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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.*

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## EDITORIAL COMMENT

### Telling the Public

#### A Change of Attitude

**I**F we were asked what we regarded as the outstanding feature of this year's Radio Show, we would say that it is to be found in a revolutionary change of attitude on the part of the radio manufacturer, and especially of his publicity department, towards the buying public. In our view this change is more revolutionary even than the improvements in this year's instruments, good as these are.

For years manufacturers have been telling the public what a good thing it is to have a wireless set in the home and each manufacturer has done his best to point out to the public how much better or how much cheaper his sets are than those of his rivals.

#### Influence of Saturation

Now that the point of saturation is beginning to be reached in the distribution of sets to individual homes, and when most of the sets so distributed are still fairly serviceable, the manufacturer has at last been brought face to face with the fact that this type of propaganda will no longer sell a set to those who already have one, and may even tend to encourage users to continue with their old sets because no effort is made in such publicity to make them aware that the new types have so much more to offer. The change which has come about this year is remarkable. Wherever you go in the Exhibition, and wherever you meet with radio advertising, emphasis is laid on the technical progress which wireless and television have made and the features of the sets are described without any of the former reticence in the use of technical expressions. The public is told just what the sets have been designed to do and what are the

principal improvements introduced. At last we seem to have passed that phase in the history of the wireless industry when every set had to be sold as a musical box and makers were afraid to make any reference to what was inside.

The disappearance of the Radio Theatre at Olympia no doubt came about because it was at last brought home to the organisers that such a display was only useful so long as an appeal was being made to those who had never had a wireless set and would like to know what entertainment broadcasting could provide.

The approach of saturation and the knowledge that nearly every prospective buyer of a set is already a user of some set has brought about this revolutionary change in the manufacturer's attitude towards the public. It is now appreciated that the public is experienced in wireless, is by now capable of summing up the deficiencies of the old sets and will be responsive only to the appeal of new technical improvements such as the manufacturers are able to offer this year. These new features are at last being explained intelligently to a discriminating and experienced public.

#### The Element of Surprise

We hope that the manufacturer will not lose sight of the importance of this approach to the public, and we believe also, now that the market for wireless sets has stabilised, that it would be useful from all points of view and would certainly increase public interest if new models and new devices were reserved as far as possible to be launched as surprises at show-time rather than released all the year round, often leaving little element of surprise for the annual exhibition, and so creating the impression that progress is far less marked from year to year than is really the case.

# Diversity Reception

*THOUGH the elaborate "spaced aerial" reception methods employed by the B.B.C. for long-distance relays are quite out of the question for domestic purposes, it should be comparatively easy to apply the simpler two-channel anti-fading system described in this article.*

## USE OF INTERCONNECTED RECEIVERS FOR

By R. H. TANNER, B.Sc., A.C.G.I.

THE normal method of securing diversity reception by the use of aerials spaced from one another by distances large compared with the received wavelength is hardly suitable for home use; few people have a garden of adequate dimensions even if short waves alone are considered. However, a similar improvement in reception can often be effected by the use of a frequency diversity system, whenever it is possible to

The essential parts of the circuit of a present-day superhet receiver are depicted in Fig. 1, and few sets of this type will be found to differ greatly from this, although the number of stages employed in the various sections of the circuit will depend on the complexity and sensitivity of the individual receiver. For diversity reception, two such receivers are necessary, and it is preferable though not essential that both should be of the same make and type, as they will then have similar AVC characteristics and similar AF sections.

The interconnections of the AVC systems may be made in one or two ways, depending on the arrangement of the decoupling, but in most cases the best method is to connect the two correspond-

separately, the connection is broken by the switch  $S_1$ .

The mixture of the two audio-frequency outputs is not such a simple problem and may be solved in many quite different ways. The decision as to the best method to use in any individual case will depend to a certain extent on the amount of diversity reception likely to be carried out. In cases where this is small, two possibilities present themselves. The first and simplest is to use two loud speakers placed side by side, one fed from each set. For instance, the two sets may be left in their own cabinets, with only one lead between them connecting the AVC systems. If this lead is provided with a plug-and-socket connector, which may replace  $S_1$ ,

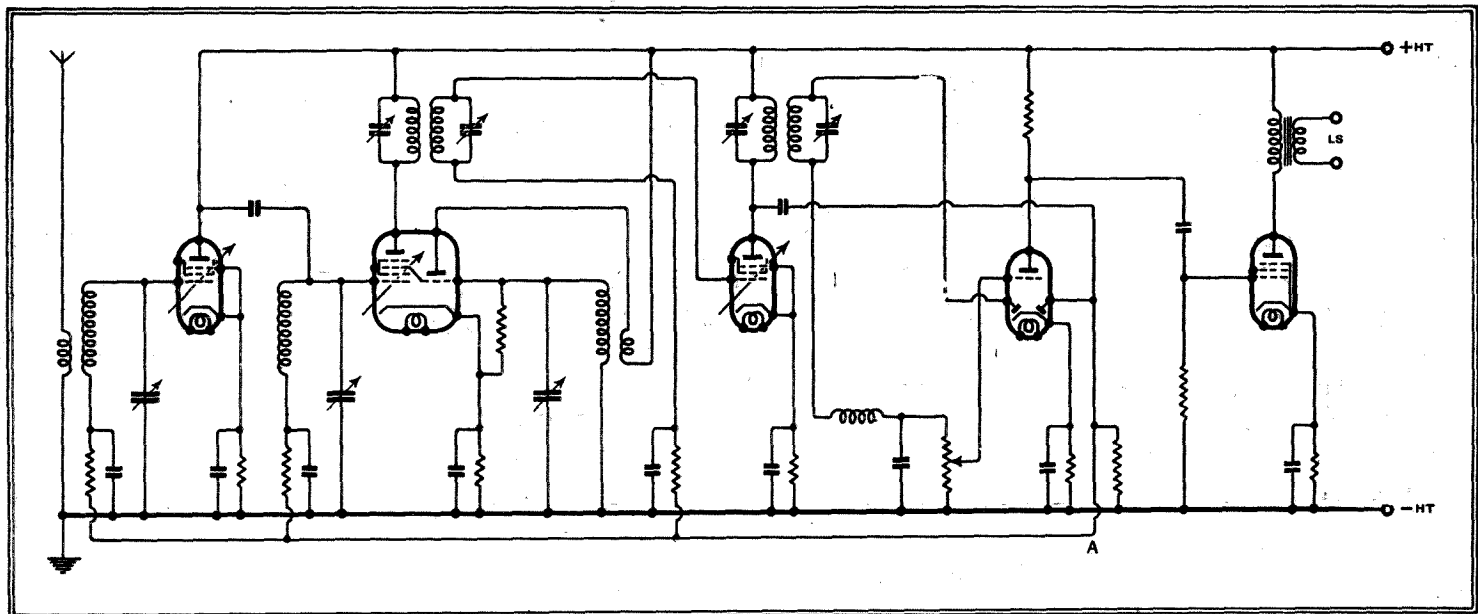


Fig. 1.—Circuit of a typical modern receiver suitable for diversity reception. Decoupling, screen supplies and wave-change switching have all been omitted for simplicity.

receive two transmitters radiating the same programme, even though both may be fading severely. In this way, the Empire programme can be received with pleasanter results in remote parts of the world. In addition, many foreign programmes on all wavebands are radiated by two or more transmitters and thus lend themselves to this method of reception.

The general principles of diversity reception were dealt with in a recent article in *The Wireless World* (January 13th, 1938) by H. W. Griffiths, and it is sufficient to say that in the simplest case the AVC systems of two receivers are coupled together and the audio outputs mixed to give a composite and, it is hoped, fading-free programme.

ing points marked "A" by the simple filter shown in Fig. 2. This filter is included to prevent the mixing of the two intermediate frequencies which would otherwise give rise to most objectionable whistles. During tuning operations, or when the two sets are being used

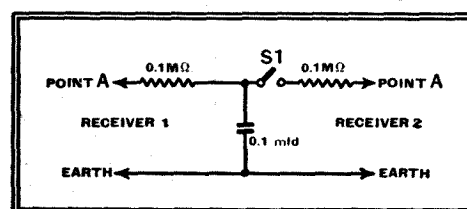


Fig. 2.—Interconnection of the AVC systems of two receivers through a simple filter circuit.

the sets may readily be separated and their individual usefulness is completely unimpaired. With the loud speakers mounted on two separate baffles no means of altering the relative phases need be provided, but if they are mounted together on one baffle, provision must be made for reversing the speech coil connections to ensure that the two outputs will add up and not tend to cancel one another out. In this connection, it should be mentioned that difficulties may be experienced if the lead lines connecting the two transmitters to the programme source differ greatly in length, as they may, for example, in the case of two American stations. The additional phase delay thus introduced into one circuit causes the two programmes to sound

# at Home

## COUNTERACTING FADING

slightly out of step, with somewhat unpleasant effects. No echo, however, could be detected when listening to London and Welsh Regionals together.

The second possibility is to use the circuit shown in Fig. 3, where only one speaker is used and mixing takes place in the speech coil circuit. Two separate output transformers must be used and a reversing switch provided. The two sets are again kept quite distinct, and when not in use together may be arranged to supply two programmes to different parts of the house.

When it is intended that diversity reception shall be the set's chief function, a rather more elaborate alteration may be made with advantage. The mixing is arranged to take place in the grid circuit

of the output valves, which in this case must be similar, as they are arranged in push-pull. The circuit is shown in Fig. 4 with the alterations indicated by dotted lines. The rebuilt set has the advantage

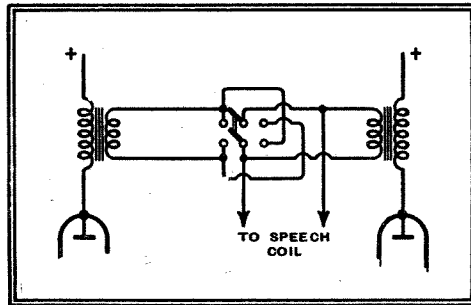


Fig. 3.—Feeding a single loud speaker from two independent receivers, connections to the output valve anodes are shown.

of greater output without distortion even when only one station is being received. In the case of mains-operated equipment, two high-tension supplies are now available and advantage of this may be taken by feeding the output valves independently of the remainder of the set. This will generally prove to be an equitable

arrangement, as the current drain on the two sources should be approximately equal. Alternatively, when using two identical receivers, the HT supplies may be paralleled. Three additional switches have been included in the diagram, the first of which, S1, has already been dealt with. The second, S2, is used to disconnect the HT supply from one of the receiver sections when using the rest of the set in a normal manner. The third, in conjunction with a centre-tapped choke, allows the relative phases of the two programmes to be reversed. For convenience these last two may readily be combined and controlled by one knob with three positions. The centre-tapped choke feeding the output valves may be merely the secondary winding of a standard push-pull transformer, the primary of which is left unconnected. As it is not required to carry DC, it may well be of the miniature nickel alloy type. The only other change necessary which has not yet been mentioned is the provision of a suitable push-pull output transformer matching the valves to the speaker.

So far nothing has been said on the important question of aerials. The best

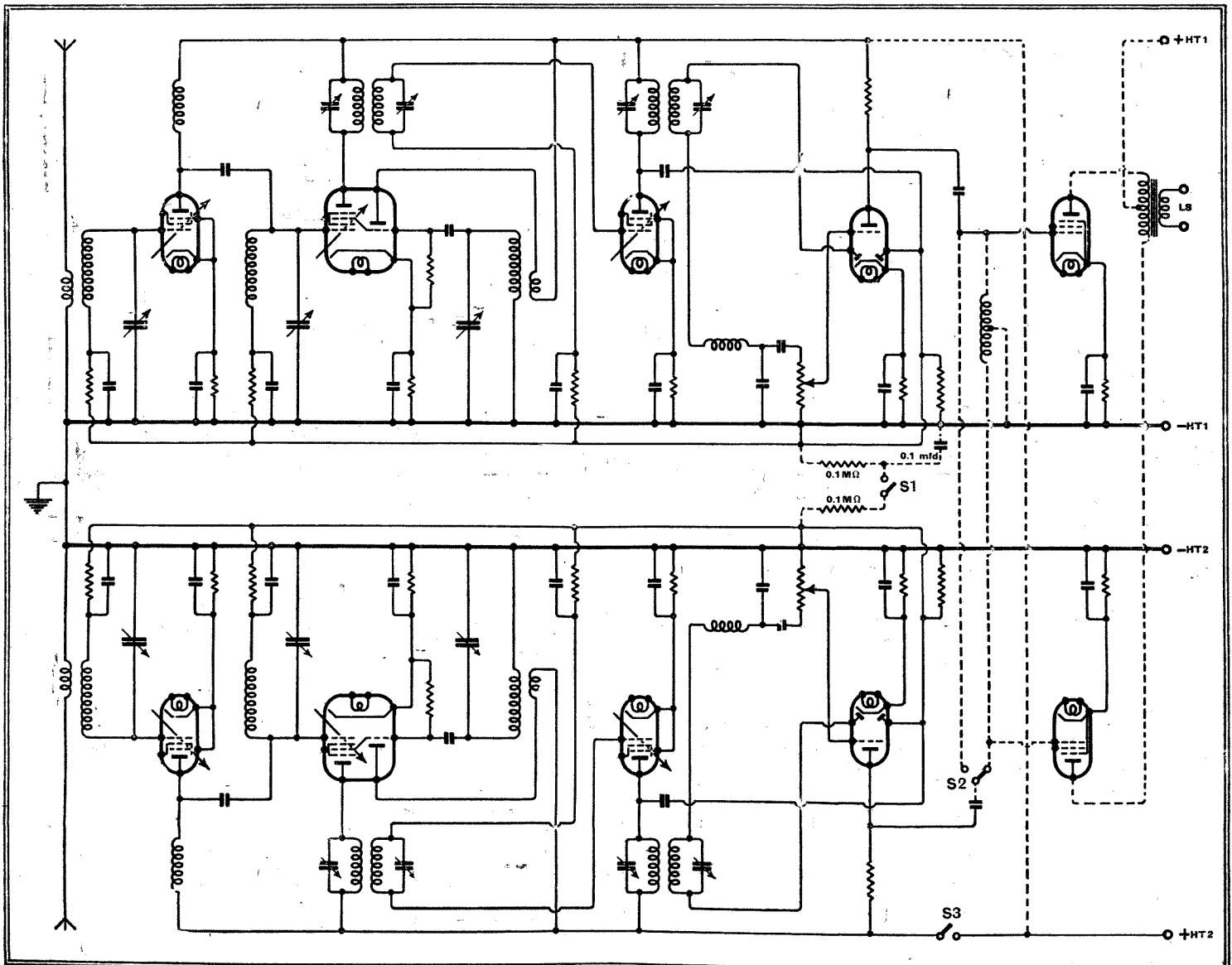


Fig. 4.—A complete diversity receiver, consisting of two sets of the type shown in Fig. 1, with the suggested alterations indicated by dotted lines.

**Diversity Reception at Home—**

arrangement, especially for short-wave work, is to erect two so that the electrical coupling between them is small. In this way the interaction between the two input circuits is reduced to a minimum. One interesting idea for short-wave reception involves the use of one horizontal and one vertical aerial, and with this arrangement it is possible that the diversity effect will be present even with the two sets tuned to the same station, owing to the fact that the horizontally and vertically polarised waves will not normally fade together. In parenthesis, it may be repeated that for true "spatial" diversity reception the aerials should be spaced apart at several wavelengths distance, although the receiver requirements are the same for both systems.

It is sometimes perfectly feasible to use the aerial for both receivers without undue

ill effects, assuming, of course, that no experiments with spatial diversity reception are intended. It is, therefore, always worth while carrying out the simple test of tuning-in a station on one set, with the AVC systems isolated, and then removing the aerial from the other receiver, noting the resultant increase in signal strength. If this appears excessive, it is worth while trying the experiment again with a resistance of from 10,000 to 50,000 ohms in each aerial lead before deciding that it is necessary to erect a second antenna.

This article is not intended to be an exhaustive study, but is directed rather towards suggesting subjects for further experiments. Sets differ too greatly in details of design and in performance for any hard and fast rules to be laid down. The system has been successfully tried out, so far as reception conditions in London would allow.

Obviously the type of connecting wire suited to the aerial circuit will not necessarily be right for the power supply circuit. But there are more subtle distinctions than this, and it is the purpose of this article to treat briefly of the type of insulation and wire best adapted to the different parts of the circuit and its correct disposition.

The natural place to begin seems to be at the aerial terminal, and here we are dealing only with currents at radio frequencies and of small magnitude, which need to be nurtured carefully so that as little as possible is lost. The size of conductor in this part of the circuit, except where the highest frequencies are concerned, is based mainly on the mechanical rigidity required, and should not be less than 18 SWG., while 16 SWG. is to be preferred as it is about twice as strong. For the short and ultra-short wavelengths the latter size should be considered a minimum, as the stability needed to ensure constancy of the stray capacities and inductances is not otherwise obtained; similar remarks apply to the oscillator wiring of a superhet if correct ganging is to be obtained.

It is usually considered that bare wire is preferable to tinned wire at the highest frequencies on account of the "skin effect," but since bare wire is readily corroded should the set be out of use, it is the opinion of the writer that it is better to use silver-plated wire if possible, since it is not only a better conductor than copper but less liable to corrosion; the use of lacquer coatings will, of course, raise the losses.

In the RF circuits the best insulator of all is air, and it should be used wherever possible. There are many cases where unsupported wire would be liable to make contact with other wiring, or the chassis,

# Theory into Practice

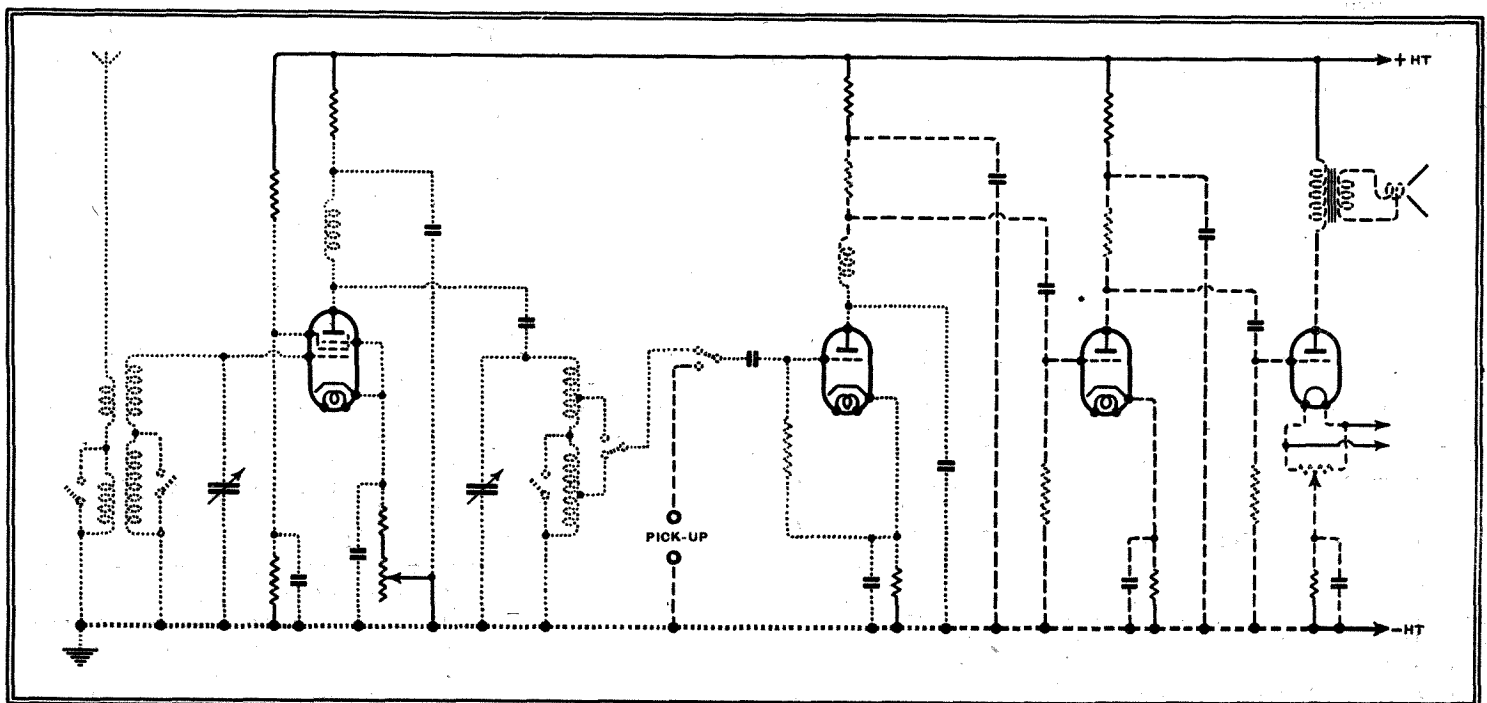
## II.—RECEIVER WIRING AND ITS INSULATION

By R. H. WALLACE

**I**N the circuit diagram of a receiver all the wiring is represented alike by neat black lines, the only indication of its nature generally given by the designer being as to whether it is to be screened or not. Unfortunately, the faith thus placed in the discretion of the builder is not always fully justified, and many ex-

*ALTHOUGH a theoretical circuit diagram conveys much information in a small space, it does not tell quite the whole story. This article and the one that preceded it deal with the problems encountered in translating a theoretical design into a practical receiver.*

cellent designs are impaired by the wiring of the various parts of the circuit not being properly adapted to their special requirements.



Skeleton diagram of a "straight" receiver, showing nature of the currents flowing in the various sections of the wiring. Full lines indicate wires "dead" to both RF and AF, while those wires which carry AF are shown in broken lines. Dotted lines indicate radio-frequency wiring. It is assumed that all the decoupling condensers are completely effective.

**Theory into Practice—**

and the use of uncovered wire can be made possible here by the suitable positioning of one or two pillars of ceramic or other insulator, according to the wavelength involved. Next in efficiency to air come the special "low-loss" insulators now to be had. Unfortunately, few of these are flexible enough to be used directly as a wire covering, except in the form of small beads threaded thereon, and their cost militates against their extended use. The only common field of employment of this material as an insulator for wire is in the better class of screened lead where the beads are used as spacers; this class of lead is much better than a fine wire threaded through sleeving, both in respect to losses and constancy of capacity. In special cases, for short, straight runs it is possible to use bare wire inside a metal tube, with only a few spacing washers of ceramic or varnished paper at intervals, thus making practically a concentric feeder.

The above remarks apply with greater force the higher the frequencies in use; at no frequency will the use of the best materials be otherwise than an advantage, but the benefit derived from their employment may be negligible at lower frequencies, appreciable at medium, and quite essential for satisfactory results at the highest.

In a similar manner the effects of stray inductive and capacity coupling vary with the wavelength. Most people are aware of the precautions to be adopted, but not all are sufficiently discriminating in their perception of which leads are at RF potential. A case in point is the lead to earth from a decoupling condenser. The fact that one end of a wire is connected to the chassis is taken by some to mean that it cannot be carrying RF currents; actually in this case it has to pass currents balancing those flowing in the other lead, and so can cause interaction with other wiring if near to it. At the higher frequencies even the chassis cannot be considered as "dead" in the RF sense, and it is necessary to connect the earth lead of the set directly to the part of the chassis where the connection from the ganged condenser is made, as this gives the shortest earth paths with most designs. In such cases also it is wise to use copper strip or braid for the wiring from condenser and inductances to ensure that these are as low in resistance as possible. On the same grounds the use of a common earth lead from several components to the chassis is to be deprecated, and each section of a ganged condenser should be separately earthed to the chassis.

**Uncontrollable Regeneration**

The foremost objection to excessive stray capacity to earth is that it restricts unduly the tuning range of the set, but if the dielectric involved is poor the losses will be greatly increased, so much so as to prevent satisfactory operation in some cases. Both of these evils are lesser ones than that of interaction between the dif-

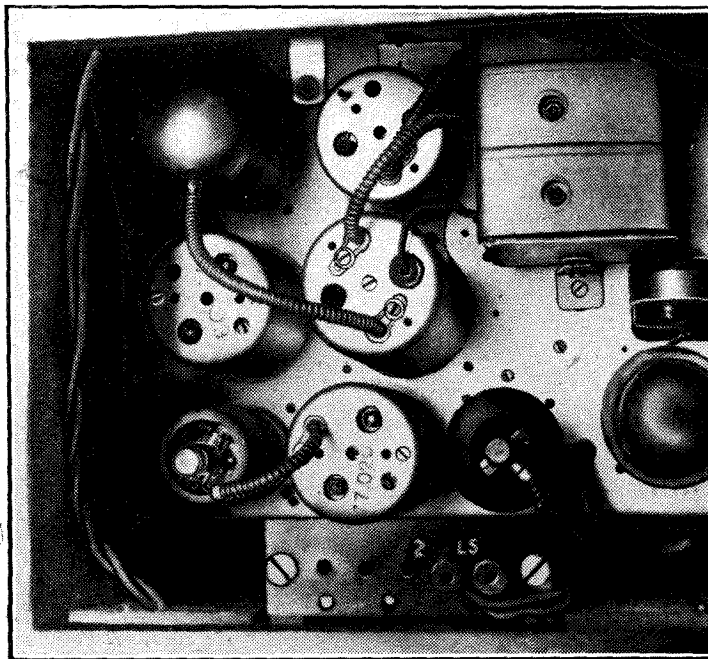
ferent portions of the circuit, and it is the function of screening to prevent this taking place to an excessive extent. The amount of screening needed is dependent on the amplification involved; where this is low the amount of screening needed is small, but with high-gain RF amplifiers complete isolation of the various circuits is essential; this is where the use of differing frequencies in the various stages, as with the superhet, enables large amplifications, such as would hardly be possible with a straight set, to be obtained.

It is the essence of good design to reduce all stray regeneration to a minimum, as it is easy to introduce a controlled amount later if needed, while the effect of stray couplings is not easy to calculate and may vary a great deal between

grid circuits, caused by stray couplings among the wiring, would be enough to cause instability even if every component were separately screened. Nevertheless, it is not possible to screen much of the wiring individually without heavy losses, even with the best insulation, and one has to rely rather on careful placing and the use of screening boxes to make a stable amplifier. In the writer's opinion the use of more than 6 inches of ordinary screened sleeving or 9 inches of special screened lead per stage should be unnecessary with a good design. Exception must be made in the case of reaction wiring where the losses are relatively unimportant.

Special reference must be made to the most difficult stage of all, from the point of view of design, namely, the detector. The difficulties with this arise from the fact that it has to be treated both from the standpoint of RF and AF currents. The wiring must be considered as a part of the two sections of the set and must be low-loss on the grid side and well screened on the anode side. The diode should receive similar care.

The subsequent stages of the receiver should be quite free from RF impulses and the length and disposi-



Use of screened leads in a high-gain superhet. Also note that the volume-control potentiometer is mounted on a bracket in such a way as to bring it close to the valve with which it is associated.

one set and another made to the same specification.

The small fields due to the currents in the leads of the RF section are not likely to cause much trouble from inductive pick-up, and in any case the screening used to prevent capacity effects will be almost as effective in combating the former at these frequencies. The manner of wiring may, however, add considerably to the inductance of the tuned circuit at very short wavelengths where the self-inductance of a few inches of wire may be significant, and a careful arrangement of the connections is well repaid. The great thing is to avoid the formation of loops in the wiring, and this adds to the effect; it will be found preferable in most cases to keep the "go" and "return" wires close together, and put up with the attendant increase of stray capacity, rather than separate them and increase the inductance.

At the highest frequencies regeneration is not likely to be much trouble, and indeed is often difficult to provoke; of more importance is the reduction of losses to the lowest possible amount. At the other end of the spectrum the stage gain is high and the interaction between the anode and

tion of the wiring is of less moment, while its insulation against the increasingly higher voltages becomes much more necessary. Capacity interaction will be less, but owing to the greater currents flowing inductive pick-up is more likely to take place. Careful layout of the set will solve most of the problems of this part of the design, while screened wire may be used more liberally, though the use of an excessive amount will reduce the high-note response. The grid circuits naturally call for the greatest care both in insulation and in their relation to other parts.

The voltages on the wiring of the AF amplifier are the steady ones due to the anode supply of the valves plus the signal voltages; the latter may rise to very high peak values. In deciding on the insulation required it is wise to allow for twice the steady voltage in anode wiring, while that of the grid should be at least as good; in the case of large output stages the grid peak volts may rise to as much as 200.

**Theory into Practice—**

Pick-up wiring, being an extension of the grid wiring, needs complete screening, and if the high-note response does suffer it is generally easy to arrange for the output of the pick-up to be compensated accordingly, while the hum induced by the absence of the protection would normally be intolerable. Care should also be taken that these leads do not run near the gramophone motor coils, or the heavy field will penetrate the screen. Microphone leads are even more susceptible to this trouble, as subsequent amplification is usually higher and the screening material must be carefully chosen for low resistance if it is to be fully efficient; a heavy braid is probably the most suitable.

**Perishable Insulation**

In connection with the use of rubber insulation it should be remembered that almost all natural rubber suffers considerably from ageing, which causes it gradually to harden, and this is the more rapid the higher the ambient temperature. If flexibility is important in a lead it is wise to replace it every five years or so. Natural rubber is also affected by oil, and in radiograms care is needed to ensure that the oil from the motor cannot drip into the set, while the motor leads themselves are better covered with varnished sleeving, which resists this attack.

All the wiring beyond the decoupling resistances may be considered as "dead" in the RF and AF sense, so long as the associated condensers are of sufficient capacity, and these wires may be of any reasonable length. This, however, must not be taken as an indication that they may be treated carelessly at such points as those where they pass through a screen or chassis, or rub against an earthed component, and extra insulation should be provided at such points.

With the higher voltages used in television apparatus special care must be taken and no bare wire or terminal should be nearer than  $\frac{1}{4}$  in. from any earthed point for voltages of up to 10,000 volts, while for the projection-type cathode-ray tubes where the potential is as high as 25,000 volts the least distance should be  $1\frac{1}{2}$  inches. Even with these precautions it is safer to use some insulation such as heavy varnished sleeving, in case the

wires become displaced; sharp points and angles in the wires should be avoided as these tend to concentrate the stress and cause failure. The insulation of the time-base circuits ought to be rated for 1,000 volts to be on the safe side.

In the case of the filament and heater wiring the voltage drop permissible and the carrying capacity of the wire are of more importance than the insulation, except in a universal set where all the wiring should be insulated to a high value throughout. For leads of, or over, 18 inches the potential drop is the deciding factor, while below this length the safe current in the wire is the limiting consideration. With average valves and transformers, and especially in the case of the rectifier, it is unwise to permit a drop

of more than 0.05 volts in these leads and the accompanying table has been prepared with this value as a basis.

Heater leads, since they carry heavy currents, have large external fields; twisted flex, screened if possible, makes the best connections. The wires should be kept short and as far away from the other leads as possible, especially the grid circuits.

Wiring design is essentially a common-sense matter once the conditions obtaining in the different parts of the receiver are realised, and careful attention to these details will result in a set that will not only work well when new, but will continue to do so for years even under adverse circumstances. Reliability is the true test of a really good design:

**TELEVISION PROGRAMMES****THURSDAY, SEPTEMBER 1st.**

12, C. H. Middleton "In the Garden."\* 12.15, Come and be Televised.\* 12.45-1, Inter-school Spelling Bee.\* 2.30, O.B. from the Regent's Park Zoo. 3, Jack Hylton and his Band. 3.30-4, 160th edition of Picture Page.\* 4.30, Zoo O.B. 5, Film, Cicely Courtneidge in "Aunt Sally." 6.30, "Cabaret Cruise."\* 7, Forecast of Fashion.\* 7.15-7.30, Film. 8.30, 170th edition of Picture Page.\* 9, "Libel," play by Edward Wall. 10.30, News.

**FRIDAY, SEPTEMBER 2nd.**

12, C. H. Middleton "In the Garden."\* 12.15-1, Come and be Televised.\* 2.30, Intimate Cabaret. 2.45, Zoo O.B. 3.15, Catch-as-Catch-Can Wrestling. 3.30-4, "Queue for Song."\* 4.30, Zoo O.B. 5, Film, Jack Hulbert in "Jack Ahoy." 6.30, "Cabaret Cruise."\* 7, Forecast of Fashion.\* 7.15-7.30, Films. 8.30, "Queue for Song."\* 9, Cabaret. 9.20, News Film. 9.30, Cartoon Film. 9.35, "A Hyacinth Halvey" one-act comedy. 10.10, Interval Music. 10.25, News.

**SATURDAY, SEPTEMBER 3rd.**

12, C. H. Middleton "In the Garden."\* 12.15-1, Come and be Televised.\* 2.30, Jack Hylton and his Band.\* 3, The History of Fire-fighting. 3.30-4, "Cabaret Cruise."\* 4.30, Demonstration by members of Women's League of Health and Beauty. 4.45, Judo Demonstration.\* 5, Film, "Aunt Sally." 6.30, "Queue for Song."\* 7, Forecast of Fashion.\* 7.15-7.30, Films. 8.30, "Cabaret Cruise."\* 9, Two short plays. 9.20, Films. 9.40, Variety Starlight. 10, Interval Music. 10.25, News.

**SUNDAY, SEPTEMBER 4th.**

8.50, News. 9.5-10.20, "Winter Sunshine," a comedy by G. A. Thomas and Archibald Batty.

**MONDAY, SEPTEMBER 5th.**

3, "Hyacinth Halvey" (as on Friday at 9.35

p.m.). 3.35, Gaumont-British News. 3.45-4.15, O.B. from Northolt Park of the Race for the British Empire Cup.

9, Film, "The Student of Prague." Cast includes Anton Walbrook, and Dorothea Wieck. 10, Interval Music. 10.25, News.

**TUESDAY, SEPTEMBER 6th.**

3-4.15, "The Importance of Being Earnest," a trivial comedy for serious people by Oscar Wilde.

9, Louis Golding shows some of the cherubs he has collected in his wanderings. 9.10, Cartoon Film. 9.15, "Gianni Schicci," one-act opera (Puccini). 10.15, Musical Item. 10.25, News.

**WEDNESDAY, SEPTEMBER 7th.**

3, Contrasts. 3.10, Gaumont-British News. 3.20-4, A review of songs from the "Mizzen Cross Trees," "Powder and Pipeclay" and "Rogues' Gallery."

9, Starlight. 9.10, Cartoon Film. 9.15, Talk on Sport. 9.30, British Movietone News. 9.40, Variety. 10, Interval Music. 10.25, News.

\* Items from the studio at Radiolympia.

**News from the Clubs****Thames Valley Amateur Radio and Television Society**

Headquarters: The Albany Hotel, Station Approach, Twickenham.

Hon. Sec.: Mr. L. Cooper, 3, Summer Avenue, East Molesey.

The following programme has been arranged:—

September 12th.—Restart of the Morse Instruction Group.

September 14th.—Lecture by a representative of the Automatic Coil Winder and Electrical Equipment Co., entitled "Electrical Measurements and Instruments."

September 17th.—Visit to the B.B.C. Listening Post at Tatsfield.

September 25th.—20-metre Field Day.

October 12th.—Annual general meeting.

November 9th.—Talk and demonstration by the 5-metre group.

December 3rd.—Provisional date for the annual dinner.

December 14th.—Lecture entitled "Transmitters or Television."

**West Herts Amateur Radio Society**

Hon. Sec.: Mr. A. W. Birt, 6, Hempstead Road, Kings Langley.

The August meeting was held at the Hon. Secretary's station, G3NR, and during the evening G3NL was worked on 7 Mc/s. G3NR then demonstrated his 28 and 56 Mc/s apparatus and also a QRP CO, input 0.84 watt, with which he recently worked G8IT and received a 569 report. G3MI is active on 14 Mc/s, CW and phone. Two other members are awaiting their full transmitting licences.

**Eastbourne and District Radio Society**

Headquarters: The Science Room, Cavendish Senior School, Eastbourne.

Hon. Sec.: Mr. T. G. R. Dowsett, 48, Grove Road, Eastbourne.

The August 8th meeting was devoted to five-metre work.

**RECOMMENDED SIZES OF HEATER CONNECTIONS.**

Length of Twin Wire.	Current in Amperes.				
	1 amp.	2 amps.	4 amps.	6 amps.	10 amps.
Up to 18in.* Rubber-covered Flex Wire.	14/0.0076 or 7/0.012	23/0.0076 or 11/0.012	40/0.0076 or 16/0.012	70/0.0076 or 28/0.012	110/0.0076 or 34/0.012
Up to 36in. Rubber-covered Flex Wire.	23/0.0076 or 11/0.012	40/0.0076 or 16/0.012	70/0.0076 or 28/0.012	110/0.0076 or 34/0.012	162/0.0076 or 65/0.012 †
Up to 9in.* Single Wire Rubber-covered or Sleeved.	One 0.036 (20 SWG.)	One 0.036 (20 SWG.)	One 0.036 (20 SWG.)	One 0.048 (18 SWG.)	One 0.064 (16 SWG.)

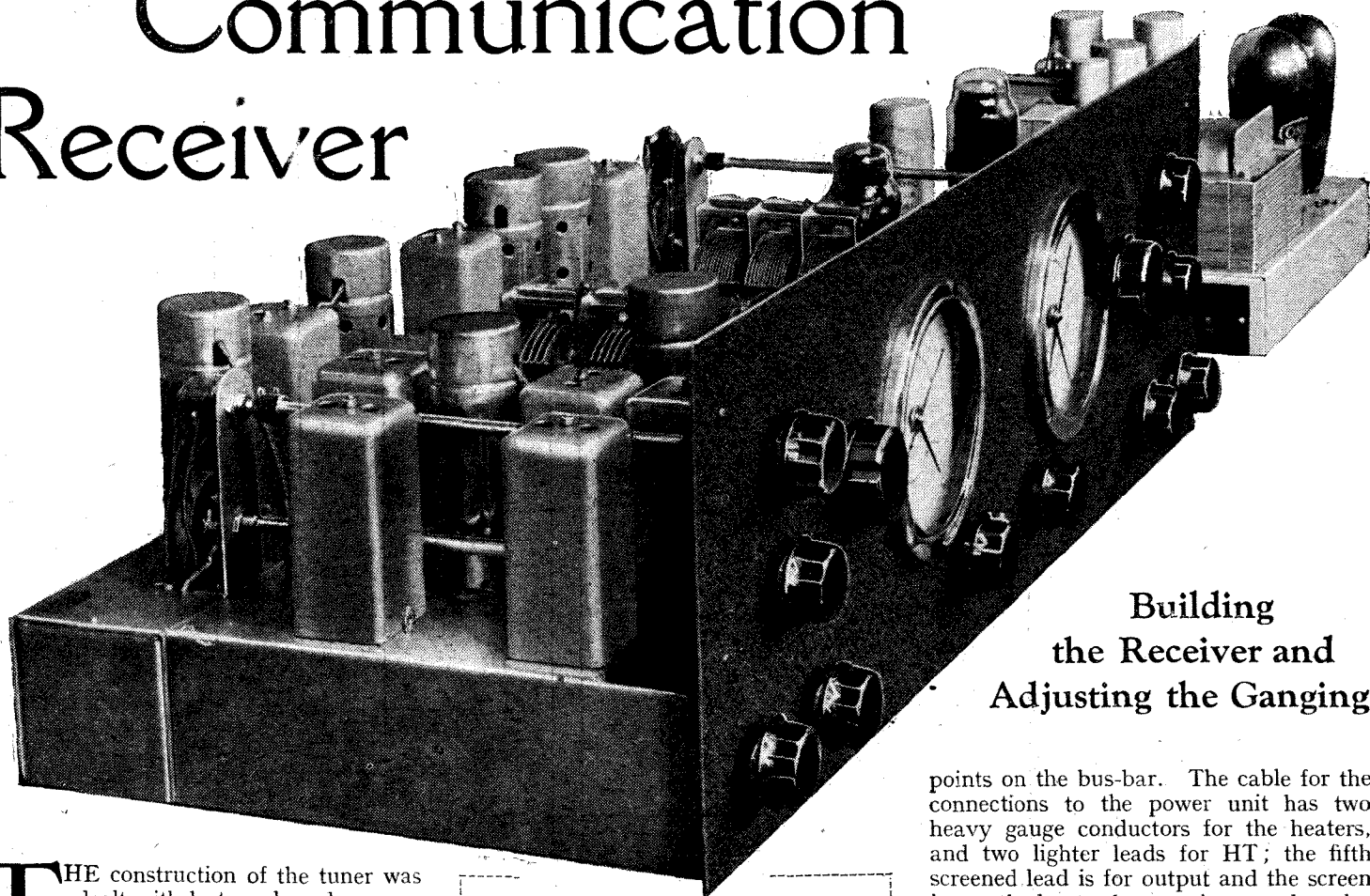
\* Drop of 0.07 volt.

† This is maximum current advisable and shorter lengths should be no less. 0.0076 is 36 SWG. and 0.012 approximately 30 SWG.

# The Wireless World

How a Receiver is Designed.—XXIV.

## Communication Receiver



### Building the Receiver and Adjusting the Ganging

**T**HE construction of the tuner was dealt with last week and we now turn to the IF amplifier and early AF equipment. The circuit diagrams, both of this section of the apparatus and of the power unit, appeared in *The Wireless World* for August 18th, but we shall defer consideration of the construction of the power unit until next week.

Everything in the receiver is quite straightforward and no difficulty should be encountered. Components are not cramped together and there is plenty of space to work in. As usual the greatest care is needed in the switch wiring, but there is no reason why anyone should make a mistake if the diagrams which accompany this article are carefully followed.

The chassis is divided into compartments to give the necessary screening and a single hole is provided in each partition to take the inter-unit leads. With very few exceptions these are the HT, screen, AVC, cathode, and heater wires, and they are run as bus-bars straight round the set, the various connections being taken off at appropriate points en route. The use of different coloured sleeving is convenient for the ready identification of the various leads, but is not, of course, essential. Care must naturally be taken to make sure that no short-circuits occur between the leads of the bus-bars at the points of connection, where the wires can-

*FOLLOWING upon the details of the tuner which appeared in last week's "Wireless World," this article describes the construction of the receiver. The process of adjusting the IF amplifier is treated as well as the details of ganging.*

not well be sleeved. To avoid the possibility of such short-circuits it is a good plan to cover the joints with rubber tape which is readily obtainable from cycle shops. Again, this is not an essential, but a precaution, for with a little care it is easy to stagger the connections along the bus-bar so that there is no likelihood of trouble with the joints left bare. When all has been done the neatest job is obtained by binding the leads of the bus-bar together with thread, and this also increases the mechanical strength.

Connections to the tuner cannot be made when it is in place in the receiver chassis. The leads should, therefore, be cut extra long and connected to it before it is mounted. It can then be placed in position and the leads cut to their correct length and joined to their appropriate

points on the bus-bar. The cable for the connections to the power unit has two heavy gauge conductors for the heaters, and two lighter leads for HT; the fifth screened lead is for output and the screen is earthed at the receiver end only. Although there are only five leads, a seven-pin plug is used to avoid confusion with earlier equipment, using 4-volt valves.

Now, before turning to the adjustment of the apparatus, there is something which must be said about valves. The types chosen have been selected primarily for performance, secondly for general availability, and thirdly for economy. The RF valve is a Mullard EF8; the frequency-changer is the Osram X65, the IF valves KTW63, detector D63, BF oscillator and phase-splitter KTZ63, output stage PX4, rectifier U52; the tone-control stage and the push-pull AF stage have American 6N7 valves.

For one reason or another constructors may wish to use other valves, and there is no objection to this if the correct substitutions and the appropriate alterations are made. Although with the exception of the EF8 all the valves used are of American type, the valves actually employed in the development were British counterparts except for the 6N7 stages for which there are no British equivalents. With the exception of the RF and output stages, American valves or American types of other British makes can be used everywhere without alteration. For the X65, the 6J8G can be used and the counterparts of the KTW63 and KTZ63 are respectively