The Wireless World

THE PRACTICAL RADIO JOURNAL

26th Year of Publication

No. 894. FRIDAY, OCTOBER 16TH, 1936. VOL. XXXIX. No. 16.

Proprietors : ILIFFE & SONS LTD.

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Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone: Waterloo 3333 (50 lines).
Telegrams: "Ethaworld, Sedist, London."

COVENTRY: Hertford Street.
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BIRMINGHAM:
Guildhall Buildings, Navigation Street, 2.
Telegrams: "Autopress, Birmingham." Telephone: 2971 Midland (4 lines).

MANCHESTER: 260, Deansgate, 3.
Telegrams: "Iliffe, Manchester." Telephone: Blackfriars 4412 (4 lines).

GLASGOW: 26B, Renfield Street, C.2.
Telegrams: "Iliffe, Glasgow." Telephone: Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates :
Home, £1 1s. 8d. ; Canada, £1 1s. 8d. ; other countries, £1 3s. 10d. per annum.

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CRITICISM is already beginning to break out on the subject of expenditure on television stations and programmes. Letters are appearing in the Press and there has, in addition, been a certain amount of agitation with a view to opposing expenditure of B.B.C. revenue in this direction.

The reasons given for objecting to the inroads which television is making into B.B.C. finances are that it is the listeners' money which is being used and diverted from the sound programmes as a whole to provide television transmissions in a restricted area and for a potentially limited number of users.

We think it is very desirable to do what is possible to check the growth of this feeling of discontent before it spreads. The achievement of television and its development as a regular service is something for this country to be proud of, and whether or not television attains popularity at once must depend upon the attractions of the programmes transmitted. When the public recognises the value of the entertainment, then we may hope that sets will be sold in increasing numbers and may as time goes on be available at lower prices than those which rule to-day. But this goal will never be achieved unless the B.B.C. is courageous enough to be unstinting in efforts to provide the right material for the programme service.

It is altogether wrong to talk of the revenue of the B.B.C. as listeners' money, as if it were in the nature of payment for a theatre or concert ticket. The 10s. is payable as a licence fee for the use of a wireless receiver and, as such, it comes under the same category as a dog licence, which carries with it no promise as to the behaviour of the dog.

It is, perhaps, unfortunate that so much publicity has been given to the fact that the B.B.C. revenue is based upon the licence receipts. If the 10s. licence had been regarded as on the same basis as a dog licence and broadcasting financed by a Government grant, these arguments might never have arisen. It has, no doubt, been convenient to arrange for the B.B.C. revenue to be in proportion to the licence fees collected, but apart from this the payment of the annual licence ought not to be mixed up with arguments as to what the listener is entitled to expect by way of programmes.

Aerials

Special SW Types

FOR many years now the wireless aerial for broadcast reception has been a necessary but rather uninteresting accessory to reception. Beyond seeing that the aerial wire was laid out on approved lines and kept free from rubbing contacts and bad joints, there was little more that could be done with it.

With the coming of short-wave reception there has been a general revival in interest in aerial design, and for television reception, in particular, special aerial designs have important advantages, particularly in the direction of reducing interference from local causes. The dipole arrangement, favoured for ultra short-wave reception, is discussed in articles in this issue.

The ideal condition for employing a dipole aerial is where one transmission on a fixed frequency is to be received, as in the case of the television broadcasts. The complications arising when an aerial of this type is required to provide for reception on a number of different wavelengths limit its usefulness in such circumstances.

Experiments with Television

EFFECT OF HEIGHT—MOTOR CAR INTERFERENCE—HORIZONTAL OR VERTICAL?

THIS article contains valuable information on the use of doublet or dipole aerials for television reception. The advantages of height, both for signal strength and reduction of interference, are shown, and the relative effectiveness of horizontal and vertical arrangements is discussed.

RECENT transmissions of television pictures and sound from the Alexandra Palace to Radiolympia have afforded an excellent opportunity for carrying out certain fundamental and important measurements with television aerial systems. M. G. Scroggie, in his article "Television and the Aerial,"* has shown the necessity for certain investigations into the properties of television aerials, and this article is intended to follow up his excellent introductory work on this subject.

It is not an over-statement to say that the aerial for television reception requires more careful design and consideration than that required for broadcast reception on the medium and long waves. In the first place, ultra-short waves are much more rapidly attenuated than long waves in their passage over the earth's surface. Secondly, high transmitting power is not so readily available from both technical and economic considerations.

These two factors result in a lower average field strength in the vicinity of the receiving aerial, and a consequently lower signal input to the receiver itself. Furthermore, the presence of neighbouring conductors or semi-conductors vastly influences the field strength, and in most cases causes a further reduction, although an increase is sometimes noted when certain conditions are fortuitously present.

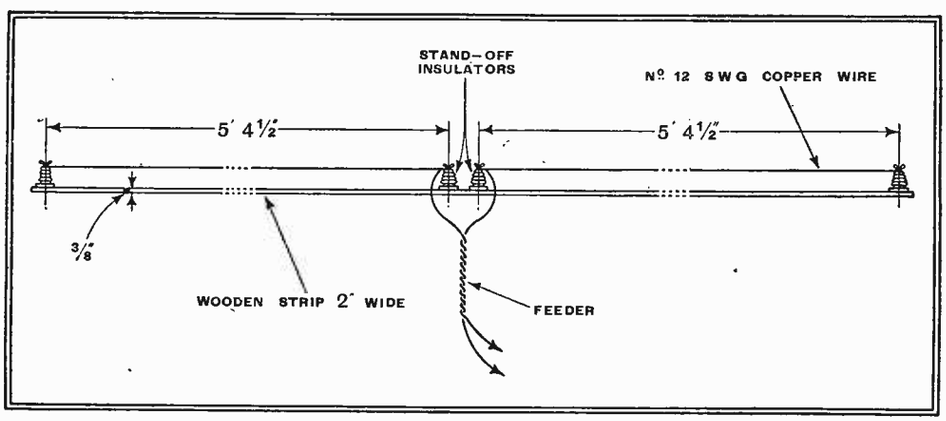


Fig. 1.—Construction and dimensions of the half-wave doublet aerial used for the experiments.

If electrical interference were completely non-existent, then receivers might be built with increased gain to compensate for these inadequacies of field strength, but this is not a practical basis on which to work. Electrical interference from the ignition systems of motor vehicles affects television reception in many areas, the electrical disturbances being mainly due to the sequential sparking at the plug points. The characteristic clicking noises vary with engine speed, and may be heard when listening on and around 7 metres in the vicinity of any main road. The effect on a high-definition television picture is to superimpose upon it numerous small scintillations of night sky appearance.

Directional Advantages

Fortunately this form of interference may be reduced in most cases by arranging the aerial system so that it is more effective in picking up the required transmission than the unwanted electrical noise.

The exhaustive experiments to be described were made in order to ascertain what performance could be reasonably expected from the simplest form of efficient aerial system, and how it should be placed with respect to the ground to obtain a maximum signal-to-noise ratio.

The aerial used for the experiments comprised a half-wave doublet, suitably matched to a low-impedance transmission line, approximately 100ft. in length. The dimensions of the doublet are given in Fig. 1, together with a sketch of the general arrangements.

The aerial was so arranged that it could be erected in a vertical position with respect to the ground, and could be raised or lowered through a total height of 33ft., corresponding to approximately one and a half wavelengths of the received transmission. The measuring apparatus consisted of a suitable input system and frequency changer feeding into an IF amplifier, the frequency of which was 1.6 megacycles, and the gain of which was adjustable in suitable decibel steps. This amplifier was followed by a valve voltmeter, of which the input time constants were adjusted so that the indications (in the case of electrical noise) more closely corresponded to the annoyance factor than to peak or RMS values.

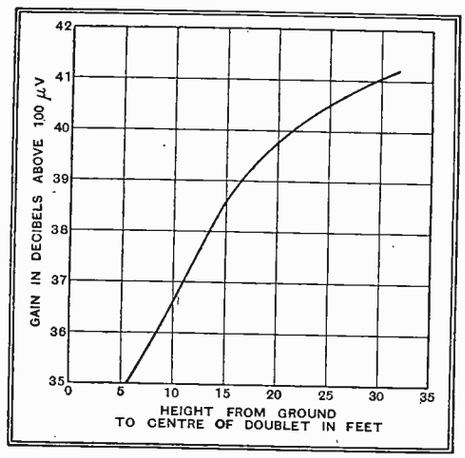


Fig. 2a.—Curve showing variation of signal strength with height above ground of the vertical half-wave doublet.

The whole apparatus was well built and screened, and was very stable in operation. Although the absolute sensitivity in microvolts input for full scale deflection was not exactly known at the television wavelengths, the relative inputs in decibels were known to within + or −0.5 db., and, of course, relative values are of major importance for the experiments to be made. Preliminary calibrations, however, were made and the input in microvolts required to give a full voltmeter deflection at maximum gain in the system was estimated to be of the order of 100 microvolts.

The curves showing the results of these

* *Wireless World*, August 28th, 1936.

Aerials

By F. R. W. STRAFFORD

(Research Dept., Belling and Lee, Ltd.)

experiments are thus relative to 100 microvolts, so that 40 db. represents 100 × 100 = 10,000 microvolts, 6.0 db. = 100 × 2 = 200 microvolts, and so on.

The tower of Alexandra Palace is at a distance of approximately 5.3 miles from the point at which the aerial was erected, and was visible from ground level. The route is thus an optical one, and the

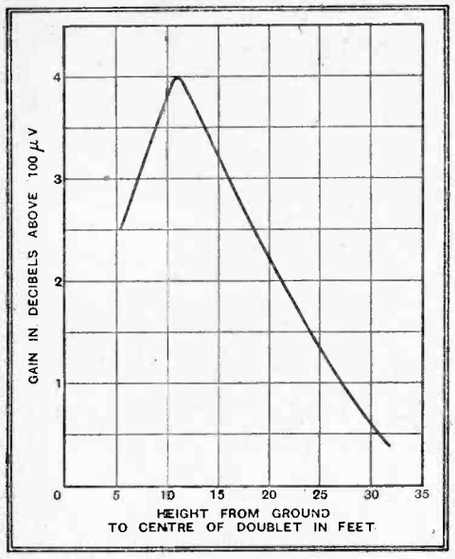


Fig. 2b.—Variation of ignition interference strength with height above ground (vertical aerial).

receiving aerial system already described was located in a field over 100ft. from the nearest buildings.

Fig. 2*a* shows how the field strength increased with the height of the aerial above the ground, and it is at once apparent that in a location free from surrounding buildings this increase is very rapid. Converting from decibels: at the ground level the signal produced an input of 5.6 millivolts, while at one wavelength height

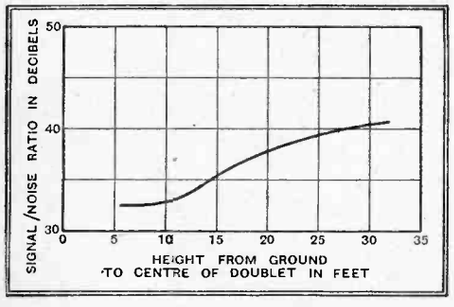


Fig. 2c.—Resultant variation of signal/noise ratio with height above ground (derived from curves 2a and 2b).

Fig. 3.—Receiving aerial and measuring equipment.

(22ft.) this is increased to 10.25 millivolts.

It was now necessary to determine the manner in which the aerial responded to a typical source of ignition interference. A saloon 8 h.p. car of a popular make was located at a distance of 50ft. from the aerial when at ground level. The engine throttle was pre-set so that the revolutions would closely correspond to a road speed of 30 m.p.h. Fig. 2*b* shows the results, from which a very interesting fact arises. An optimum height apparently exists at which the ignition interference is at a maximum. This was confirmed by testing with other cars, identical results being noted. Fig. 2*c* was obtained by subtracting the curve of Fig. 2*b* from 2*a*, and thus indicates the signal-to-noise ratio in decibels against the height of the aerial.

In its decibel form this curve looks rather flat, and it might be thought that very little improvement in signal-to-noise ratio resulted from placing the aerial well above ground level. By converting these decibels to ratios the picture is changed somewhat. Up to a distance of about 10ft. from the ground the ratio is of the order of 40 : 1, but at a height of about 20ft. this increases to 90 : 1. It is thus apparent that in order to secure a reasonable value of signal-to-noise ratio with a vertical aerial it is necessary that the lowest portion should be at least 15ft. from ground level, particularly if the source of ignition interference is at a distance of 50ft. or less. It is believed that the signal-to-noise ratio should be at least 60 : 1 in order that interference-free reception of television pictures may be obtained.

These experiments immediately indicated the need for a comparison of vertical with horizontal aerials, and accordingly a structure was built upon which was located, at 16ft. from the ground, an identical aerial system, excepting that it was adjustable in either a vertical or horizontal plane with respect to the ground by known angular increments.

A photograph of the arrangement of the measuring apparatus and the aerial system is shown in Fig. 3.

Vertical Aerials Best

Some very interesting results and curves were obtained by this very flexible arrangement. Of principal note is the great variation of the received signal strength when the aerial is rotated from a vertical to a horizontal position, particularly when the horizontal position is such that the station is at 90° with respect to the centre of the aerial. The difference here was 23 db., a ratio of nearly 14 : 1.

When the aerial was rotated from vertical to horizontal, so that the ends pointed to the Alexandra Palace, the difference was only 15 db., or 5.6 : 1. It is obvious that when located in fairly open surroundings, and with a clear view of the transmitting site, the wave retains its vertical polarisation to a marked degree, even close to the earth's surface. If the experiments had been conducted at a much greater height, it would be expected that the decibel differences between the vertical and horizontal aerial would be even greater still. The experiments suffice to show the pronounced superiority of a vertical over a

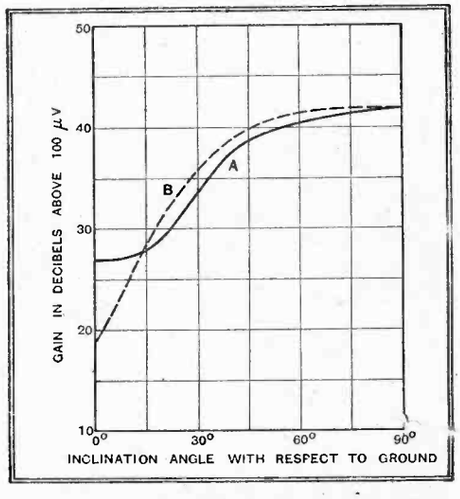


Fig. 4.—Variation of signal strength with aerial inclination in two vertical planes. A, aerial pointing towards Alexandra Palace; B, at right angles to it.

horizontal aerial system in so far as the magnitude of the received signal is concerned. The curves in Fig. 4 show that slight departures from the vertical position are permissible, since only small changes of received field strengths occur. It is when the angle is less than 50° with respect to the ground (vertical = 90°) that the

Experiments with Television Aerials—

signal falls off so markedly. When the aerial was in the horizontal position there was quite an appreciable change in signal strength when pointing at the transmitter, as compared with the transmitter bearing at right angles, the difference being 8 db. If it is impossible to erect a vertical aerial, it thus seems necessary to point the horizontal aerial to the station in order to obtain maximum signal strength.

The manner in which car ignition interference varies with distance from a horizontal half-wave aerial at 0° and 90° bearing upon the car respectively, is shown in Fig. 5. It can be seen by reference to

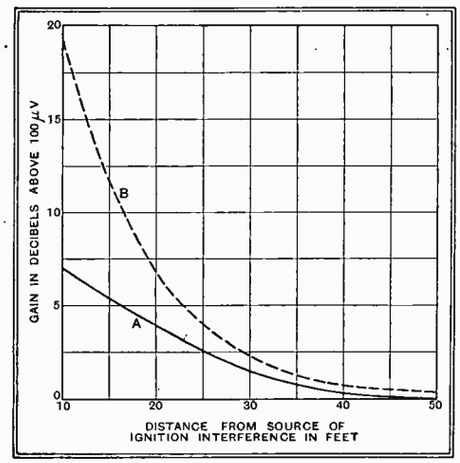


Fig. 5.—Variation of ignition interference with distance; horizontal aerial 16 feet above ground, aerial at right angles to source of interference for curve A and pointing towards it for Curve B.

curves A and B that with a horizontal aerial located 50ft. from the car, and half a wavelength in height from the ground, the signal-to-noise ratio will be approximately 26 db., as compared with the vertical aerial ratio of 36 db. This figure is that obtained when the horizontal aerial is in its best receiving condition, namely, pointing towards the transmitter. It might be noted here that the normal polar reception distribution of a half-wave aerial shows the maxima at right angles to the aerial, and zero at the ends. It must be remembered, however, that this implies horizontally polarised transmitted waves, and not vertically as in the case of the television transmission. This probably accounts for the complete reversal of the directivity of the half-wave aerial in these experiments.

Reverting to signal-to-noise ratio: the vertical aerial is thus 10 db. better than a correctly bearing horizontal aerial of the same height. If circumstances are such that the transmission emanates from a position at right angles to the aerial, the vertical is then 17 db. better on signal-to-noise ratio. It is quite obvious from the foregoing that in all respects horizontal aerials are to be deprecated and vertical systems to be recommended wherever possible. An excellent plan is to mount the aerial by stand-off insulators on a suitably impregnated and varnished lath, and suspend it from a rope, taking care to anchor the lower end to prevent it gyrating in breeze. The aerial should be erected as far as possible from the road, and as high as circumstances will permit.

Since writing the main part of this article further measurements have been made at the writer's residence, which is located at the edge of Epping Forest in the northern vicinity of Loughton, the distance being 9.25 miles. There is much intervening forest and high land, and although one would expect a slight departure from vertical polarisation of the received waves in this location, a vertical aerial was found to be 6 to 10 db. better than a horizontal, at a distance from the ground varying from a few feet to 25ft.

It is hoped to deal in a further article with the effect of directional vertical aerials in which reflectors and directors are employed, and the measurements for this work are now being made.

Television at Thirty Miles

By ERNEST H. ROBINSON

RECEPTION of both sound and vision signals from places as remote as Cambridge, Ely, Bournemouth, and Southend have been reported, but, so far, there is little information as to the limits of the real service area of the new station. Field strength contour lines are, of course, very irregular, depending upon the height of the receiving station and the intervention of high ground between transmitter and receiver. In one locality at least, thirty miles south-west of Alexandra Palace, pictures can be received of a quality which compares very favourably with that which can be had five miles from the transmitting station.

The receiver is a standard Baird Televisor which came straight from the Radiolympia Exhibition without any "vetting" or hotting-up. The aerial, erected on a mast on the roof of the house, the top of the mast being about two hundred and fifty feet above sea level, is also standard Baird equipment, and is a half-wave di-pole, transformer matched (see *The Wireless World*, October 2nd, page 348), the signals being fed to the receiver through lead-covered co-axial cable. The distance between transmitter and receiver is almost exactly thirty miles, and between them is no ground substantially higher than the aerials.

At this distance the only real differences from the pictures received in the London area are a kind of grain on the background due to the low signal-to-noise ratio, and almost constant "flash" interference, caused by motor car and aeroplane ignition, due to the sensitivity of the vision portion having to be pressed to its utmost. The receiver is a hundred yards from the nearest road, and along that road traffic is light.

The "grainy" background seems to take some sharpness from the pictures, but is not in any way distressing. The white flares due to motor car ignition are occasionally annoying.

Before any pictures were received, it was thought that the major difficulty due to distance might be in the holding of synchronisation. With pictures received on the Baird system there is no difficulty at all in this respect, but very dark pictures received on the Marconi-E.M.I. system are inclined to slip a cog or two, but they come into step immediately more light is transmitted.

The C.R. Tube controls seem to need much more accurate and careful setting than when the instrument is nearer town. The setting of the control of output from the vision amplifier circuit is critical. This has not been noticed in Baird instruments nearer the transmitter.

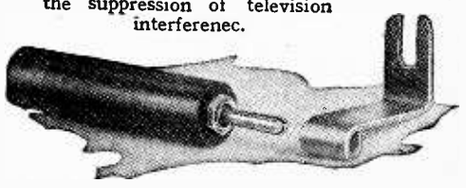
The cathode-ray tube in the Televisor, which gives pictures about ten by eight inches, is conservatively used, and there is little of the familiar barrel distortion due to curvature of the tube end. The colour is a softish black and white, and is most attractive. The light is excellent, and the drawing of thin curtains across the windows is all that is necessary for very good reception. Contrast is also good. Sound volume "full on" is ample for a medium-sized room.

Interference from "A.P."

A Simple Cure

IT now seems certain that reports in lay newspapers have hardly exaggerated the seriousness of the interference from which North London broadcast listeners have suffered (on both National and Regional wavelengths) during the experimental television transmissions from Alexandra Palace. The matter has been touched upon from a technical point of view in our Correspondence columns and now the Research Department of Belling and Lee expresses the opinion that break-through of the sound accompanying television may cause trouble anywhere within a radius of four miles from the Palace.

A Belling-Lee ¼-wave choke for the suppression of television interferenec.



A cure has been sought, and, according to the Belling-Lee engineers, the most satisfactory remedy is afforded by the insertion of a ¼-wave choke, usually in the aerial lead, but, in exceptionally difficult cases, in every lead over six feet long that enters the receiver. A midget choke of compact and convenient design has accordingly been produced; this is now commercially available at the cost of 2s.

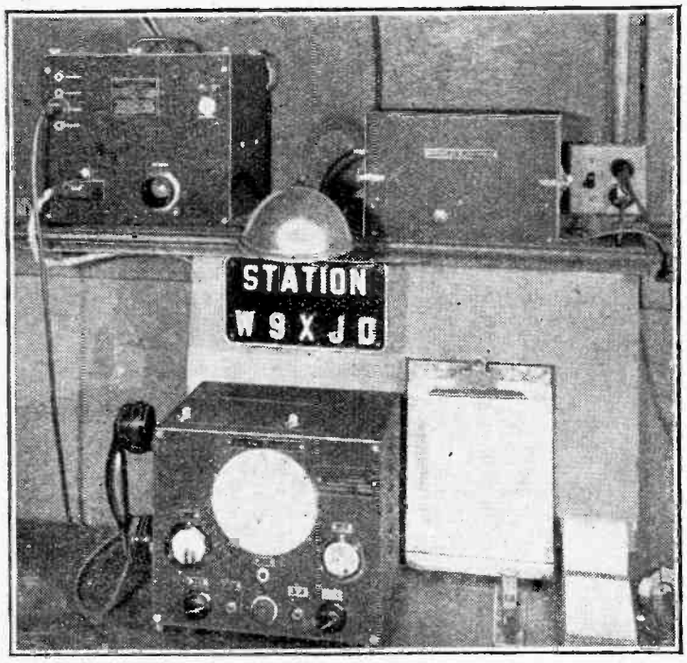
American Police Wireless

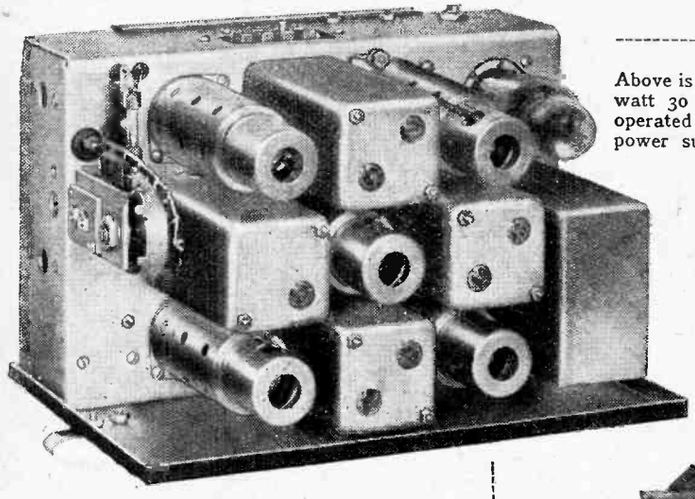
AN INTERESTING NEW DEVELOPMENT IN EQUIPMENT OF THE ULTRA-HIGH-FREQUENCY TYPE

IN America, where for many years now wireless has been such an essential part of the various municipal police systems, very considerable progress has been made in the development of this rather specialised type of mobile equipment. Long ago radio telephony was adopted as being generally more convenient than telegraphy for communication with the patrol cars, since it does not require a skilled operator in the crew of each vehicle.

The single-way working system, whereby the patrols could only receive acknowledgment or to request more details. Obviously much valuable time is saved by the duplex method of working.

Since, in most cases, quite a limited range suffices for municipal police work, the U.S. Federal Communication Commission has allocated a



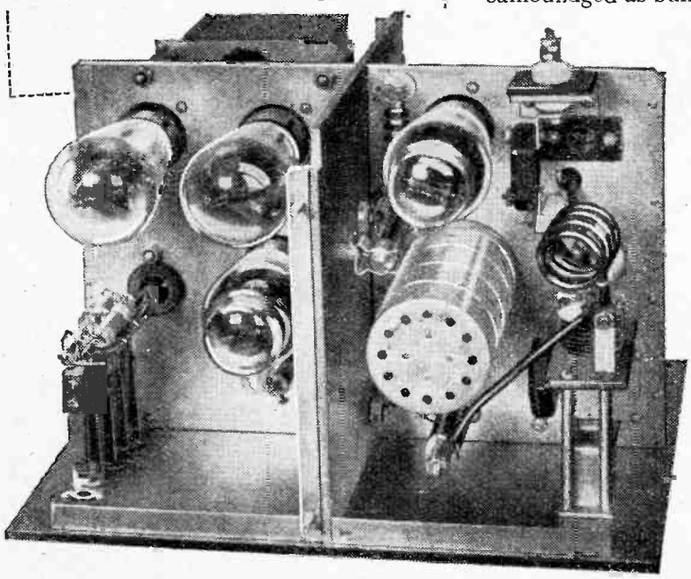


Above is seen a receiver and 15-watt 30 to 42 Mc/s transmitter operated from a common AC power supply unit and a single aerial, and to the left a superheterodyne-super-regenerative receiver used by American police cars and also at the headquarters station. The picture below shows the arrangement of a 15-watt 30 to 42 Mc/s mobile transmitter with the modulation amplifier on the left and the power amplifier on the right.

messages and not reply, was found to be unsatisfactory in many respects, though even this limited form of communication was an invaluable asset. More recently attention has been given to the development of the two-way, or simplex, system, thus enabling the patrol cars both to send and receive messages, and the great advantages this has afforded have now induced the designers of police wireless equipment to advance still one step further and evolve equipment of the true duplex type, which enables the recipient of a message to break-in, as in the case of the ordinary telephone, either for acknowledgment or to ask for more details on any point not clearly understood.

Wavelengths allocated

With the simplex system the sender of the message has no means of knowing whether it is received and correctly understood until the finish, when a manual change-over to receive, or transmit as the case may be, has to be made for an



channel in the ultra-short-wave region for this type of service, the actual frequency band being from 30 to 42 megacycles, i.e. 10 to 7.14 metres.

Some interesting equipment of the duplex type and for use on these wavelengths has been developed by the General Electric Company of America of which a brief description can be given.

Duplex working from a car presented many problems, not the least of which was the matter of an aerial, or aerials. Low height, for the wireless may often be used when the car is travelling at high speed, does not make for good efficiency, especially when transmitting. Several types have been tried, including short fixed vertical rods, telescopic masts and aerials camouflaged as bumpers, while roof aerials have been employed in saloon cars for reception purposes only.

The vertical aerial has been found greatly superior to most of the other types, and schemes have been evolved for using the same vertical aerial for both transmitting and receiving even with the duplex system. For this purpose the General Electric Company of America has developed a filter for interposing between the transmitter and the receiver which makes use of a section of transmission line, the attenuation characteristics of which are so good that it is possible to obtain satisfactory reception

American Police Wireless—

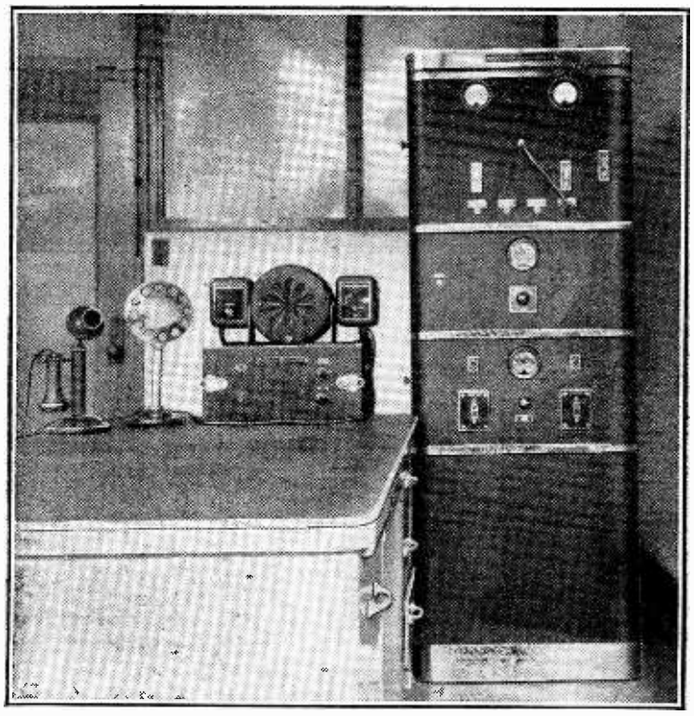
with the aerial radiating signals from a 15-watt transmitter and with only about four per cent. difference in frequency.

For this class of work the receiver must be very sturdy, since it is subjected to considerable vibration, and it must be capable of giving reliable reception under very adverse conditions. To function satisfactorily in any large city, with its mass of steel-constructed buildings where, within a distance of a few yards, the signal strength may change enormously, very rapid and efficient AVC action is essential to maintain the signal at a reasonably constant level. The sensitivity must also be high and, in addition, the receiver must be capable of giving good rejection to electrical interference.

It is a well-known fact that the super-regenerative circuit possesses these desirable characteristics, but it lacks selectivity, and it can cause considerable interference to other receivers owing to radiation from its aerial.

A receiver was eventually evolved by the G.E.Co., that possessed the good features of the super-regenerative system but without its disadvantages, the solution of the problem being found by combining the super-regenerative and superheterodyne circuits, the former system being employed for the second detector.

The superheterodyne portion gave the required selectivity and acted as a buffer to aerial radiation from the super-regenerative detector.



A 75/150 watt ultra-short-wave transmitter and superheterodyne-super-regenerative receiver arranged for use with two separate aerials.

From the details available it appears that one signal frequency HF amplifier, using a Type 78 valve, is employed before a triode-pentode frequency changer. Then follows a 6B7 duo-diode pentode, the pentode portion being employed as an IF amplifier and its diodes for conventional AVC. The second IF stage is the pentode section of a 6F7 triode-pentode, the triode being used as a super-regenerative second detector. This is followed by a Type 79 double triode, one section of which supplies the quenching oscillations and the other functions as an intermediate LF amplifier for a Type 41 output pentode.

The quench frequency is about 20,000 c/s and the intermediate frequency is 9 Mc/s.

The best adjustment of a super-regenerative detector produces a certain amount of hiss, though, of course, this practically disappears when a carrier wave is present. On police patrol duty the receiver is kept switched on for most of the time and, in order to minimise the annoyance caused by the heavy background of the receiver while standing-by for messages, the G.E.Co., has incorporated a noise-suppression circuit operated by the carrier wave.

When a signal is applied to the grid of a super-regenerative detector its anode current falls and this change is utilised to reduce the grid bias on the LF amplifier, which in the quiescent state is biased to current cut-off.

In order to simplify the handling of the wireless equipment, the receiver is pretuned and operated by remote control.

Robust construction, reliability and good frequency stability under very adverse conditions are essential features of the mobile transmitter designed for this class of work. It cannot be kept switched on the whole time, yet it must be ready for use at any moment. Since only a few seconds can be allowed for the valves to warm up, frequency stability is of paramount importance. Five valves are used in the G.E. Co.'s transmitter, three in the modulating amplifier and two in the HF generator. A double-button carbon microphone is employed, its output being amplified by a Type 47 valve which drives two 46's in class B push-pull. These modulate a 2A3 power amplifier which is excited by a similar valve used as a master oscillator.

The transmitter is assembled on a four-section chassis arranged in the form of a cross. The modulator occupies one section, all transformers and chokes are in another, while the master oscillator and power amplifier each has a separate compartment. The power output of the two Type 2A3 valves is 15 watts.

The requirements of the police headquarters wireless equipment will most likely vary in different localities, but standardisation has been allowed for where a 15-watt transmitter will give the required service range. When used as a headquarters transmitter, the 15-watt set can be operated entirely from the AC mains, though otherwise it is identical with the car sets.

A range of transmitters from 15 watts to 1.5 kilowatts has been developed for the main control station, and the higher-powered sets are mostly crystal controlled.

CLUB NEWS

Ipswich Radio Society

It has been decided that the old Ipswich Radio Society shall be revived, and the first meeting for the election of officials has already taken place. Meetings are to be held on the second Tuesday in each month, an additional meeting being held on the fourth Tuesday during the winter. The Society has already enrolled several transmitters in its ranks. All interested should get in touch with the Secretary at Radio House, St. Peter's Street, Ipswich.

The Irish Short-wave Club

A long-felt want has been filled by the inauguration of a short-wave club in Dublin. At the outset work will be confined to reception, but later on a transmitter will be erected for the benefit of members. The services of two well-known Dublin amateurs, EI2F and EI8D, have been secured for lecture work.

There is an entrance fee of 2s. and a weekly subscription of 6d.; country members 5s. per annum. Meetings are held at 8 every Tuesday evening in the Club's temporary premises at 47, Dolphins Barn Street, Dublin. Full details of the club can be obtained from the Secretary, 3, Clare Lane, Dublin.

Scottish Short-wave Radio and Television League (Glasgow Branch)

The above club, sponsored by the *Daily Record* of Glasgow, holds its meetings at Newspaper House, Hope Street, Glasgow, on Friday evenings at 7.45. Arrangements for the present session include lectures on television and on short-wave work. Morse classes are also being held. Arrangements have been made for conducted parties to visit the Scottish transmitter at Westerglen on Saturdays. Full particulars of the society can be obtained from the Secretary at 14, Bolivar Terrace, Glasgow, S.2.

The Cambridge Short-wave Club

This society is to hold meetings on alternate Wednesdays, commencing on October 21st. The meetings will be held at 13A, Ram Yard, Cambridge, and all who are interested are invited to write to the Hon. Secretary at 19, Trafalgar Street, Cambridge, for further details.

The Croydon Radio Society

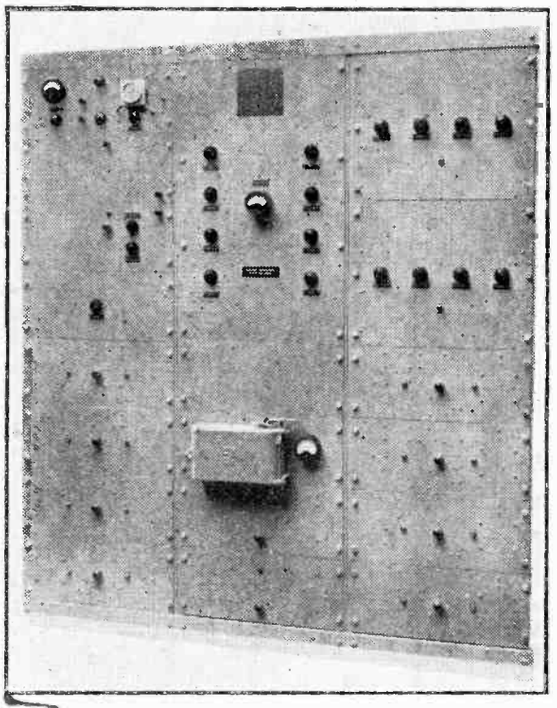
The syllabus of the meetings for the first half of the winter session has now been issued by the above society. Meetings are held every Tuesday evening at 8 at St. Peter's Hall, Ledbury Road, South Croydon. Next Tuesday (October 20th) Mr. B. R. Bettridge, of the Marconiphone Co., Ltd., is to give a talk entitled "Valves and Recent Developments in Ultra-short-wave Work," while the following Tuesday evening is to be devoted to gramophone pick-ups, all members being requested to bring their models for testing and comparison. Full details of the society can be obtained from the Hon. Pub. Secretary, Mr. E. L. Cumbers, at 14, Campden Road, South Croydon.

Television at the Empire Exhibition

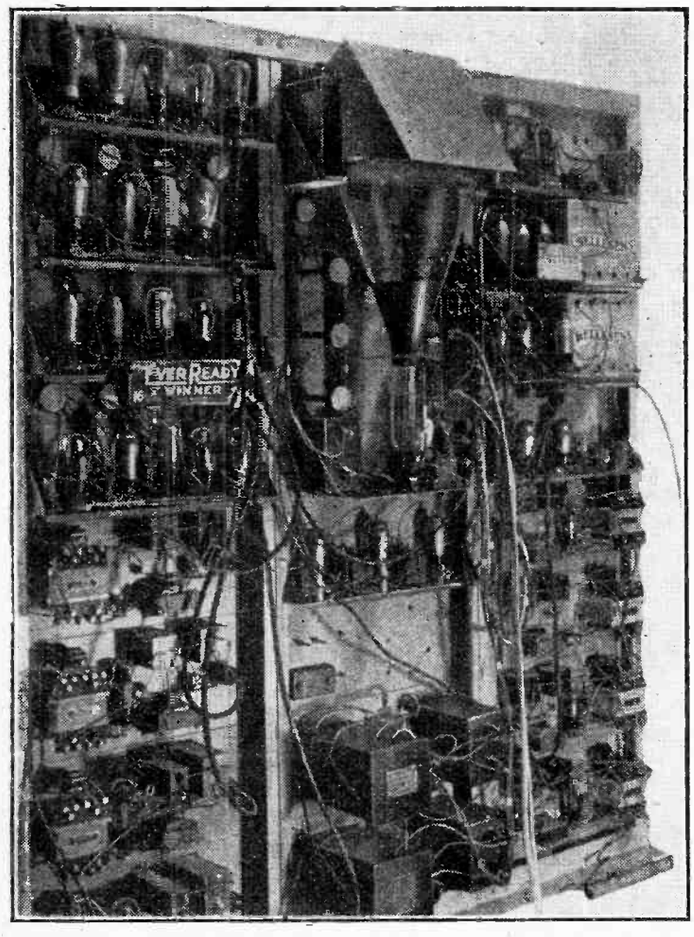
HOW THE NEW ART WAS INTRODUCED TO SOUTH AFRICA

By J. H. REYNER, B.Sc., A.M.I.E.E.

AS a result of a record hustle visitors to the South African Exhibition at Johannesburg are being able to see for themselves cathode-ray television both as regards transmission and reception. During the first few days of August a telephone enquiry was received by the author from Johannesburg as to the possibility of installing television at the Exhibition. A conference was hurriedly held, with the result that the contract was arranged and work had commenced within a few days from the initial enquiry. The only available boat which would enable the apparatus to arrive in time for the opening on September 15th was due to sail on August 25th, which left rather less than three weeks in which to complete the equipment, but by dint of almost continuous work the contract was completed on time.



Front and back views of the rack carrying the amplifiers, time-base units, power supply units and cathode-ray equipment.



The apparatus comprises a direct-vision transmitter scanning head-and-shoulders subjects with a definition of ninety lines. This feeds five 10in. Ediswan cathode-ray receivers, all operating in unison. The transmitter, spotlights, time-bases, amplifiers and power units are all mounted on the stage, while the receivers are located at various intervals about the auditorium. The audience, therefore, is able to see at least one of these receivers from any part of the hall and is also able at the same time to see the person actually being televised. This novel feature adds considerably to the interest of the demonstration, particularly as members of the audience themselves may pass up on to the stage and be televised if they so wish.

Most of the electrical equipment is housed on one large steel rack some 6ft. square. The photographs show front and rear views of this rack, and all the important apparatus is in duplicate. Looking at the rear view, the main vision amplifier is on the right, with the sound amplifier immediately underneath. On the left are two amplified time-base units, while in the centre is a monitor cathode-ray receiver in parallel with the five auditorium receivers. Immediately underneath is the synchronising amplifier.

The remainder of the panels, as will be seen, are power supply units, delivering 4,000, 1,000 and 300 volts, suitable spares of each type being provided.

An interesting feature is that the focusing of the lens on the scanning disc housing is operated by remote control from the front of the rack so that the demonstrator can focus the subject while actually looking at the picture on the monitor receiver. A similar arrangement operating through a periscope enables the sitter to be suitably centralised, and the remote control cables from the panel can be seen in the centre of the picture.

Two-way sound is provided so that the demonstrator can speak to the person being televised, while a reply can be reproduced on loud speakers at each of the receivers. The microphone for the former channel can be seen on the left. A further interesting point is the inclusion of a test panel, which comprises a signal generator with attenuator and valve voltmeter so that the vision amplifier can be checked in part or as a whole at any time.

All the apparatus arrived satisfactorily and is actually running at the moment. The audiences are showing an increasing interest, the attendance being greater each day, and South Africa is rapidly becoming "television-minded."

THE RADIO INDUSTRY

COSSOR receiving equipment is being used for the public television demonstrations at the Science Museum, South Kensington, which, as mentioned last week, are to continue until further notice.

The names of the sets for which the various Exide LT cells are suitable will, in future, be printed on the labels.

Microphone Pre-Amplifier

WHY IT IS NEEDED WHEN A MICROPHONE IS USED WITH A BROADCAST RECEIVER

THE idea of using the AF stages in a broadcast receiver as a microphone amplifier by connecting the microphone to the gramophone pick-up terminals is not new, and has, indeed, been done quite effectively in the past for entertainment purposes, and also for carrying out experiments in home recording.

If a suitable microphone is used quite good results can be obtained in this way, but there are quite a number of people who, having acquired a modern instrument, such as a transverse-current microphone, find that only a mere whisper of sound is emitted from the loud speaker. The first thought is that a wrong connection has been made, or that the microphone is faulty, for, as we are often told by those who consult our Information Bureau, the receiver works quite satisfactorily with a gramophone pick-up!

In the majority of cases there is nothing wrong with the set, or with the microphone, or in its method of connection, the real explanation being that the output from the microphone is so small that the AF stages, or single stage only where one of the high efficiency pentodes is fitted, do not provide sufficient amplification.

With the majority of sets an input of between 0.25 and 0.75 volt is required at the pick-up terminals to fully load the output stage, but a microphone of the transverse - current type, such as that described in *The Wireless World* of January 11th, 1935, gives on an average something less than 0.1 volt; possibly 0.05 volt would be a more accurate figure. This is just about one-tenth of the output from the average type of gramophone pick-up.

Thus to obtain a comparable sound output from the loud speaker an additional amplifying stage giving a gain of about ten times is needed.

For various reasons it is not practical to place the extra valve after the final stage in the set. Apart from the fact that if the additional amplification is attempted at this point a large power valve operated at a comparatively high voltage is required, there would be involved, also, the bother of arranging switches to cut out the extra valve for radio reception.

The most satisfactory way of obtaining the additional amplification is between the microphone and the receiver. The gain of this stage can then be adjusted so that the actual input to the gramophone terminals is about the same as that of the pick-up normally used with the particular set.

A stage gain of the order required can quite easily be obtained from a small battery triode operated with an anode potential of from 60 to 80 volts.

The use of a mains valve is not recommended since it is almost certain to introduce hum unless very special care is taken and some extra smoothing chokes and condensers are used.

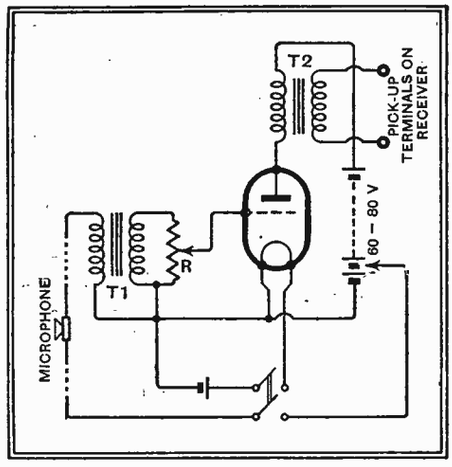


Fig. 1.—Pre-amplifier circuit with battery operation that enables a transverse-current microphone to be used with any broadcast set having pick-up terminals.

One advantage of employing batteries is that the whole of the extra parts can be assembled as a self-contained unit, and two wires only will then suffice to join it to the receiver.

The circuit in Fig. 1 shows the general lay-out of a suitable unit for use with any carbon microphone of the type mentioned.

The two transformers T1 and T2 are microphone and intervalve AF transformers respectively. If T1 has a ratio of about 1 : 10 the volume control potentiometer, R, should be 50,000 ohms. Transformer T2 need have only a small step-up ratio, and a 1 : 2 component will serve quite well. Any general purpose two-volt valve can be used, though its rated amplification factor should not be less than about 10. A Hivac type XL or a Marconi or Osram L11 are typical examples of midget valves suitable for use in this position.

In order to obviate including a separate battery for supplying the microphone polarising voltage either the LT accumulator or a part of the HT battery may be used.

Some microphones will be quite sensitive on two volts, while others may need six or more volts to give the best results.

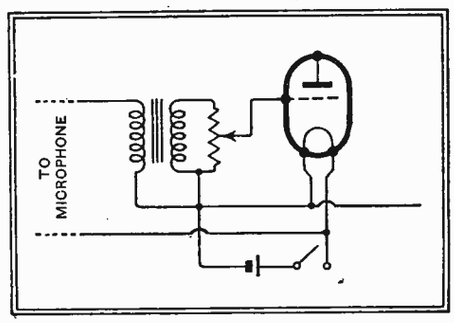


Fig. 2.—Sometimes it is possible to simplify the unit by using the filament battery for the microphone, the modifications required being shown above.

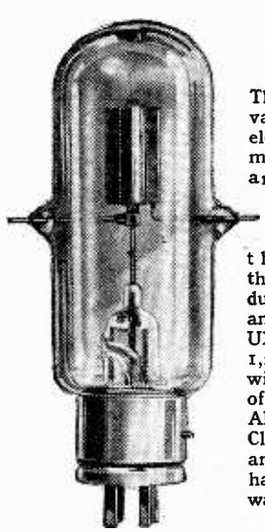
When the microphone takes its voltage from the HT battery the smallest potential that will give good results should always be used. This style of microphone has a resistance of about 300 to 400 ohms so that on 10 volts, for example, it will pass 25 mA or so. On 6 volts, which is usually the lowest voltage tapping available, the current flowing will be of the order of 10 to 12 mA.

From this it will be seen that whenever possible the microphone should be operated from the LT accumulator as the smaller sizes of HT battery are not intended to be discharged much in excess of 7 to 8 mA.

The circuit in Fig. 2 shows the connections and switching for operating the microphone from the filament battery.

It would, of course, be quite a simple matter to arrange the circuit so that a separate microphone battery is used.

H. B. D.



AMERICAN TRANSMITTING VALVE.

The Gammation 154 valve has tantalum electrodes and a filament consuming 6.5 amperes at 5.0 volts. The grid and anode are brought out through the sides of the bulb, thus reducing the capacity, and a standard 4-pin UX base is used. At 1,250 volts the valve will give an output of 15.5 watts as an AF amplifier under Class A conditions, and at 1,500 volts it has an output of 200 watts as a Class C RF amplifier.

UNBIASED

By FREE GRID

Here you see the recently exhibited cineolfactor in action.

ACCUSTOMED as I am to the baseness and black ingratitude of human nature, I must confess that I was considerably taken aback when strolling through the recently held Exhibition of Inventions, to come across one of my own brain children with absolutely nothing on it to indicate its parentage. I refer, of course, to the device for providing the necessary smell accompaniment to our radio and television programmes, and to ordinary cinema films.

Although it is quite true that in my original idea as published in *The Wireless World* I suggested the application of smell to radio programmes and did not specifically deal with the question of converting the talkies into the smellies by the application of locally-generated odours I am, I consider, perfectly justified in thinking some little credit is due to me for imparting the basic idea. Should any of you be in any doubts concerning this I invite you to turn up the specifications of my invention on page 587 of the December 6th, 1935, issue of *The Wireless World* and see for yourselves.

The Smellies

My idea of smellievision, or Radiolfaction as I preferred to call it, went considerably further than this present device since the smells were to be controlled by wireless waves, and had it not been for an unfortunate oversight on my part I, rather than others, might have occupied the limelight at the exhibition. As it was, I failed to find the slightest recognition given to my pioneering work in any of the literature which I have brought away with me from the show. If, therefore, before very long you detect an unusual odour while enjoying the programme in your local cinema I would ask you to spare a kindly thought for me as being the person who put over the idea. I am now conducting preliminary experiments with a view to adding still further to your cinema enjoyment by bringing out the "feelies," but I am finding it difficult to secure the necessary delicacy to the impression of touch with my present crude apparatus.

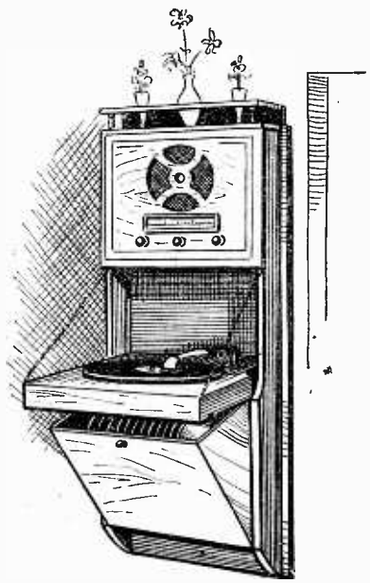
Love's Problems

I HAVE had some fairly tough wireless problems in my time but I must confess that the particular one which I have recently tackled has beaten them all, and before starting the practical work I should be glad to know if any of you can suggest any improvements to my ideas. The problem was brought to my notice by one of the older of the little Grid Leaks (female species) whose friend has recently enticed some man, in a weak moment, into marrying her. It appears that the unfortunate young man is not very well blessed with this world's goods and they propose, therefore, to try the old foolishness of living on love in a cottage. It will not be long, of course, before they find as I did long ago, that love is a far from satisfactory diet and is no substitute for roast beef and Yorkshire. This is, however, no concern of yours or mine, but it has been necessary for me to mention the fact to you in order that you may be in a position to understand my difficulties.

The "cottage" is one of those ultra-modern rabbit hutches which are springing up like mushrooms outside our large cities; I mean the type in which you have to open the window and door if you want to stretch yourself upon getting out of bed in the morning. Despite all these drawbacks the intending Benedicts very sensibly do not intend to forgo the pleasures of radio, and, furthermore, are desirous of having a radiogram. Unfortunately there is simply no room for the ordinary type of radiogram, and it has, therefore, fallen to my lot to design a special instrument for them.

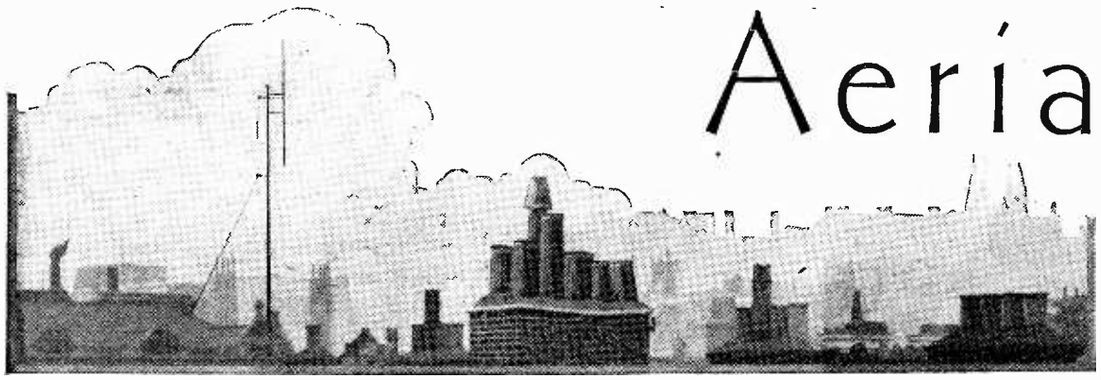
The room in which it is desired to house the instrument is literally not large enough to swing a cat, although, as the estate agent pointed out to me rather coldly, when I complained about it, there are not many people who indulge in this particular pastime nowadays owing to the activities of the R.S.P.C.A. I propose to solve the problem by building a receiver into an old ship's "compactum" washstand, which I find I can pick up cheaply from the premises of a marine-store dealer, and I append my drawing herewith for your comments and criticisms.

These compactums, as some of you may be aware, are frequently to be found in the cabins of cargo boats and other vessels not piped for running water. As their name implies they are, of course, built for compactness, and a basin is fixed to a small platform which folds vertically into the apparatus when not in use. I propose to replace the basin by a "playing desk" as you see in my drawing. These compactums usually possess a mirror behind which is a water storage tank, and I am replacing the mirror by the loud speaker fret and a horizontal tuning dial together with the necessary control knobs, while the works will fit into the erstwhile tank at the back. At the top of the instrument there is usually a rack for a water jug and tumblers, and these will be ideal for placing the wretched flowers which all women will insist on sticking on every available piece of furniture. The lower compartment, usually occupied by the waste-water tank, I propose to convert into a record storage cabinet.



The newly-weds' radiogram.

As I have said before, if any of you have any better ideas—more especially those of you who may have tried this love-in-a-cottage stunt—please let me know of it before I commence my labours. Please don't make the obvious suggestion of incorporating an autochanger, but tackle the box-resonance question. Would it suffice to refrain from boarding-in the top and bottom of the loud speaker compartment or must I put in fretwork sides also? This is important.



Aerials

By "CATHODE RAY"

Special Short-wave Types Compared with the Ordinary Domestic Collector of Signals

I HAVE had several requests to do some explaining about aerials. Until recently it has not been necessary for radio users to know the least thing about how aerials work. A few rules of thumb, such as putting the wire up as high as possible, keeping it away from walls, avoiding tramway standards as supports, soldering all joints (but better still have no joints at all), and cleaning the insulators with a stiff toothbrush twice yearly, were enough basis for a reputation as a "wireless expert." A similar set of rules covered the installation of the "earth"—use thick unjointed copper wire, avoid long runs, bury vast areas of metal in "damp subsoil" (if any), and water nightly during droughts, or connect to a *main* water (but not gas) pipe.

All this may be very sound and useful practical knowledge, enough to carry most people quite happily through life (so far as the subject in question is concerned); but the man who really knows what he is doing may have still better reasons for breaking nearly all of these rules. Now that screened aerials, transmission lines, short-wave and ultra-short-wave aerials are coming into general use, the limitations of the rule-of-thumb "expert" are shown up rather painfully.

Not that I propose to embark on the complete theory, in full textbook dress. But one ought to have a slightly better idea of things than that the aerial is a sort of feeler that picks up the waves. Because, presumably, the more the feeler sticks out the more responsive it is, and that is hopelessly wrong where short waves are concerned.

Perhaps the easiest way to get some sort of mental picture of what takes place invisibly and inaudibly among the aerials that now disfigure the world's landscapes is to consider stringed musical instruments. One can feel and hear them vibrating, and having noted how they do it there is not quite so much difficulty in imagining how similar phenomena can take place in the electrical world which is outside our senses.

Let AB in Fig. 1*a* represent any string of a piano, violin, ukulele, or other instrument. It is caused to transmit sound waves through the adjacent air by striking, scraping, or plucking it, thus making it vibrate from side to side as suggested by the dotted lines. By doing so it alternately compresses and rarifies the air around it, causing waves to spread out. The frequency (more commonly known among musicians as pitch) depends on the length, weight, elasticity, and tautness of the string.

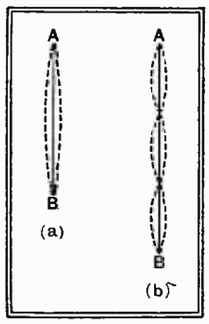


Fig. 1.—A musical instrument string vibrating at its fundamental frequency and at its third harmonic.

This system corresponds roughly to a radio transmitting aerial of the very simple type known as the dipole, used by Hertz about half a century ago, abandoned, and now revived for short-wave work. Amplitude of motion corresponds to current (*amps*, but not so named for that reason), and it is seen that vibration (or oscillation) of the string is set up by communicating motion to it somewhere about the middle, the ends being fixed. In the early days of radio an aerial was struck or banged into oscillation by pulling it and letting go (that is to say, by starting a sudden surge of current in it), allowing the oscillation to die away gradually, just as a piano string vibration dies away slowly when the key or pedal is held down. But now there are ways of feeding a continuous oscillation of the right frequency into an aerial, keeping it going all the time. But note that it must be fed at the middle or thereabouts; not at the end. Current can no more flow in and out of the end of a wire than the fixed end of a string can move backwards and forwards. The distance from any point on AB to the dotted lines in Fig. 1*a* represents not only the limits of vibration of a string, but also the current at each point in an aerial.

The frequency of the radio transmitter is decided by the elasticity (capacity) and weight (inductance) of the aerial, both of which depend on the length. A low frequency (long wavelength) usually necessitates a long aerial, but quite a short aerial can be used if it is weighted in the middle with an inductance coil, in the same way as low notes are obtained within a reasonable size of piano frame by weighting the strings with copper. But the result is not so good in either case.

Fundamental Wavelength and Harmonics

Wavelength, of course, is just the speed of the waves divided by the frequency. Sound travels at about 1,100 feet per second, so the wavelength of middle C, which has a frequency of 261, is 4.38 feet, or 1.33 metre.

When a violinist wants to get that amazingly high note with which his solo often ends he touches the string with his finger (producing another point of *no* vibration, technically termed a *node*—again a fortuitous pun) and obliges the string to vibrate at a higher frequency that it otherwise would (Fig. 1*b*). These are harmonics, which must always be a multiple of the original or fundamental frequency. Similarly, an aerial that naturally oscillates at, say, 1,500 kc/s can be made to oscillate at 3,000, 4,500, 6,000, etc.

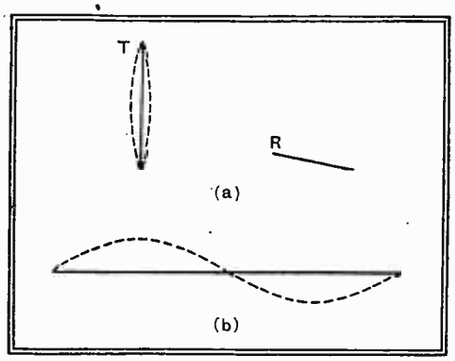


Fig. 2.—A receiving aerial R directed towards the transmitting aerial T is unresponsive. For maximum response it should be parallel, with its axis at right angles to the line joining the two. Diagram *b* represents a current wave; the amplitude of current at any distance along the axis corresponds to the amplitude of movement at any point along a vibrating string.

So much for the transmitting end. Suppose you have two pianos (or harps, or banjos) and play one note. The corresponding string in the other instrument, if

Aerials—

accurately tuned, begins to vibrate; but its faint sound is overwhelmed by the first. However, it can actually be observed if the experiment is done with tuning forks. The wave travelling through the air strikes the "receiving" string, and if it is tuned correctly sets it going too. The radio equivalent is obvious. But note that a long-wave aerial may respond to a short wave that happens to be a harmonic. There is another point about reception. It will not do to have the receiving aerial pointing any old way. If a receiving aerial (R in Fig. 2*a*) is pointing straight at the transmitting aerial T, there is nothing doing. The maximum results occur when the two are parallel. This rule is liable to be upset by reflections from the ground, and other disturbing effects.

Remember that all this time I am referring to dipole aerials. The ordinary pole-and-wire aerial of the backyard is a more complicated arrangement that has yet to be dealt with. In the meantime this discussion chiefly concerns ultra-short-wave radio, for a reason that is now to be revealed.

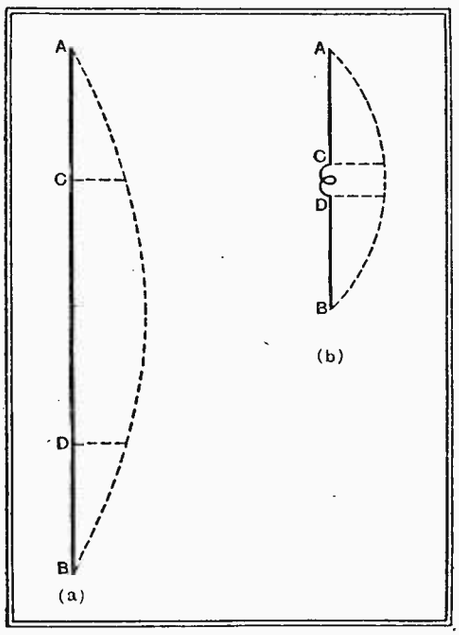


Fig. 3.—When a coil is inserted at the centre of a dipole aerial, its inductance takes the place of part of the aerial, which must be shortened to respond to the same wavelength. The dotted lines show the amplitude of current along the aerial.

I have already mentioned that there is some connection between the length of an aerial and the frequency—and hence the wavelength—to which it tunes. The connection is a rather uncertain one, because aerials are usually—one may say almost invariably—complicated by coils and condensers put there (1) for feeding in or drawing out the oscillations, and (2) for varying the tuning in a more convenient manner than by altering the length of the aerial itself. But if the aerial consists of a plain straight wire or rod, with nothing else anywhere near it, *the natural fundamental wavelength is double its own length*. So it is called a half-wave aerial.

If you draw a diagram of a wave of current (Fig. 2*b*) you will see that half of this is the same as the diagram showing the current at each point along the length of an aerial. And if a simple aerial is oscillating at the third harmonic, it accommodates three times as much wave (Fig. 1*b*), so it is a $\frac{3}{2}$-wave aerial, and there is a similar correspondence between the current diagram and the diagram of the waves themselves.

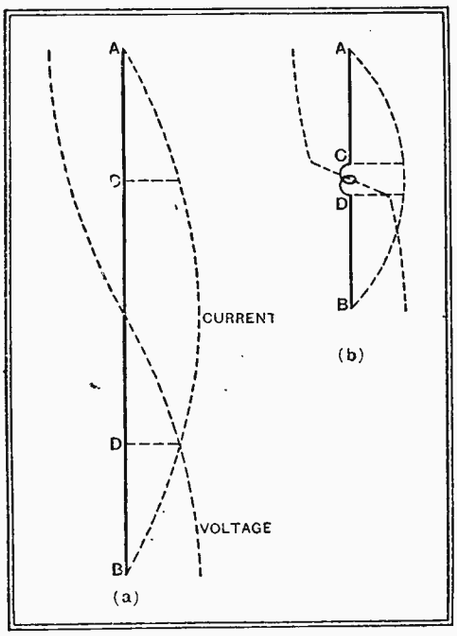


Fig. 4.—The same as Fig. 3, with the addition of voltage lines, showing that at any part of the aerial where there is zero current there is maximum voltage, and vice versa. There is obviously a comparatively high voltage across the terminals of the coil.

Practical example: What is the length of a dipole aerial to resonate fundamentally to Droitwich (1,500 metres)? Answer: $\frac{1,500}{2}$, or 750 metres, or 2,280 feet. Which is absurd (from a practical point of view), especially when it is remembered that it ought to be spaced several times its own length from all other objects, such as the earth.

Another example: What is the length of a dipole to tune to the Alexandra Palace sound channel (7.2 metres)? Answer: 11 feet, which is reasonable, especially as owing to the necessity for coupling and tuning the aerial by means of coils and/or condensers, it is always rather shorter than half a wavelength.

Fig. 3*a* shows the current diagram of a half-wave unloaded aerial. When a coil is used, the inductance of the aerial must be correspondingly reduced by cutting a chunk CD out of the middle, and as the coil is a "concentrated" part of the circuit it is relatively ineffective as an aerial. The reception is reduced, as suggested by Fig. 3*b*.

On the other hand, an enthusiast situated on a larger plot than the average modern dwelling might feel that he had room for more than a mere 11 feet of dipole. But reference to the diagrams shows that the current does not keep on increasing as the aerial is made longer; on the contrary, in a full-wavelength aerial the current at the centre is nil! At long wavelengths nearly all the inductance resides in the tuning coil, so that the active portions AC and DB (Fig. 3*a*) are minute parts of the whole, and any increase in them is well rewarded.

Before objecting that dipoles, even of the heavily loaded sort, are never used for long-wave reception, bear with me a little longer while I dispose of short waves first.

Minimum Current: Maximum Voltage

An important addition to the current diagram is a voltage curve, which can be drawn in by remembering that maximum current is minimum voltage and vice versa. Theoretically you could touch the exact centre of a well-balanced high-power transmitting aerial, where the maximum current is flowing, without burning the end of your finger. But the ends of the aerial must be well insulated, for they take the full voltage. Fig. 4 is the same as Fig. 3 but with the voltage curves added. There are methods of coupling a dipole aerial by voltage, and they obviously must be applied at or near an end.

It is all very well to talk about coupling to an aerial, but when for effectiveness it is suspended in mid-air it is asking something. An ordinary lead-in would add to the length of the aerial and upset the calculation entirely. But it has been found that if two parallel wires, or concentric tubes, are used, the same voltage and current relations along the length hold good; and that if the wires are close together they do not act as an aerial to any great extent. The diagrams show that although current and voltage change as one moves along the wire, after half a wavelength they come back to the original

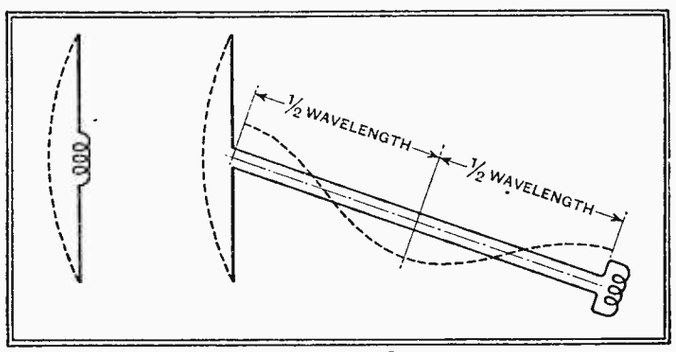


Fig. 5.—It is generally awkward to instal the receiving apparatus at the centre of the aerial. A parallel line of a multiple of half the wavelength enables it to be located any reasonable distance away.

conditions. So a feeder consisting of any number of half-wavelengths can be inserted without making any difference,

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other than a slight loss. Fig. 5 shows how a coupling coil can be located more conveniently by this means. In transmitting stations, for example, a great many half-wavelengths have to be inserted to bridge the distance from the oscillator to the aerial. And the same methods are used in short-wave and ultra-short-wave reception. Actually, there is a great deal more "to it" than I have mentioned—impedance matching, tuned and untuned feeders, and so forth; mostly with a view to getting every bit of efficiency possible. But the foregoing may serve to introduce the subject.

Earthed Aerials

The reader who is accustomed only to the "ordinary" aerial will no doubt have been surprised at the complete absence above of any reference to earth, except indirectly as something to be got away from as far as possible. The earth is, historically, a subsequent complication. It was found that if half a dipole were stuck vertically out of the ground, making good electrical contact with the earth, it behaved very much as if the other half were below the surface (Fig. 6). Ground level marks the middle of the dipole. This is a good deal more convenient for many purposes, particularly for long waves. A vertical aerial in its simplest and truest form is comparatively rare. The height is nearly a quarter of a wavelength (over 1,000 feet in the case of Droitwich), less that replaced by the coupling coil. For domestic reception it is usually very troublesome to raise the aerial more than about thirty feet. And the "effective height" is greatly reduced by the presence of adjacent buildings and other obstructions.

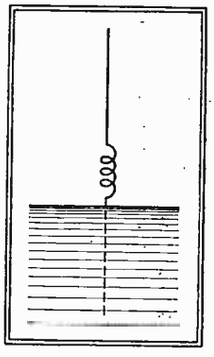


Fig. 6.—The "ordinary" aerial, with the earth connection, may be looked on as a half-buried dipole.

The inverted L aerial lends itself much better to a domestic environment. The horizontal portion, or "flat top," adds nothing to the voltage generated by the passage of the radio waves, assuming perfectly level ground with no excrescences such as houses; but in actual situations there is no doubt that it does help. This is proved by the reception that is obtained when the downlead is screened to reduce interference. And in any case it increases the current set up in the aerial by a given voltage, by reason of the much greater capacity. It forms, in fact, one plate of a condenser, the other being the earth.

The subject of the screened-downlead aerial for excluding interference has been very frequently explained. It furnishes an example of how the old rule against bringing the downlead very close to earthed objects may be successfully defied, provided that there is a transformer to step down the voltage and impedance.

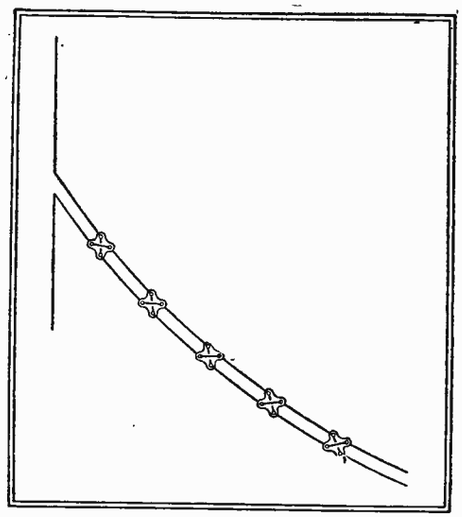


Fig. 7.—To minimise the already small amount picked up by a parallel-wire downlead, the wires are crossed over at intervals.

The twin wire feeder, used for short-wave dipole aerials, also serves as an anti-interference system, but as for efficiency there is a spacing of several inches the pick-up is not negligible. It can be made so, however, by reversing the wires at intervals with special insulators (Fig. 7); any voltage picked up by one section is opposed and neutralised by the next.

On the Short Waves

IN discussing my last notes with G2MV, it became apparent that a little further explanation of the point dealing with the march of the sunspot cycle from 1749 to 1936 might be welcome.

The point which it was desired to emphasise was that, although we have a continuous record of sunspot activity from 1749 to date, we have only experienced one sunspot maximum period, *i.e.*, 1927-28, from the short-wave communication standpoint.

Moreover, the maximum of 1927-28 was not a particularly large one when compared with some of those which preceded it during the period over which we have records.

In fact, when one examines the continuous curve from 1749 it can be seen that during some of the maximum periods, which occur at approximately every eleven years, the activity reached almost twice that of the first radio maximum in 1927-28.

It therefore follows that the coming sunspot maximum in 1938-39 may be either smaller or greater in intensity than its immediate predecessor, and at the moment it looks as if it will be greater, which means higher frequencies, or still shorter waves. Nobody, from a study of short-wave conditions in October of last year, would have thought that the optimum frequency for evening transmission from New York would, this year, be as high as it is at the moment, *i.e.*, 17 Mc/s (16 m.).

Due to the increased solar activity, therefore, the tendency is to make use of the higher, or daylight, frequencies for a much greater percentage of the day (even in winter) than we would do during the sunspot minimum years. Quite apart from changing propagation conditions, too, improvements in aerial and transmitter technique are also increasing the higher limiting frequency for any given circuit, so that even given equal intensities in the maximum of '27-'28 and '38-'39 we may expect to see even higher frequencies used in the latter.

A final reference to sunspots might be to remark that signals generally improve in strength during the maximum years because a greater proportion of the high-angled radiation is bent and returned to the earth; less of the energy radiated in this manner being lost to outer space.

Before turning to the review of conditions, a reference must be made to the return of 28 Mc/s (10-metre) activity during the last week in September, and some of the U.S. group really gave outstanding results on the loud speaker as late as 7 p.m. G.M.T.

Among the best signals were WIHQN using 150 watts into a horizontal wire 7 half-waves long and running east and west, W2HFS, W2JKV and W5CEE. On 32 Mc/s (9 metres) several police transmitters have again been well received on a domestic all-wave receiver, the best being W2XCN.

From My Log

My notes for the period under review begin on Thursday, September 24th, and at 7 p.m. G.M.T. conditions were active up to 20 Mc/s (14 metres) at least, and on 15 Mc/s W2XAD, using his European beam, was a local station signal.

Active conditions were noted on 28 Mc/s on Friday, September 25th, the half-wave of WQP being particularly strong.

At midnight both W8XK on 15 Mc/s and W2XE on 11 Mc/s were very good, as also were W1XK and W2XAF on 9 Mc/s; whilst even W3XAL on 6 Mc/s was fair. VP3MR, Georgetown, was good in this band.

Some surprisingly good signals from the U.S. amateurs on 14 Mc/s were intercepted on Sunday evening, and in particular the performance of W3APO on this occasion was better than the best heard from any U.S. commercial station.

Conditions remained similar to the above over the week from September 28th to Friday, October 2nd, W3XAL on 17 Mc/s being a consistently good signal during the evening till close down (11 p.m. B.S.T. during the week in question).

Round the world echo was noted on the Empire transmitters GSG (17.79 Mc/s) and GSH (21.47 Mc/s) at midday, Saturday, October 3rd, and during the morning and afternoon very strong signals were received from Alexandra Palace on both the sound and vision frequencies.

Later Saturday afternoon fair signals were obtained from Bandoeng PMH on 15.15 Mc/s (next to GSF).

At 11.30 p.m. on Sunday W2XAF, W1XK and COCH were all fair to good on 9 Mc/s, also conditions seemed more favourable than usual on 28 Mc/s.

Since September 1st W2XAF has been using a horizontal dipole for all transmissions, which no doubt accounts for the increased strength lately. W2XAD, too, has been using a European beam regularly and will probably change to low-power modulation in the near future.

ETHACOMBER.

Broadcast Brevities

NEWS FROM PORTLAND PLACE

Start of the Television Service

MONDAY, November 2nd, will see the start of the B.B.C.'s regular television service from Alexandra Palace. That the "send-off" will be appropriately auspicious need not be doubted.

The programme on the opening day will not be too ambitious. The inaugural ceremony at 3 p.m. is expected to last some fifteen minutes, and will be followed by a news reel and a variety show.

In the evening will be presented another edition of "Picture Page," one of the most successful programme ideas yet exploited in television.

Prominent personalities and stars of the stage and screen will be featured in the programme from the very beginning.

High Speed Make-Up

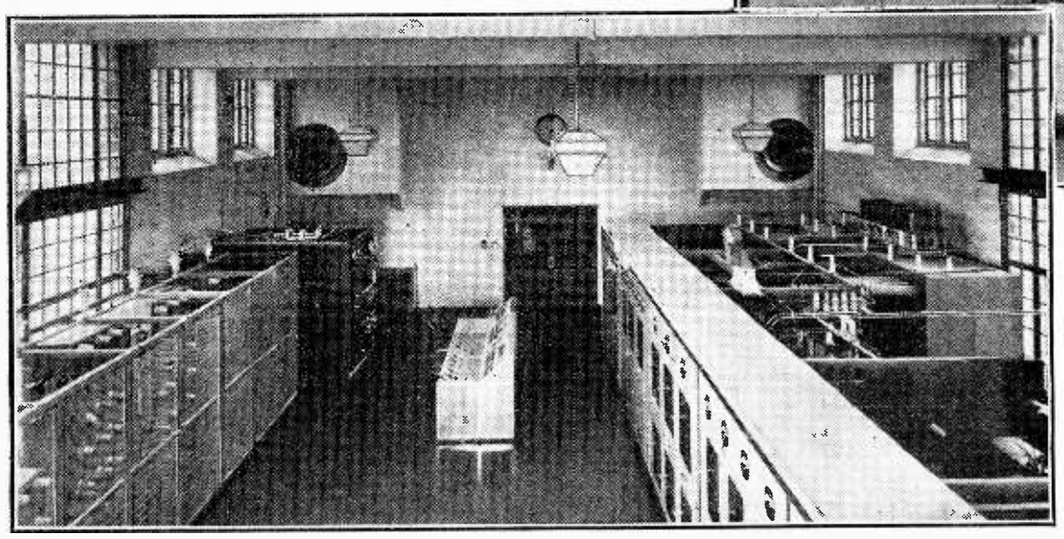
Mary Allan, the make-up expert, is among the heroines of these early days of television. Unaided, she made beautiful all the members of Henry Hall's Band in one hectic hour before they appeared last week in what was generally considered to be among the best programmes of the tests.

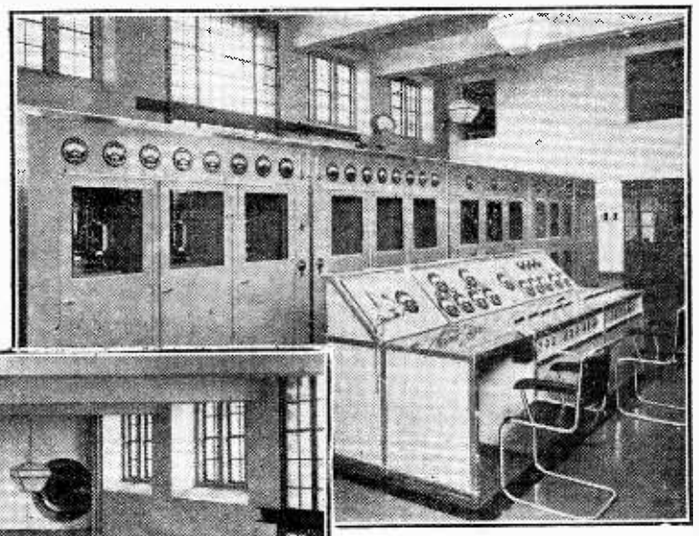
The roll of honour must also include D. H. Munro, Productions Manager, who keeps things humming and oscillates so rapidly between studio floor and office tower that he has been seen in both places at once. D. C. Birkinshaw, Engineer-in-Charge, who supervises Marconi-E.M.I. and Baird operations with the tact and patience of a traffic policeman; Dallas Bower, who combines elaborate programme production with film supervision in his spare moments; Cecil Madden, deviser of "Picture Page"—in fact, the list could justly include the whole staff, everyone being fired with the determination to make television a success.

Surprise for the Conductor

Hyam Greenbaum experienced a shock on the second day of the tests. Having conducted the Television Orchestra in the closing cadence of a tune for the film "Television Comes to London," he stepped back to note how the orchestra appeared on the screen of the check receiver in a darkened corner of the studio. He rubbed his eyes in amazement at an apparent miracle, for the orchestra's official red jackets had been strangely transformed into the flowing garments of a gypsy band.

It took him a few feverish seconds to realise that the transmission had been rapidly faded over to Younkmann's Czardas Band in the Exhibition Hall of Alexandra Palace.





THE "WORKS."—A peep inside the transmitting hall of the new Scottish North-East Regional station at Burhead, which was officially opened on Monday last by Sir Murdoch MacDonald, M.P. The transmitter, which has been designed to a similar circuit as that used for the Lisnagarvey and Droitwich stations, delivers to the aerial a power of 60 kilowatts. The station operates on a wavelength of 391.1 metres, the same as that of the Scottish Regional transmitter at Westerglen, with which it is synchronised.

Study in Contrasts

THE "Saturday Contrast" programmes are not belying their title.

It is a far cry from the banks of the Thames in the heart of London to the banks of a quiet Warwickshire canal—the two spots from which the Saturday Contrasts are to be radiated on the afternoon of October 24th.

The London affair will be a sound picture, with running commentary by Capt. E. H. Robinson, on a small bore rifle contest at Shell-Mex House, Victoria Embankment, between Lensbury and Britannic House (the national champions) and the London district teams.

From Warwick will come a description ("running commentary" would hardly apply in this case) of coarse fishing in the canal at Lowsonford. Mr. G. H. P. Higginson will take the microphone to the canal bank.

It is hoped that the fish will rise to the occasion.

Points About the Pips

HOW many listeners realise that the Greenwich pips are not always precisely punctual? The B.B.C., which always prefers truth to romance, confesses to enquirers that the last of the six pips is sometimes as much as one-twentieth of a second late. Occasionally, let it be whispered the pip is correspondingly early.

Time Signals v. Artistic Effect

Although the Greenwich time signals are radiated at frequent intervals during the day, they are occasionally suppressed if likely to interfere with the artistic presentation of a programme. (In concerts of modern music the pips sometimes enhance the general effect.)

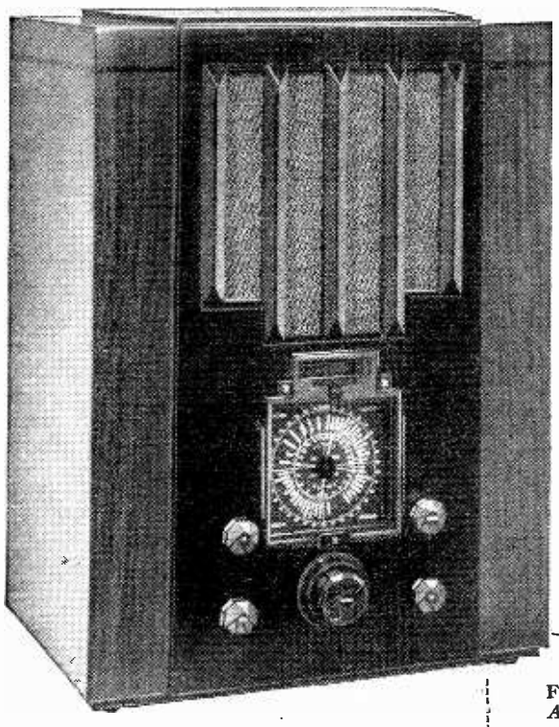
When a time signal is suppressed it is usually radiated at the next available quarter. Two signals—those at 10.30 a.m. and 6 p.m.—are inviolate, as these are relied upon by shipping for the setting of chronometers.

Broadcasting Two Naval Battles

FEW sea "dramas" in fiction or real life are rounded off with the completeness that makes the sea battles of Coronel and the Falkland Islands stand out in history.

On November 1st, 1914, Rear-Admiral Craddock's cruiser squadron was defeated and partly destroyed by the German Admiral Von Spee's armoured cruisers off the coast of Chili. Five weeks later Admiral Sturdee, with *Invincible* and *Inflexible*, accomplished the task set him by the British Admiralty. Von Spee's squadron, fighting to the last, was sent to the bottom near the Falkland Isles.

The story will be retold in a graphic broadcast in the National programme on Sunday, November 1st.



Pye —MODEL T10—

AN ALL-WAVE RECEIVER OF HIGH OVER-ALL EFFICIENCY

FEATURES.—*Type.*—*Table model superheterodyne for AC mains.* *Wave ranges.*—*(1) 13-33 metres. (2) 30-82 metres. (3) 198-560 metres. (4) 900-2,000 metres.* *Circuit.*—*RF amplifier (on short waves only)—octode frequency-changer—var.mu pentode IF amplifier—double-diode-triode second detector—pentode output valve. Full-wave valve rectifier.* *Controls.*—*(1) Tuning. (2) Volume. (3) Variable selectivity. (4) Sensitivity. (5) Wave range. (6) Mains on-off switch.* *Price.*—*18 guineas.* *Makers.*—*Pye Radio Ltd., Radio Works, Cambridge.*

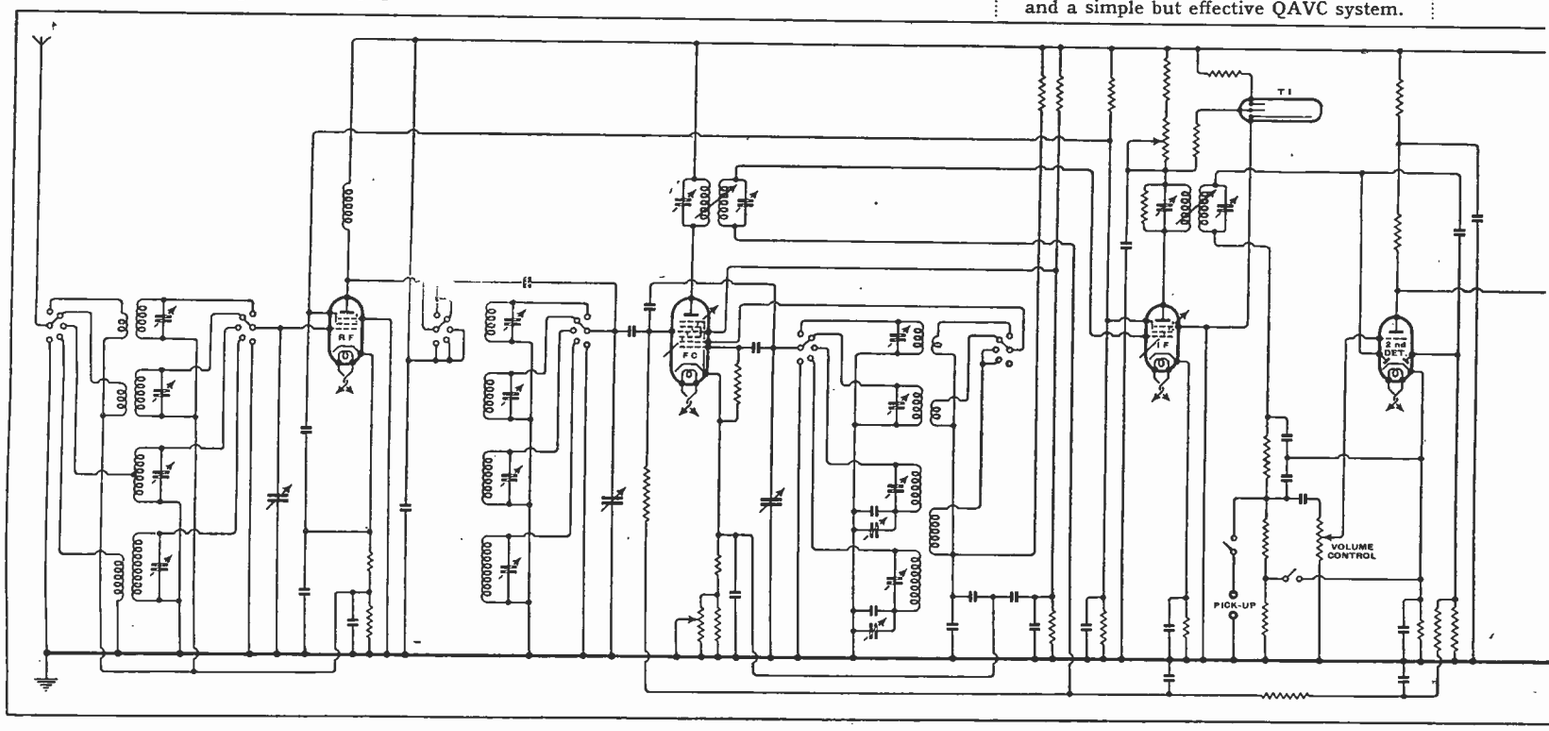
IT is a characteristic of Pye productions that they invariably give the impression of being well engineered. Not only are the mechanical details of the chassis a source of satisfaction to anyone with an eye for craftsmanship, but the electrical design generally reveals one or more points of originality suggesting a receiver which has been evolved for a specific purpose rather than one which is a mere adaptation of some currently popular circuit.

Thus we find in the T10 that an RF amplifier is introduced for the two short-wave ranges only, and is cut out of circuit on the normal broadcast wave ranges where sufficient range is already provided by the remaining stages of the circuit. Most designers leave the RF stage in operation on all wavebands in order to take advantage of the extra selectivity provided by the tuned intervalve coupling. This advantage is not foregone in the Pye receiver, as the two groups of coils preceding the frequency-changer valve each include four tuned circuits. On the medium- and long-wave ranges, however, the circuits are coupled to form a bandpass filter without intermediate amplification.

The RF amplifier valve is of the variable-mu type but is not controlled from the AVC line. On the medium- and long-wave ranges it is suppressed by applying negative bias and by connecting a by-pass condenser between anode and earth.

The frequency-changer valve is of the octode type and is included in a balanced circuit designed to maintain good conversion efficiency without pulling on the shortest wave ranges. This valve and the IF amplifier which follows it are both controlled from the AVC line, and in the case of the frequency-changer there is an additional control of sensitivity consisting of a variable resistance in the cathode return lead. This control is operated by a separate knob on the front of the cabinet and with it is associated a switch controlling the bias circuits of the second-detector stage by means of which the inter-station noise suppression control

The provision of RF amplification on the two short-wave bands only is a logical if unconventional feature of the circuit, which also includes variable selectivity and a simple but effective QAVC system.



may be put out of action. Quiet tuning between stations is effected by biasing the signal diode rectifier, and the sensitivity control in the frequency-changer stage determines the level above which the signal strength of a station is able to open up the rectifier circuit.

The IF amplifier operates at 465 kc/s, and both the input and output transformers associated with it are of the type in which the coupling is varied mechanically. The neon-type tuning indicator is also operated from this stage, control being effected through the volt drop in the anode-decoupling resistance.

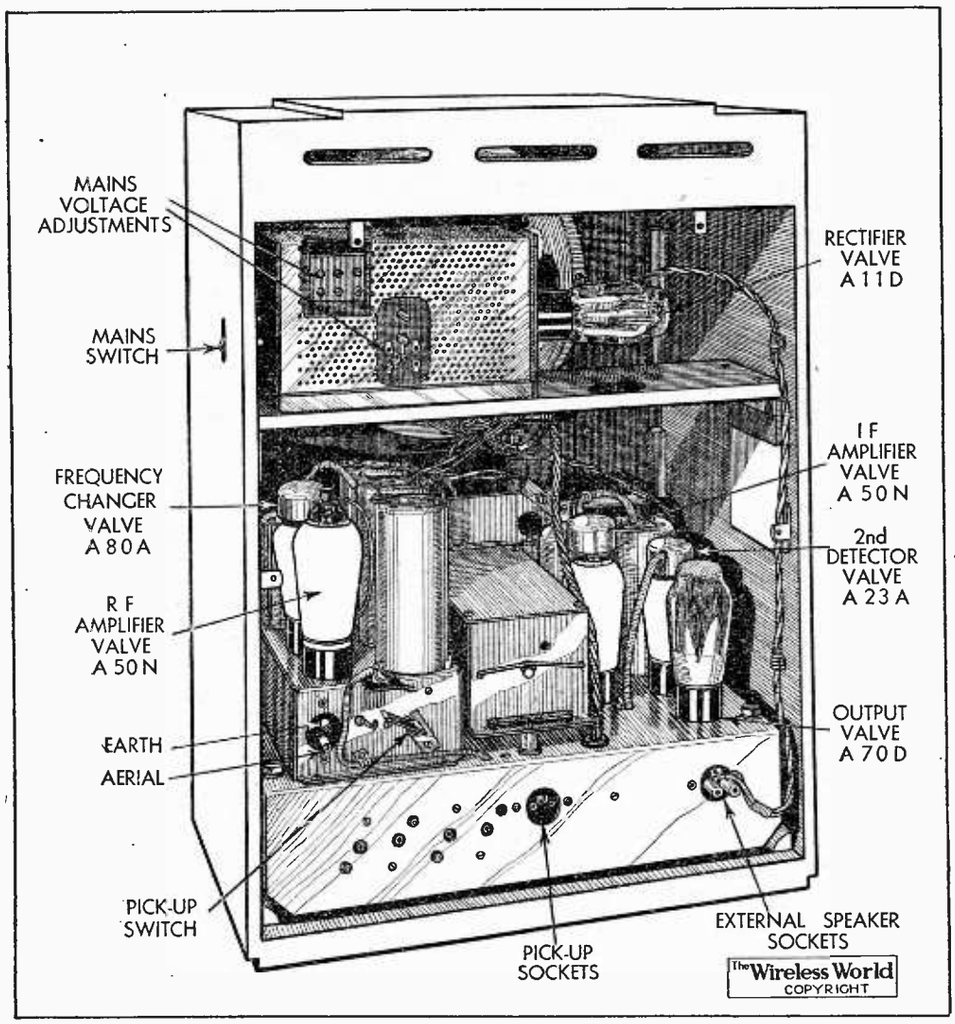
A separate diode is used for the supply of AVC bias, and the triode amplifying portion of the second detector stage is resistance coupled to a pentode output valve capable of delivering 2.5 watts at 7 per cent. distortion to the 9-inch moving-coil loud speaker. The tone-correcting resistance and capacity across the primary of the output transformer have fixed values designed to suit the characteristics of the loud speaker employed.

Tone Control by Selectivity

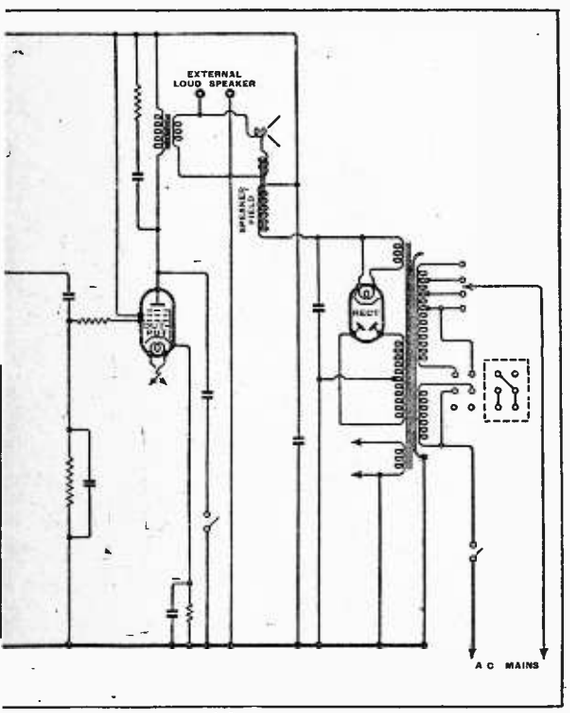
Tone control is, therefore, virtually carried out in the IF stage, and, with the variable selectivity control in the mid-position or a little below, very good quality is obtained with ample bass response, due to the effective baffle area of the large cabinet. There is no noticeable harmonic distortion at normal levels, with consequent clarity in orchestral items and other concerted music. Decreasing selectivity calls up a vigorous upper middle register response before the really high frequencies are reached, with the result that full-width audio-frequency reproduction is best appreciated at a somewhat lower volume level.

The variable selecticity alone does not provide quite sufficient top cut for the interference which town-dwellers may experience on the short-wave ranges. Accordingly the makers have arranged a switch contact at the maximum selectivity (low tone position) which connects an additional fixed condenser across the anode circuit of the pentode output valve. There was a good deal of local interference while the set was undergoing test, and the background noise on the short-wave range bands were entirely free from second-channel whistles.

It was on these bands that the action of the simple but effective inter-station noise suppression circuit was best appreciated. The cut-off on each side of a station has the precision of a mechanical relay, and while the quality and volume of the station, when properly tuned, in no way differ from the conditions when the QAVC is out of action, the silence between stations is complete without even a trace of mains hum.



The chassis is rubber mounted and the power pack forms a separate unit and is mounted on a shelf above the main chassis.



forced us to keep the selectivity control in this position except for a few powerful Continental transmissions.

Of the efficiency of this set on the short waves there can be no doubt. On any afternoon after 3 p.m. (G.M.T.) Pittsburgh, Schenectady and Bound Brook were all strong enough to force themselves on the attention of the listener without effort on his part while traversing the "ultra-short" waveband. Any fluctuations of signal strength came easily within the scope of the AVC system, the excursions of which could be verified by slightly mis-tuning a station and listening to the rise and fall of the side-band hiss. The selectivity provided by the two tuned circuits preceding the frequency-changer ensured that short-wave stations were received at only one point on the dial, and for the same reason the normal broadcast

The range of the set on the medium- and long-wave broadcast ranges is more than adequate, and the omission of the RF stage is quite justified. With the QAVC circuit in action no fewer than eleven foreign stations, in addition to the various Regional B.B.C. programmes, were of sufficient strength in daylight to overcome the QAVC bias, and many more stations were available, though, of course, with more background noise with the QAVC switched out of circuit. Adjacent station selectivity was possible in all cases with the exception of the locals, where, in the case of the Brookmans Park transmitters, one channel was lost on either side of the National and 1½ channels on either side of the Regional when using the set in Central London. The high sensitivity is main-

Pye All-Wave Receiver—

tained on the long-wave range, and the Deutschlandsender was clearly received between Droitwich and Radio-Paris with but slight side-band splash from the former station. It is, perhaps, here that one feels most the need for a tone-control independent of the variable-selectivity control.

The circular tuning scale is of ingenious design with four quadrants, one for each waveband. There are four pointers attached to a central boss, and as the scales are of necessity somewhat cramped the pointers are of the knife-edge variety so that relatively the same accuracy of reading is provided as with a larger scale and the thick pointers generally provided. In addition, there is an independent pointer which makes one complete revolution over a 360 deg. scale, and from it readings may be taken for future reference of the settings of stations not marked on the dial. The pointers are driven by a two-speed knob with a ratio of 200:1 for fine tuning, the slow-motion knob being fitted with a finger-tip control for ease of manipulation.

At the back of the set sockets are provided for the addition of a gramophone pick-up, and an interesting type of low-capacity switch has been added as an extension to the wave range switch spindle in order that the pick-up leads may not affect the radio performance. An external loud speaker of the low-impedance type may be added, and the Pye system of plugs and sockets enables any combination of internal and external loud speaker to be made. By the simple process of reversing a connector plate the set can be instantly converted for 100-150 or 200-250-volt mains.

In conclusion, we would congratulate the makers on the production of a very comprehensive instruction manual including much useful information on short-wave reception.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

Television Costs

READING your leader in the issue of October 2nd, the paragraph, "It cannot be expected that members of the public in large numbers will put down nearly a hundred pounds for a television receiver until . . .," made me ponder.

If—and your estimates are fairly accurate—the cost of a receiver is to be one hundred pounds, where do you consider the public in large numbers are coming from?

I should say, at a rough guess, that 80 per cent. of the listening public to-day could not afford twenty pounds, yet 100 per cent. of licence holders are, through part of their annual 10s. fee, financing television experiments for the benefit of 20 per cent. of their better-off brethren.

I consider it is a scandal that the B.B.C. should be saddled with the responsibility of finding the cash for television, to the detriment of the ordinary broadcast programmes, and thereby to the majority of their regular listeners.

Pick up "The Radio Times"; you will find that week after week the book is, with monotonous regularity, the same programme, same artists, the same orchestras, at the same time, same day. This savours of contracts to obtain minimum rates, and by tying the B.B.C. to television we are not helping them to avoid it.

This brings us to your second paragraph, programme value.

Are the licence holders to be expected to pay a heavier licence to allow the B.B.C. to compete with other interests? It is rather looking ahead, but I do think the point will arise, and it is better to face it now.

At present "television" is, so to speak, a rich man's plaything. The average man, apart from appreciating the wonders of it, is not actually looking forward to it. And why?

He has learnt from bitter experience, with his four- or five-valve set, how costly replacements are. What is he going to do if he had a television receiver with about twenty valves and a cathode-ray tube to replace at times?

How is it certain firms can advertise skeleton sets containing six B.V.A. multiple valves at a price of £7? Valves could be sold to the public at half their present prices with a handsome profit. This problem has got to be tackled before the average man thinks of increasing his liabilities with a television set.

With all the best respects to the *Wireless World*, and, let me add, which I purchase each week, not as a technical man, but because of the interesting matter which it contains in its pages.

E. W. A. MACKENZIE.

Tottenham, N.17.

"Optical Problems in Television"

I WAS very interested in the article under the above title by Mr. Percy W. Harris. He raises a point which is often overlooked, that the phenomenon of persistence of vision and the problem of flicker in television reception is not so easily solved as in cinematography.

It has long been realised that flicker is a function of brightness; but we were led to believe that flicker would disappear at a picture frequency round about 40.

Unfortunately, this is not the case with television. In fact, with the present-day high-definition television, in spite of a high picture frequency, flicker is still apparent, which, of course, is accentuated by the improved illumination of present-day cathode-

SUMMARY OF SETS TESTED AND REVIEWED BY *THE WIRELESS WORLD*

For the convenience of potential purchasers of manufacturers' receivers, the following list has been compiled of sets reviewed in the pages of *The Wireless World* from July 3rd to October 9th. This list will be supplemented from time to time with the details of the latest reviews. Earlier lists of reviews published since October 4th, 1935, were printed in the issues of March 27th and July 3rd, 1936.
It is possible to give only a brief summary here, and readers are referred to issues, dates of which are given in the last column, for the full reviews.

Maker.	Set.	Type.	Circuit, Valves excluding rectifiers.	Wave Ranges.	Price.	Reviewed.
					£ s. d.	1936.
A.C. Cossor, Ltd.	378	Table	Straight 3 (A)	M, L	8 8 0	July 3rd
Philips Lamps, Ltd.	246B	Car Radio	Superhet 6 (*)	M, L	17 17 0	„ 10th
Murphy Radio, Ltd.	B23	Table	Straight 3 (B)	M, L	6 7 6	„ 24th
Degalliers, Ltd.	Challenger 524	Chassis	Superhet 21 (A)	8–16, 16–57.5, 57–187, 187–555, 850–2,050 m.	40 0 0	Aug. 7th
McMichael Radio, Ltd.	365	RG	Superhet 4 (A)	M, L	29 8 0	„ 21st
The Gramophone Co., Ltd.	H.M.V. 485A	RG	Superhet 5 (A)	7–16, 16.7–51, 46–140, 185–560, 750–2,200 m.	37 16 0	Sept. 11th
Marconi's Wireless Telegraph Co., Ltd.	RG34A	Table	Superhet 9 (B)	14–200 m. (5 bands)	—	„ 25th
Philips Lamps, Ltd.	795A	Table	Superhet 4 (A)	16.7–51, 200–585, 725–2,000 m.	18 18 0	Oct. 2nd
Pilot Radio, Ltd.	U650	Table	Superhet 5 (A)	16–52, 48–150, 175–550, 750–2,100 m.	16 16 0	„ 9th

Abbreviations: RG = Radio-gramophone; A = AC; B = Battery; M = Medium; L = Long. * 12 volts.

ray tubes. We are still looking for larger images and still more illumination, and so under existing conditions flicker is likely to remain.

I am at present interested in a scheme where frequency economy is essential, but with a new method of synthesis it is anticipated that flicker will be overcome even when a comparatively low picture frequency is used.

In conclusion, I do not consider that it will be essential to have an image made up of so great a number of lines as 500, as suggested by Mr. Harris, when we have learnt the right way to analyse our image.

London, S.E.9. R. W. CORKLING.

Single-Span Receiver for Short Waves

I SHOULD be pleased to hear from any of your readers regarding the means they used in adapting their Single-Span receiver to include the short-wave range.

I had looked forward to an article in *The Wireless World* on this conversion, particularly after the reference to the subject in the "Hints and Tips" column of May 11th, 1934, and I regret this has not been done.

Regarding the Single-Span receiver itself, when linked to the "W.W." P-P quality amplifier and a good loud speaker, I have nothing but praise. It is all that a good set should be, and I feel that it is worthy of having its field of usefulness extended by the addition of a short-wave range. Will one of your more experienced readers, who has made this alteration, help in this matter?

Appreciating your very able efforts to keep us well abreast of modern radio developments. H. J. G.

Edinburgh.

[The Single-Span principle is not directly adaptable to SW reception, since on these wavelengths an aerial filter would not be very effective in reducing second-channel interference. There is no reason why such a set should not be successful on SW, however, if a tuned aerial circuit is substituted for the filter.—ED.]

Receiver Specifications

I HAVE just read again the correspondence columns in your issue of September 11th, and I see that Mr. Haywood, of Coventry, is making a claim to "stage" rating for B.T.H. I should like to point out to Mr. Haywood that the Ediswan (?) "two-stage" set was a three-stage receiver, as it contained a detector with two stages of A.F., the valves for these latter being contained in one envelope, and called by the makers TS2.

This, however, is by way of introduction. I should like, if I may, to criticise some of the specifications put out by manufacturers nowadays when describing their receivers.

It is easy to get hold of makers' catalogues at any radio shop, and I would suggest that anyone interested should get a supply and read them in a perfectly unbiased attempt to get any information about the goods "described."

For myself, I can claim twelve years' service experience, and quite average common sense, but I must admit that in some cases it takes me half an hour's study to discover whether a set is for AC or universal supply, and that in a number of cases this is finally solved by the acquaintance I have with the manufacturers' "type letters."

If proof of this is required, I would point out that all the catalogues in the shop where I work have been gone over and marked "AC," "U" or "B" to indicate the power supply.

Again, it is very kind of manufacturers to give one a coloured plate of the receiver, but it is awkward when asked "How many valves?" to have to admit ignorance, because the manufacturer will not supply the information. It is also bad that a superheterodyne can only be distinguished from TRF because somewhere in the text one sees mention of a heptode.

Further information that should be supplied is the power consumption. Of course, one can always measure this, but the manufacturer surely *knows* how much his products take from the power supply!

And finally, some statement of absolute sensitivity and top cut-off would be very welcome. I observe one manufacturer this year is putting out a dial showing the IF band width. Most users will not know what the figures mean, but this is a step in the right direction.

Do the manufacturers want to sell sets, or pigs in pokes? H. MOORBY.

Inverness, N.B.

Home Recording

I HAVE read with interest the article on home recording by Mr. Robert W. Bradford, in the September 25th issue, and I would like to endorse his praise of the V.G. recorder and records, they are excellent. When replaying there is no need for any scratch filter whatsoever, and the full frequency response of a high fidelity radiogram can be used without a trace of needle scratch. Also the quality of the recorded item, whether it be music or speech, is like the original—whether it be radio or microphone.

I notice that Mr. Bradford is using an expensive "Level Indicator," perhaps the cheap method I use may be of use to experimenters in this field. If the cutting head is wound to 15 ohms (V.G. supplied me with one at no extra cost), then a 6-volt. 0.04 amp. lamp will give a very clear indication of volume level, being just alight for normal volume recording. At present I am using a circuit I have devised for preventing the amplifier giving more than a predetermined output, however loud the input. I have made many records with the circuit in use, and have not had a trace of distortion anywhere. The persons singing or playing can do just as they please, and recording is merely putting the cutting head to the blank disc, and stopping the motor at the end. G. P. DENNY.

Worthing.

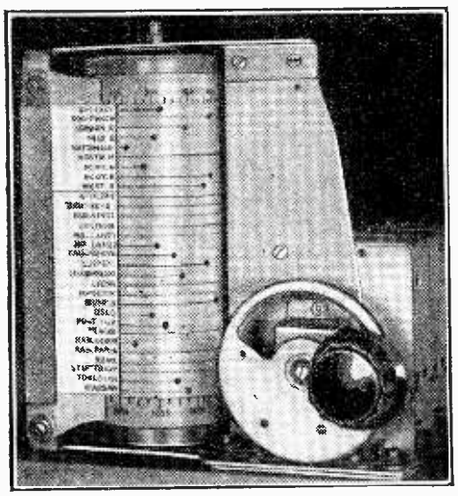
Modern Radio Communication, Volume I, 6th edition, by J. H. Reyner, B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E., M.Inst.R.E. Pp. 330 + xiii and 157 illustrations. Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 5s.

THAT this volume should run to its sixth edition is sufficient evidence of its merits. It takes its place among the more important of elementary textbooks for serious students of radio communication, especially prospective candidates for preliminary and intermediate examinations.

Although the size of the volume has not been changed, several improvements and some slight corrections have been made. Only fundamental principles are treated, and the use of mathematics has been avoided as far as possible. For the proofs of certain statements and formulæ, too advanced for an elementary textbook, the reader is referred to Volume II. Most chapters conclude with one or more examples for the student to work, and numerical answers are given at the end of the book. Specimen examination papers are also given. O. P.

Alphabetical Tuning Scale

MUCH ingenuity has been devoted to the devising of tuning scales, but so many designs that provoke our admiration at a first introduction fail to stand the crucial test of practical use. So far as those showing station names are concerned, a common shortcoming is that the names are grouped on the dial in a sequence corresponding to their position in the radio spectrum, and, unless the user can memorise the approximate position of a desired station, its location may take some time.



The Burns tuning dial, allowing station names to be grouped alphabetically or in any other order desired.

Alphabetical or geographical grouping is an obvious remedy for this, but it is one that tends to complicate the design of the tuning system.

A dial that seems to offer a highly practical solution to the problem has been designed by Mr. W. A. Burns; its operation is almost self-evident from the accompanying illustration. A rotating drum, suitably linked to the condenser spindle, is marked with dots which correspond to the various stations when registering with the edge of the station-name scale. Circumferential lines drawn on the surface of the drum in the manner shown give clear indication as to whether right- or left-handed rotation of the knob is required for tuning-in the desired station.

It is understood that the system of construction, which is clearly susceptible to modification to suit special requirements, is the subject of a patent application.

CURRENT TOPICS

News of the Week in Brief Review

Cheaper Radio Telegrams

A NEW night wireless telegraphic service has been introduced for the convenience of passengers on transatlantic liners who desire to communicate cheaply with the U.S.A. Telegrams handed in before midnight will be delivered on the following morning, the charge being a flat rate of 19 cents per word to any part of the United States. The ordinary rate varies from 21 to 29 cents according to the distance of the destination from the coast station. This service will be available on ships of all nationalities.

Fiji Islands Calling

SINCE the installation of the new transmitter at the Suva short-wave station, a very considerable increase in range has taken place. Amalgamated Wireless (Australasia), which operates the station, is particularly anxious to receive reports from this country, and would gratefully acknowledge any which are sent either to Suva or to the head office at Sydney, N.S.W. The station works on 9,540 kc/s (31.45 metres), and may be heard from 10.30 a.m. to midday (G.M.T.) daily except Sunday.

In Old Baghdad

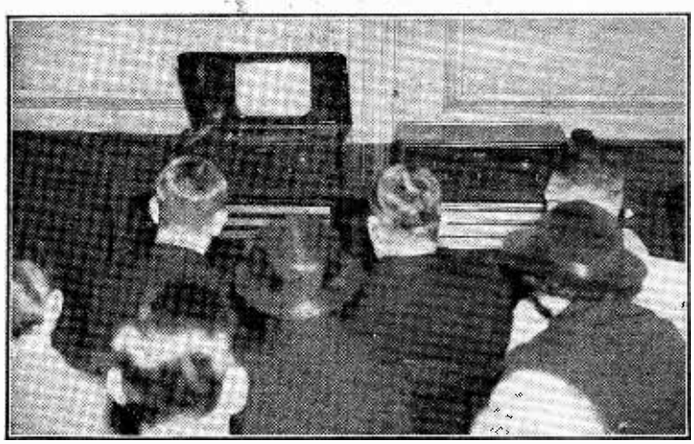
IRAK is apparently determined to make herself as well known to the nations of the world as she was in the days of the great Caliph, as it has been decided to erect a high-powered station about 12 miles from Baghdad. The station will be designed and built on the most modern lines, and the preparation of plans has been put into the hands of Mr. Barlow, the British radio engineer recently engaged by the Irak Government to advise them on wireless matters.

New Use for Ultra-shorts

THE application of ultra-short waves have been many and varied, the latest idea in the U.S.A. being to use them in order to enable the driver and guard of a railway train to keep in telephonic communication with each other. It might be thought that an ordinary line telephone would serve the purpose equally well and be far less expensive. Apparently, however, American trains are greatly addicted to the habit of breaking a coupling, and it is just at such a period that a vital need is felt for communication between the two severed portions of the train.

Bombay Police Wireless

THE use of wireless by the various police forces of the world is gradually spreading, the latest addition to the ranks of users being the Bombay police. At first two cars only are being equipped with apparatus, these carrying out experimental work in conjunction with the installation at police headquarters. After the expiry of a year the position will be reviewed, and, if favourable results have been obtained, the use of wireless will be greatly extended.



TELEVISION FOR ALL. Co-operation between the Southern Railway Co. and Baird Television, Ltd., has enabled a further series of free demonstrations of television to take place daily at Waterloo Station during the normal periods of transmission from Alexandra Palace. The present times are 11 a.m.–noon and 3–4 p.m. daily.

America and Sponsored Programmes

THERE are signs that many American listeners are getting a little tired of the advertisements accompanying the sponsored programmes of their broadcasting stations, and are showing a willingness to make a contribution towards the cost of programmes without advertising. They are not likely to get these programmes by wireless, however, since there would be no guarantee that pirate listeners would not derive enjoyment from the programmes without contributing towards their cost. The idea is to provide programmes to subscribers *via* landline after the manner of the relay exchanges over here. Already the sponsors of the scheme are making preliminary enquiries in several U.S. cities. They would not relay radio programmes as is done over here, but would send out their own, it being proposed to provide three programme channels to give, respectively, light music, classical music and talks.

Wireless Theory at Fault?

IT has long been one of the axioms of radio that the speed of wireless waves is similar to that of light waves, namely, about about 300,000,000 metres per second. According to reports received from France, however, experts are now throwing considerable doubt upon this figure, it being alleged that the speed of wireless waves is much slower, the actual figure given being 250,000,000 metres per second. This astonishing upsetting of pre-conceived ideas is said to be due to extensive measurements in connection with longitude determination in which all the large observatories of the world co-operated in 1933. These figures have not yet been confirmed, however, and, as the report somewhat naïvely adds, it would be very unsafe to draw any final conclusions at present.

Test Match Commentaries

DURING the present tour of the M.C.C. Team in Australia a special broadcast of one hour's duration will be made each day, commencing at 1.45 p.m. (G.M.T.) from Melbourne, VK3LR, on 31.34 metres, use being made of a horizontal rhombic aerial directed on London. The programme, in addition to cricket news and commentaries, will contain talks of general interest, sandwiched between light musical items. An epitome of the week's Australian news in English, French and German will be featured on Sundays, Wednesdays and Fridays respectively. The transmissions will be preceded by the call of the Australian lyre bird, and, to assist identification still further, the midnight chimes of the Melbourne Central Post Office clock will be heard a quarter of an hour after the commencement of the programme. This transmission will be known as Programme D.

Programme A, which is transmitted daily from 8.30 a.m. to 10 a.m. (G.M.T.), consists of talks, market reports, weather and news, and is intended primarily for listeners in the State of Victoria. Programme B consists of a relay of the National programme of the local medium-wave station, 3LO, and is transmitted from 10 a.m. to 12.30 p.m., and from 12.50 p.m. to 1.30 p.m. (G.M.T.). Programme C is similar in nature to programme A, but is intended for the benefit of Australian listeners generally rather than only for those in Victoria. It is transmitted from 12.30 p.m. to 12.50 p.m. (G.M.T.) daily.

A Fatal Experiment

TWO medical students at Ghent in Belgium have been badly injured in an explosion which took place during a wireless experiment which they were carrying out. They were endeavouring to discover if an explosive mixture could be ignited by ultra-short-wave emanations. It is not clear, however, whether the explosion was due to the wireless waves or arose through some other cause. One of the students has since died.

Turkish Developments

BROADCASTING is said to be growing steadily in popularity throughout the Ottoman Republic, it being reported that the total number of receiving sets in the country now exceeds 6,000. There are at present only two transmitters, these being at Ankara and Istanbul, but the erection of two new stations is contemplated in the near future.

U.S. Listeners

ACCORDING to a report issued by the American Commission on radio reception, the State of New York has by far the largest number of radio-equipped homes, the figure being just under three million. Next comes Pennsylvania with two million. Illinois, California and Ohio have approximately 1½ million each, while all the other States have less than one million, the lowest being Nevada with 22,000. The total number of radio-equipped homes in America is 23 million.

New Apparatus Reviewed

Recent Products of the Manufacturers

G. I. MICROPHONE

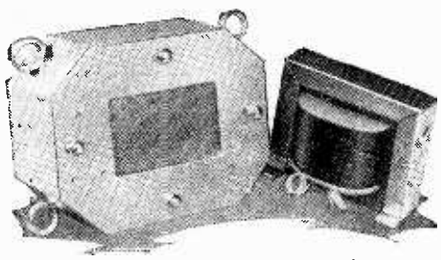
THIS microphone is a transverse-current type based on the design of *The Wireless World* model described last year. It is understood that several modifications have been effected in the internal construction, though the dimensions and shape remain the same.

These modifications have increased its resistance slightly, but as this is accompanied by a very low noise level and quite high sensitivity the changes are all to the good.

The microphone gives a satisfactory response throughout the whole of the audible range, and there are no resonances of any real consequence anywhere between 50 and 8,000 c/s. There is a slight falling off in the output above about 7,000 c/s, but even so the level up to 10,000 c/s is quite adequate for all normal requirements of public address, amateur experiments and home recording. The bass output is also sufficiently well maintained to ensure a good balance.

The reproduction of speech is exceptionally good and there is no trace of harshness, which is one of the failings of some carbon microphones.

Sibilants are inclined to be a little overstressed if the speaker is too close to the microphone and talks loudly, but this effect entirely disappears by speaking quietly or moving about four feet away. A variable control of polarising voltage might serve the same purpose. Best results were obtained by facing the microphone and not speaking across its face.



G. I. transverse-current microphone and transformer.

Our tests were made with polarising voltages of four, six and eight, and six appears to be the most suitable for general purposes. The current passed is then between 7 and 8 mA.

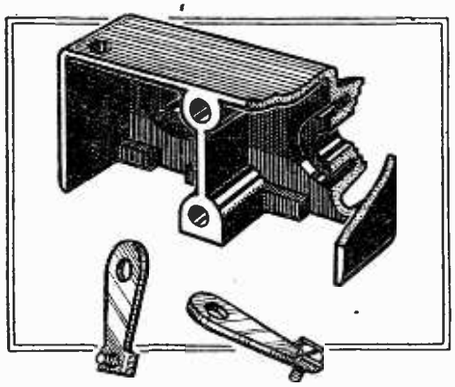
Though the sensitivity is high, the output is hardly sufficient to enable the microphone to be operated satisfactorily from an ordinary broadcast set without the addition of a small pre-amplifier.

The workmanship and finish are outstandingly good. Cream and chromium is the scheme adopted.

It is made by Gilbert Industries, Ltd., 518, London Road, Westcliff-on-Sea, Essex, and the price is 25s. A special transformer for it costs 8s. 6d.

FOR LOUD SPEAKER OVERHAULS

MESSRS. HOLIDAY & HEMMERDINGER, Holmer Works, Dolefield, Bridge Street, Manchester, 3, have introduced a set of feeler gauges for use in re-centring moving-coil loud speakers. The material used is non-metallic and there are four sets, each of four gauges, contained in a neat leather case. The four thicknesses are 0.015, 0.010, 0.0075 and 0.0005 inch and the price of the complete outfit is 2s. 6d.



Belling-Lee high-voltage terminal mount.

BELLING-LEE TERMINAL MOUNT

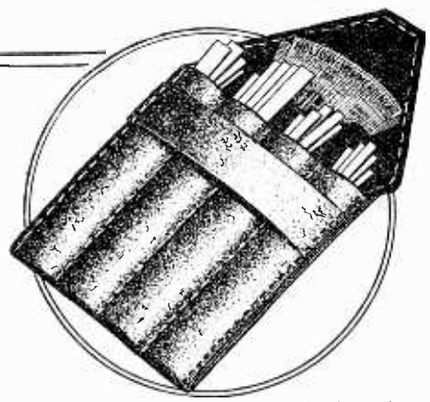
BELLING AND LEE, LTD., Cambridge Arterial Road, Enfield, Middlesex, have introduced a new terminal mount that has been designed especially for use in high-voltage circuits. It is intended for incorporation in apparatus associated with television where DC voltages of 6,000 or more are employed.

A special feature of the device is that the position of the terminals is arranged to give a long surface path between them so that leakage is reduced to a minimum for a mount of this size.

It is moulded from high-grade bakelite and can be mounted in an upright or in a horizontal position. With each mount is supplied two metal-tag terminals, their purpose being to enable it to be secured in place with the terminals upright, yet providing accessible contact points for the wiring. When mounted on its side these tags need not be used. The mount supports two terminals and the holes are approximately $\frac{13}{16}$in. in diameter, so it will accommodate terminals with shanks up to 2BA in size. It measures 2in. long, 1in. wide, and is a shade under $\frac{7}{8}$in. high; the price is 6d. complete.

PYE "MATCH-ALL" EXTENSION LINK

THE majority of modern receivers provide a connecting point for an extension loud speaker, and it is customary to specify an impedance figure for any extra unit that may be used. It is essential that this advice be observed, for if the extra loud speaker has an unsuitable impedance it will adversely affect the reproduction of both internal and external loud speakers.



Gauges for centring moving-coil loud speakers.

Though many listeners may have spare loud speakers available, there is thus a natural reluctance to make use of them if their impedances are of the wrong values. It will, therefore, be of interest to know that Pye Radio, Ltd., Radio Works, Cambridge, have evolved a unit designed especially to enable any loud speaker to be matched to, and used as an extension unit with, any wireless receiver.

Described as the "Match-All" Extension Speaker Link, it consists of a transformer provided with tappings on both primary and secondary windings.

As in some cases the unit may be used as an auto-transformer, it is very wisely stated in the instructional leaflet that the unit be isolated from the DC circuits.

Where matching is effected to the low-impedance winding on the receiver's output transformer this condition is complied with automatically, but in cases where the "Match-All" unit is connected to the primary side, or to a choke-filter circuit of an early type receiver, a condenser of from one to four mfds. must be joined in each lead between the unit and the set.

A table is provided giving the correct connections for matching loud speakers of from one to 6,000 ohms or more to either high- or low-impedance output points on a receiver.

When the extension speaker is located a considerable distance from the set, say 30 feet or more, it is recommended that two matching units be employed, one close to the receiver and the other at the distant point.

The connections recommended in such cases provide for a satisfactory matching to a long extension line without an appreciable loss in volume or any impairment of the reproduction. Ordinary twisted flex or bell wire can then be used for the line.

Pye extension loud speaker matching unit.

The unit is assembled in a metal container measuring 4¼in. overall diameter and 2in. high, and the price is 10s. 6d.

Listeners' Guide for

Outstanding

THE RACE-COURSE SCENE from the original production of "The Arcadians" in 1909. Leonard Henry and Horace Kenney again take part in the broadcast version, which will be revived in the Regional programme at 8.15 on Wednesday and again Nationally on Friday, October 23rd.

THE long-awaited inaugural broadcast of the new concert-cum-cinema organ in the St. George's Hall takes place this week. It is announced that in the three-quarters of an hour programme on Thursday at 8 four well-known broadcasting organists—Harold Ramsay, Quentin MacLean, Reginald Foort, and Reginald Porter-Brown—supported by Henry Hall and the B.B.C. Dance Orchestra, and Mark Lubbock with the Theatre Orchestra, will demonstrate its possibilities. It will be interesting to hear an organ of this type combining with an orchestra and a dance band in "straight" and rhythm music.

◈ ◈ ◈

NEGROID

TWICE during this week negro songs come into the programmes. On Sunday, by courtesy of the Columbia Broadcasting System, a programme of negro spirituals will be relayed Nationally from America at 9.5. It will consist of part of a religious service from the Negro Church, Washington, D.C., conducted by Elder Lightfoot Solomon Michaux.

The second occasion will be on Tuesday at 8.45 (Regional), when the first of three programmes on negro songs headed "From Jungle to Jazz" will be broadcast. The idea underlying this cavalcade of negro songs is to show the development from melody and rhythm of the Zulus to songs and rhythm of to-day. In this first broadcast Africa will be the theme.

The programme has been devised by Jules Bledsoe, who will also be singing, supported by the Variety Orchestra.

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RUNNING COMMENTARIES

ON Saturday afternoon two sports commentaries will be given in the National programme. The first is at 2.5, when Colonel R. H. Brand will describe the progress of the play in the National Covered Court Tennis Championships of Great Britain from the Queen's Club, West Kensington. Immediately following this, at 3.30, listeners will be switched over to the Brooklands Motor Course, where they will hear F. J. Findon on the Brooklands Mountain Championship.

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"STAR-GAZING"

WHILST having nothing to do with astronomical observations, it is an apt title for a programme which picks out the stars of the theatre world. In the series of programmes "Star-Gazing" by the collaborators of "Scrapbook" fame, Leslie Baily and Charles Brewer, theatrical celebrities will tell how incidents in their lives have brought them before the public. Could a better choice than Robert Hale be made for the first broadcast on Thursday at 7.30 (Nat.), and again on Saturday, October 24th? He will bring with him his children, Binnie and Sonnie, who he discouraged, without success, from following in father's footsteps.

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MUSIC OF THE WEEK

THE seventh season of the Sunday Orchestral Studio Concerts begin this week in the Regional programme at 9.5, with Section B of the B.B.C. Orchestra and Alexander Kipnis (bass).

For the music series this week has been chosen works for string quartets and is headed "The String Quartet Before Haydn." The recitalists will be the Stratton String Quartet and the Roth String Quartet. The first concert is on Sunday at 6.15, when the works of Northern German composers will be given. On Monday at 6.40 (Nat.), Tuesday at 7 (Nat.) and Thursday at 7.30 (Reg.) works of Italian, Austrian and South German composers will be dealt with respectively.

A distinguished visitor, José Iturbi, will be heard playing the solo pianoforte work in Mozart's pianoforte Concerto in D minor during the Symphony Concert to be broadcast from the Queen's Hall at 8.15 and 9.25 on Wednesday. Not only is he a first-class pianist, but he is also a conductor of exceptional attainments. He is to conduct at the Sunday Orchestral Studio Concert on October 25th. The Symphony Concert on Wednesday opens with the B.B.C. Choral Society singing Gerrard Williams' arrangement of "God Save the King." Dr. Adrian Boult will be conducting the B.B.C. Symphony Orchestra, and Noël Eadie and William Parsons will be heard in Vaughan Williams' "A Sea Symphony."

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"GHOSTS OF LONDON"

IN this series of programmes of musical memories devised by Wilfrid Rooke Ley, listeners will be given pictures of happenings in the lives of famous musicians when resident in or visiting England. The first of the series will be given Nationally at 9.30 on Sunday.

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A CENTURY OF OPERETTA

ANOTHER distinguished visitor comes into this week's programmes with the broadcast "One Hundred Years of Operetta," when Victor Reinshagen conducts the Theatre Orchestra. Webster Booth will be the soloist. Apart from the fact that the orchestra will be under the baton of such an outstanding theatre musician, this programme should be very

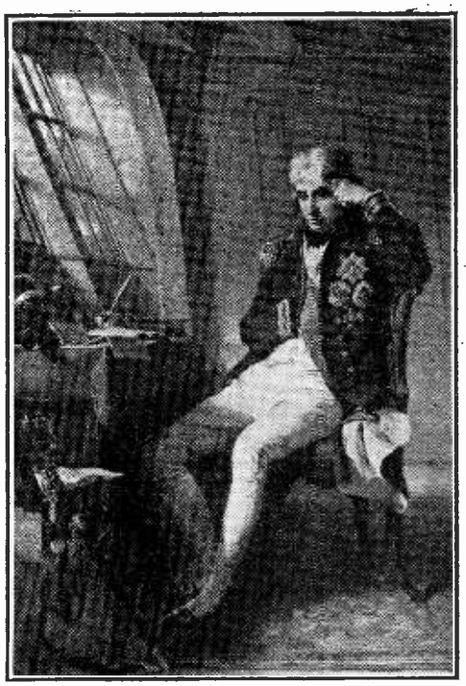
interesting and tuneful. Victor Reinshagen, who is a Russian by birth and Swiss by nationality, is, at the age of twenty-eight, conductor at the State Theatre, Zurich.

the Week—

roadcasts at Home and Abroad

TRAFALGAR DAY

THE right atmosphere will undoubtedly be introduced into the broadcasting play "Nelson's Last Journey," for the author is Thomas Woodrooffe, the commentator, who was a lieutenant-commander in the Royal Navy. This play will be given on Trafalgar Day (Wednesday) at 7.30 (Nat.), and will deal with the time from Nelson's last night ashore at the inn at Burford Bridge until the great victory and tragic death.



"THE EVE OF TRAFALGAR." Nelson in his cabin in the "Victory" on the eve of the great battle: from the painting by Lucy.

FLORENCE NIGHTINGALE

A RADIO adaptation of Reginald Berkeley's play "The Lady with a Lamp" is to be given on Monday and Tuesday at 9.35 (Nat.) and 7.30 (Reg.) respectively. Val Gielgud has been able to secure Diana Wynyard for the part of Florence Nightingale. This will be her second broadcast; the first was in "A Winter's Tale" in January last year.

LADY ELEANOR SMITH talking to Gipsy Petulengro at the "In Town To-night" dinner last year. Petulengro will be heard during the betrothal ceremony broadcast from a gipsy encampment in Hertfordshire to-night (Friday) at 8.40 (Reg.), when Thomas Woodrooffe will be the official commentator.

GUITAR RECITAL

SPANISH music will be given its true interpretation when Segovia gives a guitar recital on Monday at 8.30 (Nat.). He is a great exponent of this expressive Spanish instrument, and this recital should be listened to by all who attempt to play the guitar, which is the most fashionable instrument in modern dance bands.

SCANDINAVIAN

THE first of a series of inter-Scandinavian concerts will be given to-night at 7.15 from Helsinfors and will be relayed by all Finnish, Norwegian, Swedish and Danish stations. The Helsinfors Municipal Orchestra will play a selection of famous Finnish music, the outstanding item being "Tulen sunty" (The Birth of Fire) by Jean Sibelius. This work is written for baritone solo, male choir and full orchestra, and is seldom heard outside Finland. The choir will be the Finnish Students' Choir (Ylippilaskunnan Laulajat).

DANISH OPERA

A SHORT programme which should be well worth tuning in comes from Copenhagen on Tuesday at 8.20, lasting only half an hour. The Danish wireless orchestra will give a representative selection of Danish operatic works by Bechgaard, Borresen and Carl Nielsen.

HIGHLIGHTS OF THE WEEK

FRIDAY, OCTOBER 16th.

Nat., 8, Lauri Wylie's "Wireless Puppets." 9.40, Chamber Music: Vivien Lambelet, Isidore Phillips and the International String Quartet.
Reg., 7.30, Hawaiian Rhapsody, a radio musical play. 8, B.B.C. Military Band and Arthur Fear. 8.40, "O Romani Rommerin."
Abroad.
Brussels I, 8, "Tales of Hoffmann."

SATURDAY, OCTOBER 17th.

Nat., 7.30, "In Town To-night." 8.15, B.B.C. Orchestra (C), and Garda Hall. 9.20, Music Hall.
Reg., 4.15, Lauri Wylie's "Wireless Puppets." 7.30, The Alfredo Campoli Trio. 8.30, Discussion: "Conflict or Conciliation in the Coal Field?" 10.25, Ambrose and his Orchestra.
Abroad.
Radio-Paris, 9, Choral and Band Concert from the Salle des Etats de Bourgoyne, Dijon.

SUNDAY, OCTOBER 18th.

Nat., 5.35, "Hippolytus." 7.5, Recital: Joan Coxon and Paul Makanovitzky (violin). 9.5, Negro Spirituals from America. 9.30, "Ghosts of London."
Reg., 5.45, Concert by the Orchestre Radio from Brussels. ¶Operatic Programme: Munn and Felton's Band. 9.5, Sunday Orchestral Concert.
Abroad.
Berlin, 7, "Rigoletto."

MONDAY, OCTOBER 19th.

Nat., 7.20, "Entertainment World." 8.30, Guitar Recital: Segovia. 9.35, "The Lady with a Lamp."

Monday, October 19th, continued.

Reg., 8.30, "I was There"—Klondyke—T. E. Hockley. 9.30, Concert Marches: B.B.C. Military Band.
Abroad.
Berlin, 7.10, "Raise the Curtain": Excerpts from current Berlin Theatre Programmes.

TUESDAY, OCTOBER 20th.

Nat., 6.25, The Bernard Crook Quintet. 8, St. George's Hall Organ.
Reg., 7.30, "The Lady with a Lamp." ¶Van Phillips and his Two Orchestras. 11.40 Pianoforte Recital: William Busch.
Abroad.
Konigsberg, 7.10, Orchestral Concert.

WEDNESDAY, OCTOBER 21st.

Nat., 7, Carroll Gibbons and the Savoy Hotel Orpheans. 7.30, "Nelson's Last Journey." 8.15 and 9.25, Symphony Concert from the Queen's Hall. ¶Dorothy Hogben's Singers and Players—Music of the Hunt.
Reg., 6, B.B.C. Military Band. 8.15, "The Arcadians." 9.30, The World Goes by.
Abroad.
Brussels 1, 8, European Concerts: "Francesca da Rimini."

THURSDAY, OCTOBER 22nd.

Nat., 6.40, One Hundred Years of Operetta. 7.30, "Star-Gazing."
Reg., 6, B.B.C. Dance Orchestra. 8.45, "North of the River": London Entertainments to be found north of the Thames.
Abroad.
Copenhagen, 7.10, Liszt Concert.

LISZT PROGRAMME

THIS week's Thursday concert from Copenhagen is devoted to the works of Liszt, who was born on October 22nd, 1811. The augmented wireless orchestra will be playing under the direction of Nicolai Malko. The concert begins at 7.10.

OPERA

THE outstanding opera performances of this week come from the theatres and opera houses. From the Théâtre Royal de la Monnaie comes Offenbach's "Tales of Hoffmann," relayed by Brussels No. 1 at 8 to-night. If only for the haunting barcarolle this relay is certain to have many listeners. Earlier in the evening, at 6.30, Budapest No. 1 relays "A Winter's Tale" from the Royal Hungarian Opera. English listeners are invariably interested in the music of any composer who uses the plays of our own immortal Shakespeare.

On Saturday Monte Ceneri relays Mascagni's "Cavalleria Rusticana" at 8 from the Teatro Sociale, Bellinzona.

Sunday brings a studio performance of Verdi's "Rigoletto" from Berlin (Funkstunde) at 7. From Königsberg comes another studio performance at 7, namely, "Das Dorf ohne Glocke" (Künneke).

THE AUDITOR.

PAUL GILSON, the great Belgian composer, whose dramatic oratorio, "Francesca da Rimini," will be given in French for the Belgian European Concert to be broadcast from Brussels No. 1 at 8 on Wednesday.

Inherent Receiver Noise

II.—SOME FURTHER ASPECTS

By A. L. M. SOWERBY, M.Sc.

Part I appeared in our issue of October 9th.

IN the first instalment the author explained the nature of the two kinds of noise that impose a limitation on the usable sensitivity of a receiver. He now goes on to discuss other problems of noise, of particular interest being those relating to the superheterodyne receiver.

THERE remains to see how far the amount of noise produced by thermal agitation and by the amplifying valves themselves is capable of reduction, and how far it depends on the type of set used and the wavelength being received.

Both thermal and shot noise depend on the width of the frequency-band passed by the set. In a non-distorting amplifier no harmonics of any frequency initially present can arise during amplification; noise-frequencies present at the anode or grid of the first valve are therefore harmless provided they are filtered out before they can reach the detector. In a straight set F must therefore be taken to stand for the overall resonance curve of the receiver.

It need hardly be emphasised that the band of frequencies passed cannot be too far reduced without losing the outer sidebands that carry the higher notes of music. A certain small amount of noise can be excluded, at least theoretically, by making sure that the band of frequencies presented to the detector for rectification is no wider than that which we require eventually at the loud speaker, instead of relying solely on the audio-frequency side of the set to keep the band-width down. On the other hand, it can be shown that one component of the noise produced at the detector can be reduced by making sure that the AF amplifier passes a band of frequencies no wider than that of the tuned circuits. For minimum noise, therefore, the tuned circuits and the AF amplifier should cut off at the same upper frequency.

These precautions, however, only touch quite small components of the total noise; so far as the main bulk of it is concerned either the tuned circuits of the AF amplifier may be used to control the total range of frequencies. It has already been mentioned that the modulation-depth caused by music drops towards the higher audible frequencies, while noise-voltage remains high; this accounts for the high-pitched hissing character of the noise and indicates that a limitation of high notes by a falling characteristic will have more apparent effect on the noise than on the music. The musically abominable knob labelled "Tone Control" can therefore often be made use of when receiving a distant station; music remains more or less intelligible even though noise is quite drastically cut.

Thermal noise is controlled, also, by the value of the resistance between grid and cathode of the first valve. If, as is usual, this position is filled by a tuned circuit, it can be shown that for a constant injected voltage the noise/signal ratio is reduced by decreasing the radio-frequency resistance of the circuit. For a constant signal input, halving the RF resistance quadruples the signal power at the loud speaker, but only doubles the noise power. Bringing the signal output back to its original level by reducing the gain of the set to half its original value leaves us with the noise power halved as the sole final result of the series of adjustments.

In finding this relationship it was assumed that the tuned circuits subsequent to the first, or, alternatively, the AF amplifier, were controlling the range of frequencies finally reaching the loud speaker, and that the reduction of RF resistance did not narrow the frequency-band at all. If such a change is to be admitted, reduction of RF resistance would naturally have even more effect, and it can be shown that in the very unlikely event of the first circuit controlling the frequency-range halving its RF resistance would divide the noise output by four for an unchanged signal-output. In this case variation of inductance also has its effect, but this is not normally within our control, since the value has to be such as to tune over the wave-range required. Where the first tuned circuit across which the thermal noise is being developed is followed by further identical tuned circuits in cascade (as in a multi-stage amplifier) the effect of these in reducing the frequency-band is given as a curve in Fig. 4.

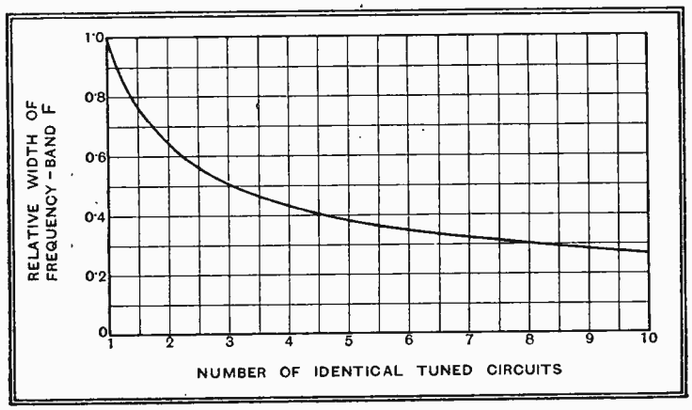


Fig. 4.—In cases where the tuned circuits control the band of frequencies passed, this curve gives relationship between F and the number of circuits used.

Lines of Attack

The practical range over which we can control thermal noise is, unfortunately, very limited; reduction of frequency range at the cost of quality of reproduction, and decrease of the resistance of the first tuned circuit in which it arises are the only lines of attack. Since tuned circuits are already fairly "good" in most cases, and the frequency-band of the average set wants widening rather than restricting, not much can be done.

There is always the possibility of immersing the first circuit in liquid air (−190° C.), which would reduce the output of noise to little more than one-third of its normal value, while by using liquid helium (−267.9° C.) it could be reduced to less than one-fiftieth. But this, while perfectly possible as an experiment in a laboratory, is hardly practicable for everyday reception!

On the broadcast band, as we have seen, shot noise is normally much less intrusive than thermal noise. This does not remain true for short-wave reception, so that it is worth while to glance at the possibility of reducing shot noise by careful design of the set. The shot *current* is determined solely by the anode current of the first valve; it is an elementary precau-

Inherent Receiver Noise—

tion to keep this low. In this connection the effects of secondary emission should not be overlooked; if there is secondary emission from the anode the steady current will be correspondingly reduced, but the shot noise will be increased since we now have to take into account the irregularity of electron-departure as well as of electron-arrival. Even though the steady values of the opposing currents have to be subtracted, the irregularities will add.

The shot-voltage applied to the grid of the second valve in the set is the product of the shot-current and the impedance (tuned circuit, etc.) through which it flows. Since the signal voltage is built up in exactly the same way, by the passage of the signal currents through this same impedance, changes in the anode circuit will affect both signal and noise in practically the same way. Changes in the tuned circuit, therefore, will not seriously alter the signal/noise ratio—except, of course, through altering the frequency band passed, but this has already been discussed.

The main point to notice here is that the gain of the first stage should be made as high as possible, so that by the time the signal reaches the first anode, where the shot noise will be added to it, it should be as large as possible. This means that the first valve should be one that gives a $0.53 \times 1/10^{-6}$ and a magnification m of 50.5. If we assume that the tuned circuit in the grid of the valve has the same characteristics as these we have just found for the anode circuit, the noise values work out thus:

Thermal Noise.

$$Vt = 1.25 \times 10^{-10} \sqrt{10^4 \times 3 \times 10^3} \ (F = \pm 5 \text{ kc/s}) = 0.69$$ microvolts.

With a gain of 6 times, this becomes 4.14 μV at the grid of the second valve.

Shot Noise.

$$Vs = is \times R = 5.64 \times 10^{-10} \times 3 \times 10^3 \sqrt{10^4 \times 3 \times 10^{-3}} = 9.3$$ microvolts.

This time the shot noise is more than double the thermal noise, and both, it will be noticed, are far lower in value than we found on the broadcast band. In view of the fact that the grid circuit, even though of dynamic resistance only 3,000 ohms, has the very respectable magnification of 50, a good step-up from the aerial may be expected, and it should be possible to obtain reasonably noise-free signals on 20 metres with an input to the aerial of well under a microvolt.

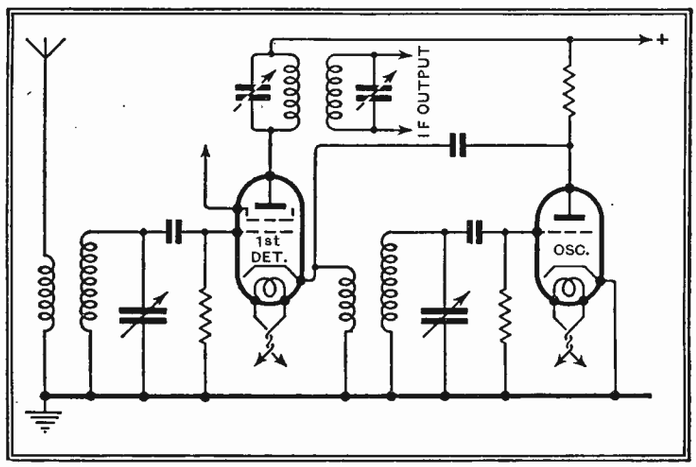


Fig. 6.—Skeleton circuit of superheterodyne in which no RF stage precedes the frequency-changer. Note that oscillator noise now has to be compared only with *un-amplified* thermal voltage in first circuit.

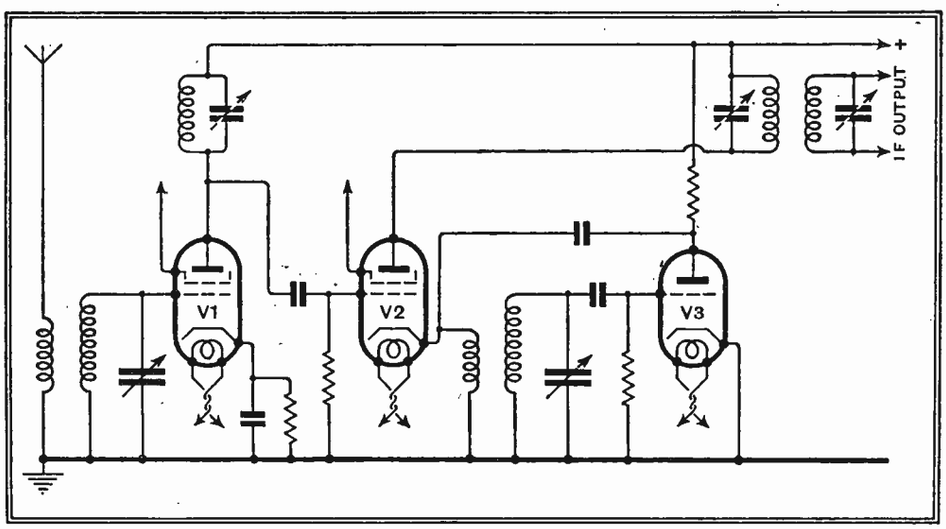


Fig. 5.—Skeleton diagram of first two stages (RF and frequency-changing) of superheterodyne discussed in text. V1 = RF amplifier, V2 = first detector, V3 = oscillator. Note that oscillator noise is injected at a point where *amplified* thermal noise and shot noise already exist.

very high stage gain while consuming the minimum of anode current.

On short waves the values of shot and thermal noise come out rather differently. Data for tuned circuits is not so readily available at these wavelengths, but if we assume that a radio-frequency stage gain of 6 times is obtained at 20 metres with a valve of slope 2 mA/V, and that the tuning range of the anode circuit is from 12 to 30 metres (all reasonably practical figures), we find that the tuned circuit has an effective dynamic resistance of 3,000 ohms, uses an inductance of 0.63 microhenrys, and has an RF resistance of 1.19 ohms, which give an L/r ratio of

The fact that the frequency band covered by the tuned circuits is very much wider than is the case on medium waves is not of very much importance, for the AF amplifier will cut off most of the extra range before the loud speaker is reached. But it is true that secondary effects at the detector will introduce some small additional amount of noise that could have been avoided if it had been possible to restrict the band of frequencies reaching it more nearly to that actually required for final reproduction.

So far we have restricted our discussion to the sources of noise in a "straight" set, consisting of ordinary high-frequency stages followed by a detector. The introduction of the superheterodyne principle makes some slight difference to the noise level even on the broadcast band, while on short waves it can introduce a considerable amount of extra noise if care is not taken with the design.

Taking the broadcast band first, it is at least perfectly evident that in the oscillator valve we have a further source of short noise. Restricting ourselves for the present to the type of superheterodyne in which a radio-frequency stage precedes the frequency-changer (Fig. 5), we see that there is already shot noise in the signal reaching the frequency-changer; the contribution from the oscillator is at least not likely to exceed the noise already present. And this, as we have seen, is in turn swamped by the thermal noise in the first tuned circuit. We therefore conclude that on the broadcast band a superheterodyne should not be appreciably noisier than a straight set, provided that both begin with a stage of ordinary high-frequency amplification, and provided, also, that the process of frequency changing is not such as to bring noise from additional sources.

This last point evidently requires investigation, which can only be undertaken mathematically. If one works out the various combinations that arise when four voltages of different frequency (oscillation, carrier, one sideband, and noise) are simultaneously impressed on a first detector having a grid-volts/anode-current curve expressible by an equation of the fourth power, one reaches the rather frightening conclusion that the output at the anode contains currents of 160 different frequencies. Most of these fortunately turn out to be harmless, either on the grounds that they cannot pass the IF amplifier, that they will be turned out by the preselector, or, more usually, because their magnitude is trifling.

Suppose we are receiving a signal at 1,000 kc/s with a superheterodyne of which the intermediate frequency is 100

Inherent Receiver Noise—

kc/s. The oscillator will be set at 1,100 kc/s. Any noise voltages round about 1,000 kc/s will be converted, along with the signal-sidebands, into current round the intermediate frequency. Noise accompanying the original carrier is thus passed through to the detector exactly as in a straight set. If there is present at the grid of the frequency-changer any noise voltage round about 1,200 kc/s (the second-channel interference point), this, also, will be converted to IF, and will go through the set along with the signal. In the absence of selective tuning to eliminate this voltage before the frequency-changer is reached, the noise voltage in a superheterodyne would be 40 per cent. greater, and the power output of noise double that of a straight set of equal sensitivity.

Second-channel Noise

Still keeping to the case where a stage of radio-frequency amplification precedes the frequency-changer, we can make a rough estimate of this second-channel noise. The thermal noise in the grid circuit of the first valve will be comparatively small, because at the second-channel frequency the tuned circuit will have an impedance of roughly one-twentieth of that which it has at the frequency to which it is tuned. The anode circuit also being off tune, this reduced voltage will undergo but small amplification, so that in the end it will be only about one-thirtieth of that associated with the carrier. The shot noise is less reduced, for it is subject to the preselection of the second tuned circuit only; across this the shot current at the second-channel frequency will develop perhaps one-tenth of that at signal frequency. The shot noise will thus contribute more than the thermal noise at the second-channel frequency, but the sum total of the extra noise will still be quite small.

Additional minor sources of noise are also possible; for example, noise voltages at 100 kc/s on either side of the second and third harmonics of the oscillator can give rise, after frequency changing, to noise at intermediate frequency. But even one tuned circuit at 1,000 kc/s can be relied upon to reduce the noise voltages at 2,100, 2,300, 3,200, and 3,400 kc/s to insignificant proportions.

In a superheterodyne in which the frequency-changer is the first valve the position is rather different, and much more difficult to define exactly. The comparatively simple frequency-changing circuit of Fig. 6 shows that since the oscillation is injected in the grid-cathode circuit, any noise accompanying it has to be compared with the unamplified thermal noise present in the first tuned circuit. First, there is the thermal noise in the oscillator grid circuit; the anode current corresponding to this will develop some not inconsiderable voltage across the rather indefinite impedance of the reaction coil. The shot current of the valve will also produce a noise voltage across the same coil, and the two together are injected into the grid circuit of the first detector in series with the unamplified signal. However vague we may be as to the exact magnitude of the oscillator noise we can at least be certain that it is likely to exceed very considerably the thermal noise of 3 to 4 microvolts, which is the sum total of the "natural" noise accompanying the signal. In addition, there is little to prevent at least a certain amount of oscillator noise at the second-channel frequency from reaching the first detector; this will contribute a little extra to the total noise.

In agreement with these conclusions, it is generally recognised, as an empirical fact, that a sensitive superheterodyne built to the circuit "frequency-changer, two IF stages, detector" is impossibly noisy, while a set of equal sensitivity built to the circuit "AF stage, frequency-changer, one IF stage, detector" offends enormously less on this account, and behaves, from the noise point of view, more or less indistinguishably from an equivalent straight set.

We have already seen that noise on the short waves differs from that on the broadcast band in two respects: first, it is much less, and, second, shot noise, instead of thermal noise, predominates.

The selectivity of a short-wave tuned circuit, expressed as discrimination against signals removed from resonance by a fixed number of kilocycles, is much lower than that of one intended for the broadcast-band. Even at the higher intermediate frequencies (about 450 kc/s) habitually chosen for short-wave sets, a very considerable portion of noise at the second-channel frequency consequently reaches the grid of the frequency-changer, so making a superheterodyne nearly twice as noisy as a straight set. The only means that suggests itself of reducing this extra noise is to use as many tuned circuits as convenience permits between the AF valve and the frequency-changer. Extra tuned circuits preceding the first valve may reduce noise picked up by the aerial, but will have no effect whatever on either thermal or shot noise.

APPENDIX.

Some Noise Formulæ.

Thermal Noise.

$$V_t = 1.25 \times 10^{-10}\sqrt{FR}$$

at 290 degrees absolute. (17° C., 63° F.)

If r = equiv. series resistance of tuned circuit

V_0 = signal reaching first grid,

then, on the assumption of constant injected signal voltage into the circuit,

V_t/V_0 is proportional to $\sqrt{r}$ for constant bandwidth, F.

V_t/V_0 is proportional to r where first tuned circuit controls F.

In this latter case, if we take F as being the range over which the response of the tuned circuit exceeds $1/\sqrt{2}$ of that at resonance,

$$F = r/L$$

and $V_t = 2.5\,\pi \times 10^{-10} f \sqrt{L}$ volts

or, if C is the tuning capacity,

$$V_t = \frac{2.5\,\pi \times 10^{-10}}{\sqrt{C}}$$

For p tuned circuits, all alike, F as defined above is $\left(\sqrt{2^{1/p}-1}\right)\frac{r}{L}$. Fig. 4 gives values of $\left(\sqrt{2^{1/p}-1}\right)$

Shot Noise.

$$i_s = 5.64 \times 10\sqrt{FI} \text{ amps.}$$

$$V_s = i_s \times R = 5.64 \times 10^{-10} R\sqrt{FI}$$

where R is dynamic resistance of tuned circuit.

$$V_s/V_t = \frac{i_s(R + R_0)}{\mu V_g}$$

This is *independent of* R if R is negligible compared with R_0 (screened valve); *small* if μ/R_0 is large enough.

RANDOM RADIATIONS

By "DIALLIST"

Fine Short-wave Reception

THE other night, when B.B.C. stations were relaying from the U.S.A. the results of the final of the Women's Golf Championship, I flicked over the switch of the "all-wave" set to see what direct reception was like. Running over the 19-metre band I found the transmission coming from Radio City, New York, in the most amazing way. The strength was such that full loud speaker volume was obtained with the control turned well down. There was no fading, quick or otherwise, no atmospherics, no distortion. It was, without exception, the best reception of short-wave signals that I have ever had from the other side of the Atlantic.

That was between 22.30 and 22.50 G.M.T., when it would be daylight in New York. It was interesting to notice how the signal began to deteriorate as darkness drew on at the transmitting end. There was noticeable decline in the strength, and slow fading became apparent. The B.B.C. engineers can't have had much trouble with their relaying that night, for at the time when they were working with New York, signals were at the very top of their form.

It Doesn't Always Happen

Transatlantic and other distant relays are not always so straightforward as that, though. I was talking the other day to one of the B.B.C. engineers, and asked him to add to my knowledge of the receiving outfit at Tatsfield. Tatsfield, as you probably know, is a double-purpose receiving station. One of its duties is to keep a watch on frequencies of long-wave and medium-wave stations on behalf of the I.B.U.; the other is to receive such short-wave transmissions as the B.B.C. wants for its relays. When these come from across the Atlantic three fairly widely separated channels are generally used simultaneously. The receiver is built on the grand scale, with three separate signal frequency and intermediate frequency departments, one for each transmission. By an ingenious arrangement any signal which falls below a certain level is instantly cut out. As fading doesn't occur simultaneously on different wavelengths, only the signal that is best and strongest at any moment is accepted and passed on to the audio-frequency circuits. Thus, in the

course of a single relay there may be dozens of changes from station to station and back again and, unless very rapid fading is present the output from the receiving set can be kept pretty constant.

An Operator's Problem

A SHIP'S wireless officer sends me a problem which I pass on to readers in the hope that they may be able to offer a solution. "I wonder," he writes, "if anybody can tell me why it is that very long waves are usually better received in daylight than after dark. I am thinking particularly of GBR, which works on 18,750 metres. Coming from Jamaica this trip I could read GBR easily in the daytime, but at night I couldn't hear him at all. When the distance from the station is less than 1,500 miles the signal is readable at night, though it is surprisingly weak considering that GBR has 350 kilowatts in the aerial." He goes on to tell me that Droitwich is quite well received on the ship's smoking-room wireless set up to 2,500 miles, beyond which atmospherics get the upper hand.

Very long wavelengths, such as that used by GBR, are rather outside the scope of most amateur experimenters nowadays, though years ago I remember winding a set of coils for the special purpose of receiving St. Assise, the big French commercial station, which was then working on something like 22,000 metres. It is rather interesting to note that with these very long waves we are getting well into the audio frequencies. 18,750 metres, for instance, corresponds to 16,000 cycles.

This Advertising Business

THE British authorities seem to have had a certain amount of success in their endeavours to induce the French Government to put the brake on English advertising programmes from stations in France. The French Government has announced that it will in future tax the gross receipts from advertising to 48 per cent., which is a fairly high figure. Some of the lay papers loudly foretell that now that France has taken action the Duchy of Luxembourg may follow suit. I don't think it will myself, and there is absolutely no means of compelling it to take any action at all. The only thing that will stop the pouring of radio advertising into this country from abroad is the discovery that it doesn't pay the advertiser. It will probably go on paying him so long as large numbers of our own people tune in foreign stations because they can't get what they want at home. The logical solution is for the B.B.C.'s programme people to see that listeners do get on one set of the home wavelengths the light and bright fare for which they yearn.

"Language Lessons"

I AM glad to see that the whole question of political and propaganda broadcasting is to be considered in the hope of arriving at a satisfactory working arrangement between European nations. On the long and medium waves there are two loopholes which may present difficulties. The offending country may plead (*a*) that its propaganda items are intended only for home consumption and that it is not to blame if foreigners using sensitive sets pick them up; or (*b*) that violent triades in foreign tongues are not propaganda at all, but just language lessons. These pleas, though, will not wash on the short waves, of which the outstanding quality is the ranges that they achieve, and it is on the short waves that the bulk of propaganda is done. Ask anyone who is stationed in the East about it and he will tell you that half a dozen countries are making regular broadcasts of a political nature from high-powered short-wave stations, not only in English but in many "native" tongues as well. Language lessons, of course!

Television Bad Luck

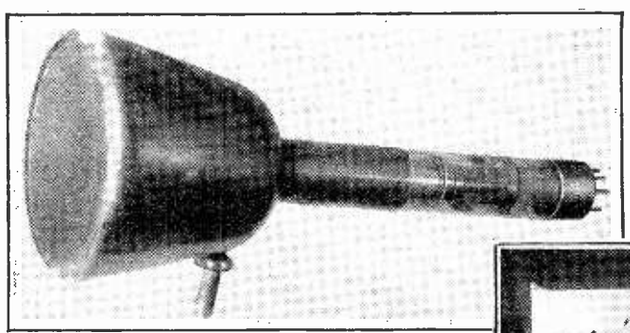
THE B.B.C.'s television staff has had pretty bad luck in the way of illness. Mr. Gerald Cock, the head of the department, is laid up in bed as I write, and wasn't there to keep an eye on the first test transmissions. Then one of the announcer hostesses went down with appendicitis not long before the Radio Exhibition, and there have been other minor casualties as well. Mr. Cock trusts to be fit and well again before the regular service starts on November 2nd, and I am sure that we hope that both he and all the members of the Alexandra Palace staff will be in the best of form for the opening day.

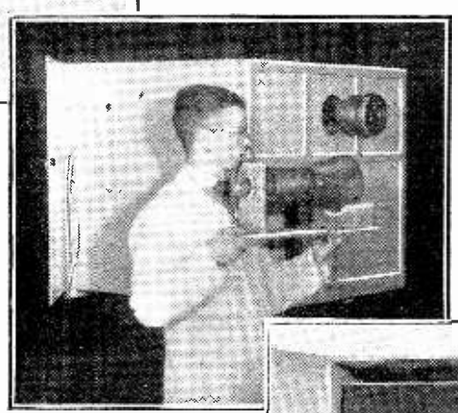
A recent portrait of Mr. Gerald Cock, Television Director of the B.B.C.

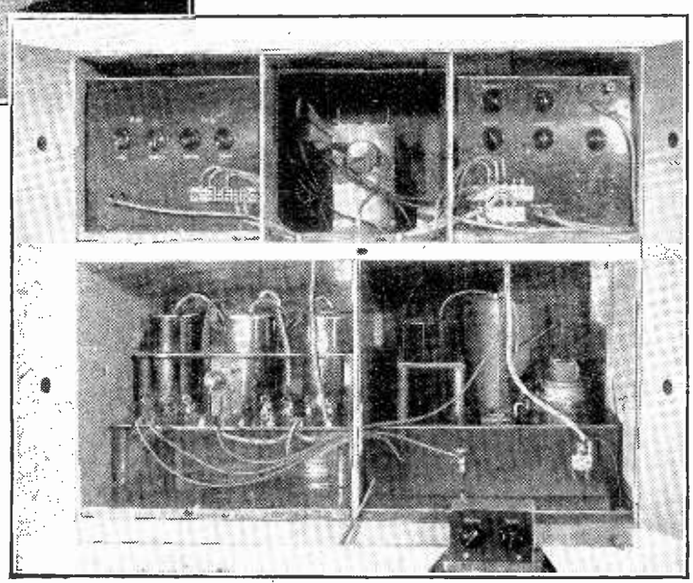
Many Thanks

A KIND reader, to whom my best thanks, sent me a whole bundle of radio magazines from Egypt, Australia and New Zealand. Very interesting reading they make, and they open one's eyes quite a bit to broadcasting conditions in other countries. Australia and New Zealand both have excellent broadcasting services, and in both countries there is an army of keen experimenters and long-distance men. It's good to see that home construction still flourishes at the other side of the world; articles on building sets—even crystal sets—appear regularly, and advertisement pages show that there is a considerable market for components. It is, though, rather sad to find so few British goods or receiving sets announced or referred to in these journals. Australia is building up a wireless industry of her own, it is true; but there should still be room for the British set if only more of our manufacturers would turn out suitable apparatus.

MAGNIFYING THE TELEVISION IMAGE







The upper illustration shows the new Telefunken cathode-ray tube used in the projection of pictures. It has a flat end and gives a picture 5 cm by 6 cm in size, which is projected on to a screen by an optical system, part of which can be seen in the centre photograph. The enlarged picture obtained on the screen is 100 cm. by 120 cm. The lower illustration shows the interior of the receiver used with this system.

Recent Inventions

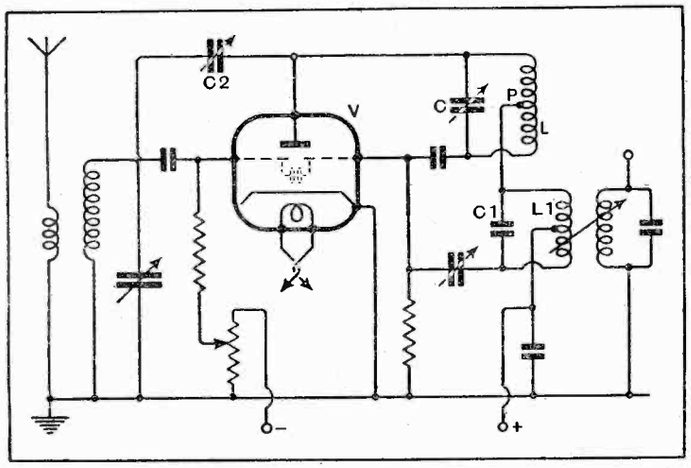
Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.

SUPERHET CIRCUITS

TO increase selectivity, as well as overall amplification, one of the intermediate-frequency circuits is back-coupled to an extent which would normally produce undesirable self-oscillation, which is, however, prevented because the local-oscillator valve is already oscillating at a much higher frequency.

As shown, the combined detector and oscillator valve V is of the double-grid type, and generates local oscillations in the circuit L, V1 through the medium of an electromagnet M, which moves the coils L, L1 towards or away from each other. The magnet, in turn, is controlled by the anode current of an auxiliary amplifier V2, the grid of which is biased by the load resistances R, R1 of two diodes.

The two input circuits A, A1 of the latter are coupled to the IF coils L, L1, the circuit A being tuned 9 kc/s below and the circuit A1 9 kc/s above the intermediate frequency. The presence of a strong interfering station will



Superheterodyne frequency changer for which is claimed high efficiency.

now cause the "balance" of the load resistances R, R1 to be upset, and will so apply a negative grid-bias to the amplifier V2. This, in turn, energises the magnet M to swing the coils L, L1 apart, and so "narrows" the width of the accepted side-band.

N. V. Philips Gloeilampenfabrieken. Convention date (Germany) April 13th, 1935. No. 450081.

C. The resulting intermediate frequency appears in the circuit L1, C1, which is back-coupled across the grid and plate of the valve by a connection to the mid-point P of the coil L. The back-coupling compensates for the heavy damping of the IF frequency which normally occurs owing to the large amplitudes present in the mixing tube, and in this way enhances the selectivity of the set. The local oscillations are prevented by a balancing condenser, C2, from getting back into the aerial and so being radiated.

Radio Akt. D. S. Loewe. Convention date (Germany) December 13th, 1933. No. 450247.

o o o o

AUTOMATIC SELECTIVITY

THE width of side-band accepted by the tuned HF circuits of a broadcast receiver is automatically regulated in accordance with the degree of interference present in the particular part of the wave-band to which the set is tuned. In most selectivity-control circuits, the effective width of the band "accepted" by the set depends only upon the intensity of the programme then being received. By contrast, in the present arrangement, the controlling factor is the strength of any interfering signals that may be present.

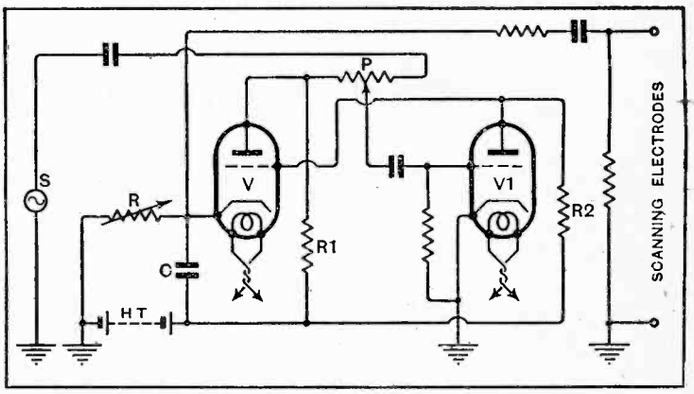
The required effect is secured by altering the closeness of the coupling between the two IF valves V,

TIME-BASES FOR TELEVISION

"SAW-TOOTHED" oscillations for scanning purposes are produced by charging-up the condenser C from a source HT through a variable resistance R. The condenser is shunted by a combination of two valves V, V1. At a critical anode voltage, the valve V discharges, and in doing so produces a voltage across R1 which throws the grid of the valve V1 negative, and so cuts down its anode current. This, in turn, produces a voltage drop across the resistance R2 which throws the grid of the valve V more positive, and by making it more conductive, accelerates the process of discharge. At the end of the discharge period the reverse action takes place, the voltage across the resistance R2 now swinging the grid of the valve V more negative, and increasing its internal resistance so that the condenser is again effectively insulated. The net effect is to "snap" the discharge valve V into and out of operation.

Synchronising-impulses are applied from a source S through a tapped potentiometer P, which regulates the amplitude of the synchronising-voltage to the amplitude of the feed-back voltage, thus ensuring a smooth and continuously adjustable control.

Hazeltine Corporation (assignees of H. M. Lewis). Convention date (U.S.A.) February 9th, 1935. No. 449743.

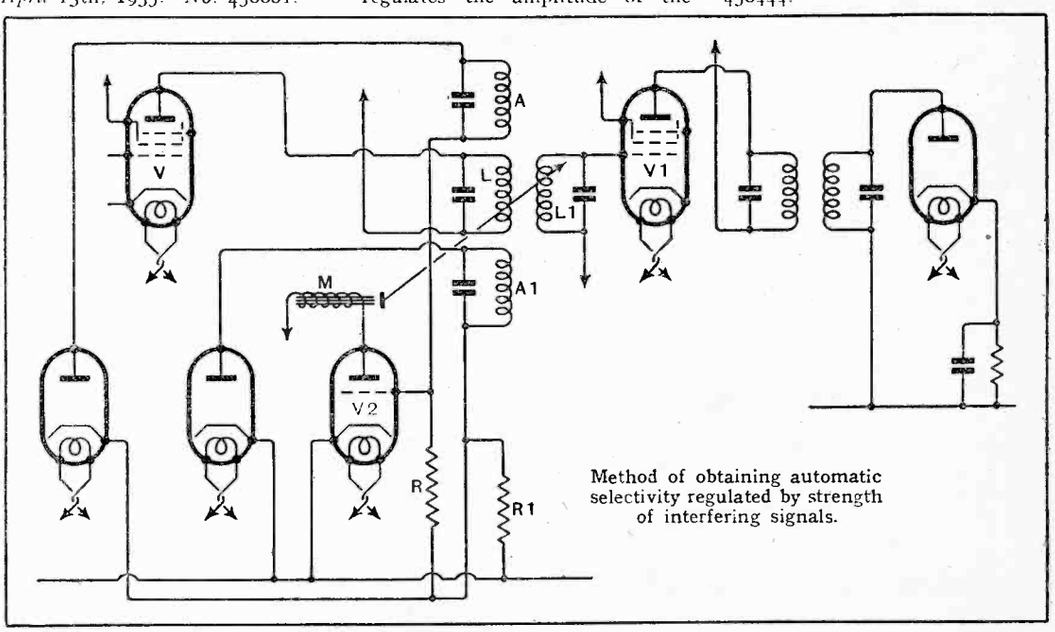


Time-base circuit for use in television apparatus.

FREQUENCY MODULATION

CERTAIN advantages are claimed for the transmission of wireless signals, either for sound or television, by a process of frequency modulation as distinct from the more usual method of amplitude modulation. In order to effect frequency-modulation, the original signals are applied to deflect the stream of electrons passing through a cathode-ray tube. As it impacts against the fluorescent screen of the tube, the stream produces radiations which are passed through a screen of varying transparency. They then fall on to a photo-electric cell, the output from which is amplified and fed to the transmitter. The transparent screen is so graduated that the light passing through produces a current of sinusoidal form in the photo-electric cell.

H. A. Richardson. Application date November 30th, 1934. No. 450444.



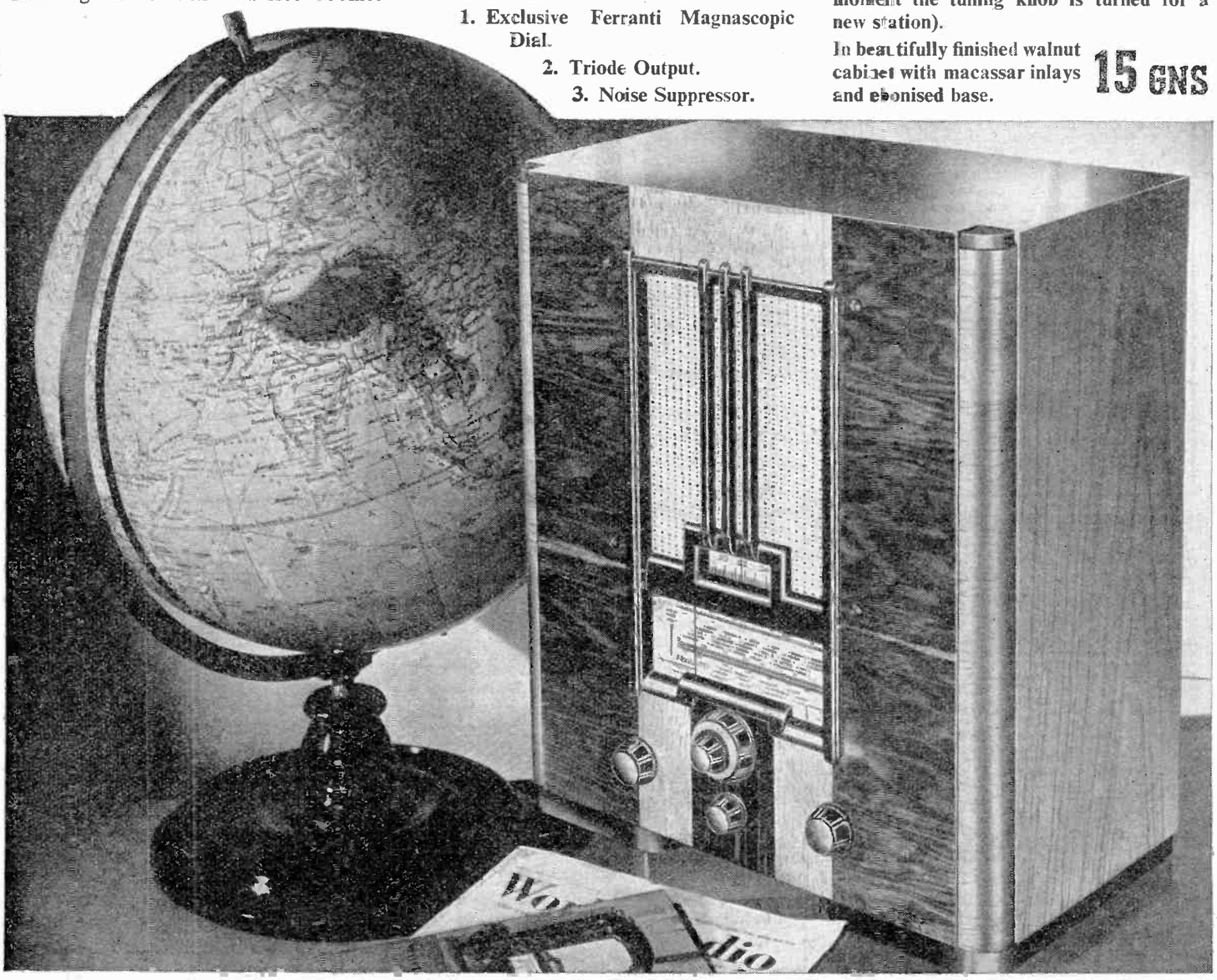
Method of obtaining automatic selectivity regulated by strength of interfering signals.

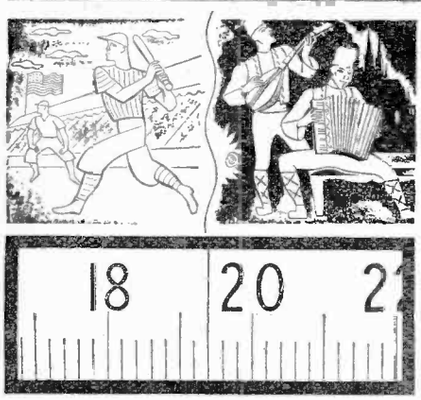
Get the thrill of new stations in far-off continents — Bombay . . . . Sydney . . . . Schenectady . . . . Rio. Log them quickly, precisely, with the Magnascopic Dial — the new tuning device exclusive to Ferranti. Short-wave reception naturally varies with conditions but by enjoying these short-wave adventures you lose nothing. You still get home stations with the truth and reliability that have made Ferranti famous. Send the coupon below for "World Listening on Ferranti"—a free booklet telling you all about short waves and giving full details of sets. N.B. Ferranti World Radio is only obtainable from Registered Ferranti Dealers, men chosen specially for their technical skill and knowledge. Remember that *only these registered Ferranti dealers can supply Ferranti World Radio.*

The Ferranti All-Wave range starts at 9 gns. Illustrated here is the Arcadia All-Wave A.C. Receiver with FIVE remarkable features:

1. **Exclusive Ferranti Magnascopic Dial.**
2. **Triode Output.**
3. **Noise Suppressor.**
4. **Variable Selectivity and High Fidelity (when searching for stations the receiver is highly selective, but when the right station is found a knob can be turned to reduce selectivity and gain high fidelity reproduction).**
5. **Exclusive self-resetting device (after listening to a station with high fidelity reproduction, an automatic device resets the receiver to its highly selective state the moment the tuning knob is turned for a new station).**

In beautifully finished walnut cabinet with macassar inlays and ebonised base. **15 GNS**





world listening on FERRANTI

Only a hair's breadth separates Schenectady and Budapest

Because many of the short-wave stations come so close together it's difficult to log them quickly and precisely on the ordinary tuning dial. So Ferranti have added a Magnascopic Dial that gives you enlarged readings of such a size that you can always see exactly where you are and where to find the various other stations. This Magnascopic Dial, which is found only on Ferranti sets, has been described by the Press as "the cleverest tuning device yet introduced." You will find it helpful on Long and Medium as well as Short Waves.

To Ferranti Ltd., Dept. W.W.10, Moston, Manchester, 10. Please send me a free copy of "World Listening on Ferranti."

NAME

ADDRESS

COUNTY

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.

MISCELLANEOUS ADVERTISEMENTS

NOTICES

THE CHARGE FOR ADVERTISEMENTS in these columns is

12 words or less, 3/- and 3d. for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue: 13 consecutive insertions 5%; 26 consecutive, 10%; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to **FIRST POST on MONDAY MORNING** (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Stamford Street, London, S.E.1, or on **SATURDAY MORNING** at the Branch Offices, 19, Hertford Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham, 2; 260, Deansgate, Manchester, 3; 26B, Renfield Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to ILIFFE & SONS Ltd., and crossed ~~& Co.~~ Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NEW RECEIVERS AND AMPLIFIERS

A
A

DEGALLIER'S, Ltd.—Again, owing to increased business, we have to extend our premises now at 18, Connaught St., Marble Arch, W.2.—The firm for reliable short wave radio (1937), have on show in London the largest selection of fully guaranteed brand new all-wave receivers; callers invited to handle all at their leisure without obligation to purchase; all S.W. receivers guaranteed to get stations on the low bands, including the Americas, etc. Hours of business 10 a.m.-7 p.m., Saturdays 9 p.m. Early closing day Mondays. All goods cash with order or c.o.d.; send 2d. stamp for beautifully illustrated catalogues and full reports by technical department of this journal on Challenger receivers.

WE Guarantee to Receive the American Transmissions at full programme strength after 4.30 p.m. daily; those interested welcomed without obligation.

6/6 Each, Valves, "never before such a bargain," every one a first, no throw-outs or seconds, metal, metal glass, glass counterparts, and glass: 1a6, 1b5/25s, 1c6, 1v, 2a3 2a5, 2a6, 2a7, 2b7, 5y3, 5z4, 6a6, 6a8, 6b5, 6b7, 6c5, 6c6, 6d6, 6e5, 6e6, 6f5, 6f6, 6f7, 6h6, 6j7, 6J7, 6k7, 6L6, 6L7, 6R7, 6Q7, 6X5, 6z5/12Z5, 10, 12a, 12a5, 12a7, 12z3, 15, 18, 19, 22, 24a, 25A6, 25y3, 25z5, 26, 27, 30, 31, 32, 33, 34, 35/51, 36, 37, 38, 39/44, 41, 42, 43, 45, 46, 47, 48, 49, 50, 53, 55, 56, 57, 58, 59, 71A, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 89; 6r7, 25a6, 25z6, 6n7, 6X5, 5W4. Line cords for American Midgets, 4/9.

£3/10.—5-valve Midget T.R.F., medium and long wave, 7X, 10X6, A.C./D.C., 200-250 volts, carriage 1/4; also several others at £2/15, £4, £4/10, and £4/2/6.

£8.—"Challenger" Table Grand Model 6-valve superhet, "Mono-vision" tuning control, A.C. 200-250 volts, 3 bands, 18-55, 190-550, 800-2,000 metres, 3½ watts output, tone control, delayed A.V.C.; carriage 4/6; (16½×16×8).

£9.—"Challenger" Table Model 6-valve superhet, 3 bands, 16-52, 190-550, 900-2,000 metres. A.V.C. tone control, P.U., terminals (17×13×9), A.C./D.C., 200-250 volts; carriage 4/-; also available in A.C., same price.

£9.—Challenger Car Radio 6-valve superhet, no interference, A.V.C., remote control, definitely no suppressors needed on plugs, carriage 4/3; also the R.C.A. Car Aerial, "the last things," 15/- post paid; also Emerson 6-valve, same price.

13 Guineas.—The New Challenger 8 (type 800) table model de luxe, 22×18×12, high fidelity 8-valve superhet, A.C., 200-250 volts, 4 distinct bands, 11-39, 39-108, 190-550, 900-2,000 meters; this receiver has the following improvements and additions over the last series of the famous Challenger 8: wave bands calibrated in meters and station names, simplified centralised tuning, super Vernier, slow-fast tuning, self-contained control panel, perfect tone quality at low volume, new type 10 inch M.C. speaker, from a whisper to 8 watts pure undistorted tone, no overloading at full volume, oscillator fundamental without use of harmonics, persistent oscillator of highest output, isolating filters eliminate oscilla-

(This advertisement continued in third column.)

DELIVERING THE GOODS

It is only a few weeks since I announced the arrival of the new Hartley-Turner reproduction. The most important contribution to this was the Hartley-Turner Duode Speaker.

I anticipated a good demand for the new Speakers and had built up a fairly good stock, but I certainly did not anticipate how many people were waiting for us to go one (or two) better than the other manufacturers.

We have received a larger number of orders than we expected and it is very difficult at this time of the year suddenly to increase production of field coils and output transformers.

The success of this new Speaker has given us the incentive to lay down plant for bigger production, and within a month I hope we can meet all demands.

There is, however, the possibility that the demand will increase still more and I suggest that if you place your order now you will get quicker delivery.

H. A. Hartley

HARTLEY-TURNER DUODE SPEAKERS

Standard Model D.C.....	£6	0	0
De Luxe Model D.C.....	£6	15	0
Standard Model A.C.....	£7	5	0
De Luxe Model A.C.....	£8	0	0

Super Duode:
Price to be announced later.

HARTLEY-TURNER RADIO LTD.,

THORNBURY ROAD,
ISLEWORTH, MIDDLESEX.

Telephone: HOUnslow 4488.

NUMBERED ADDRESSES

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." All replies should be addressed to the Box number shown in the advertisement, c/o "The Wireless World," Dorset House, Stamford Street, London, S.E.1. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes: in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM

Readers who hesitate to send money to advertisers in these columns may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged: on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Stamford Street, London, S.E.1, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post. When sending remittances direct to an advertiser, stamp for return should also be included for use in the event of the application proving unsuccessful.

NEW RECEIVERS AND AMPLIFIERS

(This advertisement continued from first column.)

tion and motor-boating, fully delayed A.V.C. bias, absolute minimum of noise, and sensitivity control for noise suppression, A.V.C. re-enforced capacitators prevent drift, pre-aged intermediate frequency transformers, I.F. barrier, discs anchor coil leads, plug in loud speaker, also provision for external speaker, moisture sealed out by tropical zone impregnation, self healing electrolytic condensers, one complete chassis of dreadnought construction, moderate voltages assure full valve life, economical to operate (consumption 45 watts), long life eliminates repairs, correct valve selection, no compromise, no hum, full weight transformer, true push-pull, stabilised high tension supply, stabilised biasses, ceramic coil insulation, fully loaded plate coils give maximum gain, prebalanced coil assembly, matched sets of individual coils, no taps, sealed insulation, thin laminations of special silicon steel, 7 K.C. selectivity, fractional microvolt sensitivity, shielded switching permits high-gain, positive silver-plated contacts eliminate switch noises, audio frequency range 30-8,000 cycles, diode detection, prizmatone high fidelity R.F. preselector stages on all bands, carriage 6/- for experimenters, less cabinet deduct 15/-; if public address Rola, 12in. G.12 supplied in place of standard speaker add £2. (Note.—This speaker cannot be incorporated in table model cabinet.)

£17.—Challenger 8 Console 800C, height 3 feet 6 inches, width 24 inches, depth 12½ inches, chassis as incorporated in 800 model but incorporating the G.12 high fidelity 12in. speaker; carriage and crate 10/-.

29 Guineas.—"Challenger 800 R.G." radiogram with automatic record changer, measurements, height 2 feet 8 inches, width 3 feet, depth 21 inches; this also incorporates the G.12; carriage and crate 15/-.

NOTE.—The Challenger 800 is available for A.C./D.C. 200-250 volts, employing 11 valves, at an additional cost of 20/- on each model.

£16.—Challenger 12 A.C./D.C. 200-250 volts, the first time that D.C. users have been able to get 10 watts undistorted from their speaker, which is a large 12in. K. type Rola, triple parallel rectification, push-pull parallel four pentode output; carriage and crate 7/6; chassis, valves and speaker alone, £15.

£26/5.—Midwest R.T. 18 chassis, valves and P.A. speaker, 6 bands A.C. 100-250 volts, calibrated in metres and K.C. illuminated pointer indicator, silent tuning control, automatic visual band selector, metal valves, 36 tuned circuits, 10 tuned circuits in cascade, range 4½-2,400 metres, output 20 watts undistorted; carriage 10/-; also available in the Midwest D.C. cabinet at £36/15; carriage and crate 20/-.

£40.—Challenger 24-valve superhet twin chassis, valves and 2 speakers, handling 50 watts output, sensitivity ¼ microvolt absolute, tuned H.F. stages on all bands, 3 I.F. stages, the last one being used for selectivity only, frequency response at the speakers, within 2db, over whole range, wave band coverage 8-2,050 metres in 5 bands, magic eye tuning, variable selectivity; carriage 18/-; various cabinets available; this is the actual receiver that we supply to the Navy, Army and Air Force canteens.

DEGALLIER'S, Ltd., 18, Connaught St., Marble Arch, London, W.2. Paddington 2745. [2781

"Radio Data Charts," A Series of Abacs Post free 4/10

No. 8

Notes on the Suppression of Electrical Interference with Broadcast Reception

The question keeps cropping up regarding the efficiency of doublets as anti-interference aerials.

Reprinted below is a letter well worth reading. It compares the performance of a particularly good and correctly erected multiple doublet with that of an "Eliminoise."

The letter was received from Messrs. Keates & Co. (Radio) Ltd. who handle Scott Receivers and who found it practically impossible to demonstrate these sets in their Bishopsgate premises. Admittedly the background of interference in the heart of a city like London is fierce, but only the *"Eliminoise" did all that was claimed for it.

26th September, 1936.

Messrs. Belling & Lee Ltd., *JMM/VEB.*
Cambridge Arterial Road, Enfield, Middx.

Gentlemen,

We have now received the Eliminoise and cable and thank you for your helpfulness as the equipment was urgently required for experimental purposes.

Up to date we have been using a special double doublet tuned to resonate on 15 and 9 megs. bands, and although it was the best we have tried we are always looking for something better.

We erected your aerial on the roof of our offices here in the middle of the City, actually side by side of our existing aerial, and found immediately a very definite improvement which frankly put this aerial a long way ahead of anything we have come across, and we are therefore intending to use this system exclusively in future, and to recommend it to all our trade friends.

In our locality here, the background and local noise level is extremely high all day long, making short-wave reception previous to the erection of your aerial virtually impossible. We can now give reasonable programme value from stations that were completely unintelligible owing to local background.

Candidly, we are enthusiastic about this development which will be of considerable use to us in the sale of our exceedingly high gain receivers which are so highly developed that the "Wireless World" says of them: "the signal to noise level has never been bettered on any set we have so far tested."

Very truly yours,
For KEATES & CO. (RADIO) LTD.
(Sgd.) J. M. Mason.

*Trade Mark.

NEW RECEIVERS AND AMPLIFIERS

FERGUSON, Belmont and Air King All-wavers lead the field; wholesale distributors.—Leonard Heys, 36, Henry St., Blackpool. [0530

TRANS-ATLANTIC RADIO Offer Finest Radio Value! Send for lists; attractive A.C.-D.C. compacts from £2 16; 6-valve all-wave superhets. from £6/15.

TRANS-ATLANTIC RADIO Co., 15, Percy St., W.1. Museum 3096. American Radio Service Specialists. [2940

HIGH Quality 4-valve A.C. Radiogram, in walnut cabinet, new, £9/15; Bryce transformer, 500-0-500, 4 L.T.s, 12.6.—How, 109, Thurlow Park Rd., S.E.21. [2923

TOBE-DEUTSCHMANN Communication Kit, air trimmed, built tuner, valves, power, speaker, £15/10; also National and Skyrider range.—A.C.S., Ltd., 52, Widmore Rd., Bromley. [2943

SPECIALIST. Car radio only. Expert fitting and repairs. Sets from £7/10 to 40 guineas.—St. John Chesney, 38, Hugh St., London, S.W.1. Victoria 0780. [0534

FOR the Finest Value in All-wave Receivers, see McCarthy advertisement on page 11.—McCarthy Radio, Ltd., 44a, Westbourne Grove, London, W.2. Telephone: Bayswater 3201. [0510

6-VALVE 9-stage All-wave Superhet Manx Chassis, comprising large micro-dial, volume control and variable tone control, pick-up connections; circuit: tuned H.F. stage on all wave-bands, Octode mixer, band-pass I.F.'s, double diode triode detector, giving full A.V.C. 3-watt pentode output, complete and ready to use with 6 Dario valves; chassis and valves carry 12 months' guarantee; cash with order; £8/10. on 7 days' approval or c.o.d.

FREE with Above Chassis.—Mains energised 8in. moving coil loud speaker.—Hulmes, Station St., Birmingham. [2704

RECEIVERS AND AMPLIFIERS
CLEARANCE, SURPLUS, ETC.

CLEARANCE List (Trade Only).—Write Leonard Heys, 36, Henry St., Blackpool. [0527

SEND for Bargain List of Brand New Decontrolled Receivers; amazing prices.—P. A. C., Ltd., 54, Lamb's Conduit St., W.C.1. [2243

£3/15 for Full Size Table Grand Model 5-valve Superhet.; carriage paid; cash with order or c.o.d., or send for list of other equal bargains.—Kay, 1, Old Church Lane, N.W.9. Colindale 8266. [0535

BARGAINS.—5- and 6-valve 1936 superhets by well-known makers, reconditioned and guaranteed 3 months; cash with order, 7 days' approval; £7/7, or c.o.d.—Wyndham Trust, Station St., Birmingham. [2613

£6/10.—Ekco A.C.76 1935-36 model, brand new, in original sealed carton, also one each used Philips 830 and 834 D.C. receivers, in good order, £3 each.—Lister, 209, Portswood Rd., Southampton. [2908

BATTERIES & CHARGING PLANT

14/11.—Battery chargers, 1 amp., 2-6v., incorporating latest Westinghouse rectifier; postage 9d.; illustrated list free.—Arden Agency, Wollaston, Wellingborough. [2917

PUBLIC ADDRESS EQUIPMENT

SPECIAL Offer!!!

8½ Guineas Assembled; 8 guineas kit; Vortexion 20 watt 3-stage P.A. amplifier, in steel case, 8in.×10in.×9in. high, with carrying handle, input with controls for microphone and pick-up and tone control, output for 7½ and 15 ohm speakers, weight 25lb.; only 8½ guineas, with valves.

VORTEXION, 182, The Broadway, Wimbledon, S.W.19. See also New Mains Equipment. [2787

PUBLIC Address Work Undertaken.

P.A. Vans for Hire, stationary equipment for fetes, conferences, etc., portable equipments for small dances, etc.

ROSS and ROBINSON, Ltd., 8, Western Circus, W.3. [0521

MIXING Circuits for P.A. are Fully Discussed in the Partridge P.A. Manual:—

HOW to Mix any Number of Microphones and/or Pick-ups with independent control of each unit is clearly explained. Also tone control, line technique, pre-amplifier design, impedance matching, etc. Free, trade only, from:—

N. PARTRIDGE, B.Sc., A.M.I.E.E., King's Buildings, Dean Stanley St., London, S.W.1. [2301

12 Watt P.A. Amplifier on Demonstration with Crystal Microphone, Peizo pick-up, at Holiday, Hemmerdinger, 2, Dolefield Bridge St., Manchester. [2912

WEBSTER Electric A.C. 3-stage Talkie Amplifier, push-pull triode outfit, 15 undistorted watts, new, £5/10; Senior R.K. on 4ft. square×1in. baffle, with field rectifier, £3/15; Marconi K.17 pick-up, 17/-; Paillard A.C. gramophone motor, 18/-; or the lot, £10.—Armstrong, Clifton, Woodmansterne Lane, Banstead. [2927

TANNOY Transportable G.A.60 Amplifier, A.C. output 20 watts, complete with 2 Tannoy P.S. speakers, new Tannoy microphone, E.D.C.C. 250-watt convertor, steel silence cabinette, spare D.A.60 G.U.1 valves, perfect condition; accept £49, or near offer, a bargain.—W. Littler, 2, Barras Lane, Coventry. 'Phone: 4933. [2933

USED SETS FOR SALE AND WANTED
MARCONI

1937 Marconi Model 239 Radiogram, list £23/2, hardly used; £16.—Birch House, Tongdean Av., Hove. (Preston 4122.) [2924

R.G.D.

PRIVATE Owner Going Abroad Wishes to Dispose of R.G.D. 1936 Model 1202, 12-valve superhet, automatic record changer, triple speakers, 6 watts output, cost £112; also 1934-35 model 1201, 12-valve superhet, automatic record changer, twin speakers, 6 watts output, cost 95 guineas; both A.C. models, one owner, excellent condition, may be viewed between 4.30 and 7.30 p.m. on Monday, the 19th, at Flat 2, 31, Buckingham Gate, S.W.1. [2910

W.W. OLYMPIC-S.S.

OLYMPIC Single-Span Receiver, only 90/-.—Coltart, 41, Dykebar Av., Glasgow, W.3. [2915

MISCELLANEOUS

MCMURDO-SILVER Masterpiece III, twelve valves, 13-2,000 metres, 18-watt output, exceptional D.X. ability, cost £100, new condition; £45.

SCOTT XV, fifteen valves, 13-2,000 metres, world-wide range, 20 watts output, as new; £49.

H.M.V. 800 Autoradiogram, 15 valves, 13-2,000 metres, high fidelity, twin speakers, record changer, contrast amplifier, electric clock, current list 110 guineas, new condition; £65.—A.C.S., Ltd., 52, Widmore Rd., Bromley. Ravensbourne 1926. [2942

ROUND the World Receivers, Pilot, Fergusson, Ace, Stewart Warner, Zenith, etc.; all American valves; traders only.—Perseus Radio, Burton-on-Trent. [2918

EXCHANGE OR WANTED

WANTED.—Marconi radiogram, 1933-34.—Write H. C. Gaze, High St., Kingston. [2909

WANTED, "Wireless World" 1935 A.C. Short-wave Receiver.—Rees, 135, Adelaide Rd., N.W.3. [2920

WANTED, "Wireless World" Push-Pull Quality Amplifier, less valves.—Box 9550, c/o *The Wireless World*. [2916

WANTED, Midwest Multitube all-wave chassis and speaker.—B., c/o Maxwells, Deeside, Brighton, 6. [2932

NEW MAINS EQUIPMENT

V

V

VORTEXION Lead Again.

VORTEXION Supply the B.B.C., G.P.O., L.T.P.B., and Borough Councils, etc., so why not you?

ALL Fitted Screened Primaries and Tapped 200-250v., with centre tapped filaments, guaranteed one year.

250-0-250 60 m.a., 4v. 1-2a., 4v. 2-4a.; 10/- open, 12/6 shrouded.

350-0-350v. 60 m.a., 4v 1-2a., 4v. 2-4a.; 12/6 open, 16/- shrouded.

350-0-350v. 120 m.a., 4v. 2.5a., 4v. 2-4a., 4v. 2-5a.; 14/6 open 16/6 shrouded.

425-0-425v., 120-160 m.a., 4v. 5-10a., 4v. 2.5, 4v. 1-2, 4v. 1-2, supershrouded model, 2½% regulation; 26/-.

500-0-500v. 120 m.a., L.T.'s, as above; 19/- open, 23/- shrouded 400 or 450, same price.

500-0-500v. 150 m.a., 3v. 4v. 2a., 4v. 2-5a., 4v. 4a., 26/- open, 30/- shrouded; 400 or 450, same price.

CHOKES, 30h. 60 m.a., 5/6; 7-13h., 10/6; 30h., 150 m.a., 12/6; regulation, 7/6.

OUTPUT Transformers, 4-10 watt, W.W. Q.A., 17/6; 20 watt super shrouded, 30/-.

AUTO Transformers, 100-120 to 200-240v. 60 watt, 9/-; 120 watt, 12/6; 200 watt, 16/6; 500 watt, 30/-.

QUOTATIONS for Specials by Return.

VORTEXION (S. A. Brown), 182, The Broadway, S.W.19. Tel.: Lib. 2814. [2885

ALL

POWER

TRANSFORMERS, Ltd.—Transformers and chokes embodying all the best in design; no better value at any price; Radiolympia models; tapped and screened primaries, filaments, centre tapped.

250-0-250v. 60 m.a., 4v. 1-2a., 4v. 2-4a., 12/6, post 7d.; extra filament, 4v. 1a., 12/6.

350-0-350v 60 ma., 4v. 2-3a., 4v. 2-4a., 15/-, post 8d.; extra filament, 4v. 1a 16/-.

350-0-350v. 120m.a., 4v 2.-3a., 4v. 4-6a., 4v. 1-2a., 19/-, post 1/-; extra filament, 20/-.

WRITE for List; special quotations by return.

ALL POWER TRANSFORMERS, Ltd., 8a, Gladstone Rd., Wimbledon, S.W.19. Tel.: Liberty 3303. [2771

PARAMOUNT Mains Transformers.

PARAMOUNT in Quality, lowest in price; example, 250v. 60 m.a., 4v. 1a., 4v. 4a., open type 9/-, shrouded, 11/-, post 9d.; 350v. 75 m.a., 4v. 2.5a., 4v. 4a, open type 12/-, shrouded 14/-, post 9d

WRITE for List, "Paramount Mains Transformers."—R. H. Salter, 66, Hartfield Rd., Wimbledon, S.W.19. 'Phone: Liberty 3226. [2303

TANTALUM for A.C. Chargers, H.T. and L.T.—Blackwell's Metallurgical Works, Ltd., Garston, Liverpool. [2729

LOUD SPEAKERS—SECOND HAND CLEARANCE, SURPLUS, ETC.

VAUXHALL.—Magnavox mains energised, 2,500 or 6,500 field coil, 10in. cone, 17/6; 7in. cone, 12/6.

VAUXHALL.—Magnavox permanent magnets, universal, suitable for Class "B" power or pentode, 7in. cone, 16/6; 10in. cone, 22/-.

VAUXHALL.—American Rolas, 2,500, 8in. 15/-, 9½in. 19/6. Permanent magnets, 8in. 19/6, 9½in. 24/6.

VAUXHALL.—Above, fully guaranteed, complete with humbucking coils; state power or pentode transformer; unused manufacturers' stock.

VAUXHALL.—Immediate delivery, carriage paid; lists free; cash with order or c.o.d.—Vauxhall Utilities, 163a, Strand, W.C.2. Temple Bar 9338. [0456

MAGNAVOX D.C. 152 (9in. cone), 22/6; Magnavox 154 (6½in. cone), 16/3; all with humbucking coils, power or pentode transformers, and 2,500 or 6,500-ohm fields; Magnavox P.M.254, 18/-; Magnavox P.M.252, 22/6.

ATTENTION to All Orders Within 48 Hours; carriage paid; cash with order or c.o.d.; send for list.

WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0451

VALVES

ANDERSON.

ALL Types of American Valves, fully guaranteed first grade; Raytheon, Sylvania, Philco, Triad Impex; 5/- each; also line cords, American type condensers and replacements for American sets; stamp for list.
J. F. ANDERSON, 35, Lansdowne Rd., Walthamstow, E.17. Telephone: Walthamstow 0827. [2947

AMERICAN Valves, first grade, in all types; trade supplied.—Metropolitan Radio Service Co., 1021, Finchley Rd., N.W.11. Speedwell 3000. [0436

HIVAC, TUNGSRAM, and all Reliable Americans, a complete service to traders; orders c.o.d. or send for lists.—Leonard Heys, 36, Henry St., Blackpool. [0529

ALL Types of American Valves in Stock of Raytheon, Sylvania, and Arcturus makes, at competitive prices, guaranteed for six months; send for full list; 350 ohms line cords, 2/8.
WARD, 46, Farringdon St., London, E.C.4. Telephone: Holborn 9703. [0452

AMERICAN Valves, standard type, 5/- each; write for new descriptive price list of over a hundred fully guaranteed glass, metal and transmitting valves.—E. M. Fellows, Ferney Rd., East Barnet, Herts. [2869

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VALVES by Well Known Non-ring Manufacturers, complete range of battery, a.c. mains, rectifiers, brand new stock with six months' guarantee; 2 volt, detector 2/5, power 2/9, screen grid pentode, H.F. pentode, 5/-; the following American type valves, fully guaranteed, at 5/6 each, No. 80, 42, 43, 57, 58, 77, 78, 6C6, 6D6, 25Y5, 25Z5.—Write for other prices to Dulci Electrical Co., Ltd., 7, Lizard St., London, E.C.1. [0530

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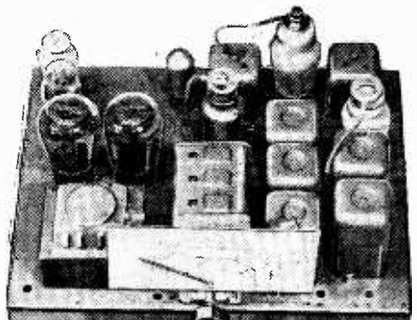

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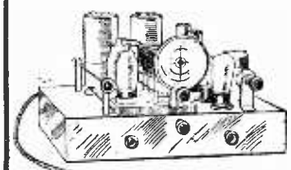

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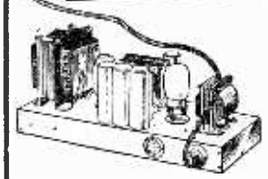

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SHORT-WAVE Coils, 4- and 6-pin types, 13-26, 22-47, 41-94, 78-170 metres, 1/9 each, with circuit; special set of 3 S.W. Coils, 14-150 metres, 4/- set, with circuit; Premier 3-band S.W. coil, 11-25, 19-43, 38-86 metres; simplifies S.W. receiver construction, suitable any type circuit, 2/-.

COIL Formers, in finest plastic material, 1½in. low-loss ribbed, 4- or 6-pin; 1/- each.

SUPER Ceramic Condensers, S.L.F., .00016, .0001, 2/9 each; double-spaced, .00005, .000025, .000015, 3/- each; all brass with integral slow motion, .00015 tuning, 3/9; .00015 reaction, 2/9; British Radiophone 2-gang .00016 with trimmers, 5/6.

MAINS Valves, famous Europa 4 v. A.C. types, 4/6 each; H.L., L., S.G., Var.-Mu-S.G., H.F.-Pens., Var.-Mu-H.F. Pens. 1, 3 and 4-watt A.C. directly-heated output Pentodes; full-wave rectifiers, 250 v. 60 m.a. A.C./D.C. types; 20-volt .18 amp. S.G., Var.-Mu-S.G., H., H.L., Power; following types all 5/6 each; full-wave rectifiers, 350 v. 120 m.a. and 500 v. 120 m.a.; 2½ watt indirectly-heated Pentodes; Frequency Changers, Octodes and Heptodes.

BATTERY Valves,—2 volts, H.F., L.F., 2/3; Power, Super-Power, 2/9; S.G., Var.-Mu-S.G., 4- or 5-pin Pentodes, H.F. Pens., V.-Mu-H.F. Pens., 5/-; class B, 3/6.

AMERICAN Valves.—Genuine American Hytron first-grade valves, 3 months' guarantee; all types, 5/6 each; new metal-glass valves, all types, 6/6 each; genuine American Duotron valves, all types, 3/6 each.

VALVE Holders for all Above Types, 6d. each; octal bases, 9d. each.

PREMIER Mains Transformer, wire-end type with screened primaries, and tapped 200-250 v., centre-tapped filaments. Guaranteed one year; H.T. 8 and 9 or H.T. 10 with 4 v. 4 a. C.T. and 4 v. 1 a. C.T., 8/6; 250-250 v. 60 m.a., 4 v. 1 a., 4 v. 2 a. and 4 v. 4 a., all C.T., 8/6; 350-350 v. 120 m.a., 4 v. 1 a., 4 v. 2 a. and 4 v. 4 a., all C.T., 11/6; any of these transformers with engraved panel and N.P. terminals, 1/6 extra; 500-500 v. 150 m.a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., 19/6; auto transformers, step up or down, 60 watts, 7/6; 100 watts, 10/-.

SMOOTHING Chokes, 25 m.a., 2/9; 40 m.a., 4/-; 60 m.a., 5/6; 150 m.a., 10/6; 2,500 ohms, 60 m.a. speaker replacement chokes, 5/6.

MILLIAMMETERS, moving-iron, flush 2½in., all ranges from 0-10, 5/9; visual tuning, 6 or 12 m.a., 5/6; moving-coil meters, 2½in. 0-1 m.a., 18/6; 3½in. 0-1 m.a., 22/6; multipliers, 1/- each.

ELECTROLYTICS.—U.S.A. 4, 8 or 12 mfd. 530 v. peak, 1/9 each; Dubilier, 4 or 8 mfd. 500 v., 3/-; 50 mfd. 50 v., 1/9; 12 mfd. 20 v., 6d.; 25 mfd. 25 v., 1/-; T.C.C. 4 or 8 mfd. 650 v., 4/-; 15 mfd. 50 or 100 v., 1/-; 50 mfd. 12 v., 1/-; paper condensers, W.E., 250 v. working 4 mf., 2/-; 2 mf., 1/-; 1 mf., 6d.; 350 v. working 4 mf., 2/6; 2 mf., 1/6; Dubilier 500 v. working 4 mf., 4/-; 800 v. 4 mf., 6/-; Wego 450 v. working 1 mf., 1/-; 2 mf., 1/9; 4 mf., 3/-; 700 v. working 2 mf., 2/-; 4 mf., 3/6.

TRANSFORMERS, latest type Telsen R.G.4 (list 12/6), 2/9; Lissen Hypernik Q.P.P. (list 12/6), 3/6.

ELIMINATOR Kits for A.C. Mains, 120 v. 20 m.a., or 150 v. 25 m.a., 10/-; tapped S.G. det. and output; complete kit with long-life valve rectifier (replacement cost only 2/-).

HIGH-GRADE Power Packs by Prominent Makers, input 100-250 v. A.C., output 220 v. at 40 m.a., 4 v. 3 a. C.T., complete with valve rectifier; 16/6.

PREMIER L.T. Charger Kits for A.C. mains, including Westinghouse rectifiers and tapped mains transformers, 8 volts at ½ amp., 14/6; 8 volts 1 a., 17/6; 15 volts 1 a., 19/-; 15+15 volts 1 a., 37/6; 15+15+15 volts 1 a., 50/-; 8 volts 2 a., 29/6.

TELSEN Iron-cored Screened Coils, W.349, 4/- each; electric soldering irons, 200-250 v., A.C./D.C., 2/3.

3-WATT A.C. Amplifier, 2-stage for mike or pick-up, complete kit of parts with 3 valves; 40/-.

SPECIAL Offer!—12/6 P.M. speaker, 35/- transverse current mike, complete with transformer and 7/6 stand; if purchased with above kit, 25/- the lot.

7-WATT A.C./D.C. Amplifier, 3-stage, high-gain, push-pull output; complete kit of parts with 5 specially matched valves, £4/4.

SPECIAL Offer!—21/- pair matched speakers, 35/- transverse current mike, complete with transformer and 7/6 stand; if purchased with above kit, 35/- the lot.

10-WATT 3-stage A.C. Amplifier Kit with 5 Valves; £5/5.

(This advertisement continued on next page.)

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

(This advertisement continued from previous page.)

SPECIAL Offer! 21/- pair matched speakers, 35/- transverse current mike, complete with transformer and 7/6 stand; if purchased with above kit, 35/- the lot.

20-WATT 3-stage A.C. Amplifier Kit with 5 Valves; £8/8.

SPECIAL Offer!—£6 pair P.M. exponential horn speakers, 35/- transverse current mike with transformer and 7/6 stand; if purchased with above kit, £5/10 the lot.

PREMIER (Reisz Pattern) Transverse-current Mike, high output, straight line response, 30/-; transformer, 5/-; table stand, 7/6.

MAGNAVOX, mains energised, "154," 7in. cone, 2,500 ohms 4 watts, 12/6; "152," 9in. cone, 2,500 ohms, 17/6; "152 Magna," 9in. cone, 2,500 ohms, 6 watts, 37/6; Magnavox P.M.s—"154," 7in. cone, 16/6; "252," 9in. cone, 22/6; reliable P.M.s, 10/6; Cossor P.M.s, 13/6.

ROLA Latest Type P.M.s, 18/6; K.B. 7in. mains energised, 1,500 or 2,500 ohms, 7/9; Goodmans' 8in. mains energised, 1,000 ohms field, 10/6 each.

DIALS.—Clarion illuminated S.W. slow-motion dial with 2in. knob, 2/-; Premier all-wave 2-speed dial, full vision straight-line, dual ratios 10-1 and 150-1, 6/6, with escutcheon.

POTENTIOMETERS by Well-Known Makers, all values up to 1 meg., 2/-; with switch, 2/6.

GRAMOPHONE Motors.—Collaro gramophone unit consisting of A.C. motor, 100-250 v. high quality pick-up and volume control, 45/-; Collaro motor only, 30/-; Collaro Universal gramophone motor, 100-250 v., A.C./D.C., with high quality pick-up and volume control, 67/6; Collaro Universal motor only, 49/6; Edison Bell double-spring motors, including turntable and all fittings, 15/-; Cosmochord gramo unit, comprising A.C. motor, pick-up and volume control (list 55/-), 35/9; Cosmochord pick-up with arm and volume control, 10/6; pick-up head only, 4/6.

TUBULAR Condensers, non-inductive, all values up to .5 mfd., 6d. each.

WIRE-END Resistors, any value, 1 watt, 6d.; 4 watts, 1/-; 3 watts, 1/6; 15 watts, 2/-; 25 watts, 2/6. each.

RELIABLE Morse Keys With Morse Code Engraved on Bakelite Base, 2/- each.

BAKELITE Case Buzzers, 1/6; "loud-tone," 2/6 each; super quality lightweight headphones, 3/9 pair.

RECEIVERS, G.E.C., A.C./D.C. mains, 3-valve sets, complete with 3 Osram valves, in exquisite bakelite cabinet with Osram M.C. speaker, ready to plug in to any mains, brand new, in sealed cartons, fully guaranteed (list £7 15s.), 69/6; carriage paid.

H.F. Chokes, S.W. 10-200 metres, 2/-; S.W. screened, 1/6; standard screened 180-2,000 metres, 1/6.

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165 and 165a, Fleet St., E.C.4 (next door to Anderton's Hotel). Early closing Saturday 1.30 p.m. Central 2833. [0488

MAINS RADIO'S Superb Bargains are now Displayed on page 8. Don't miss them.

MAINS RADIO DEVELOPMENT COMPANY, 4-6, Muswell Hill Rd., London, N.6. Tudor 4046. [2914

OLIVERS Offer:—Erie 1-watt colour coded resistances, all values; 3½d. each. 3/- dozen, 2/6 dozen in lots of 3 dozen.

ALUMINIUM Chassis, 18-gauge, 16in.×10in.×3in., undrilled, 5/-. Collaro gramo. motors, A.C., 110-250v. 50 cycles, unitplate, turntable, auto. stop, etc., 23/6.

HUNT'S Cardboard Case Electrolytics, 4 mfd., 1/6; 8 mfd., 1/9; 8 plus 4 mfd., 2/5; 8 plus 8 mfd., 2/9; 50 mfd. 50v., 1/6; metal cased electrolytics, B.I. 8 mfd., 2/4; 4 mfd., 2/1; 25 mfd. 25v., 1/-.

ROLA and Magnavox 2,000 ohms and 2,500 ohms field, with output transformers, guaranteed, 10/6 each; Marconi mode. 25 pick-up, brand new, 17/6 each.

ALL Tubular and Plessey Condensers, as advertised last week; write for bargain lists, all enquiries welcomed, quotations per return.

OLIVERS, 676, Christchurch Rd., Boscombe, Hants. Orders under 5/6 postage 3d. extra. [2935

ONE Radio Lab. Complete Instrument, £6; two Tannoy, flat flair horn speakers, 12-guinea type, £5 each.—J. Howard, 94, Tavistock Rd., Plymouth. [2929

CRYSTAL Sets, complete, guaranteed, Burne-Jones, 5/6; ditto, double circuit, 8/-; large P.O. type, 10/-; crystal detectors, complete parts 1/-; sensitive permanent detectors, 1/6.

HEADPHONES, Brown, G.E.C., Sterling, Nesper, B.T.H., Ericsson, etc., from 2/6 pair, postage 6d.; list free.—Post Radio, 183, Caledonian Rd., London, N.1. [2867

R.P.R. RADIO.—Radiolab Universal valve and set tester, list £12/12, new condition; £6/15; nearly all types Ferranti transformers and meters in stock.—112, Pentonville Rd., London. [2938

A.F.5cs, 14/6; O.P.M.6c. 12/6; O.P.M.1c, 12/6; O.P.M.2, 10/-; A.F.6, 14/-; B.T.H. R.K. Senior L.S., 27/6; with A.C. eliminator, 37/6; Cossor Melody Maker, with 3 valves, 20/-; D.O.60, 20/-; carriage.—P. Berry, Tudor House, Pinner [2949

EXPERIMENTER'S Surplus.—B.T.H. R.K. Senior speaker, rectifier, massive baffle, £4; H.R. Novotone, £3 (Major); Columbia P.U., 17/6; Ferranti 150 milliamp meter, 25/-; Ferranti 250v. 1,000 ohms P.V., 35/-; Ferranti A.F.5.C., 12/6.—Barker, 5, High St., Swanscombe, Kent. [2901

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MOVIE Cameras, projectors, screens, films; inspection invited.—Illustra Enterprises, 159, Wardour St., London. [0486

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G5NI back from U.S.A., Hammarlund Comet chassis from £10; transmitting bottles half price; mains transformers, etc.; American list 1½d.—Radiomart, 44, Holloway Head, Birmingham. [0531

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A HAPPY Wife for ½d. a Week, and a warm bed for you, too, after a winter night's D.X.; a Warmglow electric blanket costs only 47/6.—Leaflet from Warmglow Co., Leigh-on-Sea. [2906

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COSMIC RADIO SERVICES, Ltd., 23, Water St., Liverpool, accept quality mains equipment, meters, etc., in part exchange. [2904

I BUY, sell, exchange good quality receivers, accessories, components; H.P. facilities; promptness, efficiency.—Bostock, 1, Westbourne Terrace, S.E.23. Forest Hill 2236. [0529

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TRADE Service.—All makes of English and American receivers; quotation by return.

REWINDING.—Mains, L.F. and output transformers, speakers, headphones, etc.; keenest terms for contracts.

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ANY Moving Iron Loud Speaker, L.F. transformer, or pick-up, 2/6; output transformer, 4/-; postage extra; mains transformers, moving coils, electric clocks quoted; trade discounts.—See below.

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REPAIRS to Moving Coil Speakers a Speciality; cones and coils fitted, fields altered; prices, including eliminators, quoted, loud speakers, 4/-; L.F. and output transformers, 4/-, post free; guaranteed satisfaction; trade invited; estimates free; prompt service.—Loud-Speaker Repair Works, 5, Balham Grove, London. Battersea 1321. [0394

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WANTED.—Evesheds, megger or wee megger, send price. —Passingham, Church St., Keighley. [2903

WANTED, 1935 R. and A. Alpha speaker.—Jenkins, Dalston Drive, Didsbury, Manchester. [2921

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Printed in England for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1, by The Cornwall Press Ltd., Paris Garden, Stamford Street, London S.E.1. "The Wireless World" can be obtained abroad from the following: FRANCE: W. H. Smith & Son, 248, Rue Rivoli, Paris; Hachette et Cie, Réaumur, Paris, and branches. BELGIUM: W. H. Smith & Son, 74-75, Boulevard Adolphe Max, Brussels. AUSTRALIA: Gordon & Gotch, Ltd., Melbourne (Victoria), Sydney (N.S.W.), Brisbane (Queensland), Adelaide (S.A.), Perth (W.A.), and Launceston (Tasmania). NEW ZEALAND: Gordon & Gotch, Ltd., Wellington, Auckland, Christchurch, and Dunedin. INDIA: A. H. Wheeler & Co., Bombay, Allahabad and Calcutta. CANADA: Imperial News Co., Toronto, Winnipeg and Vancouver; Benjamin News Co., Montreal; Gordon & Gotch, Ltd., Toronto. SOUTH AFRICA: Central News Agency, Ltd. UNITED STATES: The International News Co., New York.