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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS

EDITORIAL COMMENT

All-wave Wireless

The Feature of this Season

DEVELOPMENT in wireless is continuous process which has been carried on without interruption since the earliest days. Yet, of necessity, a time lag has always occurred between the laboratory development of a new idea and its appearance as a commercial product The time elapsing between these two states is a very variable quantity, so that it often appears as if wireless development is by leaps and bounds rather than a progressive flow. We have thus become accustomed to expect something new after any apparent interval in progress and the natural time to look for its appearance is at the annual Radio Show. Past years have seen such developments as the superheterodyne, AVC, and visual tuning indicators, to mention only a few, and the question as to what to expect this year naturally arises at this time.

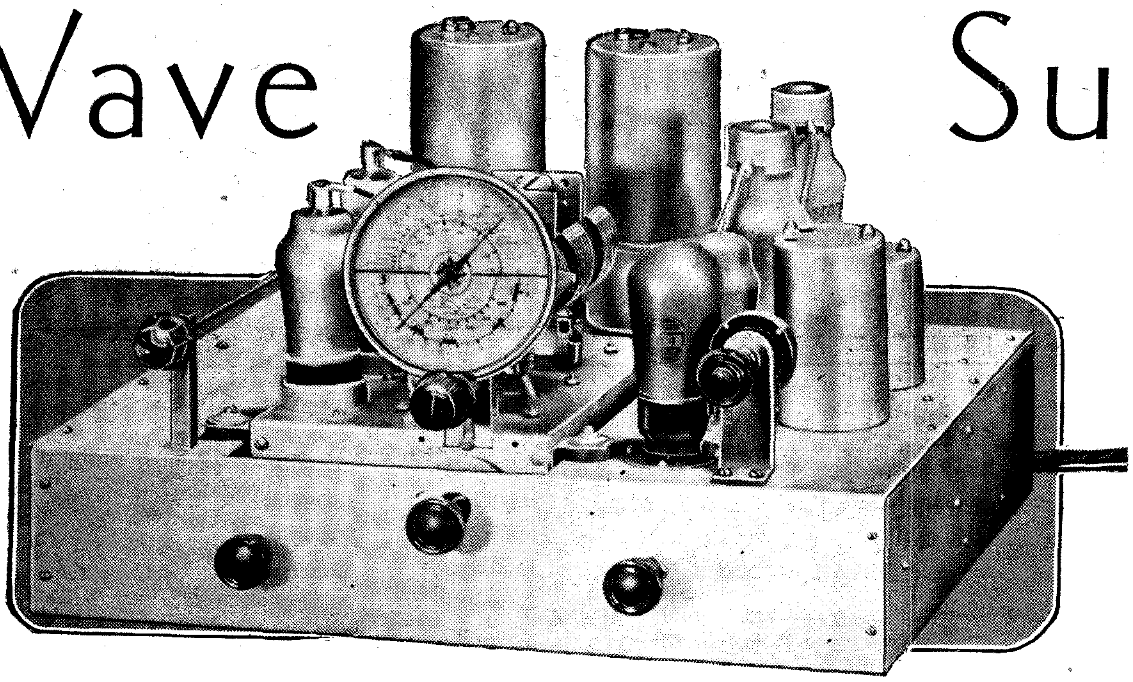
All the indications point to the fact that the feature of many of the new receivers will be an all-wave tuning range, using the term in its usual limited sense. From one point of view, this is hardly an innovation, since for many years it has been possible to obtain receivers covering a very wide tuning range. It is a development, however, in that the feature will be included in many receivers of the less expensive class. It is at the same time an achievement from the technical point of view and one which has probably caused more headaches among designers than any other within recent years. The difficulties of all-wave receiver design cannot be really appreciated except by those who have met with and overcome them.

The reasons why a demand has been created for this development are not far to seek. Listeners now find less interest than formerly in long-distance reception on the ordinary broadcast bands, for the reason that the high power of broadcasting stations has made it an easy matter to obtain almost any European station. The difficulty which persists is that of interference from adjacent stations and, as this is at present incapable of solution without serious effects on quality, many people are coming to rely solely on the local and a few of the stronger Continental stations for their entertainment. Short-wave reception gives back the lost interest in distance listening, whilst the range of reception is not merely Continental but world-wide. An element of skill, too, enters into the handling of the receiver and the range of wavelengths covered is so great and the diversity of stations receivable so large, that it is possible once more to enjoy a return to the much-maligned occupation of "knob-twiddling."

Opportunities for Experimenters

In the field of all-wave and short-wave sets, more than in any other, perhaps, those who experiment and build their own sets are at an advantage, because the technique is by no means stabilised and improvements are being made so rapidly that commercial practice cannot at present keep pace with them. The first AC operated all-wave receiver to be designed by *THE WIRELESS WORLD* for description as a constructional set is announced in this issue. This receiver is fully representative of modern technique. It is highly sensitive on all wavelengths, it is selective with the selectivity variable at will from a panel control. High-quality reproduction has been a principal aim, whilst the signal/noise ratio is good. A signal-frequency amplifier and two signal-frequency tuned circuits are in use on all wavelengths ; this feature alone is one which would have been almost impossible a very few years ago. The IF amplifier is also of a new and unusual design, and greatly facilitates the attainment of good variable-selectivity characteristics. The AVC system is one which does not introduce distortion but is yet effective in its chief purpose—that of reduction of fading.

The Wireless World All-Wave Su



A SENSITIVE THREE-BAND SET WITH VARIABLE SELECTIVITY

THE increasing interest which is being taken in short-wave reception makes it desirable to include these wavelengths within the tuning range of sensitive receivers. That portion of the total range of wavelengths used for wireless communication which is usually termed short-wave extends from about 10 metres to 100 metres, but it is by no means essential to cover the whole of this band. The vast majority of short-wave broadcasting stations and amateur transmitters work between 16 and 50 metres, and it is this portion of the band which is essential.

Any increase in the tuning range is naturally reflected by a tendency towards an increase in cost, for more bands have to be included. It is therefore economical to make the tuning range no wider than is essential. Now it is just possible to cover some 16 metres to 50 metres in one band, and it has accordingly been decided to include only this short-wave range in the receiver in addition to the usual medium and long wavebands. The set consequently has three tuning ranges of approximately 16-50 metres, 180-550 metres, and 1,000-2,000 metres.

THE superheterodyne is the only type of receiver with which it is possible to obtain high selectivity on short wavelengths and it consequently lends itself well to the production of an all-wave receiver. The principle is one which has carried all before it in the field of broadcast reception and it is one which is equally suitable for short waves. The receiver described in this article covers three bands and a signal-frequency HF stage is always operative, thus keeping the signal-noise ratio at a maximum.

The complete circuit diagram appears in Fig. 1, and it will be seen that a signal-frequency amplifier employing an HF pentode type valve is employed and is operative on all wavelengths. The use of such a stage is advantageous in that it keeps the signal-noise ratio at a maximum, and the two tuned circuits very greatly reduce the possibility of second-channel interference even on short wavelengths.

The frequency-changer is of the heptode type, having a tuned-grid oscillator circuit. Correct ganging is secured by means of the padding condenser system, and use is made of the padding condenser also to assist in the reaction circuit. It can be seen that the coupling between the oscillator tuned circuit and the oscillator anode circuit is partially by means of the mutual inductance between the reaction and tuned coils, and partly by means of the reactance

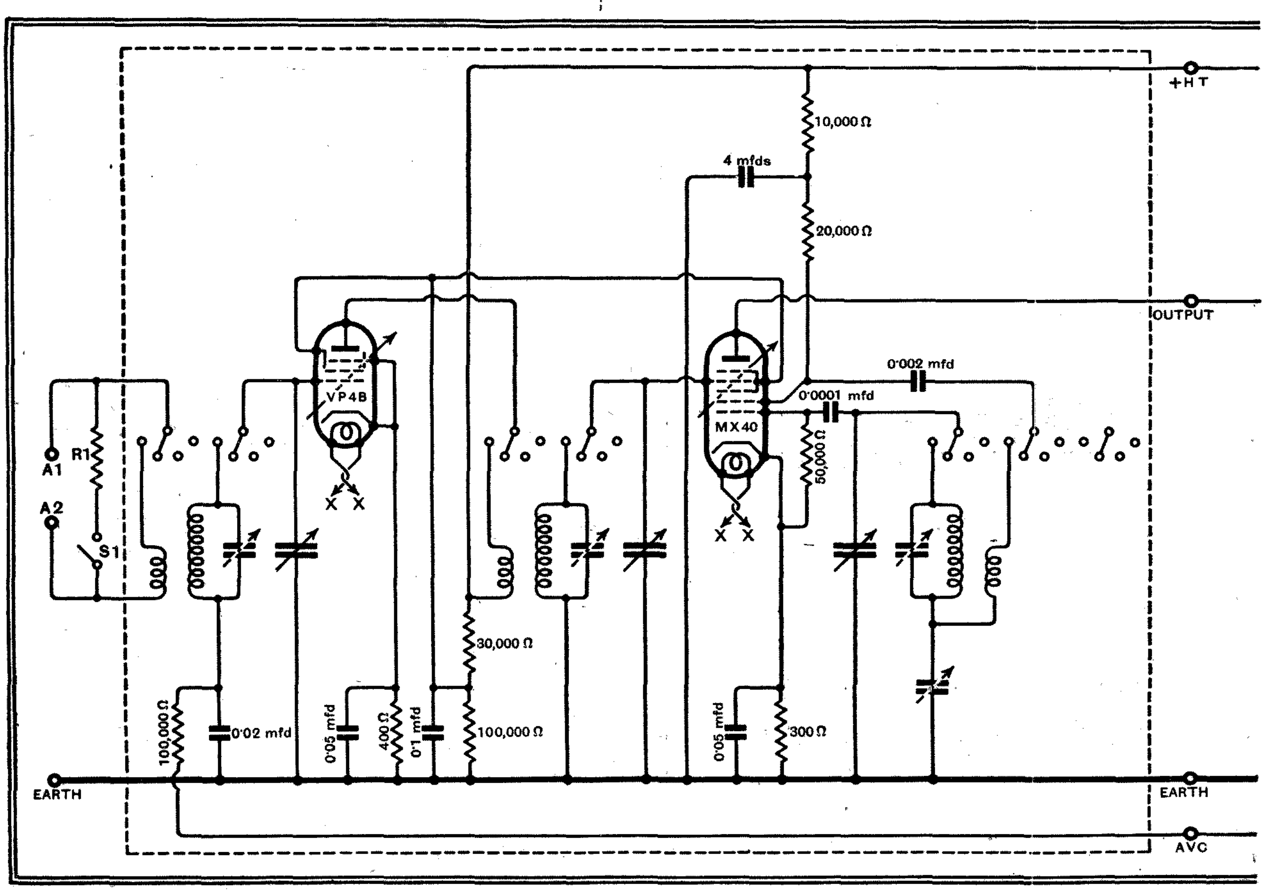
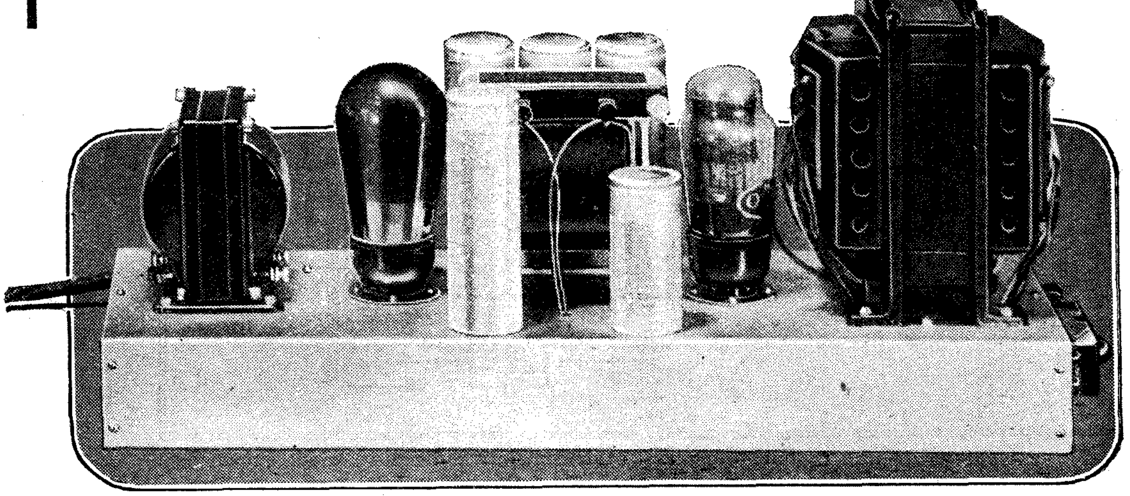


Fig. 1.—The complete circuit diagram of the receiver shows that two signal-frequency tuned circuits are used with a heptode frequency-changer and an HF pentode for the HF stage. There are two IF stages specially arranged with six tuned circuits to give good variable-selectivity characteristics.

per Seven

By W. T. COCKING



of the padding condenser which is common to both circuits. This particular arrangement of the circuit connections enables a much more constant output to be obtained from the oscillator, and so enables more even sensitivity to be secured.

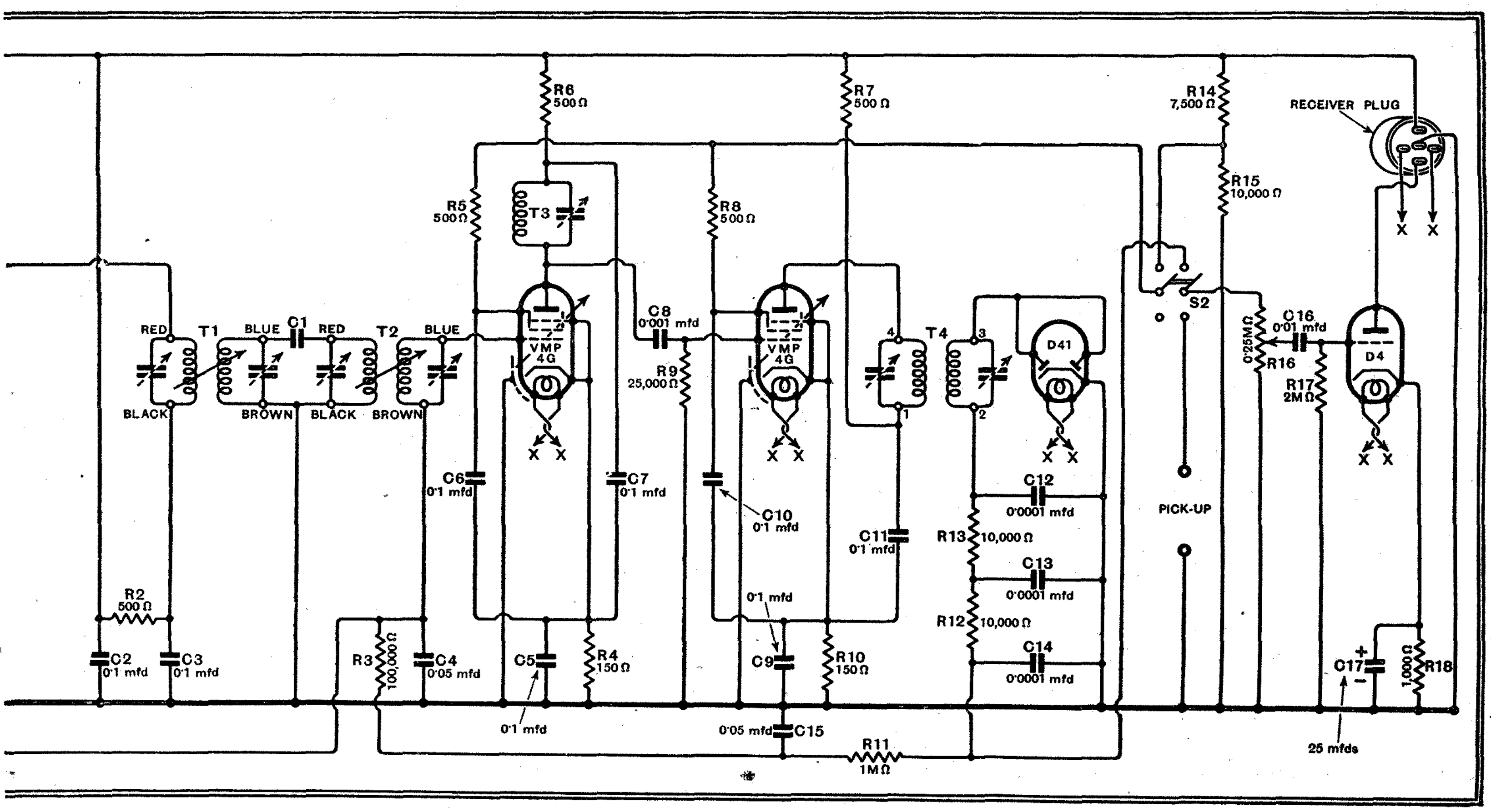
The inclusion of short waves in a receiver brings two big problems in its train—one of construction and the other of adjustment. On short wavelengths it is vitally important not only that the construction be sound but also that all connections are made correctly, and this does not mean merely joining together the correct points. It means that all connecting leads are important in their length and relative positions. If the apparatus is to be reasonably compact, this throws a big burden on the constructor, for it is all too easy unwittingly to make important errors. The second difficulty, that of adjustment, lies in the ganging, for it is not always easy to carry this out properly on short wavelengths, since comparatively few test oscillators cover the requisite range.

These difficulties have been completely overcome in this receiver by the use of a manufactured tuner. This tuner includes the whole of that portion of the circuit in the dotted box in Fig. 1—gang condenser, coils, switches, trimmers and valve-holders all wired up and ready for use. Moreover, if the specified valves are used the ganging has already been performed in the factory, and no ganging adjustments are necessary. The only adjustments which the constructor has to make are to the IF amplifier, which must be lined up to the correct frequency of 456 kc/s for which the tuner is designed.

The IF amplifier includes two valves and is of rather special design in order to secure good variable-selectivity characteristics. Two variable-selectivity IF transformers are used between the frequency-changer and the first IF valve, and they are coupled together by the condenser C1. This condenser is of very small capacity and is constructed when wiring the set by the correct placing of two wires.

The IF Circuits

The frequency-changer anode is decoupled by the 500-ohm resistance R2 and the 0.1 mfd. condenser C3, the further 0.1 mfd. condenser C2 being provided to give a low-impedance path to HF across the HT supply. The coupling between the two IF valves is by a tuned anode circuit of high dynamic resistance but very low Q. This is done in order that the first valve may give good amplification but yet have a high input impedance—an important point if good variable selectivity characteristics are to be realised. The tuned circuit T3, therefore, is of high inductance and moderate efficiency. Even so, the Q is too high for correct results in this receiver, and it is accordingly adjusted to the right figure by the use of a low value—25,000 ohms—for the grid leak R9. This is advantageous in that it permits considerable latitude in the choice



The All-Wave Super Seven—

of operating conditions; it is, for instance, possible to use a higher value for R9 and so obtain greater gain in cases where this is more important than a flat resonance curve at low selectivity. Owing to the use of a low value of grid leak the coupling condenser C8 is given the fairly large value of 0.001 mfd.

The second IF valve is coupled to the diode detector by the transformer T4 having fixed coupling between its coils. This transformer has characteristics suited to the variable types and serves the purpose of filling up the trough in the resonance curve which would be obtained if the other two were used alone or if all three were variable.

The detector is a diode and also provides AVC. The by-pass condenser C12 has a capacity of 0.0001 mfd., and the output is taken through a two-stage filter comprising R12 and R13 of 10,000 ohms each and the two 0.0001 mfd. condensers C13 and C14. The diode load resistance R16 has a value of 0.25 megohm and acts also as the volume control. The DC output of the detector developed across R16 is fed off through the filter R11 and C15 of 1 megohm and 0.05 mfd. respectively to the AVC line. The first IF valve is controlled and has its bias applied through the filter R3 C4, which is also effective in feeding the HF valve, although this has a further filter incorporated in the tuner.

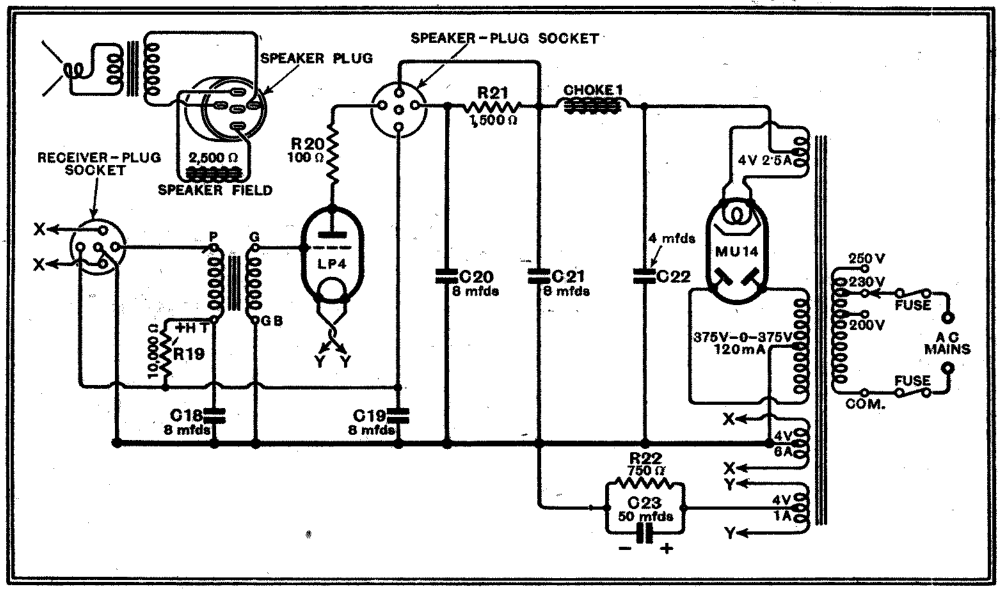


Fig. 2.—The power unit contains the mains equipment in addition to a triode output valve fed through a high quality LF transformer.

The second IF valve is not controlled; this is partly because AVC control would adversely affect the variable-selectivity characteristics by altering the valve damping on the primary of T4, but more because it would be likely to cause serious distortion on strong signals through overloading in this valve. The frequency-changer is also uncontrolled, in spite of the fact that the valve has variable-mu characteristics. The reason for this is that it is difficult to prevent the AVC voltage from affecting the oscillator frequency on short waves, and this would, of course, seriously interfere with the reception of a fading signal. Much more reliable results are secured, therefore, by omitting AVC control on this valve.

The AVC System

Some may be surprised at the use of non-delayed AVC, but recent articles in *The Wireless World* have shown it to be the only simple AVC system which is free from distortion. From the point of view of quality it has important advantages over the customary delayed diode system, and although it is inferior from the theoretical viewpoint in regard to its action in maintaining constant detector input, in practice it is very good. The only other arrangement which is satisfactory from the point of view of quality is an amplified method which involves an extra valve and many more components. Experience showed that the results with the simple diode circuit were so good that it was felt unnecessary to increase the complication and cost of the set by including amplified AVC.

If full output is to be secured on weak signals, a somewhat greater degree of LF amplification is needed with non-delayed AVC than with any delayed system. The detector output is consequently fed from

LIST OF PARTS

Certain components of other makes but of similar characteristics may be used as alternatives to those given in the following list.

RECEIVER.

1 Tuning unit and dial — Rothermel "Radio-Heart"
2 Variable selectivity IF transformers, with coupling unit, **T1, T2** — **Sound Sales IF465**
1 IF transformer, T4 — **Bulgin C50**
1 IF coupling coil, T3 — **Bulgin C43**

Condensers:
- 2 0.05 mfd., tubular, **C4, C15** — **T.C.C. 250**
- 8 0.1 mfd., tubular, **C2, C3, C5, C6, C7, C9, C10, C11** — **T.C.C. 250**
- 3 0.0001 mfd., mica, **C12, C13, C14** — **T.C.C. "M"**
- 1 0.001 mfd., mica, **C8** — **T.C.C. "M"**
- 1 0.01 mfd., mica, **C16** — **T.C.C. "M"**
- 1 25 mfds. 25 volts, electrolytic, **C17** — **T.C.C. "FT"**

Resistances:
- 1 100 ohms ½ watt, **R1** — **Erie**
- 2 150 ohms ½ watt, **R4, R10** — **Erie**
- 5 500 ohms ½ watt, **R2, R5, R6, R7, R8** — **Erie**
- 1 1,000 ohms ½ watt, **R18** — **Erie**
- 2 10,000 ohms ½ watt, **R12, R13** — **Erie**
- 1 25,000 ohms ½ watt, **R9** — **Erie**
- 1 100,000 ohms ½ watt, **R3** — **Erie**
- 1 1 megohm ½ watt, **R11** — **Erie**
- 1 2 megohms ½ watt, **R17** — **Erie**
- 1 10,000 ohms 2 watts, **R15** — **Erie**
- 1 7,500 ohms 4 watts, **R14** — **Erie**

1 Volume control, tapered, 0.5 megohm, **R16** — **Erie**
4 Resistance boards 5-way — **Bulgin C31**
1 Resistance board 10-way — **Bulgin C32**
2 Valve holders 7-pin (without terminals) — **Clix Chassis Mounting Standard Type V2**
1 Valve holder 5-pin (without terminals) — **Clix Chassis Mounting Standard Type V1**
1 Valve holder 5-pin (special with 7-pin type fixing holes) — **Clix Type CE457**
1 Switch, rotary, DPDT, **S2** — **Bulgin S114**
1 Switch, rotary, SPST, **S1** — **Bulgin S91**
1 5-way cable with twin 70/36 leads and 5-pin plug — **Goltone**
1 5-way connector — **Bryce**
5 Ebonite shrouded terminals A (2), E, PU (2) — **Belling-Lee "B"**
2 Screened connectors — **Bulgin P65**
1 Pair bevel gears, equal sizes, 1:1 ratio, ⅞in. dia. × 26 teeth — **Meccano Type 30**
1 Large knob ¼in. bore — **Bulgin K12**
5 Small knobs ¼in. bore — **Bulgin K14**
1 5/32in. brass shaft 12in. long — **Bulgin**
1 Reducing sleeve for 5/32in. shaft to ¼in. knob — **Bulgin**
1 Length screened sleeving — **Goltone**
Chassis — **Scientific Supply Stores**

Miscellaneous:—
2 supports for control shaft 2¼ins. long × ⅜in. sq., drilled for 4 BA screws; 8 lengths systoflex; 2 ozs. No. 18 tinned copper wire; bracket for volume control, etc. Screws: 6 4BA 1in. r/hd., 32 6BA ¼in. r/hd., 8 6BA 1in. r/hd., all with nuts and washers.

Valves:—
- 2 VMP4G metallised, 1 D41 metallised, 1 MX40 metallised — **Osram or Marconi**
- 1 D4 metallised — **Ferranti**
- 1 VP4B metallised — **Mullard**

POWER UNIT.

1 Mains transformer with screened primary; primary, 200 to 250 volts, 50 c/s.; secondaries: 375-0-375 volts, 120 mA; 4 volts 2.5 amps. centre-tapped; 4 volts 1 amp. centre-tapped; 4 volts 6 amps. centre-tapped. — **Heayberd WS7**
1 Smoothing choke 10 henrys 130 ohms 100 mA **Ch1** — **Rich & Bundy E104M**
1 LF transformer 3.5:1 ratio — **Ferranti AF5**

Condensers:—
- 1 50 mfds. 50 volts, electrolytic, **C23** — **T.C.C. 521**
- 1 4 mfds., 460 volts, electrolytic, **C22** — **T.C.C. 802**
- 4 8 mfds. 460 volts, electrolytic, **C18, C19, C20, C21** — **T.C.C. 802**

Resistances:—
- 1 100 ohms ½ watt, **R20** — **Erie**
- 1 10,000 ohms 1 watt, **R19** — **Erie**
- 1 750 ohms 2 watts, **R22** — **Erie**
- 1 1,500 ohms 20 watts, **R21** — **Bulgin PR6**

4 Valve holders 5-pin — **Clix Chassis Mounting Standard Type VI**
1 5-pin plug for speaker connection — **Bulgin P3**
1 4-way connector — **Bryce Light Pattern**
1 Fused mains input connector with 1½ amp. fuses — **Belling-Lee 1114**
Chassis — **Scientific Supply Stores**

Miscellaneous:—
3 lengths systoflex; 1 oz. No. 18 tinned copper wire, etc. Screws: 26 6BA ¼in. r/hd., 8 6BA ½in. r/hd., 9 4BA ⅜in. r/hd., all with nuts and washers.

Valves:—
- 1 MU14 — **Osram or Marconi**
- 1 LP4 — **Ferranti**

The All-Wave Super Seven—
the volume control R16 to the grid of a triode LF amplifier through the 0.01 mfd. coupling condenser C16. The grid leak R17 has a value of 2 megohms, and the triode derives its bias by means of R18, which is shunted by a 25 mfds. condenser C17.

This triode is coupled to the output valve by means of a high quality transformer. This transformer, together with the output valve, are included on the same chassis as the mains equipment, and the circuit appears in Fig. 2. A triode delivering about 2.5 watts output is employed, and biased by the voltage drop along the 750 ohms resistance R22. An anode stopping resistance R20 of 100 ohms is used.

Turning now to the mains equipment, the mains transformer has secondaries rated at 4 volts 1 ampere for the output valve filament, 4 volts 6 amperes for the heaters of the early valves, 4 volts 2.5 amperes for the rectifier heater, and 375-0-375 volts at 120 mA. for the HT supply. A full-wave indirectly-heated rectifier is used, and delivers an output of about 390 volts unsmoothed, with a 4 mfds. electrolytic reservoir condenser C22. Preliminary smoothing is effected by the choke Ch1 in conjunction with an 8 mfds. condenser C21. The supply for the output valve is then tapped off, but as the voltage is rather high the feed is taken through the 1,500 ohms resistance R21, and another 8 mfds. condenser C20 is employed as a by-pass to earth. The supply for the early valves is further smoothed by being passed through the field winding of the loud speaker. This must have a resistance of 2,500 ohms and requires a current of some 50-60 mA. for adequate energisation.

The Valves

The construction of the receiver and its operation will be dealt with in next week's issue, but in the meantime some notes regarding the valves employed may be of interest. As long as the usual heater supply of 4 volts is employed no change can be recommended in the two valves used in the tuner. The HF valve is a Mullard VP4B, and differs from ordinary HF pentodes in having an unusually low input capacity, and also in having a top grid-connection; the grid is brought out to the top-cap and the anode to the base instead of the reverse. This leads to somewhat shorter leads, and a consequent reduction in stray capacities. The frequency changer is a Marconi or Osram MX40.

In the IF amplifier, Marconi or Osram VMP4G valves are used, and again no change can be recommended since they have been carefully selected to give the required performance. While other valves of similar characteristics will undoubtedly work and give quite good results, the same combination of high amplification, stability, and good variable selectivity characteristics may not be secured. The detector is not quite so important, and although the Marconi or Osram D41 has been used in developing the receiver, any duo-diode of similar characteristics can be employed.

For the LF valve and the output stage, Ferranti D4 and LP4 types are used, but exact equivalents exist in nearly all makes, so that quite a wide choice is permissible. The rectifier is a Marconi or Osram MU14. All valves, except, of course, the LP4 and MU14, should be metallised.

(To be concluded.)

On the Short Waves

NOTES FROM A LISTENER'S LOG

THE U.S. Federal Communication Commission's new rules relating to the operation of international broadcast stations such as W2XAF and W8XK have recently appeared and came into operation on August 1st. Some extracts from these rulings are given below, as it is felt that they may be of considerable interest to British listeners.

Firstly, these stations will no longer be called "Experimental Relay Broadcasting Stations" but "International Short-Wave Stations" as indicated in the first paragraph, and in addition, to quote from F.C.C. Rule 1012a, "but may transmit the programs of regular broadcast stations, including commercial stations, *if the call letters when identifying both stations are given on their respective assigned frequencies only* and the statement is made over the international broadcast station that the regular program of a broadcast station (identify by call letters) is being broadcast."

F.C.C. Rule 1012d states: "Station identification and program announcements shall be made with international significance suited for the foreign nation or nations for which the service is intended or in which the reception is believed to be best on account of the frequency, season and hour of operation."

Finally, Rule 1013b says: "A separate licence and call letters will be issued for each frequency except where frequencies in two or more groups are required to maintain a particular international broadcast service to certain foreign country or countries, one frequency from each of the groups required will be authorised by one licence and call letters.

"In such cases these frequencies shall be used consecutively during a day as required and they shall not be used simultaneously either on the same or different transmitters."

The minimum power rating is fixed at 5 kW except in special cases.

From these rules it would appear that the U.S. is beginning to take international short-wave broadcasting very seriously, and, coupled with this move on the part of the F.C.C., one hears rumours of impending changes in the equipment and aerials used by the N.B.C. transmitter W3XAL and the C.B.S. transmitter W2XE.

When one tunes into the various American commercial telephone and telegraph transmitters such as WKF, WLA, WMF, WDU, WCA, etc., it is obvious that reception of similarly equipped short-wave broadcasting stations would be well-nigh perfect over a large percentage of the time.

In fact, W2XAD, when using his European beam, a too rare occurence unfortunately, already gives us some idea of what may be achieved with 20 kW and a fairly simple horizontal array.

I have now some information regarding the "solar eclipse" station URAD (or U1BWF) which was operated by the members of the Harvard Eclipse Expedition to the U.S.S.R. in June. URAD, a 50-watt transmitter, was situated in a Russian baggage car of pre-War vintage, and functioned generally on 14.041 Mc/s (and on two other special frequencies) under the able guidance of W2BWF.

Most of the traffic was cleared with SM5SX and SU1CH, but one 'phone QSO was made with the U.S., and this, of course, right over the North magnetic pole!

A number of CW contacts was made with the States, however.

Finally, to close our American chapter, since July 15th W2XAD has been running 1¾ hours later than usual, i.e., until 9.45 p.m. BST.

Short-wave Broadcasting

Conditions seemed to have been fairly good during the week which ended on Sunday, July 19th, and W2XE on 15.27 Mc/s in particular was an improved signal in the evenings.

This station closes down on 15.27 Mc/s at 11 p.m. BST and starts up a few minutes later on 11.83 Mc/s, where he is generally a noticeably poorer signal.

On Monday, VQ7LO was quite a fair signal on 6.08 Mc/s at 8.10 p.m., with a "Sea-Shanties" programme of gramophone records, and Bucharest was also a good signal on 6.1 Mc/s, but accompanied by a slight heterodyne. At 10.30 p.m. this station broadcast a news bulletin in English.

Erratic conditions were experienced on W3XAL on 17.78 Mc/s on Tuesday evening, July 21st, this station at times being quite good, but normally only poor to fair, and it was inaudible on the Wednesday.

Thursday, July 23rd, saw the appearance of Poděbrady OLR in the short-wave firmament, and this new 34-kW transmitter tested on three frequencies, 6.115, 11.76, and 15.23 Mc/s, between 8 a.m. and 8 p.m., changing frequency every 30 minutes. All the frequencies were well received, but there was considerable interference between DJD and OLR on 11 Mc/s owing to Poděbrady being about 7 or 8 Kc/s too high in frequency in this case.

Further tests were made between 8 p.m. on Friday, July 24th, and 8 a.m., Saturday, July 25th, and in general the 15.23 Mc/s frequencies were the most satisfactory.

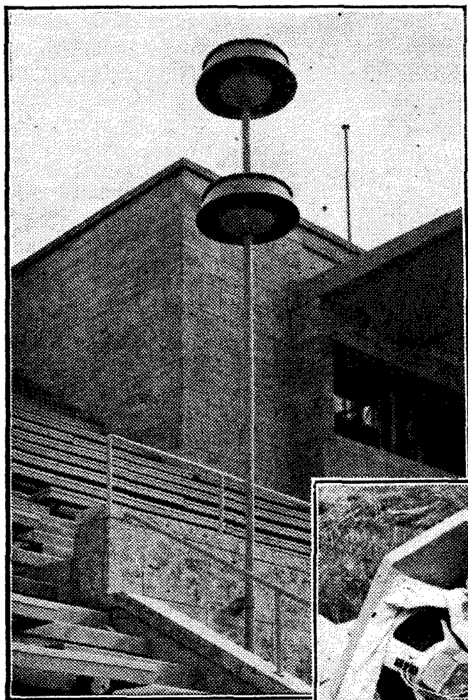
The best results on 15 Mc/s for some time were obtained from W2XAD, W2XE and W8XK at 10 p.m. Friday, July 24th, when all these transmitters had fairly good programme value; W3XAL was also better than usual when signing off at this time.

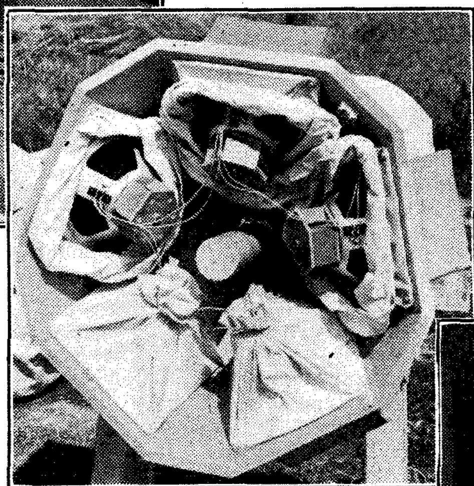
In closing, it has been noted that sunspot activity during the last few days has been small, and, probably in consequence of this, W1XK has again begun to put in an appearance during the mornings on 9.57 Mc/s.

ETHACOMBER.

Loud Speakers at the

NEW TYPES TO MEET THE SPECIAL REQUIRE



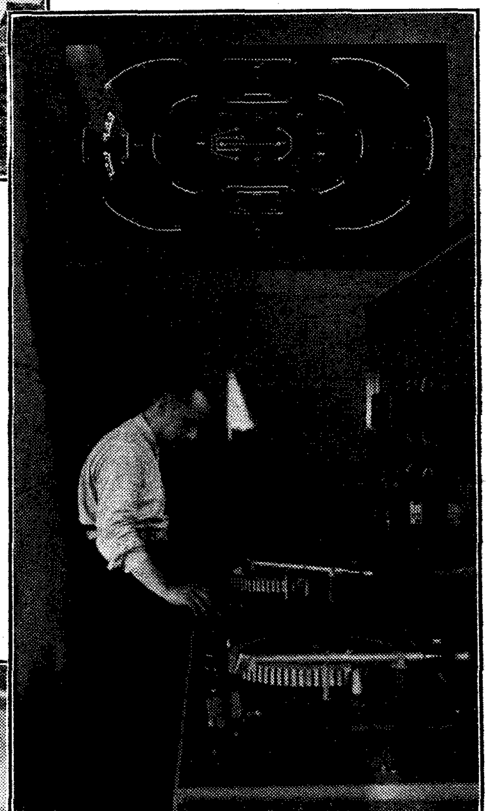


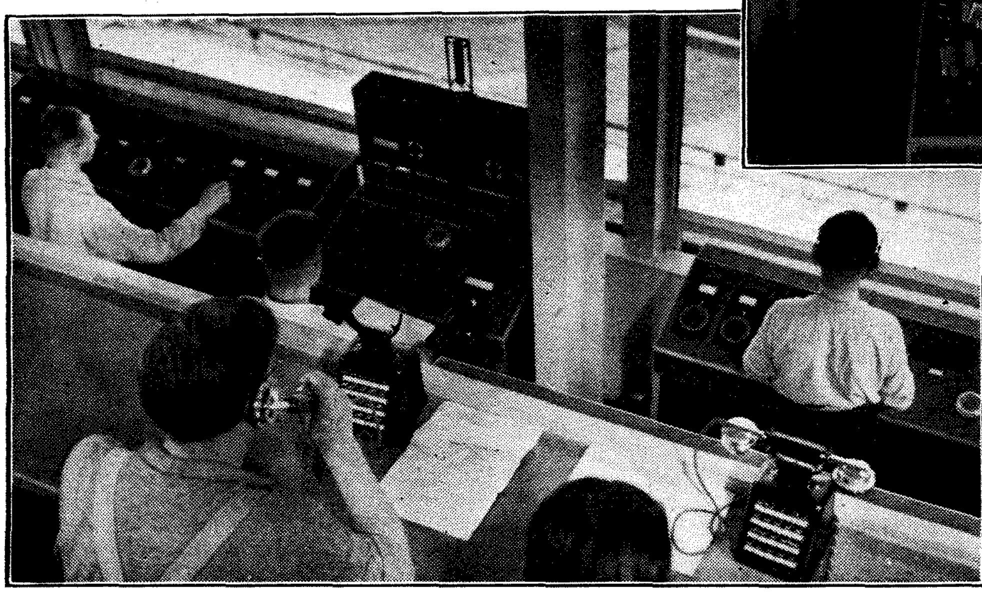
(Above) The latest Telefunken "dipole" loud speaker assembly, which is phased to cancel radiation in a horizontal plane. Echo effects in the Stadium as a whole are reduced without affecting the results as far as adjacent listeners are concerned. (Right) Interior of one of the units.

AUDIENCES of to-day must indeed be very different from those who assembled in the sports arenas of Ancient Greece to applaud the champions' efforts and to witness the dramatic action on the open-air stages. In olden times neither microphones nor loud speakers provided the onlookers with the latest results, nor could they amplify the voices of the masked actors.

At the Olympic Games at present taking place in Berlin uniform distribution of sound in the great Olympic Stadium, on the Parade Ground, in the Swimming Stadium, on the Marathon course, at the regattas in Grünau and Kiel, and on the various hockey, football, and indoor sports grounds is an essential requirement, as is the sound amplification for the Dietrich Eckart Open Air Theatre.

The mass meetings organised by the Nazi Party during the last three years have made it possible for those concerned in the development of public address to produce instruments and to make experiments which, they claim, have advanced the technique of public address in Germany beyond the present standard in other countries. However this may be, the Germans have certainly made valuable contributions, and their latest apparatus is highly interesting.





(Left) General view of the sound control room at the Olympic Stadium, Berlin. (Above) Turntables for supplying music during the intervals. The map above the operator's head shows automatically the loud speakers and microphones in circuit at any given moment.

Uni-directional, omni-directional, and "dipole" loud speakers—an entirely new type—are used at the various meeting-places of the Olympic Sports. Eight complete systems, comprising microphones, amplifiers, control desks and loud speakers have been installed in the Reichs Sports Field, which includes the Olympic Stadium, the Swimming Stadium, the Hockey Ground, the Parade Ground, the Riding Field, the Dietrich Eckart Open Air Theatre, the Sports University, the Terrace Restaurant, and the crowd control installation for the Reichssportfeld electric railway station.

These eight sytems, employing over 100 microphones and about 250 loud speakers, have a power output of 10,000 watts, which is sufficient for an audience of over 600,000, distributed over an area of 350,000 square metres.

Public address apparatus has also been installed at the Regatta Course at Grünau, the Marathon Course on the Avus, the Cycle Racing Course, the Riding Ground at Döberitz, the Golf Links at Wannsee, four other sports fields, the Olympic Village, in five Youth Camps, and in the halls of the "Pergamon" and the Old Museum. The task of providing these sites with public address equipment was so great that Telefunken had to call in other firms to cope with the order.

The existing types of loud speakers were found inadequate in a number of cases, so that entirely new instruments had to be created to suit the acoustical properties of some of the buildings and grounds.

The loud speakers in the main stadium proved to be the most difficult problem. The omni-directional mushroom type of loud speaker could not be used owing to the lack of sound absorption caused by