered six-valve TRF receiver.

For headphone reception the writer prefers a detector and one L.F. stage, or alternatively a single H.F. stage followed by a triode detector. Amongst battery type receivers for loud-speaker reception a tuned H.F. stage followed by a triode detector, and two stages of R.C.C. coupling was once tried out over a long period, with every satisfaction.

A battery-operated superhet without any L.F. amplification is a very suitable headphone combination.

Experienced readers will, of course, have their own ideas, but if the suggestions outlined are followed, a satisfactory signal-noise ratio should result, in average locations.

Listening on 7 Mc/s.

At intervals, some interesting conversation is to be heard in the 40-metre phone band. Many amateurs devote most of their time to transmitting, but there is a minority who are very active constructors. Much ingenuity is apparent in the modification of ex-Service apparatus.

One amateur held my attention for quite a while, when demonstrating a home-made tape recorder. This, due to lack of sufficient tape, was arranged on endless belt principles, between the table and ceiling. The play-back in part of his earlier conversation was very realistic and of excellent quality.

The Professionals

Can you recognise a professional radio engineer/amateur on the phone bands, when you hear one? The writer recognised at least three, many months before they mentioned the fact over the air. It is not difficult. The genuine professional, when talking of radio, does not talk down to the listener, or hold the floor as it were, *or* give one the impression that he knows all there is to know about radio. It is rather that his explanation of a particular effect, defect, phenomenon, or theory, is not only the correct one, but the only acceptable one.

The foregoing remarks bring to mind others, heard on the commercial telephone bands, and on 14 Mc/s. The former after midnight, from various parts of the world, and with speech inverters out of circuit. Commercial operators discuss a variety of subjects at times and quite a lot of radio.

The Outside World

As a friend remarked recently, the possession and operating of a short-wave receiver, brings with it a realisation as to the world existing outside one's own country. This applies equally to the modern all-wave receiver.

Short-wave listeners have diverse interests relative to this pastime. Some are amateur bands DX listeners, others search for DX broadcast transmissions. I am aware of quite a number who listen exclusively on the short-wave broadcast bands.

All Bands

The writer is numbered amongst what he believes to be a minority who are "all-band listeners." That is, one who listens over the full tuning range of his receivers as a general procedure.

This includes, amateur phone from 10 metres and over all other amateur bands. Listening to short-wave broadcasts, to schedule, and otherwise, and the chance conversation to be heard at intervals on frequencies allocated to commercial and service transmissions.

One can learn quite a lot by listening to the conversation of other enthusiasts. For example, on the 7 Mc/s. and 14 Mc/s. bands, the writer has heard practically all types of commercial communication receivers, and ex-Service apparatus discussed, and opinions which were based on first-hand knowledge expressed.

On the commercial phone bands, one sometimes hears matters of radio interest, of travel, personal experiences, and out-of-the-way places. Sometimes the trawler skipper tells an interesting story,

He may mention the position of his craft. Some idea of the area covered by these ships, and the conditions under which they work are to me matters of interest.

Travel talks are one feature of the short-wave broadcasts to be heard from Australia, Canada and the United States. Listening to them one finds much of interest, relative to the various countries, peoples, their work, outlook, and way of living.

Checking up the latest station list to hand, the writer has averaged out the number of short-wave frequencies, wavelengths and station names printed. The total number of frequencies shown is 1,550. This does not mean that this number of stations are in daily operation, and in any case several are allocated a number of different frequencies.

It means, however, that anyone sufficiently interested to listen on these bands will find sufficient to search for, and also find it worth while to follow the various specialised club and other publications in which time and frequency details are given.

Logging

Keeping an up-to-date log book adds much in the way of interest, and keeping that interest alive. Apart from that, one gains a definite idea as to the capabilities of different types of receiver, not forgetting that a log is essential if detailed reports are to be sent out.

A modern atlas, and a world globe are also essential if the business of listening is to be undertaken on a sound workmanlike basis. I find that the small educational type world globe, in conjunction with a magnetic compass meets my requirements.

S.W. Broadcast DX

In searching for DX the listener may listen to schedule, if such is to hand. A considerable amount of DX is heard following this procedure. Sometimes, however, unexpected catches are tuned in. There are to be found in up-to-date lists, stations whose transmissions have not so far been heard, and the time schedules of which are not to hand.

It is a good idea to check over your station list of calls and frequencies, tick those which you have never heard, and which appear as doubtful so far as hearing them are concerned. Cover these frequencies, during your listening periods, during the day or night according to the particular frequency.

Spot Frequency Listening

A long period report is usually appreciated by most station authorities. Try listening on spot frequencies at a given time each day. If more than one receiver is available, this procedure can be carried out over a period of months. An hour is the minimum of time to devote to this class of listening, if reports are to be of use to those concerned.

An hour is not too long and allows one to obtain a fair amount of technical and programme detail.

The more useful and convincing the data given, the better the chance of receiving verification.

The high-power stations know that they are getting out, what they want to know is what happens to the transmission after it leaves their aerial and reaches you, and other listeners. Reports are carefully checked, and compared with programme data at the station.

The Australian stations, for example, will not verify a report covering less than one half-hour of the programme.

I would in conclusion, sum up short-wave station reporting in brief as follows: Send a report where and when it would appear to be of use; give as much detail as possible; like everything else worth doing, tackle the job conscientiously, stick to facts, and don't guess. A verification will usually follow.

Marine Distress Signals

QUICK and accurate methods for tuning transmitters to the distress frequency are of vital importance in marine radiotelephone installations. The Minister of Transport is well aware of this problem, and in a recent statement he expressed much concern at the increasing number of occasions when fishing vessels and other small craft have sent out distress calls on the wrong frequencies, with the result that the messages have not been heard by the coast stations.

On a recent occasion, a fishing vessel in distress by night in the English Channel sent out calls for help on the ship-to-ship wavelength, and a long period elapsed before its signals were heard. The skipper stated afterwards that he was not certain of being able to find the distress frequency in the dark and, rather than risk losing the frequency to which his radiotelephone was tuned, continued to call for help on the wrong frequency.

This problem has been overcome in the "Mermaid" radiotelephone equipment manufactured by Messrs. Philips Electrical Ltd. for use in trawlers, launches, yachts, fishing-vessels, and other small craft. On the transmitter of this equipment, the selection of any one of eight spot crystal frequencies between 1.6 and 3.8 Mc/s is carried out by means of a mechanism known commercially as an auto-selector or click-knob.

With the device, a selector switch, easily manipulated even with a gloved hand, is turned to one of eight marked positions. Each of these represents a pre-set wavelength, and No. 1 is always the distress frequency. A knob alongside the pointer is then turned and released and the set is instantly and exactly tuned to the required wavelength. The tuning controls are locked into position and cannot move until a new frequency is selected. This mechanism can be worked by touch in the dark.

Other types of auto-selectors are available for functions requiring the stopping and locking of shafts at predetermined positions. They are similar in design but are of different capacities. The small type SZT.101 auto-selector used on the Philips "Mermaid" equipment can transfer a maximum torque of 2.4lb./in. (3 kg./cm.) and can stop a shaft in any one of 12 pre-set positions. The larger type SZT.102 can transfer a maximum torque of 12lb./in. (15 kg./cm.) and can stop a shaft in any one of 11 pre-set positions. It also has additional facilities for manual adjustment of the controlled spindle.

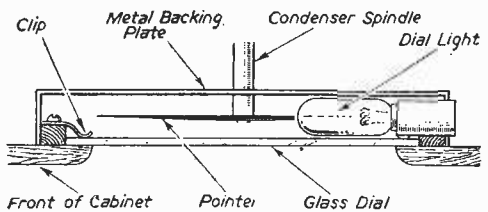
MAKING TUNING DIALS

A Handyman Idea for Home-constructed Receivers

By R. V. HARDY

AMATEURS with a camera can make tuning dials which have the "professional look" by a simple process. A small dial suitable for a dual-wave midget set would measure about 3¼in. by 3¼in. and be designed for use with a condenser driven by drum and cord.

Commence by fitting a plain card to the radio set in place of the dial, and secure the pointer to the condenser spindle: then tune-in and identify a number of stations. The position of the pointer for each station is marked on the card, which is then removed. Prepare a large-scale drawing of



General arrangement of the completed tuning dial.

the proposed dial on a sheet of white paper. A convenient size is three times the size of the actual dial, in this case 9¾in. by 9¾in. This is the overall size of the dial and allowances must be made for a margin when fitted to the cabinet. In the prototype the margin allowed on the finished dial was ¾in., which is 1¾in. on the large-scale plan.

After the dial has been marked out in pencil the card is fitted exactly over the centre point and the positions of the various stations marked in. The lines are now drawn with Indian ink by means of a drawing-pen, and the station names printed in. A professional effect may be obtained by using a Uno stencil and special pen, sold by artists' and draughtsmen's supply shops, for the printing.

Photographed

The completed drawing is now photographed. Any type of camera may be used, but it is essential that focusing be absolutely sharp, and if the camera is not provided with special focusing arrangements, such as a ground-glass screen, it will be necessary to measure accurately the distance between the camera lens and the drawing.

In order to obtain a good black-and-white negative use process plates or films in place of the usual type. These may be purchased from the larger photographic dealers, and require a somewhat longer exposure than the usual type. As a rough guide, if the photograph is taken out of doors in bright sunlight, use an aperture of F22, when an exposure of 10 seconds will be approximately correct. After the negative has been developed a print is made on to a magic-lantern slide, usually by means of an enlarger. These slides may be purchased from most photographic dealers, who will usually undertake to print and develop the slide if required.

When the slide is dry it may be coloured as required by using any of the colours recommended for use with lantern slides. Apply the colour in a very diluted form, repeating the application until the desired shade is obtained. This will obviate brush marks.

Coloured Scales

The writer usually colours the space between the black lines and in the sections marked with the station names—yellow for the medium band and red for the long-wave band: but this is purely a matter of personal taste.

When illuminated from behind the effect is most attractive. It is advisable to have a metal backing plate painted white fitted behind the dial light as shown on the left.

Larger size glass dials can be made in exactly the same manner, using process plates instead of lantern slides. These are supplied in standard sizes: ¼ plate 3¼in. by 4¼in., ½ plate 6½in. by 4¼in. and whole plate 8½in. by 6½in. When finished the plates may be cut to different sizes by means of a glass-cutter.

Those owning plate cameras may use the plate itself, after developing, for the dial. In this case, if a white paper with black letters has been photographed, the dial will be black with clear letters. If a clear dial with black letters is required, a black paper with the dial and letters marked with white ink must be used.

Yet another method consists of photographing the large-scale drawing and printing on Ilford Ortho Stripping Paper. The gelatine with the dial thereon may then be removed from the paper backing and transferred to a glass or Perspex dial, or to a metal, wood or cardboard backing. In the three latter instances transparent gum must be spread thinly over the backing to form an effective adhesion.

USES OF QUARTZ VIBRATORS

SINCE the discovery of the piezo-electric effect in 1880, the importance of the quartz crystal in research and in practical application has grown. In radio, electronics and ultrasonics, increasing numbers of applications for quartz vibrators are being found. During the years 1938-45, for instance, the production of crystal units increased from 10,000 to 1,500,000.

"Quartz Vibrators and their Applications," by P. Vigoureux, D.Sc., R.N.S.S., and C. F. Booth, O.B.E., M.I.E.E. (published by H.M.S.O. for D.S.I.R., price 30s. (6 dollars 75 cents U.S.A.), by post, 30s. 10d.), deals with the subject of piezo-electricity from both the theoretical and practical aspects and the work is intended to provide comprehensive information on the qualities and uses of quartz vibrators.

The applications of quartz vibrators described by the authors include frequency generation, multi-channel telephony, radio transmission, ultrasonic submarine detection and accurate time-keeping.

Modern Superl

A Receiver Unit for Use with the Am

By R.

THE modern Audio Amplifier, described in the July, 1949, issue, is a versatile unit and many different associated chassis would have to be described to cover all its uses. Probably the majority of constructors will require it as part of a good, all-wave receiver for domestic use with facilities for connecting a gramophone pick-up, and accordingly such a unit is first described.

The amplifier is necessarily of some size, so clearly there is no purpose in using miniature technique in the associated equipment, particularly as the larger standard components are easier to work with. Nevertheless, the unit, which consists of five valves, comfortably fits on a chassis only 10in. x 6in. x 2½in. deep. The valve line-up is a R.F. amplifier, used as much to secure good signal-noise ratio as to provide amplification, the frequency changer, one I.F. amplifier, a cathode-follower, diode detector, and finally a single stage of audio amplification. It will be explained, when alignment procedure is discussed, how to cut out the R.F. stage and, in fact, the set can be put into use as there described and without the R.F. coil unit and valve if desired.

To reproduce the results obtained from the prototype it is necessary to give more detail for a tuning unit than was found necessary for the amplifier. The experienced constructor will know what liberties he can take and he will be left to introduce any modifications that he finds will suit his particular purpose. The less experienced constructor will be well advised to follow the design implicity, however, and the following, read in conjunction with the drawings, will ensure success even for the beginner in quality superhet construction.

The chief difficulty of the constructor being in the alignment of his receiver, advantage is taken of one of the coil units sold already aligned in a receiver assembly by the manufacturer so that the minimum of adjustment is required.

Circuit

The Osmor unit used will be well known to readers. As will be seen from Fig. 1, it makes use of bottom end coupling on long and medium waves but conventional transformer coupling is used on the short waveband. The aerial input generates signal voltages across the impedance of C3 which is also in the grid circuit of V1, and this common impedance provides the coupling. To the short waves, the impedance is negligibly small and the transformer coupling takes charge. This circuit is, in certain circumstances, prone to modulation hum, to avoid which the aerial filter C1, C2, R1 is included. R2 decouples the A.V.C. voltage fed to V1 grid and R4 provides the minimum bias for this valve.

V1 anode is coupled via the short-wave transformer primary (operative only on short waves as before) to C10 and is coupled into the grid circuit of V2 by the common impedance of C14 on medium and long waves. A.V.C. is fed via R8 on medium and long waves only. The normal padding condensers are used to provide the bottom end coupling on medium and long waves. The triode of the frequency changer is anodo tuned and the usual grid leak and condenser, C20, R12 is included to bias the triode. R13 provides minimum bias for the hexode section but is inoperative on the triode section because the grid leak is returned to the cathode.

The I.F. is 465 kc/s, as usual, and one stage is found sufficient to load the amplifier from any signal of worth-while strength. A.V.C. is fed to the I.F. amplifier via the I.F. transformer secondary.

The conventional diode detector suffers from two defects. It loads the last I.F. transformer

LIST OF COMPONENTS

R1, 6, 7, 11, 15, 17, 20, 23, 29 = 10 kΩ.
R2, 8 = 220 kΩ.
R3, 10, 12, 14, 24 = 47 kΩ.
R4, 13, 16 = 220Ω.
R5, 21 = 1 megΩ.
R9, 19 = 33 kΩ.
R18, 25 = 1 kΩ.
R27 = 100 kΩ.
R22 = ½ megΩ volume control.
R26 = 100 kΩ volume control.
R28 = 1 megΩ volume control.
C1, 2 = .01 μF.
C8, 9, 16, 17, 21, 28, 29, 30, 31, 32, 33 = .1 μF.
C36, 37 = .1 μF (metal cased tubular).
C10, 19, 34, 35 = 500 pF.
C20 = 100 pF.
C39 = .003 μF.
C40, 42 = .02 μF.
C41 = .005 μF.
C44 = .05 μF.
C38, 43 = 16 + 8 μF electrolitic.
Chassis = 10in. x 6in. x 2½in.
2 Valve cans.

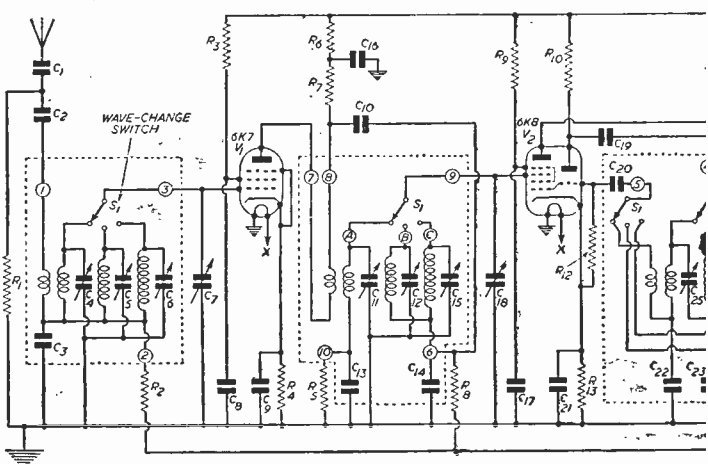


Fig. 1.—Theoretical circuit of the tuner unit. The components within

et Tuning Unit

er Described in our July, 1949 Issue

NDLE

circuit, damping its tuning and reducing adjacent channel selectivity and also it introduces distortion on signals deeply modulated. The infinite impedance detector does not suffer from these defects but unfortunately does not lend itself to the provision of A.V.C. The solution is to use a cathode-follower to isolate the I.F. circuit and avoid damping. The low impedance presented by this valve to the output circuit permits a lower resistance load on the diode following it which, in turn, avoids the deep modulation distortion mentioned. The resistance R19 forms this load and at the value quoted (33KΩ) is distortionless up to 95 per cent. modulation. For convenience, a double-triode is used as cathode-follower and detector—a diode-triode cannot be used because separate cathodes are required. R18 biases the cathode-follower, but this resistor is not used as the signal load because the D.C. bias would then appear as an excessive delay voltage on the diode detector. R18 is therefore bypassed by C33 and the H.F. choke is inserted as a signal load of low resistance to D.C. The impedance of a long-wave coil (2,400 μH) is about right but a short-wave screened choke is used in the original. This is about 3mH.

R20, C34, C35 form the I.F. filter. The output of this circuit consists of an audio component passed on to the audio circuits via C36 and a D.C. component not wanted in the audio circuits which is therefore blocked off by C36. The D.C. is needed for A.V.C. R21, C44 smooth out the audio component in their branch of the circuit and leave across C44 an A.V.C. voltage fluctuating with the slower variations of signal strength caused by fading.

The radiogram switch shorts out the radio signal when playing records and isolates the pick-up when radio is used, so the pick-up can be left permanently connected to the input point.

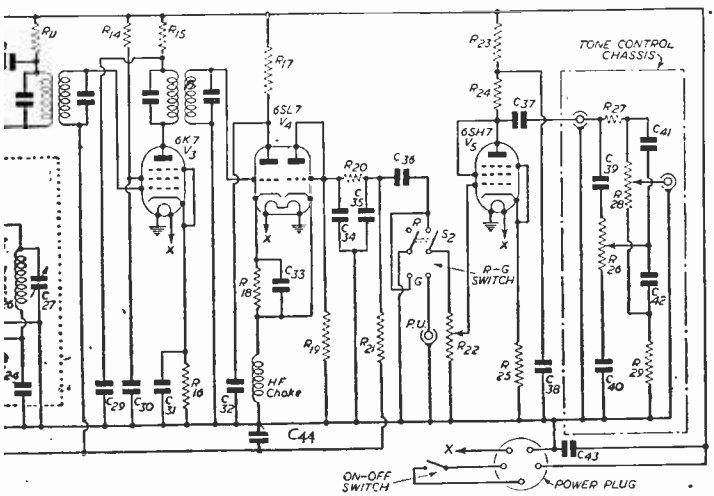
An audio stage is included to give sufficient signal voltage to permit a tone control stage to follow. A comparatively low gain is required, so it is permissible to introduce a measure of negative feedback (and so reduce distortion) by omitting the usual bypass condenser. The volume control and the tone controls operate on both gram and radio.

The tone control network permits bass boost and bass lift at the opposite ends of R26 and a treble lift and treble cut at the extremes of R28, with a level position in the middle of each control, thus permitting a wide range of control. These tone control circuits are constructed in a separate, small, totally enclosed chassis interconnected between the tuner and the amplifier by screened cable (actually coaxial cable). This total screening is to avoid hum pick-up in this vulnerable part of the set. On the original these controls were fitted alongside the motor under the lid and so the less technical users of the family are not confused by the multiplicity of knobs. The dial used, made specially to suit the coil pack, is large and is intended to match the speaker aperture in size. Thus, if a horizontal table cabinet is used the tone control unit can be fitted underneath the speaker to match the knobs under the tuning dial.

The designer's pet aversion is the knob with dual purpose. It is far better, as is done in the present unit, to provide separate knobs for each purpose. On the main chassis are the mains on-off switch, remotely controlling the amplifier, wavechange switch, tune, volume control and radiogram switch.

Construction

It is better to gather together all components before commencing construction so as to ensure



e dotted portions are parts of the coil pack (with the exception of C20).

LIST OF COMPONENTS (Contd.)

1 Osmor Q coil pack type HO.
1 Osmor H.F. stage.
1 Osmor glass dial assembly.
1 pr. I.F. transformers.
1 3-gang tuning condenser. 500 pF each section.
1 Drive drum.
1 Drive spring.
1 Drive spindle for outside cord drive.
Dial cord.
5 Octal valveholders.
1 Screened H.F. choke 3 mH Bulgin type H.F. 28.
3 Coaxial sockets and plugs.
1 On/Off rotary switch.
1 2-Pole 2-Way rotary switch, Wafer type.
Coaxial cable.
5 Core cable.
V1, V3 = 6K7.
V2 = 6K8.
V4 = 6SL7.
V5 = 6SH7.

that provision is correctly made for each. The unit can be made on a standard 10in. x 6in. x 2½in. chassis, but if the constructor is making his own chassis it is better to mark out the holes before bending into shape. Fig. 2 shows the detailed drilling, assuming, of course, that the components are as originally used. Before drilling ensure that the components to be used do actually fit. When the chassis is drilled and formed assemble all the components. Wherever there is a metal to metal joint that is to be used for earthing components, e.g., the valveholders, tag boards, coil assembly, carefully clean the two surfaces and make certain that they are bolted firmly into contact. Failure to do this will result in instability. Valve screening cans are used for the R.F. and I.F. amplifying valves. The R.F. trimming condensers are mounted with spacing pieces to bring them clear of the chassis. It was found better with this layout to fix the dial brackets for the Osmor dial (one specially made as in Fig. 3) with flanges inwards. It will be noticed that the dial projects from the panel to permit an outside coil drive. The tuning spindle must be of this type whereas the one usually supplied with the coil pack is for under-chassis drive and not suitable for this purpose. The correct type is easily available. Take care that underneath fixed plate soldering tags of the variable condenser passing them through the holes in the chassis as the unit is mounted. Make certain that all the feet of the condenser make good, clean contact with the chassis when bolted down, and connect each of the moving plate connecting tags to soldering tags bolted to the chassis immediately underneath. A good earth connection at many different points is necessary if the condenser connections are not to cause instability.

When satisfied that no mechanical snags will arise, remove the coil units carefully and lay them aside. The majority of the wiring can be completed without these in place, and it is important that the coils be handled with care and disturbed as little as possible. Under no circumstances should the cores be adjusted until the unit is on test.

First, connect one heater pin of each valveholder to an adjacent earth tag, then run a stout lead to connect the second heater pin of each holder in parallel. The bypass condensers should next be wired in, the outside foil (marked OF or by a ring round the condenser case) being connected to the earth point of the appropriate valveholder and bringing the condenser right up to the pin of the valveholder to which the other end is to be connected, so that the wire can be clipped as short

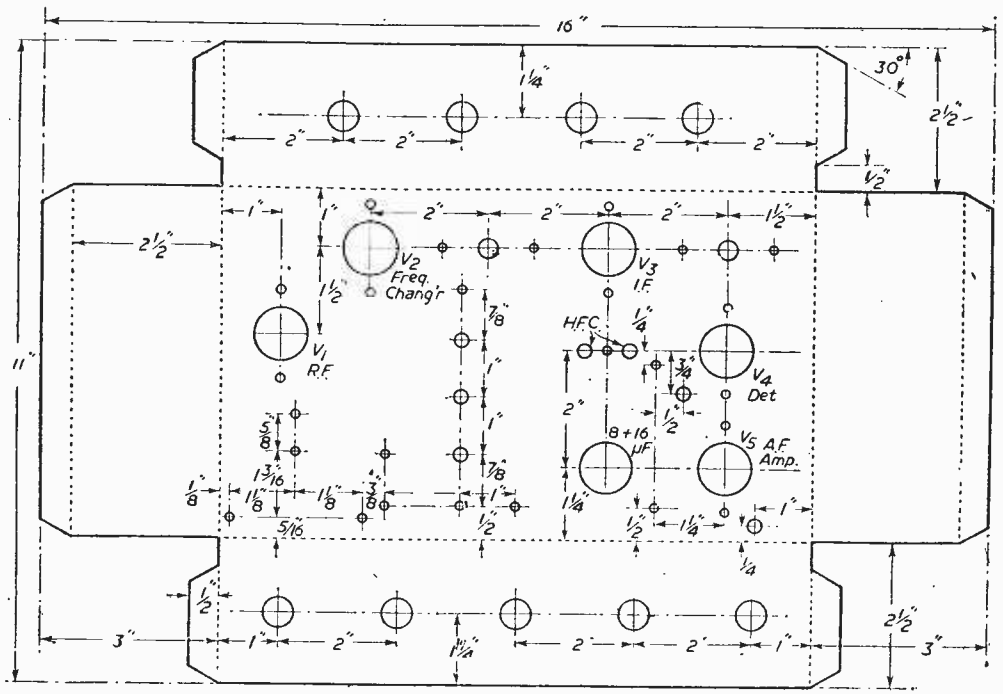


Fig. 2.—Drilling and cutting details of the chassis.

the dial assembly runs freely. A touch of a file in the groove taking the tapered pin may be necessary and grease should be applied whilst assembling.

The most convenient valveholders are the moulded type incorporating soldering tags. If these are not used, fit soldering tags under the holding-down bolts. Connect lengths of wire to each of the as possible. The rest of the wiring can now be added, working methodically from aerial to output, marking each off on the circuit diagram as it is connected. All leads, but especially those to grid and anode of the valves, should be as short as possible, and it will be noticed that the layout is such as to ensure this. All components should be

held rigidly, and small tag boards are used at points where found necessary to anchor the end of components remote from the valveholder pins.

The wiring of the R.F. coil assembly to the wavechange switch should be done with fine wire and small-gauge sleeving. Connect these leads to the trimmer bank before the R.F. coil assembly is mounted, leaving for each of the three trimmers two tails, one to connect up to the R.F. unit and the other to pass through the chassis to the wavechange switch. As the main coil pack is mounted underneath the chassis, these leads are passed through the hole in the base of the coil pack and carefully soldered to the wavechange switch as indicated. Different coloured sleeving will ensure connection in the right order. The wire from the fixed plates of the tuning condenser section nearest to the dial also passes through this hole and is connected to the pole of the wavechange switch.

The layout chosen requires the H.F. coil unit to be mounted with the coils towards the tuning condenser. To facilitate adjustment of the coil cores, the two fixed condensers on this unit are carefully disconnected from the mounting bracket and soldered to a tag on the trimmer holding-down bolt, out of the way of the coil cores.

The reason for mounting the R.F. coils and decoupling components on top of the chassis is, of course, to screen against coupling, and to increase the effectiveness of the screen they are mounted with their axis at right-angles to those of the main coil unit. To complete the screening it is found desirable to make the dial bracket already mentioned (shaped as in Fig. 3) from 18-gauge aluminium to isolate the coils from the condenser sections. If preferred, an oblong piece of aluminium could be bolted to the bracket supplied with the dial assembly. The shape indicated provides a cut-out in the flange to permit insertion of the fixing nut of the dial. A two-way soldering tag is bolted to this screen to anchor components connected to the coil unit.

The preferred order of connecting the ganged condenser sections (i.e., reading from the dial, F.C. grid, oscillator, aerial) requires the top grid connections to cross.

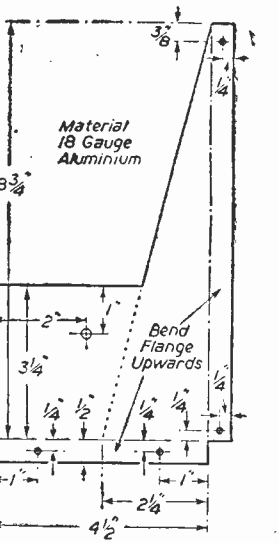


Fig. 3.—Details of the dial bracket.

(To be continued.)

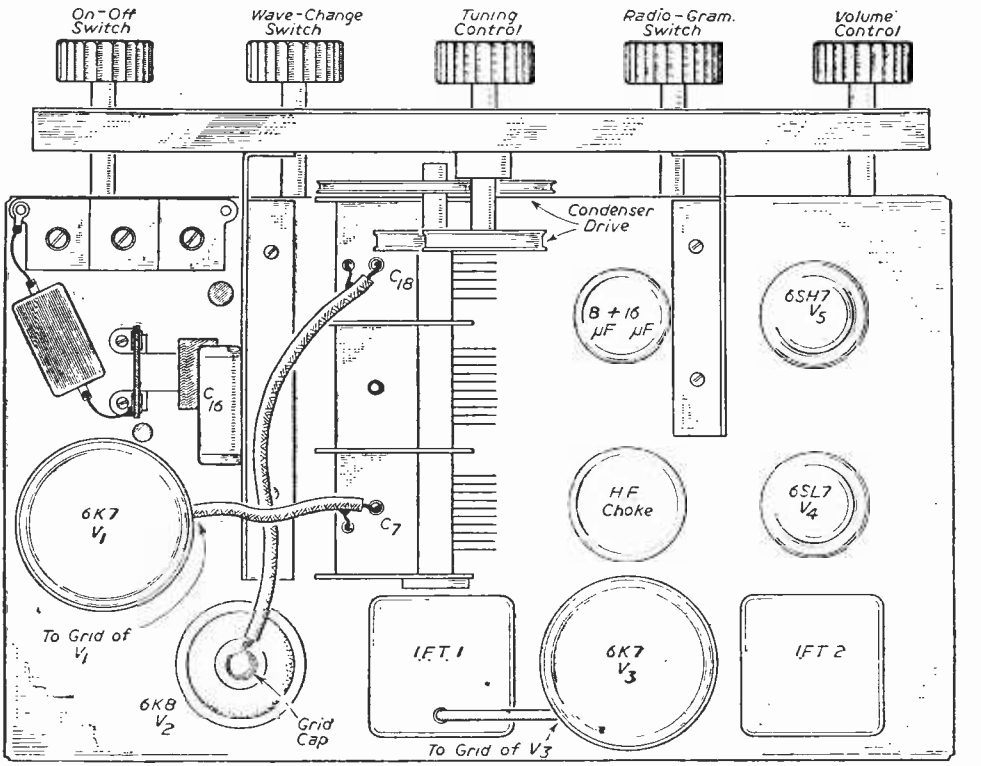


Fig. 4.—Top of chassis view of the tuner.

Using the Electric Supply Mains

Some Points About Normal House Wiring and Supplies

By E. C. COX

MANY radio enthusiasts use the electricity supply mains as a source of power to operate their equipment, and usually accept this supply as A.C. or D.C. at a certain voltage, and think little more about it. There are, however, one or two points to bear in mind both from the point of view of safety and as a matter of general interest.

Nature of Supply

The first thing to do in using the supply mains is to ascertain the nature of the supply as regards voltage, and whether it is alternating current or direct (sometimes known as continuous) current. This may sound obvious, but it is surprising the number of people who purchase apparatus without first considering the nature of the supply available.

The surest way of finding out the necessary particulars about the electricity supply is to write to the local office of the Electricity Board, and this procedure is to be advised. The electricity meter does not always state whether the supply is A.C. or D.C. and sometimes indicates the supply volts as, for example, 200/240, which is useless for most radio purposes.

A.C. Supplies

The eventual electricity supply for domestic purposes is alternating current at 240 volts 50 cycles per second, and steps are being taken towards this standard. It may be many years, however, before this object is achieved.

The layout usually employed for distribution purposes is known as the three-phase, four-wire system, and is supplied from a substation where it is reduced from a high-voltage supply by means of a power transformer. The three secondary windings of this transformer are connected in a "star" arrangement, the common point of which is solidly earthed at the substation (Fig. 1).

This common point is called the neutral, and the voltage between any of the "free" ends of the winding and the neutral is the voltage at which the supply is taken by a domestic consumer. The supply to a row of houses would be taken consecutively from the three phases and thereby tend to balance the load on the transformer.

The neutral of the supply is not, strictly speaking, at earth potential at any point other than the power transformer, due to voltage drop in the neutral conductor, and consequently must not be connected to earth. Dangerous currents can flow if the neutral is earthed on a consumer's premises, especially so if a fault develops anywhere on the system supplied by the local substation. For this reason A.C./D.C. radio-receivers are never connected to earth.

A point to note in the case of A.C. supplies is that the maximum stress on the insulation is not the supply voltage only, but $\sqrt{2}$ times this voltage.

D.C. Supplies

Nowadays, D.C. is usually converted from A.C. by means of rotary convertors or mercury arc rectifiers. The distribution arrangement often employed in this case is known as the "three wire" system, and consists of two "outers," positive and negative, the voltage between them being twice the voltage at which a domestic consumer would be supplied. The third conductor, or "neutral," is earthed at the point where the D.C. supply originates, and is midway in the voltage gradient between the two outers (Fig. 2). A consumer's supply is obtained from the neutral and either outer, thus the conductor at approximately earth potential can be either negative or positive.

As in the case of A.C. supply, the neutral must not be earthed or dangerous currents may flow.

The D.C. supply voltage has a slight ripple, which is due to the fact that it is the sum of many voltages which are not constant. This ripple is easily

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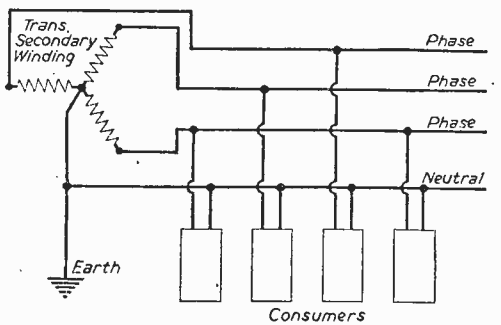


Fig. 1.—Three-phase, four-wire system for A.C.

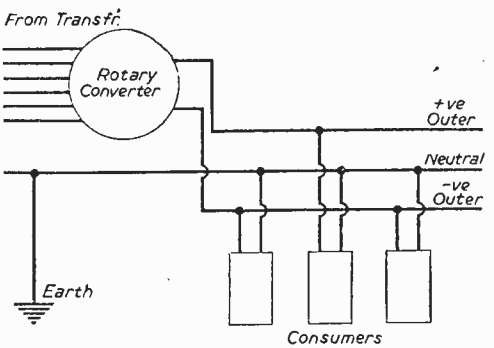


Fig. 2.—Three-wire D.C. supply.

Designing Your Own Receiver—6

Advice and Guidance for the Beginner

By STANLEY BRASIER

IT will have been evident from what has already been said that a receiver—or rather the valves in the receiver—need individual treatment if the utmost is to be expected from any particular set, for although valves and components are made to a high factor of standardisation, slight discrepancies in this respect are bound to occur and it is up to the constructor to accommodate for them.

There is sometimes a difference in performance between two identical types of commercial receivers because once the final design has been decided upon the receivers obviously have to be mass-produced to the specification, using the specified parts, and it is not an economical proposition to "hot up" each set to its peak performance. It should be stated, however, that a receiver is rejected if it does not conform to a predefined minimum standard of efficiency.

Experimental Receiver

It is useful to remember that if a receiver is to be built for the specific purpose of experiment, components may be included which will facilitate such work. For instance, a variable ratio output transformer will accommodate various types of valves and loudspeakers, especially if a preset type of bias resistor is included. A built-in milliammeter connected in the anode circuit of the output valve will give much information and also warn the beginner in respect of the indiscriminate adjustment of the bias resistor, *which should never be subjected to haphazard adjustment.*

Provision for 'phone signals from the detector stage may be made (anode to chassis via fixed condenser), and such facilities as provision for alternative aerial connections, variable H.F. coupling to give variable selectivity, etc. (See Fig. 5.)

Testing Instruments

In considering the bare requirements with regard to testing instruments for the beginner it will be obvious that our choice will be a voltmeter, a milliammeter and an ohm-meter. Such a choice immediately suggests a multi-range universal meter. But, consider. This type of instrument was designed, presumably, to obviate the expense of providing a high quality movement for each purpose. But there, apart from its portability, it would appear that its advantages cease, for, although it may have numerous ranges of volts, milliamps, etc., it is impossible to make use of more than one range for any particular measurement. Moreover, such an instrument is not easy for the beginner to design (assuming that his finances will not run to a commercial model), and its portable feature will not normally apply to the amateur. All of which is intended to suggest that separate instruments are far more useful. It is often necessary to note the effect of some adjustment on voltage and current and, in addition to the time-saving factor, this is where separate instruments score. These advantages are consolidated by the fact that first-class basic instruments are readily available in the form of government surplus, at a price that everyone can afford. Indeed, at no time has such an opportunity existed for the amateur to stock himself with his requirements in this direction.

Voltmeter

It is not proposed to give specific constructional details of the instruments required, but rather to guide or advise the beginner in his choice of meters with a view to the work involved. For instance, in the case of the moving-coil voltmeter it should be realised that such an instrument is basically a milliammeter, and the voltage indication registered on the scale of the instrument is a product of the current passing through it and the resistance through which it is connected.

If, therefore, we wish to measure a voltage of 250 and have in our possession only a milliammeter

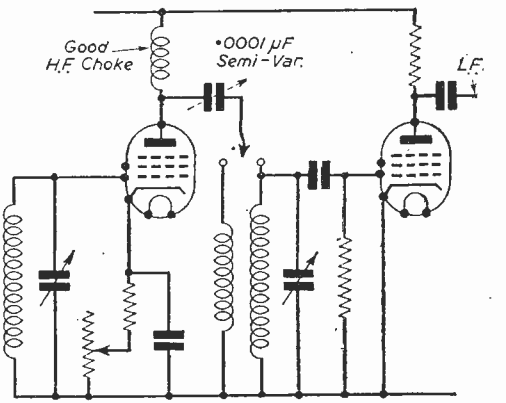


Fig. 5.—Choke-coupled H.F. stage showing how variable selectivity may be added.

reading say 0-1, we can, by Ohms Law, find the resistance necessary to limit the current to this amount. Thus, $R = \frac{250\text{ v.}}{1\text{ mA.}} \times 1{,}000 = 250{,}000$ ohms.

Then if this resistance is joined in series with the milliammeter across 250 volts, the current shown will be 1 milliamp. But it will also represent 250 volts. It is, therefore, only necessary to include this resistance in the make-up of the instrument, mark the scale 0-250, and we have a voltmeter.

If the voltage to be measured is 125, then with the same resistor in series, current

$$= \frac{E}{R} = \frac{125 \times 1{,}000}{250{,}000} = 0.5$$

milliamp, which means that for half the voltage, the meter will show half the current quarter voltage, quarter current, and so on. From this it will be gathered that the nature of the scale will be linear, and that the resistance of the meter will

be 1,000 ohms per volt, i.e., it reads to 250 and its total resistance is 250,000 ohms.

Measurements may also be taken with a voltmeter of lower total resistance say, 50,000 ohms, but, when measuring 250 volts the current consumed would then be $\frac{250 \times 1,000}{50,000} = 5$ mA. Such a meter would have an ohms per volts reading of 200.

From the foregoing it will have been learned that the less the resistance of the voltmeter, the higher

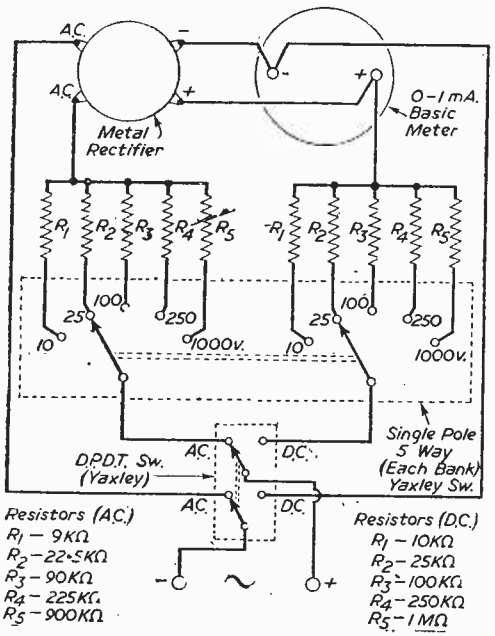


Fig. 6.—Comprehensive circuit, with switching, of A.C./D.C. multi-range voltmeter. Note: D.C. resistor values are actual, A.C. values approximate (before calibration).

will be the current consumed, and from what we know of Ohms Law it will be appreciated that the greater the current load introduced into a circuit, the more will be the voltage disturbance created.

When we were checking low-current valve electrode voltages during the testing of the receiver it was stated that the mere connection of the voltmeter could alter the voltage that previously existed, and the reason for that should now be clear. It also proves the advisability of using a voltmeter which consumes low current and consequently has a high "ohms-per-volt" rating. In this connection a meter having a resistance of 1,000 ohms per volt is usually considered to be practicable and useful for normal radio work, although instruments to 20,000 ohms per volt may be obtained and are essential in television work because of the very low currents involved.

When selecting his basic meter, therefore, the amateur should choose either a movement of 0-1 milliamps or a voltmeter having a resistance of 1,000 ohms per volt. The voltmeter can be of any range because, knowing the external resistance required, the instrument can be made to measure any particular range. The built-in resistor in the ready-bought voltmeter, however, should not be overlooked, and naturally will only be used for the range for which the meter is scaled. Further ranges will be useful and it is only necessary to include resistors of 1,000 ohms for each volt of full scale reading required, for each range. Theoretically, the resistance of the meter should be included in the total resistance of each range, but this may usually be neglected since its proportion to the external resistance is extremely low. The resistors may be of the carbon type and must be accurate. In this respect calibrated resistors for certain ranges are available from some advertisers, but it is necessary to specify the *current* range of the meter with which they are to be used. Alternatively, it is quite possible for the amateur to calibrate his own resistors, but for this information readers are asked to refer to an article by the writer in June, 1949 issue of PRACTICAL WIRELESS entitled "A.C. Mains Accumulator Charger," Part 2.

Ranges

It is suggested that useful ranges for a multi-range voltmeter are 10, 25, 100, 250 and 1,000 volts D.C. and A.C. The ordinary moving coil meter will not register on alternating current and if such readings are required a small rectifier will be necessary. These are easily obtained, but here again it is necessary to specify the current range of the meter and the procedure for calibration of the resistors is the same. For connections see Fig. 6.

Some thought should be given to the nature of the scale calibration and full-scale reading when purchasing the basic meter. If there is any choice 0-25 is a good range because it is also applicable to easy reading of the added range of 250 and to complete the whole range suggested above it is only necessary to add markings 0-10.

The meter may also be of any useful range in *milliamps* providing the basic movement is 0-1 mA. It is only necessary to remove the shunt and proceed as for volts, for, remembering, that the scale is always linear, its calibration for current will still hold good when calibrated for volts.

Calibration

The various ranges of the D.C. voltmeter may be calibrated from a grid battery for the lower ranges and an H.T. battery for high ranges, for it is not essential to check at the highest point of the scale. If the full scale reading is 250, calibration may be made at, say, 120 and will be correct for the whole of the scale. It is a great help, however, if another accurate voltmeter is available for checking purposes.

When dealing with the A.C. ranges calibration facilities may come from either the mains or the secondary windings of a mains transformer. Here again checks should be made against a standard meter and it will be noted that the lowest range, 0-10, is not linear and will need special calibration.

Milliammeter

In considering the requirements for a multi-range D.C. milliammeter, it is first necessary to decide upon the lowest range of measurement required. 0-5 mA is a useful minimum, but for some accurate work 0-1 mA is essential. Whatever it is,

(*Continued on page* 176)

(*Continued from page* 174)

extra ranges can always be added, for it is only necessary to add an extra shunt *in parallel* with the instrument as in Fig. 7. The necessary formula for the calculation of their value is also given in the issue of PRACTICAL WIRELESS referred to earlier, but the method of calibration will be different in this particular case. If our basic meter is, for example 0-5 mA, we may wish to add ranges of perhaps 25, 100 and 250 mA. After finding the value of the required shunt for 25 mA, the meter is joined in series with a variable resistor and dry battery of about 4.5 volts. The resistor should be of a value that will permit 5 mA to flow when connected across the voltage used, and is easily calculated from Ohms Law. When set up the resistor is adjusted so that a reading of exactly 5 mA is shown. If now the shunt wire is joined firmly across the terminals of the meter the needle will drop considerably and the shunt wire (which should be slightly longer than necessary) is gradually shortened until the meter needle registers exactly 1 milliamp. As this position indicates one-fifth of 5 mA (without the shunt), it indicates also one-fifth of 25 milliamps (with the shunt), so that this full scale range has now been calibrated.

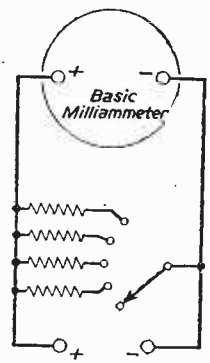


Fig. 7.—How shunts may be switched for multi-range milliammeters.

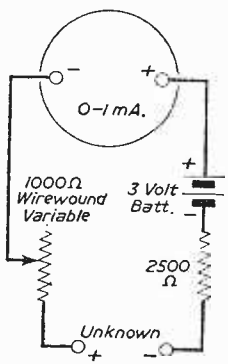


Fig. 8.—Circuit arrangement for an ohm-meter.

The value of the variable resistor is now reduced so that the meter reads full scale—and 25 mA is now being passed.

After disconnecting the circuit, the 25 mA shunt is removed and substituted by the wire prepared for the 100 mA shunt. When the circuit is re-connected the needle will register around the quarter-scale mark and the shunt is adjusted until it does so exactly. It is most important to remember in this case, and for subsequent higher ranges, that the *meter must be entirely disconnected between shunt adjustments*, otherwise the instrument will most certainly be destroyed.

Shunts should be non-inductive and in practice the length of resistance wire is doubled in half and then in this state wound on to a paxolin strip or any suitable former.

It is not difficult to construct new meter scales or adapt others to one's purposes, and this subject will be dealt with in the final stages of this series.

(*To be continued*)

More About the Two-band Aerial

Further Details of the Aerial Described in our Sept.-Oct., 1950 Issue

By O. J. RUSSELL

FROM letters received from users of the two-band matched impedance antenna, there are a number of points which should be of interest to amateurs, especially as these points apply equally to other problems generally found with aerials in transmitting practice. Such points very often do not receive the emphasis they deserve, although they are of fundamental importance.

Not Windom

Before passing to the "practical" consequence of "theoretical" considerations, it should be stressed that the reference to the WØWO antenna as a Windom is quite erroneous, and has misled a number who may have seen this description applied to it. Windom systems are essentially single-wire feed systems, and the fact that the WØWO system happens to be fed "off-centre" does not make it a Windom antenna. As far as efficiency goes, there is, of course, no radiation of any magnitude from the twin-wire feed of the WØWO antenna if correctly matched. Contrary to the writings of some "experts," the single-wire feeder Windom antenna does radiate from the feeder, so that the WØWO has the advantage of putting more energy into the actual radiating antenna portion.

Feeder Radiation

We shall see more about "feeder radiation" later, because this is tied in with observations which have puzzled some amateurs. It has been noticed that the feeder currents were slightly unbalanced when using the antenna on 14,050 kc/s. This is due to the fact that the actual design was quoted for a 7,136 fundamental, and 14,250 kc/s on the second harmonic. Now, of course, new licences are in any case restricted to C.W. for the first year of operation, while for any serious work on C.W. D.X., the bottom portions of the bands are traditionally reserved for C.W. The C.W. D.X. hunter—newcomer and old-timer alike—would be happier with an antenna cut to resonate at, say, 14,050 kc/s on the second harmonic, which would also be nicely in the C.W. end of the 40-metre band. The lengths and tapping points given for the 68ft. top can be scaled up for any given frequency as suggested, by multiplying by the ratio 14,250 divided by the new frequency in the 20-metre band. To save headaches, for the C.W. ends of 40 and 20 metres, the overall top length (L) becomes 69ft., with the feeder tapping point (F) at 23ft. from the end. This is only an extra foot of top length, but, although the antenna is reasonably broadband, it will be found that feeder balance should be improved to exact

balance over the C.W. ends of the bands, making it the "preferred" length for the serious D.X. enthusiast. The importance of 1ft. in the top length shows that a little trouble is well repaid, and if through mischance the aerial has to pass near other wires or metal objects, the possibility of a little adjustment about the design figures should be considered. Also, the tap should be made at the end of the antenna most free from surrounding objects, if the location is a difficult one from the point of view of local obstructions.

Capacity Effects

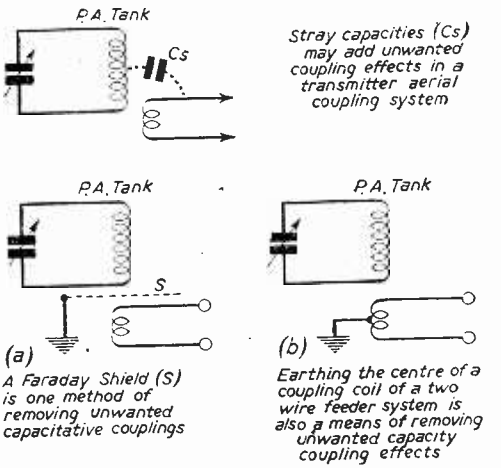
A further aspect, which may produce puzzling results, is the question of spurious capacity effects on the coil used to couple the feeders to the transmitter tank circuit. In some cases, it has been found that the P.A. loading was markedly different according to which way round the feeders were connected. With a loaded P.A. current of 75 mA., it was found that merely reversing the feeders at the coupling coil caused this to alter to 100 mA. Puzzling, until it is realised that in the coupling system as shown in the diagram, the invisible presence of stray capacities to the coupling coil provide an alternative path for coupling, quite apart from the intended inductive coupling. Usually, stray capacity effects tend to excite the entire feeder and aerial as a single "long wire" system. If the feeder and aerial lengths happen to be near a suitable length, a very small amount of capacity can couple substantial amounts of energy in this unwanted way. Such effects are doubly undesirable. Firstly, energy that should be transferred by the balanced feeder is diverted into surface currents so that proper aerial operation is not fully obtained. Secondly, harmonics of the operating frequency are even more readily transferred, so that television interference and similar troubles may be greatly accentuated.

Faraday Shield

The classical remedy is the erection of a full-dress earthed Faraday shield between the tank coil and the coupling coil. Exactly the same effective action may be produced by earthing the centre-point of the coupling coil, which becomes, in effect, its own Faraday shield, and unwanted capacity effects are bypassed to earth (see diagram). The normal coupling coefficient of the coil is unaltered, but the behaviour of the transmitter loading may be altered. If any capacity coupling effects are operating, the earthing of the coupling coil at the centre will show this up by a marked reaction upon the correct tuning point of the P.A. tank circuit. The tank tuning condenser will, in general, have to be reduced in capacity to restore resonance. Furthermore, it may be found that the loading on the P.A. tank has decreased greatly. Do not assume "that the R.F. is being diverted to earth," but tighten the coupling between the pick-up coil and the tank circuit to restore normal loading. With the spurious loading due to capacity removed, the energy formerly diverted can now be properly coupled into the coupling coil and correctly transferred to the top radiator.

Two Bands

The above points on feeder coupling apply, of course, to many other aerial systems as well as the two-band WØWO. The earthing of the coupling coil centre is an elementary precaution, but it is one persistently ignored. Should the spurious capacity effects have been the means of your radiating a signal in some direction not covered by the top section proper, the remedy (short of a new aerial) is to tie the feeders together and feed the system as a genuine long wire for that direction, and thus put all the energy into the desired direction.



Figs. 1 and 2.—The aerial/set stray capacities and how they may be removed.

For normal operation use the system so as to avoid stray capacity effects, and in that way you will get the maximum efficiency under all conditions, rather than a half-and-half mixture of opposing effects. Oh yes, "two-band" antenna. . . . Well, theoretically, the system should operate on the fourth harmonic as well, with the possibility of a slight shift from optimum matching. Try it, anyway, and see how it works out.

V.H.F. Contest for Amateurs

THE second annual V.H.F. Contest for Amateurs, organised jointly by the Amateur Division of E.M.I. Sales & Service, Ltd., and the Amalgamated Short Wave Press, will take place during the week ending April 21st-22nd, 1951.

Once again the contest will be decided on a "merit" basis. This means that although each competitor will endeavour to make the greatest possible number of contacts, the "merit" of his achievements will be assessed only after careful consideration of the conditions under which his station is working. Thus competitors working under difficult conditions will have an equal chance with the more fortunately placed stations.

All V.H.F. amateur stations are being circularised, and further information regarding the contest may be obtained from the Amateur Division of E.M.I. Sales and Service, Ltd., Hayes, Middlesex.

E.M.I. Sales and Service, Ltd., are awarding an E.M.I. dual range output meter (Model Q/D121) to the winner of the transmitting section of the contest.

Closing date for receipt of completed contest logs is May 8th, 1951.

Photo-electric Multipliers

Another ex-Government Valve Explained

By E. G. BULLEY

VALVES of this type can be classed as those designed for special purposes, and as such valves are to-day obtainable on the surplus market this article is written to assist those readers who purchase them to understand something about the valves. Before proceeding, however, it is as well to mention that the American types are known as phototube multipliers and may be advertised as such.

The principle of operation is very similar to that of the photo-electric cell, in which the actual operation depends upon the amount of illumination directed on to the cell before photo-electric current will flow. Now it is this current that is multiplied in a multiplier by means of secondary emission. This phenomenon is one that is created for this purpose, unlike that in radio valve practice.

Cathode Coatings

Photo-electric current is the result of photo-electron emission from the cathode to the anode. It is as well to mention, at this stage, that the spectral response characteristic depends entirely upon the type of cathode, that is to say, different cathode coatings respond to different forms of light such as ultra-violet and infra-red, etc.

In multipliers, the electrode structure is a somewhat complicated assembly, but this is necessary to maintain the secondary emission in the correct paths. Such complications involve that of screening the auxiliary cathodes or dynodes as they are sometimes called.

It is as well here to give a brief description of the multiplier so that the reader will appreciate the actual operation of such valves. As previously mentioned, valves of this nature depend upon secondary emission. which is the result of electrons being released from the photo-electric cathode proper. These electrons are so focused that they in turn strike the next cathode or dynode, and secondary emission is thus amplified. This process is repeated, dependent upon the number of stages. For example, a nine-stage multiplier contains one photo-electric cathode, one anode and nine auxiliary cathodes. Thus, assuming one has a nine-stage multiplier, the auxiliary cathodes are numbered 1-9 from the cathode proper but not including it. Now these auxiliary cathodes are all operated at a positive potential, each successive stage being operated at a higher voltage than the previous one.

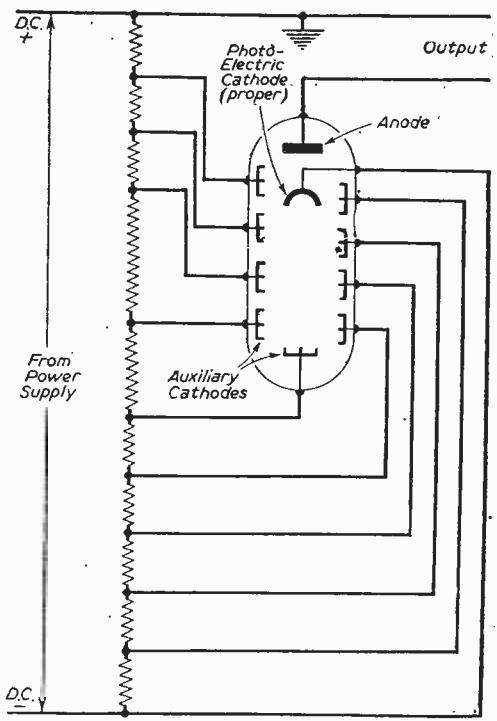
It can therefore be seen that the photo-electric current produced at the cathode proper is multiplied many times before being finally passed on to the anode. An important point to remember, however, is that the potential between the last auxiliary cathode and the anode is such that the anode current is just at saturation and no more. By so doing, the dark current characteristic is reduced as well as the possibility of ion bombardment between the other cathodes. The latter causes the loss of linearity.

Valves having low dark current are quite stable in operation and the sensitivity of such a valve is maintained at a very high level.

Final Cathode

The final auxiliary cathode in any multiplier is usually shaped so that it partially encloses the anode. This does to a certain extent prevent the interference from the anode potential and thus avoids the fluctuation in the focusing of the photo-electric current.

The various voltages for the auxiliary cathodes are usually tapped off a series of bleeder resistances, as shown below. This bleeder chain is connected direct across the positive and negative D.C. output from a suitable power supply. Alternative methods of connecting the supply to such valves depend upon their application, one being from a tapped transformer.



Theoretical arrangement of a P.E. Multiplier.

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RECEIVER R.1355 as specified for "Inexpensive Television." Complete with 8 valves VR65, and 1 ea. 5U4G, VU120, VR92, and a copy of "Inexpensive TV." **ONLY 55/-** (carriage, etc., 7/6).

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R.3084 RECEIVER. Incorporating 7 EF50, 2 EF54, 1 EC52, 1 VU39A, 1 HVR2, 1 EA50, plus 30 m/cs. I.F. Strip. Guaranteed absolutely brand new in maker's original packing case. **75/-**. (Plus 10/- carriage and packing.) This receiver is ideal for conversion to vision receiver.

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Programme Pointers

This Month MAURICE REEVE Deals with Some More Recent Programmes

Half-hour Recitals

THERE is a regrettable tendency to include in half-hour "recital" programmes works such as the Liszt Sonata, the longer Beethoven ones and the Schumann Fantasie, which can be got into the time only by sacrificing all their poetic and feeling content. Artists, on being engaged to play these works, should be sufficiently conscientious to insist on a broader time allowance. The ship is only spoilt for a penn'orth of tar, otherwise.

"Take It From Here" has been scintillating rather more than usual lately. A skit on "Tom Brown's Schooldays" was very funny indeed.

Workers' Playtime

The quintessence of wisdom concerning studio audiences was uttered by Frank Randall recently in "Workers' Playtime." Mr. Randall had his audience in such fits of laughter that scarcely any dialogue was possible during the ten minutes or so of his act. But after one of the longest bouts of screaming, shrieking roars, he said, "This isn't much fun for the listeners, is it ?." No, of course it wasn't. Listeners were told nothing of what Mr. Randall was up to; we only felt he was well earning his reward. To us it was just 10 minutes of completely inept boredom. I do earnestly suggest to the Minister of Labour that he redirect all studio audiences into other channels of nationally important work forthwith and immediately.

Abbey Simon

Abbey Simon is a young American pianist who is sunning himself in the smiles of those who have the dishing out of good dates. He is very brilliant and tackles the hardest nuts in the pianists' bag. At present he seems a bit too taut, and as soon as he can relax the tension, enabling him to bring out the inner beauties of the more difficult passages, he should be very good. Just now he is rather like a person who, given a push at the top of a slope, cannot control the momentum of his descent, though he is firmly on his two feet at the bottom.

Proms

The "Winter Proms" have come and gone again. Are they really necessary ? I am convinced they give the orchestra far more work than is good for them, whilst the surfeit of music they provide militates against the drawing powers of the symphony concerts. But we must presume the programme designers know they cannot eat their cake and have it, too.

"Gaiety" Technique

"Farewell, Gaiety" was doubtless meant to be a nostalgic show, but I can only say it served to confirm my recent remarks on that type of show. We no longer have the actors with the "Gaiety" technique, and that technique obviously cannot be imitated. It is lamentable that the illustrious theatre couldn't be saved, but I am convinced that the type of show for which it became renowned is no longer possible. A Gertie Miller by any other name could have been so sweet.

"Freedom Our Ideal"

This was a programme of excellent conception and nearly excellent execution. Some first-rate elocutionists were gathered together, to recite or declaim some of the immortal passages in this evergreen theme, and it was little short of a stroke of genius to preface it, punctuate it and conclude it with excerpts from the ninth symphony, and to cite the greatest of composers as perhaps the mightiest of the long line of strivers after the ideal. As one heard the solemn and heart-stirring opening of the first movement, one knew how right it was to put Beethoven in the van of the fight for freedom.

"Curtain Up"

"The First Year," describing what we are told is the most difficult hurdle in the matrimonial stakes, was a pleasant entertainment in "Curtain Up." The author, Frank Craven, an American, pleasingly described the perplexities of a young girl torn between the attractions of two totally opposite types of young men. Well played by George Margo, Natalie Lynn, Warren Stanhope and others.

PROFESSOR BOFFIN

"Pretty fair output, what ?"

"The Linden Tree," from the pen of J. B. Priestley, was better still, because it is a better play. Describing the heart-searchings of a schoolmaster who refuses to admit the validity of his seniors calling upon him to retire at 65 because he feels perfectly fit and capable of carrying on, and of his wife, who, sick of the school life, breaks the home up when she learns that the longed-for day is to be postponed, it contains good Priestley dialogue, characterisation and situation. Gladys Young and Edward Chapman were in Sybil Thorndike's and Lewis Casson's original parts.

Also in "Curtain Up" was "The Yellow Book," in which the lamp of suspicion played on the various characters in the usual way with considerable success and without unduly giving away either the murderer or his motive. It was the stage version of David Whitelaw's novel, "Mystery at Furze Acres," with, amongst others, Roger Delgardo, Marjorie Westbury, David Peel and Donald Gray.

A Sex War

How long will the "We Beg to Differ" sex war last? I confess it often amuses me, which is more than I can say of most of the weekly shows. But I think the bulk of criticism is perhaps right in thinking it is wearing a bit thin. It is thinnest when its protagonists tackle serious subjects: they often get into deep water and dialectical difficulties when their wisecracking and sex-badinage is thinnest or non-existent. At their best, their lightest and least responsible, they are as delightful as ever.

Club Reports

BRIGHTON & DISTRICT RADIO CLUB

Hon. Sec.: R. T. Parsons, 14, Carlyle Avenue, Brighton, 7.

A SERIES of lectures, with film strips, on Mullard valves and a talk by Mr. Bennington on V.H.F. propagation conditions are two of the highlights of the club's future programme. Visits are also planned to places of outside interest, such as the power station and local telephone exchange. A cupboard has been purchased in which to install the club station. This will facilitate operation during Ragchew evenings when G3EVE will be looking for C.W. contacts on 80 metres.

READING RADIO SOCIETY

Hon. Sec.: L. A. Hensford (G2BHS), 30, Boston Avenue, Reading, Berks.

THE meetings during January were devoted to a series of talks on operation in the 160-metre band. On Thursday, 11th Mr. L. Watts (G6WO) and Mr. L. Hensford (G2BHS), gave details of complex V.F.O. driven transmitter, and simple crystal driven transmitter respectively; along with aerial coupling methods and gave examples of their experience in using these transmitters. On Saturday 27th, Mr. C. Pearce (G3FUO) described the development of his transmitter from a simple C.O. detailing his experience of B.C.I. and T.V.I. in the process. He also gave a demonstration of a simple cross-town 'phone Tx employing only one 6F6.

The annual general meeting of the society will be held on March 31st, at Abbey Gateway, commencing at 7 p.m.

WORCESTER & DISTRICT AMATEUR RADIO AND TELEVISION CLUB

Hon. Sec.: H. M. Rudge, 21 Teme Road, Worcester.

THE club has recently acquired fresh premises at the Rainbow Club, Rainbow Hill, Worcester where meetings will be held on Thursdays at 7.30 p.m. New members and visitors are welcome at all meetings.

At the annual general meeting held in January P. Bolton, (G3CVK), was elected chairman; J. Morris-Cary (G8JC), vice-chairman; C. Sheppard treasurer: and H. M. Rudge secretary.

EXETER & DISTRICT RADIO SOCIETY

Hon. Sec.: E. M. Wills (G3EAZ) "Moor View," Wreford's Lane Exeter.

THE above society meets every Thursday at 7.30 p.m. in the Exeter Hobbies Association but at the top of Haldon Road, Exeter. The future programme is as follows:

March 15th: Visit to Marypole Head Repeater Station.
March 22nd: "Oscilloscope Time-base Synchronisation."
March 29th: Radio Fundamentals III.
April 5th: Competition Night. Home Construction competition. Practical Servicing Competition Quiz.

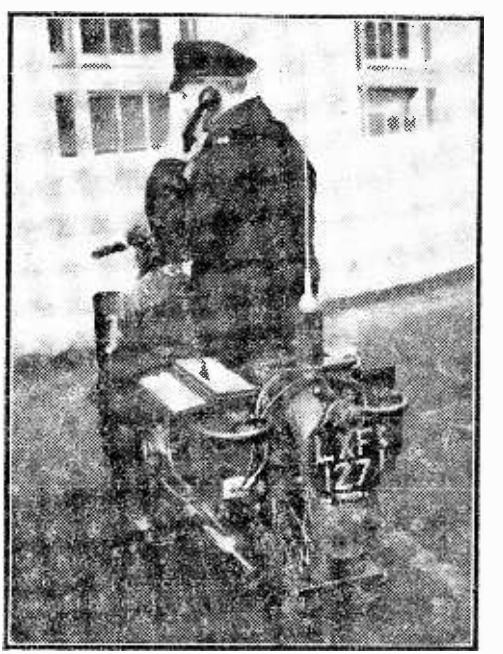
LEEDS & DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: E. Sollitt, 20, Conway Place, Harehills, Leeds, 8.

THE club has at present some 50 members, a large proportion of which are transmitting amateurs. Activities include Morse training classes, radio-maths. classes, also lectures by other amateurs on a large variety of radio and allied subjects. There are also a number of visits to places of radio interest in view for 1951. The club has a transmitting room in which transmissions are made at regular intervals, under the call G3BEW on 40 and 80 metres. The club meets every Friday evening from 7.30 p.m. to 9.30 p.m.

Radio Patrolmen

SCOTLAND YARD recently put into action a squad of road police patrolmen with radio equipped motor-cycles. Hitherto efficient radio has not been possible owing to the limitations of weight and the fact that the power supply on a motor-cycle is only at 6 volts. The new equipment has a vibratory converter for H.T. and the load on the receiver is about 3 amps. and on the transmitter 12 amps. Approximately 10 watts are put into the aerial and a selective calling device is used giving buzzer and/or lamp indication on the handlebars. The transmitter is carried on a pannier on one side of the rear carrier (upon which is mounted the aerial), and the receiver and handset is on the other side.



One of the new mobile radio-patrolmen showing the equipment in action.

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).

"Resonance Indicating Signal Generator"

SIR,—May I take this opportunity of congratulating you on an excellent magazine, especially with regard to the designs which appear on your centre pages which have, in the past, given me much food for thought and assistance. May I also extend congratulations via your editorial column to Mr. T. H. Robinson for his recent article on a "Resonance Indicating Signal Generator."

Theoretical considerations on this design leave me convinced that this instrument will surpass for both sensitivity and stability the "grid-dip oscillator" of American origin, whilst possessing all its other facilities.

I shall shortly be constructing the instrument mentioned and will pass on the details for other amateurs who may be interested. The idea is to make up the instrument for use additionally as a heterodyne frequency meter, and to that end will include a crystal check oscillator and a voltage stabiliser. The oscillator will operate on a fixed band, 1.7 to 2 Mc/s, and will be followed by a harmonic amplifier which will feed into the resonator probe, thereby ensuring that the oscillator is not "pulled" by the external circuits under test. Using the type of dial as illustrated in the article, together with a straight-line-frequency condenser and a little padding, frequency could be read direct from the dial to within 500 cycles and greater accuracy could not be wished for in amateur circles. The harmonic amplifier would be modulated by the suppressor. EF50 type valves will be used.

Again, many thanks to yourself and your contributor.—L. A. CHINNERY (E.18).

A Strange Fault

SIR,—May I, through these columns, thank the many kind readers who came to my aid in solving my problem regarding the obstinate R1155 which would refuse to work.

Having replaced the DL63's which, incidentally, were VR101's, by 6Q7's, I am now getting perfect reception from the set and hope to continue doing so for a long time to come.

Thanking everyone again for their prompt response to my cries of distress.—GASTON S. CARUANA (N.W.5).

Standard Terms

SIR,—I am sure many readers will agree on the necessity of standardising the many radio terms for several common components. There has been a great deal of discussion on the subject and some divergence of views, but, in my opinion, the following are reasonable suggestions to start the ball rolling:

Resistor, inductor and capacitor for these components and resistance, inductance and capacitance for their respective electrical properties.

I feel the term "condenser" should be discontinued as "capacitor" describes the mode of action of that component far better.

I would suggest the definite substitution of picofarad for micromicrofarad, which is both ridiculously long winded and $\mu\mu$F. is impossible to type correctly. μF. should be replaced by mF., as "milifarad" is never used in normal wireless communication.

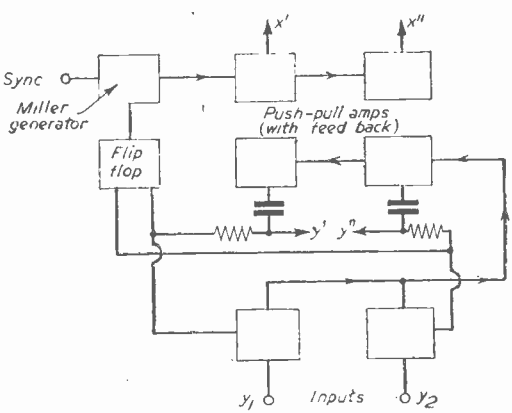
So how about some more views on this controversy?—H. SASSON (Leeds, 2).

[*All standard terms and abbreviations are, of course, to be found in our Encyclopædia.*—EDITOR.]

"Electronic Double-beam Switch"

SIR,—I was greatly interested in the article by Mr. C. E. Craven, on an electronic "double-beam" switch for an oscilloscope, as a few months ago I was confronted with the problem of measuring the phase shift in an electronic circuit, necessitating the use of a "double-beam" oscilloscope.

Whilst Mr. Craven's circuit is adequate for some applications, it falls down on this one, as the start of



Block diagram of the arrangement suggested by Mr. Whitlock.

the trace does not correspond with the start of or, for that matter, any one point of the time base scan, due to the fixed switching frequency. Thus it is easy to see how one could be confused in such a case.

I found a better solution was to use the square pulse from the screen of a Miller generator during the flyback to switch a flip-flop circuit, from the anodes of which is obtained the D.C. switching potentials for trace separation and input stage selection. The diagram on p. 185 will make this clear.

The switching operation is thus carried out during the flyback period and the beginning of each trace corresponds with the same part of the scan each time.

Trusting that this information will be of use to other readers, and hoping to see more articles on test equipment in this popular magazine in the future.—R. H. WHITLOCK (Wolverhampton).

Record Playing

DEAR Thermion,—It is common knowledge that fibre needles are not suitable for use with the material known as "Geon."

Trailing needles with a point diameter of .001in., the correct size for L.P., are not made in this or any other country.

Suitable pick-ups can be bought over the counter for as little as 39s. 6d. I refer to the ultra-lightweight pick-up made by Cosmocord for Decca. Beyond this price there are at least half a dozen other pick-ups which can be used.

Tests of the wearing qualities of L.P. records by G. A. Briggs and C. E. Watts have proved that many times the life may be expected over the life of "78" records. Surely it is no great hardship to level the turntable?

Your statement that those "behind the gramophone industry in this country" are not convinced that the time is ripe for the introduction of L.P. in this country would seem to indicate that you are only prepared to listen to the voice of E.M.I. The Decca company think the time *is* ripe, and, as our most go-ahead firm, their opinion must carry equal weight. I am the buyer for one of the largest record dealers in this city, and in the country, and it may surprise you to learn that we sell many more Decca group records than E.M.I. group. Furthermore, our sales of L.P. records are increasing by leaps and bounds and our customers, having purchased the correct equipment, have no problems in playing them.

Personally I am so convinced of the overwhelming superiority of L.P. that I have sold my large collection of classical records and turned the money back into L.P. records.

My own apparatus may be of some interest. It comprises a Williamson amplifier with pre-amplifier feeding a B.T.H. R.K. speaker in a bass reflex cabinet of 9 cu. ft. capacity and a Wharfedale W10/CSB, both fed via a separator unit. The pick-up is a standard Wilkins and Wright moving coil, suitably adjusted to the correct pressure of approximately eight grams. A sapphire needle of the required point diameter is fitted.

Results to those used to 78 r.p.m. records are a revelation and this combined with the inestimable boon of long-playing means greater listening pleasure than I would have believed possible.—F. THOMPSON (Newcastle-on-Tyne).

DEAR Thermion,—*Re* your article in the February issue of PRACTICAL WIRELESS, I think there is a great deal in favour of L.P. records. Firstly, the quality is so much greater than that obtained with standard discs. Secondly, surface noise is non-existent. Thirdly, they are unbreakable and supplied in special containers. Fourthly, they are cheaper in the long run. After using L.P. records, the standard 10in. and 12in. seem ridiculously short in playing time—and no one who values his records would place them at the mercy of any auto-change systems. I agree they do need a special lightweight pick-up, but this has the advantage of reducing the wear and tear on the grooves. I agree too the playing desk must be carefully sited—the remotest suspicion of a loose floor board is fatal.

I have a Decca Dual Speed playing desk, feeding into the Williamson amplifier with tone compensation unit, driving a standard Goodmans 12in. speaker and am thoroughly satisfied with the Decca L.P. recordings. I look forward to the day when the other recording firms will follow Decca's lead. I feel sure the L.P. record will outdate the standard record as surely as television will outdate sound broadcasting.—W. HURST (Manchester).

Magnetic Recording

SIR,—I should like to place on record my appreciation of the recent series of articles on home-recording. This is a branch of the hobby which I have long been interested in, but have found a scarcity of material and notes available for the home constructor. There are books, but they are professional. With the help of your articles I have made some apparatus which is giving me splendid results and, as I am getting tired of ordinary radio experimenting and could not afford to start on to television, this has given me a new interest for my spare time. I am now waiting to see if some manufacturer will produce some sort of combination machine which will play ordinary and long-playing records, and will take tape or wire! After all, pick-ups are being introduced with plug-in heads for different types of recording, so why not a motor to suit?—G. COLLINS (N.W.9).

USING THE ELECTRIC SUPPLY MAINS

(*Continued from page* 172)

removed by a simple filter circuit of choke and condensers, as in the common "eliminator."

Fuses

An important consideration in operating equipment of low power rating, say of about 60 watts, from a heating circuit, is the position of the fuse protecting the equipment. If the fuse is located in the equipment itself the flexible cable may be required to carry five or six times its maximum current before a fuse of a size that is usually found protecting a heating circuit would operate. The safest method is to use a fused plug with a rating similar to a normal domestic lighting fuse.

Long lengths of lighting flexible cable should be avoided, since the voltage drop when an excessive current flows may prevent the fuse from operating quickly.

Impressions on the Wax

Review of the Latest Gramophone Records

THE reputation of Malcuzynski as an interpreter of Chopin is well known, yet he has often extended his repertoire to embrace a wider scope of piano style. On this occasion he gives a splendid account of the solo part in Rachmaninov's "Concerto No. 3 in D Minor, Op. 30," on *Columbia LX*1352-6. It is a work that has gained so much favour in the public eye during recent years that it is fast rivalling the popularity of the famous second concerto. The Philharmonia Orchestra under Paul Kletzki bring us Rachmaninov's rich scoring in an ideal performance to complete a splendid production.

Another highlight among the recent releases is Tchaikovsky's "Variations on a Theme from Suite No. 3 in G, Op. 55," played by the Philharmonia Orchestra under the able baton of Nicolai Malko, on *H.M.V. C*4058-60. These records will bring tremendous pleasure to the countless listeners who have long fallen willing victims to the genius of Tchaikovsky.

Most lovers of the ballet will recall the ballet of the chessboard "Checkmate" as played by the Sadler's Wells Company. The music, written by Bliss, has now been recorded by the Royal Opera House Orchestra, Covent Garden, conducted by Robert Irving, on *Columbia DX*1718-20.

Rafael Kubelik's brilliant conducting is further enhanced by his latest recording on *H.M.V. C*7822-3. The works selected are interesting examples of Dvořák in orchestral vein. The "Scherzo Capriccioso, Op. 66" is particularly individual in style, scored for a large orchestra, and ranking as one of his most important miscellaneous works. The ten "Legends" are orchestral versions of the piano duets, and this last of the set makes worthy companion music to the Scherzo. For these performances, Kubelik encourages the Philharmonia musicians to the height of their familiar skill.

The London Baroque Ensemble, conducted by Karl Haas, make an interesting recording of Haydn's "Divertimento in G Major, Op. 31, No. 1," arranged by Haas, on *Parlophone SW*8118-9. "The Fourth London Trio in G Major" and "Grenadier March," both by Haydn, make an attractive coupling.

Other orchestral recordings which will be eagerly sought after are the "Dance of the Seven Veils," by Richard Strauss, played by the Royal Philharmonia Orchestra, conducted by Sir Thomas Beecham, Bart, on *H.M.V. DB*21149, and "Overture Die Fledermaus," by Johann Strauss, played by the Philharmonia Orchestra, conducted by Josef Krips, on *Columbia DX*1707.

Vocal

Theo Hermann, who has made quite a name for himself as a singer of bass songs, makes his début for Columbia with a recording of two of Schubert's songs on *Columbia LX*1358. With Gerald Moore playing the interesting piano accompaniments, this record will give immense pleasure to the listener.

Other records from which you may take your choice are "Come Back to Sorrento" and "Valencia," sung by Jan Peerce, on *H.M.V. DA*1962; "I Leave My Heart in an English Garden," coupled with "I Bless the Day," sung by Webster Booth, on *H.M.V. B*10027; and "Che Faro Senza Euridice" and "Ombra Mai Fu (Largo)," both of which are sung in Italian by Jean Watson, contralto, on *Columbia DX*1721.

Variety

For Parlophone this month the Geraldo Orchestra and two of the band's singers offer attractively arranged versions of popular songs of the day. "Orange Coloured Sky" is the American novelty number sung by Nadia Dore, and the romantic coupling is the French song, "All my Love," sung by Eve Boswell, on *Parlophone F*2443.

Frank Sinatra has chosen two tunes from recent Hollywood musical productions—"Life is so Peculiar" and "Nevertheless," which he sings on *Columbia DB*2790. Steve Conway gives his version of "Autumn Leaves" and "Love Like Ours" on *Columbia DB*2775, and Tony Bennet makes his début on Columbia with "Just Say I Love Her" and "Our Lady of Fàtima," on *Columbia DB*2789.

Harmony is supplied by the Radio Revellers with "Stick it on the Wall, Mrs. Riley" and "The Ball of Kirriemuir," on *Columbia DB*2785. The latter number is a song of Scottish origin which became a firm favourite with the Forces during the last war.

Billy Thorburn's novelty ensemble and the Stargazers combine talents for a recording of "Sunshine Mountain" and "Good Luck, Good Health, God Bless You," on *Parlophone F*2442.

Roberto Inglez and his Orchestra offer two more tunes in his danceable Latin-American style on *Parlophone R*3349. "Autumn Leaves" and "All my Love" are two titles that have won favour on the Continent.

Humphrey Lyttelton and his New Orleans-style jazz band give us yet two more numbers emanating from the early days of jazz. They are "Low Down Dirty Shame Blues" and "Buddy's Habits," on *Parlophone R*3351.

This month Sidney Torch's skilled hands direct his orchestra through "The Petite Waltz" and "Elfinette," on *Parlophone R*3348. "The Petite Waltz" is, of course, a firm favourite in this country.

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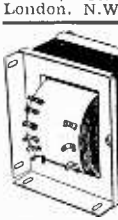

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