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EDITORIAL COMMENT

Inter-Nation Broadcasts

Undesirable at This Time

SUGGESTIONS have recently been put forward that now is the time to utilise broadcasting in Europe to create a better understanding between nations by means of broadcasts from England in various Continental languages. If Britain, it is suggested, were to use the microphone to make statements of Britain's policy in the present European entanglements, much could be done to clear the air and remove suspicion from the mind of the general public in Continental countries.

We have ourselves put forward from time to time a plea that there should be more frequent exchanges of broadcast talks translated into various languages, but we have at the same time made it clear that in our view broadcasts of a political nature should not be encouraged.

What Is Propaganda?

The matter can really be brought down to a simple basis. If the talks are propaganda of a political character they should be banned. If they are an exchange of ideas intended to acquaint nations of each other's point of view, then they might prove very helpful. But the difficulty is that almost any talk of this kind made in Europe at the present time would be regarded by some nationals as in the nature of propaganda.

The League of Nations might be justified in using the microphone for the purpose of putting the League's point of view to various nations in their respective languages, but here again resentment would be bound to be expressed by those countries not in sympathy with the policy of the League. It seems far wiser to keep broadcasting out of the picture so long as a censorship of foreign views is exercised in any country.

If such talks had taken place in normal times much good might have come of it, but to introduce them now, when feelings run high, could not fail to aggravate the situation.

The B.B.C. has acted wisely in closing the microphone to such uses during the present period of international difficulty.

The Variable Selectivity IV.

A Receiver of Unusual Merit

THE aim of every educated listener is to receive broadcasting with quality as near to the original as possible.

Circumstances familiar to all of us, and beyond the control of the receiver designer, make it physically impossible for us to receive programmes with good top reproduction without interference, except on very strong stations. It is possible to try to compromise with a good average of selectivity, but this will still let in interference in the case of weak stations and will yet limit the quality on strong local transmitters.

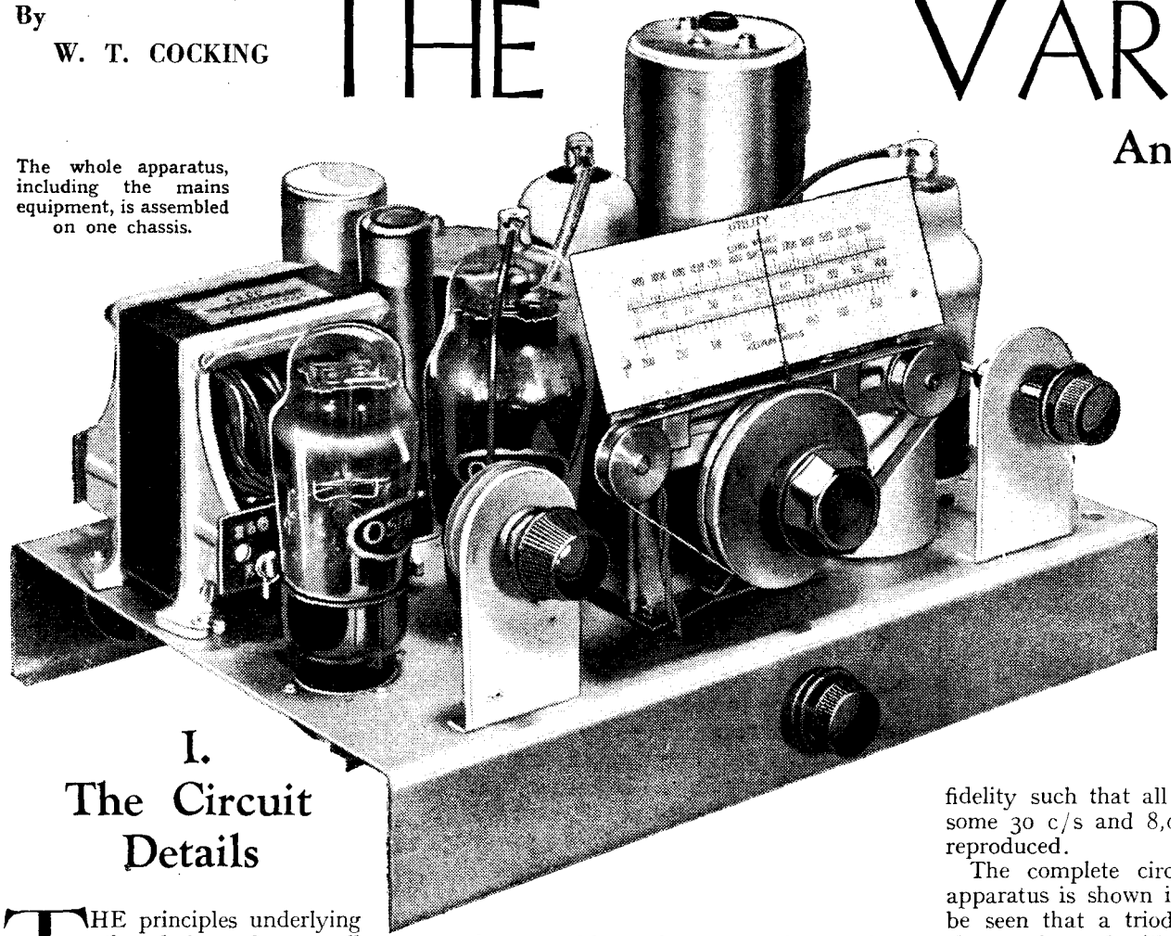
Variable selectivity seems at present to be the only solution to an unsatisfactory compromise.

In the receiver described for construction in this issue variable selectivity has been incorporated in a three-valve superheterodyne with most efficient results. The receiver is, moreover, inexpensive for so high a performance as it gives, and we commend this design to our readers with every confidence that they will find its efficiency, both in sensitivity and quality, outstanding. The variable selectivity enables a degree of quality reproduction on the local station to be obtained which is really remarkable and the receiver is essentially easy to construct.

By W. T. COCKING

THE VARIABLE-

An Inexpensive Six-stage Superhet



The whole apparatus, including the mains equipment, is assembled on one chassis.

I. The Circuit Details

THE principles underlying the design of a small superheterodyne were discussed in last week's issue of *The Wireless World*, and it was shown that by careful design a very high standard of performance can be obtained with no more than three receiving valves. These valves perform the functions of first detector, oscillator, IF amplifier, second detector, AVC rectifier, and output pentode, and these without any attempt at reflexing. Although even greater amplification could be secured by such means, it has not been attempted in this case, for experience with reflex circuits shows them to be somewhat unreliable and subject to unexpected variation with quite small changes in circuit constants. That the performance obtainable without such means is adequate for general reception, including both local and distant, is well brought out by the curves which accompanied the article already referred to. An average sensitivity of about 150 μV. with a degree of selectivity capable of discriminating against the adjacent channel by some 400 times represents a very high performance for a small superheterodyne. It is the more outstanding when it is coupled with a degree of fidelity such that all frequencies between some 30 c/s and 8,000 c/s can be well reproduced.

The complete circuit diagram of the apparatus is shown in Fig. 1, and it will be seen that a triode-hexode frequency-changer is used with an HF pentode for the IF amplifier. A duo-diode-output pentode provides detection and AVC, as well as feeding the loud speaker, and the HT supply is obtained with aid of an indirectly heated full-wave rectifier. Only a single signal-frequency tuned circuit is used, and, with the special system of aerial coupling which has been embodied, this has been found to give freedom from second-channel interference and much greater efficiency than the more conven-

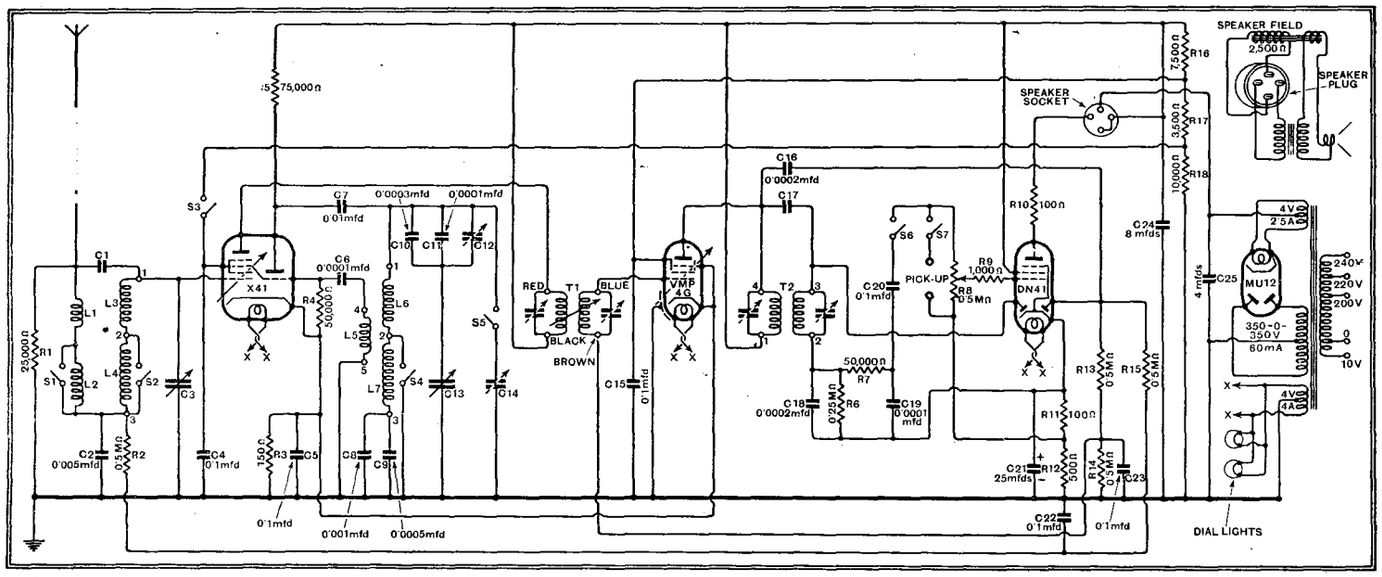


Fig. 1.—The complete circuit diagram of the new receiver shows the novel aerial coupling system. The aerial circuit as a whole is roughly tuned by L1 and L2 and is coupled to the tuned circuit by C1 and C2.

SELECTIVITY IV.

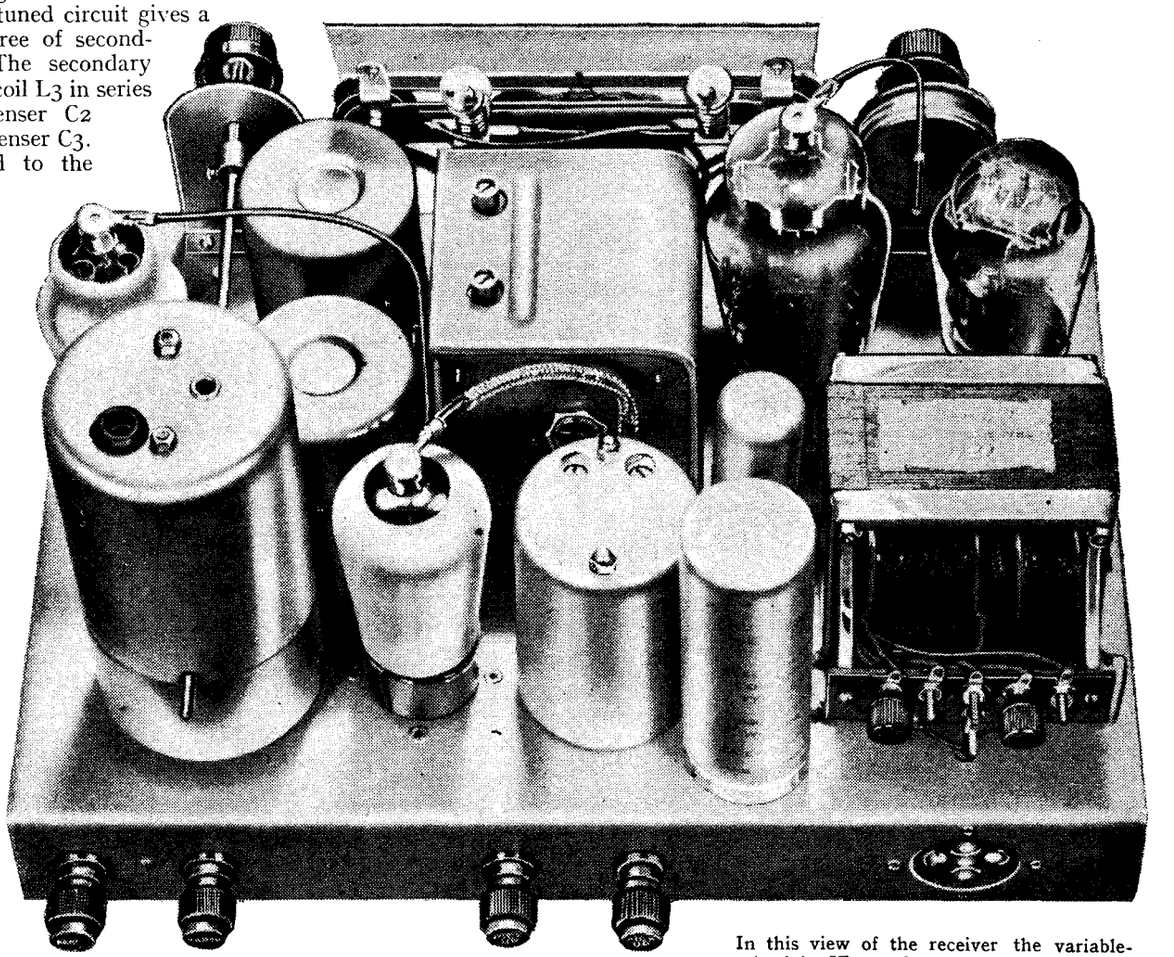
THE small superheterodyne is particularly suited to the needs of the average listener, for it can provide ample sensitivity and selectivity for distant reception, while the inclusion of variable selectivity enables a high standard of reproduction to be obtained for local reception. The performance of the receiver described in this article is exceptionally high, but the total cost of the parts necessary for its construction, including all valves, loud speaker and cabinet, is only some twelve pounds five shillings

tional pair of tuned circuits, coupled in the form of a band-pass filter.

The aerial circuit consists, in fact, of a pair of coupled circuits, but only one is variably tuned. On the medium waveband the switches S1 and S2 are closed, and the primary circuit consists of L1 and C2 in series with the inductance and capacity of the aerial itself. The constants are so chosen that resonance is secured towards the middle of the medium waveband, but an excessive response is prevented by the 25,000 ohms damping resistance R1. A good response over the whole waveband is thus secured; it is greatest in the middle and falls gradually towards the ends of the band. Outside the waveband the response falls, and as this coincides with the range of second-channel frequencies this fixed tuned circuit gives a very appreciable degree of second-channel rejection. The secondary circuit consists of the coil L3 in series with the fixed condenser C2 and the variable condenser C3. This circuit is tuned to the frequency of the wanted station and is responsible for the greater part of the second-channel rejection. It is coupled to the primary in two ways; first by the condenser C2, which is common to both circuits, and secondly by the "top-end" capacity C1. C2 has a value of 0.005 mfd., and as its reactance increases at low frequencies it gives greater coupling at the low frequency end of the waveband than at the high. The effect of the top-end capacity C1 is just the opposite, and this gives greater coupling at high frequencies than at low. The combination of the two couplings consequently tends to produce constant coupling throughout the waveband. Actually, of course, the coupling is not exactly constant, but it is much more nearly so than if any form of single coupling were used. The condenser C1 is of very small capacity, and is not a component in the accepted sense of the word, but is obtained in the wiring by the juxtaposition of certain leads.

On the long waveband the switches S1 and S2 are open, and the primary inductance is augmented by L2 to such a value that resonance now occurs in the middle of the long waveband. Similarly, the secondary inductance is increased by L4. No change in the values of the coupling components has been found necessary, however.

Turning now to the oscillator circuit, the triode section of the triode-hexode is used for generating the local oscillations. The tuned circuit is included in the anode circuit of the valve and is shunt-fed by means of the 75,000 ohms resistance R5 and the 0.01 mfd. condenser C7. On the medium waveband S4 is closed and S5 open so that the inductance is L6 alone, and it is tuned by the variable condenser C13, which has in series with it the padding capacity comprising the condensers C10, C11 and C12. Of these, C12 is the adjustable trimmer and the other two are fixed condensers, giving a total of 0.0004 mfd.



In this view of the receiver the variable-selectivity IF transformer can be seen on the extreme left, and the fixed coupling transformer between the IF valve and the smoothing condenser.

Two condensers are, of course, needed only because 0.0004 mfd. is not a standard capacity.

On the long waveband S4 is open and S5 closed. The inductance then consists of L6 and L7 in series, the stray circuit capacity is augmented by the trimmer

Variable Selectivity IV—

C14, and the padding capacity is reduced by the insertion of the additional series capacity of 0.0015 mfd. obtained by the two condensers C8 and C9. It has been found unnecessary to make this long wave padding capacity variable, for it is not very critical. The reaction coil L5 is connected in the triode grid circuit and is fed through the 0.0001 mfd. condenser C6, the valve being biased by the grid-current flow through the 50,000 ohms resistance R4.

The intermediate frequency output of the hexode section of this valve is fed to the IF valve through the IF transformer T1. This transformer has high-Q coils, and they are variably coupled so that variable selectivity can be obtained. The coupling in the second transformer T2 which feeds the diode detector is fixed, however, and as the mutual inductance between the coils of the standard component is slightly too small for the best results in this receiver, the coupling is augmented by the capacity C17 between the high-potential ends of the two circuits. This capacity is obtained in the wiring in a similar manner to C1, and it materially increases the efficiency.

The Detector and Output Stage

The detector is fed from the secondary, and its load resistance R6 is given a value of 0.25 megohm with a by-pass capacity C18 of 0.0002 mfd. IF filtering is accomplished by means of the 50,000 ohms resistance R7 in conjunction with the 0.0001 mfd. condenser C19. The LF potentials are fed to the pentode section of the valve through the 0.1 mfd. condenser C20 and the 0.5 megohm volume control R8. The pentode is one of the high efficiency type, and anti-parasitic resistances are accordingly included in grid and anode circuits, the grid resistance R9 being given a value of 1,000 ohms and the anode resistance R10 a value of 100 ohms.

The primary of the output transformer is included in the anode circuit of the pentode, and the space-charge grid is fed directly from the main HT line. Grid bias for the pentode is obtained by the voltage drop across the 100 ohms resistance R11. The bias applied to the AVC diode, which is fed with IF potentials from the primary of T2 through the 0.0002 mfd. condenser C16, is obtained by the sum of the voltage drops across R11 and R12, the latter resistance having a value of 500 ohms. The diode load resistance consists of the two 0.5 megohm resistances R13 and R14 in series, the latter being by-passed by the 0.1 mfd. condenser C23. The full AVC bias voltage developed across the load resistance is applied to the frequency-changer through the filter comprising R15 of 0.5 megohm and C22 of 0.1 mfd. and through the 0.5 megohm decoupling resistance R2. One half of the AVC bias only is applied to the IF valve in order to avoid distortion on strong signals, and this is obtained by connecting the earthy side of the secondary of T1 to the junction of R13 and R14.

The frequency-changer and the IF valve have the same initial bias applied to them. The two cathodes are connected together and taken to the earth line through the 150 ohms resistance R3, which is by-passed by the 0.1 mfd. condenser C5. The anodes of all valves are fed from the main HT line without decoupling, since this has been found to be unnecessary, but the screen potentials are taken from a potentiometer connected across the HT supply. This potentiometer comprises the resistances R16, R17, and R18, and potentials of 100 volts for the IF valve, and 70 volts for the frequency-changer are available.

The mains equipment is of simple type, but is adequate for the needs of the receiver. The mains transformer has windings giving 4 volts at 4 amperes for the receiving valves and the dial lights, 4 volts at 2.5 amperes for the rectifier, and 350-0-350 volts at 60 mA. for the HT supply. An indirectly heated rectifier is used, and a 4 mfd. electrolytic condenser C25 is employed for the reservoir condenser. Smoothing is effected by the field winding of the moving-coil loud speaker in conjunction with the 8 mfd. electrolytic condenser C24, and after smoothing a supply of some 200 volts is available. The field winding has a resistance of 2,500 ohms, and is, of course, energised by the current which it smooths. In order to avoid hum being generated in the speaker itself from the ripple on the current through its field a hum-bucking coil is fitted.

A list of the components required for this receiver appears below, and it should be remarked that in certain cases, such as the coils and IF transformers, it is important to employ the specified parts. Fixed condensers and resistances can be of any good quality make, of course, and this applies also to such components as the mains transformer, provided that the physical dimensions are such as to permit their being mounted on the chassis.

(To be concluded.)

THE LIST OF PARTS

1 Two-gang condenser, 0.0005 mfd., **C3, C13** — **Utility "Mite" W347/2**
1 Dial — **Utility "Straight Line" W346**
2 Bulbs for above, 4 volts 0.1 amp. — **Bulgin 410**
1 Aerial coil, L3, L4 — **Bulgin C6**
1 Oscillator coil, 465 kc/s, **L5, L6, L7** — **Bulgin C59**
1 Aerial loading coil, L1, L2 — **Bulgin C42**
1 IF transformer, 465 kc/s, **T2** — **Bulgin C50**
1 IF transformer, 465 kc/s, **T1** — **Sound Sales IF465**
1 Mains transformer, Primary: 200/250 volts 50 c/s. Secondaries; 350-0-350 volts 60 mA., 4 volts 2.5 amps. C.T., 4 volts 4 amps. C.T. — **All-Power PT/BP**
2 Trimmers, 0.0003 mfd., **C12, C14** — **Sound Sales 3VC**

Fixed Condensers.

3 0.0001 mfd., **C6, C11, C19** — **Bulgin PC301**
2 0.0002 mfd., **C16, C18** — **Bulgin PC302**
1 0.0003 mfd., **C10** — **Bulgin PC303**
1 0.0005 mfd., **C9** — **Bulgin PC305**
1 0.001 mfd., **C8** — **Bulgin PC201**
1 0.005 mfd., **C2** — **Bulgin PC205**
1 0.01 mfd., **C7** — **Bulgin PC101**
6 0.1 mfd., **C4, C5, C15, C20, C22, C23** — **Bulgin PCP1**
1 4 mfds., electrolytic, **C25** — **Dubilier 0283**
1 8 mfds., electrolytic, **C24** — **Dubilier 0281**
1 25 mfds., 25 volts, electrolytic, **C21** — **Dubilier 3013**

Resistances.

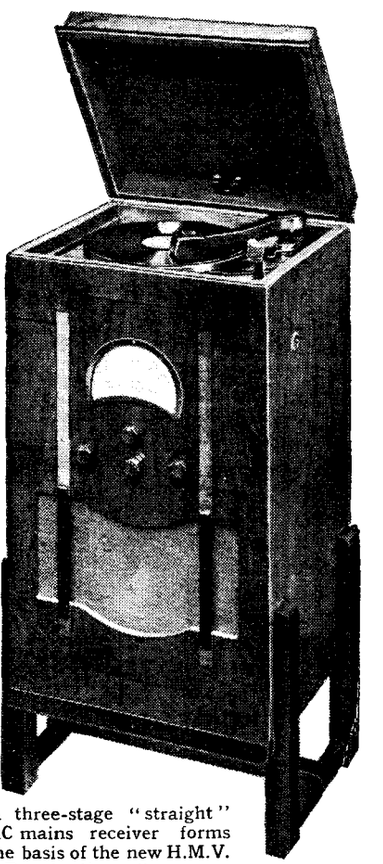
2 100 ohms, ½ watt, **R10, R11** — **Ferranti G.5**
1 150 ohms, ½ watt, **R3** — **Ferranti G.5**
1 500 ohms, ½ watt, **R12** — **Ferranti G.5**
1 1,000 ohms, ½ watt, **R9** — **Ferranti G.5**
1 25,000 ohms, ½ watt, **R1** — **Ferranti G.5**
2 50,000 ohms, ½ watt, **R4, R7** — **Ferranti G.5**
1 75,000 ohms, ½ watt, **R5** — **Ferranti G.5**
1 250,000 ohms, ½ watt, **R6** — **Ferranti G.5**
4 500,000 ohms, ½ watt, **R2, R13, R14, R15** — **Bulgin HW31**
1 3,500 ohms, 1 watt, **R17** — **Erie**
1 10,000 ohms, 1 watt, **R18** — **Erie**
1 7,500 ohms, 2 watts, **R16** — **Erie**

1 Tapered volume control, 500,000 ohms, **R8** — **Ferranti PG**
1 Multi-contact switch, S1, S2, S3, S4, S5, S6, S7 — **Magnum WW7**
4 Ebonite shrouded terminals, A, E, and Pick-up (2) — **Belling-Lee "B"**
1 4-pin plug — **Bulgin P9**
3 Valve top connectors — **Belling-Lee 1175**
2 Knobs — **Bulgin K26**
1 Length screened sleeving — **Coltone**
2ozs. No. 20 tinned copper wire, 12 lengths systoflex, etc.
Chassis, complete with three 7-pin and two 5-pin Clix chassis-mounting valve holders, screws, nuts and washers. — **C.A.C.**
Valves.
1 X41, 1 VMP4G, 1 DN41, 1 MU12 — **Osram or Marconi**
Loud speaker, 2,500 ohms field resistance and pentode transformer — Rola ST603/2500
Cabinet — **C.A.C.**
Approximate cost including valves and cabinet, £12 5s.

Two New H.M.V. Products

"Popular" Radio-gramophone and a Record-filing Cabinet

THE Model 370 has been introduced to meet the demand for a radio-gramophone at the price of a good table-model receiver. A "straight" circuit, with variable-mu HF amplifier, detector, and resistance-coupled high-efficiency output pentode, has been adopted, and the gramophone pick-up has a high output suitable for feeding the output valve direct. The turntable is driven by a constant-speed squirrel-cage motor, and an interesting feature of the gramophone side is the new method of "flock-spraying" the inside of the lid to localise acoustic radiation from the needle and pick-up. The price of the Model 370 is 16 guineas.

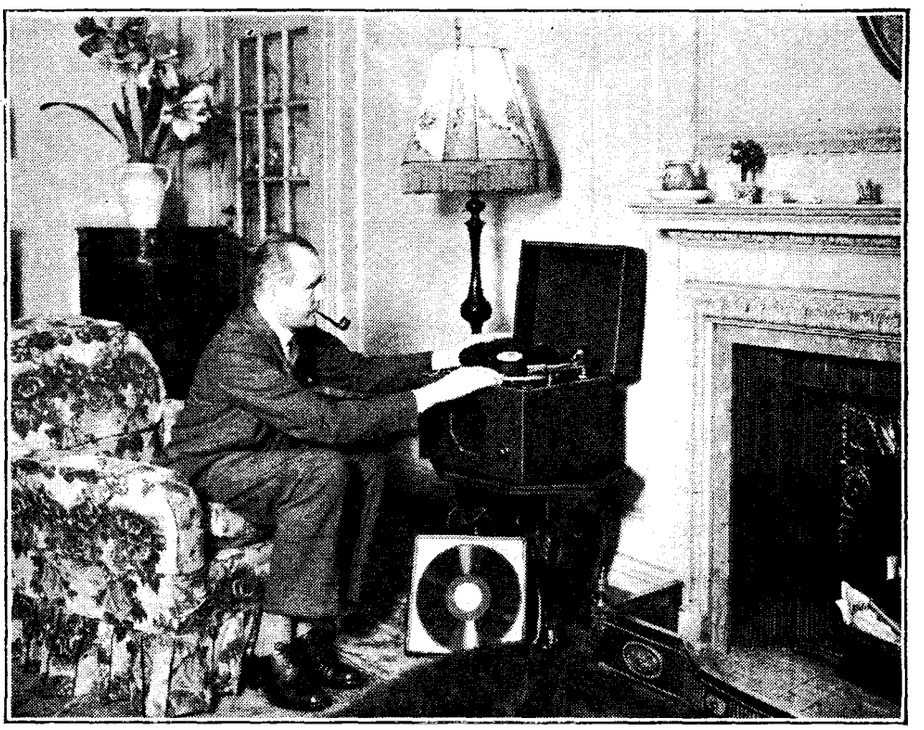


A three-stage "straight" AC mains receiver forms the basis of the new H.M.V. "Popular" radio-gramophone.

The new H.M.V. record cabinet at 5 guineas should make a strong appeal to all gramophone enthusiasts. It holds 400 ten- or twelve-inch records, either individually or in albums, and is finished in figured walnut.

Talking Books

A NEW DEVELOPMENT TO HELP THE BLIND



Sir Ian Fraser using the new machine and long-playing records. The box specially designed for posting is shown on the floor.

ONE of the greatest handicaps of those who have lost their sight is undoubtedly the inability to read. Braille has, of course, been of inestimable service, especially to those who have been able to learn to read it in early years, but it is not nearly so easy to acquire speed in Braille reading for those who have been deprived of their sight as adults.

It is for this reason that Captain Sir Ian Fraser, the well-known blind Member of Parliament, has for a long while devoted a great deal of attention to the problem of a suitable means of recording speech and reproducing with records suitable for distribution amongst blind persons.

The talking film may eventually prove to be the ideal means of reading aloud to the blind man in his home, as it has the advantage that it can be run for long periods at a time, but at present the film still has the considerable disadvantage that it requires elaborate equipment to play from it, and the various processes, such as rolling the reels and adjusting the apparatus, introduce added difficulties for the blind user.

The Choice

Influenced by these considerations, and with a thorough acquaintance of other possible solutions of the problem, Sir Ian Fraser, in co-operation with the National Institute for the Blind and St. Dunstan's, set to work, and set others to work, to develop a suitable long-playing record, which has now been brought to a practical stage where about four thousand words can be put on to one side of a 12in. record, the record playing for about twenty-five minutes.

The ordinary gramophone turntable revolves at 78 r.p.m., whereas in the slow-playing record the speed is only 24 r.p.m. Instead of about a hundred cuts to the inch the long-playing record has 200 grooves.

As might be expected, all kinds of technical difficulties were met with, and had to be surmounted in developing the recording side at these slow speeds. In cutting on the wax, where the adjacent grooves were so close, speech would often cause an impression through the wall of the groove already cut, with the result that a kind of echo of the speech was produced. It was found that this took place mostly on low frequencies, where the greatest amplitude occurred, and consequently it was found necessary to filter out some of these low frequencies.

Although the records may be played through a loud speaker, great volume is not required, and it is more agreeable to have the reproducing machine quite near the listener, within three or four feet, perhaps, where it simulates a person sitting in the chair next to him and reading directly to him.

In these circumstances, with quiet volume, the bass cut is not noticeable, and the speech sounds fairly normal.

A special Garrard turntable has been constructed which gives the varying speed from 24 to 78 r.p.m., and is supplied ready mounted on a base-plate with a crystal pick-up. For the sake of economy, a one-valve amplifier is used, and it is found that a crystal pick-up and a high-magnification pentode valve give sufficiently loud volume for all reading purposes, and even enough for a small room should a machine be used for dance music.

Naturally, for institutes or large groups of blind listeners, a power amplifier would have to be employed, but it is thought that the principal use of the Talking Book will be the more intimate personal reading aloud to the individual blind man in his own home.

Building up a Library

The technical difficulties having been overcome, the next step was to start to produce a library of "record books." Several complete books are now ready, and it is hoped to go on adding to the library, even at the outset, at the rate of two new books every month.

A special committee has been set up to choose the books so as to keep a proper balance and ensure that all tastes will be met as far as possible.

There are to be three types of reproducing machine, and although the records will be loaned to blind persons free of charge, they will be required to purchase their own machines at cost price. The concession of a lower postage rate on the records has been obtained from the Postmaster-General, and a special posting case has been designed for their safe transit. One of these cases is shown in the photograph resting against the leg of the table.

The machines will consist of an electrically driven reproducer with a crystal pick-up; for those who have not got electricity available but want the best reproduction they can get, there will be a type with a clockwork motor, crystal pick-up and earphones, for use to listen direct, or a length of flexible lead and a plug will be available to connect the pick-up output to the L.F. side of an existing wireless set; the third machine is similar in motor construction to the last, but has an ordinary sound box and tonearm and a built-in horn.

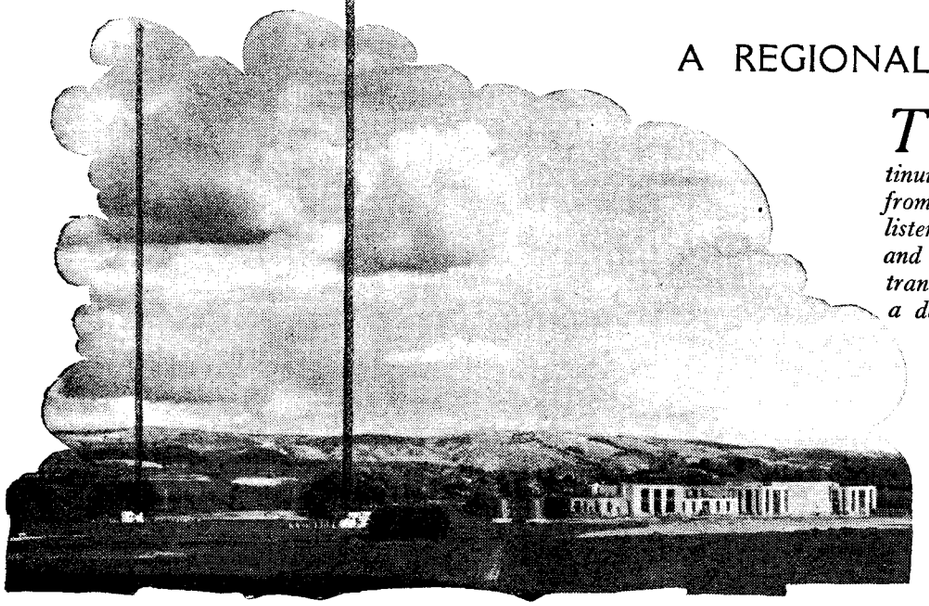
Demonstrations of these machines can be given to interested blind persons at the Talking Book Library, 204, Great Portland Street, W.1, between 9.30 a.m. and 1 p.m., or 2 p.m. and 5.30 p.m. on any weekday.

By LESLIE BAILY

Does Broadcasting

A REGIONAL TOUR OF INVESTIGATION

THAT the B.B.C. should establish a South Region is the considered opinion of our author after continuing his tour of investigation along the South Coast from Brighton to Plymouth. Fortunately, perhaps, for listeners in this area, Fécamp "comes in like a local!" and largely atones for the absence of a reliable B.B.C. transmission. Mr. Baily concludes this article with a description of what he saw at Washford Cross.



The future "Welsh Regional" at Washford Cross, where the West National and Regional transmitters are situated.

II.—Along the South Coast

AFTER returning to London from the Midland Region I set out along the South Coast, which is no Region at all. It is No Man's Land. Technically, this extensive and lovely country, from Margate right along to Bournemouth, is in the London Region; actually there is no Regional programme-organising staff. No London Regional Director exists to develop programme resources here, to send his staff scouring the district as they do (for instance) in the Midlands. So the London Regional programme is just a secondary National programme; it lacks local character.

That is the first of two contributory causes of the incomplete service given by the B.B.C. to this southern strip of England. The second may be given in the words of a Brighton wireless dealer: "We get Droitwich National very well," he told me, "but the Regional fades. People with modern AVC sets don't mind so much, but many people haven't AVC. Fécamp comes through like a 'local.' Most people use Fécamp as their favourite alternative to Droitwich. In early B.B.C. days Bournemouth was our local station; we could receive it well, and we took an interest in its programmes, but now we can't get it."

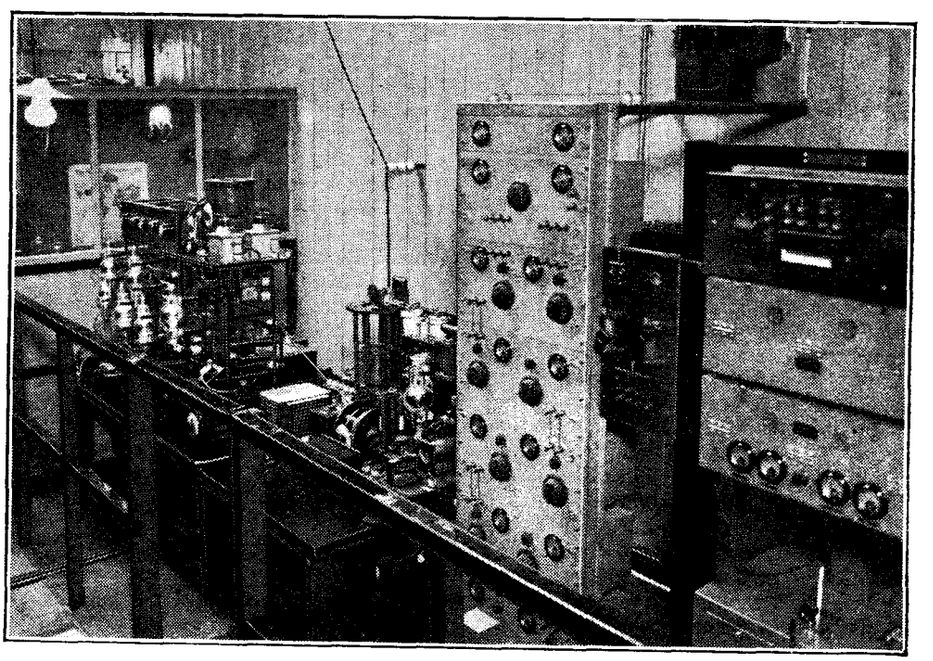
At Chichester and at Southampton I was told the same story. Bournemouth transmitter has a range nowadays of only, I suppose, ten miles, owing to its synchronisation with Plymouth on a very low wave. It relays the London Regional programme. Thus faded are the glories of 6BM! I noticed the old call-sign still adorning the brass plate outside the wooden hut in which 6BM first went into action on October 17th, 1923. The same old "Q"- type transmitter is there, plus tuning-fork control. Eight engineers man this B.B.C. antique; all the programme men have been withdrawn.

Going farther west I found similar Regional fading at Dorchester, though here we are getting into the West Region, which transmitter gives quite a satisfactory signal in day-time. As I motored into this ancient town the thought recurred that the life and the history of the South might be exploited to good effect by a South Regional Director based at Bournemouth or Southampton.

"Yes," retorted a Dorchester trader, "but I don't suppose people round here would thank the B.B.C. for that! They haven't much local pride; they'd rather hear some dance music from Fécamp."

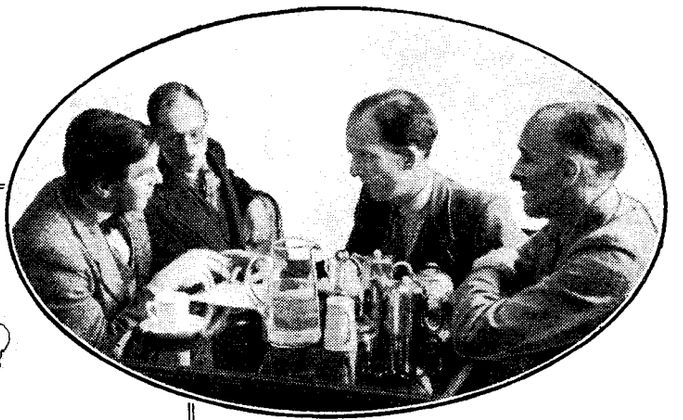
Is the Southerner as lacking in character as that? Or does he simply need a lead from the B.B.C.? It is hardly satisfactory to the B.B.C.'s standing that Fécamp is, in actuality, the "South Regional"! Before long 6BM must be replaced by a modern transmitter. Surely this is an opportunity to establish a thorough-going South Region, with a sufficiently powerful transmitter to give "quality" reception throughout the area, accompanied by a programme drive to awaken the Southerner to his own heritage.

In striking contrast, I stumbled across

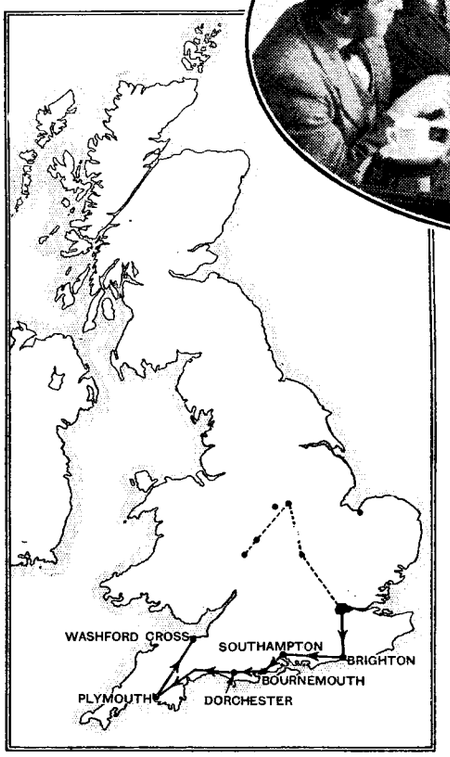


OLD AND NEW are curiously blended at Plymouth. Side by side with the original transmitter is the modern tuning fork and frequency doubling apparatus.

Serve Britain ?



DISCUSSING RADIO DRAMA over the tea cups at Bristol. On the left is Mr. Francis Worsley, who is to organise original programmes in the Plymouth area.



The tour continues.

formidable preparations for a "Big Push" in the West to improve both reception and programmes. The old West Region, which illogically incorporated Wales and the West of England, has just been split into two: Welsh Region and West Region. The latter has its headquarters at Bristol, and encompasses Cornwall, Devon, Somerset, Dorset and Wiltshire.

To broadcast this Western programme at least two new transmitters are to be erected, one of which will replace the present obsolete Plymouth transmitter, the condition of which can be judged from the photograph. The modern tuning-fork control panel on the right puts the ancient 300-watt transmitter (A.D. 1924) quite out of complexion.

New Hope for Plymouth

There is no programme staff at Plymouth. More faded glories! But here, I rejoice to report, a new day is dawning. New studios are likely to be built. Best of all, Mr. Francis Worsley, one of the livest men in the West Region, is to be sent here as programme organiser, and intends to put this district on the map.

The new Plymouth transmitter will carry the service right down into Cornwall. This is another of those "neglected areas" for which I am keeping a sharp look out during my tour of B.B.C. Britain. As one of the West Regional programme organisers said to me: "It wasn't much use our developing the programme resources of the extreme West if people down there couldn't pick up the Western programme!"

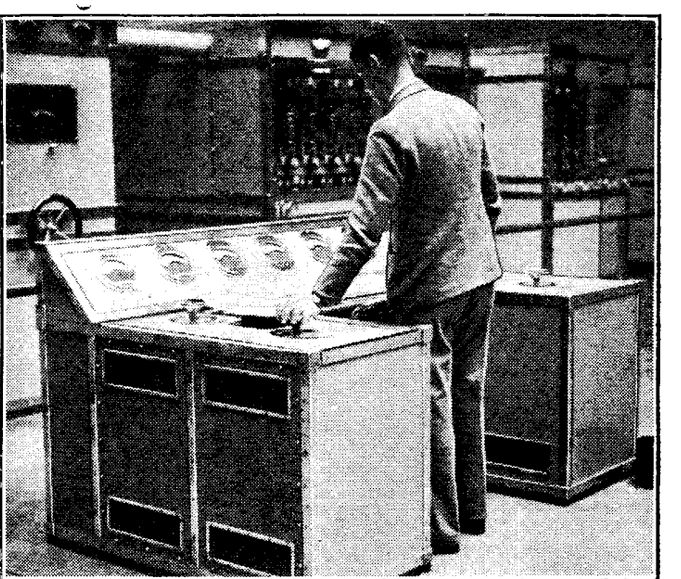
When the new transmitters get going with the West programme (which will not be for over a year, as the sites are not even chosen), the present West Regional transmitter at Washford Cross will be rechristened "Welsh Regional." It stands on the Somersetshire cliffs, its two 500ft. masts looking across the Bristol Channel to South Wales. There are two "umbrella" aerials, Regional on one mast, National on the other.

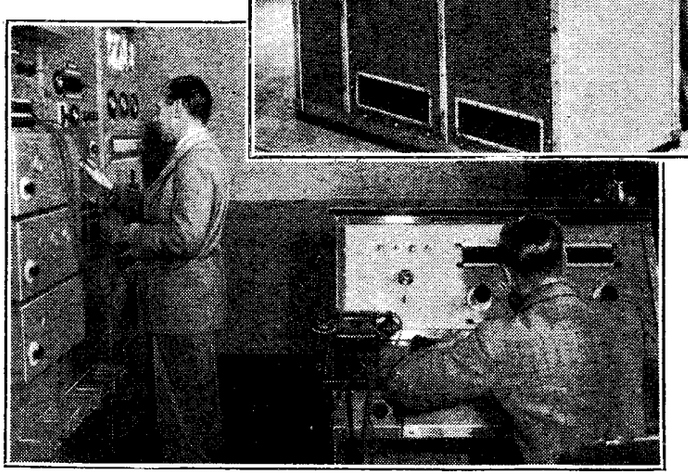
Electrical storms have been cracking guy-wire insulators like nuts lately. The guy sections get charged up until there is a flash-over from one section to the next. Mr. Humphries, the engineer-in-charge, showed me several foot-long insulators which had been cracked clean in two and burnt brown.

It was decided to test whether the radiation from the aerial caused any large voltage across these insulators, so a rigger went to the top of the mast and fixed a spark-gap across an insulator about 12ft. from the mast-head. As the insulator was several feet away from the side of the mast the rigger reached it by sitting in a bo'sun's chair which was dropped over the top of the mast and then swung outwards by men pulling on a rope on the ground! When the rigger returned to the mast the aerial was energised, but no spark occurred. Several times the rigger had to repeat his giddy aerobatics, to tighten the spark-gap. In the end it was decided that the voltage was negligible.

Running "Easy"

The actual power of West Regional is now 57 kilowatts. West National is 30 kw. By laying on every ounce it would be possible in each case to go up to nearly 80 kw. Thus the station is running "easy," and in the power-house I noticed that only two of the four 420 horse-power Diesel units are needed to run the station with both Regional and National radiating.





Two action pictures at Washford Cross. Above is an engineer adjusting the power input to the transmitter. (Left) Taking a line frequency characteristic.

One engine was having its annual overhaul. Valves and rockers had been taken down, the pistons removed, "decoked," and fitted with new rings. The very thorough overhaul (which occupies three men for a fortnight) includes measuring

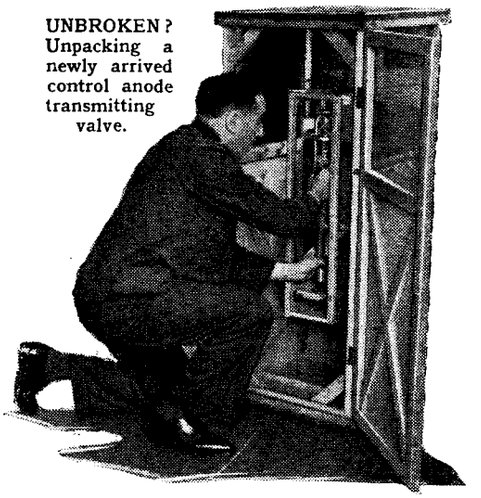
Does Broadcasting Serve Britain?

with micro-gauges the cylinder bore and other places likely to wear.

Although the station is working so much below full power, the engines burn fourteen tons of oil every week. The lowering of West National's power was, of course, dictated by the synchronisation with London and North Nationals on 261 metres. Each of these transmitters has a tuning-fork apparatus, but one keeps all three constant, as they are linked together by land lines. When I was there North National was feeding the other two with the "fork tone"; this arrives at 1,122.07 cycles and is put through ten stages of frequency doubling, which multiplies it up to the required radio frequency (1,149 kilocycles). North and West and London National take it in turns to supply the "fork tone."

The West Regional wave is also controlled now, though not to the fine limits achieved by the tuning-fork method. That is not necessary unless working on a common wave, but some time ago the International Broadcasting Union made a rule that all stations must keep to within plus or minus 10 cycles of their allocated frequency. Accordingly, a Parkin Drive has lately been installed for West Regional.

Mr. Humphries took me to see the Parkin Drive in a room which is kept at 83 degrees. Basking in this heat-wave in late autumn I learnt that the Parkin Drive consists of an oscillatory circuit of exceedingly robust and foolproof construction. The moving and fixed vanes of the variable condenser, for instance, are made of two metals of inverse temperature coefficients, so that if one expands the other equally contracts, and there is thus not the slightest change of frequency. The signal from this apparatus is used to drive the first stage of the transmitter. Tatsfield measures the radio frequency twice a day, and when it creeps up towards 10 cycles error the engineers at Washford Cross adjust the Parkin Drive and bring it back to zero; this happens perhaps once a fortnight.



UNBROKEN? Unpacking a newly arrived control anode transmitting valve.

There are thirty-two of them there—radio engineers, riggers, Diesel men, and others—under Mr. Humphries. One needs to visit these outposts like Washford Cross, Plymouth and Bournemouth to appreciate the good service the modest B.B.C. engineer puts in for you and me, but as I raise my hat to the engineers down in the Golden West I think that their life is not so unenviable, with the sea almost lapping their doorsteps.

(**Next Tour:** *North Devon Coast to Bristol.*)

Short-wave Broadcasting

CONDITIONS are still more than usually good, especially on the higher frequencies. Concurrently with the remarkable long-distance contacts on the 10-metre amateur band came a wonderful improvement in W8XK on 13.9 metres, which was also reflected, to a certain extent, in the behaviour of the 16- and 19-metre stations.

Between 16 and 13 metres there are many high-powered commercial telephony stations to be heard, and a few of them relay long-wave programmes or transmit gramophone records for test purposes.

On 15.5 metres, Bandoeng, PMA, may be heard during the mornings, and just above, on 15.57, is PPU, a station at Rio de Janeiro, which may be heard at its best during the afternoons.

LSN, LSM, and LSQ, all of Buenos Aires, occupy a variety of wavelengths in the same region, and several transmissions from Rugby may also be heard. All this, of course, is not strictly "short-wave broadcasting"—but it all adds variety to the matter available to the owner of a short-wave receiver.

The only broadcast stations that one can usually hear in the 16-metre band are Daventry, Zeesen, Huizen, and Bound Brook (W3XAL). The latter is invariably good, which makes it hard to account for the absence of the other Bound Brook station, W3XL, listed as working on 17.23 metres, but rarely heard.

The most interesting newcomer to the 19-metre band is La Paz (CP7) on 19.6 metres. This is the only Bolivian station that has ever come over to this country with anything like regularity. The transmission is not strong, but should be picked up reliably with any good receiver.

There are now four U.S.A. stations in this band—W8XK, W1XAL, W2XE, and W2XAD. Since all four work so close together they are rather difficult to identify unless one has a really accurate calibration of the receiver. DJB and DJQ make reception rather difficult, sometimes, in this band. They were both heard at a perfectly fantastic strength on a recent Sunday afternoon.

Quite a few of these high-power Europeans seem to ignore the dictum that "locals should be seen and not heard." The exception, in this part of the country at least, is Daventry. Never does the Empire programme, on any wavelength, seem to be received at a greater strength than about R4. Possibly in Scotland or Cornwall things are very different.

The elusive Addis Ababa station is now quoted as working on three wavelengths—16, 25.3, and 39.3 metres. He has often been heard, and even identified, on the latter wavelength; but very few listeners have had any success on the other two. The input is only 2 kW., and that does not appear to be fully modulated.

Conditions at this time of year are generally good for Asia, especially the Far East. On the amateur bands the Philippine Islands have been frequently heard, although Japanese signals are conspicuous by their absence. One would imagine that there was a possibility of receiving stations like Hong Kong on 34.29 metres, Calcutta on 49.1, and Kuala Lumpur on 48.92.

Strangely enough, very little is heard from Asia except the Dutch stations in Java, which are nearly always strong and reliable. Some of the Japanese stations were exceptionally good about a month ago, but they appear to have faded out by now.

The writer would be glad to hear from readers who happen to receive unusual stations, or who receive some unknown station that they would like to identify. A long watch is being kept with a calibrated receiver, and many unknown stations have ultimately been traced. MEGACYCLE.

BOOK REVIEW

Modern Radio Communication. Vol. II. By J. H. Reyner, B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E., M.Inst.R.E. Pp. 161+xi and 111 illustrations. Sir Isaac Pitman & Sons, Ltd. Price 7s. 6d. net.

IN this volume the subject is dealt with in its more advanced aspects and in greater detail than in the more elementary first volume,* which is already well known. In the main, the non-mathematical character has been maintained, though brief mathematical treatment is given where its avoidance altogether would leave the explanations incomplete. The chapters are necessarily short, but the author has succeeded in giving a remarkable amount of information in the limited space available. The chapters on feeders and on filters and attenuators are particularly well written, explanations being very lucid though concise. There are three appendices giving the theory of coupled circuits, details of non-fading aerial systems, and the theory of detection.

The book is of high quality from all points of view, and can be confidently recommended to those making a study of the fundamental principles of the science, and especially to those who have used the first volume.

Although there are notably few errors, one slip was noticed, and as this refers to fundamentals it is considered expedient to point it out. It occurs in Appendix I on coupled circuits. The circuit equations should be

$$i_1(R_1 + jX_1) + jM\omega i_2 = e \quad . \quad . \quad . \quad (1)$$

$$i_2Z_2 + jM\omega i_1 = o \quad . \quad . \quad . \quad . \quad (2)$$

whereas the "j" was omitted from the second term of each. The final results are thus

$$R'_1 = R_1 + (M^2\omega^2/Z^2_2)R_2$$

$$X'_1 = X_1 - (M^2\omega^2/Z^2_2)X_2,$$

where X_2 is inductive reactance. The author obtained a plus sign in both expressions, which are fundamental equations of an air-cored transformer. O. P.

* Volume I, Review, *Wireless World*, March 29th, 1935.

CURRENT TOPICS

Events of the Week in Brief Review

Double Fees for Pirates

THIS is France's latest blow at the pirate: All listeners who had failed to pay licence fees by October 22nd became liable to a double tax. In the week preceding "zero hour" licences were being taken out at the rate of 10,000 per day.

Avoiding Interference

BY co-operation between themselves, amateur transmitters in many of the R.S.G.B.'s twenty national districts are avoiding mutual interference. Before a member purchases a quartz crystal (for frequency stabilisation) he consults a register held by his district representative to ensure that no other district member already possesses a crystal of a near-by frequency.

Silent Carriers on November 11

ON Armistice Day, French amateur transmitters will observe a "silent minute" to commemorate the fallen. At 11 a.m. their transmitters will be run at full power, but the carrier waves will not be broken by either speech or morse.

This impressive ceremony was inaugurated by the French last year, and in 1935 amateurs in many other nations will follow suit by radiating "silent carriers."

Super Power for U.S. ?

A SCHEME for providing the United States with a chain of twenty-five 500-kilowatt stations is now being considered by the Federal Communications Commission. Following upon the success of the 500-kilowatt WLW at Cincinnati, engineering opinion now has it that the only way to serve remote listeners is with super power.

Each of the super power stations would have an exclusive wavelength.

Bridge by Radio

TO-NIGHT, November 1st, two four-man contract bridge teams representing the United States and Buenos Aires are competing over a bridge table 6,000 miles across. The American four, headed by Ely Culbertson, will engage a team representing the Jockey Club of Buenos Aires.

Two short-wave stations provide the link. They are W2XAF, Schnectady, and station LSX of Transradio International at Buenos Aires.

Both stations are relaying the entire contest, so listeners tuning in either will be able to follow the entire proceedings.

G 2 YL

MISS NELLIE CORRY (G2YL), Walton-on-the-Hill, made amateur history during the week-end by working all Continents on a wavelength of 10 metres. Contacts were secured on Sunday last as follows:—

9 a.m., Assam (India); 10.30 a.m., Queensland (Australia); 11 a.m., Uruguay (S. America); 2.5 p.m., Algiers (Africa); and 3.20 p.m., Florida (United States).

Later in the day the "W.A.C." on 10 metres was also secured by Mr. H. L. O'Heffernan (G5BY).

The first claim of having worked all Continents on 10 metres was made on October 13th by the South African amateur, ZS1H.

Neutrality

A CLAUSE in the Danish Radio Act decrees that broadcasting must observe strict neutrality in all contingencies. Consequently, last week the programme director at Copenhagen banned a new fox-trot entitled "Black Sheba from Addis Ababa."

More Money from Amateurs

HITHERTO, amateur transmitters have paid ten shillings a year for transmitting and ten shillings for receiving licences, but as all their work is done on short waves the G.P.O. has decided that if they wish to listen to broadcasting they shall pay another ten shillings. This will be equivalent to the ordinary listener's licence, and will bring in over a thousand pounds more money to be shared by the G.P.O. and the B.B.C.

I.E.E. Wireless Section

MR. R. H. WATSON WATT, B.Sc. (Eng.), will give the chairman's inaugural address at a meeting of the Institution of Electrical Engineers at 6 p.m. on Wednesday next, November 6th. The meeting will be held at the Institution, Savoy Place, W.C.2.

Most Powerful Station?

NEW ZEALAND'S main broadcasting station, 2YA, is to have a new 60-kw. transmitter at Titahi Bay, fifteen miles from Wellington, to replace the existing 5-kilowatt plant at Mount Victoria, overlooking the city.

It is claimed that 2YA will be the most powerful broadcasting station in the southern hemisphere.

ANTI-INTERFERENCE WAR is being waged energetically in France under the direction of M. Mandel, the P.M.G. This photograph, taken in a Paris suburb a few days ago, shows a "parasite" sleuth hot on the scent.

Amateurs and Hospital Radio

AN ambitious series of lectures has been planned by the Southend and District Radio Society, one of the most active and old-established in the South of England. In the near future "Valves" will be discussed by Mr. B. Nixon (G.E.C.); "Loud Speakers," by Mr. Falkus (E. K. Cole); and "Droitwich," by Mr. J. Pulling (B.B.C.).

The Mayor of Southend is president of the Society, which has accepted the responsibility of maintaining all local hospital radio installations.

An Electricity Change-over

THE methods adopted in the recent large-scale conversion from DC to AC supply in Northern Ireland are dealt with in *The Electrical Review* of November 1st. Mr. D. P. Sayers, B.Sc., A.M.I.E.E., who is in charge of the Northern Ireland change-over, writes of the way in which consumers in that area were dealt with. Particular interest attaches to the sections relating to radio apparatus.

U.S. 'Plane Broadcast

WHEN the giant Pan American Airways 'plane takes off from San Francisco for China in the near future to institute a regular mail and passenger service across the Pacific, it will carry an engineer and announcer of the National Broadcasting Company. At frequent intervals during the flight broadcasts will be picked up from the 'plane by San Francisco and relayed over the American networks.

"Wireless World" Diary

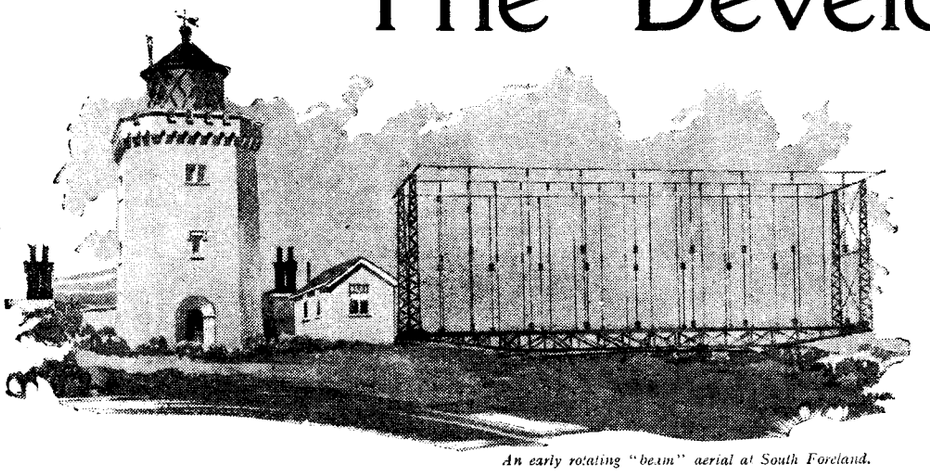
THE *Wireless World* Diary for 1936 is more than a diary; it is an experimenter's handbook, with 76 pages of useful information and formulæ in addition to the usual week-at-an-opening diary pages.

The main features include the world's broadcast wavelengths (on all wavebands); abacs for the rapid calculation of coil windings, decibel equivalents, wavelengths, etc.; hints and tips; comprehensive data regarding the latest types of frequency changers; pentodes and multi-electrode valves; and a large section dealing with representative circuits.

The Diary is now obtainable from all booksellers, stationers and bookstalls, price 1s. 6d., or direct from the publishers, Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, price 1s. 7d., post free.

Two companion publications, similarly priced, are the *Autocar* Motorists' Diary and the *Motor Cycle* Diary; each containing a wealth of up-to-date information for road users.

The Development of



An early rotating "beam" aerial at South Foreland.

By COMMANDER J. A. SLEE, R.N. (Ret.), C.B.E.

IV.—The Past Eight Years

SINCE the Washington Radiotelegraphic Conference of 1927, the development of aerials has been almost entirely confined to two main fields of study, viz., aerials for "beam" stations and aerials for broadcasting stations.

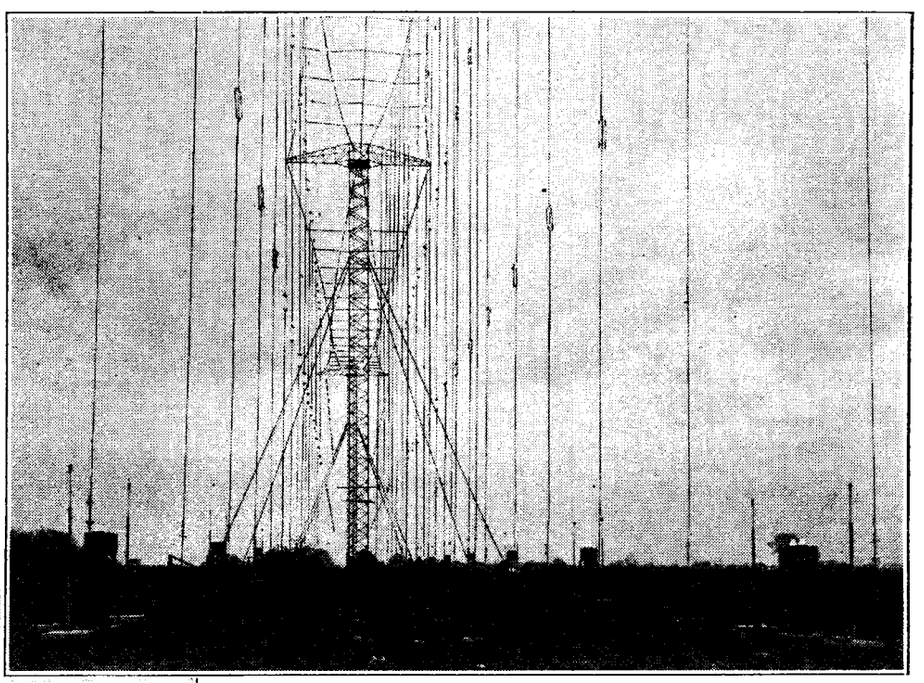
THE fundamental principle of directional transmission in the horizontal plane can be stated quite simply. If two simple vertical wires are erected, in all respects similar and half a wavelength apart, and if equal oscillating currents are made to flow in them exactly in phase with one another, then there must be zero radiation along the plane passing through the two wires; and the radiation will be maximum along a line at right angles to this plane.

As more pairs of wires are added, the maximum becomes more clearly marked. Each pair of wires must be half a wavelength apart, and all must be in the same line. The natural unit of such a construction is when the line of vertical wires has been increased to one wavelength. The horizontal polar diagram of radiation of such an aerial array is practically a cosine diagram, the field strength along the maximum being approximately $1\frac{1}{2}$ times that which would be obtained from an all-round transmitter employing the same power.

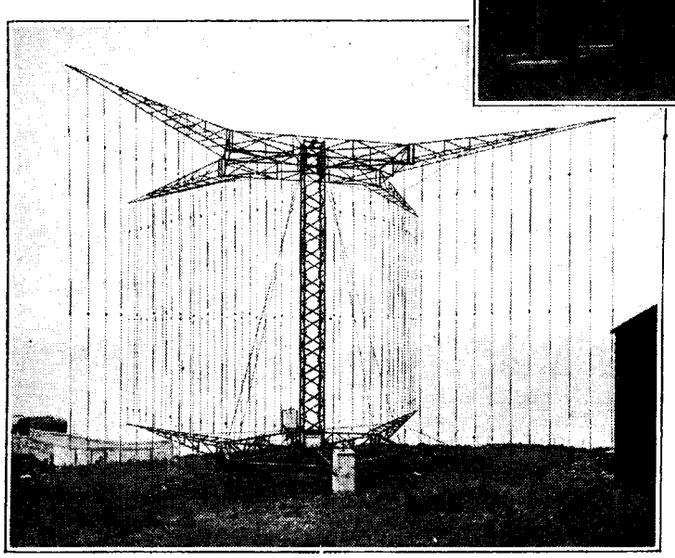
If more than one unit is used, all the wires being in the same line, the maximum becomes more clearly marked and greater, and the beam of transmission becomes narrower, though there are small subsidiary lines of emission between the edges of the main beam and the zero line. In modern practice the number of units is sometimes increased to five, when the field strength along the line of maximum radiation is about five or six times as great as that which would be obtained from an all-round transmitter of the same size. There are two main maxima in opposite directions.

If a second array of wires is set up, parallel to the aerial wires and quarter of a wavelength distant from it, the induced current flowing in these wires will set up interference effects with the radiation from the aerials, destroying it in one direction and adding to it in the other. The array acts as an almost perfect plane reflector. The resulting beam is thus unidirectional and the value of the remaining maximum is doubled. It will now be about 12 times the field strength obtainable from an all-round transmitter of equal power. These are measured figures as obtained in practice from the best form of construction, and are about two-thirds the theoretical values.

In such a construction one row of wires is fed with energy; the other row is not fed and is a pure reflector. Alternatively both rows of wires can be fed, the current in all of them being equal and in



The addition to a beam aerial of a reflector, as shown in this photograph, considerably enhances its directional properties.



A famous revolving beam aerial—at Inchkeith.

the Wireless Aerial

phase. The two rows must then be half a wavelength apart.

The problem confronting the engineer is first of all to erect this complicated structure and then to arrange the supply of power to all the wires in the aerial array (not in the reflector array) so that the current shall be equal and in phase in all of them.

The fundamental idea of directional transmission due to the interference effect between the radiation from two similar vertical aerials half a wavelength apart, the current in the two aerials being equal and in phase, is, of course, susceptible of considerable variation in practice. For instance, a row of vertical half-wave aerials, half a wavelength apart and connected to one another alternately at the top and bottom, will give a similar result. The interference principle is fundamental, but there are many methods of applying it.

Great mechanical and electrical accuracy is necessary to maintain a sharply defined beam with the greatest possible radiation in the required direction.

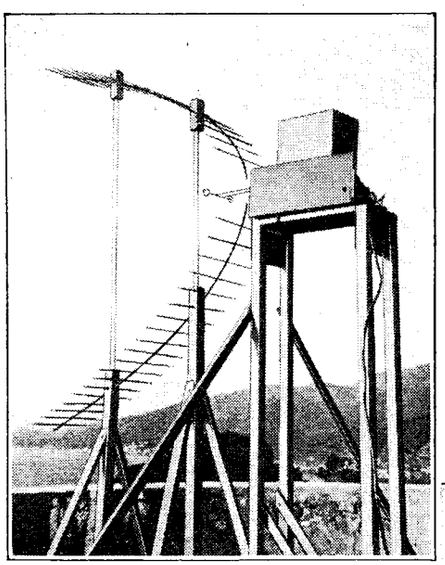
When using fairly short waves, the whole aerial array may be so small that it is physically possible to rotate it, thus giving directional transmission on any desired bearing. With the micro-wave transmitters this principle is carried to an extreme degree of development.

The whole theorem is reversible; just as efficient working can be obtained with a receiver as with a transmitter.

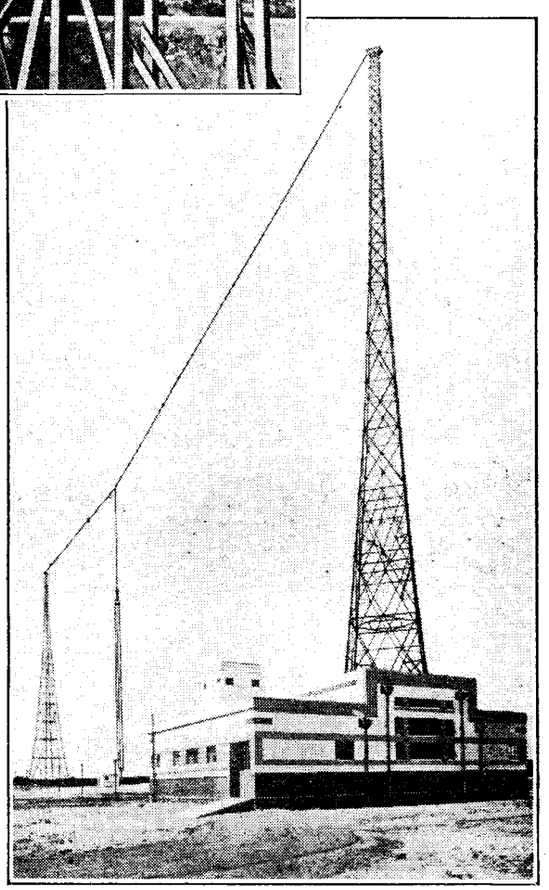
The study of the propagation of short waves shows that they are not propagated parallel to the surface of the earth, but are greatly inclined upwards. The object to be achieved is to give the maximum direction of propagation such an inclination in the vertical plane as will make the most effective use of reflection from the ionosphere. This can be done by utilising the principles of interference in a slightly different way. If each vertical wire could be divided into two sections, each half a wavelength long, and if the currents in the two halves were in phase, a directional effect in the vertical plane could be obtained. This is done in practice, three half-wave aerials being in use, the sections being connected in series through small inductances so designed that even-numbered half waves are developed in them, the three odd-numbered half waves being left in the straight radiating sections.

The different possible solutions to these problems are responsible for the varying aerial constructions resorted to in different places.

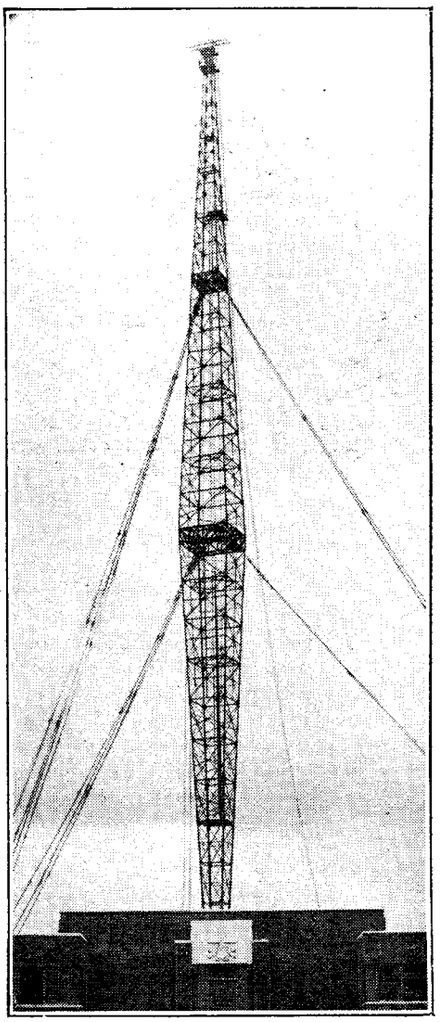
For small stations, or for all-round transmission, two main types of aerial have been developed, a straight conductor, whose length is some odd number of quarter wavelengths, or some form of elevated dipole.



An extremely narrow beam is possible with the micro-wave aerial, of which this is an example.



A typical modern broadcasting aerial.



The last word in broadcasting aerials is this vertical type in which the mast is itself used as an aerial. Efficiency can be raised to as high as 80 per cent.

In order to control the direction of transmission in the vertical plane, arrangements similar to those described above for beam station aerials are sometimes applied to vertical aerials for all-round transmitting stations.

Aerials for Broadcasting

Broadcasting aerials have been developed along two lines.

First the aim has been to increase the efficiency to the highest possible point, and, secondly, to control the proportion of the energy radiated, which takes the form of a wave connected to the surface of the earth, to the total radiated energy.

The frequencies most commonly used for broadcasting make it possible to work in terms of wavelength, and the first step was to use aerials actually one quarter of a wavelength high. High insulation, high conductivity, and scientifically constructed inductances have all contributed to a reduction in total resistance, which can now be carried so far as to make the response curve of the aerial itself so sharp that it is unsuited for the radiation of high-class musical telephony, the upper and lower side-bands being unduly weakened by the sharp resonance

The Development of the Wireless Aerial—

curve of a circuit of such low resistance. In modern aerial design it is this fact which sets the limit to the efficiency of the aerial, a figure which reaches about 70 per cent. for aerials of the quarter wavelength type.

It has been found that for the purpose of broadcast programmes on medium wavelengths the only useful part of the energy radiated is that which is transferred by the part of the electromagnetic wave which remains in contact with the earth's surface. That part which leaves the earth's surface and is reflected by the ionosphere is of little or no use for programme purposes, but can cause interference with other programmes outside the service area of the station.

It is therefore desirable to use aerials which will cause the highest proportion of direct ray and the lowest proportion of indirect ray radiation.

The best results are obtained by the use of vertical aerials half a wavelength high. With such a construction there is, of course, zero current and maximum potential at the bottom as well as at the top, the point of maximum current and minimum potential being half way up. Special arrangements are necessary for feeding energy to such a device. In some cases the mast or tower itself is used as the aerial. The efficiency of such an arrangement can be raised as high as 80 per cent.; that is to say, if 10 kilowatts are developed in the final closed circuit, 8 kilowatts will be radiated into the ether.

Directional transmission is sometimes applied to medium-wave broadcasting stations so as to alter the shape and position of the service area with respect to the position of the station.

For instance, if a station is provided with a simple vertical aerial, the service area will be, roughly speaking, circular, the station being in the centre, provided, of course, that the nature of the country is the same all over the service area.

If a second aerial is erected a quarter of a wavelength away—it need not be fed—the shape of the service area will still be roughly circular, but the transmitting station will be on the edge of the circle instead of being in its centre.

Developments of this nature are proving themselves of great value in arranging the organisation for broadcasting in the European area.

More 10-metre Successes

SINCE the announcement of the first two-way contact between England and Australia on 10 metres appeared last week, many more long-distance contacts have been made on this surprising waveband.

To Mr. E. J. Laker (G6LK) goes the credit for most of the Australian contacts. On October 19th he worked with VK2HY, VK2HZ, and VK2LZ, and on October 20th with VK2LZ, VK4BB, and VK4EI.

G6LK and many other British stations have made successful contacts with the South American stations LU1EP and LU9BV (both in Argentina) and with the South Africans, ZS1H, ZT6K, and ZU6P.

The writer logged over fifty North American stations within two hours, and SU1SG in Cairo is being heard regularly.

Among the best of the U.S.A. stations are W4AUU, W4AJY, W9HAQ, and W9LF, all of whom have been entered in the log as R8. West Coast stations heard include W6CAL (San Francisco) and W7AMX (Portland).

Other European stations that appear to have been making contacts with America are PA0QQ (Holland), D4KPJ (Germany), and, of course, Belgian ON4AU and French F8GS, both of whom were in contact with the States long before we were able to hear the Americans in this country.

All this splendid work makes one wonder how long it will be before American and Australian signals are heard here on *five* metres. It seems highly probable that next year will see it done. MEGACYCLE.

FERRANTI AC12C AMPLIFIER

THE question has been raised as to the reason for the discrepancy between the overall frequency response curve of the Ferranti AC12C amplifier published in the Ferranti Constructional Booklet No. R105 and that published in *The Wireless World* review in the issue for October 25th, 1935. The latter shows a drop of 3 db. at 8,000 c/s, whereas the Ferranti curve indicates a loss of 0.5 db. at this frequency.

The difference is to be accounted for by the different output transformer ratio employed when taking the curves. The measurements in *The Wireless World* laboratory were carried out, using the 22.5-1 ratio on the multi-ratio transformer fitted, for which a portion only of the secondary is used. The Ferranti curve on the other hand represents the performance with the 15-1 ratio utilising the whole secondary winding, so that the leakage inductance is lower and the high-frequency response better.

Wireless in Abyssinia

Interview with Engineer at Akaki

OVER eighty newspaper correspondents now stationed at Addis Ababa feed their readers with "stories" transmitted by the 3-kilowatt station at Akaki, some 10 kilometres from the Abyssinian capital.

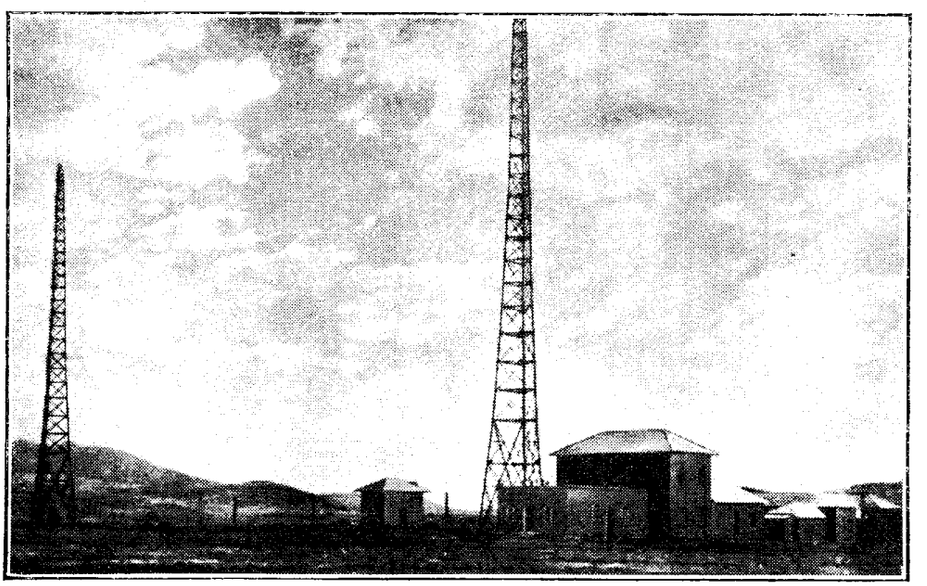
The chief engineer of the station, Mr. Frank Hammar, has just granted an exclusive interview to a representative of *The Wireless World*, in the course of which he described how the busiest station on the face of the globe now conducts its daily work.

Although a large part of the correspondence is sent out on high-speed Creed transmitters, there is plenty of work for the Abyssinian operators, who have all been trained by Mr. Hammar. Many of these youths are under twenty years of age and require constant supervision. Under the special conditions imposed by the war, they work with great zeal, but find the utmost difficulty in grasping even the most elementary principles and technique.

Thus certain errors creep in, which is not surprising when it is remembered that the Akaki transmitters operate twenty-four hours a day. The staff works in long shifts to cope with messages totalling some 30,000 words per day as compared with a normal daily output of 500 words.

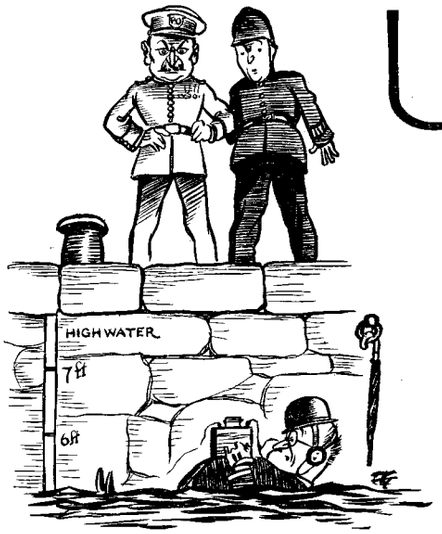
Stories of a broadcasting service in Abyssinia are inventions of energetic and imaginative newspapermen, according to Mr. Hammar. There is no broadcasting in the country, and, indeed, there are only thirty listeners in Abyssinia, all of them being Europeans with short-wave sets. Reception on the medium and long waves is quite out of the question on account of overpowering atmospherics.

The only broadcasting ever attempted in Abyssinia are the running commentaries arranged by the American National Broadcasting Company. Tests have not been unsuccessful, but the quality is poor, partly owing to the lack of good microphones.



The 3-kW. short-wave transmitter at Akaki, near Addis Ababa, constructed by Standard Telephones and Cables, Ltd.

UNBIASED



Permissible below high water mark.

Below High Water

THERE are innumerable proverbs and wise saws in all languages which endeavour to inculcate in the mind of the long-suffering citizen the virtues of thrift, and all of them command my most sincere respect, as I was very strictly brought up in my youth. To this day I remember the wise old proverb hanging over my crib telling me that "If youth did know what age did crave, many a penny he would save."

It is due to the presence of this trait in my character that I found myself at the recent Motor Show at Olympia. My interest lay in the Motor Boat section, in which I placed a tidy-sized order for a rakish-looking cruising craft which is now taking shape on the stocks at Southampton. My reason for placing this order was not so much an endeavour to help trade as to assist me in saving an honest ten shillings, for a legal friend whose hobby is delving into old statutes tells me that many things, such as shooting without a licence—illegal on terra firma—are permissible below high-water mark. Another of these things, so he alleges, is the possession of an unlicensed wireless set. Although, therefore, I have to take out a separate licence for my car radio, I do not have to do so in the case of a boat, and so, by placing my order I earn a clear ten shillings, for does not the old proverb tell us that "a penny saved is a penny earned?"

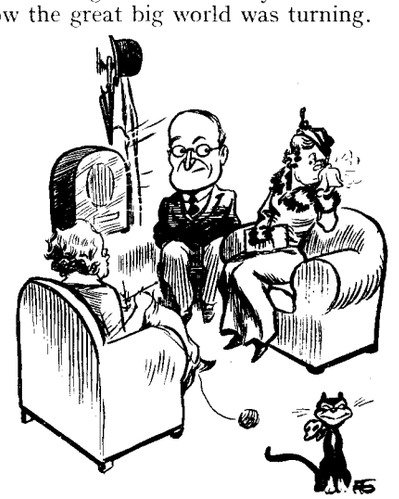
I have, however, been somewhat disconcerted by another friend who has pointed out to me that I shall never be able to make use of the floating-dock at Southampton when desirous of having the bottom of my craft scraped and painted, as this would automatically bring me above high-water mark and so within the jurisdiction of the Postmaster-General who would undoubtedly have one or more of his myrmidons lying in wait there ready to pounce.

If my friend's opinion is correct I shall be compelled to fall back upon the old-fashioned dry-dock, but I should be very grateful if any members of the legal profession among my readers would give me his views on the subject.

Infectious

I HAVE from time to time been compelled to express the opinion in somewhat forcible terms that the intelligence of womankind leaves room for improvement. In response to several indignant letters from philogynists I have been making valiant efforts during the past few weeks "to see the silver lining," but all the little progress that I had made has been brought crashing to the ground by a further incident which has occurred to confirm me in my own original opinions.

I happened to be sitting in slippered ease before my fire, feebly endeavouring to put up with the B.B.C. programme, owing to the fact that the "on-off" switch of my set had become seized-up in the "on" position. Without warning, Mrs. Free Grid arrived home accompanied by a particularly obnoxious specimen of homo sapiens in the form of a vinegary spinster who runs one of the new-style kindergartens where they endeavour to impart knowledge to children by studying the complexes (or is it complices?) of their alter ego instead of driving it in with a slipper as they did in my young days. Naturally all thoughts of further listening to the B.B.C. programme went by the board, and I was just thinking of retiring when the second news bulletin commenced and I thought I would tarry awhile to see how the great big world was turning.



She thought it disgraceful.

I casually noticed that the voice of the announcer was rather thick, as though he had a slight cold in the head, but I was completely knocked back with astonishment when Mrs. Free Grid's repellant acquaintance promptly moved her chair away from the loud speaker and took from her bag a disinfectant-soaked handkerchief which she applied to her mouth, at the same time remarking somewhat acidly that she thought it disgraceful the way in which the B.B.C. allowed their announcers to spread infection among millions of listeners. She, for one, never failed to take with her a disinfected handkerchief when visiting friends' houses, as

By
FREE GRID

she found that so many people hadn't the common sense to switch off when it was obvious that an announcer was suffering from a cold, this last shaft being, I suppose, intended for me.

Well, well, we live and learn.

Political Trivialities

NOW that we are all to be plunged into the hurly-burly of a General Election I shall have little time to spare during the next few weeks, since I shall be busy visiting the various party meetings in order to heckle the candidates concerning their reactions to radio.

It is, I consider, a crying shame that candidates of all political complexions endeavour to conceal the real issues of the election behind a barrage of petty trivialities such as the international situation and the question of the national finances. Not a word is heard regarding legislation to enforce radio manufacturers to pay the carriage both ways on their "carton" models, to which I have so often referred in this journal, and in addition, listeners are still compelled to defray the cost of their own wireless licences; absolutely nothing is being done to remedy this deplorable state of affairs.

And now, to add insult to injury, many manufacturers are restricting the period during which carton models may be exchanged to a beggarly ninety days; the result is that we are compelled to rush feverishly through this stately old ritual and so cause it to lose most of its old-world dignity.

I have received many letters urging me to put up personally for election in order to represent readers of *The Wireless World*, and were it not for the fact that Downing Street is a badly screened area, very unsuitable for wireless reception, I would do so like a shot. Even this would not deter me, but the thought of losing £150 certainly does stick in my gullet.

Burndept All-Wave

A "Straight" Set with a Fine All-round Performance

FEATURES.—*Type.*—*Table model "straight" receiver for long, medium and short waves. Universal AC/DC mains operated.* ***Circuit.*—***Var.-mu pentode HF amplifier—pentode grid detector with reaction—pentode output valve. Half-wave valve rectifier and barretter current regulator.* ***Controls.*—***(1) Tuning. (2) Volume and on-off switch. (3) Reaction. (4) Waverange.* ***Price.*—***10 guineas.* ***Makers.*—***Burndept Ltd.*

THIS receiver is universal in every sense of the term. Not only may it be plugged into any mains supply between 180 and 250 volts without any adjustment, but it can be used to explore the fascinating region from approximately 50 down to 17 metres, in addition to the long and medium waveranges.

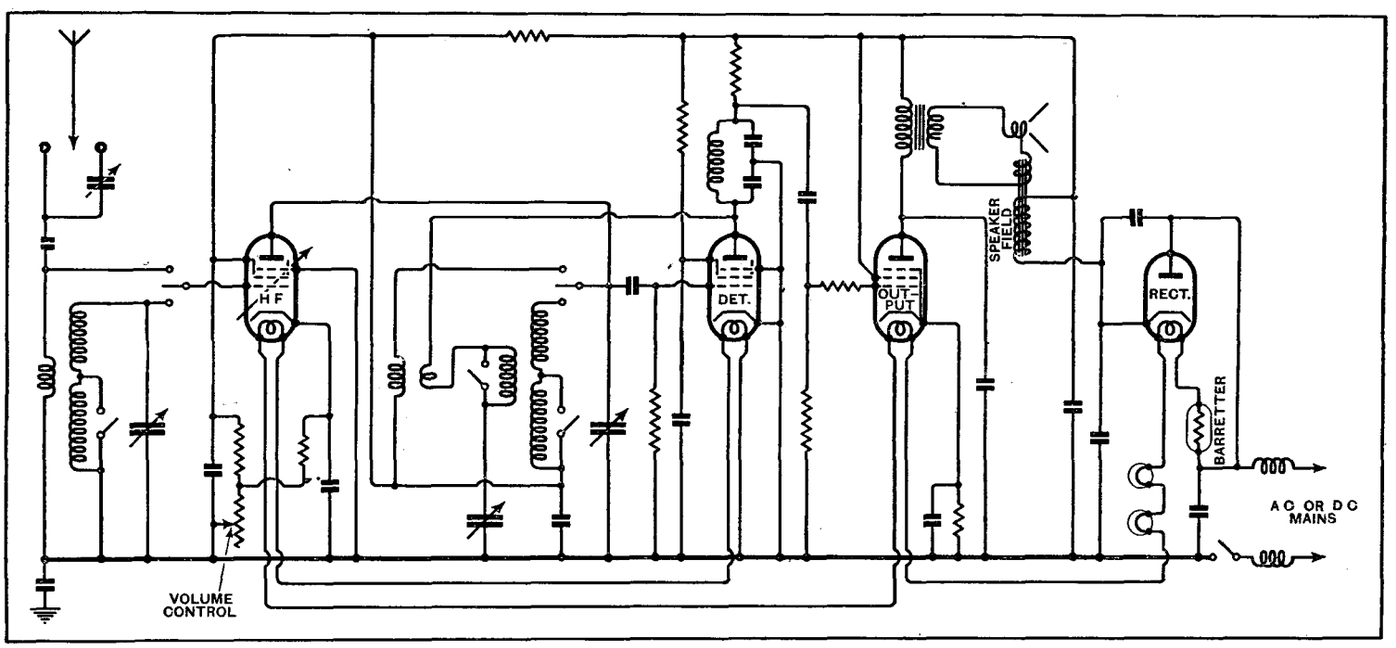
The three-valve straight circuit which has been adopted is admirably suited to this purpose and enables a high standard of performance to be obtained at a very reasonable cost. Pentode valves are used throughout and the HF amplifier is of the variable-mu type, in which volume is controlled by simultaneous variation of the grid bias and screened potential. A single tuned circuit is used in the input circuit, and the aerial is coupled to it through series condensers, one of which is adjustable.

On the short waves an HF choke is substituted for the tuned circuit. Simple tuned anode coupling is employed between the HF and detector stages and two separate reaction windings are used, one for the medium and long waves and the other for short waves only. Both the HF and detector valves are adequately decoupled, and an efficient HF filter prevents stray leakage through the resistance-capacity coupling to the output valve.

The moving coil loud speaker is fitted with a hum-bucking coil, and the field is used for smoothing. Incidentally, the dry electrolytic smoothing condensers are of unusually large capacity and are mounted outside the main chassis and near the loud speaker itself. An indirectly heated half-wave rectifier is used and filter coils are included in both mains leads. A barretter lamp regulates the filament heater current and obviates the necessity for preliminary mains voltage adjustment.

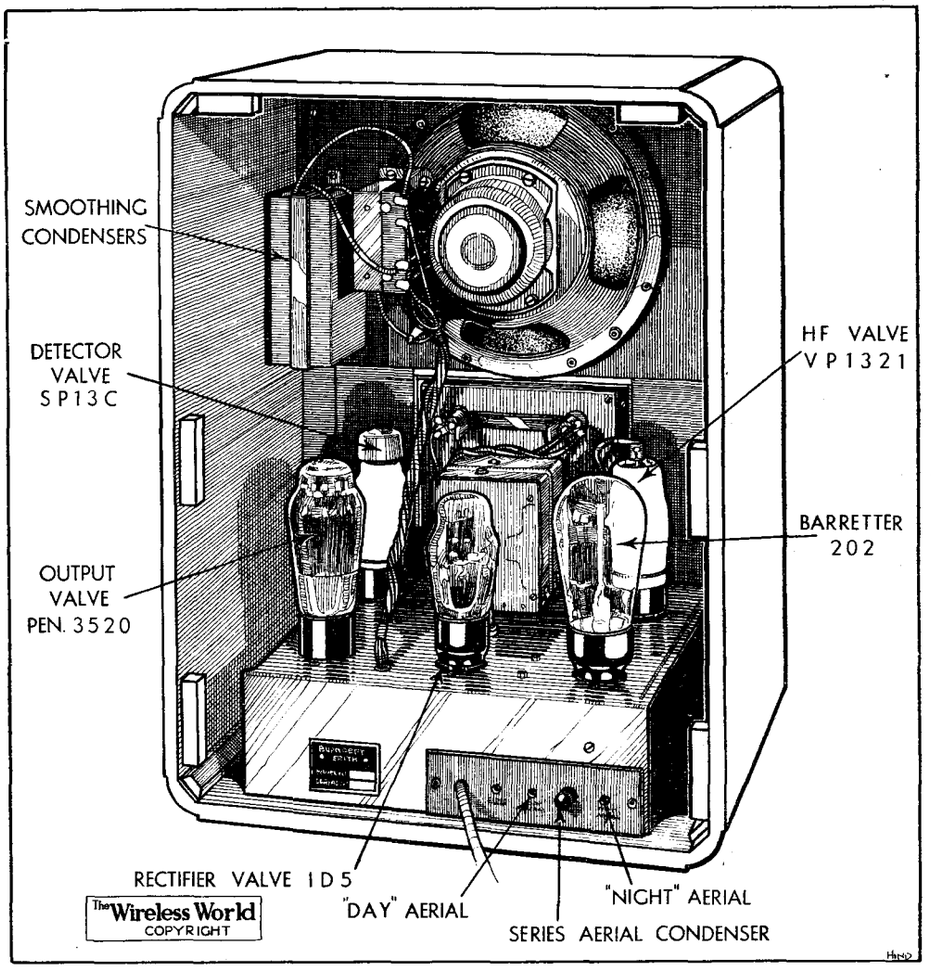
The set is fitted with a lucid tuning scale on each range of which the wavelength calibrations are coloured to correspond with coloured markings on the waverange switch. Another interesting point is the method of designating the alternative aerial sockets at the back of the set. One is termed the "Day" aerial and gives maximum range and moderate selectivity, and the other the "Night" aerial for increased selectivity at the expense of some reduction in sensitivity. This can be easily afforded as the difference between the day and night signal strength of the majority of stations exceeds the difference in sensitivity between the two positions of the aerial connection.

The set takes rather longer to warm up than the majority of receivers designed for AC mains only, and half a minute or more should be allowed for this process. Before one has covered more than a few degrees



Complete circuit diagram. The aerial coupling is aperiodic on short waves, and separate reaction windings are used for the normal broadcast wavebands and the short-wave range.

Mains Receiver + + +



The aerial coupling is adjustable by means of a small knob at the back of the chassis. Note the electrolytic condensers mounted near the loud speaker field, which acts as the HT smoothing choke.

of the dial it will be apparent that this is a set with an extraordinarily high signal-to-noise ratio. One might almost say that the performance is that of a set fitted with QAVC, for with the normal average setting of the volume control stations appear at full volume and clarity from an absolutely silent background. Even with the control at maximum, which is seldom required, except for long-distance reception on the short-wave band, background hiss is considerably less than that of the average small superheterodyne.

Range and Selectivity

If under daylight conditions the Burndept set must concede something to the superheterodyne in the matter of range there is no practical difference between the two types after dark as far as the number of stations available is concerned. It is only to be expected that the selectivity does not quite reach superheterodyne standard, but with careful handling it does not fall very far short. Using the "Night" aerial and with careful manipulation of the volume and reaction controls the Brookmans Park transmitters could be dropped outside a fringe of two to three channels wide on either side of their normal setting when using the set in Central London. On long waves Radio-Paris and Droitwich could be comfortably separated. Some break-through of the local medium-wave stations at the bottom of the long-wave range was noticeable, but was not sufficient to cause any serious trouble when listening to, say, the aircraft telephony transmissions on 900 metres.

The short-wave performance is exceptionally lively, and if at first a slightly higher reduction ratio seems desirable towards the bottom end of the scale a little experience with the set soon enables one to master the knack of precise tuning. At all events, this is a fault which is much preferable to the more prevalent one of backlash in the drive, which in this set is entirely absent.

In the set tested two oscillation points were to be found on increasing reaction progressively from zero on the short-wave band. The "plop" indicating the commencement of the first oscillation is much fainter than that associated with the second. It is on the threshold of this first oscillation that the best results are obtained Having elucidated this point no difficulty was found in tuning-in American short-wave broadcasting and W8XK on 19.72 metres was found to provide a programme of B.B.C. reliability during the period of the test.

The reproduction is of that satisfying quality which combines a full body of tone with a bright high-note response and at the same time errs neither on the side of woolliness nor harshness. Perhaps the best compliment that we can pay to the quality of reproduction is to say that at no time throughout the tests was there any incentive to look for the tone control, and that it was not until a list of the controls was being prepared that its absence was noted.

This is undoubtedly the set for a family with widely divergent wireless interests, for it caters well for every need from good quality reception of the local station to the collection of a comprehensive bag of distant short-wave transmissions. Further, the price is much below what one would expect to have to pay for such versatility.

Next Set Review:—
PHILIPS 575A

THE RADIO INDUSTRY

A NEW firm, The Wondergram Co., Ltd., of 45, Ropergate Street, Pontefract, has been formed for the purpose of producing a novel automatic record-changer embodying a device for reversing records and thus playing them in their proper sequence. The apparatus, which will deal with nineteen records (thirty-eight selections), is to be sold at a cost within the reach of the general public and is first to be produced as a separate unit or "playing desk" for use with an ordinary set.

Triotron SG valves, types S207 and S208, are now being superseded by improved counterparts —S215, a screen grid valve, and S213, a variable-mu SG valve. The new valves have steeper slopes and lower anode-grid capacities than those they replace. Both are of the 2-volt battery type fitted with 4-pin bases.

The business of Fox Industrial, Ltd., has been acquired by McCarthy Radio, 44a, Westbourne Grove, Bayswater, W.2, who will continue to manufacture similar receivers and amplifiers, and will also deal with the servicing of apparatus formerly produced by Fox Industrial.

We have received from Fry's, Ltd., 24-25, King Street, Royal Mint Street, E.1, a leaflet describing pocket saws, which would appear to be extremely useful to the wireless amateur.

Short-wave converters of various types, both for battery and mains operation, are described in leaflets issued by Unit Radio, 347, City Road, London, E.C.1.

The development which has taken place in aircraft wireless has made it necessary for the Marconi Company to create a new organisation, known as the Marconi Aircraft Wireless Establishment, in which will be centred all activities concerning the development, design, and manufacture of all kinds of aircraft wireless apparatus. This establishment has just been opened at Wandle Road, Hackbridge, Surrey.

Listeners' Guide

Outstanding Broadcasts at H

HARLEM HALF-HOUR. Night life in New York's negro quarter will be portrayed in "The Little Show" at 10.20 on Wednesday (Nat.). The photo on the left was taken in a Harlem cabaret.

NIGHT FALLS . . .

WHY not a Crazy Week in British broadcasting?

The first welcome step in this direction is "Night Falls on 'Slow-on-the-Uptake,'" a revue which may place in their true perspective the recent broadcasts from "Somewhere in Hungary." Leslie and James Baily, the joint authors, are giving us the Grand Inaugural Programme of the Rustic Region, relayed by very long land lines and introduced by the Rustic Regional Director, Leonard Henry.

In addition to the Six Pep Sisters there will be numbers by the Slow-on-the-Uptake Gleemen and selections by the Town's silver-plated band. The wandering microphone will add glamour by actually penetrating, without a ticket, to the down platform of Slow-on-the-Uptake junction. Besides Leonard Henry, the inhabitants of Slow-on-the-Uptake may bear a striking family resemblance to Vivienne Chatterton, Dick Francis, Ernest Sefton, John Rorke, and Carleton Hobbs.

So let us listen to the enchanting sounds of night falling on this rustic neighbourhood at 8.30 on Monday (Nat.).

PADEREWSKI'S BIRTHDAY

PADEREWSKI'S seventy-fifth birthday on Wednesday, November 6th, is to be celebrated in the B.B.C. programmes with a recital by Clifford Curzon, who will play the famous Polish composer's Variations and Fugue in E flat minor, Opus 23 (Nat. 7.30). Paderewski was a pupil at the Warsaw Conservatoire in his boyhood days, and then, from his nineteenth to his twenty-second year, was one of its professors of the pianoforte. He is one of the rare masters of music who have distinguished themselves in other fields; his great work of setting the Polish Republic on its feet will go down in history.

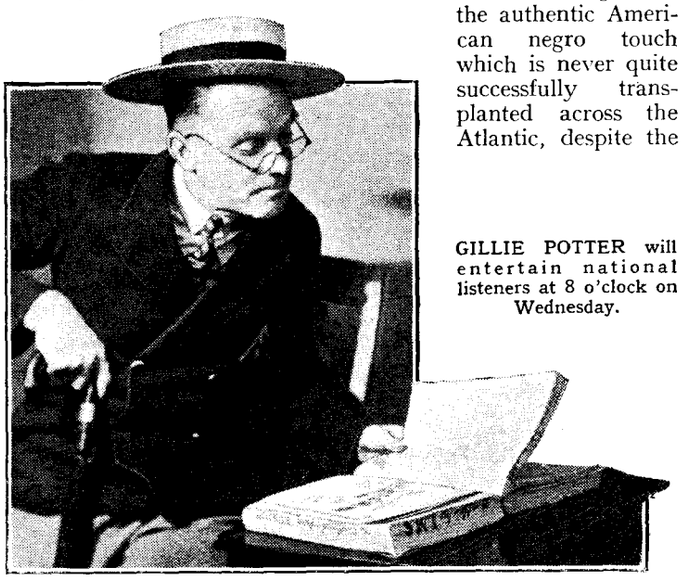
Unfortunately, Paderewski continues to disappoint millions of listeners, for it is more than ten years since he broadcast. This was at Savoy Hill on March 15th, 1925. Recently it was proposed that a Paderewski recital should be relayed from Switzerland to the United States, but the event was indefinitely postponed.

"BORIS GODUNOV"

ONE of the most curious episodes in the history of Russia in the seventeenth century is brought to the stage in Mussorgsky's opera, "Boris Godunov," of which the Prologue and Scenes 1 and 2 will be relayed from Sadler's Wells on Thursday evening in the Regional programme (7.45).

Boris Godunov, one of the most popular nobles under Ivan the Terrible, has caused the assassination of Dmitri, brother of the Emperor and his only heir. Boris achieves supreme power in Russia through the marriage of his daughter with Feodor, the weak-minded son of Ivan, through whom he virtually rules until trouble is brought about by the appearance of a pretender to the throne who claims to be the murdered Dmitri.

Scene 1 takes place in the courtyard of the Monastery of Novodievichy, Moscow, where the crowd is appealing to Boris for his protection. Scene 2 brings us to the Coronation of Boris in the courtyard of the Kremlin, and, as can be imagined, the composer has made full use of his opportunities in portraying the stately procession.



GILLIE POTTER will entertain national listeners at 8 o'clock on Wednesday.

POISONED BY ARSENIC

MADELEINE SMITH was accused of poisoning her French lover, Pierre L'Angelier, with arsenic. This happened in 1857, and the nine days' trial which followed created an enormous stir in the British Press and even on the Continent.

A radio report—a ninety-minute condensation by John Gough of the verbatim speeches with a few cuttings from contemporary papers—will be broadcast on November 4th (Reg., 8) and Tuesday, November 5th (Nat., 8).

The narrator will be William Crichton; the Lord Advocate, John Stewart; the Chief of Faculty, Douglas Allen; and Madeleine Smith, Mary Sutherland.

NIGHT IN HARLEM

THE late night cabaret broadcasts which are being featured under the title "Little Show" are filling a distinct need, especially with busy people who have no time to listen until after 10 in the evening.

Next Wednesday the "Little Show" deserts the West End of London in favour of the negro quarter of New York. We are to have a Harlem Half-Hour—described as a "show of sentiment and sophistication"—which should give us the authentic American negro touch which is never quite successfully transplanted across the Atlantic, despite the glut of coloured shows which are met with all over Europe.

PETER DAWSON

IT seems a long time since Peter Dawson was heard on the ether. On Tuesday next the ever-popular baritone will have an hour to himself with the B.B.C. Theatre Orchestra in a Celebrity Concert of favourite songs and ballads. (Reg., 8.15.)

for the Week

ome and Abroad

HIGHLIGHTS OF THE WEEK

FRIDAY, NOVEMBER 1st.
Nat., 8.30, "It Seems Only Yesterday." 10, "I Knew a Man—'Mrs. Pankhurst'," by Thelma Cazalet. 10.30, B.B.C. Contemporary Music Concert.
Reg., 7.30, Variety of Music. 9.30, Arthur Young and his Youngsters.
Abroad.
Radio-Paris, 8.45, "The Flying Dutchman" (Wagner).

SATURDAY, NOVEMBER 2nd.
Nat., 8.30, "Music Hall." ¶B.B.C. Military Band. ¶Ambrose and his Embassy Club Orchestra.
Reg., Fred Hartley and his Novelty Quintet. ¶Recital for two pianos: Edna Hatzfeld and Mark Strong.
Abroad.
Hamburg, 7.10, "An International Menu—Italian, Russian, Swedish, German, Hungarian and Austrian."

SUNDAY, NOVEMBER 3rd.
Nat., Troise and his Mandoliers. ¶Luton Prize Band. 9, B.B.C. Military Band.
Reg., Bratza (violin) with B.B.C. Orchestra. 6.45, London Palladium Orchestra. ¶Sunday Orchestral Concert, conducted by Sir Henry J. Wood.
Abroad.
Berlin (Funkstunde) 7, "Oberon" (Weber) from the State Opera.

MONDAY, NOVEMBER 4th.
Nat., "Night Falls on 'Slow-on-the-Uptake.'" ¶B.B.C. Orchestral Concert.
Reg., 8, The Trial of Madeleine Smith. ¶Eddie Pola in "The Nut Club."
Abroad.
Brussels I, 8, Lyric Drama: "Yannick" (de Taeye) from the Theatre Royal, Ghent.

TUESDAY, NOVEMBER 5th.
Nat., 8, The Trial of Madeleine Smith. ¶Walford Hyden Magyar Orchestra.
Reg., B.B.C. Dance Orchestra. 8.15, Peter Dawson and the B.B.C. Theatre Orchestra.
Abroad.
Berlin (Funkstunde) Richard Strauss conducts his Symphony in F minor.

WEDNESDAY, NOVEMBER 6th.
Nat., Paderewski Recital by Clifford Curzon (piano). 8.30, B.B.C. Symphony Concert conducted by Sir Hamilton Harty. ¶"The Little Show"
Reg., The Vario Trio. 8.45, "The Countess Maritza" (Kalman)
Abroad.
Kalundborg, 8 p.m.—1 a.m. Radio Ball by Copenhagen Dance Bands.

THURSDAY, NOVEMBER 7th.
Nat., 8, Meet Mickey Mouse No. 4—A Whoopee Party. ¶Boyd Neel String Orchestra.
Reg., B.B.C. Dance Orchestra. 7.45, "Boris Godunov" relayed from Sadler's Wells. ¶Alfredo Campoli and his Orchestra.
Abroad.
Brussels I, 8, Mozart Concert.

BRITISH MUSIC ABROAD

BRITISH music will be heard on Continental wavelengths tonight and to-morrow. At 6 this evening the Breslau gramophone programme of European bands playing their own national music includes the B.B.C. Military Band in Elgar's "Pomp and Circumstance" and Vaughan Williams' "Wasps" Overture. Saturday brings English sea shanties from Cologne at 5.

PADEREWSKI'S 75th birthday will be celebrated on November 6th by a recital of his works by Clifford Curzon (Nat 7.30). This photograph was taken when Paderewski broadcast from Savoy Hill in 1925.

THREE GUITARS

THERE are some curiosities in chamber music on Sunday. At 2.40 Vienna offers trios written for the guitar, the artists being the Vienna Guitar Chamber Music Trio. Twenty minutes later English listeners will be interested in the programme of the Trio Vocal Belge broadcasting from Brussels No. 2; they are giving a special version of "Three Blind Mice" and other nursery rhymes arranged for three voices and piano.

At 7 p.m. Kalundborg broadcasts Spohr's Duet in E flat for two violins.

SUBSTITUTES FOR JAZZ

ALL the world is watching Germany's effort to find substitutes for the State-banned jazz. At 10 p.m. on Wednesday the Deutschlandsender and Stuttgart will broadcast new German dance music played by Adalbert Lutter. This composer has been specially commissioned by the Deutschlandsender to provide tunes which not only exorcise the hated jazz but introduce some quite new orchestration effects. The programme should be well worth listening to if only for its novelty interest.

OPERA ABROAD

TO-NIGHT is a great occasion for Wagner lovers. Beginning at 4.55, Vienna offers a relay from the State Opera House of "Parsifal"—an opera which could only be generally performed on the expiry of the European copyright in 1913. Wagner's stipulation was that public performances of this opera should be given only in the special setting of the Festspielhaus, Bayreuth. The sacred trend of this Festival Drama has doubtless influenced the choice of All Saints' Day for its State Opera performance.

Another treat for Wagnerites will be the broadcast of "The Flying Dutchman" from Radio-Paris at 8.45 to-night (Friday).

A feature of the Rome broadcast this evening of "Madame Sans-Gêne" (Giordano) will be the personal appearance of the composer, who conducts.

Sunday's operatic highlight is a Berlin State Opera performance of Weber's "Oberon," to be relayed by the Funkstunde transmitter at 7. On Thursday, November 7th, Strasbourg will broadcast lengthy excerpts at 8.30 from Mozart's "Figaro," interpreted by the Station Orchestra, Choir and Soloists.

FRAU WINIFRED WAGNER, daughter-in-law of Richard Wagner, in the composer's study at Bayreuth. The painting is of Cosima Wagner, his wife. There are two Wagner broadcasts to-night: "Parsifal" from Vienna and "The Flying Dutchman" from Radio Paris.

ALL SAINTS' DAY

TO-DAY is All Saints' Day, and accordingly sacred music is prominent in the Continental transmissions. A typical programme of this kind will come from Beromunster at 8.10; Brussels No. 1, 6.30 and 9 p.m.; and Hilversum, 7.45 p.m.

Radio-Paris to-morrow (All Souls' Day) will give a special concert by the Raugel Choir, conducted by M. Bigot.

RICHARD STRAUSS

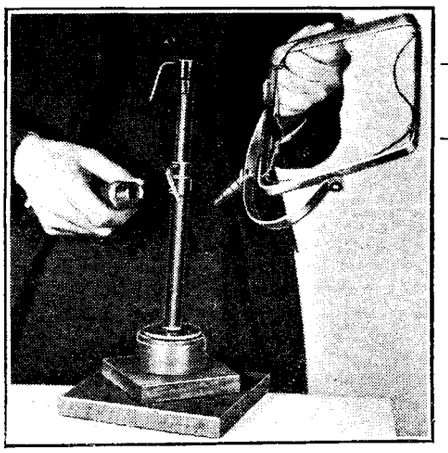
RICHARD STRAUSS, the famous composer, will himself conduct a memorable concert which is being relayed to all German stations at 9.15 on Tuesday. This is the first of a series of concerts extending over two years which will acquaint listeners with all the more outstanding works of the composer.

RADIO SONG CONTEST

FOR listeners who can tune in Copenhagen at 3.45 on Wednesday afternoon there is a broadcast linking up two festivals at Copenhagen and Oslo respectively. Boy choirs will sing in an international song contest. THE AUDITOR.

New Apparatus Reviewed

Recent Products of the Manufacturers



Hinderlich combined table, floor and hand-type microphone stand.

MICROPHONE STAND

READERS who have constructed *The Wireless World* transverse-current microphone, or have one of similar pattern, may be interested to learn that a microphone stand is now obtainable from A. Hinderlich. The specimen submitted for examination combines the function of table, floor or hand support, and is quickly adapted for each of these three functions.

The microphone is suspended by a rubber cord in a brass cradle fitted in a "U"-shaped frame; one is rotatable about a horizontal axis and the other about a vertical axis, so that the microphone can be set at any angle or pointed to any part of the room.

When used as a table model this assemblage is fitted into the smaller of two short enamelled-iron tubes which slide one within the other, the adjustment allowed for height being from 17in. to 22in.

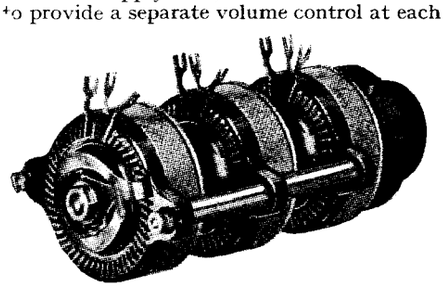
This telescopic stand can be replaced by two longer rods when a floor-type stand is required; these allow the microphone to be set at any height from the ground between 42in. and 72in., the same clamping fittings being used for both arrangements.

Alternatively, the cradle and frame can be fitted with a wooden handle for use as a hand-type instrument.

It is a most useful combination stand and costs 12s. 6d. complete. As a table model only the price is 7s. 6d., and as a floor model only 10s. Brass tubes for the floor model cost 2s. 6d. extra.

KABI GANGED POTENTIOMETER

IN public address work, or whenever several loud speakers, and sometimes headphones as well, are operated from a common supply line, it is often advisable to provide a separate volume control at each point, and the design of this should be such that it gives the desired control without upsetting the impedance of the line.



Kabi triple-gang potentiometer with insulated spindle.

Potentiometers and resistances suitable for this purpose and assembled as ganged units are included in the Kabi range of components distributed by F. W. Lechner and Co., Ltd., one specimen of which sent in for examination consists of three five-watt Kabi Midget Potentiometers built up in the form of a single unit, but with each separate component isolated electrically from the other.

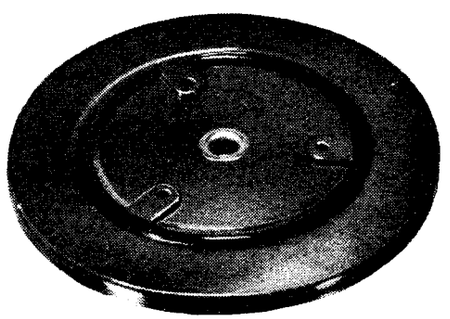
Each potentiometer in this assembly is 500 ohms, but any combination can be supplied. These units are particularly neat, strongly made, and in every respect well suited for this purpose.

The moving fingers do not contact direct with the resistance elements, which are wire-wound, but with small brass studs so that the resistance varies in steps, but since there are fifty contact studs the variation is made in relatively small increments. The action is smooth, and they are electrically silent.

The model illustrated here costs £2 5s.

RELIANCE TURNTABLE

THIS accessory has been introduced by the Reliance Manufacturing Co., Ltd., for fitting to portable and transportable receivers that embody a frame aerial and therefore require to be orientated to obtain the best results, since aerials of this pattern possess directional properties It is a ball-bearing turntable containing no fewer than four dozen steel balls, and the fixed and movable parts are made of bakelite.



Reliance ball-bearing turntable made of bakelite.

This material is tough and should wear well; furthermore, it has the distinct advantage of being electrically silent in use. Three screws only are required for fixing it in position.

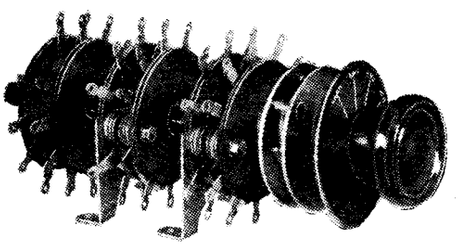
The sample sent for test measures 4⅜in. in diameter, and is ⅜in. deep. It rotates smoothly with heavy or light loads, and there is no screening effect on the frame aerial as the only metal used consists of the steel balls and a centre brass rivet; furthermore, it is a good insulator.

This turntable costs 2s. 3d., and it is available in black or walnut bakelite.

BULGIN FIVE-WAY MULTI SWITCH

ONE of the most useful features of the new Bulgin five-way switch is that any number of sections can so easily be arranged as a ganged assembly operated by a single knob. The switch is designed primarily for use in all-wave receivers, the first four positions being used for wave-band switching, two for short, one for medium, and one for the long-wave bands, while the fifth position can be employed as a radio-gramophone switch.

The assembly comprises a drive and position locator unit to which is fixed the driving shaft consisting of a ¼in. square rod. Locator units with 6in., 9in., or 12in. long rods are available. On this rod is assembled the switch contact units. Each section carries twenty contacts arranged in two sets of ten on thin bakelite discs, and opposite pairs on each disc are joined by the moving fingers. Thus each unit is a double-pole five-way switch which can be employed to select the coils required for each of the wavebands, primary and secondary, or grid and reaction, or grid and aerial windings as the case may be. One unit suffices for each two-winding coil in the set.



Bulgin five-way multi switch showing two units with brackets and one without, assembled on a 6-in. shaft.

The contacts are silver-plated, and the moving fingers have a well-defined wiping and self-cleaning action, the surface of the fixed contacts being bright and perfectly clean where the fingers pass over them.

Each switch unit has a mounting bracket for holding it rigidly in place. The units can be slid along the rod to bring them as close as possible to their respective coils, an important feature since it ensures short leads to the switches.

The drive unit costs 2s. 9d. with a 6in. shaft, 3s. with one of 9in., and 3s. 3d. with a 12in. The price of the two-pole switch-contact-unit is 2s. 6d. without and 2s. 9d. with bracket. It is a very neat well-designed, and one of the best British-made switches for its price we have tested.

Cossor Extension Speaker

THIS cabinet instrument, which has just been introduced and is known as Model 595, is of the permanent-magnet type and is fitted with a four-range output transformer offering impedances of 3,000, 8,000, 12,000, and 20,000 ohms. It is, therefore, suitable for all current types of output stages.

The cabinet is finished in walnut with a bakelite escutcheon, and the overall dimensions are 13in. by 12¼in. by 7¼in. The price is 39s. 6d.

Letters to the Editor

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

All Wave Sets

UNDER the title of "all wave sets" a number of radio receivers incorporating one or more short-wave bands have appeared on the market. I would like to suggest that, in order to protect the non-technical public, the British Radio Manufacturers' Association should forbid the use of this misnomer. As an alternative, receivers could be described as "three-wave band" or "four-wave band" receivers, etc.

The United States Federal Trade Commission has recently prohibited American radio manufacturers from using the term "all wave" in connection with radio receivers.

F. W. DEWHURST.

Huddersfield.

The Price of Quality

MR. J. S. THOMAS'S letter in your issue of September 13th raises the question of the cost of valve replacements in high fidelity receivers.

May I go further and say that the cost of high quality apparatus is still largely prohibitive to many potential users. Valves, coils, tuners, all types of transformers, etc., though not requiring replacement every year, nevertheless often become obsolete and require renewal if the apparatus is to be kept up to date.

This applies particularly to quality reproducers, and one wonders if the prices charged for these instruments are really justified, in spite of their excellent performances.

I feel certain that manufacturers of "high fidelity" apparatus would benefit themselves and their customers if they would endeavour to bring their goods more within the reach of a growing band of impecunious but "quality-minded" listeners.

London, N.21. F. R. HOWARD.

Battery Sets

THE letters you have published on high-powered battery sets have been very interesting. There appears to be misconception in England on this subject with regard to short-wave receivers for overseas, for all battery sets are cut down to the barest necessities: the low consumption of current is invariably stressed.

May I point out the mistake in this idea? In the first place, a large majority of people in the Colonies depend on wireless for their entertainment (with a gramophone, too, of course). Cinema shows are few and far between, theatres non-existent, musical recitals, too. Lacking these amenities we are very willing to spend more on our wireless sets than, say, the average person at home. In addition, there is a very large number of homes with their own electric lighting plants, usually 110-volt D.C. Reference to the manufacturers of such sets as to the number in use would probably produce a big surprise for wireless-set makers. Well, since we are willing to buy a good set, since economy in current does not interest us, for we have charging facilities, why will no one cater to our needs? Admittedly there is a demand for sets with few valves, low consumption, but I venture to say that that is not the demand of the majority. It would be enlightening, too, to get the export figures for high-tension accumulators, though it must be borne in mind that more accumulators of the wet type would be used if there were the sets requiring them.

May I give what I consider the requirements for a battery set that would be popular abroad?

(1) A set designed especially for short waves, with medium waves a secondary matter. No long waves.

(2) A highly selective, powerful set, with delayed AVC, necessarily a superheterodyne. Tuned HF valve, detector-oscillator of the VHT2 type. Two intermediate stages for selectivity and power, second detector, DDT type, followed by push-pull output. An extra valve after the second detector, RC coupled, would be an advantage. (In my own set I use three HF pentodes, with a VHT2 and an HD22: output QP21.) Too big a fetish should not be made of single-dial tuning. The aerial and HF stage can be ganged with a trimmer on the aerial condenser, the oscillator being separately tuned. Nor should "no coil changing" be too strongly stressed. After all, when one's sole means of entertainment is a wireless set, one is willing to go to a little trouble to get the last ounce from it. Single-dial tuning and a collection of switches do not permit of this.

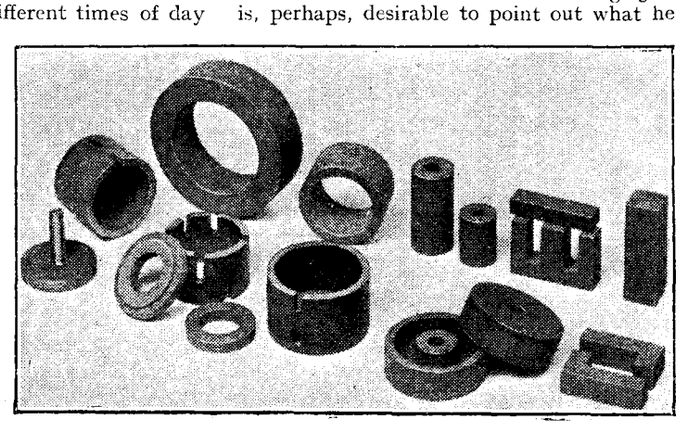
(3) The set should not be waistcoat-pocket size with a lot of unrecognisable components tucked away in awkward corners. Very many of us have to do our own repairs, so that a biggish set with all parts easily get-at-able, and plainly marked with their values (resistances, etc.), is desirable. Since the set will probably be used with HT accumulators with series parallel switch for working or charging, then a single HT+ lead is most desirable, too.

I am sorry to have gone to such lengths in my requirements, but I feel it necessary, as there is not a single set on the English market that comes anywhere near my specification. Yet American sets, which are so popular, run to a dozen or more valves, get results, sell well.

One thing I must stress, a point English set makers dismiss lightly: high selectivity. They appear to have no conception of the conditions abroad, where there are no commercial medium- or long-wave stations, where all work is confined to separate bands at different times of day and night, the same bands necessarily as those in which reliable broadcasting takes place.

F. H. JOHNSTON.

Assam.



IRON CORES.—This photograph, recently received from Germany, shows some of the many forms in which Ferrocart cores for HF coils are now being made.

A New Time Base

IN his article describing a two-valve time base circuit in the issue of October 4th, Mr. Desmond MacCarty has dismissed an important point very briefly, viz., the provision of an *isolated* HT supply.

When this supply is obtained by rectifying AC, mains interference with the deflection in the form of sweep velocity modulation will occur *via* the inter-winding capacity of the supply transformer unless special precautions are taken. The effect will be most marked at high sweep frequencies when C1 and C2 are small.

The cure is to provide double electrostatic screens on the transformer, the one next to the primary being connected to the gun and the other to the positive side of the smoothed rectified output. The capacity between screens is in parallel with C1. The heater winding for V1 can also cause trouble unless wound over an earthed screen.

Dept. of Elec. Engineering, University College, Nottingham. C. P. EDWARDS.

Output Valves

I AM obliged to Mr. J. H. Owen Harries for the additional and very informative data, in his letter appearing in your issue of October 4th, which he produces to supplement his original criticisms of my article of July 5th. I am only sorry that he could not give a more definite measure of how much more "objectionable" the distortion represented by Curve B (my Fig. 2, September 6th) is than the second harmonic distortion represented by Curve A. Unfortunately, there seems at the present to be no quantitative means of settling how far his statement in this respect is justified.

It seems to me that he glosses over this second harmonic rather too readily; and, in fact, introduces push-pull working to balance it out. I am in perfect agreement with him as to the merits of push-pull; but that is rather by the way.

I admit the point (though it did not come within the scope of my discussion) which Mr. Harries scores in favour of the Class A triode, that for rising load impedances the distortion decreases, whereas with other types of valve the distortion rises for both increase and decrease of impedance. This is of less importance now than it used to be when loud speaker impedance depended much more on frequency.

With reference to Mr. Harries's Fig. 3 it is, perhaps, desirable to point out what he

Letters to the Editor—

did not say, that this covers a substantially greater grid swing than the 21 volts maximum peak recommended, and the droops consequently look worse. And in making a comparison with the Class A triode one should understand that if the 6B5 were run at equal efficiency the grid swing, and consequently distortion, would be lower still.

In practice this is very important. For good quality reproduction the Class A triode must be kept strictly within bounds. If the output is allowed to exceed the rating even slightly, not only is there all the distortion that Mr. Harries imputes to other types of valves, but also the much more sudden and severe distortion due to grid current. Now the *mean* amplitude of most programmes is far lower than the peaks; consequently a triode stage must be run, on the average, at a very small fraction of its already poor efficiency. Unless power is provided on the most exceptionally lavish scale, one has these alternatives: miserable volume; or peak distortion far greater than that of the worst pentode run within its limits.

On the other hand, a valve such as Mr. Harries criticises can be run so that at mean volume the distortion is negligible and the efficiency better than that of the triode stage, and at the same time there is a far larger reserve of power available to take care of the peaks, without even then exceeding a moderate 4 or 5 per cent. of harmonics.

It appears, then, that Mr. Harries has proved his case for the Class A triode, as an academic standard of quality—one which can even be used, in exceptional cases where cost is no object. He, on the other hand, quite readily agrees that it is not necessarily the best to use in all circumstances.

Bromley, Kent. M. G. SCROGGIE.

Random Radiations

By "DIALLIST"

Education by Wireless

THE proposal that educational broadcasts as well as the heavier types of talk should have one wavelength reserved for them, instead of being broadcast sporadically in the midst of programmes otherwise devoted to light entertainment, raises the question of how far the B.B.C. is justified in making use of its broadcasting system for purposes that are directly educational. The Director General admitted some months ago that he was disappointed by the response of education authorities to the broadcasts for schools. From one point of view there is a good deal to be said for such broadcasts, for they provide almost the only means whereby children in primary and secondary schools can be brought into touch with men and women of outstanding eminence in their own lines. That the talks and lessons are carefully prepared and are quite excellent of their kind there can be little doubt; nor does one dispute the fact that they are of considerable value to those schools which make use of them.

On the other hand, the B.B.C.'s funds are provided entirely by those who take out receiving licences, and it is open to question whether a proportion of the fees paid should be diverted to purposes which are, after all, the concern of the Board of Education rather than of the B.B.C. [We would remind "Diallist" that the licence fee is for the use of a receiver and is not a subscription to the programmes.—ED.]

The Indirect Method

There are not a few people with whom I have chatted on this subject who hold the view that broadcasting in general is one of the finest potential educational means that we have, but that it should be used *indirectly* for increasing knowledge and improving taste. Their attitude, in other words, is that lessons, as such, should not be broadcast. Make your programmes interesting and attractive, they say; keep the standard high, and you will educate listeners without their realising what is happening to them. There's a good deal in this when you come to think it over. Broadcasting has unquestionably taught thousands upon thousands of people to appreciate good music, good plays and good English. It has, in fact, brought about a startling revolution in the nation's mentality during the few short years of its existence. The man in the street is *much* better informed than he was a dozen years ago; he knows more of what is going on in the world; his interests are wider and his conversation is a great deal more varied than it was in the pre-broadcasting era. This is mainly due to the influence of broadcasting, and if that isn't education on the grand scale I don't know what is!

Short-wave Oddities

TWO rather interesting phenomena are to be observed on the short waves at the present time. The first concerns wavelengths of the order of 10 metres. Some time ago the Radio Research Board reported an instance of reception at Slough of 10-metre transmissions from Buenos Aires. Since then long-distance reception on wavelengths round about 10 metres have been reported several times, particularly between this country and those lying to the west. So far as I know, wavelengths as short as 10 metres were not very much used, if indeed they were used at all, during the last periodic swing towards a sunspot maximum. The behaviour of waves of this length in the course of sunspot cycles is therefore coming under careful observation for the first time. Interesting results are likely, but it may be found that much shorter wavelengths achieve unexpected ranges as we approach the sunspot maximum.

The Longer Shorts

Some eleven years ago, when we were on our way towards the last sunspot maximum, it was noticeable that by far the best long-distance reception on the short waves was obtainable in the band between 60 and 80 metres. Old hands may remember the immense strength at which KDKA used to be received in this country. With the simplest of sets, consisting of a detector and two low-frequency valves—all of them triodes of types that we should consider pretty inefficient nowadays—reception at full loud speaker strength was possible night after night. Users of single-valve sets used regularly to hear KDKA, then using a wavelength of about 65 metres, with headphones.

If the optimum wavelength increases during the next two or three years, as it then did, one wonders if the Empire and Colonial broadcasting services of this and other countries will be reduced in efficiency. Daventry's greatest wavelength is 49.1 metres; Zeesen's 49.83, and Pittsburgh's 48.86.

'Ware Charging Dabblers

ACCUMULATOR charging is such a profitable business that it has naturally attracted the attention of not a few people who know nothing whatever about the process except what they learn from the book of words which accompanies the charging plant they purchase. In the past few months I have come across not a few cases of accumulators being ruined in double-quick time when handed to such people for treatment. Often the sufferer is the victim of his own kind-heartedness; wishing to help some small man who has taken on accumulator charging as a side line, he hands his batteries over to the beginner's tender mercies. It may work out all right; on the other hand, it may work out very much all wrong. Certainly it is wise before handing over batteries for charging to do what one can to make sure that the man to whom they are entrusted knows something about his business.

The Acid Touch

From more than one correspondent I have had reports about a particularly nefarious practice on the part of "shady" charging stations. This is to give batteries subjected to their care only part of the proper charge and then to top up the cells with sulphuric acid. Such accusations would not be too easy to prove, though it is quite possible that here and there the crime is committed. Though I have never tried it, I imagine that it would work quite well from the swindler's point of view by restoring the specific gravity of the electrolyte to the fully charged figure. Cells provided with indicators would then register a full charge, though actually they had had a very short ration. The effect of such a practice would, of course, be most pernicious, since it would lead to the rapid disintegration of the plates.

Perhaps the best way of assessing the treatment which your batteries receive from the charging station is to give the plates a careful examination before and afterwards, and every now and then to note carefully the hours of service that a battery gives for one charge under a measured load.

At the Transmitting End

Technical Criticisms of Recent Programmes

Continental Relays

The concert from Vienna (London Regional, October 22nd) was definitely not High-Fidelity and it seems questionable whether relays of this nature can be really appreciated unless the quality attains the same high standard as that of our own similar transmissions.

Distortion was particularly noticeable on high modulation and the sound output fluctuated considerably.

Effects

Although the Effects Department occasionally provide us with some ingenious noises the "thunder" in "Top Hat" (London Regional, October 18th) sounded very unconvincing.

There must be several more satisfying alternatives to a sheet of metal. H. C. H.

BROADCAST BREVITIES

BY OUR SPECIAL CORRESPONDENT

The Maida Vale Studios

SIR NOEL ASHBRIDGE'S pride as he gazed on one of his "crazy" studios at Maida Vale last week was tinged with modesty.

"These are not all our own ideas," he told me. "We have taken advantage of good, and rejected bad, practice now current on the Continent."

As an example the "Chief" pointed out the "zig-zagged" walls to break up standing waves. At Maida Vale these angular projections are solid; in Germany they are hollow, with the result that unpleasant diaphragm effects have been noticed.

Defying Convention

These new Maida Vale studios might well be the envy of the world. For the first time the B.B.C. has been unrestricted as regards studio space.

Two of the four new studios—Nos. 2 and 3—are for large orchestras, but whereas one has been "jazzed," as an engineer put it, the other is conventional in shape.

Sound Absorption

All four studios have walls treated with building board which appears to absorb 25 per cent. of the sound at each reflection. Nos. 4 and 5 are somewhat similar, but here again one of them, for experimental purposes, defies convention. It has non-parallel walls, and the visual effect is extraordinary. One gets the impression that something has gone wrong during the construction.

Building Within a Building

Each studio in this vast old skating rink forms an entirely separate structure. A wall of heavy brickwork, which is carried right up to the roof of the old building, is provided between each pair of studios as a screen to prevent transmission of sound from one studio to another through studio ceilings. Moreover, all parts of the studios are entirely free from contact with the main building.

The Recording Rooms

One could spend many interesting hours in the new recording rooms in which six Marconi-Stille machines can be kept in continuous operation, providing three channels.

I learnt that considerable improvement in background noise reduction in steel tape recording has been effected within the last few weeks; in fact, the engineers claim a reduction of about 10 decibels.

Disc Recording

There are also six disc recording machines at Maida Vale. An engineer recorded a few bars of an orchestral rehearsal which I was listening to on the loud speaker. After submitting the record to a hardening process—a matter of seconds with a chemically damped cloth—he played back the rehearsal. The quality was literally indistinguishable from the original.

"Safety First" in Music

APART from dance bands, the music one picks up in the average "O.B." leaves much to be wished for. I am not thinking of relays from Muck-in-the-Gutter and other rural retreats where the primitive strains of the local band add colour by their very imperfection, but of concerts relayed from theatres, music-halls, cinemas and restaurants.

Often balance and control are execrable, and the concerts, from a programme point of view, are stale and unprofitable through duplication and blind reliance on "safe" selections which are supposed to be public favourites.

Leslie Bridgewater's Appointment

It is good news, therefore, that Mr. Leslie Bridgewater, of "Quintet" fame, has joined the music staff of the B.B.C. to become technical expert in light music.

Since October 1st the Music Department has been responsible for the music side of all O.B.'s, and Mr. Bridgewater's task will be to superintend the flood of melody which fills odd gaps in the transmissions from 11 a.m. onwards.

Leslie Bridgewater has had a long experience in the world of the cinema, the theatre, recording, and broadcasting. Perhaps his main speciality is the composition of incidental music for West End plays.

CAROLINE VISCOUNTESS BRIDGEMAN, D.B.E., who has been appointed a Governor of the B.B.C. for the remaining term of the present charter. Mr. Harold Brown, a Governor, now becomes Vice-Chairman.

Spaced Aerials at Tatsfield

"DIVERSITY reception" is being employed at Tatsfield for picking up the weekly "Five Hours Back" programmes from America. Actually four receivers are used, with spaced aerials, and the short-wave transmitters usually chosen are W2XAL, Bound Brook, on 17,780 k/cs and W2XAD, Schenectady, on 15,330 k/cs, two receivers being tuned in to each station.

A curious effect has been noticed when an attempt is made to mix the outputs of the two pairs of receivers. There is a distinct echo which the Tatsfield engineers are inclined to attribute to the different length of the landlines connecting the American studio with the transmitters.

Rhombic

This diversity reception is the great topic of interest at Tatsfield these days. There is a feeling that, given plenty of scope for experiments, there is practically no transmission of any considerable power on the earth's surface which cannot be picked up, minus fading, by means of spaced aerials.

Two new aerials now going up specially for diversity reception tests are horizontal diamond-shaped. Or, as the engineers prefer it, of a rhombic formation.

Overheated Waves

CORNWALL has problems of its own in the reception of broadcast programmes, as is shown in this extract from a letter which the B.B.C. has received from the Delectable Duchy:—

> ". . . REGIONAL PROGRAMME TO-NIGHT WAS CHOKING ITSELF IT LOST BLANCE IN HER PROMENADE TONIGHT. ONING TO THE WEATHER THE WAVES GET OVERHEATED AND SO GET SPENT OUT BEFOR SET GET HOLE OF IT. SO YOU ONLY GET HIGH NONTS WITH LITTLE OR NO BLANCE. . . ."

Picturesque Language

THE traditional secretiveness of B.B.C. engineers must not be attributed to lack of the power of forceful and fitting expression. When a picturesque expression is called for the B.B.C. engineers can supply it.

Doors Stop Banging

Take a case in point. In the synchronised transmissions of London, North and West Nationals, sundry sharp shattering noises have been evident. Without twitching an ear, Sir Noel Ashbridge's department described these as "door bangs," and this very appropriate description has stuck. Not so the "door banging" itself, for the good news has come through that certain alterations in the drive equipment of the three transmitters is having the desired effect of reducing these unwelcome sounds, if not disposing of them entirely.

"Swopping" Aerials at Daventry

SINCE, six months ago, the G5SW short-wave transmitter at Chelmsford was transferred to Daventry it has been possible to carry out some valuable alternative aerial tests.

Keeping the old transmitter in steady operation, the engineers have run the two Empire transmitters on two separate channels in the same frequency band, "swopping" aerials without breaking the transmission.

Eager Empire Audience

The ensuing correspondence has revealed that, taken as a whole, the Empire audience is more technically enthusiastic than home listeners. Any change in signal strength, apparent modulation or studio technique is reported upon immediately, so the Empire post-bag is always eagerly awaited at Broadcasting House.

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Frequency and Wavelength

(This list is included in the first issue of each month. Stations with an aerial power of 50 kW. and above in heavy type)

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Kaunas (Lithuania)	155	.....	1935	7
Brazov (Romania)	160	.....	1875	150
Kootwijk (Holland) (*Relays Hilversum*)	160	.....	1875	100
Lahti (Finland)	166	.....	1807	40
Moscow, No. 1, RW1 (Komintern) (U.S.S.R.)	174	.....	1724	500
Paris (Radio Paris) (France)	182	.....	1648	80
Istanbul (Turkey)	187.5	.....	1600	5
Berlin (Deutschlandsender Zeesen) (Germany)	191	.....	1571	150
Droitwich	200	.....	1500	150
Minsk, RW10 (U.S.S.R.)	208	.....	1442	35
Reykjavik (Iceland)	208	.....	1442	16
Motala (Sweden). (*Relays Stockholm*)	216	.....	1389	150
Novosibirsk, RW76 (U.S.S.R.)	217.5	.....	1379	100
Warsaw, No. 1 (Raszyn) (Poland)	224	.....	1339	120
Luxembourg	230	.....	1304	150
Ankara (Turkey)	230	.....	1304	7
Kharkov, RW20 (U.S.S.R.)	232	.....	1293	20
Kalundborg (Denmark)	238	.....	1261	60
Leningrad, RW53 (Kolpino) (U.S.S.R.)	245	.....	1224	100
Tashkent, RW11 (U.S.S.R.)	256.4	.....	1170	25
Oslo (Norway)	260	.....	1153.8	60
Moscow, No. 2, RW49 (Stchelkovo) (U.S.S.R.)	271	.....	1107	100
Tiflis, RW7 (U.S.S.R.)	280	.....	1071.4	35
Finmark (Norway)	355	.....	845	10
Rostov-on-Don, RW12 (U.S.S.R.)	355	.....	845	20
Budapest, No. 2 (Hungary)	359.5	.....	834.5	20
Sverdlovsk, RW5 (U.S.S.R.)	375	.....	800	50
Geneva (Switzerland). (*Relays Sottens*)	401	.....	748	1.3
Moscow, No. 3 (RCZ) (U.S.S.R.)	401	.....	748	100
Voroneje, RW25 (U.S.S.R.)	413.5	.....	726	10
Oulu (Finland)	431	.....	696	1.2
Ufa, RW22 (U.S.S.R.)	436	.....	688	10
Hamar (Norway). (*Relays Oslo*)	519	.....	578	0.7
Innsbruck (Austria). (*Relays Vienna*)	519	.....	578	1
Ljubljana (Yugoslavia)	527	.....	569.3	5
Viipuri (Finland)	527	.....	569.3	10
Bolzano (Italy)	536	.....	559.7	1
Wilno (Poland)	536	.....	559.7	16
Budapest, No. 1 (Hungary)	546	.....	549.5	120
Beromünster (Switzerland)	556	.....	539.6	100
Athlone (Irish Free State)	565	.....	531	60
Palermo (Italy)	565	.....	531	4
Stuttgart (Mühlacker) (Germany)	574	.....	522.6	100
Grenoble, P.T.T. (France)	583	.....	514.6	15
Riga (Latvia)	583	.....	514.6	15
Vienna (Bisamberg) (Austria)	592	.....	506.8	100
Rabat (Radio Maroc) (Morocco)	601	.....	499.2	25
Sundsvall (Sweden). (*Relays Stockholm*)	601	.....	499.2	10
Florence (Italy). (*Relays Milan*)	610	.....	491.8	20
Cairo (Abu Zabal) (Egypt)	620	.....	483.9	20
Brussels, No. 1 (Belgium). (*French Programme*)	620	.....	483.9	15
Lisbon (Bacarena) (Portugal)	629	.....	476.9	20
Tröndelag (Norway)	629	.....	476.9	20
Prague, No. 1 (Czechoslovakia)	638	.....	470.2	120
Lyons, P.T.T. (La Doua Tramoyes) (France)	648	.....	463	100
Cologne (Langenberg) (Germany)	658	.....	455.9	100
North Regional (Slaithwaite)	668	.....	449.1	50
Sottens (Radio Suisse Romande) (Switzerland)	677	.....	443.1	25
Belgrade (Yugoslavia)	686	.....	437.3	2.5
Paris, P.T.T. (Palaiseau Villebon) (France)	695	.....	431.7	120
Stockholm (Sweden)	704	.....	426.1	55
Rome, No. 1 (Italy)	713	.....	420.8	50
Kiev, RW9 (U.S.S.R.)	722	.....	415.5	36
Tallinn (Esthonia)	731	.....	410.4	20
Madrid, EAJ2 (Radio España) (Spain)	731	.....	410.4	3
Seville (Spain)	731	.....	410.4	5.5
Munich (Germany)	740	.....	405.4	100
Marseilles, P.T.T. (Realtor) (France)	749	.....	400.5	90
Katowice (Poland)	758	.....	395.8	12
Scottish Regional (Falkirk)	767	.....	391.1	50
Toulouse, P.T.T. (Muret) (France)	776	.....	386.6	120
Leipzig (Germany)	785	.....	382.2	120
Barcelona, EAJ1 (Spain)	795	.....	377.4	7.5
Lwow (Poland)	795	.....	377.4	16
West Regional (Washford Cross)	804	.....	373.1	50
Milan (Italy)	814	.....	368.6	50
Bucharest (Romania)	823	.....	364.5	12
Moscow, No. 4, RW39 (Stalina) (U.S.S.R.)	832	.....	360.6	100
Berlin (Funkstunde Tegel) (Germany)	841	.....	356.7	100
Bergen (Norway)	850	.....	352.9	1
Sofia (Bulgaria)	850	.....	352.9	50
Valencia (Spain)	850	.....	352.9	3
Simferopol, RW52 (U.S.S.R.)	859	.....	349.2	10
Strasbourg, P.T.T. (France)	859	.....	349.2	100
Poznan (Poland)	868	.....	345.6	16
London Regional (Brookmans Park)	877	.....	342.1	50
Graz (Austria). (*Relays Vienna*)	886	.....	338.6	7
Helsinki (Finland)	895	.....	335.2	10
Hamburg (Germany)	904	.....	331.9	100
Toulouse (Radio Toulouse) (France)	913	.....	328.6	60
Brno (Czechoslovakia)	922	.....	325.4	32
Brussels, No. 2 (Belgium). (*Flemish Prog'mme*)	932	.....	321.9	15
Algiers, P.T.T. (Radio Alger) (Algeria)	941	.....	318.8	12
Göteborg (Sweden). (*Relays Stockholm*)	941	.....	318.8	10
Breslau (Germany)	950	.....	315.8	100
Paris (Poste Parisien) (France)	959	.....	312.8	60
Odessa (U.S.S.R.)	968	.....	309.9	10
Belfast	977	.....	307.1	1
Genoa (Italy). (*Relays Milan*)	986	.....	304.3	10
Torun (Poland)	986	.....	304.3	24
Hilversum (Holland). (15 *kW.* till 4.40 p.m.)	995	.....	301.5	60
Bratislava (Czechoslovakia)	1004	.....	298.8	13.5
Midland Regional (Droitwich)	1013	.....	296.2	50
Barcelona, EAJ15 (Radio Asociación) (Spain)	1022	.....	293.5	3
Cracow (Poland)	1022	.....	293.5	2
Heilsberg (Königsberg Ermland) (Germany)	1031	.....	291	100
Parede (Radio Club Português) (Portugal)	1031	.....	291	5
Leningrad, No. 2, RW70 (U.S.S.R.)	1040	.....	288.5	10
Rennes, P.T.T. (Thourie) (France)	1040	.....	288.5	120
Scottish National (Falkirk)	1050	.....	285.7	50
Bari (Italy)	1059	.....	283.3	20
Paris (Radio Cité) (France)	1068	.....	280.9	2
Tiraspol, RW57 (U.S.S.R.)	1068	.....	280.9	4
Bordeaux, P.T.T. (Lafayette) (France)	1077	.....	278.6	50
Zagreb (Yugoslavia)	1086	.....	276.2	0.7
Falun (Sweden)	1086	.....	276.2	2
Madrid, EAJ7 (Union Radio) (Spain)	1095	.....	274	10
Madona (Latvia)	1104	.....	271.7	50
Naples (Italy). (*Relays Rome*)	1104	.....	271.7	1.5
Moravska-Ostrava (Czechoslovakia)	1113	.....	269.5	11.2
Fécamp (Radio Normandie) (France)	1113	.....	269.5	10
Alexandria (Egypt)	1122	.....	267.4	0.25
Newcastle	1122	.....	267.4	1
Nyiregyhaza (Hungary)	1122	.....	267.4	6.2
Hörby (Sweden). (*Relays Stockholm*)	1131	.....	265.3	10
Turin, No. 1 (Italy). (*Relays Milan*)	1140	.....	263.2	7
London National (Brookmans Park)	1149	.....	261.1	20
North National (Slaithwaite)	1149	.....	261.1	20
West National (Washford Cross)	1149	.....	261.1	20
Kosice (Czechoslovakia). (*Relays Prague*)	1158	.....	259.1	2.6
Monte Ceneri (Switzerland)	1167	.....	257.1	15
Copenhagen (Denmark). (*Relays Kalundborg*)	1176	.....	255.1	10
Kharkov, No. 2, RW4 (U.S.S.R.)	1185	.....	253.2	10
Nice (La Brague) (France)	1185	.....	253.2	60
Frankfurt (Germany)	1195	.....	251	25
Prague, No. 2 (Czechoslovakia)	1204	.....	249.2	5
Lille, P.T.T. (Camphin) (France)	1213	.....	247.3	60
Trieste (Italy)	1222	.....	245.5	10
Gleiwitz (Germany). (*Relays Breslau*)	1231	.....	243.7	5
Cork (Irish Free State). (*Relays Athlone*)	1240	.....	241.9	1
Swedish Relay Stations	1240	.....	241.9	1
Juan-les-Pins (Radio Côte d'Azur) (France)	1249	.....	240.2	2
Kuldiga (Latvia)	1258	.....	238.5	10
Rome, No. 3 (Italy)	1258	.....	238.5	1
San Sebastian (Spain)	1258	.....	238.5	1
Nürnberg and Augsburg (Germany). (*Relays Munich.*)	1267	.....	236.8	2
Christiansand and Stavanger (Norway)	1276	.....	235.1	0.5
Dresden (Germany). (*Relays Leipzig*)	1285	.....	233.5	0.25
Aberdeen	1285	.....	233.5	1
Austrian Relay Stations	1294	.....	231.8	0.5
Danzig. (*Relays Königsberg*)	1303	.....	230.2	0.5
Swedish Relay Stations	1312	.....	228.7	1.25
Magyarovar (Hungary)	1321	.....	227.1	1.25
German Relay Stations	1330	.....	225.6	2
Montpellier, P.T.T. (France)	1339	.....	224	5
Lodz (Poland)	1339	.....	224	1.7
Dublin (Irish Free State). (*Relays Athlone*)	1348	.....	222.6	0.5
Milan, No. 2 (Italy). (*Relays Rome*)	1348	.....	222.6	4
Turin, No. 2 (Italy). (*Relays Rome*)	1357	.....	221.1	0.2
Basle and Berne (Switzerland)	1375	.....	218.2	0.5
Warsaw, No. 2 (Poland)	1384	.....	216.8	2
Lyons (Radio Lyons) (France)	1393	.....	215.4	25
Tampere (Finland)	1420	.....	211.3	0.7
Béziers (France)	1429	.....	209.9	1.5
Miskolc (Hungary)	1438	.....	208.6	1.25
Paris (Eiffel Tower) (France)	1456	.....	206	5
Pecs (Hungary)	1465	.....	204.8	1.25
Bournemouth	1474	.....	203.5	1
Plymouth	1474	.....	203.5	0.3
International Common Wave	1492	.....	201.1	0.2
International Common Wave	1500	.....	200	0.25
Liepàja (Latvia)	1737	.....	173	0.1

NOTE.—Since the publication of the previous list alterations have been made to the following stations: Moscow (U.S.S.R.), Finmark (Norway), Seville (Spain), Odessa (U.S.S.R.), Torun (Poland), Paris (Radio Cité) (France).

SHORT-WAVE STATIONS OF THE WORLD

Arranged in Order of Wavelength and Frequency

(N.B.—Times of Transmission given in parentheses are approximate only and represent G.M.T.)

Metres.	kc/s.	Call Sign.	Station.	Tuning Positions.
84.67	3,543	CR7AA	Mozambique (E. Africa). (*Mon., Thurs., Sat.*, 18.30 *to* 20.30.)	.....
75.0	4,000	CT2AJ	Ponta Delgada (Azores). (*Wed., Sat.*, 22.00 *to* 24.00.)	.....
70.2	4,273	RV15	Kharbarovsk (U.S.S.R.). (*Daily* 06.00 *to* 14.00.)	.....
67.11	4,470	YDB	Sourabaya (Java). (*Daily* 03.30 *to* 06.30)	.....
58.31	5,145	OK1MPT	Prague (Czechoslovakia). (*Experimental*)	.....
51.28	5,850	YV5RMO	Maracaibo (Venezuela). (*Daily*, 22.00 *to* 02.00.)	.....
50.60	5,930	HJ4ABE	Medellin (Colombia). (*Daily*, 16.30 *to* 18.30, *Sun., Tues., Thurs.*, 23.30 *to* 03.00 *also.*)	.....
50.26	5,969	HVJ	Vatican City. (*Daily* 19.00 *to* 19.15, *Sun.* 10.00 *also.*)	.....
50.16	5,980	HIX	Santa Domingo (W. Indies). (*Daily*, 12.00 *Sun.* 00.38 *also.*)	.....
50.0	6,000	RW59	Moscow (U.S.S.R.). (*Relays No.* 1 *Stn.*) (*Daily* 20.00 *to* 23.00.)	.....
49.96	6,005	VE9DN	Montreal (Canada). (*Daily* 04.30 *to* 05.00)	.....
49.96	6,005	HJ3ABH	Bogotà (Colombia)	.....
49.92	6,010	COCO	Havana (Cuba). (*Daily* 21.00 *to* 23.00, 01.00 *to* 03.00, *Sun.* 04.30 *to* 06.30 *also.*)	.....
49.85	6,018	ZHI	Singapore (Malaya). (*Mon., Wed., Thurs.* 23.00 *to* 01.30, *Sun.* 03.40 *to* 05.10.)	.....
49.83	6,020	DJC	Zeesen (Germany). (*Daily* 22.30 *to* 03.30, 17.00 *to* 21.30.)	.....
49.75	6,030	HP5B	Panama City (Central America). (*Daily* 17.00 *to* 18.00, 01.00 *to* 03.30.)	.....
49.75	6,030	VE9CA	Calgary (Canada). (*Thurs.* 14.00 *to* 07.00, *Sun.* 17.00 *to* 05.00.)	.....
49.67	6,040	W1XAL	Boston, Mass. (U.S.A.). (*Sun.* 22.00 *to* 24.00, *Wed., Fri.* 00.30 *to* 01.45.)	.....
49.67	6,040	PRA8	Pernambuco (Brazil). (*Daily* 20.00 *to* 00.30.)	.....
49.59	6,050	GSA	Empire Broadcasting	.....
49.5	6,060	W8XAL	Cincinnati, Ohio (U.S.A.). (*Daily* 12.00 *to* 01.00, 04.00 *to* 06.00.)	.....
49.5	6,060	W3XAU	Philadelphia, Pa. (U.S.A.). (*Relays WCAU.*) (*Daily* 01.00 *to* 04.00.)	.....
49.5	6,060	OXY	Skamlebaek (Denmark). (*Relays Kalundborg.*) (*Daily* 18.00 *to* 24.00, *Sun.* 16.00 *also.*)	.....
49.42	6,070	OER2	Vienna Experimental. (*Daily* 14.00 *to* 22.00.)	.....
49.4	6,072	CT1AA	Lisbon (Portugal). (*Tues., Thurs., Sat.* 21.30 *to* 24.00.)	.....
49.33	6,080	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCLF.*) (*Sun.* 19.00 *to* 20.30.)	.....
49.33	6,080	CP5	La Paz (Bolivia). (*Daily* 00.45 *to* 02.15)	.....
49.31	6,083	VQ7LO	Nairobi (Kenya Colony). (*Daily* 16.00 *to* 19.00, *Sat. to* 20.00, *Mon., Wed., Fri.* 10.45 *to* 11.15 *also, Tues.* 08.00 *to* 09.00 *also. Thurs.* 13.00 *to* 14.00 *also, Sun.* 17.45 to 19.00 *also.*)	.....
49.3	6,085	2RO	Rome (Italy). (*Mon., Wed., Fri.* 23.00 *to* 00.30.)	.....
49.26	6,090	VE9BJ	St. John (N.B.). (*Daily* 00.00 *to* 01.30)...	.....
49.26	6,090	VE9GW	Bowmanville, Ont. (Canada). (*Mon., Tues., Wed.* 20.00 *to* 05.00, *Thurs., Fri., Sat.* 12.00 *to* 05.00, *Sun.* 18.00 *to* 02.00.)	.....
49.2	6,097	ZTJ	Johannesburg (S. Africa). (*Daily ex. Sun.* 04.30 *to* 05.30, 08.30 *to* 12.00, 14.00 *to* 20.00 (*Sat. to* 21.45), *Sun.* 13.00 *to* 15.15, 17.30 *to* 20.00.)	.....
49.18	6,100	W3XAL	Bound Brook, N.Y. (U.S.A.). (*Relays WJZ.*) (*Mon., Wed., Sat.* 22.00 *to* 23.00, *Sat.* 05.00 *to* 06.00 *also.*)	.....
49.18	6,100	W9XF	Chicago, Ill. (U.S.A.). (*Daily ex. Mon., Wed., Sun.* 21.00 *to* 07.00.)	.....
49.1	6,110	GSL	Empire Broadcasting	.....
49.1	6,110	VUC	Calcutta (India). (*Daily* 07.06 *to* 08.06 *irregular* 13.06 *to* 16.36, *Sat. from* 12.36, *Sun.* 04.36 *to* 07.36, *irregular* 12.36 *to* 03.36.)	.....
49.08	6,112	YV2RC	Caracas (Venezuela). (*Daily ex. Sun.* 15.30 *to* 17.30, 21.00 *to* 03.00, *Sun.* 14.30 *to* 15.30.)	.....
49.02	6,120	YDA	Bandoeng (Java). (*Daily* 10.30 *to* 15.00)	.....
49.02	6,120	W2XE	Wayne, N.J. (U.S.A.). (*Relays WABC.*) (*Daily* 23.00 *to* 04.00.)	.....
48.92	6,130	ZGE	Kuala Lumpur (Malaya). (*Sun., Tues., Fri.* 11.40 *to* 13.40.)	.....
48.92	6,132	COCD	Havana (Cuba) (*Daily* 23.00 *to* 05.00.) ...	.....
48.86	6,140	W8XK	Pittsburg, Pa. (U.S.A.). (*Relays KDKA.*) (*Daily* 21.30 *to* 06.00.)	.....
48.78	6,150	CSL	Lisbon (Portugal). (*Daily* 11.00 *to* 12.30, 18.00 *to* 22.00.)	.....
48.78	6,150	YV3RC	Caracas (Venezuela). (*Daily* 20.30 *to* 01.30.)	.....
48.78	6,150	CJRO	Winnipeg (Canada). (*Daily* 00.00 *to* 05.00, *Sat.* 21.00 *to* 06.00 *also, Sun.* 22.00 *to* 03.30.)	.....
48.4	6,198	CT1GO	Parede (Portugal). (*Daily ex. Tues.* 00.20 *to* 01.30, *Sun.* 16.30 *to* 18.00 *also.*)	.....
47.50	6,316	HIZ	Santo Domingo (W. Indies). (*Daily* 21.40 *to* 22.40, *Sun.* 16.00 *to* 17.30 *also.*)	.....
47.05	6,375	YV4RC	Caracas (Venezuela). (*Daily* 21.30 *to* 03.30.)	.....
46.69	6,425	W3XL	Bound Brook, N.J. (U.S.A.). (*Experimental*)	.....
46.52	6,447	HJ1ABB	Barranquilla (Colombia). *Daily* 21.30 to 03.30.)	.....
46.21	6,490	HJ5ABD	Cali (Colombia). (*Daily* 00.00 *to* 03.00)...	.....
46.0	6,520	YV6RV	Valencia (Venezuela). (*Daily* 17.00 *to* 18.00, 23.00 *to* 03.00.)	.....
45.31	6,620	PRADO	Riobamba (Ecuador). (*Fri.* 02.00 *to* 03.40)	.....
45.0	6,667	HC2RL	Guayaquil (Ecuador). (*Sun.* 22.45 *to* 12.45, *Wed.* 02.15 *to* 04.15.)	.....
42.02	7,140	HJ4ABB	Manizales (Colombia)	.....
41.8	7,177	CR6AA	Lobito (Angola). (*Wed., Sat.* 19.30 *to* 21.30.)	.....
38.48	7,797	HBP	Radio Nations, Prangins (Switzerland). (*Sat.* 22.30 *to* 23.15.)	.....
37.33	8,035	CNR	Rabat (Morocco). (*Sun.* 20.00 *to* 22.30)...	.....
36.5	8 214	HCJB	Quito (Ecuador). (*Daily ex. Sun., Mon.* 00.45 *to* 04.45, *Sun.* 21.45 *to* 04.15.)	.....
34.29	8,750	ZCK	Hong Kong (China). (*Daily* 10.00 *to* 14.00.)	.....
32.83	9,134	HAT4	Budapest (Hungary). (*Sat.* 23.00 *to* 24.00)	.....
31.8	9,428	COCH	Havana (Cuba). (*Daily* 16.00 *to* 17.00, 22.00 *to* 23.00, 01.00 *to* 02.00.)	.....
31.56	9,500	PRF5	Rio de Janeiro (Brazil). (*Daily* 22.30 *to* 23.15.)	.....
31.55	9,510	GSB	Empire Broadcasting	.....
31.54	9,518	VK3ME	Melbourne (Australia). (*Wed.* 10.00 *to* 11.30, *Sat.* 10.00 *to* 12.00.)	.....
31.48	9,530	LKJ1	Jelöy (Norway). (*Relays Oslo.*) (*Daily* 10.00 *to* 13.00.)	.....
31.48	9,530	W2XAF	Schenectady, N.Y. (U.S.A.). (*Relays WGY.*) (*Daily* 23.30 *to* 04.00, *Sat.* 19.00 *to* 22.00 *also.*)	.....
31.45	9,540	DJN	Zeesen (Germany). (*Daily* 08.45 *to* 12.15, 13.00 *to* 16.30, 22.15 *to* 03.30.)	.....
31.38	9,560	DJA	Zeesen (Germany). (*Daily* 13.00 *to* 16.30, 22.15 *to* 02.00.)	.....
31.36	9,565	VUB	Bombay (India). (*Sun.* 13.30 *to* 15.30, *Wed., Thurs., Sat.* 16.30 *to* 17.30, *irregular Mon.*)	.....
31.35	9,570	W1XK	Millis, Mass. (U.S.A.). (*Relays WBZ.*) (*Daily* 12.00 *to* 06.00.)	.....
31.32	9,580	GSC	Empire Broadcasting	.....
31.32	9,580	VK3LR	Lyndhurst (Australia). (*Daily ex. Sun.* 08.15 *to* 12.30.)	.....
31.28	9,590	W3XAU	Philadelphia, Pa. (U.S.A.). (*Relays WCAU.*) (*Daily* 17.00 *to* 24.00.)	.....
31.28	9,590	VK2ME	Sydney (Australia). (*Sun.* 06.00 *to* 08.00, 10.00 *to* 14.00, 14.30 *to* 16.30.)	.....
31.27	9,595	HBL	Radio Nations, Prangins (Switzerland). (*Sat.* 22.30 *to* 23.15.)	.....
31.25	9,598	CT1AA	Lisbon (Portugal)	.....
31.13	9,635	2RO	Rome (Italy). (*Tues., Thurs., Sat.* 00.15 *to* 02.15.)	.....
31.0	9,677	CT1CT	Lisbon (Portugal). (*Thurs.* 21.00 *to* 23.00, *Sun.* 12.00 *to* 14.00.)	.....
30.43	9,860	EAQ	Madrid (Spain). (*Daily* 22.15 *to* 00.30, *Sat.* 18.00 *to* 20.00 *also.*)	.....
29.04	10,330	ORK	Ruysselede (Belgium). (*Daily* 18.30 *to* 20.30.)	.....
27.93	10,740	JVM	Tokio (Japan). (*Tues., Fri.* 19.00 *to* 20.00.)	.....
25.65	11,695	YB3RC	Caracas (Venezuela)	.....
25.6	11,720	FYA	Paris, Radio Coloniale (France). (*Colonial Stn. E-W.*) (*Daily* 00.00 *to* 03.00, 04.00 *to* 06.00.)	.....
25.6	11,720	CJRX	Winnipeg (Canada). (*Daily* 00.00 *to* 05.00, *Sat.* 21.00 *to* 06.00 *also, Sun.* 22.00 *to* 03.30 *also.*)	.....
25.57	11,730	PH1	Huizen (Holland). (*Daily ex. Tues., Wed.* 13.00 *to* 15.30, *Sun., Sat. to* 16.30.)	.....
25.53	11,750	GSD	Empire Broadcasting	.....
25.49	11,770	DJD	Zeesen (Germany). (*Daily* 17.00 *to* 21.30)	.....
25.45	11,790	W1XAL	Boston, Mass. (U.S.A.). (*Daily* 23.00 *to* 00.30.)	.....
25.40	11,811	2RO	Rome (Italy). (*Mon., Wed., Fri.* 23.00)...	.....
25.36	11,830	W2XE	Wayne, N.J. (U.S.A.). (*Relays WABC.*) (*Daily* 20.00 *to* 22.00.)	.....
25.29	11,860	GSE	Empire Broadcasting	.....
25.27	11,870	W8XK	Pittsburg, Pa. (U.S.A.). (*Relays KDKA.*) (*Daily* 21.30 *to* 03.00.)	.....
25.23	11,880	FYA	Paris, Radio Coloniale (France). (*Colonial Stn. N-S.*) (*Daily* 16.15 *to* 19.15, 20.00 *to* 23.00.)	.....
25.0	12,000	RW59	Moscow (U.S.S.R.). (*Relays No.* 2 *Stn.*) (*Sun.* 03.00 *to* 04.00, 11.00 *to* 12.00, 15.00 *to* 16.00.)	.....
24.83	12,082	CT1CT	Lisbon (Portugal). (*Sun.* 14.00 *to* 16.00, *Thurs.* 20.00 *to* 21.00.)	.....
24.2	12,396	CT1GO	Parede (Portugal). (*Sun.* 15.00 *to* 16.30, *Tues., Thurs., Fri.* 18.00 *to* 19.15.)	.....
23.39	12,830	CNR	Rabat (Morocco). (*Sun.* 12.30 *to* 14.00)...	.....
22.94	13,075	VPD	Suva (Fiji). (*Daily ex. Sun.* 05.30 *to* 03.60)	.....
20.55	14,600	JVH	Nasaki (Japan). (*Tues., Fri.*, 19.00 *to* 20.00.)	.....
19.84	15,123	HVJ	Vatican City. (*Daily* 10.00, 15.30 *to* 15.15)	.....
19.82	15,140	GSF	Empire Broadcasting	.....
19.74	15,200	DJB	Zeesen (Germany). (*Daily* 08.45 *to* 12.15)	.....
19.72	15,210	W8XK	Pittsburg, Pa. (U.S.A.). (*Relays KDKA.*) (*Daily* 13.00 *to* 21.15.)	.....
19.71	15,220	PCJ	Eindhoven (Holland). (*Experimental*) ...	.....
19.68	15,243	FYA	Paris, Radio Coloniale (France). (*Colonial Stn. E.W.*) (*Daily* 12.00 *to* 16.00.)	.....
19.67	15,250	W1XAL	Boston, Mass. (U.S.A.). (*Daily* 15.50 *to* 18.30.)	.....
19.66	15,260	GSI	Empire Broadcasting	.....
19.64	15,270	W2XE	Wayne, N.J. (U.S.A.). (*Relays WABC.*) (*Daily* 16.00 *to* 18.00.)	.....
19.63	15,280	DJQ	Zeesen (Germany). (*Daily* 04.30 *to* 06.00)	.....
19.6	15,300	CP7	La Paz (Bolivia)	.....
19.56	15,330	W2XAD	Schenectady, N.Y. (U.S.A.). (*Daily* 19.30 *to* 20.30.)	.....
19.52	15,370	HAS3	Budapest (Hungary). (*Sun.* 13.00 *to* 14.00.)	.....
17.33	17,310	W3XL	Bound Brook, N.J. (U.S.A.) (*Daily* 16.00 *to* 22.00.)	.....
16.89	17,760	DJE	Zeesen (Germany). (*Daily* 13.00 *to* 16.30)	.....
16.87	17,780	W3XAL	Bound Brook, N.J. (U.S.A.). (*Relays WJZ.*) (*Daily except Sun.* 14.00 *to* 15.00, *Tues. Thurs., Fri.* 20.00 *to* 21.00 *also.*)	.....
16.86	17,790	GSG	Empire Broadcasting	.....
15.93	18,830	PLE	Bandoeng (Java). (*Tues., Thurs., Sat.* 15.00 *to* 15.30.)	.....
13.97	21,470	GSH	Empire Broadcasting	.....
13.93	21,530	GSJ	Empire Broadcasting	.....
13.92	21,540	W8XK	Pittsburg, Pa. (U.S.A.). (*Daily* 12.00 *to* 14.00.)	.....

Readers' Problems

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

A Conversion

A READER who is using a superheterodyne operating at an intermediate frequency of 110 kc/s would like to bring his receiver up to date by fitting variable selectivity, and asks whether it would be practicable to do this merely by replacing the existing IF transformers with those of the latest pattern which provide for variable coupling with external control.

It is feared that some difficulty will be encountered, for, so far as we know, there are no variable-selectivity IF transformers for operation at 110 kc/s; those now available operate at a frequency in the neighbourhood of 465 kc/s and their use would involve a new set of signal-frequency coils and a new ganged condenser.

Free Accumulator Charging

THE small LT accumulators used in lightweight portable sets are apt to be rather a nuisance, as, although the set is generally used intermittently and for short periods, fairly regular recharging is necessary. Again, some of the cells are much smaller than those with which the average charging station has to deal, and so they are sometimes charged at an excessive rate.

These facts have influenced a reader who is considering the possibility of recharging his cell by inserting it in series with his household DC mains and the domestic lighting system.

The scheme proposed is practical enough, but, of course, care must be taken that the current consumed by lamps or appliances in use at the time of charging does not appreciably exceed the recommended charging rate of the cell. The diminution of the brightness of the lamps (on normal voltages) due to the inclusion of the cell in series is quite imperceptible, and so we have one of the few instances of virtually "something for nothing."

Jumping a Stage

A QUERIST who employs an old HF-det.-LF set purely as a stand-by receiver for the local station (a few miles away) raises the question of dispensing entirely with the HF stage. His reason for doing this is that the screen-grid valve has just failed and he naturally sees no point in replacing it when so little sensitivity is required for his purpose.

With no HF valve in circuit, however, it is found that signals are too weak, and we are asked to say how the HF stage may, so to speak, be short-circuited in the simplest possible way.

We suggest the method shown diagrammatically in Fig. 1, which represents the part in question of this reader's set. It will be necessary to add a small coupling condenser between the grid terminal of the HF valve and the existing HF coupling condenser C; this condenser would normally be joined to the HF valve anode, but must now be disconnected from it. The coupling condenser C.C. should be very small.

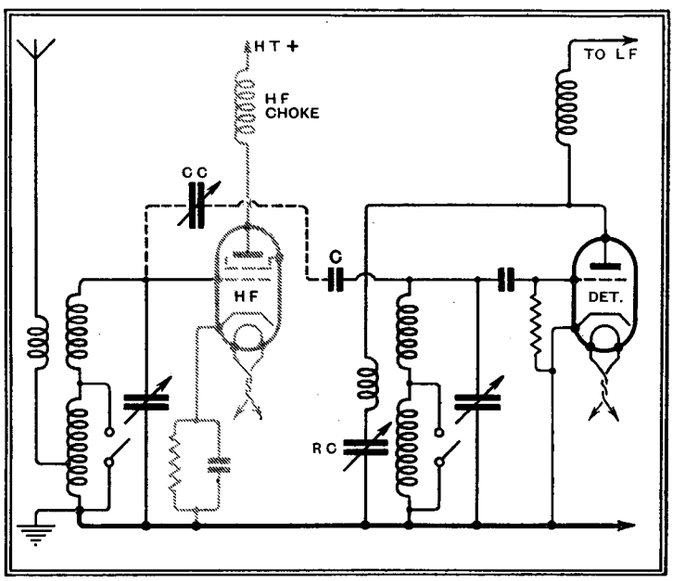


Fig. 1. — How to eliminate an HF stage without affecting selectivity to any great extent.

No Volts to Spare

IN a recently published reply to a reader's query it was pointed out that amplified AVC is virtually impracticable in a battery set; this applies with nearly as much force to a DC set.

For example, the owner of a universal superhet (worked on DC) is dissatisfied with the amount of control obtained from the AVC system, and now asks us whether the controlling voltage could be amplified in a reasonably simple manner.

As already pointed out, the answer to this is "No." The reason is that a considerable surplus voltage is necessary for the operation of an amplified AVC system; an appreciably higher voltage than that normally obtainable from DC mains is required.

Cause and Cure

THE owner of a "2-HF" set which is about three years old has recently fitted new valves throughout. Unfortunately, this has had the effect of producing uncontrollable instability at nearly all tuning positions, but it has been found that stability can be restored by removing all the connections of the reaction control circuit. But, as reaction is useful as an aid to selectivity, our correspondent is not satisfied with the set as it stands, and asks whether it is likely that satisfactory results would be obtained by wiring the entire reaction circuit with screened wire.

In all probability this alteration would have the desired effect. Referring to Fig. 2, which shows in simplified form the reaction circuit of the receiver in question, it will be seen that the extra capacity of the lead between the valve anode and the reaction coil may be considered as a "phantom" condenser (shown in dotted lines) between anode and filament of the valve. This will certainly do no harm. With regard to the other screened lead between the reaction coil and the controlling condenser RC the position is rather different; the extra capacity introduced is virtually in parallel with RC, and so is additive to its minimum capacity. As the new detector valve is presumably much more "lively" than its predecessor, the minimum capacity may in itself be sufficient to cause self-oscillation.

This, however, we consider to be unlikely, and it is much more probable that the instability is caused by stray couplings between the reaction leads and earlier HF circuits, and for this screening should provide a complete cure.

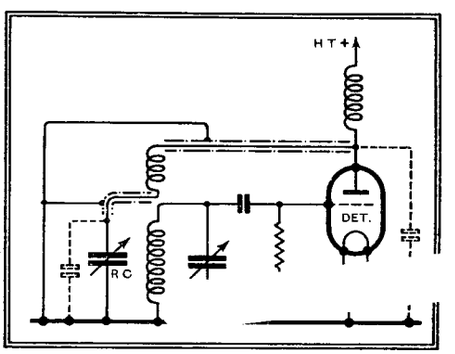


Fig. 2.—The screening of reaction leads will cure instability due to stray couplings, but will add to the minimum capacity of the reaction condenser.

The Wireless World
INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

B.B.C. Effects Department

A Weak Link in the Chain

VERY seldom indeed do we offer any criticism of the work of the production side of the B.B.C., partly because we are not specialists in this section of broadcasting activities, but principally for the reason that we sincerely believe the production side of the programmes to be very well done.

We hope, therefore, that what we have to say on the question of "effects" will be taken the more seriously because we have not shown ourselves habitual critics in the past.

The Effects Department began its activities almost as soon as broadcasting transmissions started, and many of the ideas used then were borrowed from the stage, although others had to be devised which the stage had never needed. An early problem presented itself in the fact that the microphone, the B.B.C. amplifiers, the transmitters, and the listeners' sets all had a share in creating distortion of the original and, what was more serious, failing to reproduce the original sounds at the top and bottom of the audio frequency scale.

Faithful Reproduction of "Curious" Sounds

It was necessary to play all sorts of tricks and invent curious sounds in the studio which, when reproduced in a receiver, gave the effect required.

But since those days the transmitting links, and particularly microphones, have improved enormously ; so, too, have receivers and loud speakers. The result is that listening with a modern receiver to local transmissions we hear those curious noises produced by the Effects Department and often identify them as " curious " noises and not as what they are intended to represent.

We believe that if direct comparisons could be made between the waveform of some original sounds and the waveform emanating from the speaker of a modern receiver when the B.B.C. has produced these sounds artificially, rather startling discrepancies would show up. No doubt the public is becoming steadily more critical, but this alone would not be sufficient to account for the present opinion, quite generally held, that the B.B.C. effects are a weak link in the chain.

An Old Grouse

The Control Engineer

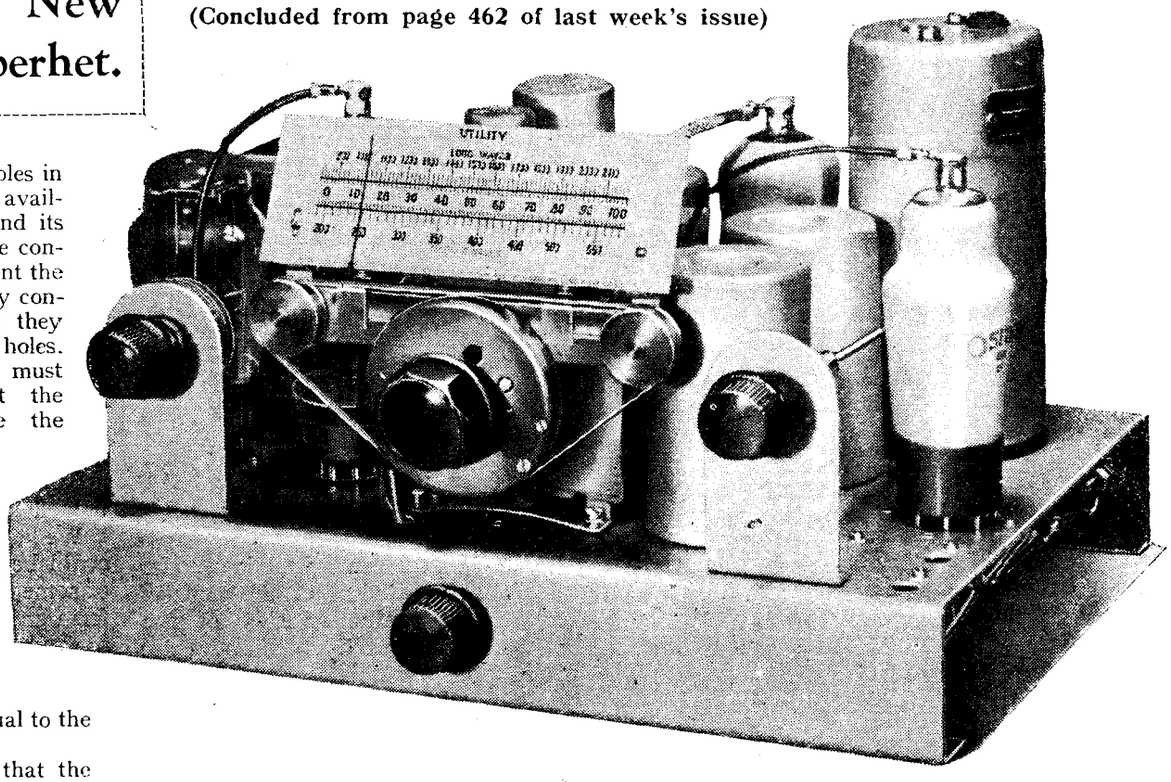
IT would hardly be fair to criticise, as we have done above, one section of the work of the B.B.C. without returning once more to the question of the activities of the control side, because here is a matter which has for years been a subject of complaint from listeners, and the fact that the trouble still persists makes it all the more distressing. We refer, of course, to the fact that it is seldom possible to set the volume control of our receivers at the beginning of a local station programme and leave it at that position to enjoy comfortable reception throughout the programme.

Why should it be necessary, for example, when a talk has just finished at comfortable listening volume for the announcer to come on and shout at us with a voice like a bull ? Surely some sort of automatic volume control could be installed at the microphone end, if the problem is one beyond the capacity of human control.

THE VARIABLE-

Constructing and Operating the New Inexpensive Superhet.

(Concluded from page 462 of last week's issue)



A METAL chassis with all holes in the correct positions is available for this receiver and its use greatly facilitates the construction. It is necessary to mount the bracket for the variable selectivity control before the trimmers, since they obscure one of the fixing holes. These trimmers, C10 and C14, must not be mounted flat against the chassis; in one case because the trimmer would foul one of the bracket fixing bolts, in the other because the capacity between trimmer and chassis would be too high. Long 6 BA bolts are used for the mounting and three full-size nuts are run on each and securely tightened before placing the trimmers on them, so that the trimmers are spaced from the chassis by a distance equal to the thickness of three nuts.

Care should be taken to see that the electrolytic condensers, the earth terminal, the coil screens, and all bolts carrying earthing tags make good contact with the chassis, and it is important to make sure that the aluminium-finish to the chassis is removed at the necessary points. The aerial and PU terminals must, of course, be insulated with the washers provided.

The wiring is straightforward, but care should be taken to follow the original plan not only in the matter of the actual connections but in regard to the positions of the wires. Those wires nearest the baseboard will naturally be put in first and for the heater wiring to the three receiving valves No. 16 gauge is used. This gauge is also used for one or two other long leads where its extra rigidity renders it advisable. It should, of course, be first straightened by stretching, otherwise difficulty will be experienced in sliding the insulating sleeving over it. Except in one or two special places, the rest of the wiring can be carried out with No. 20 gauge which is much easier to handle.

Particular care should be taken in the wiring of the detector and AVC circuits for the proximity of certain leads is relied upon to produce the condenser C17. Similarly C1 is produced by the proximity of two wires, but in this case they are extra wires inserted for this purpose only. A length of No. 16 wire is joined at one end of the aerial terminal and bent into the position shown in the drawings. Another length of the same gauge wire is supported by terminal (1) of the signal-frequency coil assembly and is bent so that it lies parallel with the first. The two wires are then sleeved for the whole of their lengths, using thin walled sleeving, and are bound together with thread to form the condenser C1.

The adjustments necessary before the receiver will give its correct performance are to the IF circuits and to the ganging. There are four trimmers in the IF amplifier, three for the medium-wave ganging and one for the long waveband—a total of eight. Some form of tuning indicator is a great help, and it can take the form of a proper output meter connected across the output transformer primary or a voltmeter connected between the chassis and the cathode of one of the controlled valves. In the former case, the meter reading will increase with signal strength, but in the latter it will decrease once the signal is strong enough to operate the AVC system. A voltmeter used in this way should have a full-scale deflection for some 6 to 10 volts.

Ganging with an Oscillator

If a test oscillator be available, connect a fixed condenser in series with its high potential output lead, and set it to 465 kc/s. Connect the earthy output lead to the chassis and the other to the grid of the IF valve. Roughly adjust the trimmers on T2 for maximum response. Then adjust the output of the oscillator so that the indicating meter reads a convenient value; if no meter is used, and the ear is relied upon, keep the input very small so that the signal is only just audible. Then carefully adjust the two trimmers to their optimum settings. In this connection it should be noted that the secondary trimmer will have little or no effect upon the indication of a voltmeter, and this circuit will usually have to be adjusted aurally.

When satisfied with the adjustments to T2, connect the output of the oscillator to the grid of the triode-hexode and adjust the trimmers in T1 roughly. Then set the selectivity control for nearly maximum selectivity, that is, nearly fully rotated in a clockwise direction, and carefully adjust each of the two trimmers in T1. A much smaller output from the oscillator than before should be required, and it will usually pay to check over the adjustment of all four IF trimmers before proceeding to the ganging. When satisfied with the adjustments, set the selectivity control at optimum. This is readily done by ear by choosing the setting which with a weak input gives the loudest signal in the speaker.

Transfer the oscillator output to the aerial and earth terminals, using a standard artificial aerial if available, if not a 0.0002 mfd. condenser between the aerial terminal and the high potential oscillator lead. Set the test oscillator to 1,500 kc/s and the tuning control at zero. Stop the receiver oscillator from functioning by joining terminal (1) of the oscillator coil to earth by a lead fitted with spring clips. Set the oscillator to give a large output of 0.1 to 1 volt and adjust the trimmer on

SELECTIVITY IV.

By W. T. COCKING

THE small superheterodyne is a receiver which is hard to beat for general broadcast reception and it is capable of an astonishingly good performance if well designed and carefully constructed. The circuit details of the Variable-Selectivity IV. were fully discussed in last week's issue of "The Wireless World" and in this article the construction of the receiver is dealt with. The initial adjustments are also treated and the performance of the set on test is fully described.

C3 for maximum response as indicated on a voltmeter connected across R3. Then set the test oscillator to 1,400 kc/s and tune the set to it by the main tuning control. Reduce the output of the test oscillator and remove the short-circuit from the set oscillator. Now tune in the signal exactly by the adjustment of the trimmer on C13 only.

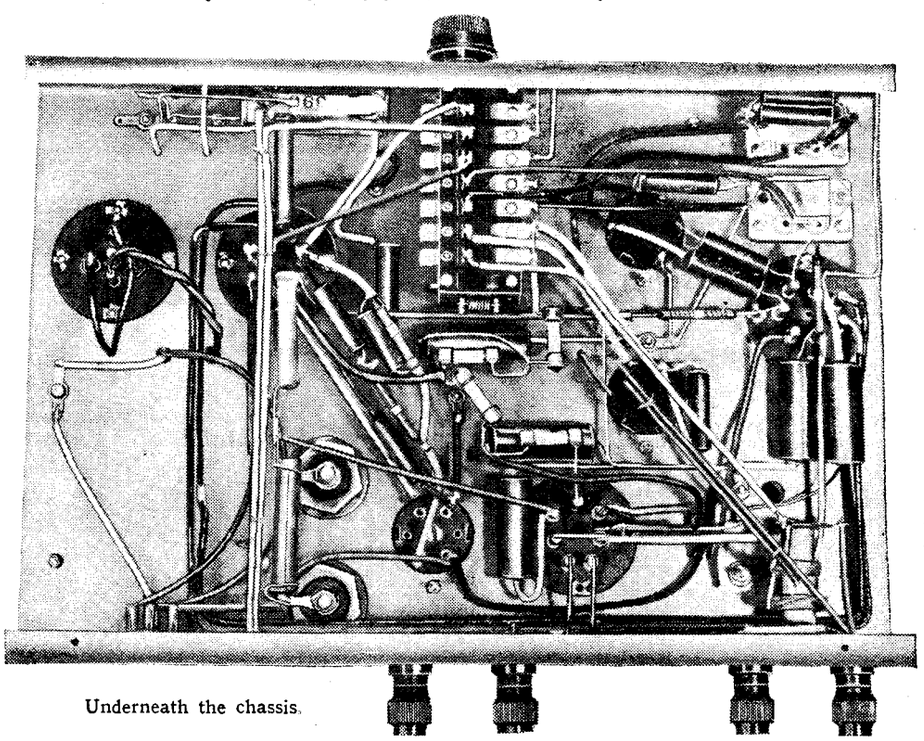
The next steps are to replace the short-circuit on the set oscillator and to set the test oscillator for large output at 600 kc/s. The receiver should then be tuned to this signal using the voltmeter as an indicator. When this has been done, reduce the oscillator output, remove the short-circuit, and tune in the signal by the adjustment of C12 only. To ensure the most accurate ganging, a return should be made to 1,400 kc/s and the trimmer on C13 readjusted in the manner already described.

The Long Waveband

When the medium wave ganging has been completed it is the turn of the long waves. Here only one trimmer, C14, needs adjustment. This is best done by setting the test oscillator at some 250/300 kc/s with a large output and the set oscillator short-circuited as before. Tune the set to the signal, using the voltmeter as an indicator, reduce the oscillator output and remove the short-circuit. Then tune in the signal by adjusting C14 only. This completes the ganging and no further adjustments should prove necessary, save, perhaps, that it is advisable to check the adjustment of the trimmer on C3 with the aerial on which the set is to be used. This is easily done by tuning in a low wavelength station on the medium waveband and adjusting this trimmer for the strongest signals.

Where a test oscillator is not available, the ganging must be carried out on signals. This is not quite so easy, but is perfectly practicable. At first screw up the trimmers on T1 and T2 fully. Then unscrew the secondary trimmer on T2 three complete turns and the primary trimmer two and a half turns, the bottom trimmer on T1 one and a half turns, and the top trimmer two turns. Unscrew C14 fully and C12 about three complete turns. Screw the two trimmers on the gang condenser fully home and then unscrew that on C3 half a turn and that on C13 three-quarters of a turn. Set the selectivity control for low selectivity (anti-clockwise) and the waverange switch for the medium waveband (also anti-clockwise).

It should then be possible to tune in a signal and if a voltmeter be connected across R3 as an indicator, a strong signal is an advantage. If the ear is used to judge signal strength, only weak stations should be used. Having obtained a signal, adjust the four IF trimmers as accurately as possible; as the signal strength increases, increase the selectivity and readjust the trimmers in T1, repeating the process until the final adjustments are made with the control set for nearly maximum selectivity. The IF circuits are now in line with one another, but it is not yet known whether they are tuned to 465 kc/s or not. If they are not, the ganging may not hold accurately.



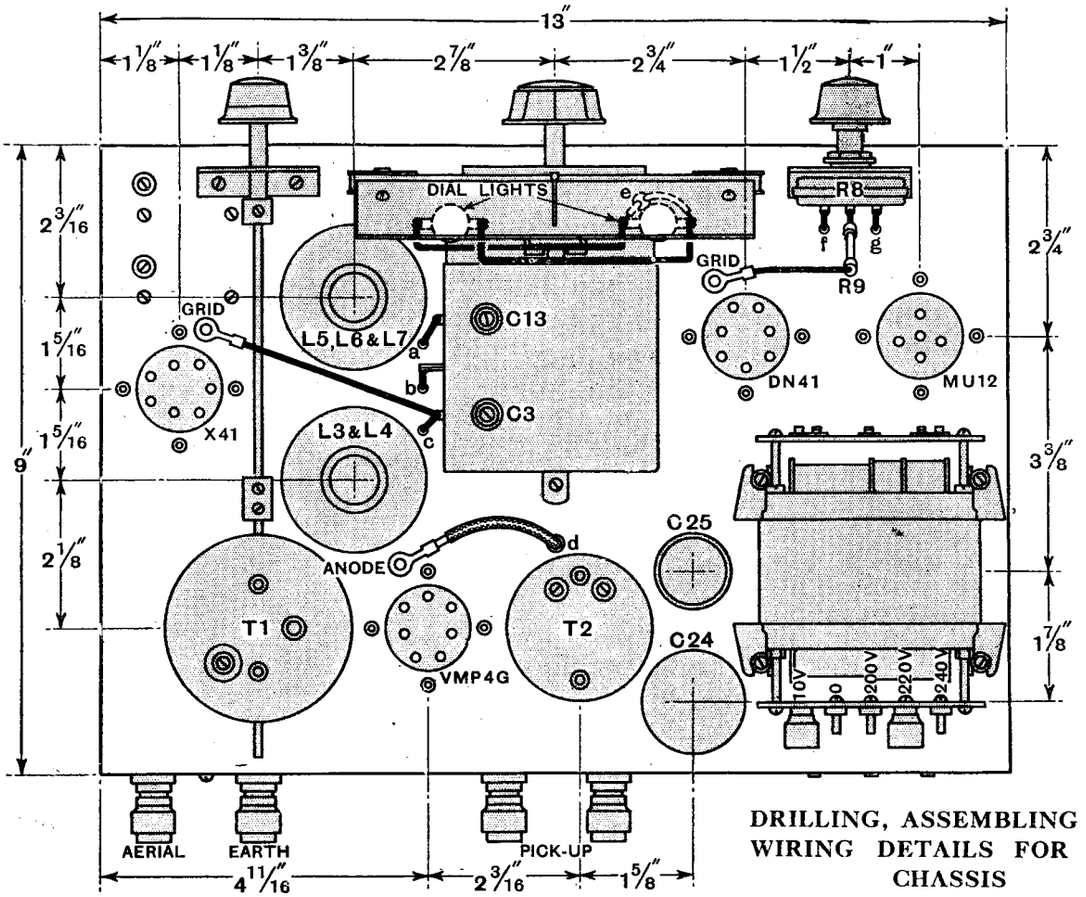
Underneath the chassis.

The next step is to tune in a low wavelength station and to adjust the trimmer on C3 for maximum response. If a station below some 220 metres can be found and identified, set the tuning control so that its wavelength is indicated by the dial and tune it in by the adjustment of the trimmers on C3 and C13. Then find a station at the other end of the waveband and adjust C12 while rocking the tuning control backwards and forwards over a few degrees until the optimum combination of settings is found. A return should then be made to a low wavelength and the trimmer on C3 readjusted. This completes the medium wave ganging provided that the intermediate frequency is correct.

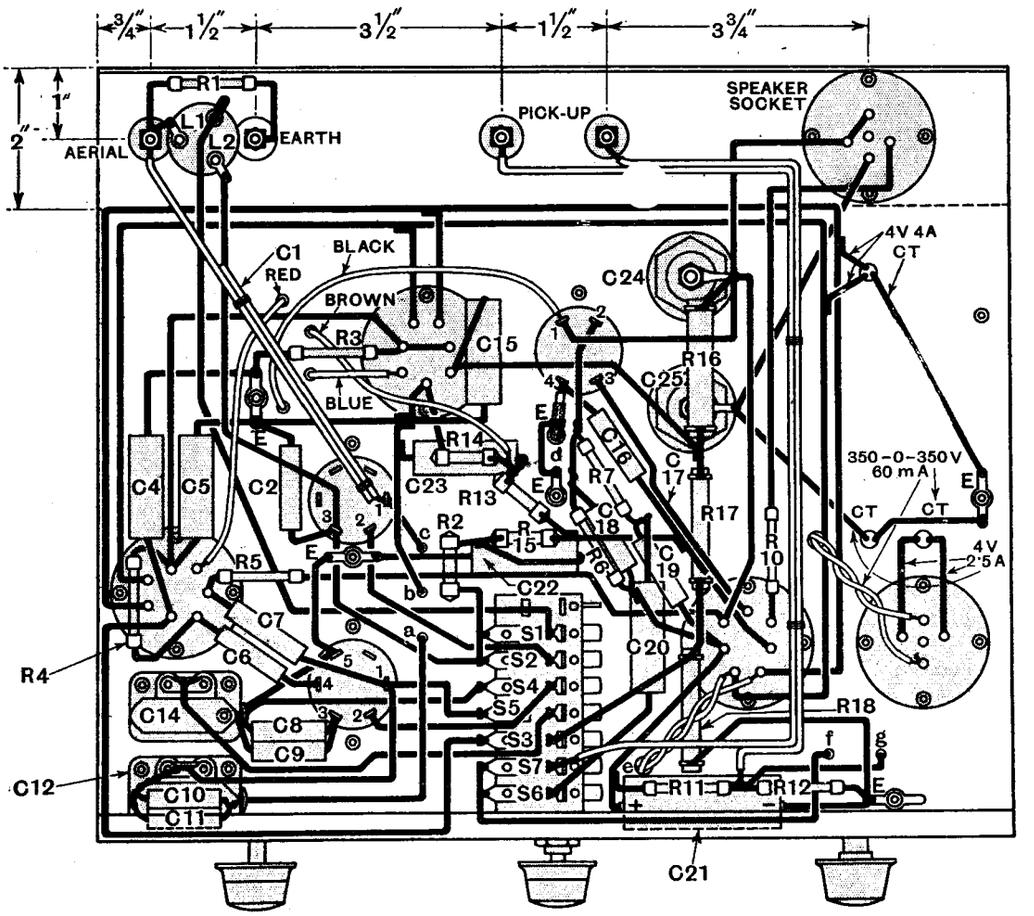
Checking the Intermediate Frequency

The question of superheterodyne whistles will be dealt with later, but it may be remarked that a whistle is quite probable when receiving a station having a frequency twice that of the intermediate frequency. That is to say, when the intermediate frequency is 465 kc/s a whistle can be expected when receiving a station on 930 kc/s. This forms a useful check upon the intermediate frequency, and the station upon which the whistle occurs should be identified so that from a knowledge of its frequency the intermediate frequency can be found. If the adjustments be widely out so that accurate ganging cannot be obtained, a number of whistles may be found, and in this case the wanted one is likely to be the strongest.

If it be found, for instance, that the whistle occurs at 1,000 kc/s, the intermediate frequency is one-half of this, 500 kc/s. This is much too high and all four IF trimmers should be screwed up somewhat until the whistle occurs at 930 kc/s. On the other hand, if the whistle occurs at, say, 860 kc/s, the intermediate frequency is 430 kc/s, which is too low, so that the IF trimmers must be further un-



DRILLING, ASSEMBLING AND WIRING DETAILS FOR THE CHASSIS



The Variable-Selectivity IV.—

screwed. Once the correct frequency has been found, the adjustments can be proceeded with in the certainty that they are final.

The long wave ganging is easy, for C14 is the only trimmer to be adjusted and its optimum setting is very near to minimum. It is best done on a station towards the middle or lower end of the waveband, such as Luxembourg, and C14 must be adjusted while rocking the tuning control backwards and forwards over a few degrees until the optimum combination of settings is found.

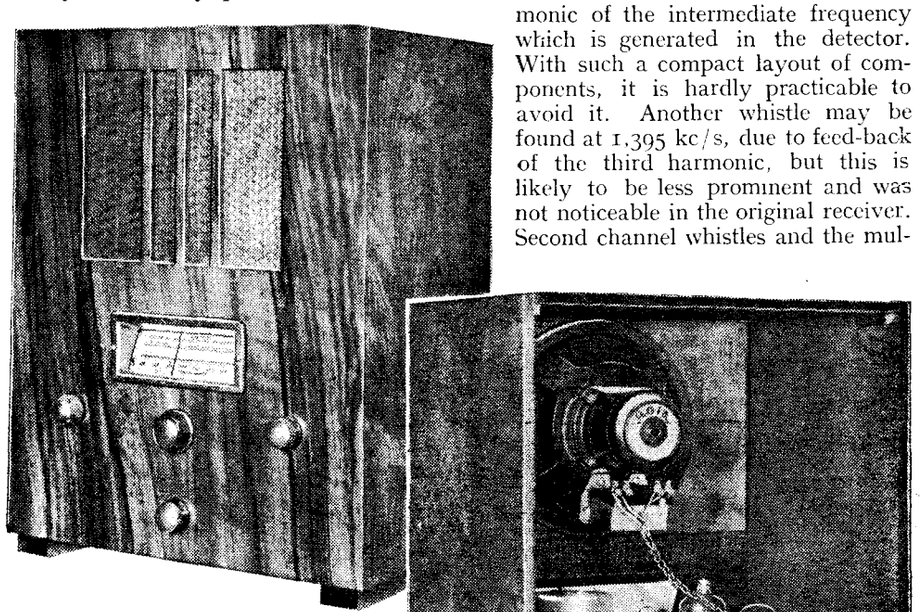
A full-size blue print of the wiring diagram is available from the Publishers, Dorset House, Stamford Street London, S.E.1. Price 1s. 6d. post free.

VOLTAGES AND CURRENTS.

Valve.	Anode Volts.	Screen Volts.	Cathode Volts.	Anode Current.	Screen Current.
				mA.	mA.
FC X41 hex. ..	205	70	2.45	1.3	2.25
,, osc. ..	40	—	—	1.7	—
IF VMP4G ..	205	100	2.45	6.85	4.25
Output DN41 ..	180	205	20.0	26.0	6.75

Volts across C25 = 350. Volts across R11 = 3.3. Field current = 56.5mA.

On test, this receiver was found to give a very satisfactory performance indeed.



The complete receiver and loud speaker housed in a C.A.C. cabinet.

The sensitivity proved adequate for the reception of all worth-while stations with quite a modest outdoor aerial. During the daylight hours and in the heart of London stations such as Fécamp, North Regional, Cologne, and Brussels on the medium waveband would not only give full volume but produced a detector input well beyond the threshold of AVC. On the long waveband, Huizen, Radio-Paris and Luxembourg gave signals which anyone could be excused for mistaking for locals.

Even with optimum coupling in the IF transformer, giving quite a high degree of selectivity, the quality of reproduction reached a high standard and with the lower selectivity possible for strong stations it proved to be exceptionally high. Mains hum was found to be negligible, and the selectivity entirely adequate, while background hiss was inaudible.

Very few whistles were found. On the long waveband a trace of one whistle could be detected when the receiver was mistuned by some 5 kc/s to 10 kc/s from Droitwich due to the oscillator harmonic beating with the London National. The whistle could only just be heard, however, and was inaudible with the receiver correctly tuned to the station.

On the medium waveband also the whistles were few. As already mentioned, one is to be expected at 930 kc/s and is due to feed-back of the second harmonic of the intermediate frequency which is generated in the detector. With such a compact layout of components, it is hardly practicable to avoid it. Another whistle may be found at 1,395 kc/s, due to feed-back of the third harmonic, but this is likely to be less prominent and was not noticeable in the original receiver. Second channel whistles and the multitude of whistles due to kindred effects which are found in some superheterodynes are completely absent.

In conclusion, it may be said that the receiver is one which will give a very satisfactory performance indeed, judged from all points of view. Even if no account were taken of its cost, its performance would be a remarkable one. When the low price of its components is taken into consideration its performance becomes really outstanding.

DISTANT RECEPTION NOTES

COLOGNE has had very bad luck in having its big anti-fading aerial blown down by a gale. Since it has been found impossible to use anything like the transmitting plant's full available power of 100 kilowatts with a temporary aerial, the standby transmitter is now at work, using a power of about 17 kilowatts. It is not likely that a new mast can be built before next summer, so I am afraid that British listeners will not find Cologne any too good this winter. The loss is rather a serious one to those who live in the east and south-east of England, for when it was in full swing Cologne gave excellent daylight reception in many places, whilst after dark it was one of the best stations going. I think I am right in saying that Cologne's aerial mast, like those of many other big German stations, was a wooden structure of the latest type.

Another German station now also under the weather (though not so literally so as Cologne) is Stuttgart, which is undergoing extensive alterations. Whilst the work is going on the main transmitter cannot be used; until dusk, therefore, the old plant is in operation with quite small power. Don't be surprised if you now cannot pick up Stuttgart during the daytime.

One of the most strongly received of European stations in the lower part of the medium waveband at the present time is the new Radio Lyons, which was officially opened a week or two ago. This is a private station working on 215.4 metres with a rating of 25 kilowatts. It is quite separate and distinct from the official Lyons (La Doua) which operates on 463 metres and is rated at 90 kilowatts. Under the Lucerne agreement the greatest power that may be used by a station with a wavelength between 200 and 240 metres is 30 kilowatts; Radio Lyons therefore has not done so badly for a private station by managing to secure 25.

The other night I picked up a French station working on 209.9 metres (two channels above the Eiffel Tower) and was rather surprised to hear the call sign given as Radio-Midi. This was a new one to me, and I began to wonder whether some fresh transmitter was taking the air. On enquiry I found that Radio-Béziers has changed its style and title to Radio-Midi, and that is that. Once more I would like to record my humble protest against these call signs that don't help the listener by showing (except in the vaguest possible way) the location of a station that he picks up. France seems rather fond of this kind of thing: in recent months Fécamp has become Radio-Normandie; Lille, Radio-Nord; Radio Vitus, Radio Ile-de-France; Radio L.L., Radio-Cité; and so on. Ile-de-France is about the only call sign which localises the station at all—and that only if you happen to be conversant with the topography of Paris. I do wish that at the next big conference of the U.I.R. some influential body of representatives would bring forward a motion that every station should henceforward be known by the name of the nearest big town. The merits of wireless as an educational factor are frequently extolled; why shouldn't it do its bit in helping to teach us geography?

D. EXER.

HINTS and TIPS

Practical Aids to Better Reception

For Testing or Fault-finding

DURING overhauls of defective receivers, and equally when introducing experimental modifications, the need often arises for the temporary connection of fixed resistances or condensers to the chassis. Everyone who has attempted such a task will know how difficult it is to dispose of the new component and its connections quickly and at the same time securely.

To overcome this difficulty the "gadget" shown diagrammatically in Fig. 1 has been developed for use in the service department of several wireless factories; although perhaps of greater interest to the professional than to the amateur, it is attractive enough to appeal to many experimenters who take their hobby seriously.

As shown in the diagram, the device consists of a series of fixed resistors and condensers of the values customarily employed in wireless sets. These are assembled in a small case or in any other convenient manner, and rotary switches are provided to enable any value of resistance or capacity to be selected at will. Suitable 10-point switches for the purpose are made by several firms such as Bulgin or Kabi.

External connections may be made through flexible "wander" leads fitted with crocodile clips, or, if preferred, terminals may be fitted. The uses of such a device will be obvious; suspected faulty components can be replaced for purposes of testing in a moment and experimental alterations to existing capacity or resistance values can be made with the greatest of ease. If required, a combination of resistance and capacity either in parallel or in series can be introduced into the receiver circuits. Perhaps the greatest advantage of all is that the effect of different values can be determined while the ear retains its original impressions—these are usually lost in the process of interchanging components.

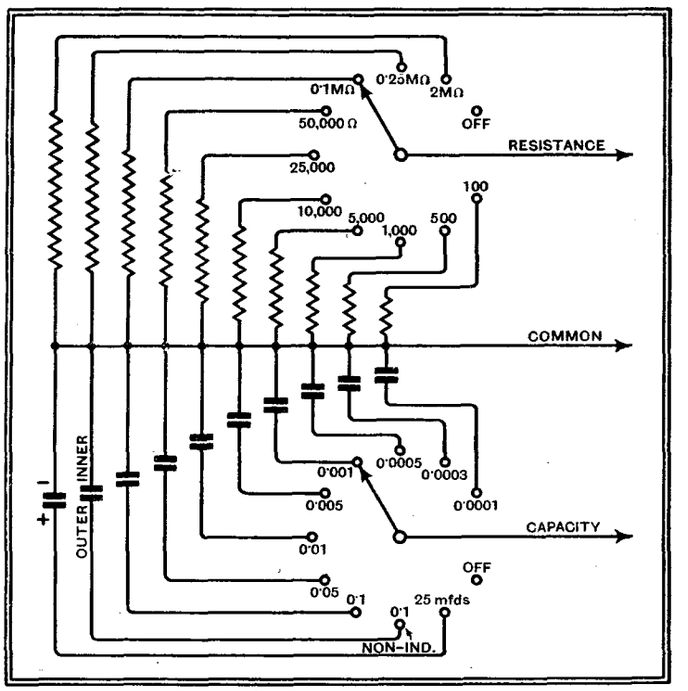


Fig. 1.—Connections of a resistance - capacity box; any value likely to be needed for testing or experimental work is immediately available.

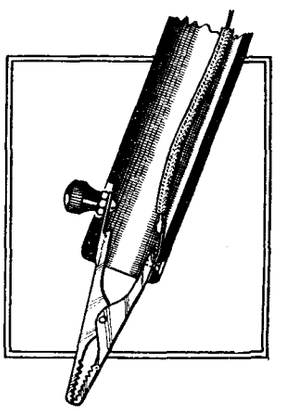
A Point to Remember

WHEN measuring or checking the anode current of HF, IF, and sometimes of frequency-changing valves, it is best to make a practice of setting the volume control at maximum. If the set includes AVC, the aerial should be disconnected, or, at any rate, the tester should make quite sure that no carrier wave of appreciable strength is being received. Indeed, this rule is a safe one to apply to all circumstances, as there is always a possibility that incoming signals will have at least some disturbing effect on the anode current of one or more of the valves.

Crocodile Test Prods

WHEN using a meter for testing purposes, it is often desired to have both hands free for adjustments while readings are being taken. Ordinary crocodile clips would be suitable for the purpose were it not for the fact that, being uninsulated, they are difficult to introduce into a "live" set without incurring the risk of shocks or short-circuits across the HT system.

The accompanying sketch shows the construction of a testing prod which has the unusual virtue that it may be clipped on to any point merely by the operation of one finger and without any risk of shock. The hollow body of each prod consists of an ebonite tube of about ¼in. inside diameter and from 4in. to 5in. long. The purpose of the tag which is soldered to the upper shank of the clip is to provide increased leverage for easy finger operation, while the lower, which is gripped between the other shank and the tube by means of the fixing screw, carries the connecting flexible wire. This screw should be countersunk well into the ebonite and then covered over with Chatterton's compound or paraffin wax to complete the insulation. If an SG or pentode valve terminal is used for the small knob, it can be attached by screwing it on to a short 6 B.A. screw which has previously been securely fixed to the tag by a lock-nut as shown in the drawing.



Test prod and test clip combined: this useful device is thoroughly insulated, and may safely be used to make connection to high-voltage circuits.

A Crystal Danger

THE crystal set, which seems again to be coming in for some share of public interest, is not ordinarily regarded as a potential source of interference to other receivers. Nevertheless, it is a fact that it can cause a good deal of trouble, and for this the high sensitivity of the modern valve set is largely responsible. If, for example, a detector coupled to a receiver tuned to the local station is subjected to vibration (say by passing traffic), the carrier wave will be modulated by this vibration, and thus interference with other sets tuned to the same wavelength may be propagated over a wide area. Similarly, disturbing "clicks" are heard through nearby sets when the crystal detector is adjusted, and for this reason the semi-permanent type of detector is to be preferred.

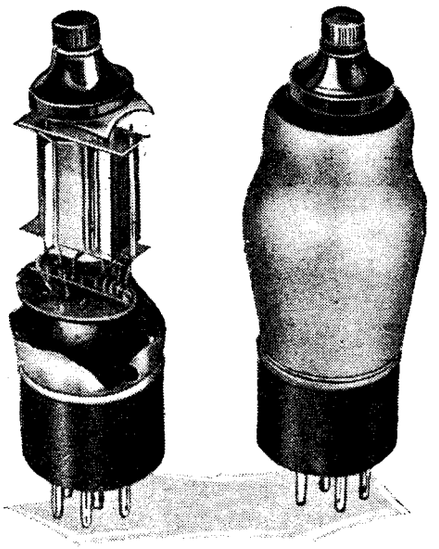
Heavy Starting Current

IT should be remembered that filaments or heaters of valves take a comparatively heavy current for a few moments after voltage has been applied to them; in this matter they resemble the filaments of the ordinary electric lamp which, when cold, has a resistance many times lower than when its normal running temperature has been reached.

A knowledge of this fact is likely to be particularly useful to those who are building receivers with universal valves. There is no need to be perturbed if a heavy current (as indicated by an ammeter) flows for an appreciable period of time after switching on.

THE RENODE

A New Valve Development in Denmark



Two views of the Renode valve.

DETAILS of a new type of valve developed by A. Schleimann Jensen of the Skandinavisk Rφrfabrik have just been released. The valve is a radical departure from accepted practice and has no grid in the ordinary sense of the word. The arrangement of the electrodes is shown in Fig. 1, and it will be seen that the emitting cathode K is surrounded by a screen Kc, which has a lengthwise slit parallel to the cathode. The auxiliary anode Ha also has a slit of the same size in it. The electrons emitted by the cathode pass through the cathode slit and are formed by it into a beam, which passes through the slit in the auxiliary anode to the main anode A. Between the two anodes the beam passes between two deflecting plates X and Y.

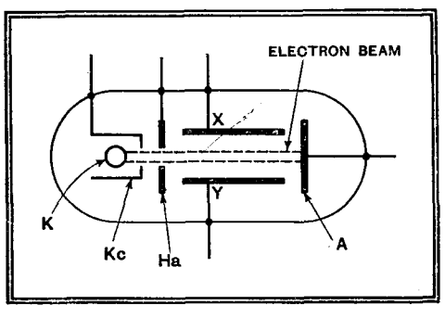


Fig. 1.—In the Renode, the cathode K is surrounded by a shield Kc which has a slot to permit the exit of electrons.

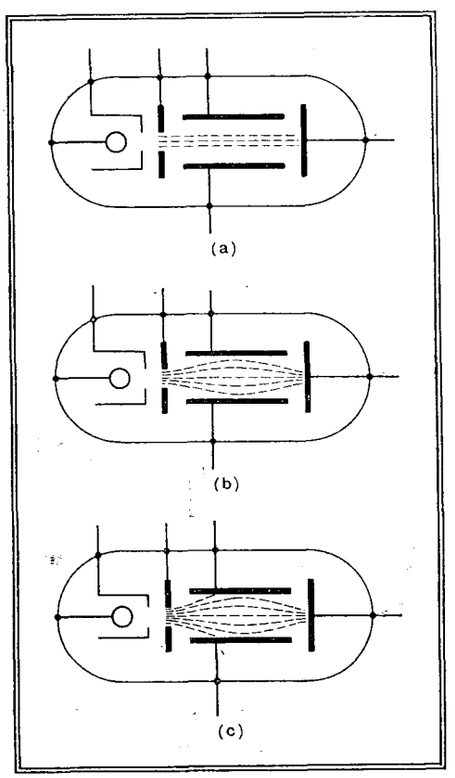


Fig. 2.—Depending upon the potentials applied to the electrodes, the beam of electrons between cathode and anode can be made narrow as at (a), brush-like as at (b) or it can strike the deflecting plates (c).

In operation the cathode and deflecting plates are operated at the same potential while the anode and auxiliary anode are positive with respect to them. The cathode shield Kc, which is termed the concentrator, has a negative bias applied to it, and when this has a certain value the electron beam between cathode and anode is concentrated into a straight path as shown at (a) Fig. 2. When the negative bias is reduced, the beam widens out (b) and eventually some of the electrons hit the deflecting plates (c). This last condition is the one normally employed, and the application of HF potentials to the deflecting plates by a circuit such as

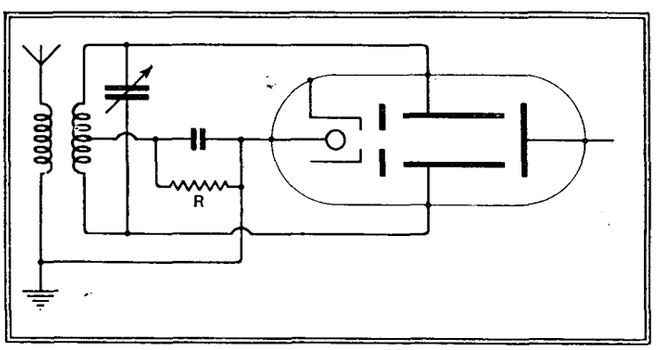


Fig. 3.—A push-pull input circuit for use with the Renode when it is operating as a detector.

that of Fig. 3 causes the beam to be deflected alternately towards one or the other of the plates. The particular plate towards which the beam is deflected at any instant collects in consequence an increased number of electrons and there is a rise in current in the external circuit.

Linear Detection

With the circuit of Fig. 3, full-wave rectification is secured, and as regards the external circuit the action seems very similar indeed to that of the ordinary push-pull diode detector. As a result of rectification, a steady potential appears across the load resistance R, and its polarity is such that the deflector plates become negative with respect to the cathode. If the HF input be modulated, this "steady" potential fluctuates with the modulation, and both plates fluctuate together at the same average potential, although their instantaneous HF potentials may be quite different. As a result, the anode current is varied at the modulation frequency. As regards the external circuit, the action is very similar indeed to that of the American Wunderlich valve, which, it will be remembered, is the equivalent of a push-pull grid detector. The internal structure of the Renode, however, and its internal mode of operation are quite different.

It is not essential to employ the Renode with a push-pull input circuit, and if the two deflector plates be joined together a conventional input circuit can be used. HF currents then appear in the anode circuit, and it is quite possible to obtain reaction effects. The curves of Fig. 4 show at A the input/output characteristics, and at B those of an HF pentode, the vertical scale representing the deflection of a mirror galvanometer in cms. The linearity with the Renode is well marked, and it is claimed that it extends to an input of at least 1 volt. As an HF amplifier the valve is also more linear than an HF pentode, and damps a tuned circuit to

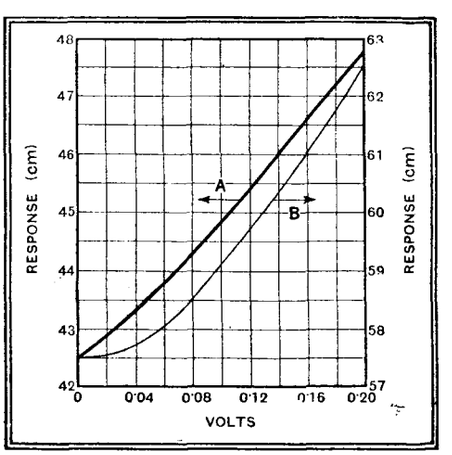


Fig. 4.—The detection characteristics of the Renode (A) compared with those of an HF pentode (B).

The Renode—

which it is connected to a lower degree, thus leading to improved selectivity. The stage gain obtainable is somewhat higher than with conventional valves, but not greatly so.

It is clear from the few details which are yet available that the new valve promises to be an extremely interesting development. As the illustration shows, the external appearance differs little from that of an ordinary valve, and the dimensions are presumably of a similar order.

In addition to the Renode a further valve, this time of more normal design, has also been developed. This consists of a triode which has two false grids, A and B (Fig. 5), inserted between the control grid and cathode. Only one-half of

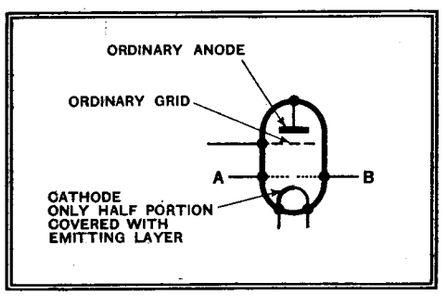


Fig. 5. The "non-radiating" valve has two false grids A and B, and a cathode which is only half coated.

the cathode is covered with an emitting layer, so that grid B is round a blank cathode, while grid A surrounds an active cathode. It is claimed that by using this valve in the correct circuit, presumably some form of balanced bridge, full reaction effects can be secured without any danger of radiation from the aerial, even if the reaction control is mishandled. Here, however, details of the circuit are not yet available, so that it is too early to form any opinion on the value of the device.

New Short-wave Journal

MUCH useful information for short-wave enthusiasts is contained in the first issue of *The Short-wave Constructor*, a magazine published at 3d. by British Television Supplies, Ltd., of Bush House, London, W.C.2. There are three complete constructional articles; the most ambitious set described is an ultra-short-wave superheterodyne intended as a basis for television experiments. This receiver operates at an intermediate frequency of 12 megacycles, and the IF circuits are designed to embrace band widths up to 2½ megacycles.

The remaining constructional articles deal with an HF-detector-LF combination covering waves between 12 and 80 metres in three steps and a simple detector-LF set with interchangeable coils. Specialised aerials for short-wave work are treated in one of the general articles, another of which, entitled "Beginning on the Short Waves," shows how easy it is for the amateur to make a start in this fascinating branch of our art.

Air-cored Inductances

Design Based on Empirical Data

AIR-CORED inductances ranging in value from 0.1 to 1 henry are occasionally used in modern sets for tone correction, whistle suppression, and for low-pass filters. Such inductances are generally designed and adjusted for the particular function they are called on to perform, but the data provided is not very helpful when coils of different value are needed for an experimental purpose. It would, of course, be possible to calculate the turns required on the basis that inductance is proportional to the square of the turns, but this holds good only provided the shape and mean diameter remain the same as the coil taken as the guide. This involves a considerable amount of tedious calculation to find a size of wire with a covering to just fill the winding space with the turns needed.

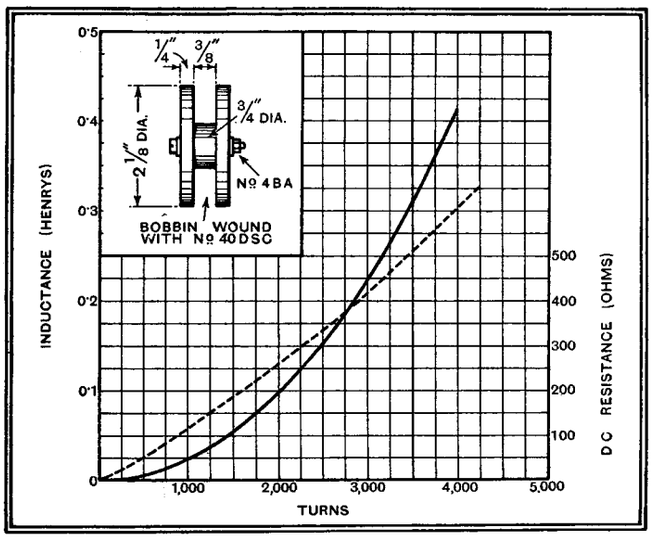


Fig. 1.—Curves relating inductance, turns and DC resistance (dotted line) for coils ⅜in. wide and wound on a ¼in centre.

Considerable data has been compiled on the winding of air-cored inductances for experimental purposes, and this has been utilised in the preparation of the two curves reproduced here. They may be regarded as an inductance ready-reckoner. The inductance curve in Fig. 1 relates to coils wound on a former with a ¼in. centre of circular cross-section and ⅜in. wide, and these dimensions are suitable for inductances up to about 0.4 henry. Anything greater than this will necessitate an unduly large outside diameter, so for coils of higher inductance it is best to increase the thickness to ⅝in. Then the curve in Fig. 2 would apply. A 0.4 henry coil in the one case and a 1 henry in the other will wind into a former just about 2in. in diameter, which is a convenient size for most purposes.

There is a fairly large overlap between the two designs, which is perhaps inevitable, since the data is compiled from experimental work, but it is hoped that they will prove helpful nevertheless where, hitherto, difficulty has been experienced in obtaining constructional data for coils of this type.

The outside diameter of the end-cheeks for a few specimen coils of ⅜in. and ⅝in. thick are given in the table. Formers can be made of ebonite or wood; the centre must be circular, but the cheeks can be finished square if it is more convenient than cutting circular discs. The three pieces are then clamped together by a short length of 4BA screwed rod and nuts, or alternatively by a long screw with a nut one side. No. 40 SWG DSC wire is used for all coils.

H. B. D.

TABLE

Turns No. 40 DSC	Diameter of cheeks for ⅜in. wide coil.	Turns No. 40 DSC	Diameter of cheeks for ⅝in. wide coil.
2,000	1⅝in.	3,000	1⅝in.
3,000	1⅞in.	4,500	1⅞in.
4,000	2⅛in.	6,000	2⅛in.

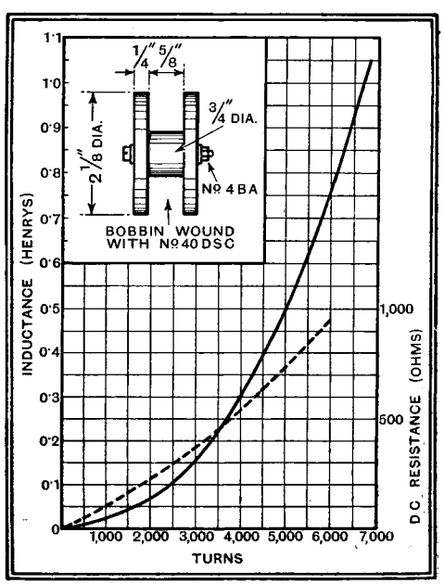


Fig. 2.—Coils of inductance greater than 0.4 henry are wound on a former ⅝in. wide and the full-line curve provides the winding data. The DC resistance is given by the dotted-line curve.

Current Topics

EVENTS OF THE WEEK IN BRIEF REVIEW

Papuan Broadcasts

NEW Guinea's first broadcasting station has been opened at Port Moresby, using the call sign 4 P.M. with a wavelength of 221 metres.

Television in Filmland

HOLLYWOOD is going all out for television. The Twentieth Century-Fox studios are inaugurating the first television-equipped stage in Hollywood as a memorial to the late Will Rogers. It is stated that the new stage is so constructed as to permit tremendous concentration of light within a confined area.

100 Kilowatts from Sweden

M. SIFFER LEMOINE, chief engineer of Swedish broadcasting, announces a project for constructing a 100-kilowatt station for the South Swedish region in the Scania district, where the existing stations, Malmö (10 kilowatts) and Hälsingborg (200 watts) have proved insufficient.

The Government is being asked for a subsidy of £75,000 to cover the cost. The site of the new station will probably be near Hörby.

History Repeated

OLDER readers of *The Wireless World* who recall the famous amateur transatlantic tests of 1922-23 will be interested to hear that a comparative series of tests, following closely the lines of those of twelve years ago, is to be held in December. During the week December 15th to 22nd British and American amateurs will make special attempts to communicate on the 80-metre band. As both telephony and morse will be used short-wave listeners should find the 80-metre channel very intriguing during this period.

Radio Feeler

A RADIO device reputed to enable a ship to "feel" its way through fog has been tested on the French liner "Normandie." A radio beam on a wavelength of 16 centimetres describes an arc of 45 degrees in the direction of the ship's travel, and if the beam is intercepted by any obstacle in its path a loud speaker announces the fact to officers on the bridge. It is stated that objects have been detected at distances up to four miles.

Laughter in Court

A Dunfermline miner who was admonished at the police court last week for annoying neighbours with an unduly loud wireless set, said that he had turned it down at night at 10.30. It was, he said, a wireless which went the same when it was turned down as it did when it was full on. (Laughter.)

Television for Australia

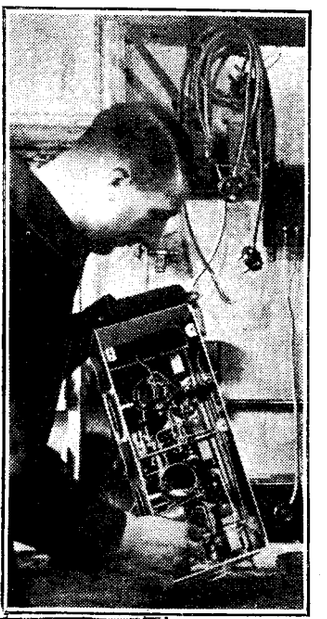
ARRANGEMENTS have recently been made whereby the Australian Radio Manufacturers' Patents Association has been granted exclusive rights for the construction and operation of television apparatus under Baird patents.

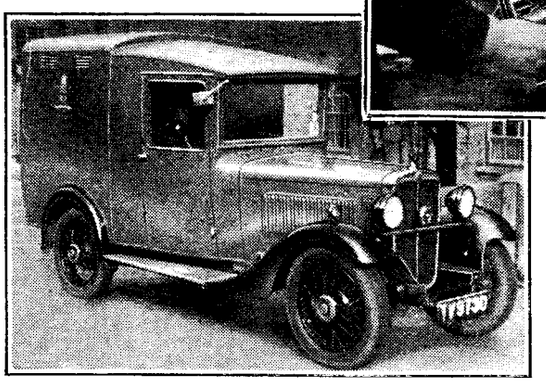
The Association, of which the majority of manufacturers in the Commonwealth are members, intends to start experimental transmissions in Sydney and Melbourne as soon as possible.

Double Fees for Pirates

LAST week we reported the great drive of M. Mandel, the French Postmaster-General, against wireless pirates and his decision to demand double fees from convicted defaulters.

The official declaration aroused such enthusiasm among non-paying listeners that a quarter of a million of them at once took out licences. Thus encouraged, M. Mandel extended the day of grace until November 5th. The post offices were accordingly adorned with an unusual exhortation (to French eyes): "Please to remember the 5th of November."





Photos: The Times.

NOTTINGHAM CITY POLICE construct their own short-wave sets for the new radio patrol service. On the left is a typical wireless-equipped car.

Another Broadcasting House

AN ultra-modern Broadcasting House is to be built in Warsaw by Polskie Radio. It will include studios for a world-wide short-wave broadcasting service.

National Police Radio Station

A NATIONAL police broadcasting station will in all probability be erected at West Wickham, Kent, within the next two or three months. Transmissions will be intended for regional stations in the leading provincial towns, whence they will be relayed to patrol cars.

Some fifty-two radio-equipped police cars now patrol the London area.

Short Waves from Poland

POLSKIE Radio, Warsaw, has inaugurated a short-wave service, and programmes, consisting chiefly of records and music, are broadcast daily, from 5.30 p.m. until 6.30 p.m., on a wavelength of 22 metres. The call sign is S.P.W., and the announcements are made in Polish, English, German, and French. Until a new short-wave transmitter is built, the Post Office Transatlantic telegraphy station at Balice, some eight miles west of Warsaw, is being used, the aerial power being about 10 kilowatts. At present two beams are used, one for China and Manchukuo, where there are many Poles, and the other to South America. An additional beam is being planned for the United States. On some occasions announcements have been also made in Chinese for the Eastern radiation. Good reception of the new service has been reported from all over Europe and abroad. The programmes at present are broadcast from the central studios in Warsaw.

Loud Speakers

TWELVE lectures on 'The Theory and Design of Loud Speakers" are to be given by Dr. N. W. McLachlan, M.I.E.E., on Mondays, commencing November 11th, from 8.30 to 9.30 p.m., at the Polytechnic, Regent Street, London, W.1. The fee for the course of twelve lectures is 10s. 6d.

Mr. Sarnoff on European Radio

CONTRADICTING the opinion held by many European observers who have recently visited the United States, Mr. David Sarnoff, chairman of the American National Broadcasting Company, considers that research in radio and television in Europe is not so far advanced as across the Atlantic. When he returned from his recent European tour he said:—

"While interesting research work is being done in several European countries, the progress being made in our own country is in advance of anything I saw abroad.

"In England the B.B.C., while Government-owned, is nevertheless permitted to exercise a measure of freedom; but in other European countries, especially where dictatorship is the order of the day, radio is primarily used for propaganda purposes."

Prison Radio Abroad

RADIO is an accepted antidote to the discomforts of prison life on the Continent. In Germany higher-grade prisoners are allowed daily listening; in Czechoslovakia the prison inmates are given selected musical and educational programmes, while in Switzerland the loud speakers are installed in the gaol corridors to enable inmates to enjoy broadcasting without having to quit their comfortable cells. In Denmark short-term prisoners are allowed radio, newspapers and tobacco.

In France, however, the gaolbird must sing his own song.

Does Broadcasting Serve

A REGIONAL TOUR

The south-west corner of England and Wales is probably the most difficult to cover, both technically and from the programme point of view. Geological vagaries upset the plans of the B.B.C. engineers, while listeners' racial differences accentuate the problems associated with programme building. Mr. Baily here describes the B.B.C.'s latest efforts to deal with the situation.

III.—The New West Region

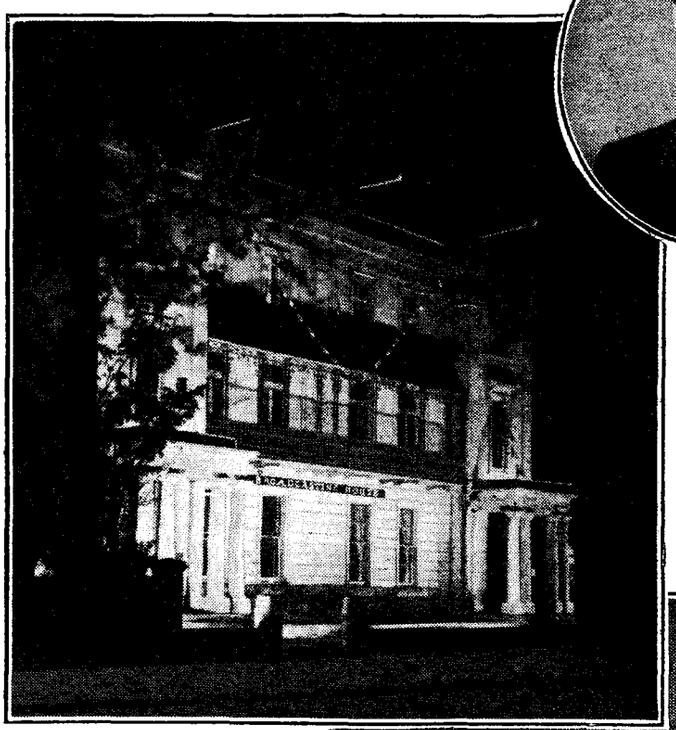
By LESLIE BAILY

THIS week we visit the headquarters at Bristol of the new West Region, which, as I indicated last week, is a sub-division of the old B.B.C. Western Area. The whole of Wales has split off, leaving Sir Noel Ashbridge and his engineering colleagues the pretty problem of building transmitters to serve the West of England with its new programme.

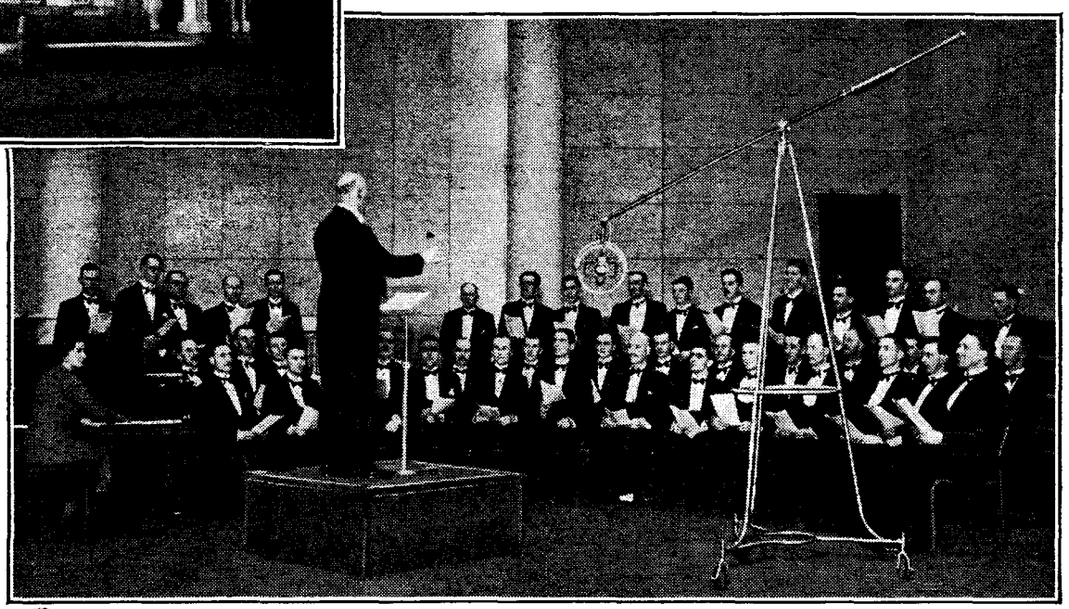
How this is to be done is complicated by the curious shape and geology of the district, which make it the most difficult region in England to cover with an adequate field strength.

Until the new Western transmitters are in being the present West Regional transmitter at Washford Cross will continue to broadcast a combined West and Welsh programme. On the programme side the split has already been made; at Bristol there has been built up a complete Regional programme-organising staff (over 40 all told), the heads of which held their first Programme Board meeting, as a unit independent of Cardiff, during October. Once a week the Programme Director at Bristol confers with his opposite number at Cardiff to portion out time on the wavelength which, for the time being, they have to share.

They are also sharing a Regional Director, Mr. E. R. Appleton, but this dual control cannot last. I predict that Mr. Appleton will move permanently to Bristol, if not to London, and a Welshman will be appointed Welsh Regional Director at Cardiff.



Mr. R. A. Rendall, temporarily "on loan" to the Palestine broadcasting authorities, is Programme Director at Bristol. On the left is Bristol's Broadcasting House flood-lit during the Jubilee celebrations. Choral music is extremely popular in the West. Below is the Exeter Male Voice Choir photographed in the Bristol studio.



The New Transmitters

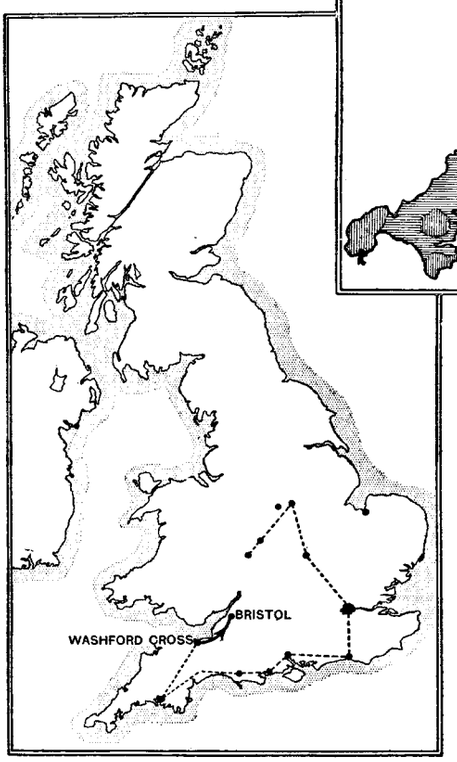
When the split is finally completed the existing transmitter at Washford Cross will become Welsh Regional—the only instance of one region's transmitter being situated in another region! Land-lines will send Welsh programmes from the Cardiff studios to the transmitter on the cliffs of Somerset, whence they will be thrown back across the Bristol Channel to Cardiff and Swansea and all the other heavily populated South Welsh towns, and as far across the mountains into Central Wales as this transmitter can reach.

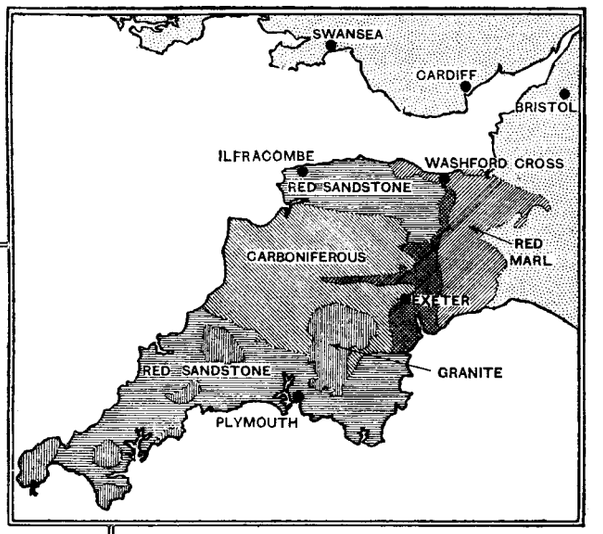
And where will the new West Regional transmitters be? One of many proposals was to have a 100-kilowatt station near Plymouth, to cover the Far West, with a relay near Bristol to serve the northern part of the Region. Another idea is a series of low-power relays.

A mobile transmitter has been exceedingly active in the West for months past, and in this connection I have had the advantage of an explanation from the B.B.C. Assistant Chief Engineer, Mr. Bishop.

Britain ?

OF INVESTIGATION





Geological formations seriously affect transmission in the West Region.

"We are looking around down there in rather an academic way," he said, "to study the attenuation in that part of the country, in addition to actually finding sites. On this research all our future plans depend—where the stations may be, their power and wavelength. Nothing has been decided. Attenuation is a difficult problem in the West, due to the nature of the subsoil."

Now look at my geological sketch map. Washford Cross stands on red marl, which is a favourable subsoil from a radio point of view. Red sandstone is bad—hence the comparatively poor reception which is obtained of West Regional in the Ilfracombe area. This same red sandstone patch includes the Brendon Hills, on which it was originally intended to build the West Regional station, but the attenuation was so bad that the site was shifted seven miles to Washford Cross, although this is a lower altitude: an interesting illustration of how much geology rules the selection of sites for broadcasting.

The carboniferous and granite patches are very deleterious; that is why the placing of a transmitter in the centre of the West Country, which seems geographically the obvious site, would in fact be the worst possible plan.

Such is the problem. It seems pretty clear that at least two transmitters will be needed, in the north and south respectively.

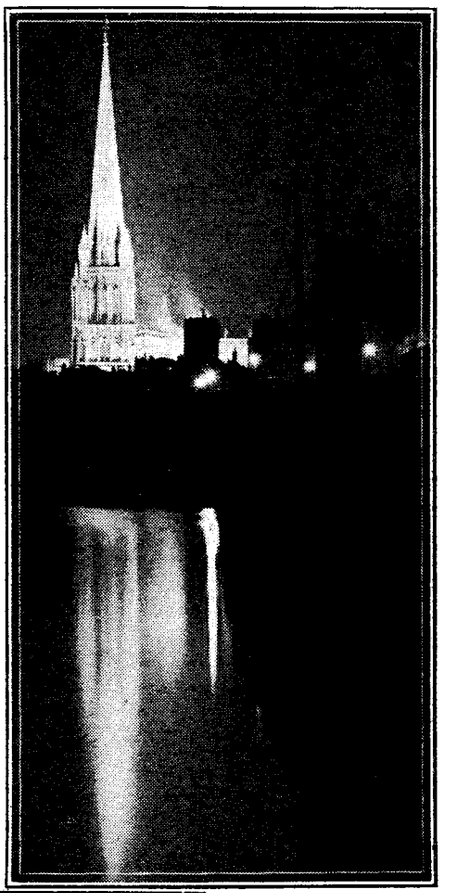
A Programme "Drive"

At Bristol they are not waiting for the engineers to solve the problem; the Western programme "drive" is starting at once. Bristol's Broadcasting House, adapted from two charming old Queen Anne houses, is to be extended by the purchase of another house next door. The "adaptation," by the way, has been done most skilfully, so that the graceful quality of the old houses is not murdered by modernism.

The Bristol Control Room, showing the S.B. and control boards, with the amplifier racks on the right.

How Bristol has rocketed into the B.B.C. firmament! Two and a half years ago Mr. Mills was here as Programme Representative, with a staff of—one typist. Now they are talking of having a pay-list of fifty in the New Year. Several of the chief officials have been transferred from Cardiff to Bristol, including Mr. Cyril Wood (Drama Director).

There is no intention *at present* to establish a permanent orchestra here, but Mr. Reginald Redman (Music Director at Cardiff) is to be transferred to Bristol in the New Year, and Cardiff will engage a new man who will, of course, be Welsh.



A Bristol landmark—St. Mary, Redcliffe, seen from the dockside.

Mr. Mills is still here as chief executive. The Programme Director is Mr. R. A. Rendall, but during his absence on loan to the Palestine Government his job is being done by Mr. Francis Worsley, who will later be sent down to Plymouth to organise the Big Push there.

The keenness with which Mr. Worsley

Does Broadcasting Serve Britain?—

impressed upon me the rich programme potentialities of the West Country augurs well for the future. Here is a region rich in history, graced with seaside resorts famed for their entertainments, and having a population with strong agricultural interests and equally strong maritime traditions. But it is clear that the staff's enthusiasm starts at the top, for the Regional Director, Mr. Appleton, proudly drew my attention to Havelock Ellis's conclusion (after a research into the birthplaces of British geniuses) that the West of England has been the most conspicuous centre of English intellectual energy—and according to Mr. Appleton it still is.

"And so if we're not the best B.B.C. Region we jolly well ought to be," said Mr. Appleton.

Mr. Appleton leads a dual life at present, spending half the week at Bristol, half at Cardiff.

Increased programme activity has caused congestion in the four studios, especially at night, as Bristol (like other provincial centres) has to cope with the fact that performers in plays, etc., are mostly amateurs who can only rehearse in the evenings, when transmissions are also in progress. Hence the extensions next door, where there will be another studio and numerous offices.

Number One studio at Bristol is magnificent. Apart from the Concert Hall at London Broadcasting House, which is in a class apart, this Bristol studio is the most pleasing I know in its proportions and decoration. It is also the largest in the provinces.

Bristol, in fact, has been an eye-opener to me.

Up at the top of the building (to give another instance of the eye-opening process) I found Mr. Daly, the Engineer-in-Charge, who showed me a modern control room and a landline centre of unexpected importance. Changes in the routing of B.B.C. lines have made Bristol a landline "hub" with five spokes. No other provincial centre has so many landline routes to handle. Programmes from London come in by landline *via* Birmingham and are sent on to the transmitters at Washford Cross, at Bournemouth, and at Plymouth, while a fifth route connects Bristol with the studios at Cardiff and Swansea.

Thus all programmes for the Western and Welsh public, whether National, Welsh, or West, pass through Bristol. And soon there will be some more "spokes," going out to the new transmitters.

Last week I told you of my rather depressing journey across Southern England, the B.B.C. No Man's Land. This week I came away from Bristol revived in spirit. In the West a great forward drive is afoot. Areas are to be opened up which have been almost untouched by broadcasting.

Next Tour: *Across Wales.*

All Continents on Ten Metres

THE startling development of the 10-metre band as a practical wave for amateur work may be said to have reached its climax on Sunday, October 27th. On that day Miss Nellie Corry (G2YL) succeeded in working with all five continents in succession.

By making a successful contact with the Indian station VU2LJ, Assam, she becomes the first amateur to qualify for the "W.B.E." (Worked British Empire) Certificate of the R.S.G.B. for 10-metre work.

The contact with VU2LJ was made at 9 a.m., and was followed by VK4BB, Queensland, at 10.30. At 11 a.m. a most surprising contact was made with CX1CG, Uruguay. Europe, Africa, and the U.S.A. followed before 3.30 p.m. on the same day.

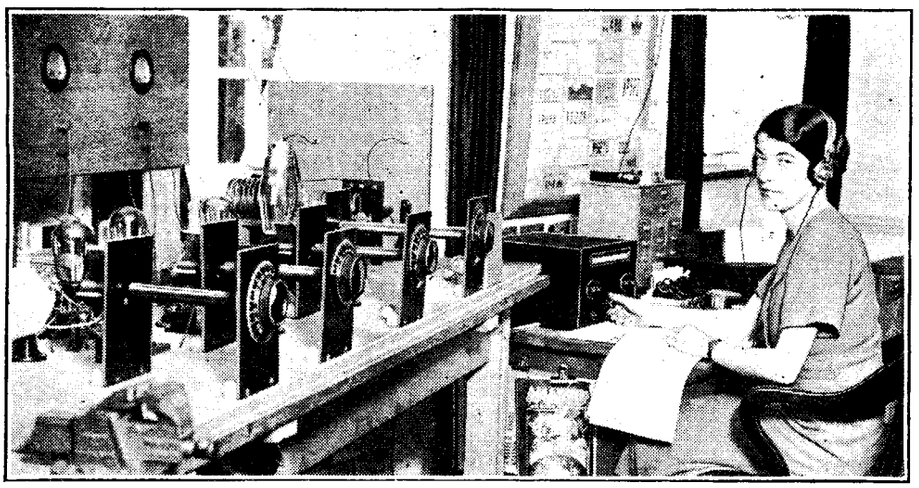
Although contacts with India were made in 1928, when 10 metres was last found suitable for long-distance work, this G2YL-VU2LJ communication is the first of what we may call the "new season."

Other R.S.G.B. members did much successful long-distance work during the week-end, although contacts with South Africa were far more difficult than usual. The two South Africans ZS1H and ZU6P came in consistently during the day, but not at the great strengths at which they have previously been heard.

An interesting reception report concerns the Newfoundland station VO11—believed to be the first Newfoundlander heard in this country on 11 metres.

Very little remains now except the first Great Britain-New Zealand contact. A Finnish station is reported to have worked with ZL3AJ, and it seems probable that the "ZL's" will be heard in this country very shortly.

MEGACYCLE.



Miss Nellie Corry (G2YL), in her den at Walton-on-the-Hill, Surrey, where on Sunday, October 27th, she qualified for the W.B.E. certificate for 10-metre work. Brief details of her log are given above.

News from the Clubs

London Enthusiasts

ONE of the most active amateurs' organisations in London is the International Short Wave Club, which holds meetings every Friday (except the second in the month) at the R.A.C.S. Hall, Cavendish Grove, Wandsworth Road, S.W.8.

Full particulars of membership can be obtained from the Hon. Secretary, Mr. A. E. Bear, 10, St. Mary's Place, Rotherhithe, London, S.E.16.

Pick-ups on Test

Gramophone pick-ups were put to the test at a recent meeting of the Croydon Radio Society at which members were asked to express their preferences for various types of pick-up concealed behind a screen. Mr. Delves-Broughton, who was in charge of the technical arrangements, brought some very old records to assist in judging upper frequency response. They were ideal for the purpose.

At the Society's meeting on Tuesday next at St. Peter's Hall, Ledbury Road, South Croydon, Mr. Delves-Broughton will describe a loud speaker of his own design.

Hon. Secretary: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

North Manchester

The North Manchester Radio Society has just been formed at Whitefield, and now meets weekly at the British Legion at Elms Street, Bury New Road. The Society, which has already planned a number of attractive meetings and visits to places of interest, is open to all radio enthusiasts in Manchester and the surrounding districts. Particulars of membership can be obtained on application to Mr. R. Lawton, 10, Dalton Avenue, Thatch Leach Lane, Whitefield, nr. Manchester.

A Talk on Supersonics

"Supersonics" was the title of a talk given at a recent meeting of the Croydon Wireless and Physical Society by Mr. A. E. Bennett. The speaker was able to put forward some interesting data relative to mechanical and electro-magnetic vibration.

Visitors are warmly welcomed to the Society's meetings. Enquiries regarding membership should be addressed to the Hon. Secretary: Mr. H. T. P. Gee, 51-52, Chancery Lane, London, W.C.2.

New Ealing Society

A wireless society is being formed in the Ealing district, and a meeting will be held on Wednesday next, November 13th, at 8, to discuss details. All who would care to attend are requested to communicate with Mr. H. A. Williamson, 22, Camborne Avenue, West Ealing, W.13.

Wireless and Light

Mr. A. S. Gosling (G2VC) will lecture on "Wireless and Light," with demonstration, at a meeting of the Bradford Experimental Radio Society on Wednesday next, November 13th, at Cambridge House, 66, Little Horton Lane, Bradford.

Re-Creating an Old Set—II.

Another Method of Using Diode Detection.

By W. MACLANACHAN

IN a preceding article (Oct. 25th issue) the conversion of obsolescent "straight" sets for local-station reception was discussed. The author now goes on to show how the original detector, when it is to be replaced by a diode detector, may be changed into an aperiodic HF amplifier.

WHEN considering alterations to an old or second-hand set of the HF-det.-LF type, the most promising line of attack is generally in the direction of improving reproduction. A worth-while gain in quality—particularly with regard to definition—can generally be obtained by coupling a high-voltage diode to the output valve without any intermediate stage of LF amplification. As every type of LF coupling is liable to introduce distortion,

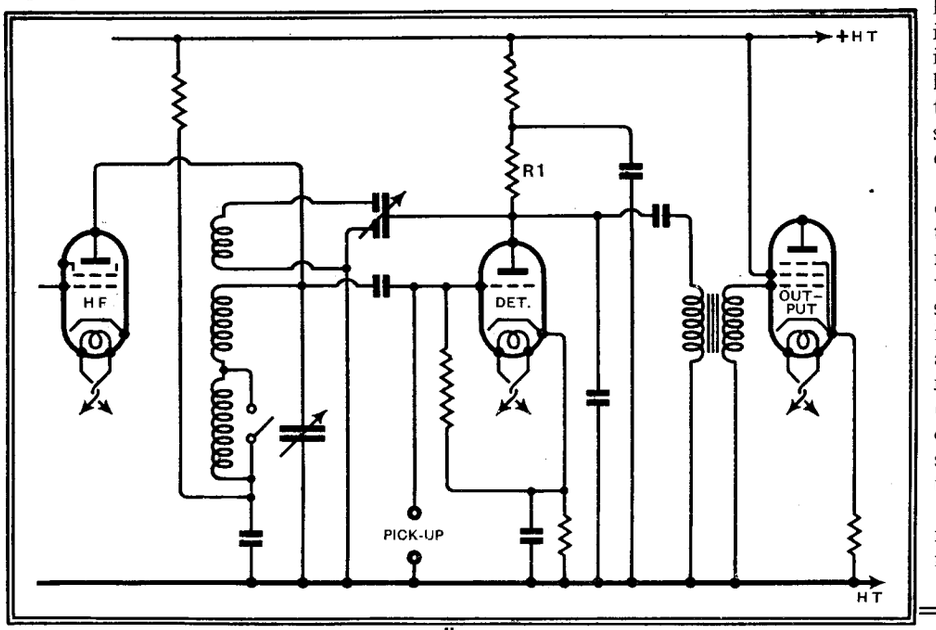


Fig. 1.—Typical detector stage with grid detection and tuned anode HF coupling.

of some form or other, the fewer the couplings and the simpler the circuit, the less the risk of trouble. The safest method is to have only one coupling and to use the resistance-capacity system for that purpose.

In some of the old commercial sets that are now obtainable at ridiculously low prices, the output given by the single HF stage on the local station is not quite sufficient fully to load an output pentode through the intermediary of a diode, and, even though quality of reproduction will often persuade one to leave things as they are, a simple way of overcoming this limitation may be tried.

In a typical receiver such as that shown in Fig. 1 the detector valve can be converted into an additional HF amplifying stage by using an aperiodic resistance coupling and appropriately biasing the valve for its new function. As shown in Fig. 2, coupling to the new detector, a simple diode, can be effected by making the diode circuit consist of a choke (No. 1), a load resistance R, and an HF filter circuit formed by choke No. 2 with the associated by-pass condensers C2 and C3. Suitable values for the components are: C1, 0.00005 mfd; C2, 0.0001 mfd; C3, 0.0001 mfd; and C4 (the LF coupling condenser), 0.1 mfd. R may be 50,000 to 100,000 ohms and R1 about 10,000 ohms, while both HF chokes should preferably be screened.

During initial experiments the reaction circuit must be entirely disconnected, or hopeless instability may ensue. Reaction in a modified form may afterwards be introduced, if required. Its inclusion will help to offset the damping imposed on the tuned circuit preceding the aperiodic stage. An exceptionally small reaction condenser may be required.

On the constructional side the change does not, as a rule, present any difficulties. The additional valve holder may be mounted between the detector and output valves and, as there is not likely to be a spare hole already drilled in the base plate, it will be easiest to use one of the standard above-baseboard holders. The removal of the LF transformer previously employed will leave enough room for the chokes and coupling condenser. The smaller components can be suspended in the wiring.

In battery sets the extra filament current taken by the diode valve is immaterial, but on AC mains sets with poor

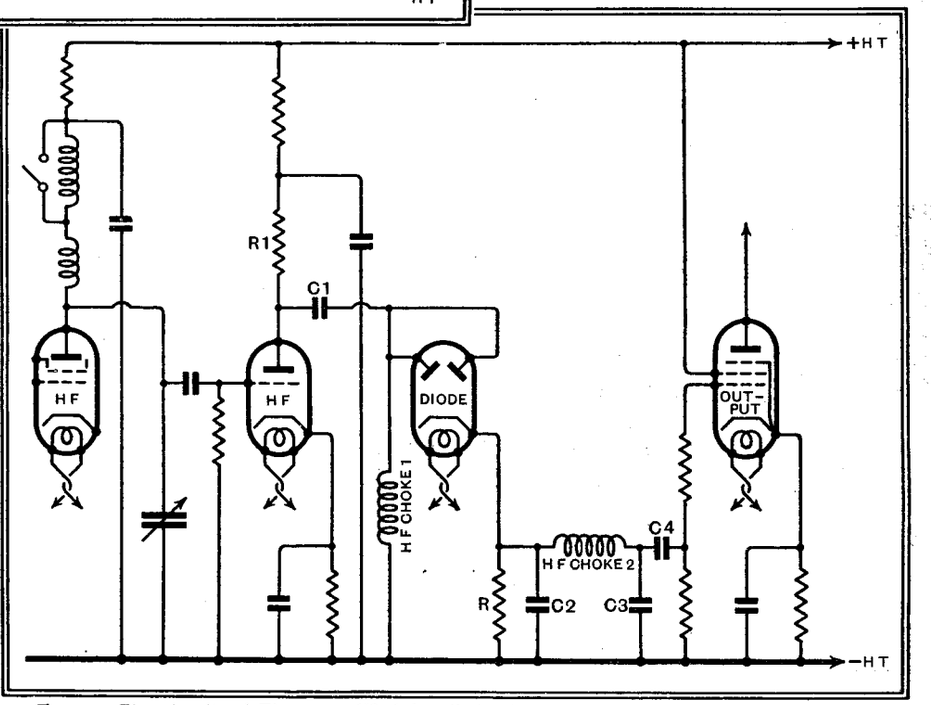


Fig. 2.—The circuit of Fig. 1 modified for diode detection. Original detector converted into an aperiodic H.F. amplifier.

Re-Creating an Old Set—II—

voltage regulation the additional drain on the heater winding may cause the transformer to overheat. In this event the removal of the pilot lamp (if it happens to be of the high-consumption type) may ease the situation. Suitable diode valves are: Cossor DD4, 0.5 amp.; Mazda V914, 0.3 amp.; Mullard 2D4A, 0.65 amp.

The triode previously used in the set as the power grid detector will usually act efficiently as the aperiodic amplifier, and, as far as the grid circuit is concerned, the only alteration normally required is to connect the lower end of the grid leak to the chassis instead of the cathode—provided that provision was made in the conventional manner (see Fig. 1) for gramophone reproduction. But, where there is no biasing resistance, the appropriate cathode resistance for the valve must be added.

Biasing the grid will greatly decrease the anode current and, consequently, increase anode voltage; so much the better for our present purpose, and it is suggested that the original decoupling resistance may be retained.

An alternative coupling very rarely used in recent years by manufacturers was the directly connected LF transformer. In this case a resistance of from 10,000 to 15,000 ohms should be inserted between the decoupling resistance and the valve anode to act as the HF coupling. A decoupling resistance of from 3,000 ohms to 20,000 ohms, depending on the voltage available, should be incorporated. The decoupling condenser for HF need not exceed 0.1 mfd, although larger values can be used if there are any spare ones in the set.

Receivers of this type employing an SG valve as a detector may be converted in a similar manner. It will often be found, when the valve rectifies on the anode bend principle, that the screening grid is fed direct from the HT line through a 0.5-megohm or even a 1-megohm resistance with a 1-mfd by-pass condenser. The actual screen potential must, for the new function of the valve, be considerably increased. A potentiometer should be employed, with values arranged to provide about half the voltage applied to the anode. The cathode resistance is bound to be of too high a value, and so should be removed, the correct value for amplifying conditions being substituted in its place.

Short-wave Topics

By J. GODCHAUX ABRAHAMS

DURING the past few months considerable activity has been noted in most countries, both European and overseas, in respect to the development of radio telephony transmissions on short waves, namely, on channels below 50 metres.

In addition to the new installations which are being carried out by the B.B.C. for the improvement and extension of the Empire service, we find that similar, if not even more important, developments are taking place in Germany, Italy, and France, not to mention Poland, Czecho-Slovakia, and other European States—all, in every instance, anxious that their transmissions should be heard not only far beyond their immediate frontiers, but that they should also be available to their nationals overseas, and especially in the North American continent.

The extension of these various broadcast services, and in particular the increased power to be used for their transmission, will prove of great benefit to listeners on short waves in the United Kingdom, first, for the reason that their capture will be considerably facilitated, in view of strength of signals, by comparatively simple one-, two- or three-valve wireless receivers, and, secondly, because on most occasions the programmes offered by these stations are of outstanding general interest; they are, as a rule, the best the country can offer. Moreover, it will be found that many of the entertainments broadcast specially to distant listeners differ from those which are available to us on the medium or long wave band.

It is due to the activity which now prevails that so many foreign stations can be heard testing at odd times on what are to us unfamiliar channels. For this reason it is useful to know the frequencies which have been allotted to the transmitters, and a careful note should be made of them.

If all her plans mature, Germany by 1936 should possess the most powerful short wave broadcasting system in the world; it is her ultimate aim to transmit programmes daily in five different languages. Four new 50-kilowatt stations are in course of erection at Zeesen, and these are to be equipped with beam aerials permitting directional transmission to both American continents, Asia, Africa and Australia. At present broadcasts are already made in German, Dutch, English, Spanish and Portuguese, but it is likely that other languages may be added in the near future. The channels allocated to this German short wave broadcasting system are as under:—

Call.	Metres.	Kilocycles.	Kilowatts.
DJE	16.89	17,760	5
DJR	19.56	15,340	50
DJQ	19.63*	15,280	50
DJB	19.74*	15,200	5
DJL	19.85	15,110	5
DJP	25.31*	11,855	50
DJO	25.43*	11,795	50
DJD	25.49*	11,770	5
DJA	31.38*	9,560	5
DJN	31.45*	9,540	50
DJM	49.35	6,079	50
DJC	49.83*	6,020	5

Italy, also, during the past few months has been concentrating all her efforts on the development of her short wave broadcasts, and for the benefit of her nationals, as well as other listeners abroad, has increased considerably the news service and features of general information in the programmes. These broadcasts are also given in several European languages, including French, English, German and Spanish. Additional 20-kilowatt transmitters are being added to the system, and will be in operation during 1936. The channels at her disposal are as follows:—

Call.	Metres.	Kilocycles.	Kilowatts.
—	11.69	25,650	20
—	13.95	21,510	20
—	16.88	17,770	20
—	19.62	15,290	20
—	19.70	15,230	20
12RO4	25.40*	11,810	20
12RO	30.67*	9,780	20
12RO3	31.13*	9,635	20
—	31.25*	9,600	20
12RO2	42.98	6,980	20
12RO	48.7	6,170	20
—	49.3	6,085	20
12RO1	49.46	6,065	20
12RO	52.4	5,725	20
12RO	53.0	5,660	20
12RO	53.48	5,610	20
12RO	54.01	5,555	20
12RO	80.0	3,750	20

Channels marked * are already in use.

Whilst on the subject of Italian transmissions, it is interesting to note their topicality in regard to the present Abyssinian campaign. Considerable traffic is maintained between IDU, Asmara (Eritrea), and Coltano, near Pisa. IDU, a 5-kilowatt station working on 22.42 metres (13,380 kc/s), with its opposite number IAC, now prepares the way at G.M.T. 15.30 for a series of war bulletins which at G.M.T. 16.00 the E.I.A.R. studio broadcasts through its entire network. Following the recent talks from Asmara and Addis Ababa (Abyssinia) by American war correspondents for relay to the N.B.C. and C.B.S. systems in U.S.A., the Italian authorities now intend to let their own representatives give running commentaries of topical events, to be transmitted *via* Asmara, for rebroadcast in Italy, on the medium wave band.

So far Polish programmes, except on special occasions, have not been available to listeners on short waves. During the past fortnight, however, tests have been carried out with a relay from the Warsaw studio through a 20-kilowatt station SPW, hitherto used for traffic with the U.S.A., Japan and Europe on 22 metres (13,635 kc/s). Most of the experimenting is done during the afternoon hours, and there is no difficulty in identifying the origin of the signals, since announcements are given out in Polish, German, French, English and Italian. Regular references are also made to Polskie Radio Warszawa, as in the case of the long wave station. It is, no doubt, this transmitter (SPW) which will be taken over by the Polish broadcasting authorities for the regular radiation of programmes destined for Polish nationals overseas; in particular, in the North American continent.

Czecho-Slovakia, also, is keen on establishing a similar service, and will use two stations installed at Podebrady, namely, one of a power of 20 kilowatts operating on 19.70 metres (15,230 kc/s) and a second transmitter (34 kW) using a channel of 25.54 metres (11,745 kc/s).

France, as we are now able to realise, is not only completely reorganising her medium and long wave broadcasting network, but is also feverishly working on a reconstruction of the Colonial service. The

Short-wave Topics—

new short wave station which is being constructed at Palaiseau-Villebon, close to the site of the high power P.T.T. transmitter, which is to replace that of the Ecôle Supérieure, will eventually prove to be capable of radiating 80 kilowatts in the aerial.

Casual mention must also be made of new installations proposed by Austria, Hungary, Portugal, Spain, Sweden, Romania and Norway. Some of these countries, I am well aware, have already possessed experimental transmitters for some time, but regular daily services are to be inaugurated, as in common with other States they realise that through these channels alone can they hope to reach other continents.

It is not within the scope of this article to enumerate the numerous centres from which the possessor of a suitable receiver can secure interesting transmissions; but attention must be drawn to the fact that through the agency of the short wave channels it is often possible to pick up transmissions which are not available to us by other means. I have in mind, for instance, the programmes which the National Broadcasting Company of America propose to broadcast during the coming winter. As an example, every Sunday evening from G.M.T. 19.00-20.00 we are to hear relays of transmissions from Japan, Canada and Hawaii. Further, under the title of "The Magic Key of the R.C.A.," the N.B.C. also forecasts a series of entertainments by noted artists from European cities—as well as a series of concerts sponsored by the General Motors Corporation. The latter are to take place every Sunday between 22.00-23.00 E.S.T., or G.M.T. 03.00-04.00 (Monday). European relays will be taken by W8XK, East Pittsburgh (Pa.), 19.72 metres (15,210 kc/s); W8XAL, Boundbrook (New Jersey), 16.87 metres (17,780 kc/s); and W1XK, Millis (Mass.), 31.35 metres (9,570 kc/s); the G.M.C. concerts by W8XK, East Pittsburgh (Pa.) and W2XAF, Schenectady (New York), 31.48 metres (9,530 kc/s). As the orchestra numbers sixty-five instrumentalists, and will be conducted by such celebrities as Arturo Toscanini, Sir Thomas Beecham, Bruno Walter, Leopold Stokowski (of the Philadelphia Philharmonic Orchestra), Igor Stravinsky and others, on those days the N.B.C. audience should run into millions.

There is little doubt that 1936 will offer to the listener on short waves the same wealth of entertainment as he now receives on the broadcasting band.

BOOK REVIEW

The Cathode-Ray Tube at Work. By John F. Rider. 322 pages + ix. 440 illustrations. Published by John F. Rider, 1440, Broadway, New York City, U.S.A. Price $2.50.

THE aim of this book is primarily to show how the cathode-ray tube may be applied to the servicing of wireless receivers, and as the author rightly believes that full advantage cannot be taken of any apparatus unless its mode of operation be thoroughly understood, the early chapters are devoted to a description of the cathode-ray tube, its operating principles, and time-base systems. One chapter is given up to describing current commercial cathode-ray gear of American manufacture.

The applications of the tube to servicing are treated in detail, and it is shown how it may be used for the measurement of current and voltage, the comparison of frequencies, and for the study of waveform. The location of distortion with its aid is treated with particular reference to amplitude and phase distortion. An important section is that devoted to the cathode-ray tube in relation to tuned circuits. This is probably the most valuable application of the tube to service work, and no fewer than fifty-four pages are devoted to a description of the principles involved, commercially available gear, and practical difficulties. Transmitting problems and the use of the tube in their solution are briefly touched upon.

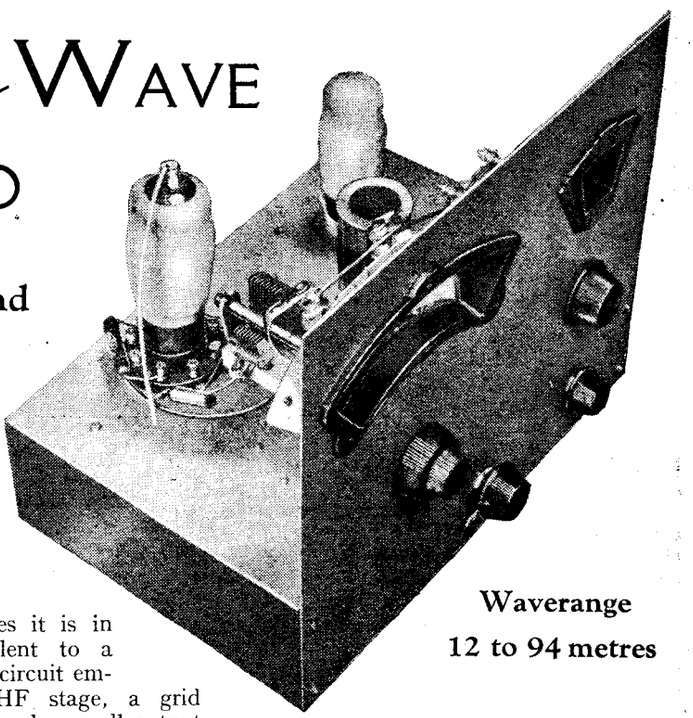
The author is obviously convinced of the value of the cathode-ray tube as an aid to servicing. While there is no doubt that it can be of enormous help in certain aspects of wireless, it is a debatable point whether it can be of such great assistance to the service man as the author believes.

The book should, however, prove of inestimable value to all those interested in the application of the cathode-ray tube to receiver testing, as well as to those who wish to obtain an insight into its uses and limitations. It is well printed and bound and copiously illustrated with photographs of oscillographs. W. T. C.

In Next Week's Issue

SHORT-WAVE TWO

A Sensitive and Economical Headphone Receiver



Waverange 12 to 94 metres

ALTHOUGH this battery-operated receiver embodies only two valves it is in every respect equivalent to a three-stage set, as the circuit employed includes an HF stage, a grid detector with reaction and a small output valve.

Its sensitivity is, therefore, quite adequate for good headphone reception of all the principal short-wave broadcast stations, in addition to which special care has been taken in its design to render it suitable for the needs of the amateur experimenter interested primarily in DX work.

A system of band-spread tuning is incorporated which enables the frequencies covered by a small part of the main tuning condenser to be opened out to occupy the full scale of the band-spread condenser. This feature is, of course, applicable to all parts of the wave-band. Interchangeable coils are fitted and three of these together cover a waverange of 12 to 94 metres.

LIST OF PARTS

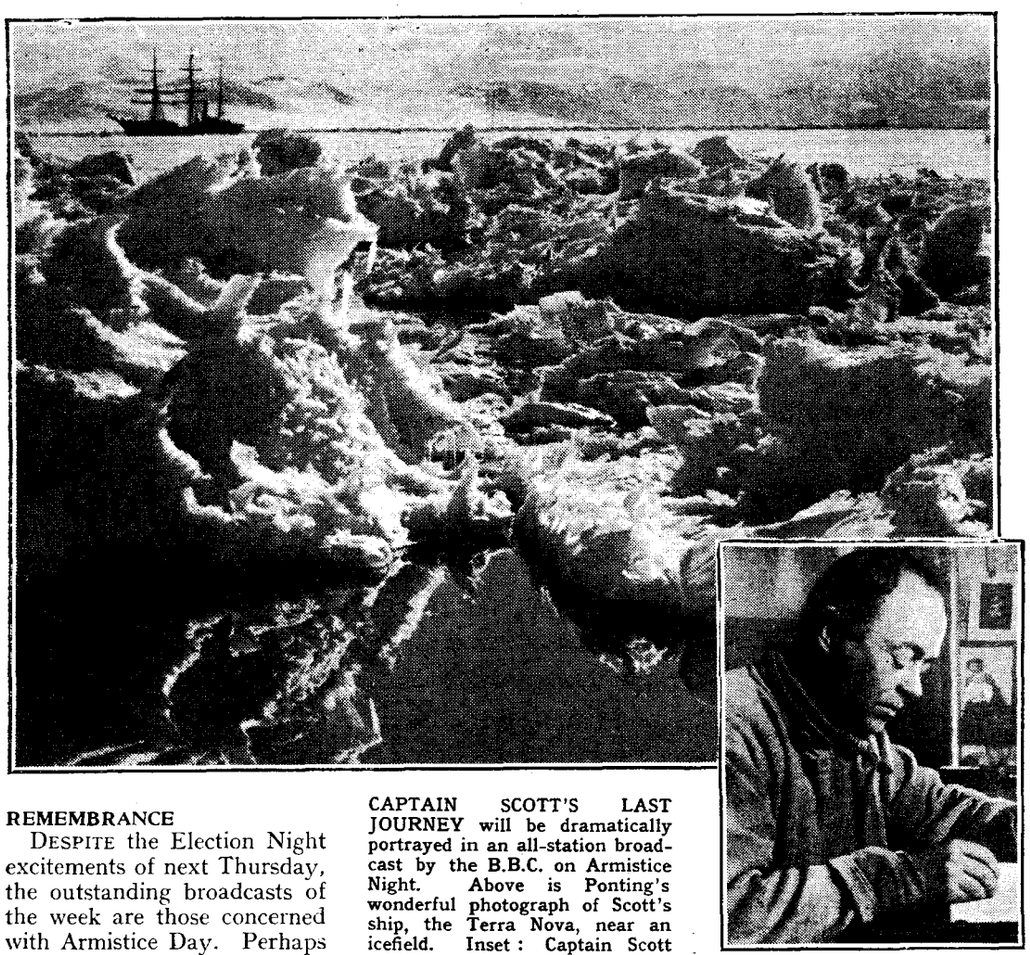
After the particular make of component used in the original model, suitable alternative products are given in some instances.

1 Variable condenser, 0.00016 mfd. **Polar Type "E"**
1 Two-ratio s-m drive **Polar "Micro Drive Arcuate"**
1 Slow-motion reaction condenser, 0.0002 mfd. **Polar "QJ"**
(Eddystone)

1 Single-ratio slow-motion drive **Polar "Panel Mounting Drive"**
1 Variable condenser, 15 mmfds. **Eddystone Microdenser**
3 Dial lamps, 2 volts **Bulgin B206**
3 6-pin coils covering 12-94 metres **Eddystone types 6LB, 6Y and 6R**
1 6-pin coil base **Eddystone 969**
1 Valve holder, 9-pin, baseboard mounting **Bulgin VH31**
1 Short-wave valve holder, 5-pin, chassis mounting **Bulgin SW41**
(Clix)
1 Single pole on-off rotary switch **Bulgin S91**
1 LF transformer, 1:3 **Graham Farish "Pip"**
(Claude Lyons)
1 Short-wave HF choke, screened **Eddystone 983**
1 Fixed condenser, 0.01 mfd., mica **Graham Farish**
1 Tubular condenser, 0.0001 mfd. **Graham Farish**
1 Tubular condenser, 0.01 mfd. **Formo**
(Bulgin, Dubilier, Polar-N.S.F., T.C.C.)
1 Fixed condenser, 0.1 mfd. **Formo Screened Paper type**
1 Grid leak, 2 megohms **Formo Formowatt**
1 Resistance, 20,000 ohms 1 watt **Formo Formowatt**
(Dubilier, Erie, Claude Lyons, Polar-N.S.F.)
1 5-way connector **Bryce**
1 5-way battery cable, 30in., with wander plugs and spade ends **Belling-Lee**
4 Ebonite shrouded terminals, A, E, Phones (2) **Belling-Lee "B"**
1 Grid bias battery, 4½ volts
3 Wander plugs, 1 black, 2 red **Eelex**
1 Valve connector **Bulgin P41**
(Belling-Lee, Clix)
1 Paxolin tube for aerial coil, 1in. long × 1in. dia. (see text)
Quantity No. 18 gauge sheet aluminium for chassis and panel
Quantity No. 18 s.w.g. tinned copper wire and insulated sleeving
1 piece 6BA screwed rod, 1½in. long
Screws—20 6BA ¼in. R/hd., 3 6BA 1in. R/hd., 2 6BA 1in. C/sk., 27 6BA nuts
Valves:—1 PT22, 1 L2 **Mazda.**

★ ★ Listeners' Guide fo

Outstanding Broadcasts



CAPTAIN SCOTT'S LAST JOURNEY will be dramatically portrayed in an all-station broadcast by the B.B.C. on Armistice Night. Above is Ponting's wonderful photograph of Scott's ship, the Terra Nova, near an icefield. Inset: Captain Scott writing his diary.

REMEMBRANCE

DESPITE the Election Night excitements of next Thursday, the outstanding broadcasts of the week are those concerned with Armistice Day. Perhaps no other transmissions during the year bring about such a unity of spirit among the listening millions.

Possibly the most poignant moment of the year follows the sounding of the Last Post at the Cenotaph on November 11th. The King, supported by other members of the Royal Family, is expected to attend. As in previous years, the music will be given by the Massed Bands of the Brigade of Guards. The Two Minutes' Silence, following the striking of 11 o'clock by Big Ben, will be ended by the salute of guns in St. James's Park. The service, conducted by the Bishop of London, will then be heard.

The British Legion will again broadcast a part of the Festival of Remembrance at the Royal Albert Hall on Monday evening at 8 (Nat.). The atmosphere of this festival, which was first relayed in 1927, is unique. A description of the scenes will be broadcast by Lt.-Commander R. Woodroffe, and among the units taking part will be Chelsea Pensioners, Women's War Organisations, and the boys of the training ship "Stork."

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CAPTAIN SCOTT'S LAST JOURNEY

DEPARTING from the custom of relaying a war play on Armistice Night, the B.B.C. will on Monday give us a programme dealing with acts of gallantry and self-sacrifice in times of peace. Val Gielgud and Peter Creswell have prepared a chronicle drama of Captain Scott's last journey to the South Pole, in which he and a small band of his followers perished. Scott, writing to his wife, said characteristically: "After all, it is the work that counts, not the applause that follows."

The characters portrayed will include Captain Robert Falcon Scott, R.N.; Sir Clements Markham, President of the Royal Geographical Society; Dr. Adrian Wilson ("Bill"); Lt. Edward R. G. R. Evans ("Teddie"); Captain Lawrence T. G. Oates, 6th Inniskilling Dragoons ("Titus" or "The Soldier"), and Lt. H. R. Bowers, Royal Indian Marines ("Birdie").

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"AMONG THE GREATEST"

A YOUNG Russian pianist—Tina Lerner—is giving a recital in the National programme on Tuesday next (8). According to the B.B.C., it is no exaggeration to class this talented lady among the greatest living pianists. She has appeared with such eminent conductors as Sir Edward Elgar, Felix Weingartner, Chevillard, and Mengelberg. With such a glowing introduction this recitalist should be well worth tuning in.

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TUNE AND TEMPO

BRYAN MICHIE has assembled a promising cast for to-morrow's night variety hour which he has entitled "Tune and Tempo" (Nat. 8.30). Clarice Mayne is a bright attraction, but another name not so well known to British radio is Margaret Carlisle, an American girl married to an Englishman. You may have heard her in the leading rôle in "Viktoria and her Hussar" and in Noel Coward's "Words and Music." To-morrow we shall hear her singing "Bill" from the "Show Boat"; "I'll Follow my Secret Heart" from "Conversation Piece"; and "Good-night" from "Viktoria and her Hussar." Also in the cast are Larry Adler, Mario Lorenzie, Marjorie Stedeford, the Rhythm Brothers, Stanley Kirkby, and Frederick Gardner and his Rhythm Six.

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WHO IS HE?

MYSTERY cannot be overdone where broadcasting is concerned. It is one of the prime lures to the loud speaker, and the B.B.C. do well to exploit this fact as in the case of the Vagabond Lover, who appears before the microphone for the first time on Thursday next, November 14th (Reg., 9.40).

Who is he? All I am permitted to say is that he is an artist who possesses great voice appeal and is also a brilliant violinist. The intention is to feature the Vagabond Lover fortnightly in programmes specially for those listeners who enjoy an atmosphere of romance created by an anonymous artist.

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PRIESTLEY PLAY

THE straight play with plenty of bright conversation can always be converted into radio drama. J. B. Priestley's play "Eden End" will be heard in a broadcast version by Barbara Burnham on Tuesday (Reg., 8.30). This is a quite recent play dealing with pre-war happenings in the North of England. The action takes place in the sitting-room of Dr. Kirby's house at Eden End in October, 1912.

The picture opposite gives a good idea of the setting.

r the Week

at Home and Abroad

ELECTION NIGHT

To the sympathetic strains of light music we shall hear of the triumphs and defeats of Election candidates from 10 p.m. on Thursday to 4 a.m. on Friday on the National wavelength.

Those curious enough to sit up throughout the six hours will gain a tolerably fair idea of the final state of the parties, for at least one half of the results may be expected before the sleepy-eyed announcer bids us "Good morning, everyone, good morning."

OPERA ABROAD

THE next seven days are unusually rich in operatic broadcasts.

To-night at 7 Beromunster relays Ferrari's "Le Donne Curiose" ("The Inquisitive Ladies") from the Basle Municipal Theatre, Pergolesi's very popular "La Serva Padrona" comes from Warsaw at 7.10, and Brussels No. 1 gives a gramophonic version of Donizetti's "Lucia di Lammermoor" at 10.25.

"Salome," Richard Strauss' opera based on Oscar Wilde's play, comes from Brussels No. 1 at 8 to-morrow evening (Saturday), though perhaps a greater attraction to opera lovers will be Weber's "Der Freischütz," from Rome at 7.50 on the same evening.

Sunday brings us Verdi's "Masked Ball," relayed by Kalundborg from the Theatre Royal, Copenhagen, at 8.

OPERETTA

GERMAN composers are to the fore in to-night's operetta transmissions. To-night brings "Schach dem König" (Goetze) from Cologne at 7.10; "Marietta" (Oscar Straus) from Radio-Paris at 8.45, and "Green Parrot's Escape" (Weisbach-Börschel) at 7.45 p.m. from Königsberg.

Audran's operetta "Grand Mogol" comes from Brussels No. 1 at 8 on Wednesday.

CATHEDRAL BROADCAST

SUNDAY'S outstanding musical event is a relay from Strasbourg at 2.45 of the inauguration ceremony for the new organ in Verdun Cathedral. Marcel Dupré, the famous organist, will give a recital, and Germaine Martinelli and Paul Cabanel will sing.

ARMISTICE DAY ABROAD

ARMISTICE programmes figure largely in the French and Belgian broadcasts this week. On Sunday at 8 Brussels No. 1 will give a military band concert dedicated to the Allies of 1914 to 1918. In the interval a play by Fleischman entitled "November 11th" will be performed in French. At 3.30 on Monday Radio-Paris transmits a play, "The Unknown Warrior's Grave."

VERDI. The life of Italy's great operatic composer will be set forth in a feature programme by the B.B.C. Theatre Orchestra and Chorus on Sunday evening. (Nat. 9).

"LONDON"

LONDONERS who like to see themselves as others see them should tune in Copenhagen at noon on Sunday for an English talk by Mr. E. Wolff on "Back-stage London."

HITLER IN GERMAN RELAY

THE exhumation of Nazi combatants who fell in the abortive rising of 1923 is the subject of a radio report from all German stations at 10.30 to-night. After the disinterment will be heard the march of the Führer and his followers.

A TENSE MOMENT in "Eden End," the play by J. B. Priestley which figures in the Regional programme on Tuesday. (Left to right) Beatrix Lehmann, John Teed, Ralph Richardson and Alison Leggatt, who appeared in the original production at the Duchess Theatre last year.

NOVELTIES

COPENHAGEN: Hebrew airs by the Jewish Choir, "Hasomir." (Tuesday, 7.)

RADIO-PARIS: National dances of Portugal, Italy, Romania and Cuba. (Saturday, 7.)

LEIPZIG: Hitler Youth Speaking Choir. (Friday, 7.10.)

THE AUDITOR.

HIGHLIGHTS OF THE WEEK.

FRIDAY, NOVEMBER 8th.

Nat., 8, Maria Elsner in "The Countess Maritza." 9.15, Piano Recital by Ernest Lush. 9.40, Election Address by the Rt. Hon. Stanley Baldwin.

Reg., 7.35, B.B.C. Orchestra. 8.45, Kutcher String Quartet. 10.30, Harry Roy and his Band.

Abroad.

Frankfurt, 7.10, "Eine Faust-Sinfoine" (Liszt) with Station Choir and Orchestra.

SATURDAY, NOVEMBER 9th.

Nat., 5.30, "Five Hours Back" (from America). ¶"Tune and Tempo," B.B.C. Orchestra. ¶B.B.C. Dance Orchestra.

Reg., Oriana Madrigal Society. ¶Recital by Iso Elinson (piano) and Francis Russell (tenor).

Abroad.

Paris P.T.T., 8.30, Cabaret: Part I—Song Tour; Part II—Revue, "Salade d'Automne" (Max Blot).

SUNDAY, NOVEMBER 10th.

Nat., Fleet Street Choir, relayed from St. George's Chapel, Windsor. 9, The Life of Verdi.

Reg., B.B.C. Military Band. ¶Commodore Grand Orchestra. ¶Sunday Orchestral Concert, conducted by Sir Henry J. Wood.

Abroad.

Kalundborg, 8, Opera: "The Masked Ball" (Verdi), relayed from Theatre Royal, Copenhagen.

MONDAY, NOVEMBER 11th.

Nat., 10.30 a.m.–11.10 a.m., Cenotaph Service of Remembrance. 8 p.m., Festival of Empire 9.30, "Captain Scott."

Reg., Recital by Parry Jones (tenor). ¶B.B.C. Orchestra.

Abroad.

Radio-Paris, 4.30, Oratorio "Redemption" (Gounod), relayed from Strasbourg Cathedral.

TUESDAY, NOVEMBER 12th.

Nat., Piano Recital by Tina Lerner. 8.30, Songs from the Shows. ¶Gershom Parkington Quintet.

Reg., B.B.C. Theatre Orchestra. 8.30, "Eden End," by J. B. Priestley. 10.30, Lew Stone and his Band.

Abroad.

Leipzig, 7.10, "The Leipzig Tuesday Edition"—Variety.

WEDNESDAY, NOVEMBER 13th.

Nat., 8.30, B.B.C. Third Winter Symphony Concert, conducted by Sir Henry J. Wood. ¶"The Table Under the Tree." ¶Roy Fox and his Band.

Reg., Leslie Bridgewater's Quintet. 8.15, Songs from the Shows. ¶B.B.C. Military Band.

Abroad.

Deutschlandsender, 7.45, Grand Concourse of Choirs, including Berlin Cathedral Choir.

THURSDAY, NOVEMBER 14th.

Nat., 8.30, Sandy Powell's Road Show. ¶B.B.C. Theatre Orchestra. 10 p.m.–4 a.m., Election Results.

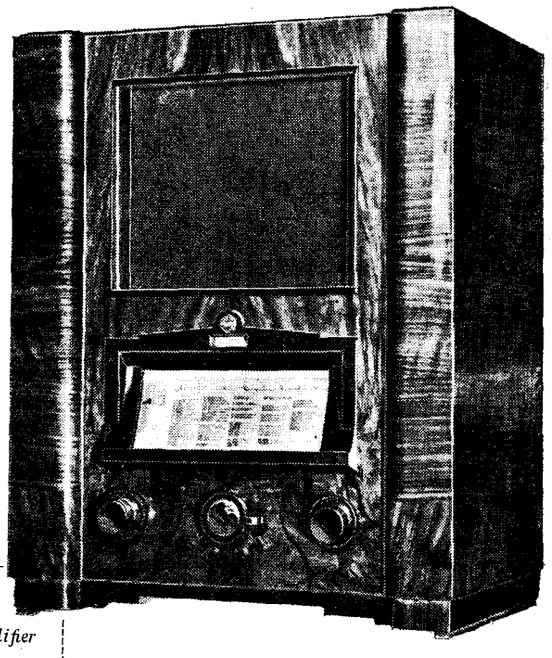
Reg., 7.30, Hallé Concert conducted by Dr. Malcolm Sargent. ¶The Vagabond Lover.

Abroad.

Kalundborg, 7.10, Eighth Thursday Symphony Concert. French Music. Conductor: Malko.

Philips MODEL 575A

An All-Wave Superheterodyne of Advanced Design



THE reputation which Philips' products have enjoyed for originality of design and the high technical standard of their construction is advanced a stage further by this comprehensive receiver. The inclusion of a short-wave range is in itself a powerful attraction, but in our view it is the many incidental features contributing to ease of operation and refinement of performance which mark this as a set out of the ordinary. So many receivers in these days are a fixed compromise between the conflicting factors of selectivity and quality of reproduction that it is refreshing to find a set in which no effort has been spared to make it excel in all departments.

More than usual attention has been given to the question of quality of reproduction. A large-capacity triode is used in the output stage and the permanent magnet moving-coil loud speaker has an unusually low resonance frequency approaching 50 cycles. Special tone correction circuits are associated with the second detector and low frequency couplings, and the tone control is compensated to avoid loss of bass at low volumes.

The inclusion of a variable selectivity control enables the user to adjust the set for the best performance either from the point of view of quality or selectivity. Another refinement is the provision of an adjustable threshold sensitivity control which overcomes the unpleasant effect of background noise between stations.

FEATURES.—***Type.***—*Table model AC instrument for short, medium and long waves.* ***Circuit.***—*Var.-mu pentode HF amplifier—octode frequency changer—IF amplifier—double-diode-triode second detector—triode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Tuning. (2) Volume and on-off switch. (3) Variable selectivity. (4) Waverange. (5) Noise Suppressor.* ***Price.***—*18½ guineas.* ***Makers.***—*Philips Lamps Ltd.*

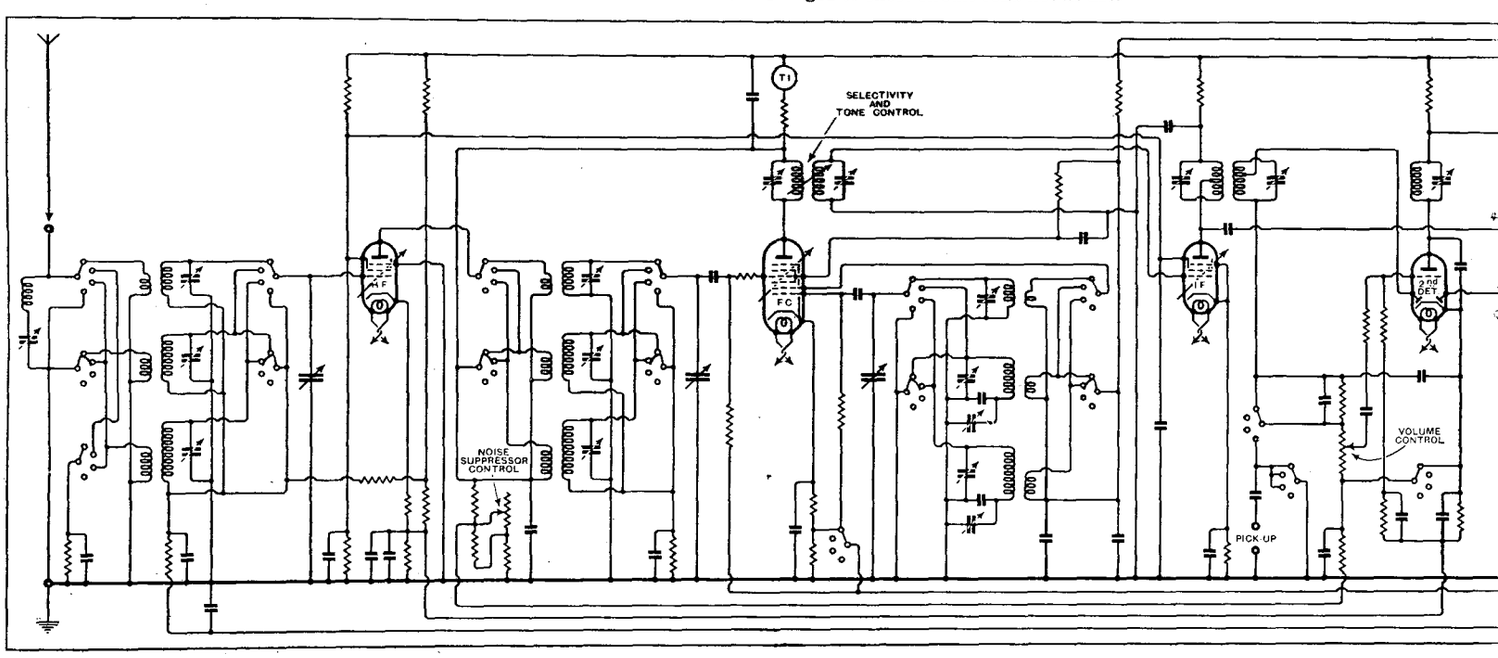
The conditions for optimum short-wave performance have been carefully studied throughout the circuit, and the switching arrangements have been considerably multiplied to make the necessary change in operating conditions at each successive stage. The short-wave coils are separately screened, and the HF stage functions on this range as well as on medium and long waves.

The aerial switching appears to be somewhat complicated and has been arranged to short-circuit the coils not actually in use so that absorption effects cannot interfere with the efficiency. An IF filter is connected across the input circuit, and a resistance-capacity shunt on the medium- and long-wave ranges serves the dual purpose of levelling up the sensitivity and also resonating the aerial coupling coils just above the top of their respective wave ranges to prevent the tendency for the sensitivity to fall away towards the top end of the tuning scale.

The frequency-changer is an octode, and on the short-wave range the AVC control to the working grid of this valve is reduced, while at the same time some measure of AVC is applied to the grid of the oscillator section.

The meter-type tuning indicator is in-

Complete circuit diagram. The short-wave coils are separately screened and the switches are arranged to short circuit coils not in use.



cluded in the anode circuits of the HF and frequency-changer stages, both of which are AVC controlled. The input transformer to the IF stage has variable coupling, which is controlled by a flexible cable. This valve, although of the variable-mu type, is not controlled. The output IF transformer is tapped both for the AVC and signal diodes, the AVC being taken from the primary to avoid side-band shriek. The load resistance and couplings associated with the diodes have been carefully worked out to compensate the audio-frequency response, and the volume control circuit has been arranged to maintain the balance of bass output even at low volume levels. The triode amplifying portion of the second detector stage is resistance-coupled to the triode output valve, and a tuned IF filter is connected in its anode circuit.

An interesting feature of the output circuit to the loud speaker is the use of a high-capacity condenser across the secondary winding which resonates with the leakage inductance of the transformer to lift the high-note response. Provision is made for the attachment of an external loud speaker across the primary of the output transformer.

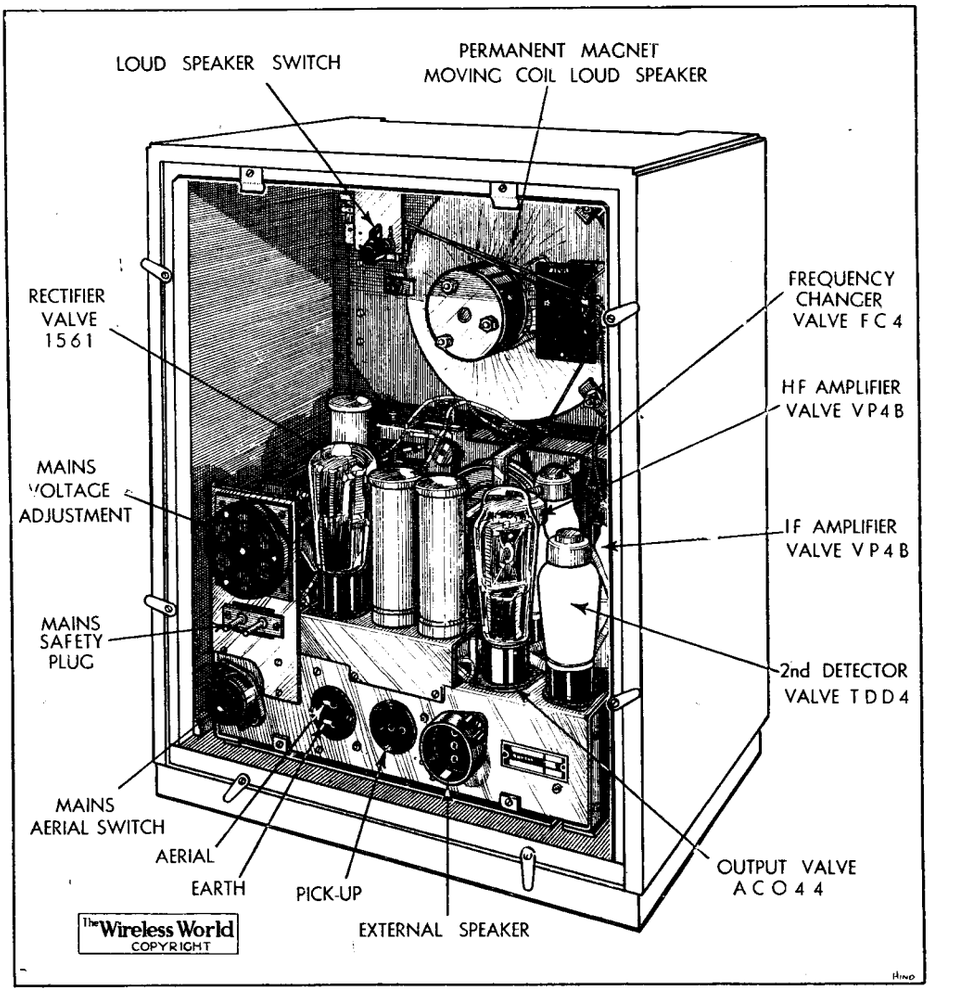
Short-wave Performance

In testing a set of this type it is only natural to turn first to the short-wave range. On three successive afternoons American broadcasting was tuned in with no more difficulty than one normally experiences in finding some of the less powerful Continental stations. Pittsburgh, Schenectady, and Bound Brook in the 19-metre region were all equally good, and as an indication of the type of interesting entertainment which one is likely to meet with on the short-wave band, it may be mentioned that on one of the afternoons an eye-witness account of the activities behind the Italian lines in Abyssinia was heard in its entirety. This broadcast was given by an American war correspondent, and was transmitted through a temporary station to Rome (2RO), thence to America, and finally rebroadcast from Bound Brook (W3XAL) on 16.87 metres.

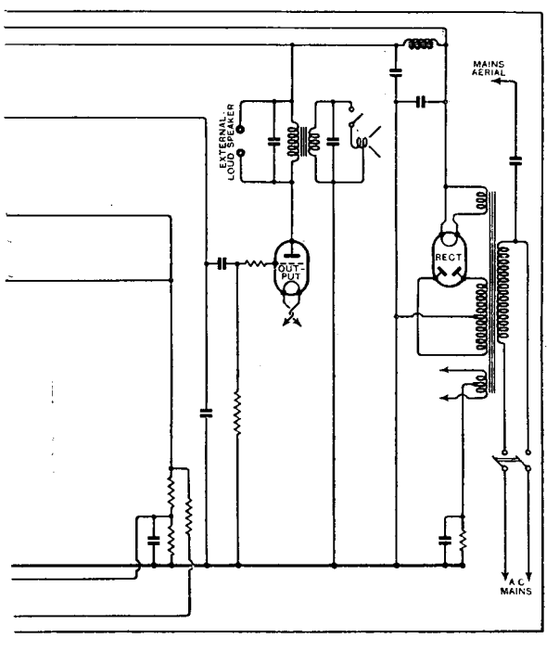
The zones occupied by the more interesting long-distance short-wave transmissions are clearly indicated on the tuning scale, and the uninitiated listener should have not the slightest difficulty in making full use of the many interesting services available. Owing to the fact that the intermediate frequency is fairly high, double tuning points are to be observed on the short-wave band, but these are quite close together and often afford a means of avoiding interference which may be marring the transmission on one of the tuning positions.

The medium- and long-wave performance in the matter of range is as high as it can usefully be made under present conditions in the ether, and the number of stations received on the medium band in daylight would be regarded as a creditable night performance for many smaller superheterodynes.

When using the set in Central London the spread of the local Brookmans Park stations was slightly more than one channel on the Regional and slightly less than one channel in the case of the National transmitters. On the long-wave band the Deutschlandsender can be received with the minimum of side-band interference from its adjacent stations, and here the value of the variable selectivity control is apparent. Incidentally, the initial tuning of the set should always be carried out with the control in the position of highest selectivity. Under these conditions the tuning indicator shows a clearly defined maximum, and this having been found the band width of the IF stage can be extended to improve the high-note response up to the limit permitted by the conditions of selectivity required.



Interior of set with safety back removed. The use of a permanent magnet speaker in a mains-operated set is an unusual feature.



Satisfying Quality

We have no hesitation in saying that the quality of reproduction is the best we have yet heard from a Philips set. The bass response in particular is far better than one would expect, having regard to the effective baffle area in a cabinet of this size. The performance is all the more remarkable in view of the fact that the loud speaker is, if anything, smaller than that of the average table model receiver. In the circumstances it might be reasonable to suspect frequency doubling in the bass, but of this there is no percentage which is detectable by ear. With the variable selectivity control adjusted for good quality the high-note range extends up to at least 6,000 cycles, and there is a useful

Philips Model 575A—

output up to 8,000 cycles. Further, the high frequency output is free from serious resonances which might otherwise give the reproduction a strident quality. The set survives the crucial test of pianoforte reproduction with credit, and there is no suggestion of burring during complicated orchestral passages which is generally the accompaniment of harmonic distortion.

The exterior physical features of the set are carried out with the customary thoroughness, and in addition to the usual Philips features of disc-type mains voltage adjustment and safety back, there is a neat mains aerial change-over plug and easily manipulated fittings for aerial and earth, gramophone pick-up and extra loud speaker. Incidentally, a switch is incorporated, by means of which the internal loud speaker may be disconnected if required.

There are five controls on the front of the set, but their operation is simplified by grouping some of these in concentric pairs. The wavelength scale which also carries a representative group of station settings, is interchangeable. The position of the waverange switch is also indicated on this scale. Station identification charts are housed in a slot below the controls, and a final word of praise is due to the carefully prepared daily short-wave guide which shows the stations in all parts of the world most likely to be in operation from hour to hour. This information is produced in tabular form, and is printed on right-hand pages only, the left-hand facing page in each case being left blank for notes.

Next Set Review:—
C.A.C. "AUSTIN" A.C. SUPER SIX

Random Radiations

By "DIALLIST"

Lost Opportunities

RECENTLY I referred to the difficulty that manufacturers had about ensuring that the servicing of their sets under guarantee should be in the hands of competent local men. Big efforts have been made by several education authorities to improve both the status of the service man and his knowledge of wireless by running special training courses in radio engineering. From three important centres come reports that these courses are not meeting with the support that they deserve. The day courses at Salford are likely to fall through; Sheffield University proposes to drop its radio course unless its numbers increase; University College, Nottingham, has but eight students for its radio course, and only one of these is a wireless retailer.

It has been suggested—and it is a very sound suggestion, too—that what is wanted in the wireless business is a revival of the old system of apprenticeship. Too many of those at present purporting to give service are men who take up wireless as a side line and have never bothered to make themselves efficient. A bright youngster, going through the mill as an apprentice and spending part of his time on a course in the service departments of manufacturers, would have every chance of acquiring experience and skill.

A Short-wave "Plan"

NEXT spring an international conference of representatives of broadcasting organisations will meet to draw up a wavelength plan for the short waves. Up to the present the allotment of wavelengths between, say, 15 and 80 metres has emulated Topsy by just growing. Now that more and more stations are coming into action this kind of thing can't go on, and already there is a good deal of mutual interference on several of the popular short-wave belts. Provided that there is a reasonable absence of the dog-in-the-manger attitude, the work of this conference should be very much easier than that of those which have sought to parcel out the medium- and long-wave broadcasting bands amongst about twice as many stations as there was really room for. On the short waves—even on the belts that are most in favour—the number of channels is so great that there should be no exceptional difficulty about fitting in all of the more important stations which desire reserved accommodation in the ether.

Yet Another Conference

In addition to the short-wave conference in Paris, another is to be called at Geneva by the League of Nations for quite a different purpose. Its object is to see whether some means can be found of eliminating propaganda broadcasts intended for external consumption, particularly those of a war-like nature. Though this conference has my best wishes and, I am sure, those of every reader of *The Wireless World*, I very much doubt whether its efforts will be successful. So many countries have now erected stations working on long, medium and short wavelengths for the special purpose of radiating propaganda abroad that it will be a terrific task to make them see the error of their ways. And even if agreement were reached all round, would it be possible to devise an absolutely watertight contract? Any country hauled over the coals for contravening the agreement could always plead that its transmissions were not intended to be heard beyond its own borders, and, as we know already, every broadcast, no matter how "improperganda" it may be, made in a foreign tongue, is always given purely as part of an innocent and laudable language lesson! Let us hope, though, that these difficulties may be overcome and that the Geneva conference may go down to history as having taken the ire out of wireless.

Franco-American Wireless

AT present every telephone call that passes from any European country to America comes through London. It is now announced that the French have decided to build a station of their own for direct telephonic working with New York. It will be some little time before the new station, which is to be near Paris, comes into operation, but when it does it may be rather a blow to our own G.P.O. Still, I suppose that the Post Office could hardly expect London to remain indefinitely the world's radio-telephone exchange. Other countries naturally want to assert their sturdy independence, and as time goes on more and more of them are bound to have their own wireless-telephone links with the rest of the world.

The *Queen Mary's* Equipment

THE *Queen Mary*, when she makes her maiden voyage next spring, will be not only the largest ship afloat, but also the most elaborately equipped with wireless. In no fewer than 500 state-rooms there will be telephone instruments, by means of which a passenger can put through a call to practically any part of the civilised world. The more modest cabins will not have telephones of their own, but their occupants can make use of kiosks in various parts of the ship. At sea the wireless link will, of course, be used, but directly the liner comes into port a land-line connection will be made.

Broadcast relaying will be done by means of thirty-eight loud speakers, and it is expected that not fewer than three alternative programmes will be available. The transmitting gear consists of four complete plants, all powerful enough to maintain communication with both sides of the Atlantic during a voyage. Verily a wonder ship!

Using 'Phones for Reception

A KIND correspondent points out that when I wrote recently in these notes that there might be a big demand for a gadget enabling telephones to be used in conjunction with a receiving set normally intended for loud speaker operation I had apparently overlooked the fact that such an appliance, designed specially for deaf people, was already being made by the Multitone Electric Company. He is quite right. I thought that I knew most of the Multitone appliances, but, frankly, I overlooked this telephone adaptor. If it is as good as the rest of the Multitone apparatus it should exactly fill the bill.

How Many Listeners

IN the United States, where the passion for facts and figures is nation-wide, 400,000 telephone calls were recently made to householders between 7 o'clock and 10 o'clock in the evening to discover whether their wireless receiving sets were in use. It was found that rather more than 36 per cent. of them were. In this country I should put the evening percentage somewhat higher, guessing a probable figure as somewhere about 40 per cent. If this is a correct estimate the number of sets in use on any evening is very nearly 3,000,000, and if we allow three listeners to each receiver this gives a grand total of between eight and nine million listeners to the evening programmes.

A German Plaint

A CURIOUS complaint is made by Herr Hadamovsky, the head of the German broadcasting organisation, in a political pamphlet which he has recently published. He weeps over Germany's share of indi-

Random Radiations –

vidual broadcasting channels under the Lucerne Plan, and claims that she is much worse off than other countries. He would have us believe that the German stations are badly heard in other countries.

A glance at a table of broadcasting stations shows that actually Germany came pretty well out of the Lucerne scramble. She has a long-wave station, the Deutschlandsender, whose output is now 60 kilowatts, but will shortly be raised to double this figure. On the medium waveband she has two high-powered stations, Stuttgart and Cologne, with individual channels in the coveted division of the waveband above 450 metres. Five other stations, none of them rated at less than 100 kilowatts, have channels of their own between 315.8 and 405.4 metres. These are Breslau, Hamburg, Berlin, Leipzig and Munich. That is not a bad share of the medium waveband, but, in addition, Germany has other channels below 300 metres besides a national common wavelength on 251 metres.

The Best Heard Country

Most curious is the plea that German broadcasts are not well received in other lands. I am sure that if a dozen British listeners were asked which European country could be relied upon on any evening to provide the greatest number of well-received programmes in every case the answer would be Germany. All of the German stations that I have mentioned come in well at all times of the year, except, of course, when repairs or alterations are in progress, as they have been for some little time now at Leipzig.

Children Prefer Women Broadcasters

THE Manchester Education Committee, which makes a good deal of use of the broadcasts to schools, states in a recent report that young children have considerable difficulty in understanding the wireless talks when the speaker is a man, but can follow with ease when a woman is before the microphone. The report goes on to say that children complain that men's voices are rough, harsh, or too deep.

I don't think that this is just a matter of personal preference; I believe that the underlying reason is probably physical. Young people's ears have a very good response to high frequencies, but are often jarred by low frequencies. Not a few radio receivers give too much emphasis to the low frequencies when dealing with speech, with the result that a young listener may find that words spoken by a man with a low-pitched voice sound muzzy and indistinct.

The Interference Menace

TIME and again *The Wireless World* has called attention to the folly of the authorities in this country who are still taking no practical steps to end interference with wireless reception. Meantime, whilst endless committees continue to explore avenues and proceed generally after the leisurely manner of committees, the interference menace grows greater day by day. Helpful and willing as they are, the Post Office authorities can do no more than their best, and that best is limited by the fact that they cannot *compel* anyone to do anything in the matter of suppressing the diffusion of interference by electrical machinery. Most readily do they investigate cases brought to their notice, but once the offender is tracked down all that they can do is to recommend that in the interests of his neighbours he should take certain steps. Should he refuse they are powerless. In many instances he replies that they can fit disturbance-suppressing appliances if they like, but that he won't pay one penny to the cost. The Post Office has no account from which the expense can be met, and unless listeners affected are prepared to subscribe the money the interference just continues. It is a lamentable state of affairs, and if we don't do something pretty soon we shall find ourselves saddled with interference for many a year to come owing to the vested interests involved.

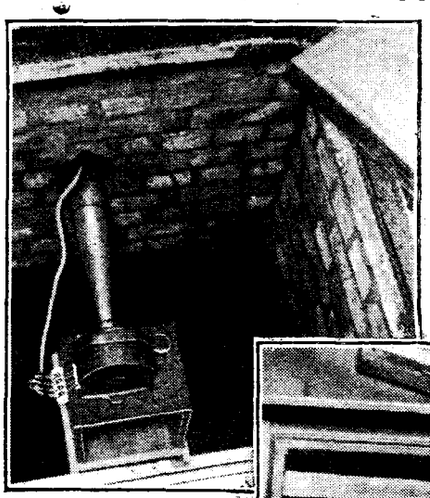
Echoes in Public Address Systems

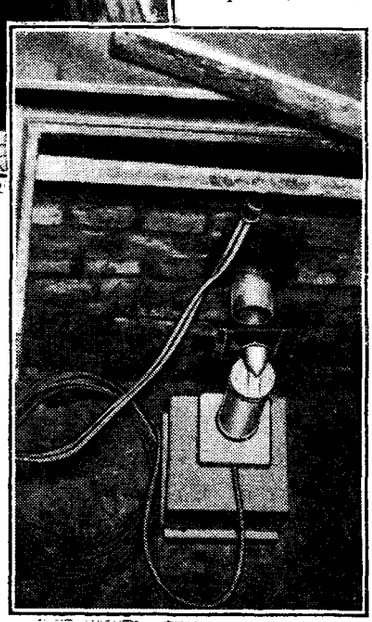
A Method of Elimination Using Acoustic Transmission Lines

IN many large public address systems the main acoustic output is radiated from a group of loud speakers situated approximately in the centre of the arena and is reinforced where necessary by auxiliary speakers wired to the main amplifier.

Under these conditions very troublesome repetitive echo effects may be set up as a result of the difference in time of arrival of the sound waves from the main and auxiliary sources. To overcome this trouble and to ensure that the reinforcement from the auxiliary units shall be in phase with the primary sound field at all points the engineers of the German Post Office have introduced a system in which air transmission lines are substituted for electrical cables.

A " master speaker " situated near the main bank of loud speakers feeds pipe lines leading to each of the auxiliary units, and the sound is there picked up by a microphone and amplified before being applied to the "boosting" loud speaker. Any frequency discrimination due to the characteristics of the pipes is corrected in the amplifier, and troubles due to the propagation of some part of the sound at a greater velocity through the walls of the tubes is overcome by inserting sections constructed with special sound-absorbing material.





"Master" loud speaker unit installed in pit and feeding acoustic transmission line.

(Right) Microphone pit below auxiliary loud speaker unit.

Installing one of the auxiliary loud speakers at the Post Stadium, Berlin.

With this arrangement the time of arrival of any given sound impulse is the same whether it comes directly from the main loud speakers or from the auxiliary units. A practical test of the system has been made with considerable success at the Post Stadium, Berlin, where the main speakers cover the central area of level ground and auxiliary speakers fixed to the fence posts at the boundary serve the surrounding covered stands.

UNBIASED

By FREE GRID

Silent Speech

I AM very surprised at the short-sighted policy of the people responsible for stage-managing the Cup Final, who, after very nearly forbidding the running commentary on next year's match, have at last given their grudging consent.

I am still more surprised, however, at the attitude of the B.B.C., who were apparently intending tamely to submit to the cutting out of the broadcast. I well remember how I solved a similar difficulty many years ago in the South Sea Islands when a request was refused for the broadcasting of a running commentary of a state banquet, the refusal being on certain totally inadequate grounds put forward by the Lord High Steward to the paramount chief.

This individual was a far-seeing man who looked well ahead, or, in other words, was one of those obnoxious individuals who go to meet trouble halfway. He feared that the commentary might be picked up abroad and so cause nervousness and a change of plan among intending missionaries, this in its turn causing serious embarrassment to him and his successors in

Casserole de missionaire.

the matter of restocking the royal larder in the years to come. Needless to say, he had no difficulty in obtaining a royal veto against the proposed broadcast when he put these views before the paramount chief.

As one of the guests I had comparatively little difficulty in overcoming the trouble, as it was only necessary for me to equip myself with a very low-powered short-wave transmitter, which was easily disposed about my person, its transmission being picked up by a receiving station situated outside the state banqueting hall, whence it was put on the landlines and relayed to the local broadcastng station in the usual way.

The *pièce de résistance* of my idea was a system of silent speech transmission, whereby my voice was inaudible and my lips immovable. As many of you who have been in prison are aware, it is quite easy to converse in low tones with a fellow-prisoner without moving the lips, thus evading the watchful eye of the warder in charge of the working party. As the result of my experimental work I found that it is only a step further to silence the voice altogether so far as ordinary hearing is concerned, although it can be heard loudly and clearly if your ear is pressed against the midriff of the speaker. If you don't believe me, try it to-night when you get home; for the benefit of non-medical readers I may explain that the midriff is situated just above that portion of the anatomy known to the vulgar as the stomach.

But I digress. Needless to say, it is an obvious step to replace the ear by a small flat microphone. My whole scheme has, of course, been used many times since then, the latest occasion being in the case of the "telepathovox" shown at Olympia last August. I cannot for the life of me see why the B.B.C. could not have employed similar tactics at Wembley without the necessity of demeaning themselves to bandy vulgar words with the opposite party.

Avanti!

SPY-CATCHING mania, which, as many of my readers will remember, was such a marked feature of the early days of the Great War, has apparently again broken out owing to the Italo-Abyssinian conflict. A correspondent signing himself "Pro Patria" has written telling me of a deep-laid plot being hatched up north to drag this country into the war on one side or another.

So far as I can gather, this "plot" concerns a well-known wireless firm up north with a somewhat non-Abyssinian name, a female member of whose staff has suddenly, for no apparent reason, taken to lion-taming.

At first I thought that my informant was trying to read into this incident some symbolic reference to the taming of the "conquering lion of Judah," but he is evidently of a more practical turn of mind. After drawing my attention to the fact that Abyssinia is infested with lions and that the wealthier members of the community keep them as pets in place of watch-dogs, so that at a moment's notice they can be mobilised into a formidable unit of defence, he states that it is obvious that this is but the beginning of an attempt to organise an anti-lion corps on these shores, so endangering our neutrality.

The young lady is, I learn, a native of Oldham, which, after all, explains a lot, but, all the same, I feel that I cannot endorse my correspondent's suspicions. I myself am of opinion that the explanation is a far simpler one, for surely anybody who has worked in such close association with a wireless manufacturer for any length of time, as in the case of this formidable female, would be ready to take on anything, even lion taming.

Counter Irritants

AMID all the efforts, in the shape of AVC and noise suppressors, which are made to combat fading, man-made static and such-like easily cured troubles, it is noteworthy that inventors continue to fight shy of tackling real he-man problems such as atmospherics.

I have always been a profound admirer of the ancient Chinese, who, as I related some time ago in these columns, possessed gramophones at a period when our own ancestors were still living in the happy care-free stone-age period when beer was beer and women still wore their wedding rings in their proper place—through their nose instead of on their finger. I am by no means alone in my admiration of the ancient Celestials; the medical profession still cure our ills by remedies so drastic and potent that we forget all about the original malady, thus following the example of the dentists of old Cathay who used to apply thumbscrews as a mild anæsthetic when extracting teeth.

It was thinking on these lines which resulted in my perfecting my new anti-interference receiver, which, in principle, is delightfully simple, although I will admit that the practical details are somewhat complicated.

In brief, I have constructed a Blattnerphone, upon which I have recorded various noises, ranging from atmospherics to the squalling of the next-door baby, and the output of this is superimposed on the original programme. At first it took a good deal of getting used to, but, just like the snoring paterfamilias who only becomes aware of the nocturnal

Blaming the public.

noises of his teething baby when there is a temporary lull, I now find that I cannot listen to the programme unless the accustomed noise accompanies it. In fact, this effect has become so pronounced that when I go to a theatre or concert hall I find it necessary to take a box of rattlesnakes with me before I can enjoy the programme in comfort, my little habit having, on several occasions, been the unwitting cause of Sir Thomas Beecham's blaming the long-suffering British public.

BROADCAST BREVITIES

By Our Special Correspondent

A B.B.C. Observatory ?

THE time may come when the ship-like austerity of the roof of Broadcasting House may be banished by the addition of an observatory dome.

A telescope is already in use up there, though not officially. One engineer, however, has been enterprising enough to try to get a nearer view of those puzzling sunspots and to see whether the behaviour of the Empire transmissions is indicated in advance by the position of the spots. May he never forget his smoked glass.

Will Records Win?

THE latest scare is that the B.B.C., bent on saving money, is insidiously reducing the number of "live" turns in favour of gramophone or steel tape recordings. The Jeremiahs have it that, sooner or later, all programmes will be recorded and that artists will only visit Broadcasting House for recording purposes.

Presumably there would be regular "milking times," Portland Place being like a huge sound dairy.

Records of Records?

Unfortunately for the artist, recorded music does not sour like milk, and as the years passed, milking times would grow fewer and fewer.

With continued advances in recording technique, there might eventually be recordings of recordings, and so on *ad infinitum* until the last remaining live singer might be glad to sell himself for exhibition at Whipsnade.

For and . . . .

Perusal of the B.B.C.'s programme lists certainly does give the impression that recorded programmes are on the increase, but I cannot see that listeners are the losers thereby.

As a B.B.C. official remarked to me last week: "There are some 'turns' which can't be got except in recorded versions. In half an hour we can give you a tip-top programme by the Berlin, Philadelphia, Boston, and other world-famous orchestras, which simply could not be brought together by any other means."

. . . . Against

He was aware, however, of a big public preference—based on psychological reasons—for flesh-and-blood performances at the microphone. For many people the pleasure of listening to a talk or a song is quite spoilt by the thought that it was recorded yesterday or the day before.

People have even complained to the B.B.C. at the inclusion of recorded items in "Round the World" broadcasts of the kind given on Christmas Day. They apparently forget the time factor, which makes it impossible, for instance, for an Australian shepherd to give an eye-witness account of sheep-folding at 3 p.m. G.M.T.

B.B.C.'s Ideal

Yet the B.B.C. sympathises with the "living artist" idea. In fact, as my friendly official put it: "The Corporation does definitely prefer to give listeners a live programme, rather than a mechanical reproduction."

If the B.B.C. continues to live up to this ideal the Jeremiahs have their answer.

Invisible B.B.C.

ONLY in the last two or three years have the B.B.C. engineers practised the art of self-effacement.

Their best effort in this direction is always reserved for the Cenotaph broadcasts on November 11th. On Monday next an observer in Whitehall would not be aware that the B.B.C. was taking any part in the ceremony.

Microphone in a Tree

No wires or cables are allowed to trail across the street, and no microphone is visible. The "O.B." van takes up its stance early in the morning within an archway on the east side of Whitehall.

From there underground cables are run to a point at the foot of the Cenotaph where the lectern stands, and to another point at the edge of the pavement connecting up with a microphone concealed in a tree.

Preserving Programmes

OF all the B.B.C. programmes only the talks preserved in the pages of *The Listener* have any real permanence and can be turned to again and again when the whim takes us. More's the pity.

Perhaps some genius will one day devise a means of preserving all that is best and brightest in the musical and variety programmes, not in the form of electrical recordings—which can only be enjoyed when the B.B.C. chooses to offer them to us—but in sober print.

"In Town To-night"

The best approach to such an ideal that I have ever come across is "In Town To-night"*—a vivacious story by J. C. Cannell of how the popular B.B.C. feature has been prepared week by week; how he and his team-mates have gone out into the highways and byways to find "characters"; and how, having been induced to face the "mike," these strangely assorted personalities have reacted to the experience. Here is material to revive a hundred memories.

The Team

Eric Maschwitz devised the feature, handing over the new child to A. W. Hanson, with what success listeners already know. Hanson was supported by a team—J. C. Cannell, Miss Mary Sharpe, "Mike" Meehan, Leslie and Kenneth Baily, and George B. Fuller. In addition, there was that "genial giant," Bryan Michie, to do the interviewing at the microphone.

Rat-catcher

The book abounds with anecdotes.

On one occasion Mr. Cannell found it hard not to smile when rehearsing a rat-catcher.

"He started off" (writes Mr. Cannell) "in the most remarkable way. I stopped him and asked what was his idea.

"'Oh, sir,' he said, 'I am trying to be perfect, like an announcer.'

"To which I replied: 'If you wish to be perfect, talk like a rat-catcher.'

"He took my advice, and was definitely successful."

How "Characters" are Found

Each member of the team tells his own story, and there are some tales from life by such "In-Town-To-night" characters as Larkin, the steeplejack, and Jack Morgan, the boy with the big ears.

It is interesting to know that contributions for "In Town To-night" are found through an incessant search in the newspapers and from a careful consideration of a mass of suggestions which pour in from listeners themselves. It is pleasant to think that the public have helped towards the success of such an excellent series of broadcasts.

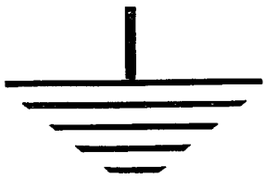
Radio and Backward Children

INTERESTING evidence to the effect that many backward and feeble-minded children are being assisted on the path to normality by radio education has been received by the Central Council for School Broadcasting. It is claimed by the principals of many schools for the mentally defective that wireless frequently provides that elusive stimulus which is necessary to start the development of the backward child. "Broadcasting," it was stated in a recent article on the subject in the periodical "Mental Welfare," "breaks down the defensive deafness of the imbecile."

In one school, after a gardening talk had been listened to experimentally, all the broadcast courses were demanded.

"PEOPLE'S CRYSTAL SET." Poland is the first country to issue a State-manufactured crystal receiver, a specimen of which is seen in the picture. It costs about 10/- and is intended to place listening within the reach of all classes.

* "In Town To-night." J. C. Cannell. (London: George G. Harrap Sons Co., Ltd., pp. 312. Price 8s. 6d.)



EARTH

By "CATHODE RAY"

The Term Defined—Its Function Explained

PROSPERO, perhaps the most radio-conscious of all Shakespeare's characters, who remarked with satisfaction, "That's my dainty Ariel!" also exclaimed in less conciliatory tones: "Thou earth, thou!"

The man in the street, who is perfectly satisfied that the purpose of the aerial is to catch the waves from the air, is less clear in his mind about the "earth." And when one day it accidentally gets pulled off by the vacuum cleaner, without any catastrophic effect on the programmes, he is in greater doubt. Another unsatisfactory feature is that his technical expert friends went off into hoots of laughter at his bright idea of connecting to some very high-class earth in a near-by flower pot, yet recommended attachment to a water pipe, which more obviously suggests water than earth. And have ships at sea any difficulty in finding an earth connection? And so on.

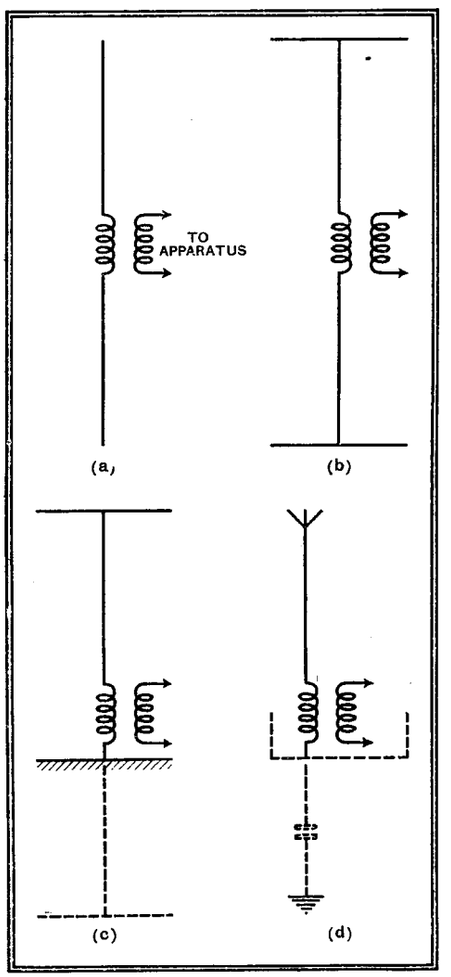
All very confusing unless one has some idea of what "earth" in a radio sense means. Perhaps one excuse for some fairly general uncertainty on the subject is that there are several ways in which the earth can function. But to begin at the beginning. . . .

A Low-resistance Conductor

The term "earth" in electrical work is taken in a very comprehensive sense to include all electrically conducting parts of this terrestrial ball. Sea water conducts electricity far, far better than any soil, so is actually earthier than earth for our present purpose. Even sea water as a conductor is vastly inferior to, say, copper; but it is present in such quantities that what it lacks in conductivity it makes up for in cross-section. Quite a thick and, therefore, low-resistance copper wire is only a fraction of a square inch in cross-sectional area, whereas the Atlantic Ocean is a good many square miles. Rock and soil are still poorer conductors, but are still more plentiful.

It is a long way from England to Australia, and even a heavy copper cable between the two would have thousands of ohms resistance. A cable of the same dimensions filled with soil or water would have millions and millions of ohms. But there is enough soil and water between England and Australia to constitute millions of cables in parallel, so the resistance is quite small after all. An earth connection, then, provides a good low-resistance line between any two places—or any hundred or thousand places—in the world. The only difficulty is that any reasonable method of connecting to earth can make contact with only a few of the ends of the imaginary cables of which it is composed. Thus, to take advantage of a large proportion of the very broad chunk of material between England and Australia one would have to sink earth plates larger in area than either country.

So, in practice, the goodness of an



Diagrams *a* and *b* represent fundamental types of unearthed aerials (dipoles). Diagram *c* shows how the equivalent of *b* is obtained by making the earth act as one-half of the aerial; diagram *d* illustrates the earthing of a set through stray capacity without any visible connection.

"earth" is limited entirely by the sectional area at the actual contact. An earth tube stuck into the ground is in direct contact with only a few square inches of soil, which are moist and conducting in wet weather and dry and useless during drought. A large plate sunk several feet deep is better. A main water pipe makes good contact with a still larger body of earth. But the best of all is the steel hull of a ship, with acres of good salt water pressing round it.

All this (except perhaps the ship) is a perfectly good explanation of how the earth can be made use of as a very economical return path for line telegraphs, or, indeed, any go-and-return electrical circuits. It was used for tramways and the like until they found that such heavy currents set up serious chemical corrosion at the contact between metal and soil. For this and other reasons it has been found more satisfactory in most cases to go to the expense of a double metallic line rather than single line and earth return.

But, so far as wireless is concerned, the foregoing explanation has been included only to show how it does *not* work. One must entirely get rid of any idea that it is there to make contact between transmitter and receiver. It is for nothing of the kind.

A fundamental wireless aerial system is a condenser opened out. Instead of the two plates being very close together they are put as far apart as possible so that the invisible forces that are set up between them cause as much disturbance as possible in the surrounding space. The very simplest circuit is just a straight wire or rod. The ends of the wire form the two condenser plates, and current surges back and forth between them. To make any use of the current (in a receiver) or to introduce the current (in a transmitter) some part of the wire near the middle must be coupled to the rest of the apparatus (Dia. *a*). A slight elaboration of the system consists in plates or right-angled systems of wires attached to the ends of the straight piece to increase the electrical capacity and consequently the amount of current that can be persuaded to oscillate between them (Dia. *b*).

Unearthed Aerial Systems

Such a type of aerial is popular for very short waves, because the wires are correspondingly short and manageable. Both wires should be something like a wavelength's distance away from the ground and other objects, to avoid disturbing effects due thereto; and it would be intensely inconvenient to install a broadcast receiver several hundred metres up in the air, so for general purposes we make use of a very handy scientific dodge. If for one half of the aerial system an earth connection is substituted, the results are equivalent. It is just as if the eliminated half lay buried underground, forming a sort of image or reflection of the upper half (Dia. *c*).

This idea works perfectly only if the earth connection is perfect. It is nearly so in the case of a ship. If the earth connection goes to a hot-water pipe, which may wander up to the roof tank, near the aerial, and then down again before reaching earth, there is a marked departure from the original plan, and best results are not to be expected with confidence. A very long earth lead of any sort introduces inductance as well as resistance. In comparison with this it may possibly be as good, or in extreme cases even better,

Earth—
for the earth lead to be disconnected. What is left is still earthed, so far as oscillating currents are concerned; Diagram *d* shows how the metal work of the set and the battery or mains leads form one plate of a condenser, the ground and *its* metal work being the other.

A portable set dispenses with an earth connection because its aerial system is fundamentally different. Instead of being an opened-out condenser it is an opened-out coil—a frame aerial.

Earth as Voltage Datum

There is another entirely different aspect of earthing. Just as heights or depths are reckoned in relation to sea level, so voltages or potentials are reckoned as above or below earth potential. The earth being, as a whole, such a good conductor, any local accumulation of electricity that is brought into connection with it is very quickly dissipated, just as a tank erected above the ocean is rapidly emptied when a means of escape is provided, while a tank plunged beneath is filled. Tanks can only be kept in an abnormal condition of fullness or emptiness by denying them any connection with the sea, or by interposing some sort of pump. And a voltage above or below earth can only be maintained by insulation or by a generator, such as a battery. So if one wants to ensure that a point in a circuit is " dead," one connects it to earth. The human body being normally connected to earth rather than to some dangerous number of volts above or below, it is safe to touch anything that is earthed.

But, in a radio receiver, earthing of circuits is more often done to keep oscillating potentials strictly to the appointed paths, making sure that all interposed screens are dead and incapable of causing stray effects. The novice is likely to be confused when he comes across the expression " . . . is earthed through a condenser," especially if the " . . . " already has a metallic connection to earth. But if that connection is via a coil or resistor it is capable of being at an oscillating potential, and must be " tied down " by means of a sufficiently large-capacity condenser. The same method is adopted when a direct connection would lead to some disaster, such as a short-circuited battery.

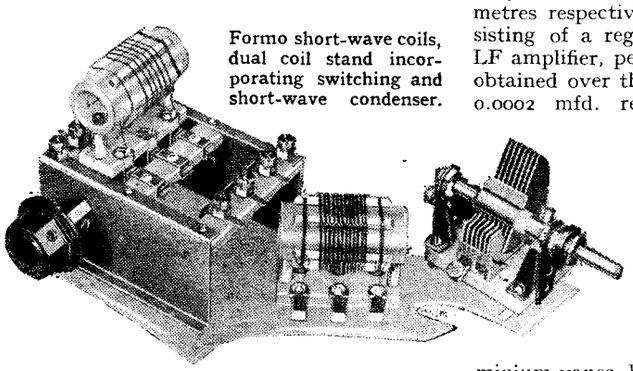
Finally, a comparatively new technical term has arisen—" earthy." An adequate explanation for this is not to be found in the familiar words of the burial service—" of the earth, earthy." It signifies which of two terminals or points is more nearly at earth potential. The engraved word " EARTH " near a terminal is an invitation—even a command—to join it to earth. But it is optional, or in some circumstances undesirable, so to treat " EARTHY." It is useful to know, however, which side of the circuit is the less sensitive to external influences.

New Apparatus Reviewed

Recent Products of the Manufacturers

FORMO SHORT-WAVE COILS AND CONDENSER

IN order that the latest Formo short-wave coils shall have the widest possible application, three separate coils are used to cover the 12- to 100-metre waveband. The coils can be used with a single coil holder and changed for each band, or they can be fitted into a dual coil stand incorporating waveband switches. In this form a pair of coils gives a coverage of 12 to 55 metres nominal, while the other combination covers a waveband of 21 to 110 metres. The switches short-circuit all the windings on the idle coil. Thus the former combination will, without changing the coils, cover that part of the short-wave band wherein lies the greatest interest.



Formo short-wave coils, dual coil stand incorporating switching and short-wave condenser.

Particular care is taken to keep stray capacities small in the coil stand, while the losses are reduced to a minimum by the use throughout of a very high grade Frequentite insulating material.

Each coil former carries three separate windings, primary, secondary and reaction respectively. The secondary, or tuned coil, is wound with a silver-plated copper strip in the case of the shortest waveband coil, but enamelled copper wire is used for the two higher-range coils. Primary and reaction windings are located at the two ends of the former and spaced from the tuned winding.

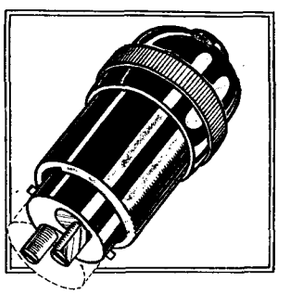
Using an 0.00016 mfd. condenser, the wave-range of each coil was found to be 11.4 to 28, 20.4 to 48.9, and 43.6 to 105 metres respectively. In a test circuit consisting of a regenerative detector and one LF amplifier, perfectly smooth reaction was obtained over the whole waveband with an 0.0002 mfd. reaction condenser and an 0.0001 mfd. fixed condenser in series with the aerial. Its performance was exemplary and actually compared favourably with that often obtained with sets having the advantage of an HF stage but less efficient coils.

The short-wave condenser is fitted with aluminium vanes, has a two-bearing rotor with a concealed pigtail connection, and is insulated throughout with the same high grade material used for the coils. The rotor shaft is insulated from the front bearing, but electrically connected to the back support. Its measured minimum capacity is 4.3 m-mfds. and the maximum 159 m-mfds.

Each coil costs 3s. 6d., the single coil stand 1s., and the dual pattern 2s. 6d. The price of the condenser is 3s. 6d.

PRESTO PLUG ADAPTOR

AN ingenious electrical fitting that can be employed either as a lamp-holder adaptor or as a two-pin plug merely by rotating the milled top by a half-turn has been produced by Ward & Goldstone, Ltd. It is made of bakelite and consists of an outer shell with a movable centre bakelite plug carrying two oval-shaped contacts which are electrically connected to two split prongs.



Goltone Presto combination adaptor and two-pin plug.

When the centre plug is fully extended it forms a plug adaptor, as the two split prongs are then flush with the top face. A half-turn to the left draws the centre part into the hollow shell, and as the split prongs remain stationary they are then exposed, so converting the device into a two-pin 5-amp. plug.

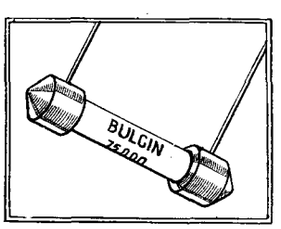
It is very simple mechanically, and there is little that can go amiss, so that it is not likely to develop faults or give trouble in use.

The price of this handy and very ingenious fitting is 10d.

BULGIN HALF-WATT RESISTANCES

AMONG the new season's Bulgin components is a range of miniature resistances of half-watt rating and measuring 1in. long only. The resistance element is encased in an insulating material resembling porcelain and has cast metal end-caps to which 1½-in. long wires are fixed.

Resistances of this rating would meet many of the requirements of a modern set, and as it is not uncommon to find a score or more all told, the miniature type, where permissible, will be found convenient.



New Bulgin half-watt resistance fitted with metal end-caps and connecting wires.

Several specimens have been tested and found entirely satisfactory; they carry their rated full load current without overheating, while the measured resistance is within the usual tolerance allowed for these components. One was 6 per cent. high, another 8 per cent., and one was just 10 per cent. greater than its marked value. They are also quite silent in use.

These half-watt resistances are made in a wide range of values from 250 ohms up to 5 megohms, and the price is 6d. each.

Letters to the Editor

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

Loud Speaker Volume Controls

I WAS greatly interested in the article on this subject by Mr. Maxwell G. Smith which appeared in your issue of October 11th. I have always held that an extension speaker is incomplete without a volume control, and prior to the present season we have been alone in making such volume control a standard fitting.

The article explains clearly how distortion is caused if the volume control consists merely of the usual potentiometer or series resistance, due to the fact that these are practically non-inductive, whereas the speaker impedance varies with frequency, but I regret the writer did not point out the three main objections to connecting an extension speaker across the primary of the output transformer. These objections are:—

1. Loss of "top" due to capacity of extension wires.

2. Possibility of unpleasant shock if speaker terminals are touched. (There is often AC speech voltage of about 200, in addition to the DC anode volts.)

3. Cost of an extra transformer on extension speaker.

I admit that the compensating condenser described in the article by Mr. Smith would have no effect at low resistance, but we have evolved a form of volume control—the "Truqual"—which overcomes the causes of distortion. At each setting of the control series and parallel resistances are introduced in the speech coil circuit, the values being chosen so that the current in the speech coil at different frequencies is reasonably proportionate, at any volume.

At minimum volume the series resistance is not more than 6 ohms with a 2-ohm speech coil compared with the usual 25 or even 100 ohms introduced by ordinary potentiometer or variable resistance. (The so-called 2-ohm speech coil has, of course, an impedance of about 6 ohms at 8,000 cycles.)

It is no doubt fortunate that extension speakers are generally used in parallel with the speaker in the set, so that mis-matching of the output valve is not caused by the volume control. It should be remembered, however, that a switch is often fitted to cut out the set speaker, and any volume control introducing high resistance in the extension speaker would then cause serious distortion with a pentode valve.

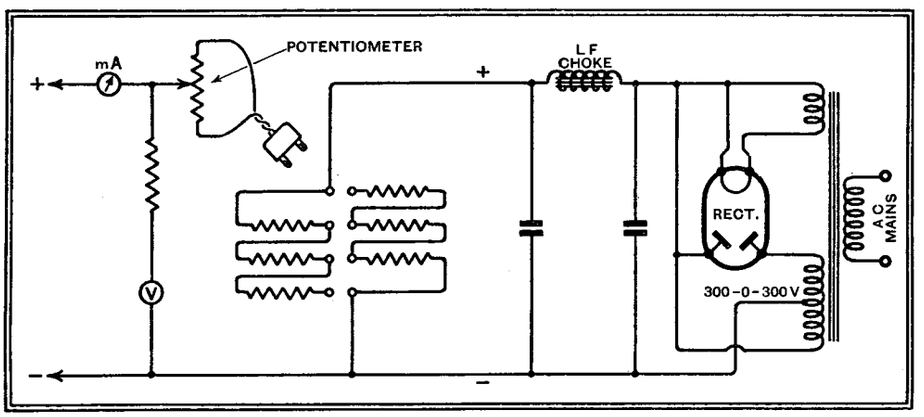
Wharfedale Wireless Works,
G. A. BRIGGS.

Voltage Measurement

AS a regular reader (not from No. 1, like Dr. Free Grid), I am much indebted to this splendid periodical. It solves readers' problems in such an admirable way that it is worth its price twice over. All hints for experimenters have been cut out and gummed in a special book by me for ready reference. As I benefited by hints from other readers, I should like to let you have the particulars of a circuit (see Fig.) which I use to take direct readings in volts of valves. Suppose I want to know if the oscillator-anode voltage of my frequency changer is really 150. I set my voltmeter to read 150 volts, connect the negative terminal to the chassis or earth terminal, and the positive to the oscillator anode. Probably the mA. meter (a central zero one with a full deflection at 5 mA.) will deflect to the right or left. Now with the potmeter adjust till your meter is back to the central position. The voltmeter will now read, say, 120 or 160 volts, depending on whether the deflection was to the left or right. This will be the true voltage at the anode. I used an 0-6, 0-120 moving-coil voltmeter, 128 ohms per volt. In series with the 120 volts, a resistance of approximately 61,500 ohms increases the readings to 600 volts, but the readings are taken from the 0-6 volt scale, where every reading has to be multiplied by 100. The six resistances are each 16,000 ohm wire-wound 20 watt, and were chosen because it was not possible to obtain a high resistance large current carrying potmeter. The one in use is a Wearite, 25,000 ohm wire-wound 15 mA. For different readings the different sockets are used. Before taking a reading do not set the voltmeter at 200 when you expect to read 80 volts, otherwise your mA. meter's needle will be kicked right off the scale. Telephone jacks and plugs would serve the purpose of bringing the different resistances into circuit very well.

The circuit used is very satisfactory, and was given to me by a friend, Dr. Detmeijer, of the Commercial Cable Co., Station Rotterdam.

M. G. VAN DER POLDER, Senior Operator,
The Commercial Cable Co.,
Station Rotterdam.



Circuit described by a correspondent.

Contrast Expansion and Other Matters

WHAT with provincial radio shows and other matters, I have not had an opportunity of dealing with certain statements that have appeared in *The Wireless World* during the last few weeks and with which I disagree.

In "Contrast Expansion" (October 4) your contributor is somewhat in error regarding the amount of volume compressing by the B.B.C. It is generally agreed that the range of volume in a concert hall is of the order of 60 db. (1,000,000 to 1 change), and, for the reasons given by "Cathode Ray," this has to be contracted. I have been told by the B.B.C. that the range normally transmitted is 24 db. (250 to 1), but careful measurements of my own have shown, during a concert broadcast, a variation of milliwatts into the speaker of from 18,000 to 25 (28.5 db.).

In apparatus designed to give a high degree of realism in reproduction, it is fairly obvious that valve overload must be avoided, and since, with background noises, 25 milliwatts is just sufficient for a normal decent-sized room (on the *ppp* passages), I do not see how contrast expansion can reasonably be used at all, for eighteen watts is a pretty healthy din.

I feel constrained, also, to rebuke both "H. P." (September 13th) and the Rev. Bonavia-Hunt (September 6th) for their unfair remarks about the B.B.C. amplifier at the Radio Show. The staff in charge of that white elephant are thoroughly competent and know their job. The amplifier is squeaked at regular intervals, and there is no doubt about the performance of the amplifier itself. I was able to get a definite check on this at the Glasgow Show, where, for four hours each day, the dance band in the exhibition was relayed through the speakers on the stands, and a groove was worn in the concrete floor by the feet of enthusiastic showgoers running between my firm's stand and the dance hall. On that occasion we definitely "put it acrorst them."

No, the big bad wolf is the Post Office. They have three kinds of land line, lousy, lousier and lousiest, and as I have some very good friends on the P.O. engineering staff, I had better leave it at that.

Isleworth. H. A. HARTLEY.

At the Transmitting End

Technical Criticisms of Recent Broadcasts

Effects

The sketch in the Gala Variety programme (Regional, October 26th) would have been infinitely more effective, well done though it was, if a suitable background had been provided. Outside the B.B.C. it is not usually possible to converse in a busy street without hearing *something* vital of the traffic.

Microphone Technique

In the same show, some of the songs of Jean Sablon were rather spoilt, due to his being too close to the microphone. This overdid the intimate touch, which a slight reduction in modulation depth would have restored. H. C. H.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

Public Address Equipment

Wide Variety of Its Uses

IT would not be surprising if a year or two from now the second largest use to which the valve has been applied were found to be in connection with public address equipments.

Just as broadcasting has been responsible for the present-day enormous production of valves, so it would seem the valve in its turn has been responsible for the development of public address equipment.

It cannot be said that the valve took much part in the beginnings of broadcasting, except, of course, on the transmitting side, because crystal sets were available and amplification, although valuable, was not essential. In the case of public address equipment, however, some means of amplification such as the valve provides was the first essential.

Public address started in a comparatively small way, but to-day it is fast developing into a big industry—still regarded as a section of the radio industry but rapidly becoming a very important section indeed.

Every day fresh applications for public address gear are being discovered. At first it was used mainly to meet the requirements of large meetings, mostly in the open air, when very great volume was needed ; then came the applications to indoor gatherings and to churches where it was required that the equipment should give just enough sound amplification to aid the listener without being blatant or obtrusive. Now applications are being found in the factory, to give general instructions or to facilitate communication with different branches where it would be undesirable to interrupt work to answer a telephone. Hotels and clubs are finding the microphone of value to replace the call boy, because persons can be enquired for simultaneously in many rooms, so often avoiding a long delay whilst the call boy goes his rounds.

Although so many uses have already been made of P.A. equipment there must be very many more directions in which it would prove of value. If any readers have suggestions for new applications, it would be interesting to hear of them.

Short-wave Broadcasts

Growing Interest to Listeners

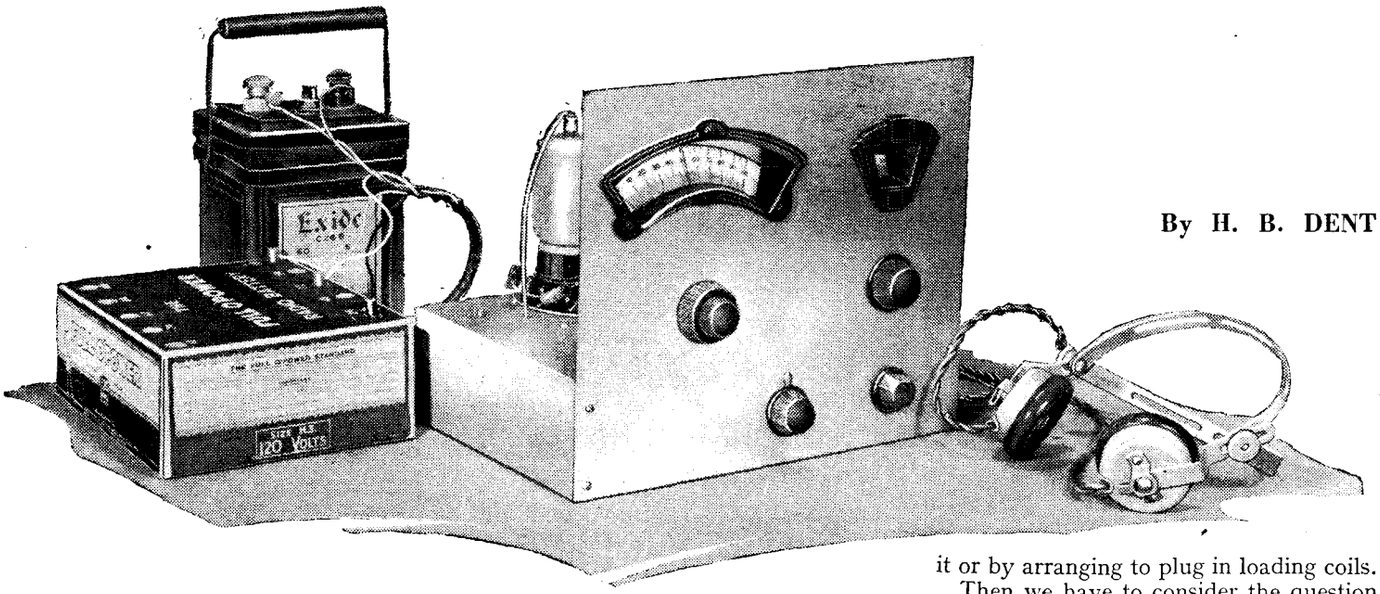
TEN years ago, if there had been available to listeners on the normal broadcast band the wealth of broadcast interest and entertainment which is now open to them on the short-wave bands, what a much greater demand there would have been for receivers! To-day, there is so much to choose from on the medium and long waves that the fact that new material is available on the short waves cannot be expected to rouse quite the same enthusiasm.

But for those, especially, who want variety, the short waves offer a great deal which is not available on other bands, including many broadcasts in English. Where interest is felt in receiving programmes over great distances short waves undoubtedly offer the best chances.

Those who have not yet interested themselves in SW reception and want to make a start cannot do better than begin their experiences with the short-wave receiver described in this issue. The construction is remarkably simple, and the results will compare very favourably indeed with those obtainable from far more elaborate equipment.

Short-Wave Two

A SENSITIVE WITH A



By H. B. DENT

MUCH can be said in favour of the ubiquitous detector and LF circuit for a simple general-purpose short-wave receiver. It has the advantage that it is relatively cheap to build, the construction is simple, and it rarely gives trouble in use. Such a set is essentially for headphone reception, yet it is always possible to add an extra LF stage, or feed the output into a small self-contained LF amplifier, and so operate a loud speaker.

As a headphone receiver it can be used at times when, for various reasons, it may not be convenient to use a loud speaker, or when late night or early morning sessions of listening are contemplated.

The keen experimenter requiring a handy stand-by set, the beginner who may have a liking for DX work, and all interested in short-wave broadcasting will find a two- or three-valve receiver invaluable. Its sensitivity is adequate for it is surprising how well a set of this type can be made to perform if only a little care is given to the detector circuit, for the sensitivity relies almost exclusively upon the precise control of reaction.

Aerial Damping

When the detector circuit is coupled to the aerial as, of course, would obtain in a det.-LF arrangement, it is not uncommon to encounter a little trouble at times with the reaction; at certain parts of the wave-band the set seems exceptionally difficult to handle, while there are others where the set cannot be induced to oscillate, though on disconnecting the aerial the set appears to be in perfect order.

This erratic performance is due entirely to the aerial circuit, for the fundamental wavelength of a normal size aerial, say one of 70 or 80 feet in length, falls right in the middle of the most useful part of the short-wave band. At its fundamental wavelength the aerial is, of course, an exceptionally efficient collector, but if it is coupled too tightly to the detector coil it will absorb all the energy in this circuit and so neutralise the effect of reaction. A very loose coupling is necessary under these conditions, but at other wavelengths the coupling will now be far too loose for good results, furthermore, the optimum coupling will vary throughout the wave-band.

This effect is often so troublesome that it is usually necessary to make some provision for shifting the fundamental wavelength of the aerial, either by introducing a small variable condenser in series with it or by arranging to plug in loading coils.

Then we have to consider the question of CW reception in which the DX enthusiast will be mainly interested. As the receiver will be used generally in an oscillating state, unless a separate heterodyne unit is employed, the aerial being directly coupled to the oscillating detector will radiate and the receiver now becomes a low-power transmitter. As such it is almost certain to cause serious interference with near-by, and possibly distant, short-wave listeners, so that, while the det.-LF combination is admittedly adequately sensitive, it is not, strictly speaking, an ideal arrangement. Obviously the aerial must be isolated from the detector by an HF stage, but this need not add to the tuning controls as the aerial circuit

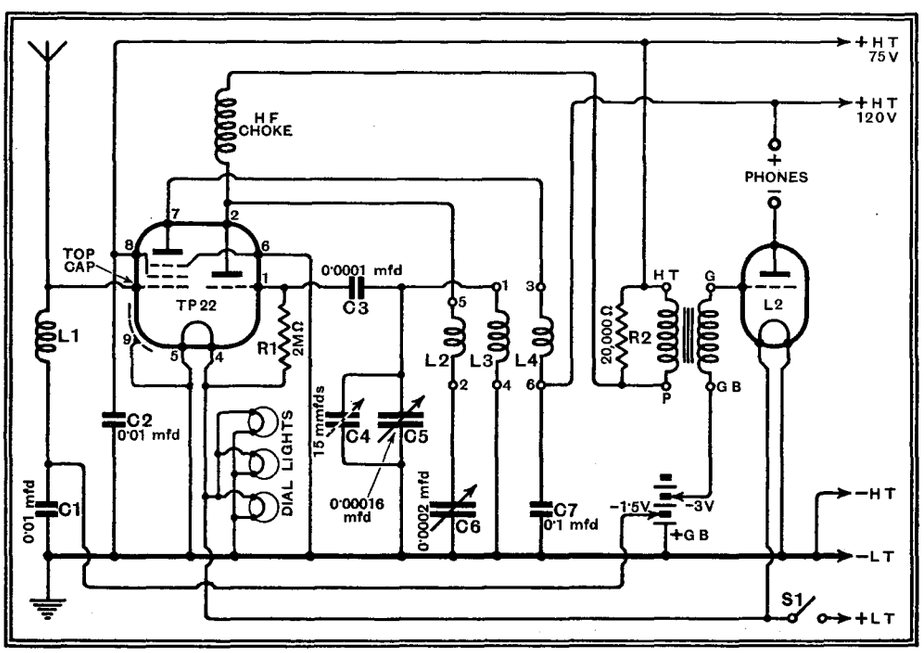


Fig. 1.—Theoretical circuit diagram of the two-valve short-wave receiver. The first valve combines the functions of HF and detector.

BATTERY-OPERATED RECEIVER WAVE-RANGE OF 12 TO 94 METRES

THE beginner making his first incursion into the realms of short-wave listening will find this simple and inexpensive receiver an ideal set for his purpose. It is adequately sensitive for receiving distant stations, either amateur or broadcast, and it is invaluable as a means of obtaining experience in the handling of short-wave apparatus. Such a set is also a valuable adjunct to an all-wave receiver, since it can be used for listening on the short waves when the larger model is required for normal broadcast reception.

may be made aperiodic. This valve is not a mere passenger despite the untuned input circuit, and in practice it contributes appreciably to the sensitivity. On both counts, therefore, its inclusion is justified.

In the receiver illustrated and described here, the circuit of which is given in Fig. 1, the detector and HF valves are combined, the valve used being a Mazda TP22 which contains the separate elements of an HF pentode and of a triode, though its official function is that of a superheterodyne frequency changer. The choice of this multiple valve is largely a matter of convenience as it affords some saving in space, also it makes for a cleaner appearance and considerably simplifies the wiring. Since its function is the same as that of two separate valves, one of which is an SG HF stage and the other a triode detector, the constructor could, if he so wishes, replace it by two valves of somewhat similar characteristics, though the HF valve need not be a variable-mu HF pentode but a plain screen-grid type. Any change must be executed with care, it being most important that all leads in the detector grid circuit be kept as short as possible.

Tuning the aerial circuit would, no doubt, lead to a slight improvement in both sensitivity and selectivity, though the gain in the former case is not as marked as one might suppose, and it is open to question whether the extra cost and trouble of embodying a tuned aerial circuit, for it would be obligatory to gang the condensers, are really worth while. The writer's view, after comparative tests, is that for general use it is hardly justified, but if one wished to get the last ounce out of a limited number of valves, then tuning the aerial would be an advantage.

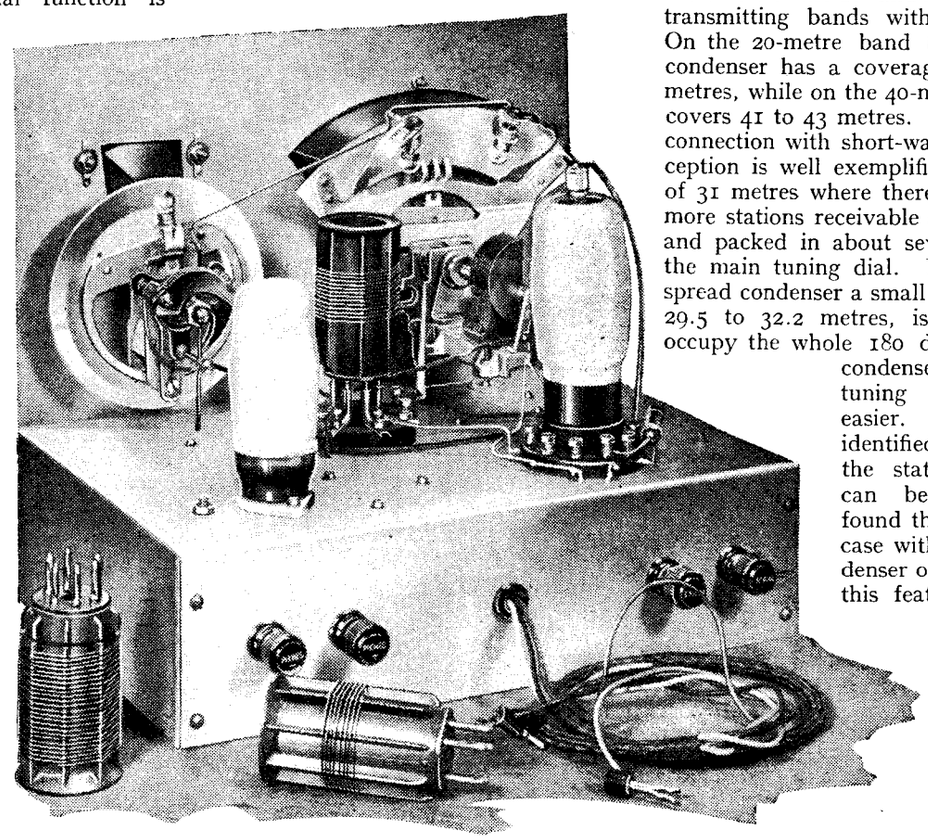
The improvement in selectivity is not likely to be very marked, for it is surprising how little interference is experienced when critical reaction is employed. With this type of set it is most important that the reaction be as near perfect as one can make it. The important factors are smoothness, freedom from backlash, and a clean start of the oscillations. It often happens, especially when a LF transformer follows the detector, that a growl, grunt, or howl is heard when the reaction condenser is advanced to the point where oscillation starts. Now, just on the verge of oscillation is the most sensitive state and if the set starts to howl at this point the sensitivity is lost.

There are several ways of suppressing this threshold howl, as it is called, but the simplest which is adopted here is by means of a 20,000 ohm resistance joined across the primary winding of the LF transformer. If any alteration is made in the arrangement of the HF and detector stages, this value may require changing. In the present case a slow-motion reaction condenser is fitted and it is strongly recommended that this advice be followed.

The short-wave band from 12 to 94 metres is covered by three Eddystone plug-in coils each of which has three separate windings, these being used as primary, secondary, and reaction respectively The secondary is in the detector grid circuit and is tuned by a 0.00016 mfd. condenser, C5 in the circuit diagram, driven by a two-ratio slow-motion drive. In parallel with C5 is a small variable condenser, C4 of 15 m-mfds. maximum capacity, its function being to open out any desired part of the scale of the main condenser so that it occupies a much longer scale.

Band-spread

It has been included also for the convenience of the amateur experimenter and DX enthusiast to whom a band-spread condenser is a virtual necessity. The size of this condenser has been chosen to bring the whole of the 20- and 40-metre amateur transmitting bands within its compass. On the 20-metre band the band-spread condenser has a coverage of 20 to 21.3 metres, while on the 40-metre band it just covers 41 to 43 metres. Its usefulness in connection with short-wave broadcast reception is well exemplified in the region of 31 metres where there are a dozen or more stations receivable at good strength and packed in about seven divisions on the main tuning dial. Using the band-spread condenser a small waveband, from 29.5 to 32.2 metres, is opened out to occupy the whole 180 divisions on this condenser's scale, so that tuning is very much easier. Also, having identified one or two of the stations, the others can be more readily found than would be the case with the larger condenser only. Admittedly this feature is a refinement, and perhaps a luxury, in what is, virtually, an inexpensive set, but it is well worth the small additional expense entailed.



Rear view of the receiver showing the two condensers with the band-spread on the left.

In the illustrations the main tuning scale is viewed through the larger of the two escutcheons, while the smaller relates to the band-spread condenser.

In a set of this type the constructor can use his discretion in the components, and provided the values of the condensers and of the resistances are not changed their

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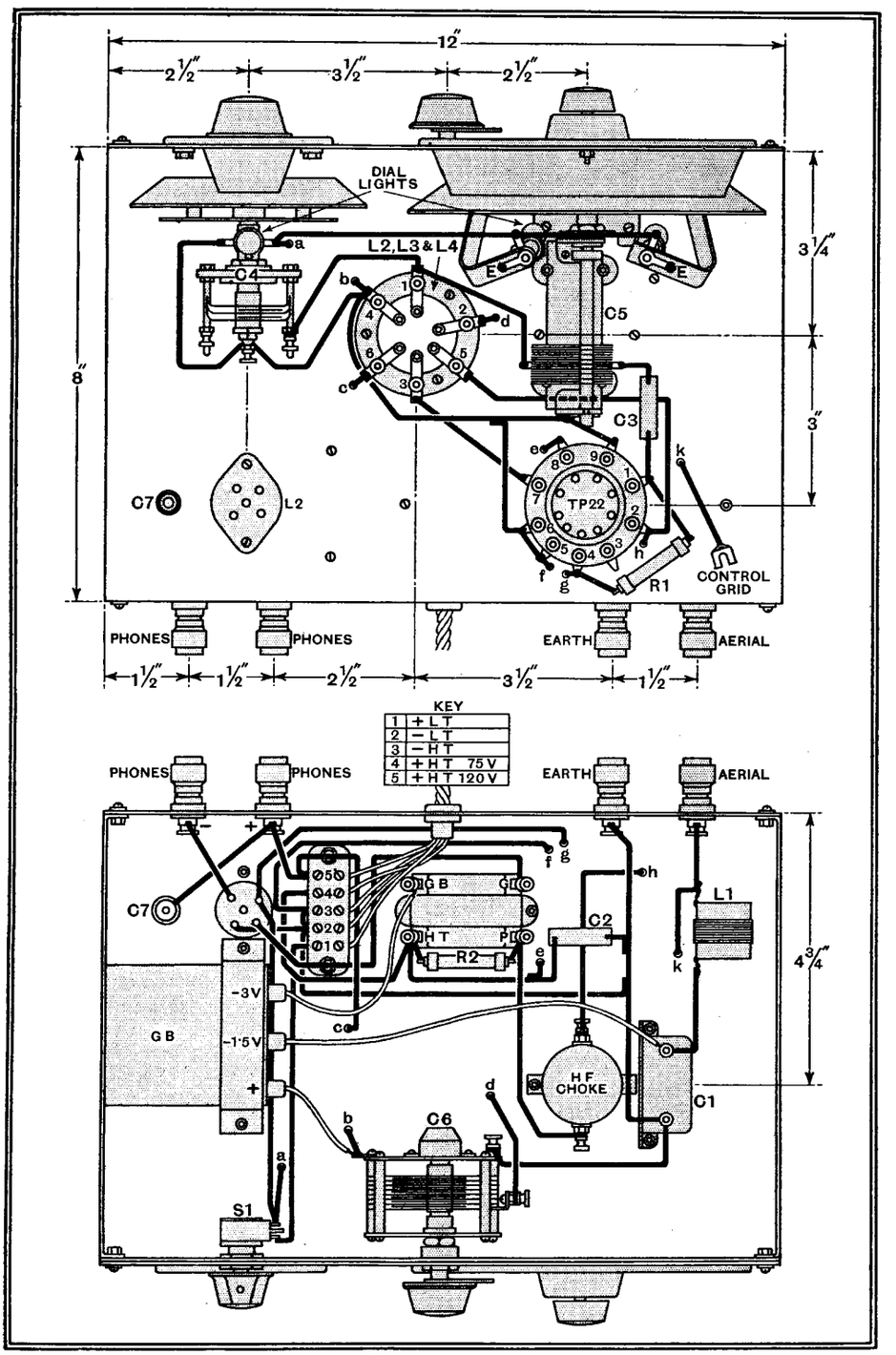
physical features should not influence the performance one way or the other. Nevertheless it would be advisable to adhere as closely as possible to the recommended lay-out, for too drastic a departure might conceivably introduce some unforeseen complications.

The chassis is three inches deep underneath, and any components used as substitutes must not, therefore, exceed this dimension.

Any good 0.00016 mfd. condenser will serve as an alternative for C5, provided its overall dimensions do not exceed 2¼in. from base to the centre of the spindle, 2¾in. in width, and 3½in. in depth from back to front, and it must be fitted with a ¼in. spindle.

For the coil there is a baseboard space 2½in. wide by about 5½in. in depth, so that ample room is available for any other style that may be favoured by the constructor.

The new Formo short-wave coils have been tried and found satisfactory, though the coupling between primary and secondary is a shade on the loose side for this particular set, as these coils are designed to be used with a tuned aerial circuit when a HF stage is employed. However, the makers are quite prepared to add a few extra turns to the primary winding on any coils required for this set. Their two-coil stand can be accommodated on the chassis, but it would have to be set back a little way from the front panel and offset slightly to the right so that it cleared the condenser dials and brought the wave-change switch knob midway between the two condensers. This will entail fitting a short extension rod to the spindle, but little difficulty will be experienced in executing this modification, as small collars or flexible couplings are now readily obtainable.



Practical wire plan and lay-out of the components on the baseboard. A metal chassis and panel is used, the size of the latter being 12in. × 10in.

A full-size blue print of the wiring diagram is available from the Publishers, Dorset House, Stamford Street London, S.E.1. Price 1s. 6d. post free.

Assembly

The actual construction is quite straightforward, and hardly calls for detailed comment here; the illustrations and practical wiring plans clearly show the position of every part and the lie of every wire. Only one special part is required, and that is the small aerial coil. It consists of a one-inch length of Paxolin tube, or its equivalent, mounted on a 1¼in. length of 6BA screwed rod and wound with 40 turns of No. 36 DSC wire with adjacent turns touching.

The chassis and the front panel are made of No. 18 gauge aluminium sheet, but while a metal front panel is essential, for it serves as a shield to hand capacity

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

1 Variable condenser, 0.00016 mfd., **C5 Polar Type "E"**
1 Two-ratio s-m drive Polar "Micro Drive Arcuate"
1 Slow-motion reaction condenser, 0.0002 mfd., **C6 Polar "QJ"**
(Eddystone)
1 Single-ratio slow-motion drive Polar "Panel Mounting Drive"
1 Variable condenser, 15 mmfds., **C4 Eddystone Microdenser**
3 Dial lamps, 2 volts **Bulgin B206**
3 6-pin coils covering 12-94 metres **Eddystone types 6LB, 6Y and 6R**
1 6-pin coil base Eddystone 969
1 Valve holder, 9-pin, baseboard mounting **Bulgin VH31**
1 Short-wave valve holder, 5-pin, chassis mounting **Bulgin SW41**
(Clix)
1 Single pole on-off rotary switch Bulgin S91
1 LF transformer, 1:3 **Graham Farish "Pip"**
(Claude Lyons)
1 Short-wave HF choke, screened **Eddystone 983**
1 Fixed condenser, 0.01 mfd., mica, **C1 Graham Farish**
1 Tubular condenser, 0.0001 mfd., **C3 Graham Farish**
1 Tubular condenser, 0.01 mfd., **C2 Formo**
(Bulgin, Dubilier, Polar-N.S.F., T.C.C.)
1 Fixed condenser, 0.1 mfd., **C7 Formo Screened Paper Type**
1 Grid leak, 2 megohms, **R1 Formo Formowatt**
1 Resistance, 20,000 ohms 1 watt, **R2 Formo Formowatt**
(Dubilier, Erie, Claude Lyons, Polar-N.S.F.)
1 5-way connector Bryce
1 5-way battery cable, 30in., with wander plugs and spade ends **Belling-Lee**
4 Ebonite shrouded terminals, A, E, Phones (2) **Belling-Lee "B"**
1 Grid bias battery, 4½ volts
3 Wander plugs, 1 black, 2 red **Eelex**
1 Valve connector Bulgin P41
(Belling-Lee, Clix)
1 Paxolin tube for aerial coil, 1in. long × 1in. dia. (see text)
Quantity No. 18 gauge sheet aluminium for chassis and panel
Quantity No. 18 s.w.g. tinned copper wire and insulated sleeving
1 piece 6BA screwed rod, 1¼in. long
Screws—20 6BA ¼in. R/hd., 3 6BA 1in. R/hd., 2 6BA 1in. C/sk., 27 6BA nuts
Valves:—1 TP22, 1 L2 **Mazda.**

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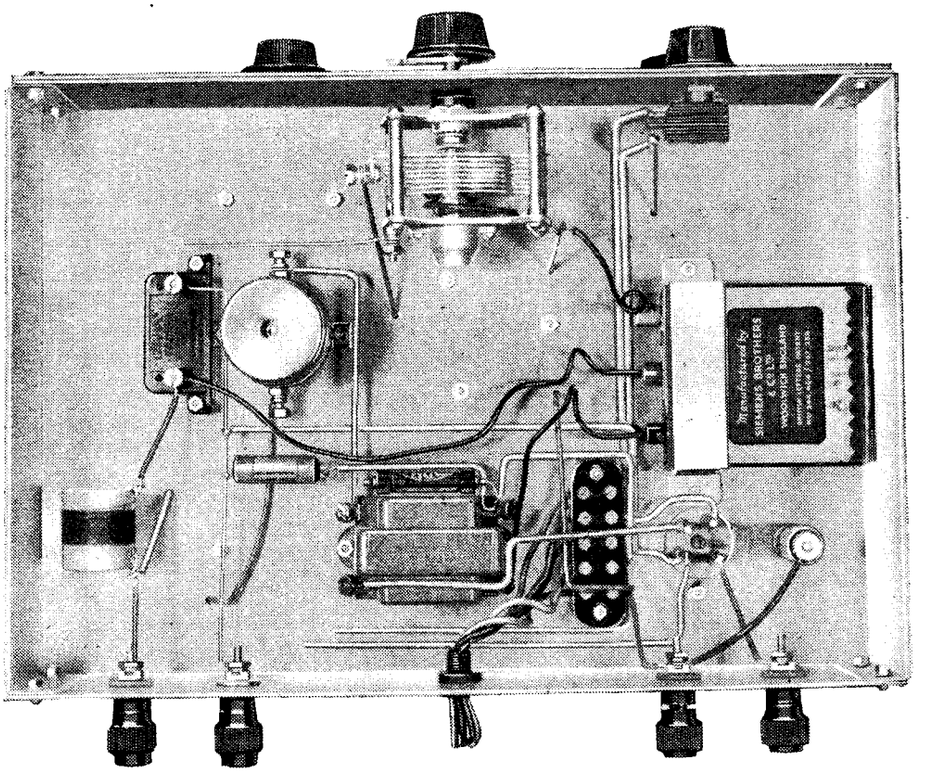
and its effects on the tuning, it is not so important to use metal for the chassis, and this could be made of wood, but the top should be metal covered. The advantages of a metal chassis are such, however, that it is strongly recommended.

There is one point that requires attention when assembling the band-spread condenser C4. It must be fitted with its dial before assembling on the front panel. At the back of the dial is a long, thin finger



The under side of the chassis, which measures 3in. deep, accommodates the reaction condenser, HF choke, sundry other small components, and the bulk of the wiring, also the small aerial coil.

secured by a screw at the lower end and having a large hole at the end adjacent to the centre hole of the dial in which the condenser spindle is inserted. This can be taken off by removing the lower fixing screw and fitted over the condenser bush then secured in position by the large lock nut and in such a position that it is in line with, but at right angles, of course, to the terminal pillar making contact with the moving vanes on the small condenser. Now insert the ¼in. spindle into the centre hole of the dial, but first loosening the grub screws, and secure it. The bottom fixing screw can now be replaced when the dial frame and the condenser should be perfectly rigid. The whole is held in position by the dial fixing bush through which the driving spindle passes. Unfortunately, the fixing of this condenser is not easily followed by examining the illustrations. The other condenser is quite easy to assemble, as it is mounted on a bracket supplied with the dial.

When the wiring is completed and finally checked the valves can be inserted in their respective holders, the telephones connected to their terminals, and the LT leads joined to a two-volt accumulator. A 120-volt HT battery is required, which can be of the standard capacity size as the set requires 4.8 mA. only. The HT+1 lead supplies the screen in the HF valve, also the detector anode, and should have between 70 and 75 volts, while HT+2 joins to the 120-volt end of the battery.

Before connecting the batteries and the aerial it should be ascertained that the reaction condenser is set to its minimum capacity, i.e., rotated to its stop in an anti-clockwise direction.

If the initial tests are made after dark the most fruitful range is that covered by the Eddystone yellow-spot coil or its equivalent in any other make. This covers a waverange of 20.6 to 48.5 metres with the band-spread condenser at minimum. The 31-metre broadcast band starts at 45 on the main condenser, from which point the band-spread condenser will carry the band up to 32.2 metres. The next profitable part of this range is at 25 on the main condenser scale, which marks the start of the 25-metre band.

For 40-metre amateur transmissions the main condenser should be adjusted to 81; then the band-spread will carry on to 42.9 metres.

The lowest range is covered by the blue-spot coil, which tunes from 12 to 27.6 metres. The 20-metre amateur band is found with the main condenser at 67, while the band-spread condenser carries up to 21.3 metres. Sixteen-metre broadcast should be found at 40, nineteen-metre at 59, and twenty-five metre at 89; all are the division marks on the main tuning condenser with the band-spread at zero. For the higher wavelengths the red-spot coil is employed. Its range is 40-94 metres.

An early attempt should be made to calibrate the receiver as soon as sufficient stations whose wavelengths can be relied on have been tuned in. The best method is to prepare a curve for each coil with the band-spread condenser at zero, then from these curves the beginning of any particular broadcast band can be easily determined, after which it can be explored carefully by the band-spread condenser. Incidentally, all the scale readings given are with the reaction condenser adjusted for maximum sensitivity.

Short-wave Broadcasting

CORRESPONDENCE from readers has once again brought up the question of choosing a suitable set for the reception of short-wave broadcast. Personal opinions appear to vary considerably, but that is quite unavoidable.

Medium-wave "local" reception and short-wave broadcast reception, for entertainment purposes, are as far apart as the two poles. Generally speaking, it is chiefly the overseas reader who is concerned, since he is the only man who is utterly dependent upon the short waves for his daily entertainment.

Listeners in this country derive most of their pleasure from the novelty or thrill of short-wave reception, and are prepared to overlook any little shortcomings in the way of interference or fading. Not so the overseas man, who wants his programme from Daventry or Pittsburgh to be as reliable as is the Londoner's reception of Brookman's Park.

A letter from a reader in Battersea reports unusually good reception of Bombay at the end of October between 4.30 and 5 p.m. on a Sunday. The elusive VUB on about 31 metres was clearly received in spite of the proximity of Zeesen and another European station, and the only fault was the usual "long-distance wobble."

Reports of really good reception from this station are very few and far between. It is understood that the power input at the other end is quite small.

Incidentally, although it is not concerned with short-wave broadcasting, a letter from Mr. Streeter (G5CM), of Alfold, Surrey, reveals that conditions at present must be fairly favourable for long-distance work on low power.

G5CM had successful contacts with two U.S.A. amateurs, the power input at his end being 3.84 watts to an Osram LP2 valve. One of the reports was "QSA5 R6," which is more than we can sometimes say for the 25 kW. American broadcast!

As long as short-wave work lends itself to wonderful effects like this, we shall undoubtedly find it amusing and interesting.

The new Canadian station, CRCX, on 49.22 metres, is the old Bowmanville station, formerly known as BE9GW. CRCX is coming across very regularly, and it seems likely that an increase of power has been partly responsible.

VE9CS, Vancouver, listed as working on 49.4 metres, has never yet been received in this country to the writer's knowledge. The power was once given as 5 watts, but it seems almost impossible that a station should continue to give regular broadcast programmes with such an input. The schedule is "Daily, 11 p.m.-midnight; Sundays, 7 p.m. till 6 a.m. Monday."

MEGACYCLE.

Improving Old Receivers

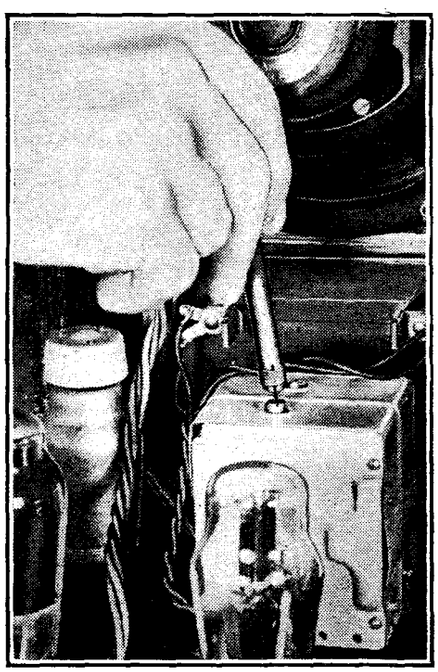
ADJUSTMENTS THAT ARE EASY TO CARRY OUT

EVERY receiver which includes ganged tuning is fitted with a number of trimmers to enable accurate ganging to be obtained. In commercial receivers they are adjusted in the factory and afterwards sealed to prevent the inexperienced from unwittingly altering their settings and so throwing the set out of adjustment. This is, of course, a necessary precaution, but as the trimmers fitted to the majority of receivers cannot be relied upon to maintain the same capacity indefinitely, it is often possible to improve the performance of a set which has seen a year or two's service by readjusting the trimmers. As the guarantee has then expired, there is little harm in breaking the seals.

THE STRAIGHT SET

With a straight set there is usually one trimmer for each section of the gang condenser, and the trimmers are nearly always mounted on the gang condenser itself, being, indeed, an integral part of it. Trimming is then carried out by tuning in a low wavelength station accurately and adjusting each trimmer in turn for the loudest signals. The station chosen should be a weak one on a wavelength around 210-220 metres, and it must be a steady signal not subject to fading.

The trimmer controls are usually in the form of screws, and a small screwdriver is needed to carry out the adjustment. Sometimes, however, they are fitted with hexagon heads, and a suitable spanner is then required. Occasionally they are provided with star-wheels which can be moved by the finger, but even then it is better to operate them with a rod of insulating material, such as a wooden pencil, in order to avoid hand-capacity effects. It will usually be found that certain trimmers are critical in their settings while others are fairly flat, and if this occurs in any case it should not be thought that the set is necessarily defective in any way.



"Trimming a straight set is an easy business."

Trimming a straight set is an easy business. The adjustments to the more popular superheterodyne are more difficult, but not unduly so. The first step is always to adjust the IF trimmers. These are generally located in the same cans as the IF coils, the adjusting screws being accessible through holes in the screening cans, which are often covered with a strip of paper for a seal. In some cases, however, the trimmers are not in the cans, but are mounted on the underside of the chassis. They are always close to the IF transformers, however.

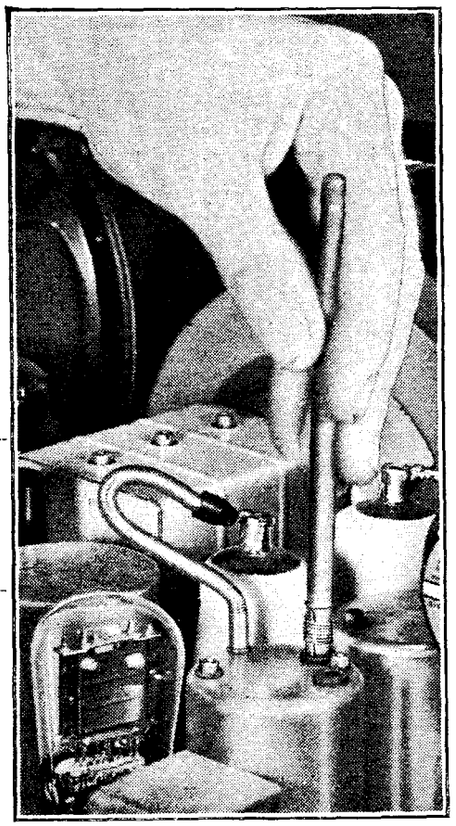
THE SUPERHETERODYNE

The procedure is to tune in a weak signal and adjust each IF trimmer there are usually four, sometimes six, and rarely three only, for maximum signal strength. One word of warning: if the amplifier is of the type using fixed over-coupled coils to obtain a band-pass effect, leave its adjustments alone. Such an amplifier is very difficult to adjust correctly without elaborate apparatus involving the cathode-ray tube. Even if the trimmers have changed their capacity somewhat, so that readjustment is really necessary, the results are likely to be better than those after a readjustment without adequate apparatus, unless the operator is highly skilled.

The signal-frequency ganging can always be tackled, however, and the initial steps are the same as in a straight set. Tune in a weak steady signal on about 210-220 metres and adjust the trimmers on the signal-frequency circuits. These are usually on the gang condenser, as is also the oscillator trimmer. The latter can be distinguished because its setting is much more critical than that of any other trimmer, and a fractional movement will probably cause the station to disappear. Once this trimmer has been found it should be reset to its original point and the other trimmers carefully adjusted.

Most superheterodynes have another trimmer associated with the oscillator circuit which is usually termed the padding or tracking condenser. The one for the medium waveband should be located, and a weak signal on about 500 metres tuned in. This trimmer should be adjusted with one hand while rocking the main tuning control backwards and forwards over a few degrees with the other until the optimum combination of settings is found. A return should then be made to the low wavelength station and the signal-frequency trimmers on the gang condenser readjusted.

"... tune in a weak signal and adjust each IF trimmer."



On the long waveband, an additional padding condenser will usually be found, and this is best adjusted in exactly the same way as the medium-wave padding condenser, but on a station working with a wavelength over 1,600 metres.

Some sets have no padding condenser on the medium waveband, but use instead a special gang condenser in which the vanes in the oscillator section are shaped differently from the others. It is then usually best to confine oneself to the adjustment of the trimmers mounted on this condenser at a low wavelength. On the long waveband there will be a padding condenser, of course.

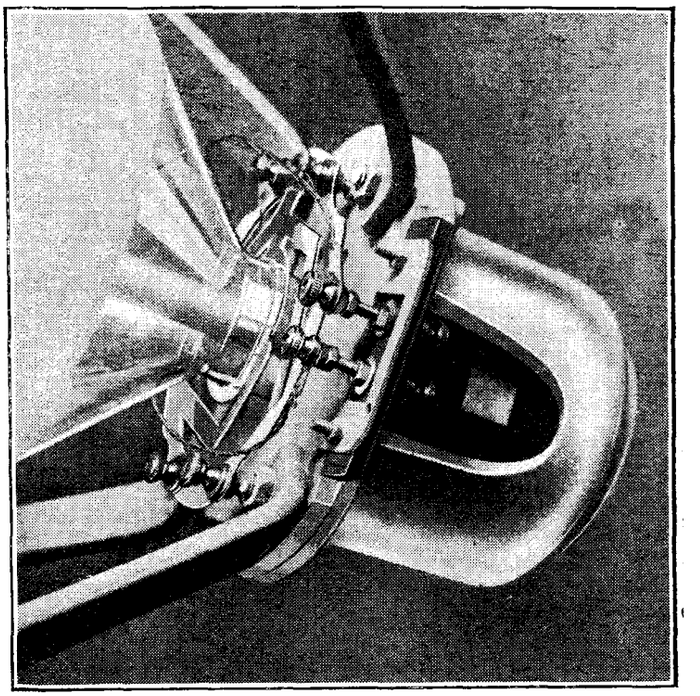
New sets are presumably correctly adjusted when they reach the purchaser, and as an attempt at readjustment might invalidate the guarantee, it is wise to leave the trimmers alone. It is, however, worth remembering that an improved performance can often be secured by adjusting the trimmer on the aerial circuit. This can only be adjusted at the factory to suit the characteristics of an average aerial, and as few aerials have exactly these characteristics, some improvement usually follows a readjustment.

Wide Range Single Cone Loud Speaker

The Advantages of Mica as Diaphragm Material

By NORMAN ROLLASON

IN view of the recent interest in loud speaker performance, particularly with reference to the frequencies from 5,000 cycles upwards, the following notes on the construction of a single-cone loud speaker may be helpful to experimenters working with a similar object in view.

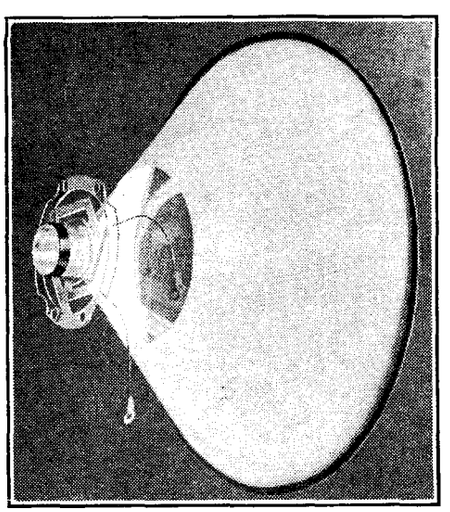


Close-up of rear suspension. Terminal heads are fitted to facilitate adjustment.

AS a result of a number of experiments, the writer was forced to the conclusion that the high-frequency response of a simple cone was dependent not upon the hardness of the material but upon its "thinness." The problem thus became one of discovering a material which whilst being thin would yet be sufficiently hard and springy to afford sufficient rigidity for the transmission of the large low-frequency output to the surrounding air without "cockling" or flapping and the unpleasant noises arising from these effects. Paper proved hopeless above 6,000 cycles except for certain cone shapes which then resulted in a resonance at 4,000 to 5,000 cycles. Even so, with a severe peak in this region the output at 8,000 cycles was reduced at the axis by approximately 60 per cent. of the output at 500 cycles, whilst a 10,000-cycle note was practically inaudible.

As the results from paper cones were obtained with the hardest and thinnest paper it was possible to use, within the limitations imposed by rigidity considerations, harder materials were given consideration. Metal foil pressings, paper cones with metal centres and card rims, thin bakelite sheet, and bakelised paper were tried and found deficient. Probably the best material was the bakelised paper. Even this material could not be reduced sufficiently in thickness to raise the high-frequency output to a satisfactory level, though the reproduction was certainly better than the usual output from paper cone speakers.

Celluloid was the next material to be tried, and although this gave good results up to roughly 6,000 cycles, and, being both hard and thin, seemed to be physically suited to the work, it appeared to be acoustically dead, for beyond 6,000 cycles there was a sharp drop, amounting almost to a cut-off.



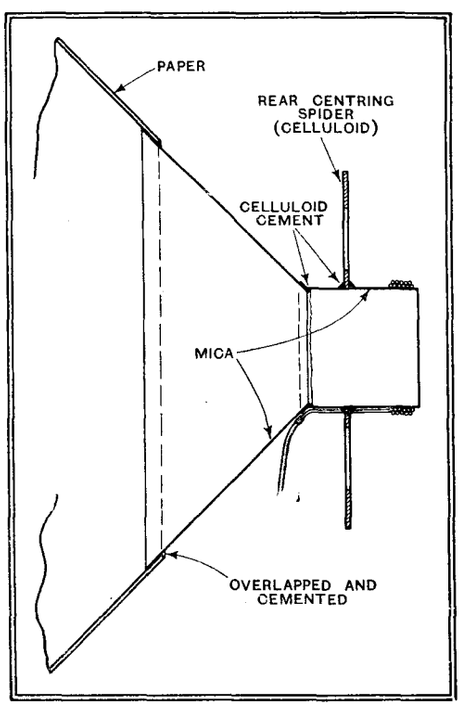
The complete diaphragm assembly including speech coil and celluloid spider.

A Composite Cone

Finally, a mica cone ten inches in diameter and 0.005in. thick was constructed and tested and found to be very satisfactory. The diaphragm proved to be capable of reproducing frequencies up to 10,000 cycles, with very little attenuation, and the response extended beyond this limit.

Since mica is a comparatively expensive substance, it was felt that, whilst the mica was desirable for the higher frequencies, the low frequencies might very well be radiated *via* a less expensive material. Accordingly, air-dried vellum was substituted for mica in the outer portion of the cone in varying amounts, until it was experimentally found that with a ten-inch-diameter cone a centre of mica four inches in diameter was required for maximum radiation of the frequencies above 5,000 cycles. The thickness of the paper used was 0.005in. and the mica centre 0.001in.

At this point a mica former was substituted for the paper one which had previously connected the speech coil to the cone apex. The mica having less resilience than the paper, this brought about a further definite increase of output in the



Cross-section of diaphragm showing details of construction.

Wide Range Single Cone Loud Speaker—

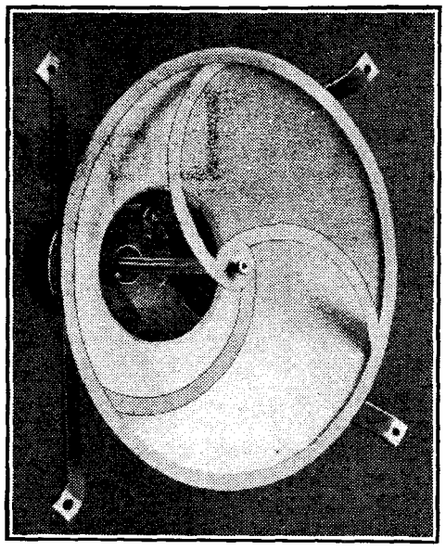
top, and the equipment was considered satisfactory in the matter of high notes.

Since the speaker had to handle the lower frequencies equally well, the next point to receive attention was the suspension. The speech coil was supported by a conventional external spider of large diameter, the three legs being long and thin but moderately wide. Celluloid proved to be the most easily worked material for this item, as the shape could be readily cut from relatively thick sheet, the legs afterwards being thinned by scraping. The spider was affixed to the coil former by celluloid cement which was used throughout and found to adhere well to the mica. The suspension at the periphery of the cone was also by means of a spider, the usual fabric surround being dispensed with. This avoided any trouble as a result of atmospheric action tightening the surround, and also gave greater initial freedom. The spider was made from thin card, treated with celluloid varnish to render it impervious to damp, and had a rim $\frac{3}{8}$in. to $\frac{5}{8}$in. wide, cemented to the periphery of the cone. The centre junction of the three legs is clamped by means of a terminal head to a rigid rod, connected at its other extremity to the central pole of the magnet; thus the position of the cone may be very accurately adjusted.

Speech-coil Dimensions

The speech-coil is of low resistance and has a diameter of one inch. The coil diameter was not found to be critical, but two factors govern its size: one is heat dissipation, which calls for a large coil in a speaker intended for a large power output, and the other is the fact that a large coil reduces the effective cone area, and there is little of this to spare where the high notes are concerned. One inch seems to be a fair compromise; indeed, it is no compromise unless the power dissipated reaches very large proportions. For the purpose of experiment the field magnet used has been a small standard commercial pot with a gap depth of only $\frac{1}{4}$in., and though the low-frequency response is good with this magnet, a higher flux density is desirable for good transient reproduction. Judged aurally, there are no resonances in the unit itself below 500 cycles, nor, for that matter, are any discernible to the ear above that frequency.

The high-frequency output is largely influenced by the formation of the cone, which tends to radiate the high notes largely in a beam. Unfortunately, compromise prevents any possibility of fully maintaining the level of high-frequency radiation from a single-cone reproducer intended for high- and low-note working, for the higher notes require an almost flat cone for the maximum evenness of radiation, any variation of angle being useless as a means of improving the unit in this respect unless it brought the cone angle somewhere near 160 degrees, which is unsuitable for LF work. Despite the strong



The periphery of the diaphragm is supported by a large diameter spider which eliminates the necessity for a "surround."

probability that the experiment would produce negative results, a diaphragm was constructed consisting of a small, flat mica cone affixed to a larger truncated paper cone. This diaphragm proved excellent as a "tweeter," giving a very even distribution of sound, but as far as the lower frequencies were concerned it proved equally satisfactory without the paper! Naturally, the true cone action being destroyed, the paper was merely a passenger.

In view of these results it was decided to make the angle of the entire cone 90 degrees, since any further flattening merely made the cone less rigid without levelling the response in any way.

In operation the speaker unit is mounted on the baffle board so that the edge of the cone just clears the sides of the baffle hole, without leaving too great a gap and so reducing the baffle effect.

As a matter of interest to those who may contemplate the construction of a similar unit, the speech coil consisted of a double layer of 32 SWG enamelled wire with a total of 40 turns, giving an impedance of approximately 3 ohms.

At the Transmitting End

Technical Criticisms of Recent Programmes

IT has previously been necessary to criticise the high modulation employed for announcements, particularly those occurring between musical items, and it seems that this point does not receive the attention it deserves, for wide variations still take place which, in some cases, detract considerably from the programme presentation and causes much wear and tear on our volume controls.

The performance of Fred Hartley and his Quintet (London Regional, November 4th) was rather spoilt in this respect, whereas the concert given by Peter Dawson and the B.B.C. Theatre Orchestra from the same station on the following evening was particularly good.

It is probably not easy to ensure that the announcements always come over at exactly the right volume, as this will obviously bear some relation to the matter of the moment, but it is significant to note that at concerts of importance which necessitate much rehearsal there is seldom cause for complaint. H. C. H.

Marconiphone Model 245

A New Radio-Gramophone of Moderate Price

DESIGNED to give the maximum of entertainment with the minimum expense, this new radio-gramophone, nevertheless, conforms to the makers' high standards of workmanship and cabinet finish. The overall dimensions are 34in. × 16in. × 13$\frac{7}{8}$in., and the panelling is in Australian and figured walnut.

A three-valve "straight" circuit with an HF amplifier, detector and new high-efficiency output pentode is employed, and the instrument is designed to operate from AC. Salient features of the set are the semi-circular translucent tuning dial with "spot-light" tuning indicator and the duplex volume control, in which the pick-up and HF volume control potentiometer are ganged.

The new Marconiphone radio-gramophone Model 245.

The pick-up is based on the Marconiphone Model 25, but has a higher output, as it is fed directly to the output valve. The motor, which is fitted with an automatic brake, consumes only 12 watts.

The price of the Model 245 is sixteen guineas.

CURRENT TOPICS

EVENTS OF THE WEEK IN BRIEF REVIEW

Sottens : 100 Kilowatts

SOTTENS is about to inaugurate its new 100-kilowatt transmitter, probably with an interruption to the service of only twenty-four hours.

Transatlantic Ten-metre Telephony

WHAT is believed to be the first two-way telephony contact on ten metres across the Atlantic was secured by Mr. H. L. O'Heffernan (G5BY) on Saturday last at 2.15 p.m. Getting in touch with W8MWL of Canton, Ohio, G5BY maintained telephony conversation for twenty minutes. A strength of R7 was reported at both ends.

Pay As You Hear

A REDUCTION of 75 per cent. in the usual licence fee of 20 kroner is permitted in the case of some 13,000 Norwegian listeners living in districts where reception is poor. Norway's licence figures now number 176,670—a record.

Listeners in Norfolk and other neglected areas of Great Britain would no doubt like their licence fees to be assessed in direct proportion to signal strength.

New Dublin Announcer

REGULAR listeners to the Athlone broadcasts from the Dublin studio will have detected the voice of a new announcer. He is Mr. L. Redmond, a native of Cork. The original Dublin announcer, Mr. Noel Hartnett, has resigned.

BELGIUM'S NEW BROADCASTING CENTRE. M. Spaak, Postmaster General, laying the foundation stone in Brussels last week of the new "Palais de la Radio" which will centralise all the broadcasting activities of the country.

Radio Priest

FATHER COUGHLIN, the Detroit "radio priest," now uses an independent network of thirty-three stations from coast to coast of the U.S. So great is the appeal that he exerts in his quasi-political talks that Father Coughlin is now omitting the musical portions of his broadcasts, relying entirely upon the appeal of the spoken word. It is estimated that the new thirteen-week series of forty-five-minute talks is costing him $300,000.

Two Sets

JUST as the average well-to-do home has two motor cars, so Americans, as they rise in the social scale, now run two "radios." It is estimated that some 10 per cent. of America's twenty million homes equipped with radio own two or more receiving sets.

R.A.F. Reunion Dinner

THE Officers' Reunion Dinner in connection with the R.A.F. Wireless School is to be held at the Royal Air Force Club, 128, Piccadilly, W.1, on Saturday, January 11th, 1936, at 7 for 7.30 p.m.

Owing to the sad death of Mr. J. F. Herd it is not possible to advise all the members direct, some addresses having gone astray. Enquiries should be addressed to Flt.-Lt. F. S. Wainscott, the Electrical and Wireless School, R.A.F., Cranwell, Lincs.

Radio as She is Spoke

IF *The Wireless World* "Dictionary of Technical Terms" had been available at Clerkenwell County Court last week Mr. Registrar Friend would have been happier.

"The wireless people," he said, "have got hold of much more wonderful words and phrases than a doctor has ever invented." He was hearing an action concerning a wireless set.

After an expert witness had given evidence the Registrar remarked to a solicitor that it would be necessary to have a wireless lexicon in court. Turning to the witness, Mr. Registrar Friend said: "When the doctor has told you what is wrong with you in Latin, he has the decency to tell you in English. Only Professor Einstein could translate or unravel what you have said."

Anti-Static War : Latest

"WHEN is a noise not a noise?" is the problem still confronting the International Electrotechnical Commission, which met in London last week to discuss radio interference.

Considerable diversity of opinion exists as to the noise level necessary to cause interruption. It is being realised that there are many factors to be considered, such as the nature of the programme interrupted and the fastidiousness of the particular listener. What may be the pleasant background murmur of the running brook to one listener may seem to another like weeping and gnashing of teeth.

Standard apparatus for measuring interference is being evolved, and will, it is believed, supply valuable data when a full conference is held in January under the auspices of the Electrotechnical Commission and the International Broadcasting Union.

POLYGLOT CONCERTS are featured late at night by Frankfurt, and this picture shows the team of announcers who introduce each item. Left to right : Otty Frank (Italian), Troute Berger (English and French), Conductor Andreae, Magda Braun (Spanish), Herr Kohmann (Polish) and Prof. Schmidheiny (English).

The Year Book for Wireless Traders

A SUMMARY of the Television Report and an article describing the principles of television are new features in the twelfth annual edition of "The Wireless and Gramophone Trader Year Book and Diary," just published.

So much information and reference data are contained in this Year Book that it should be indispensable to everyone in the radio and gramophone trade. The popular valve reference tables have been completely revised, diagrams are given of British and American valve base connections, and no fewer than 400 sets of 54 British manufacturers are listed in a complete guide to the current market. Other features include hire-purchase law, Shops Acts, patent law, P.O. and manufacturers' licences and a design for a 15-watt power amplifier. A wealth of service information is included. There are directories of manufacturers and distributors and of proprietary names and trade marks. There is also a very practical diary for 1936 with one week at an opening.

The Year Book, priced at 5s. 6d., is obtainable from The Trader Publishing Co., Ltd., Dorset House, Stamford Street, London, S.E.1. Subscribers to any "Trader" publication can obtain their copy for 3s. 6d.

U.S. and "British Bondage"

DETERMINED to free America still further from "British bondage" with respect to wireless traffic which hitherto has cleared through London (writes our Washington correspondent), the Federal Communications Commission has granted Press Wireless Inc., a radio subsidiary of a group of leading American newspapers, authority to communicate direct with Addis Ababa.

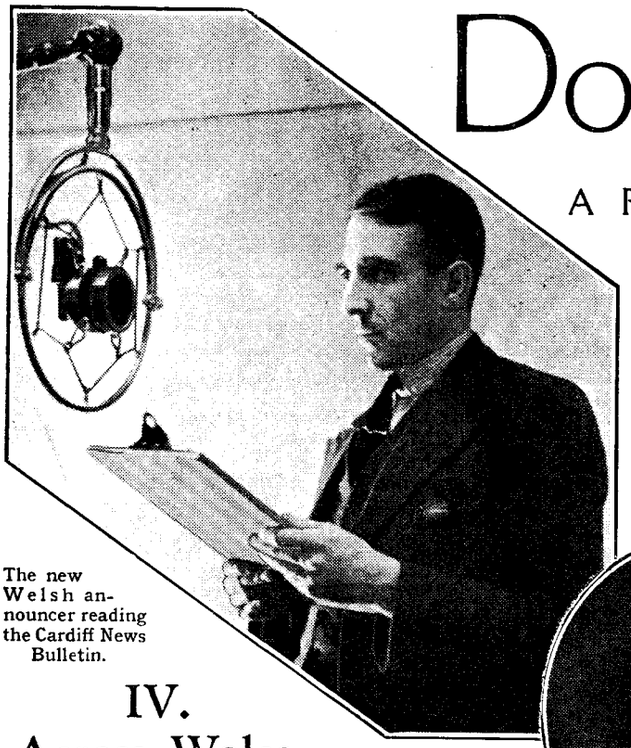
It is understood that the Commission will also grant similar authority to R.C.A. Communications Inc. to pick up Ethiopia direct on its radio station at Rocky Point, Long Island. Previously nearly all war news from Addis Ababa has been routed from the Abyssinian radio station ETA *via* London to the United States.

It is considered that direct communication between Ethiopia and the United States will eliminate any possibility of censorship in Italo-Ethiopian war news in London.

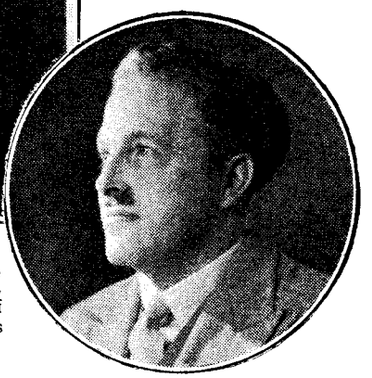
Does Broadcasting

A REGIONAL TOUR OF INVESTIGATION

NEW and exclusive details of the B.B.C.'s plans in North Wales are given in this instalment, which also explains some curious fading anomalies in the centre of the country. Mr. Baily's visits to both Cardiff and Bangor coincided with important staff changes and constructional developments auguring well for the great Welsh broadcasting "drive" now in progress.



The new Welsh announcer reading the Cardiff News Bulletin.



Mr. E. R. Appleton, who has been B.B.C. Director at Cardiff since the early days of broadcasting.

IV. Across Wales

EMBLAZONED in scarlet paint on the wall of the main studio at Cardiff is a gigantic Welsh lion—rampant! Surely a symbol of B.B.C. policy in Wales to-day.

The old illogical scheme of pooling Wales and the West of England in one vast and clumsy "West Region" has tumbled to its inevitable doom; not only are the Welsh to have a programme of their own, but immediate steps are being taken to improve reception conditions. This mountainous and extensive country has perpetually baffled radio engineers. Droitwich lays down the National programme very effectively everywhere, but now that Welsh programmes are to be independently developed the problem of Regional coverage becomes even more pressing.

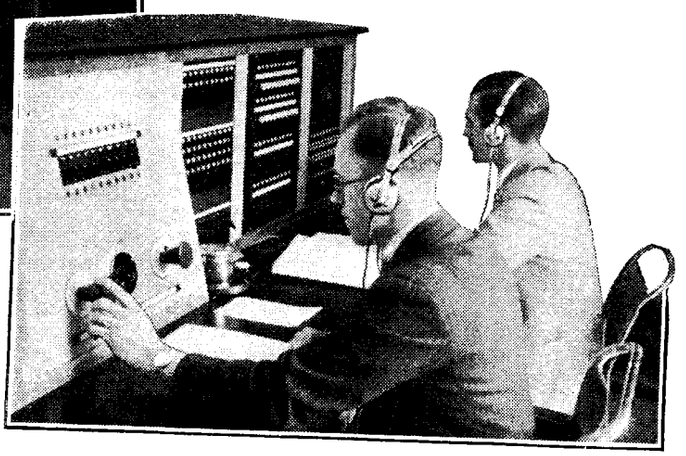
When I speak of an illogical scheme, I mean from a programme point of view; the opinions I heard during my visit to the West of England about the strong element of Welsh mixed up in local programmes are unprintable. From an engineering angle, the contention of B.B.C. technicians is that a better arrangement in 1933 was prohibited by scarcity of wavelengths; now, however, they are building a relay station in North Wales synchronised on the same wavelength.

Photograph taken in the Cardiff studio during an actual broadcast of the Children's Hour. On the right are engineers in the Cardiff Control Room.

Facts About Bangor

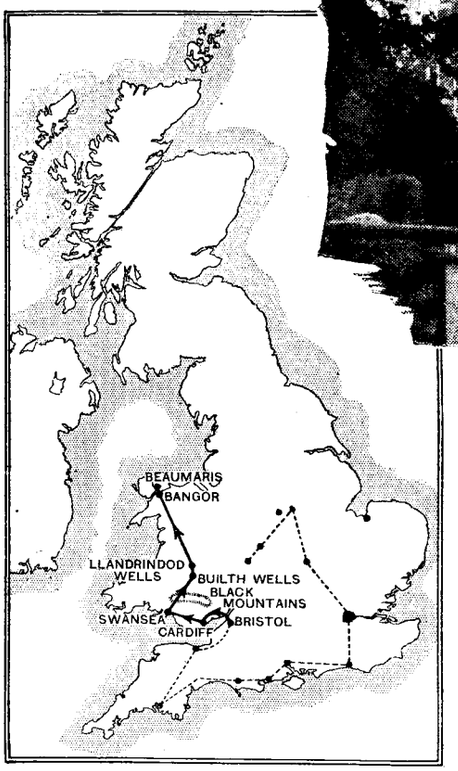
Of this station, at Bangor, I am able to-day to give exclusive details. It will wipe out the "neglected area" in the North. In the South, Cardiff, Swansea and other populous towns get a good signal from the West Regional transmitter at Washford Cross, which, as I explained last week, will in due course become *Welsh* Regional; but behind these towns rise the Black Mountains, a barrier which for years cut off Central Wales. It is now claimed that, thanks to the recent lengthening of the West Regional wavelength from 306 to 373 metres, a fairly good Regional service is given as far north as Llandrindod Wells, where it happened that "Radiolympia in Wales" was in full swing on the day of my visit: an exhibition on a most enterprising scale, sponsored by Mr. R. B. W. Edwards, from whom it transpired that local reception conditions are better than I had expected. West Regional, he said, comes in well, and AVC can cope with its moderate fading.

On the other hand, I was told at Builth Wells, nearer the mountains, that fading is severe, and that most listeners depend



Serve Britain?

By LESLIE BAILY



almost wholly on Droitwich. Mid-Wales is evidently an area where reception is touch-and-go, and the B.B.C. "drive" in Wales promises no improvements here. In fact, things are likely to get worse, because Mid-Wales will be in the mush-zone when transmitters North and South are synchronised on the single Welsh wavelength. It is a case, once more, of the few suffering to benefit the many, for I am assured by the B.B.C. that the number of listeners in the service area of the North Wales relay station will be far greater than the number in the mush-zone.

It may be asked: "Why not place a high-power Welsh Regional transmitter on the Black Mountains so as to reach Mid-Wales as well as South Wales, instead of relying on transmission from a point at the extreme south of the Region; indeed, on the opposite side of the Bristol Channel?" The reply is that attenuation from a South Wales site would be acute (the minerals and granite have a particularly bad effect), whereas attenuation across the sea from Washford Cross is slight.

Why in Somerset?

"It is not," says the B.B.C., "an anomaly to have the Welsh Regional transmitter in Somerset. It is, in fact, the best place from the technical point of view. In fact, the Somerset site serves more Welsh listeners than any site in South Wales could serve."

Until the new transmitters in Wales and the West of England are ready, a composite Welsh-West programme will be continued from Washford Cross, but already staff is mobilising in Wales for the day when Wales gets its own exclusive wavelength.

The detached residence in Bangor, near the University, which will form the North Wales headquarters. It looks out on to mountains and sea.

When I arrived at Cardiff's Broadcasting House I was irresistibly reminded of boarding school on the first day of term. All the new boys were moving in, and the few remaining old boys were bagging the best rooms. Almost all the English men and women on Regional Director Appleton's staff have been packed off to Bristol; only Mr. Appleton himself and his chief executive, Mr. Settle, remain. These two have been at Cardiff almost since the B.B.C. began there. The rest of the programme staff are Welsh-speaking Welshmen (mostly strangers to broadcasting).

But I am assured that Mr. Hughes Jones, a man of unusual brilliance, who has been appointed Welsh programme director, has no intention to make Welsh Regional a "foreign" station; feature programmes about Wales, *but in English,* are to be worked up, for instance. The question of how much Welsh to allow on the air is represented by these figures of the population of Wales:—

Speak English only ..	1,750,000
Speak Welsh only....	80,000
Speak both languages	800,000

Cardiff headquarters is a hotch-potch place; two old houses, plus a modern wing built on at the back, with five quite nice studios, a control room manned by fifteen engineers, and offices for the staff of about fifty. On December 1st a new orchestra of twenty will start work, instead of the present Studio Nonet. An adjoining house is being taken to help to accommodate the present expansion schemes.

At Swansea (a satellite connected to Cardiff by land-line) the accommodation is dreadfully obsolete: two 1924-type studios. Mr. Tom Pickering, the singer, has been appointed representative, but I hope he gets new studios soon.

The New Transmitter

I went on to North Wales, visiting first the site of the new transmitter on Anglesey. It is a couple of miles along the coast from Beaumaris, at a surprisingly low altitude, almost sea level. Height is not a factor of such great importance in site selection nowadays.

Here a 5-kilowatt transmitter will be erected. Though small in power, it will have the very latest type of circuit, employing series modulation, as at Droitwich. I found that all that had been done was the sinking of a well in the middle of the field, and the sides of that had collapsed. A couple of Welsh-speaking labourers were fixing a derrick over the

Where the Beaumaris 5 kW. transmitter will stand. A well has been sunk, but the sides have fallen in.

Does Broadcasting Serve Britain?

water-logged hole. I am assured, however, that the station should be working a year hence.

The labourers told me how eagerly the people thereabout are awaiting the new station, how irritated they have always been at the difficulty of tuning-in the Welsh programmes from Cardiff.

Directly across the Menai Straits from the site is Bangor, where the new studios and control rooms are already well advanced. Connected by land-line to Washford Cross (*via* Birmingham and Bristol), they will begin to contribute programme items probably by February. Mr. Sam Jones, formerly in charge of Welsh programmes at Cardiff, has already taken up residence as programme organiser, and Mr. Hett (formerly engineer-in-charge, Leeds) is there. He will have the unusual job of superintending both a transmitter (Beaumaris) and a studio centre (Bangor).

He showed me round the B.B.C.'s first all-mains control room, the first instance I have come across on this tour of a new tendency of the B.B.C. engineering department to put its faith in the reliability of mains supply and mains valves. Battery operated control rooms have hitherto been *de rigueur*. The transmitter across the Straits will also get its power from the mains.

The building bought by the B.B.C. at Bangor is a large detached residence, standing near Bangor University College, in what the house agent no doubt called "superb sit. commandg. mountains and sea," which would be no exaggeration. It was a busy scene inside. Electricians from London were wiring up the severe grey panels in the control room. Carpenters were fixing sound-insulation materials on the walls of rooms which were somebody's parlour and dining room yesterday and will be every Welshman's cynosure to-morrow. The effects studio was being furnished with water tank and related paraphernalia. A six-channel drama control panel was in position.

The studios are small, but in the familiar B.B.C. style: chromium fittings and buff walls. The main studio, 26ft. × 13ft. 6in., with walls covered in building board, is for general purposes. The second, slightly smaller, is insulated with rock wool covered with linen, has a "dead" acoustic, and is intended for drama.

And the programmes? I can do no better than give you the words, just as he spoke them to me, of that sparkling Welshman, Mr. Sam Jones: "This is *the* Welsh area! North Wales is replete with history and folk lore. Why, the very spot where we are to build the new transmitter is where the *Druids* made their last stand against the Roman invasion. And for *hundreds* of years—as now—while most of the Eisteddfod music prizes have gone to the South, the majority of the literary prizes come to the North. Plays, feature programmes, talks, seem likely, then, to be the *chief* product of these studios. But in the *summer* we shall also bring to you all the wealth of gay, light entertainment at our holiday resorts—Llandudno, Colwyn Bay, Rhyl. Then, Bangor itself is a city unique in the British Isles; with its half-dozen or more colleges it is the *Athens* of Wales . . . and look, man! . . . look at that *view*, isn't that an *inspiration* to us?"

He pointed through the window. The morning sun was sparkling on the sea, shifting a dreamy mist, while beyond, in greens and browns, fading into a distant purple, the mountains of Snowdonia rose in majestic procession . . . a veritable symphony to the eye.

Now, Sam, translate it into symphonies of sound!

Next Tour: *Over to Northern Ireland.*

Random Radiations

By "DIALLIST"

Wireless Sets and Railways

A BIG point has been scored by H.M.V. and Marconiphone in arranging with the railway companies to accept at companies' risk wireless receiving sets returned to the makers for repairs. The Railway Clearing House has a rule that sets returned to their makers are accepted only at owners' risk, but now that the way has been opened for a revision it is hoped that the new terms may soon apply not to H.M.V. and Marconiphone sets alone, but to those of wireless manufacturing firms in general. I don't know how many cases I have come across in which sets returned to the makers for replacements or repairs under the guarantee have been badly damaged in transit on either the outward or the homeward journey. Certainly the numbers amount to something pretty considerable. Packed as they are nowadays in special cardboard cartons made to fit them and appropriately padded, wireless sets should not be damaged by any ordinary handling on the railways. I am afraid, though, that they sometimes come in for somewhat rough treatment at the hands of porters. This will no doubt be remedied if and when the railway companies take the risk for sets in general.

The North-East Regional Station

THE site for the B.B.C.'s North-East Regional station is to be at Bewclay, a little Northumbrian village near Corbridge. Corbridge itself is a small town on the Newcastle-Carlisle main road. It is 17 miles from Newcastle and 41 from Carlisle. The site is therefore likely to provide an excellent service for a large part of Northern England and for a good deal of South-Eastern Scotland. Though the Corbridge area had long been regarded as the ideal place for the North-Eastern Regional, there was some difficulty at first about finding a site, since it was necessary to avoid the region of the Roman wall, which is, of course, a national monument. Bewclay, however, is nicely out of the way, and its choice will be approved by antiquarians and modernists alike.

Acid and Accumulators

A LONDON firm of electricians writes to me with regard to the paragraph which appeared recently in these notes on the subject of complaints that some charging stations made a practice of building up the specific gravity of the electrolyte of accumulators committed to their charge by the addition of "juice" not from the mains, but from the sulphuric acid bottle. The firm points out that the addition of acid would be more costly than leaving the accumulators on charge for the proper time. They do, however, add that there are people who "take the last ounce out of their accumulators and then get annoyed if time is spent in trying to get them into condition again so that the batteries are not ready as soon as they expect." May I say at once that the complaints I received came not from London, but from a Midland district? Whether or not they are well founded I have no means of ascertaining with certainty, but I have little doubt that this nefarious practice has been indulged in here and there when it was a question of getting accumulators ready quickly, particularly those containing some kind of indicating device which shows whether they are partially or completely charged.

Election Loud Speakers

I REFERRED a week or two ago to the case of the tradesman who was fined under the Metropolitan Police Act of 1839 for using a loud-speaker van to advertise his wares. The Act, unfortunately, applies to the Metropolitan area only, and at the time of writing both days and evenings are being made hideous in my locality by perambulating loud speakers which bellow the merits of this candidate or that. I am seriously thinking of retaliating by fitting my own car with loud-speaker equipment and following them round as a heckler!

Unrehearsed Debates

I CAN'T say that I have been very much impressed by many of the broadcast debates that I have heard in the past. They were too obviously put-up jobs; too obviously rehearsed. A debate on these lines doesn't ring true; nor is there much room for illusion when you hear one of the participants turn over typescript with a crackle just before making a smart impromptu (!) rejoinder.

Very different was the debate between Miss Rose Macaulay and Miss Arnott Robertson the other night. It was announced as an unrehearsed debate, and obviously it was. Partly for this reason, and partly because both the chairman and the ladies who engaged in verbal battle were excellent at their jobs, it was a real joy to listen to. I can't say that at its close I felt at all convinced that women were or were not bored by emancipation. That didn't matter a bit. One heard some sparkling and spontaneous talking between two witty women, and that was the great thing. Mr. Levy, as chairman, had no easy task to keep his debaters under full control, but he managed it admirably by the

exercise of tact and firmness. I hope that these unrehearsed debates may be regular and frequent features of the programmes. So long as the right debaters are chosen and given good subjects they are bound to be popular.

Programme Timing

THE fade-out of Mr. Will Hay's sketch, "Rebellion," about half a minute before it came to its end during the Music Hall Show the other night, has led to no small amount of controversy.

This is by no means the first time that a rather unfortunate fade-out has had to be made before the end of a broadcast item. For some reason or other those who conduct the B.B.C. programmes never seem to have acquired the knack of timing each item exactly. Sometimes they finish too early, in which case we have an overdose of Bow Bells; sometimes they run over time, which means apologies all round. American stations have brought the timing of items to a fine art. When you listen to their programmes you find that everything goes just like clockwork. Each item begins and ends exactly when it should, no sooner and no later. This is a matter to which I commend the earnest attention of the B.B.C.'s programme department.

A POLISH TIME SIGNAL. A two-bell system worked in conjunction with the minute and second hands of the clock is radiated by the Poznan station.

That Ten-Metre Band

What the Amateurs Have Done

MANY startling things have been said and written about the 10-metre band since the recent spectacular work with the Antipodes was carried out, and the time seems to be ripe for a calm and dispassionate survey of what has been done, and of what it may be possible to do in future.

In October, 1928, Mr. Mathews, of G6LL, established the first amateur 10-metre contact between this country and the U.S.A. The year 1928 coincided roughly with the last sunspot maximum, and conditions on 20 metres were phenomenally good. It was this that led sundry adventurous spirits to look round on "ten."

Three outstanding American stations then were W2JN, W2BG and W2ACN. All of them made many Transatlantic contacts, both with this country and with France, Germany and Belgium.

1929 appeared to be almost as good. The first contact with India, with the West Coast of the U.S.A., and with Africa (in December) were made. Much useful work was done with low power, in particular by Mr. Rodman of G2FN, who worked with California on an input of 8 watts.

After this, 10-metre long-distance work died out completely. Nothing was heard for some years except European stations and occasional harmonics from 20-metre commercial stations.

Revived Activity

Nothing of real interest occurred until 1934, when it was assumed, by the conditions on other waves and the progress of the eleven-year sun-spot cycle, that things would liven up again shortly.

In June, 1934, the R.S.G.B. announced an international 10-metre contest, running for one year from October 1st, 1934, points to be scored for all contacts over a distance of more than 100 miles.

In November, 1934, the Australians set the ball rolling by establishing many contacts with New Zealand, and many more across the Australian continent, over distances of roughly 1,000 miles.

By February, 1935, British amateurs were hearing harmonics of American commercial stations, and somewhat doubtful reports of American amateurs were also made.

In March, things really started happening. Two Australians worked with Japan; one was in contact with the East Coast of the U.S.A., and another with the West Coast. The stations concerned were VK2LZ, VK2HY. and VK2HC. By April Australia-U.S.A. contacts were commonplace.

During May affairs progressed still further. South Africa was heard in this country for the first time since 1929; contacts with Algeria and Egypt were made, and a West Coast American was heard in Spain.

Long-distance "Stuff"

In June the first South American was heard here, and the Belgian station ON4AU was logged in Australia. Clearly the stage was set for something startling!

By August the U.S.A. stations were heard here; British transmitters had worked with South America; Europeans were being heard in South Africa, and South Africans in Europe.

On October 6th Belgian ON4AU and French F8GS were in touch with VK2HZ and VK2LZ—the first Europe-Australia contacts. The events of later October have already been described in detail. Stations in this country have been in regular contact with Australia and the U.S.A.; South America and South Africa have been consistent; and, finally, the Indian station VU2LJ came in and made the first "worked-all-continents" achievement possible.

These are the hard facts. If we can deduce anything from them at this early date it is that the 10-metre band follows all the rules obeyed by the others, but is more subject to etheric conditions, fading, skip distance and the rest than are the other bands—which is precisely what one would expect.

Some time ago there was much talk of a "critical wavelength" below which all radiations would penetrate the reflecting layers instead of coming back. Obviously this wavelength (if it exists) is something shorter than 10 metres at this stage of the sun-spot cycle.

Future Prospects

The next "peak" year is not anticipated until 1938 or 1939. Is 10 metres to improve steadily until then? And will long-distance work on even shorter waves be practicable in a year or more?

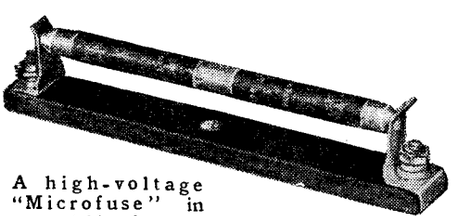
These are the questions that are worrying the amateur. Meanwhile, he has once more succeeded in doing things that he was advised were impossible. It may be that the commercial concerns and scientists knew that world-wide communication on 10 metres was possible—but they certainly did not say so! The amateur seems to have said so in a fairly effective manner.

One of the more important points emerging from this recent work is that there is a considerable wastage of frequencies going on at present. Between 13 and 10 metres there is a marked dearth of commercial activity. One might hazard a guess that all this will be changed within the next few months.

MEGACYCLE.

Low Current Fuses

THE production of a fuse capable of carrying half a milliampere continuously, yet which can be depended upon to "blow" when the current rises to 1 or 1.5 milliamp. is a distinct technical achievement. Fuses of this type, designed for operation in high-voltage circuits, are now being manufactured by Microfuses, Ltd., of 4, Charterhouse Buildings, Goswell Road, London, E.C.1, especially for the protection of cathode-ray apparatus.



A high-voltage "Microfuse" in cartridge form.

These extraordinarily delicate fuses are made on the same principle as "Microfuses" of more normal ratings, and the fusible element consists of a gold film, but in the present case this film is only about five millionths of an inch thick.

"Microfuses" of all ratings are manufactured both in the original well-known flat-strip type, with spring stud connections, or in the more conventional cartridge form, as shown in the accompanying illustration.

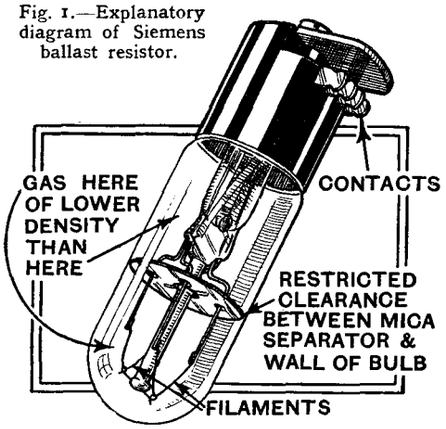
A New Ballast Resistor

Theory and Application

BALLAST resistors or barretters have been in use for a number of years in circuits where it is desired to maintain a substantially constant current irrespective of variations in voltage. A particular case is the breaking down resistance used with AC-DC sets. If a plain wire wound resistance is used here it is necessary to provide various tappings for different supply voltages, while in addition any fluctuations in the voltage of the mains will be transferred to the valve heaters and may conceivably shorten their life.

A barretter is a device in which the resistance varies according to the current, tending to increase with increasing current so that if the voltage rises the increased resistance in the barretter maintains the current approximately the same as before and vice versa.

Fig. 1.—Explanatory diagram of Siemens ballast resistor.



Any wire resistance has a positive temperature coefficient so that as the temperature rises the resistance increases. The more current passed through the wire the higher its temperature, and hence the higher the resistance, so that it might appear that we had all ready to hand a very simple method of achieving the desired results. Unfortunately, the solution is not so simple, for in order to obtain anything like a satisfactory increase in the resistance, the temperature of the wire has to be very high, and as soon as this occurs the conduction of heat from the wire becomes very large—in other words, the wire cools itself much too quickly.

Ideal Conditions

What we actually require is a balance between the heating of the wire by the current passing through it and the cooling by conduction such that if the current through the wire increases by a small amount, the temperature is able to increase by just sufficient to increase the resistance enough to pull the current back to where it was. To express mathematically, the heat loss of the wire is $W = A\,T^a$ and the resistance is $R = B\,T^b$. If b is greater than a we obtain ballasting.

Now it is found that iron wire varies its resistance with temperature in a somewhat peculiar manner and that in particular if it is enclosed in a glass bulb containing hydrogen at a certain pressure there is a range of temperature running from about 600 deg. to 1,000 deg. C., over which the conditions for ballasting are fulfilled. This is the general principle on which barretters are usually made. The size of the filament and the gas pressure have, of course, to be adjusted somewhat critically, but the mechanism is definitely effective as is borne out by the satisfactory use of the barretters in many circuits. The subject of barretters in general was very ably discussed by H. A. Jones in a paper entitled "Theory and Design of Ballast Resistances" in the "General Electric Review" for May and September, 1925. In particular, he points out that tungsten wire is not suitable for this ballasting action as it does not possess the necessary characteristics. This is unfortunate because, as it is well known, tungsten has very desirable properties from the point of view of a filament, and various workers from time to time have endeavoured to use it, without success.

Just recently, however, Messrs. Siemens Electric Lamps and Supplies have introduced a barretter using the tungsten filament. It operates on a somewhat different principle, depending for its action on the varying density of the gas inside the bulb due to the heating action of the filament.

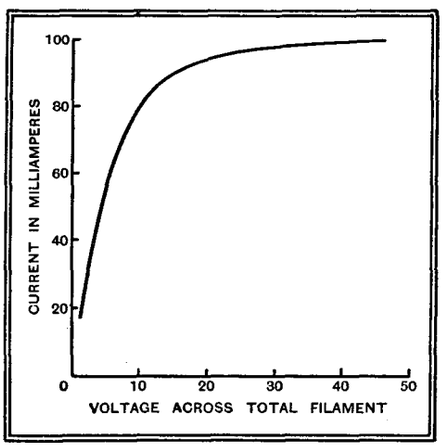


Fig. 2.—Characteristic of 100 mA. Siemens ballast resistor.

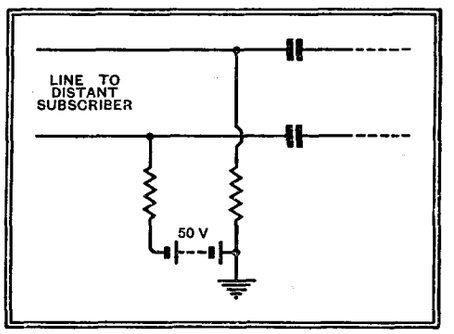


Fig. 3.—Bridge circuit used in central battery exchanges.

The conduction from the hot filament depends upon the pressure of the surrounding gas. As we reduce the pressure the conduction gets less, the filament becomes hotter, the resistance increases and the device passes less current. We can achieve the same result as a reduction of gas pressure by reducing the density of the gas, for if there are less molecules of gas to conduct the heat away, the conduction will clearly not be so great.

In any ordinary single bulb the average density of the gas must remain the same, but if we can divide up the available gas space into two portions with a restricted orifice for gas to pass between one portion and the other we can have different densities of gas in the two portions, although the average density throughout the whole will still remain the same.

Construction

This is the principle adopted in the Siemens Ballast Resistance. The device is illustrated in Fig. 1 and will be seen to be in the form of a simple tubular bulb in the top end of which is the filament. This filament is actually made in two entirely separate halves brought out to separate terminals in the base, this being done for convenience in the use of the device. Half-way down the bulb is a mica disc which comes to within a fraction of a millimetre of the outside bulb. Consider now what happens if the temperature of the filament increases. The gas in the end of the bulb becomes hotter and some of this gas squirts through the restricted space between the edge of the mica disc and the bulb into the lower portion of the tube, and because of the restricted circulation an equilibrium condition arises where the hotter gas in the top portion is able to balance itself against the rather greater mass of cooler gas in the bottom portion. The density of the gas in the top portion, however, must have been reduced, for we actually have less gas occupying the same volume as before, and as we have seen, a reduction in density reduces the radiation

A New Ballast Resistor—

and allows the resistance of the filament to increase.

The increased temperature of the filament therefore has been accompanied by an increase in resistance which maintains the current substantially constant instead of allowing it to increase in the normal manner.

As is the case with most barretters, the ballasting action only takes place over a certain limited range, but this is quite sufficient for the purpose in hand. Fig. 2 shows a characteristic of one of these ballast resistances, from which it will be seen that an increase in voltage of 15-40 only causes a 10 per cent. increase in the current.

Applications

This particular ballast resistor was developed for telephone work, which is the reason for the split filament. In telephone exchanges the current is supplied to the subscriber's instrument from a central battery through a bridge network of the form shown in Fig. 3. The actual current passed by the bridge will, of course, depend upon the length of line between the subscriber and the exchange, and theoretically each line should have its own bridge. This, however, is uneconomical, and it is customary to provide a limited number of bridges any one of which may be brought into use as required to meet the needs of any subscriber. Clearly, therefore, a compromise is necessary, the bridge being designed to suit the average length of line. Subscribers on longer lines than this will not get quite sufficient current through their instrument, and therefore the sensitivity or transmission characteristic will be reduced, while apparatus at shorter distances will carry an excessive current. Obviously, if in place of this bridge a ballast resistance can be used, an automatic compensation for the varying length of line can then be obtained.

From a wireless point of view there are other applications which are perhaps of more interest. A particular example occurred recently during some work on television amplifiers, when a troublesome flicker of very low frequency was observed. The frequency of the variation was only about 1 or 2 cycles per second. It was ultimately found to be due to fluctuations in the mains voltage, and it proved particularly troublesome. Variations of this order, of course, are rather rapid for the average barretter to handle, but some special oscillograms were taken to determine the speed with which this ballast resistor would operate.

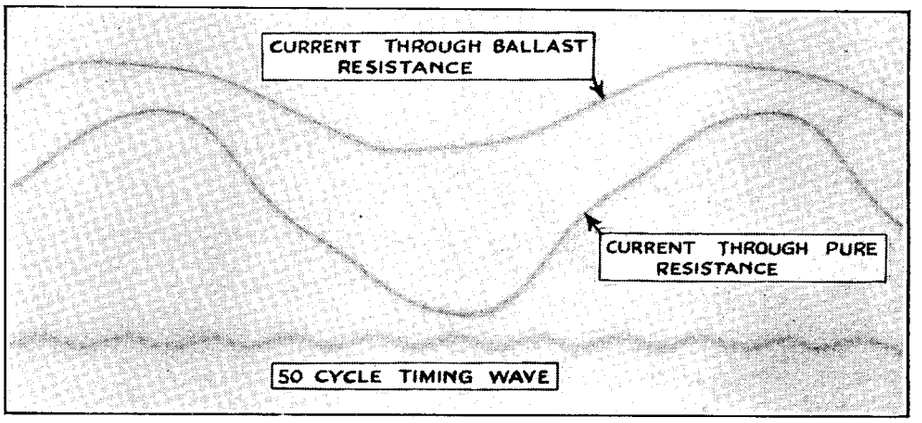


Fig. 5.—Illustrating action of ballast resistor on 7-cycle wave.

A 100-milliamp ballast resistance was tested by passing interrupted DC through it. Impulses occurred at the rate of approximately one per second and the make lasted for 200 milliseconds. The oscillogram (Fig. 4) showed that the ballast resistance took 50 milleseconds from the beginning of each impulse to reach its final resistance and that the interval between impulses was sufficient to allow it to cool down again. The indication was therefore that it would be effective in checking the sudden voltage variations which were causing the trouble, and in practice this was found to be the case.

The primary of the mains transformer has, of course, to be set to a lower tap to compensate for the voltage drop on the resistance, but actually owing to the relatively small voltage drop this did not prove a difficult matter, and the reduction of the tap to 200 volts instead of the normal 240 was quite sufficient. The 100-milliamp type of resistance was used because this was the approximate current taken by the amplifier under test.

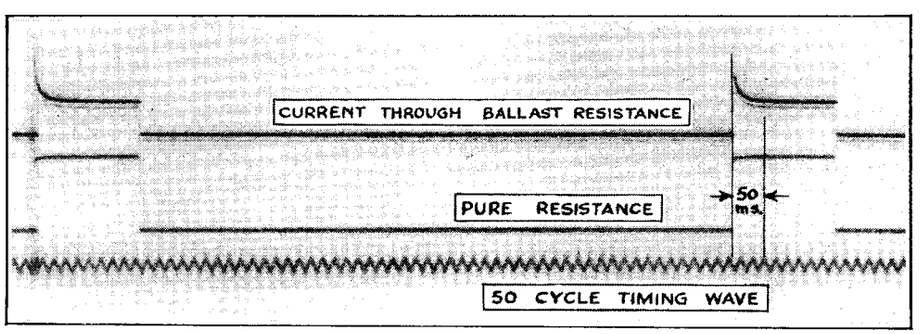


Fig. 4.—Behaviour of ballast resistor on make and break.

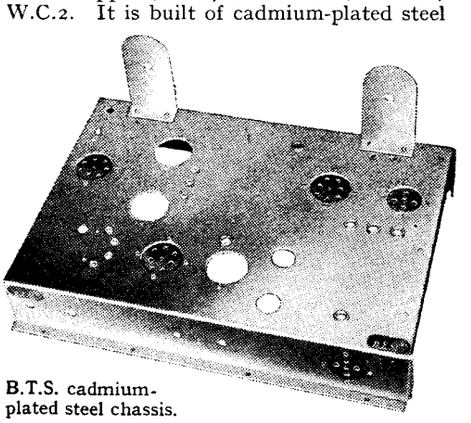
As a further investigation a 7-cycle wave form was passed through a barretter. If the barretter is effective the peaks of the wave will tend to be smoothed out. The actual oscillograph (Fig. 5) showed a very considerable flattening of the wave form even at this comparatively high frequency, so that it would seem, if properly used, this new ballast resistance has numerous applications to radio engineering technique.

Messrs. Siemens Bros. & Co. have kindly assisted in the preparation of this data.

J. H. R.

Variable-Selectivity IV Chassis

A CHASSIS for the Variable-Selectivity IV has been received from British Television Supplies, Ltd., Bush House, London, W.C.2. It is built of cadmium-plated steel



B.T.S. cadmium-plated steel chassis.

with all holes cleanly punched and fitted with valve holders and brackets for the volume and selectivity controls. Holes for the passage of wires are bushed, and the chassis is extremely rigid. It can be confidently recommended for this receiver and is priced at 10s.

Wireless Telegraphy Notes for Students. Compiled by W. R. Crook. Pp. 185 and 218 illustrations. Sir Isaac Pitman and Sons, Ltd. (39, Parker Street, London, W.C.2). Price 7s. 6d. net.

THIS is a collection of notes specially compiled for students of radio telegraphy, particularly candidates for the P.M.G.'s air licence for W.T. operators. In this category the book is very complete, and, although it is intended for use in conjunction with a fuller text-book or as an adjunct to lecture notes, it is in itself almost a text-book in concise form.

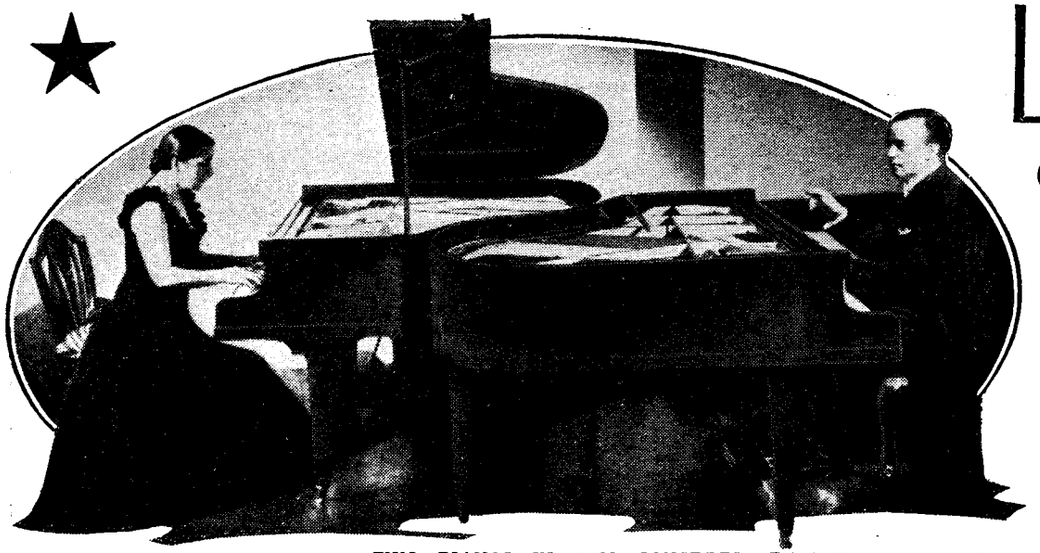
The general laws of electricity and magnetism are presented according to orthodox theory, and, apart from one slight error noticed in connection with a transformer on short circuit, the treatment is sound.

The main part of the book covers the principles of radio telegraphy and their application to communication and direction-finding. Sections are also given on radio telephony, instruments, power supplies and short-wave apparatus.

O. P.

Listeners'

Outstanding Broadcasts



TWO PIANOS IN TWO CONCERTS. Ethel Bartlett and Rae Robertson, a famous pianoforte team, who will be heard to-night (Friday) in a Stockholm Academy Concert (Motala, 7.5) and in the Royal Philharmonic Society's Concert on Thursday next (Reg., 8.15).

1911 RELIVED

A "SCRAPBOOK" automatically sorts itself into the front rank of the week's programmes, probably because, when you take all that was most memorable in a particular year, make a mélange of it and pour the whole into a single mould, the resulting dish is richer than "human nature's daily food."

Charles Brewer and Leslie Baily have chosen the Coronation year—1911—for the eighth of their "Scrapbook" series to be broadcast on Thursday (Nat., 8.30) and Regionally on Friday. London, in 1911, was packed with "personalities," and the many entertainments arranged to celebrate the Accession of King George added greatly to the general gaiety. Notabilities of 1911 in person and on records will recapture for listeners some of the great moments of those pre-War days.

"PERSONALITIES" IN PERSON

Tetrazzini will be heard singing an aria from Rossini's "Il Barbiere" at Covent Garden. An eye-witness impression of the investiture of the Prince of Wales at Carnarvon will be given by Walter Pitchford, while Air Commodore E. L. Gerrard will describe how as a young lieutenant he broke the world's long-distance flying record at a time when Britain's full strength in the air consisted of sixteen aeroplanes and three balloons.

There will be personal appearances at the microphone of Bertram Wallis, who was at the time playing a leading part in "The Count of Luxembourg," and Florence Smithson, who was starring in "The Mousmé." Lovers of drama will follow eagerly Sir Johnston Forbes Robertson speaking a prologue for a gala performance at His Majesty's Theatre, and lovers of excitement will enthuse over the great Sidney Street siege, in which the then Home Secretary, Mr. Winston Churchill, took a personal part.

AN ARNOLD BAX PREMIÈRE

AN important musical event this week will be the first performance of Arnold Bax's recently completed Symphony No. 6. This is to be included in a broadcast concert by the London Philharmonic Orchestra, conducted by Sir Hamilton Harty, at 8.15 on Thursday next (Reg.). Mozart's Concerto for two pianos is also to be played, with Ethel Bartlett and Rae Robertson as soloists.

BATH REVISITED

THE city of Bath is to be dealt with by Mr. S. R. Littlewood in his talk in the "Revisited" series at 9 on Sunday (Reg.) From the time when the famous Pump Room was bequeathed by the Roman Empire, Bath has been a city of culture, and to-day music and other forms of entertainment flourish and adorn its civic life. Mr. Littlewood, a native of Bath, will compare his recent impressions on revisiting the city with those of his boyhood.

RICHARD CURTAILED

"THE Life and Death of King Richard III" is Sunday's Shakespeare play (Nat., 5.30), which in its broadcast garb, will hold the microphone for two hours.

Let us hope that the play, when cut, will not warrant the lament Richard applied to himself:—

"I, that am curtail'd of this fair proportion,
Cheated of feature by dissembling nature,
Deform'd, unfinish'd, sent before my time
Into this breathing world, scarce half made up."

Malcolm Keen takes the part of Richard III, and the cast also includes Robert Harris, Michael Dyne, Cathleen Nesbitt, Dorothy Holmes-Gore, Fanny Wright and Stella Patrick Campbell.

BOW AND BATON

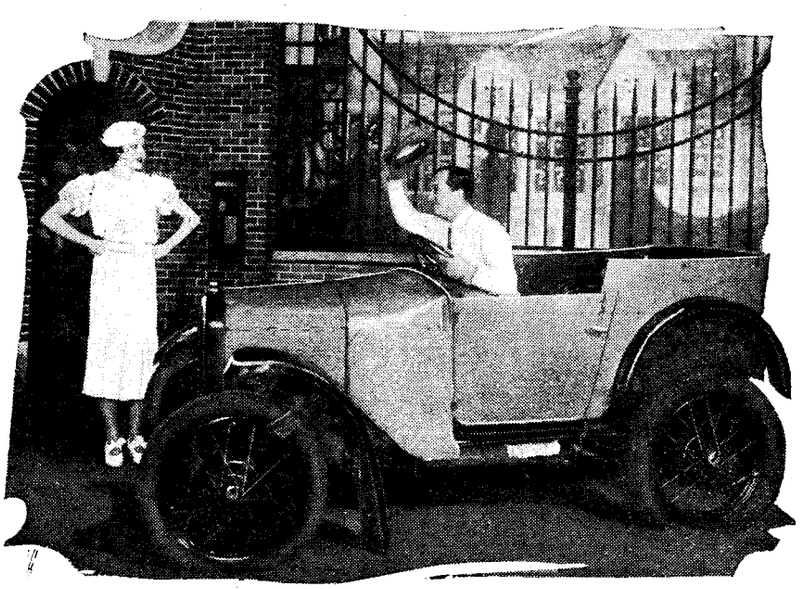
To wield baton and 'cello soloist's bow in the same week falls to the lot of few musicians. Pau Casals will do both this week.

He conducts the Sunday Orchestral concert (Reg., 9.20) in a Wagner and Brahms' programme, and on Wednesday takes the soloist's part in Boccherini's Concerto in B flat for 'cello and orchestra, and Schumann's Concerto in A minor. The B.B.C. Symphony Orchestra will be conducted by Adrian Boult.

This concert, fourth in the B.B.C. winter series, concludes with the ever-popular "Enigma Variations" by Elgar.

BOBBY HOWES' BROADCAST

LATE sitters should not miss the excerpt from the Hippodrome success, "Please Teacher," which is being relayed at 10.10 on Monday (Reg.). Bobby Howes as the impecunious Tommy Deacon will be heard in an episode at the Hindhead house of Wing Foo.



"PLEASE, TEACHER." Sepha Treble, as Ann Trent, encounters Bobby Howes, as the impecunious Thomas Deacon, outside the school. A scene from this Hippodrome success will be relayed on the Regional wavelengths on Thursday next.

Guide for the Week ★

at Home and Abroad

HIGHLIGHTS OF THE WEEK

FRIDAY, NOVEMBER 15th.
Nat., 8, "Eden End." 10, "Kitchener," by Sir Ronald Storrs.
Reg., 7.45, B.B.C. Dance Orchestra. 9.15, Ballet Music by B.B.C. Orchestra. 9, Variety Exchange.
Abroad.
Hilversum (late Huizen), 8.15, Szymanowski (pianoforte) and Maastricht Municipal Orchestra.

SATURDAY, NOVEMBER 16th.
Nat., B.B.C. Orchestra. 8.30, Alfredo and his Orchestra.
Reg., 8.15, Unrehearsed Debate: G. K. Chesterton and Bertrand Russell. ¶"Fra Diavolo" from Sadler's Wells.
Abroad.
Radio-Paris, 8.45, 3-act Opera: "Griselidis" (Massenet).

SUNDAY, NOVEMBER 17th.
Nat., Bernard Crook Quintet. ¶Reginald King and his Orchestra. 5.30, "Richard III" (Shakespeare). ¶Leslie Jeffries and Orchestra, Grand Hotel, Eastbourne.
Reg., London Palladium Orchestra. 9.20, Sunday Orchestral Concert.
Abroad.
Moscow (1) 4.30, Ballet: "The Limpid Brook" (Shostakovitch), with commentary in foreign languages.

MONDAY, NOVEMBER 18th.
Nat., 8, "The Boomerang Bet," a radio play. ¶B.B.C. Military Band. ¶Griller String Quartet.
Reg., Medvedeff's Balalaika Orchestra. ¶Edric Cundell's Chamber Orchestra. 9, "The Story of the Waltz"—B.B.C. Theatre Orchestra.
Abroad.
Stuttgart, 7.10, "The Whip"—a gala carbaret programme.

TUESDAY, NOVEMBER 19th.
Nat., Kentucky Minstrels. ¶"Meet Mickey Mouse." 10.20, Serenade by the London Symphony Orchestra.
Reg., B.B.C. Midland Orchestra. 8.40, "The Boomerang Bet."
Abroad.
Brussels I, 8, International Congress of Sacred Music.

WEDNESDAY, NOVEMBER 20th
Nat., B.B.C. Dance Orchestra. 8.30, B B.C. Symphony Concert—IV. Conductor: Adrian Boult. 10.45, "The Little Show."
Reg., 8.15, Kentucky Minstrels. ¶B.B.C. Military Band. ¶Sydney Lipton and the Grosvenor House Band.
Abroad.
Munich, 9.30, Mozart Concert from Augsburg.

THURSDAY, NOVEMBER 21st.
Nat., Alfredo Campoli Trio. 8.30, "Scrapbook for 1911." ¶B.B.C. Orchestra. ¶Casani Club Band.
Reg., Anona Winn and her Winners. ¶Royal Philharmonic Society's Concert.
Abroad.
Brussels, I, Symphony Concert, Part I, Wagner; Part II, Richard Strauss.

BUMPED OFF

THE story of a millionaire's last bet will be told in "The Boomerang Bet," by Joseph Renaud, which is to be broadcast in an English version by Lance Sieveking on Monday (Nat., 8) and Tuesday (Reg., 8.40). Like so many bets this one had unexpected results; in fact the millionaire himself was "bumped off."

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MURDER IN FRENCH

THOSE who can follow French dialogue may be interested in the Sottens version of Frank Vosper's successful play, "Murder on the Second Floor," which is being given at 6.25 on Saturday.

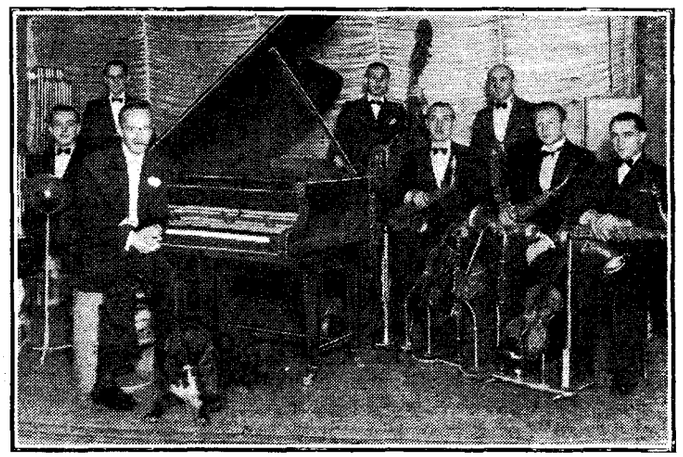
◇ ◇ ◇

NATIONAL MUSIC

KÖNIGSBERG'S usual recital of Prussian and Silesian folk music is being given to-night at 8.30, when a country band and zither trio will play folk dances. Paris PTT chooses Arabian music for a lecture-recital at 8

on the same evening. More interesting still, however, should be Vienna's relay from Oberwoelz of an old Styrian folk dance and programme at 5.45. The hamlet of Oberwoelz, near Klagenfurt, is 2,500ft. above sea level, with walls, towers, and three gates for its 600-odd inhabitants.

Irish and Scottish songs will come from Moscow No. 1 on Thursday at 5.20.



CHARLIE KUNZ and members of his Casani Club Orchestra give the late dance music on Thursday next.

OPERA ABROAD

WAGNER and Verdi share the operatic honours in this week's Continental broadcasts. Most notable will be the relay to-night (Friday) of the "Mastersingers" from the Berlin Opera House by Deutschlandsender, Furtwaengler conducting. The broadcast will actually run from 5 to 10.40 p.m., and during the dinner interval from 7.40 to 8.40 there will be a vocal recital. Another Wagner event will be a performance of the "Ring of the Nibelungs," broadcast by Leipzig at 5 on Sunday, Weisbach conducting the Leipzig Symphony Orchestra.

Rome gives Verdi's "Il Trovatore" at 7.50 on Saturday, and at 8.55 on Sunday, Verdi's "Masked Ball" comes from Copenhagen. The same composer's "Rigoletto" is relayed by Strasbourg from the Municipal Theatre at 8.35 on Thursday.

Other operatic favourites include Puccini's "La Bohême" (Budapest, Friday, 6.30); Beethoven's "Fidelio" (Prague, Friday, 6.30); and Johann Strauss' "Ritter Pasman" (Vienna, Saturday, 6.45).

HOT DRINKS can be had for nothing outside the Pump Room at Bath. The ancient city will be described by Mr. S. R. Littlewood in a talk in the "Revisited" series on Sunday evening.

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OPERETTA

THERE was once a week in which "The Merry Widow" was not broadcast. This week it comes from Brussels No. II on Sunday at 8 p.m.

Paris PTT, which prefers French operetta on Sunday, offers Messager's "Le Bourgeois de Calais" at 8.30.

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TICKLING THE IVORIES

MISS KARIN JÖNSSON, Denmark's exponent of the hot pianoforte style, will (writes a correspondent) massage the keys in a way that will make listeners sit up if they tune in the Danish stations on Monday night at 9.45.

By the way, those two fine pianists, Ethel Bartlett and Rae Robertson, who, as already stated, are playing in the Philharmonic Concert on Thursday, can be heard this evening (Friday) in the concert relayed by Swedish stations from the Stockholm Academy of Music at 7.5.

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TRUMPETERS, ORCHESTRA . . . AND DR. GOEBBELS.

GERMAN ceremonial relays are always impressive. This morning Dr. Goebbels addresses the annual congress of the Ministry of Culture. The Berlin Philharmonic Orchestra and State Trumpeter Corps will be heard (Deutschlandsender, 11.0 a.m. to 12.50 p.m.).

THE AUDITOR.

UNBIASED

Sun-spot Tuning Control

I NOTICE in my morning paper that a member of the B.B.C. engineering staff is alleged to have installed a telescope on the roof of Broadcasting House with a view to observing the movements and intensity of sun-spots, and their effect on the various short-wavelengths used for Empire broadcasting.

This is tangible evidence of the fact that the B.B.C. is slowly coming out of its usual comatose state, but I really think it only fair to point out that the connection between sun-spots and the relative efficiency of various short-wavelengths for long-distance work was studied and brought almost to an exact science many years ago by the Dutch. It will be remembered that nearly ten years ago, long before the B.B.C. had even heard of short-waves, *The Wireless World* made strenuous

Privileged to visit a well-known Dutch scientist.

efforts in the matter of getting Empire broadcasting established, and it was pointed out how remarkable was the uncanny technical skill which the Dutch showed in putting their programmes over at good and consistent strength, free from all the fading nuisance which is such a bugbear on short-waves.

This phenomenon is, of course, solely due to the study of sun-spots by the Dutch and later the Germans, and I well remember as far back as 1927 being privileged to visit the experimental station of a well-known Dutch scientist. He employed a telescope, the eyepiece of which was directed on to a photo-electric cell which, by means of various relays, operated the main tuning controls of the transmitter in sympathy with the variation of light produced by the ever-changing sun-spots.

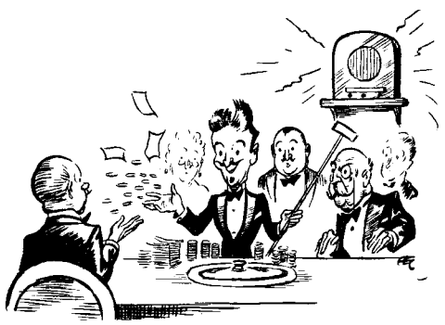
The first difficulty which arose was the question of night-time transmission, but fortunately the Dutch Empire, like the British, is one on which the sun never sets, and so it was a simple matter to establish another sun-spot control station in the Dutch East Indies which sent out short-wave impulses to the main transmitter in distant Holland.

The next difficulty was less easily surmounted. It must be realised that as the wavelength was continually varying, it would have been quite useless to furnish the Dutch colonists with a list of times at which the different wavelengths were used. Wavelengths were, in fact, varying not only hour by hour but almost minute by minute, in sympathy with the variations of the sun-spots. Clearly, some automatic control of receiver tuning was necessary, and at first the project was considered of equipping every receiver with its own telescopic sun-spot control so that its tuning would be varied by the same method as the transmitter. The night-time difficulty again crept in, however, but eventually genius triumphed, and the transmitter was made to tune the receiver in a manner which I now notice has been adopted by certain British manufacturers of receiving sets.

As those who read their *Wireless World* regularly will be aware, these so-called self-tuning receivers will, if slightly mistuned, be pulled into exact resonance by the carrier-wave of the transmitter. Obviously, if the wavelength of the carrier-wave slowly changes as in the case of the Dutch transmitter, the receiver will follow it like Mary's little lamb. It is the lack of these special receivers which makes reception of Dutch and German stations so tantalising to British colonists and others not suitably equipped. I should also mention that this system also explains why readers often find Dutch and German short-wave stations far removed from the official wavelengths published.

Music for All

I WONDER when someone will have the courage to debunk all this stuff about the speeding up of the output of our daily toil by means of broadcast music relayed by loud speakers fitted up in the various places where honest toil still holds sway.



Chamber music for croupiers.

Just because it has worked in some instances is no guarantee that it is suitable for universal adoption, and many people have found out to their cost that it actually slows down production. It all depends on the individual and the nature of the work being done.

To make the thing a universal success, the B.B.C. would have to provide special programmes to suit various occupations, and this would mean that several extra wavelengths would be wanted. Obviously one special programme would not suit all industries, for a programme designed to assist the milkmaid in her rhythmic ritual would scarcely suit the tempo of a mothers' meeting, while a tune designed to tickle the susceptibilities of the croupiers at a casino would not be likely to commend itself to a hard-working Sunday school teacher.

By FREE GRID

Even if special wavelengths for each occupation were allotted and suitable special programmes doled out, it would be of little use, for no account would have been taken of the psychology of the individual. What is wanted, of course, is a pair of headphones for everybody so that he or she could don them or otherwise according to the mood of the moment. Further than this, each pair of headphones should be attached to a separate set, so that each person could pick and choose among the programmes of the world and find one suited to his particular ego.

Apologies to the B.B.C.

I FEEL that I owe an abject apology to the B.B.C. for my apparently unjust criticisms the other week when I took them to task over the question of the Cup Final. You will remember that the football authorities became somewhat cantankerous and nearly vetoed next year's broadcast, and I chided the B.B.C. for bandying words with the other side, as a surreptitious broadcast could so easily have been arranged.

Apparently, however, the method of surreptitious broadcasting which I suggested, such as it was, is regarded as terribly old-fashioned at Broadcasting House, and the lady who is "doing for me" in Mrs. Free Grid's regrettable absence abroad, has been told in strict confidence by a fellow-homewrecker who toils at Langham Place that had the football authorities not given in, the B.B.C. had all plans laid for what I regard as a master-stroke.

Taking advantage of the fact that newsreel cinema photographers are such a common sight at the Cup Final that they attract no attention, the B.B.C. had plans to introduce one of their engineers, disguised as one of these gentry, into the grounds. He would not have been quite what he seemed, however, as his camera would have been combined with a mini-power ultra-short-wave television transmitter designed to have a range of a quarter of a mile or so, and employing the well-known 30-seconds-delay-film-recorded system of television transmission. Apparatus as low-powered as this can easily be

Unbiased—

combined with a large professional cinema camera without making it "look like wotti tain't," as my informer somewhat quaintly put it.

Outside the Stadium in a convenient house it was arranged that there should be a television receiver with Captain Allison comfortably seated in front of the screen to breathe his commentary into a handy microphone in that inimitable way of his. Such an idea bears the hall-mark of true genius and, much as I dislike to admit it, causes me to entertain feelings almost akin to respect for those at Broadcasting House; some of them at any rate.

The idea is in marked contrast to the somewhat feeble effort made a few years ago on a similar occasion, when relays of men left the Stadium every few minutes and came to the microphone to tell us what they remembered of the past few moments' play. On that occasion a far more vivid and connected account could have been given if they had had relays of men armed with lightweight amateur ciné-cameras. It would have been only the work of a few moments to have developed the films and projected them, while still wet, before the eyes of an expert commentator in a neighbouring house, and I well remember writing to the B.B.C. to tell them so. However, this new idea completely puts all that in the shade.

The Speaking Newspaper

Interesting Development of Printed Sound Tracks

A DEMONSTRATION was given in London recently of the "Fotoliptofono," a new system of recording sound on paper. Readers of this journal will already be aware of the developments which have taken place in the recording of sound tracks on paper strip. The principal advantages of the latest system are lower cost, greater ease of storage, and the fact that records can be published in ordinary daily newspapers.

Inserting a paper record, printed on ordinary newspaper, in the "Fotoliptofono."

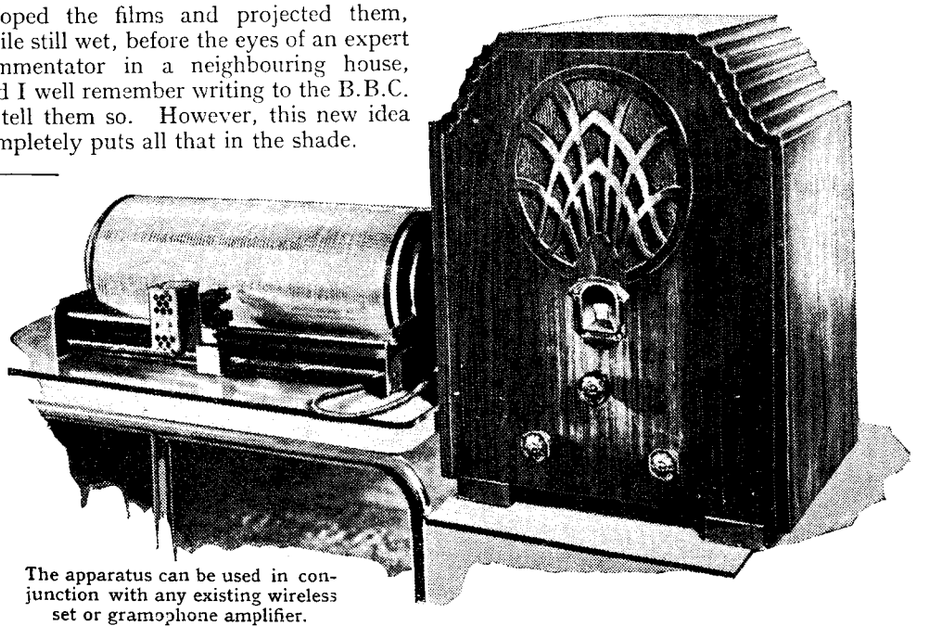
The record consists of a number of parallel tracks covering a rectangular area of paper approximately 17in. by 20in., which, when wrapped round the drum of the reproducing machine join up to form a continuous spiral. As the drum revolves the track is followed by a light beam and photo-electric cell which is moved by a lead screw much after the same principle as that of the original Edison phonograph. The registering of the ends of the sound tracks when fitting the paper to the drum is facilitated by the provision of indicating marks.

Experiments have already been made with records printed in the pages of an ordinary newspaper and the quality of reproduction attained is of a very high order. The frequency range available in this medium is from 16 to 7,000 cycles, but in the demonstration the upper limit appeared to be of the order of 4,000 cycles. This may have been attributable to the fact that the test was made using the pick-up terminals of an ordinary wireless receiver.

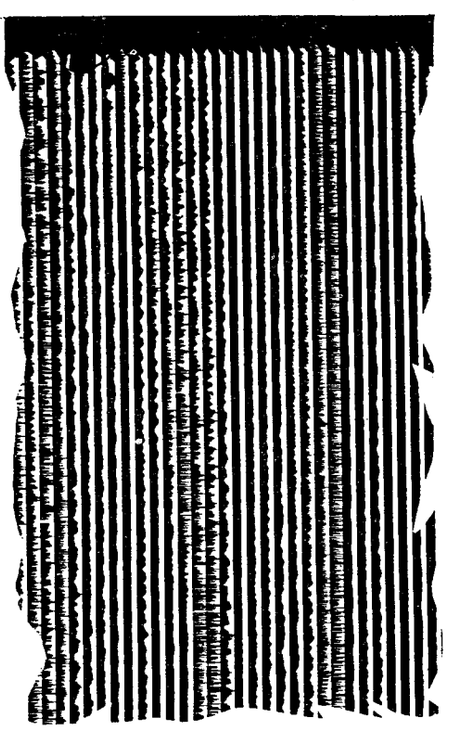
In the existing machines a clamping bar is used at the junction of the ends of the paper, and this might be expected to cause noises. The interference was, however, surprisingly small and could only be detected on sustained notes. We understand that this drawback is in process of elimination. Minor blemishes in the paper, due to folding, etc., are quite negligible as far as the reproduction is concerned and leave an imperceptibly small gap without any associated transient noises.

The possible applications of this system include the recording of the complete works of composers in book form and the transcription of books for blind persons.

The apparatus is at present marketed by the Companie Funddora Fotoliptofono, S.A., Buenos Aires, and the demonstration was arranged by their European representative, M. Georges Rubissow, in London.



The apparatus can be used in conjunction with any existing wireless set or gramophone amplifier.

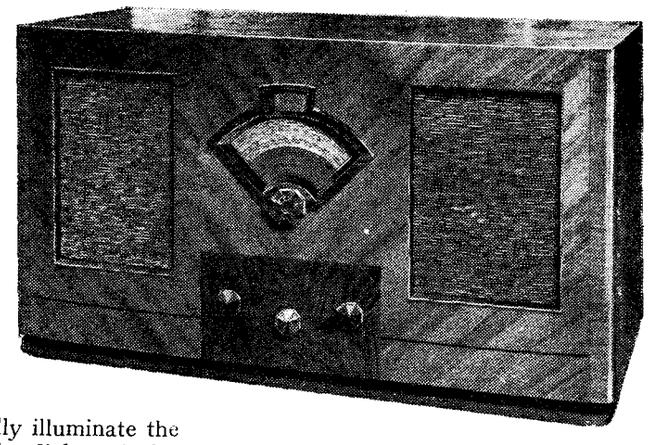


Corner of a specimen record reproduced full size.

C.A.C.

"AUSTIN" SUPER SIX

A Sensitive Superheterodyne with a Unique Tuning Scale



LAST year's edition of this model proved itself to be a receiver of exceptionally good range calculated to gladden the heart of the long-distance enthusiast. The use of twin loud speakers also showed that good quality from the local station had not been overlooked in the search for high overall amplification.

The 1936 model retains both these excellent qualities and is now fitted with an additional valve devoted solely to achievement of quiet tuning between stations. There are also minor changes in the band-pass and frequency-changer circuits, but probably the most interesting development is in connection with the tuning scale.

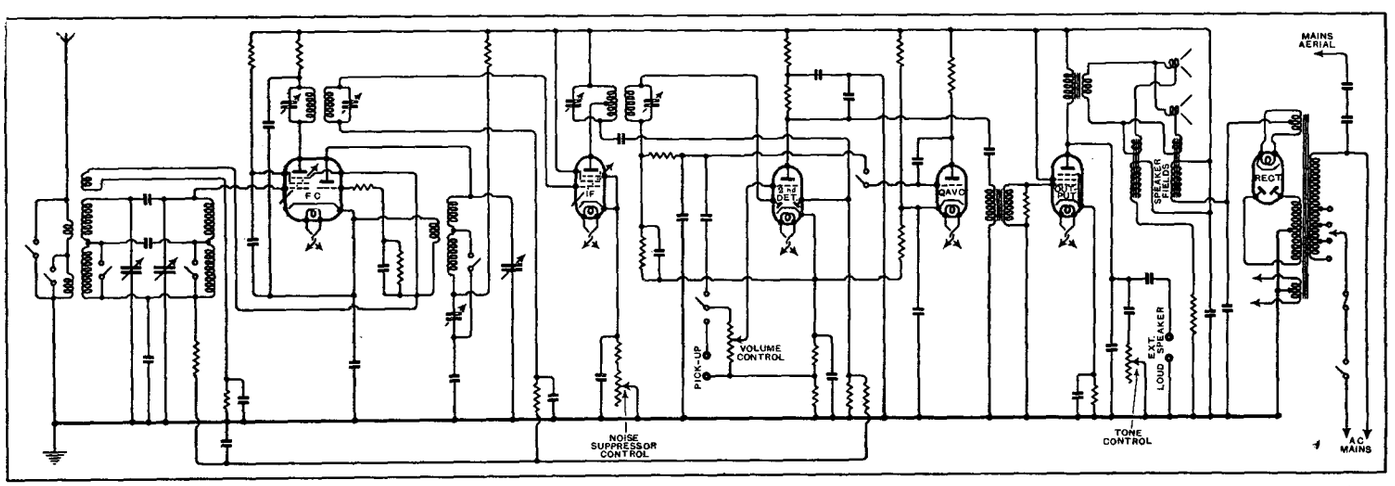
This is a most ingenious device which gives not only a much more legible scale but also one of nearly double the normal length. A small spot of light is used which successively traverses two segments of the scale on both wavebands. The two tracks followed by the light are calibrated both in wavelengths and station names and there is no cramping at any point on the scale. The medium waveband, which calls for a greater length of scale, occupies the upper half of the tuning segment. Separate dial lights operated by the wave-range switch automatically illuminate the appropriate portion of the dial, and also an indicator window showing when the gramophone side is in operation.

FEATURES.—***Type.***—*Table model AC superheterodyne for AC mains.* ***Circuit.***—*Triode pentode frequency-changer—Var.-mu pentode I.F. amplifier—double-diode-triode second detector—pentode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Tuning. (2) Volume and on-off switch. (3) Tone. (4) Waverange.* ***Price.***—*17 guineas.* ***Makers.***— *City Accumulator Co., Ltd.*

The first valve in the circuit is a triode pentode frequency-changer and this is preceded by a band-pass filter in which both top- and bottom-end capacity coupling is employed. Incidentally, a switch is included to short-circuit the aerial and earth when the set is used for gramophone reproduction. Coupled to the first tuned section of the band-pass filter is a small feed-back coil designed to neutralise second-channel whistles. The setting of this coil is critical and is adjusted before the receiver leaves the works. Cathode coupling is used between the triode and pentode portions of the frequency-changer valve and the resulting intermediate frequency (110 kc/s) is amplified by a variable-mu pentode. The primary of the output IF transformer is tapped to increase selectivity, and this arrangement also allows the possibility of a slight step-up in the AVC control, the EMF for which is derived from this winding of the transformer. After rectification by one of the diodes the AVC bias is passed to the pentode portion of the frequency-changer and the IF stage. The signal diode circuit has the usual load resistance and resistance-capacity filter and the LF component is coupled to a triode amplifying portion of the valve through the volume control potentiometer.

Inter-station Noise Suppression

The noise suppressor, or QAVC valve, forms a shunt across the diode load resistance, and the conditions are so arranged that with no signal grid current flows in this valve and forms a heavy shunt to the diode load resistance. The point at which the QAVC load is released is governed by the input to the detector, and this in turn is controlled by a variable resistance in the cathode circuit of the IF amplifier. This resistance is situated at the back of the set and with it is incorporated a switch so that the QAVC action can be completely removed when searching for weak signals. The disadvantage of many forms of QAVC control is that they introduce side-band distortion, particularly when the set is slightly off-tune. In the arrangement adopted in the C.A.C. set this trouble is overcome by virtue of the "Miller" effect in the QAVC valve. This effect is increased by connecting a small condenser between the grid and anode of the QAVC valve.



Complete circuit diagram. A separate valve is devoted to quiet automatic volume control, and a whistle neutralising circuit is associated with the input band-pass filter.

C.A.C. "Austin" Super Six—

A parallel-fed LF transformer connects the second detector stage to the output pentode, which is capable of delivering 3 watts undistorted to the twin energised loud speakers. These speakers are connected in parallel so that there is a tendency for any resonances which may be present to be mutually damped out. The field of one of the units is used for smoothing and the other is connected in parallel with the main HT supply. The anode circuit of the pentode is shunted by a tone correction circuit which is variable.

The new tuning scale greatly increases the pleasure of operating this set. The calibration is accurate and although the set is selective there is no feeling that the tuning process is in any way critical. Under the standard conditions of test in Central London the spread of the local B.B.C. stations is no more than one channel on either side of their normal setting. On the long waves the Deutschlandsender is a serviceable station as far as speech is concerned, but there is just a little too much sideband splash from its neighbours for the satisfactory reception of music even with the volume control turned to the low-pitched position. However, this is the severest test of selectivity to be found at any point on the long-wave range, and on all other stations the selectivity is more than adequate.

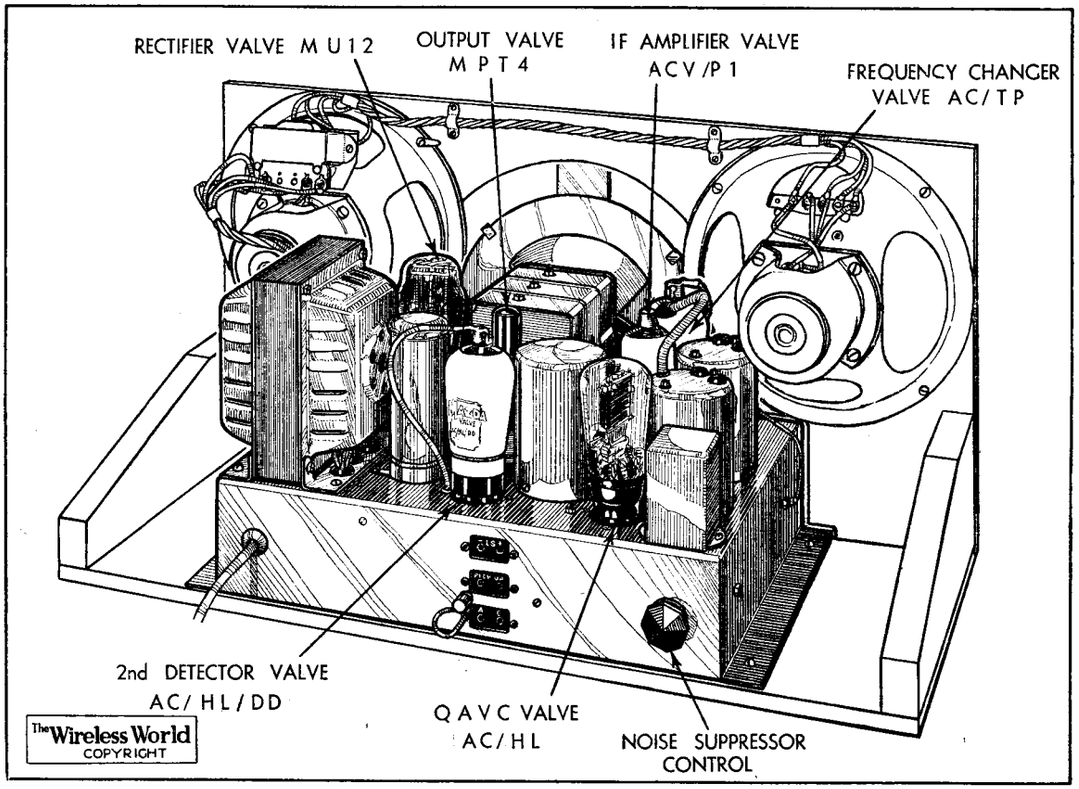
On the score of range and sensitivity this receiver once again merits the highest commendation. Under daylight conditions the carrier waves of all but two or three of the stations marked on the medium-wave scale were picked up, and good programmes could be extracted from fully 60 per cent. of these. Under night conditions there is no doubt that every station on the dial could be received with an ample reserve of magnification in hand. Practical tests showed that the noise suppressor is in fact quite free from distortion effects, and while its action does not produce any reduction of volume on the stronger stations it may be necessary to increase the manual volume control in the case of the weaker stations when the threshold is set at a fairly high level.

The AVC control works admirably and has a wide range. Faint heterodyne whistles are fairly widely distributed throughout the long-wave range but do not cause interference with any of the programmes. When first put into operation there was quite a healthy second-channel whistle on Cologne due to the London Regional station, but this was found to be due to accidental misplacement of the neutralising coil and was reduced to a negligible level after readjustment. This is a matter which could easily be put right by the dealer when the set is installed.

The quality of reproduction is without any special characteristics, which is the same as saying that it is in every way satisfactory. There is no suggestion of boom, yet the increased diaphragm area of the twin speakers gives an ample response in the bass. The range of tone control is much wider than one usually finds in sets of this type, and it was found that the best balance of tone on the medium waveband was with the control approximately in the mid-position, and on the long-waveband in the maximum high-tone position.

The form of unit construction adopted in the previous model in which the loud speakers are mounted on the same framework as the chassis has been retained. Thus, the initial testing and any subsequent servicing which may be necessary can be carried out with the actual loud speakers allocated to the set.

To sum up, the 1936 C.A.C. "Austin" receiver maintains the reputation of its predecessor for range and now has the further attractions of improved selectivity, quiet automatic volume control and a tuning dial which contributes materially to the simplicity and pleasure of operation.



Loud speakers and chassis are removed from the cabinet as a single unit. Note the noise suppressor control.

Next Set Reviews:—

HIGGS A56R

PRISM Radiogramophone

THE RADIO INDUSTRY

ACCORDING to the makers of Ekco receivers, the General Election has had a stimulating effect on the sale of sets, even at this normally busy time. Car sets, too, have come in for their share of attention, and many have been sold to candidates and their agents, who evidently wished to keep in touch with the speeches of their party leaders.

◇ ◇ ◇ ◇

A booklet containing constructional details of a 30-watt amplifier has been issued by N. Partridge, of King's Buildings, Dean Stanley Street, London, S.W.1. The amplifier contains many points of interest, and its output stage operates on the "low-impedance loading" system which, though akin to Class "B," differs from it in that grid current does not flow.

◇ ◇ ◇ ◇

We have received from Amalgamated Wireless (Australasia), Ltd., an attractive booklet describing the activities of VK2ME, the 20-kW. Sydney station of the company, which operates on a frequency of 9,590 kc/s. Daily transmissions of the station are divided into four sessions, one of which is timed to serve Great Britain, Western Europe, and Egypt.

◇ ◇ ◇ ◇

The prices of Kabi duplex carbon potentiometers have been substantially reduced; details are obtainable from F. W. Lechner & Co., Ltd., 61, Spencer Street, Clerkenwell, London, E.C.1.

◇ ◇ ◇ ◇

Small tools of many kinds are described in list No. 93, just issued by Jenks Bros., Ltd., Owen Road, Wolverhampton. Small socket wrenches, made in all the usual BA sizes, are especially useful for wireless purposes.

◇ ◇ ◇ ◇

A new illustrated booklet describing the present series of Cossor receivers will be sent free and post free to all interested readers by A. C. Cossor, Ltd., Highbury Grove, London, N.5.

◇ ◇ ◇ ◇

An Exide trickle-charger specially designed for dealing with lightly loaded batteries has just been produced.

BROADCAST BREVITIES

By Our Special Correspondent

Ullswater Report Delay

IT is futile to make mystery where there is none, but recent happenings in regard to the Ullswater Committee on Broadcasting prompt one to ask whether some unforeseen difficulties have intervened since Committee members were presented with the draft reports a fortnight ago.

I understand that publication of the report, which was expected about the middle of November, will be postponed for several weeks. Is this entirely due to the General Election?

Caution or . . . ?

Who knows but what the appearance of "inspired" articles in the daily and weekly Press forecasting with minute exactness the terms of the report has, so to speak, driven the Committee into its shell?

Magic Lantern Idea

Meanwhile several bright ideas are being discussed with the idea of overcoming this scenery handicap at once. One of them is the use of a magic lantern in St. George's Hall to provide a suitable back-cloth to the vocal efforts of the operatic stars.

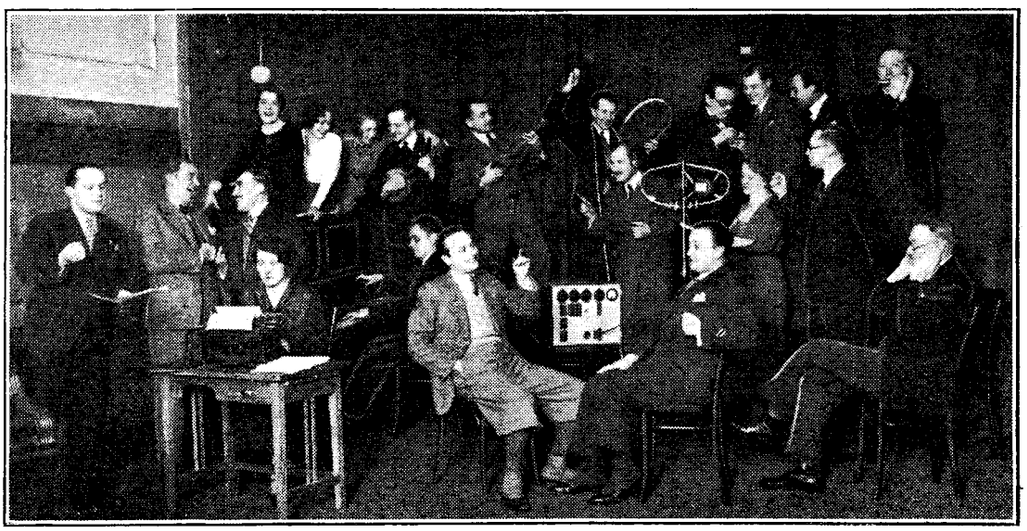
The result would not be "scenery" in the technical sense of the term, presumably because sceneshifters would not be required.

Retrogressing ?

One must admit, however, that in these days of high-definition television it seems rather primitive to be getting back to the magic lantern.

Televising Audiences

Granted such a background, however, we should want the opera televised, and this raises an interesting question. Would a St. George's Hall audience care to be seen on the television screens of a million homes? The possibilities are disturbing; television of this kind might debunk many of those stories of being "detained at the office."



CONGESTION IN THE STUDIO. Business correspondence, set testing, auditions and broadcasting are here seen proceeding simultaneously in a single studio at the Lwow station, Poland. The occasion was a "Gay Wave" programme.

They Want Scenery

A MURMUR against B.B.C. "concert versions" of famous operas fills the air.

"Why not full-length operas with scenery in St. George's Hall?" asks one of my correspondents.

This sounds so good that one can sense the snag somewhere.

The Snag

And snag there is. A B.B.C. official drew my attention to the fact that the Corporation is not permitted to use scenery at public performances.

"At present," he said, "we have to confine ourselves to concert performances of operas, but when television comes along it may pave the way for the use of scenery as an adjunct to broadcasting — that is, apart from the television programmes."

4s. 6d. for Composer, Author and Publisher

MUSIC composers have a strong case in their contention, as voiced by the Performing Right Society, that they receive practically the same fees for the broadcast performance of their works as they did in the early days of the B.B.C., when the size of the audience was negligible in comparison with the present figure of over seven million licences.

The total paid by the B.B.C. nowadays for the use of the music it broadcasts amounts to about £100,000 per annum. The composer receives for each performance about 4s. 6d. in respect of an ordinary short item and 3s. for an item in a dance programme. The sum has then to be divided with the author and the publisher!

The Crumbs That Fall

Put in another way, it can be said that while 70 per cent. of the material of broadcasting programmes is contributed by composers, they receive rather less than 3 per cent. of the total revenue derived from the listeners' licences.

Composers are, therefore, awaiting the report of the Ullswater Committee with considerable interest and anxiety. They are hoping to get the crusts, as well as the crumbs, that fall from the master's table.

Teaching in the Dark

MISS ANN DRIVER spent an interesting morning with a class of fifteen London elementary schoolchildren in a studio at Broadcasting House last Friday. Miss Driver, who has been broadcasting "Music and Movement" for very young children each week, was using this occasion to gauge the movement response of her youthful listeners.

Her task has been unusually difficult, for she has issued instructions, described movements to be copied, played music to be followed—all to a great class which she never sees. This calls for special qualities of imagination.

Taking Notes

"It is extremely difficult," said Miss Driver, "to gauge movement response in those whom you cannot see. When I say: 'Now, pretend to bounce a ball,' how can I tell whether my instruction is being accurately followed?"

Last Friday Miss Driver was able to take careful notes of the time which elapsed between the giving of the instruction, its comprehension by the scholars and their ultimate response.

Why Not Electrical Recording ?

Perhaps Miss Driver will one day record a lesson on the Marconi-Stille tape, so that it can be broadcast while she herself is in the classroom of a typical elementary school taking the lesson.

Women Announcers

IF a woman appears as an announcer in the London studio all the world buzzes with excitement, yet women are announcing almost daily in the provinces.

The reason is that understaffing is the rule rather than the exception outside London, and many a harassed B.B.C. man in the provincial studios is only too glad when an auntie of the children's hour can be persuaded to announce a relay programme.

I believe that Birmingham is the one exception, for here no female voice has been heard announcing for several years.

Cycling Thrills

THE recent enormous growth in organised recreational cycling is one of the most significant signs of the public's realisation of the charm—and the vital importance from a health point of view—of outdoor activities. H. Briercliffe, himself an ardent devotee of this form of exercise, a member of various cycling clubs and organisations, and, incidentally, a cycle mechanic by trade, will tell listeners of some of his adventures and mishaps on the road in a National broadcast on November 30th, and will also discuss the importance of cycling as a typically modern and democratic sport.

News in Gaelic

THE present tri-weekly broadcasts of news in Gaelic from the three Irish broadcasting stations are shortly to be increased in number, and will be made on Mondays, Tuesdays, Fridays and Saturdays in the near future.

Two-Programme Reception

Normal and Short Waves Simultaneously

By JOHN WAYNE

IN this article, an amateur discusses "parallel" circuits whereby normal and short-wave transmissions may be received at the same time and with the same receiver. Although some of the details are admittedly susceptible to improvement, the schemes described open up an interesting field to experimenters.

THE writer recently interested himself in the problem of receiving two stations on different wavelengths at the same time and with the same receiver. After a certain amount of initial experiment it was found that the problem presented was by no means as difficult of solution as had at first been anticipated, and a satisfactory, and at the same time simple, circuit arrangement was evolved.

It is not suggested that the circuit to be described should be considered as a final and foolproof arrangement, but it is certainly interesting both from the viewpoint of utility and as a basis for further experimental work. The circuit will interest the average experimenter who has tried all the comparatively standard circuits and who desires to explore new fields.

Rather than describe the final arrangement arrived at by the writer, it will be better to start at the beginning by giving brief details concerning the way in which the circuit was evolved. The starting point was the popular short-wave combination of an aperiodic "buffer" high-frequency stage, followed by a leaky-grid detector and pentode output valve, as represented by Fig. 1. It is, of course, known that any wavelength can be received by correctly choosing the coil L1 and the capacity of the tuning condenser C1, since the 0.25-megohm non-inductive fixed resistance R1 is almost equally "responsive" to all frequencies; that is, the resistance has a comparatively high impedance to signal voltages having wavelengths between, say, 20 and 2,000 metres.

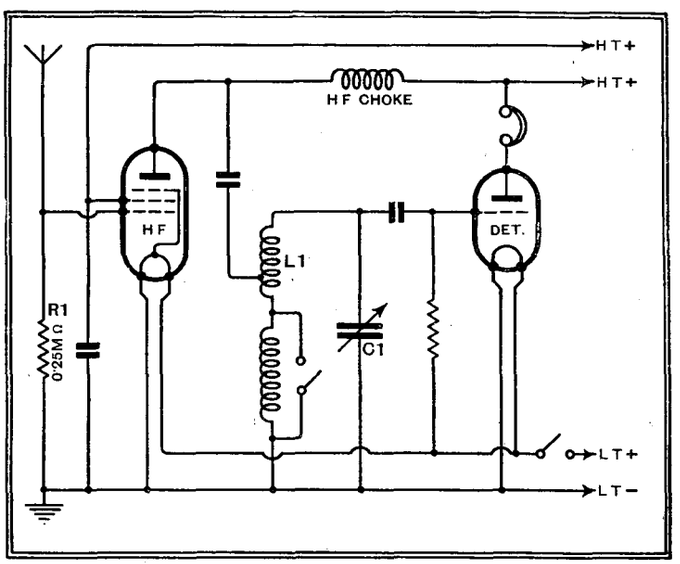


Fig. 1.—The original circuit; reaction is omitted for the sake of simplicity.

In view of this fact it was considered likely that the output from the high-frequency pentode could satisfactorily be fed into two different tuning circuits, one of which might be tuned to a short wavelength and the other to a station on the broadcast band. If this were so, it would be a simple matter to employ a single receiver for entertainment purposes and for short-wave long-distance work. Moreover, the receiver could be used for the two purposes at the same time, and be fed from the same aerial and operated by the same batteries.

Even a preliminary trial was sufficient to show that the circuit (see Fig. 2) could, in fact, be used in the manner described,

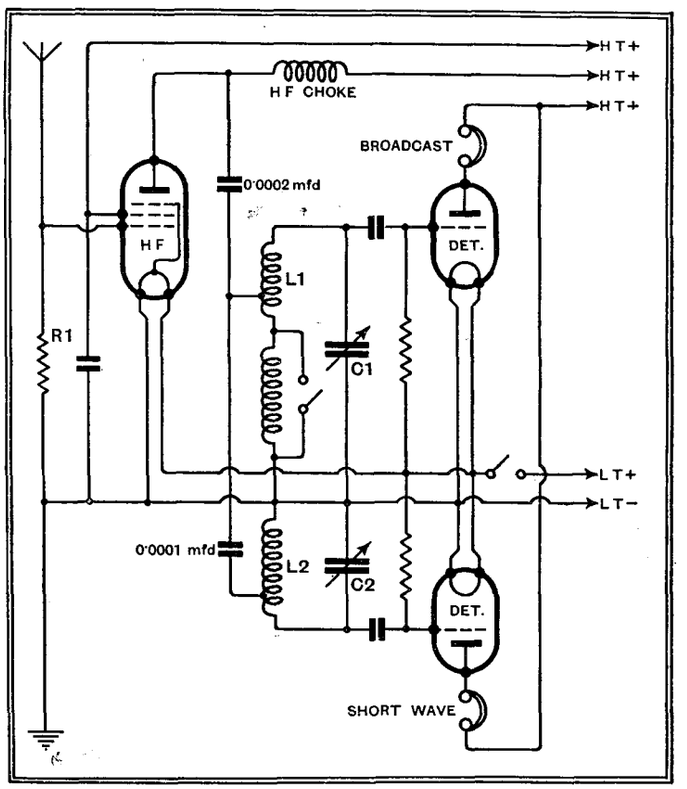


Fig. 2.—A "dual" circuit evolved from Fig. 1. The short-wave circuit comprises L2 and C2.

and the general performance was satisfactory. In fact, the results on both short and broadcast waves appeared to be practically identical with those normally obtained by using two separate receivers with their own input and power-supply circuits. Another fact which, although not startling, was of technical interest, was that the tuning of either the short-wave or broadcast detector circuit had no effect whatever on the tuning of the other.

A fair amount of experiment was undertaken with this system, both with and without the addition of LF stages after the detectors, and results were even better than the first trials had led one to expect. The greatest objection was the comparative lack of selectivity on broadcast waves due to the use of only a single

Two-Programme Reception—

tuning circuit, so it was decided to try the effect of tuning the HF valve as well as the detector, and using a short-wave HF choke in series with the aerial tuning coil with the object of obtaining a sufficiently high impedance across this for good short-wave input. The actual connections referred to are shown in Fig. 3.

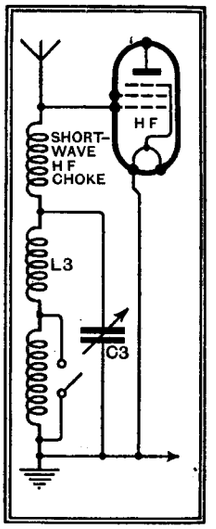


Fig. 3.—The HF choke in this tuned aerial circuit was found to be unnecessary. L_3, dual-range broadcast coils; C_3, 0.0005 mfd.

This system proved to be entirely successful, for the short-wave results were by no means impaired, whilst broadcast reception was undoubtedly improved very appreciably.

During the course of the experiments it was observed that, for no apparent reason, reception on all wavebands had become perceptibly better, and it was later discovered that this was due to the fact that the HF choke in the aerial circuit had inadvertently become short-circuited. From this it was evident that the impedance of the aerial tuning coil—a perfectly standard one of the air-core type—was in itself sufficiently high to deal satisfactorily with the higher frequencies.

A Reflex Circuit

By this time the circuit had become particularly straightforward and it appeared that it was practically impossible to go wrong. A bold step was therefore taken with a view to still further simplification and with the idea of finding out if the HF pentode could perform still another function in addition to the two which had so far been delegated to it; the output from the short-wave detector was fed back into the grid-return circuit of the HF valve, using the complete circuit shown in Fig. 4.

By this means a reflex arrangement had been combined with the long-short wave tuning system—and it worked! The short-wave output terminals were in the anode circuit of the HF pentode, whilst the output on the broadcast side was in the anode circuit of the LF pentode, as is usual. Surprisingly enough, the quality of reproduction on short waves did not seem to be seriously impaired, and it was possible to operate a speaker, at a somewhat modest volume level, on several short-wave transmissions.

Purely as a matter of interest the idea was tried of reflexing the broadcast signals instead, but when this was done a certain amount of overloading occurred on the more powerful transmissions.

In later experiments the circuit shown in Fig. 1 was combined with the reflex connections when it was found possible to receive two short-wave or broadcast signals simultaneously by employing suitable coils in the tuning circuits. One rather interesting advantage of this combination was that certain short-wave transmissions which are made on two wavelengths could be picked up simultaneously, with the result that reception almost entirely free from noticeable fading was made possible. This was because the transmissions on the two wavelengths had entirely different periods of fading and swinging, fading taking place on one wavelength when signals on the other were coming through at full strength.

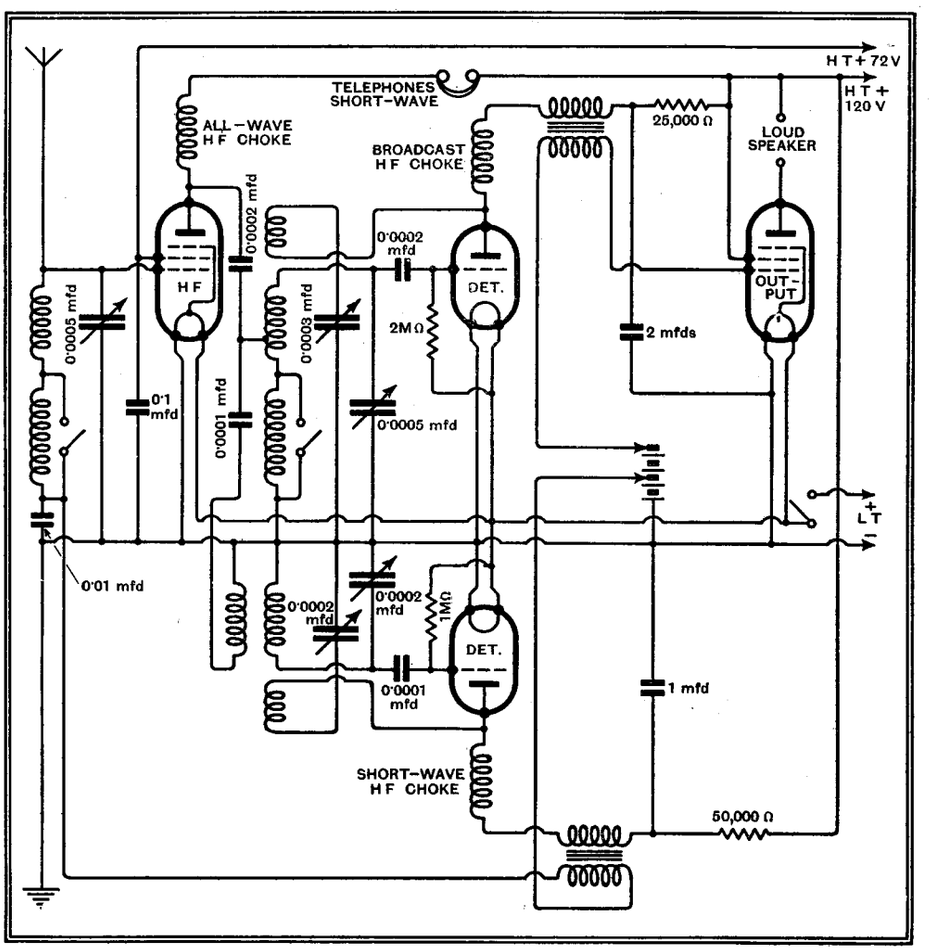
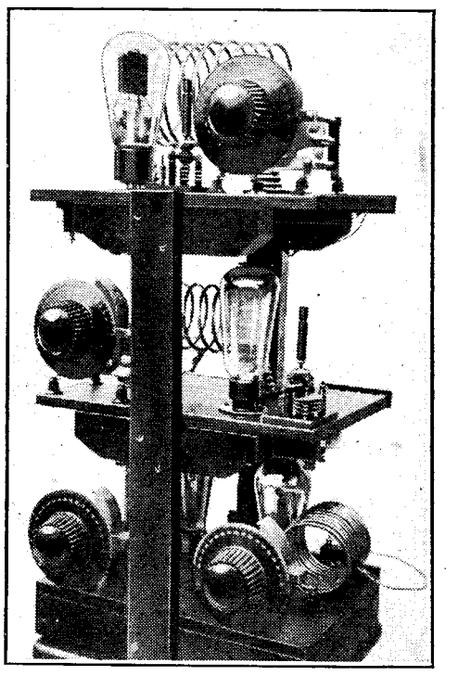


Fig. 4.—The final circuit, with values of principal components.

A Modern Amateur Station

ACCESSIBILITY to permit of quick changes of components is the keynote of Mr. R. C. Richard's station, G2RR, at Seven Kings, Essex.



The rack-mounted transmitter at G2RR.

The station is licensed for 1.7, 7, 14, 28 and 56 mc. work, and transmitters are available for all these frequencies. The photograph shows the 7, 14, and 28 mc. set in its special rack mounting. It consists of a 3.5 crystal oscillator and frequency doubler (7 mc.) on the bottom shelf, with a second doubler (or sub-amplifier) on the shelf above. The power amplifier is on the top shelf. The second frequency doubler can be used as the sub-amplifier for 7 mc. working, the coil and tuning condenser being proportioned to tune to 7 and 14 mc. without changing coils and reneutralising.

The 1.7 mc. transmitter is mounted in the same manner.

A good deal of 5-metre work has been carried out with local stations.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

The Valve

Variety and Price

THE ever-growing importance of the valve in wireless receivers and in all types of electrical amplifying equipment makes the appearance of this our annual valve number increasingly welcome. In a concise form we endeavour to include all the essential data of value to the designer and user concerning modern receiving valves.

The preparation of this Valve Supplement becomes each year a more exacting task as the variety of types increases, but we believe that the value of this information to our readers justifies the work involved.

This year we have endeavoured to add further to the usefulness of this issue by including details of the valve base connections in association with the symbols used in circuit diagrams for each valve type. Even for those who are constantly using valves of all types the variety of them is apt to make them hesitate over the connections of some of the more complicated of the species, so that some guide such as we have prepared seems essential for the general user whose association with valves may be less intimate.

We take this opportunity of reiterating a view frequently expressed before in *The Wireless World*, that there is a tendency on the part of designers to-day to endeavour to use the smallest possible number of valves in their receivers. Except for the consideration of cost, all other former objections to the generous use of valves have disappeared and there is no doubt that improved efficiency and greater reliability would result automatically if the present tendency to limit the number of valves could be overcome. But as long as the price of valves remains high manufacturers will continue to aim at limiting the number. When it comes to a consideration of the design of television receivers it will be found that the number of valves required is very high indeed, and unless a substantial reduction in price takes place, progress in the direction of popularising television with cheap receivers is out of the question.

We have also referred previously to the fact that multiple valves tend to increase the complexity of wiring and to lead to a congestion of wires in a small space. The use of more valves and fewer of the multiple types would result in a far more open wiring of receivers, thereby greatly facilitating the task of servicing.

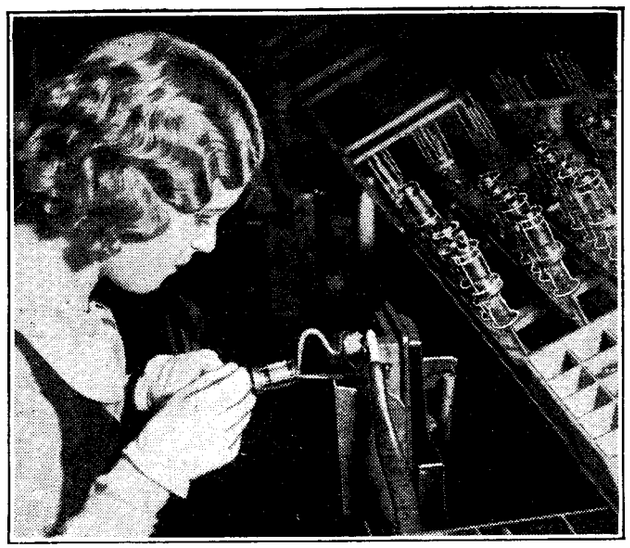
We are strongly of the opinion that a substantial reduction in the price of valves would so increase the demand that valve manufacturers would not be the losers thereby

The Electron Multiplier

Promising New Developments

IN this issue we publish a description, supplied by our New York correspondent, of a new tube recently demonstrated by Professor Zworykin and his associates.

Although the basic theory of operation of the new tube is well known, the novel design and construction of this particular type merit special attention. Hitherto, we believe, attempts to make use of this principle for high magnification have been mainly unsuccessful through causes producing instability. But the new tube is claimed to be entirely stable and it is suggested that in its further development it may prove to be a rival of the normal type of valve.



The Modern

A Physics Laboratory Run o

THE manufacture of receiving valves still remains fundamentally a laboratory process, but the complicated machinery which has enabled the necessary quantities to be produced with the requisite precision and control is a triumph of engineering skill. We are indebted to Messrs. A. C. Cossor, Ltd., for the facilities granted in preparing this article.

All joints in the construction of the electrode assembly are spot-welded.

THE making of most of the components which comprise the modern wireless receiver is an engineering rather than a scientific job. The physicist, though he understands the principles underlying the design of inductances and transformers, and can follow general circuital arrangements, has very little say in the general design of a wireless receiver, which is the rightful province of the electrical engineer. In the design of loud speakers the physicist's knowledge of acoustics enables him to share the honours. But when it comes to valves he has the field practically to himself.

Glass manipulation and the making of gas-tight seals are commonplaces of the physical research laboratory, while the technique of producing high vacua, the study of gas occlusion in metals, and the emission of electrons and their subsequent behaviour under the influence of the complex forces existing in a modern multi-electrode valve, are essentially problems for the pure physicist.

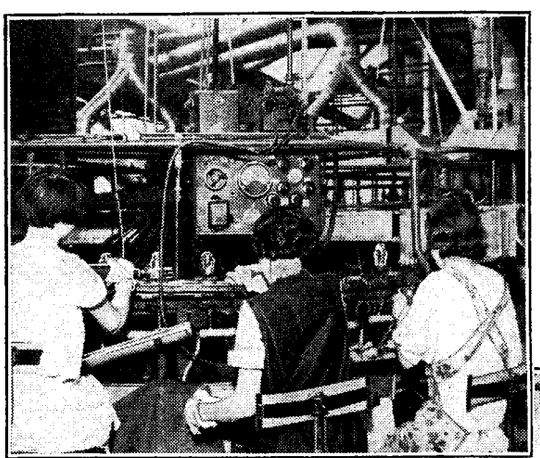
Yet the production of valves in sufficient quantities to meet the present demand calls for engineering experience of a high order. Thus we find that the modern valve works is a huge laboratory run on engineering lines, with the physicist in supreme control.

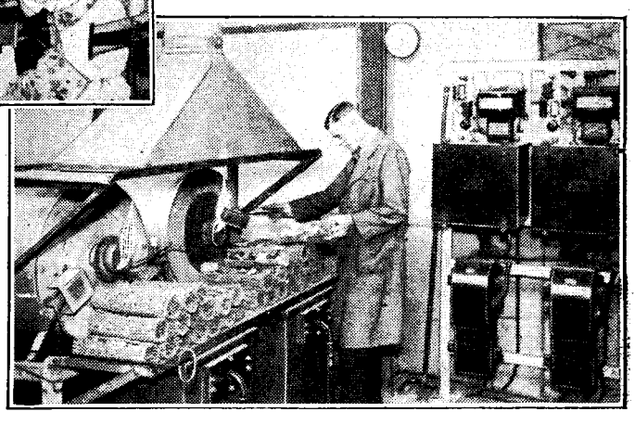
The manufacture of scientific glassware was Cossor's business long before the manufacture of valves was contemplated, so that it was only logical, when the time came, that they should turn to the manufacture of a component in which this art plays so important a part. The production side of valve manufacture is largely a matter of the successful design of automatic rotary machinery for glass manipulation. This has been a process of steady development, and minor additions and improvements are constantly being introduced.

Similarly, in the production of the small metal and mica parts associated with the electrode assembly, special machines have had to be developed. One of the most interesting is the machine for winding grids. The parallel vertical supporting wires of the grid are fed into slots on each side of a mandrel, and the wire is wound over these with a regular spacing depending upon the type of valve characteristic required. The wire is preceded by a knife-edged wheel which nicks the supporting wire and forms a trough in which the grid winding can lie. In forming this trough a slight burr is raised, and this is then folded over by a second wheel and firmly grips the wire. The junction formed is amazingly strong and cannot be pulled apart by hand. Indeed, the method is in every way equal to that of spot welding, and is, of course, much simpler in operation.

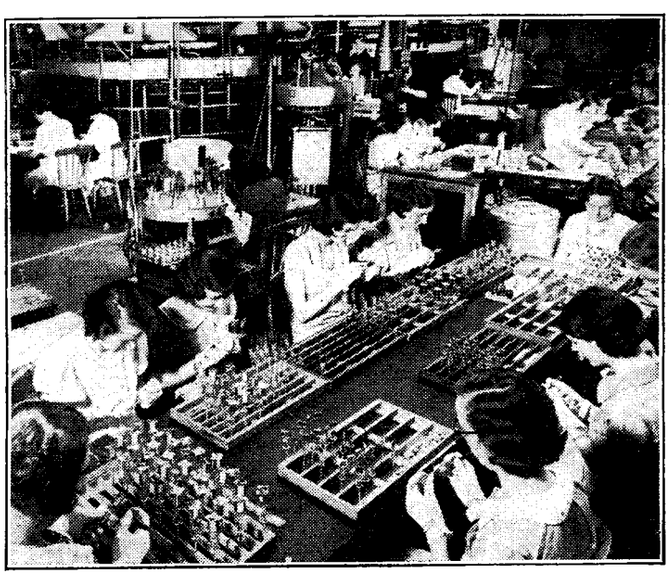
Long lengths of grid are formed in this way and are stored in special boxes awaiting the operation of cutting to size. They are inspected for the correct number of turns and after this are ready for the assembling lines.

Before assembly all the metal parts have to undergo a cleaning process. This is carried out in a tubular electric furnace through which a stream of hydrogen gas



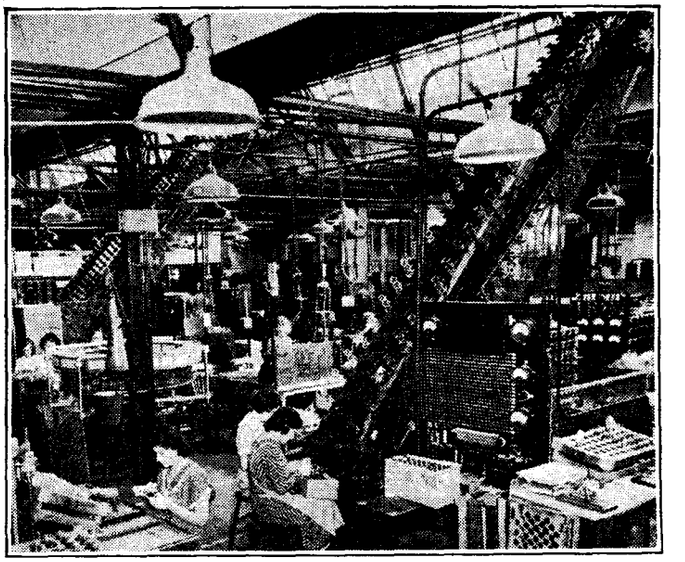


(Above) The exhausting plant. On the left the "getter" is being fired with an HF heater coil. (Right) Electrically heated furnaces in which the electrodes are cleaned in an atmosphere of hydrogen. (Left) A section of the valve assembly department with the exhausting plant in back-ground.



Valve Works

Mass Production Lines



Ageing is carried out on a slowly moving continuous belt

is passed. The furnace temperature is automatically controlled and the process is continuous, baskets of the parts being pushed in at a door at one end and after a regulated time interval passing through to water-cooled chambers at the lower end of the furnace tube. The stream of hydrogen gas is allowed to burn at a pilot hole in the door of the furnace. The gas in no way contributes to the heating of the furnace, and burning is the most convenient way of getting rid of it after it is used.

First Steps in Assembly

Other important departments contributing to the work of preparing parts for assembly are the bulb inspection and the filament coating departments. The bulbs, which at this stage have a long neck ready for sealing to the pinch, are cleaned by a baking process and are inspected for bubbles and flaws. The preparation of the active coating for the filaments is in the hands of a skilled chemist.

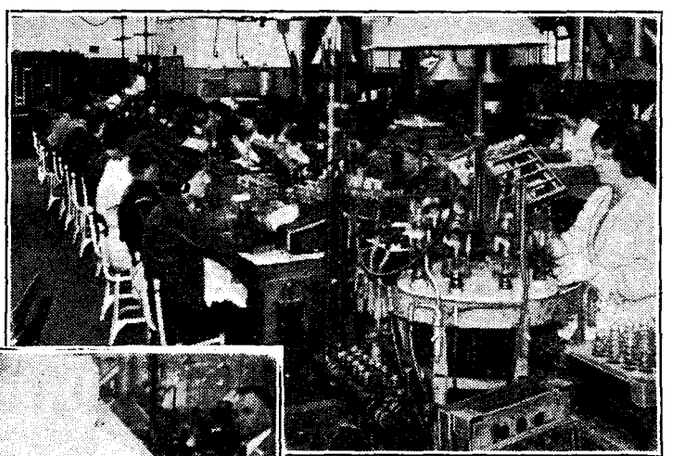
With all the materials prepared the first process in making the valve is the formation of the pinch. This starts as glass tubing which is fed into a vertical carrier above one of the rotary glass-working machines. The tube is first cut to the required length, then heated and flanged, and the top half flattened ready for sealing in the wires.

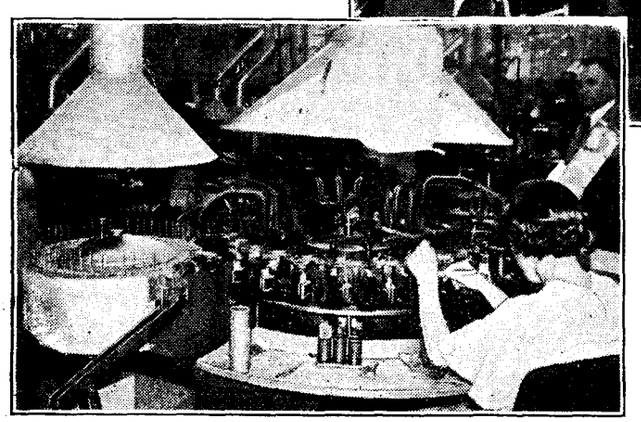
The latest type of rotary machine used for this purpose has twenty-five heads, i.e., twenty-five successive processes are carried out on each pinch before it makes one continuous circuit of the machine. The loading of the partly formed pinches in the clamping jaws of each head and the insertion of the leading-in wires is done by hand. After this the machine is entirely automatic, and even the thin tube by which the complete valve is attached to the vacuum pump is picked up and sealed in at the appropriate point mechanically. If by any chance any part is omitted in hand loading the "automatic hand" fails to pick up an exhausting tube for that pinch, so that at the output end of the machine any faulty specimens are easily recognised. Nevertheless, all the pinches which are complete are individually inspected in front of a special lamp to detect any bubbles and flaws near the seal between the wires and the glass.

The pinch is now passed to the assembly line where the first operation is to cut the wires to length. A single press is used for this operation, which, in addition, flattens the filament wires and turns them over to form a hook in which the filament itself is located. This is then welded and the next process is the welding in position of the grid. In the case of a battery valve the filament is then hooked on to side supports and the top is supported by a fine spiral spring and suspended from the mica bridge piece at the top. Next, the anode assembly in which the suppressor grid in the case of a pentode has already been located is slipped over and welded. The "getter" support is then attached.

The electrode assembly is now ready for sealing in the bulb, and this is done in machines which are situated at the end of each of the assembly benches. Throughout the process of assembly none of the parts is touched by hand, and all the operatives wear special cotton gloves.

The valves are next taken to one of the exhausting machines, which are continuously operating, and accommodate sixty-four valves in a complete cycle. The vacuum pumps rotate with the machine and two valves are allocated to each pump. The thin glass stem of the valve is inserted in a rubber joint, and all the wires leading out of the base are tucked away, with the exception of the filament leads which are used later to heat the filament. After passing under a height

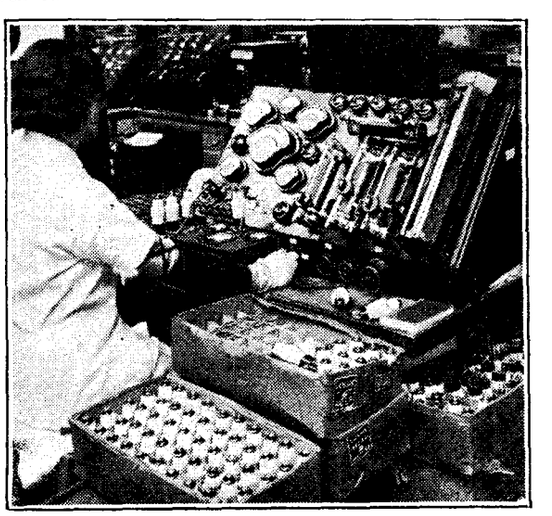




(Above) One of the assembly lines with its own separate bulb sealing machine at the output end.

(Left) Automatic rotary machine for sealing lead wires in the glass pinch. An auxiliary rotary annealing oven on the left deals with the output from the main machine.

(Right) One of the testing panels in which meters are provided for measuring every electrical characteristic of the valve



The Modern Valve Works—

gauge to ensure that the valves will not foul any part of the apparatus they pass through a long annealing oven in which there is a progressive rise of temperature. With the glass and to some extent the heaters warmed up, they next undergo a process of eddy current heating under high-frequency coils, which cover six valves at a time and travel with them for a short distance. At this point, with the electrodes at a bright red heat, the filaments are heated, and it is at this stage that the active oxide coating is finally formed. Finally, the "getter" is fired by a high-frequency coil which is placed over the valve by hand and causes local heating at a higher temperature than the general eddy current heating which the valve has previously received. As soon as the "getter" which removes the last trace of gas is fired, the stem is fused with a sharply pointed blow-pipe flame and the valve removed.

The valves, as they come off the pump, are placed on a conveyor for capping. The wires are straightened by hand and pushed through the hollow valve pins simultaneously, another operation calling for considerable practice. The caps, which have previously been lined with paste, are pushed home, and the wires soldered at the ends of the pins, after which they are cut off and the paste is set in a rotary baking oven.

Ageing

The next process is ageing, and in the Cossor works a novel continuously operating belt system accommodating nearly a thousand valves at a time is used. The process is continuous, and the speed of the belt is timed to give just the right period for the ageing process. First of all, the filament is flashed under overload conditions, and the remainder of the time the valve emits under more normal conditions in order that the emission may thoroughly settle down. Ordinary metal filament lamps associated with each valve are fitted in sockets at the side of the belt, and serve the dual purpose of load resistances and indicators of short circuits. When these occur the lamps burn brightly, and the associated valve is removed from the belt.

After leaving the ageing belt the valve goes to the testing department, where it undergoes a searching examination for any defect in the vacuum or general performance. From the photograph of one of these test units it will be obvious from the number of meters in use that the test is something more than the perfunctory check of filament continuity and emission. As a matter of fact, for some special types of valves a cathode-ray type of test gear is employed in which the whole length of the characteristic can be viewed on the screen.

So the quantity production of valves in the current list proceeds; but meanwhile research into new types and designs for the future is being carried on in the laboratory. Here a complete miniature valve manufacturing works is at the disposal of the staff, so that experimental valves can be made up at a moment's notice without interfering in any way with the flow of the main production. Here we are back to the prototype laboratory in which the new industry of valve production in vast quantities had its origin.

Random Radiations

By "DIALLIST"

In Luck's Way

THE other evening some friends asked me to come in and try a new all-wave receiving set they had just acquired. They told me that they were very pleased with its performance on the medium and long waves, but that they knew nothing whatever about short-wave reception, so would I please . . . etc. You know what so often happens when you are called upon to demonstrate the wonders of the short waves to people to whom they are mysteries. You strike one of those terribly bad nights when either there is hardly a station to be found or anything that you do manage to pick up is so marred by quick fading, or so swamped by atmospherics, that it just isn't worth listening to. Fearing the worst, but hoping for the best, I switched over to the 30-metre band to see whether there was anything going. In a matter of seconds I had an American station, coming in as strongly, as clearly and as steadily as I have ever heard one. Gasps of wonder and of admiration!

Both Sides of the Atlantic

But there was more in it than the mere reception of America, as we very soon found. Though the call sign was not given and I couldn't vouch for the accuracy of the set's wavelength calibration, the station was in all probability W2XAF, whose 40-kilowatt transmitter is at Schenectady. The item that we were receiving was clearly something out of the ordinary. New York was calling London; London was replying; there were references to Captain Stevens and Explorer II. Then I recollected that I had seen in the papers a mention of an attempt to beat the altitude record by Captain Stevens, who was to be kept in touch with the rest of the world by means of wireless. Captain Stevens called the *Daily Telegraph* in London, whose representative enquired where he was now. The reply came through perfectly clearly: he was somewhere above the State of Nebraska, and coming down to earth after reaching what he believed to be a record height. It was a most thrilling broadcast, and whatever else it did it firmly convinced my friends of the wonderful possibilities of the all-wave receiving set.

A Canard

I HAVE heard it said by people who ought to know better that, interesting and useful though they may be, all-wave sets in general are not so good on the medium and long waves as sets designed purely for reception on wavelength between 200 and 2,000 metres. This may be true of cheap-jack sets of poor design, but my experience of high-class all-wave receivers is that their performance on the medium and long waves is in every way up to the standard of other good-quality "ready-made" sets. This is as it should be, since the medium and long waves must always be main standbys for reception of genuine entertainment value. The short-wave part of the apparatus is a valuable addition which enables one to reach the far corners of the world when one is in the mood for long-distance reception and Dame Nature is kind enough to provide favourable conditions.

Music Hath Not Always Charms

DID you, I wonder, listen to the rather remarkable broadcast describing Scott's last journey when he reached the South Pole—only to find that he had been forestalled by Amundsen—and died with his comrades when but a few miles from safety? It lasted a full hour, but I heard the whole of it, for that journey has always seemed to me one of the most amazing ever made by mortal man. In every way but one the broadcast was exceedingly well done. The sole blot, to my mind, was the incidental music, which broke in in the most maddening way at every pause in the narrative. It was entirely out of place, for early in the broadcast our minds had been impressed by accounts of the utter silence of those desolate regions. I have no doubt that the music had been selected with the idea of suggesting bleakness, barrenness, and hardship. To some, perhaps, it did, but it got so much on my nerves that I began to wait for its next outburst, just as in the watches of the night one waits for the intermittent barking of a dog.

The Well of English . . .

WIRELESS has hit this language of ours some pretty shrewd blows by foisting upon it a weird collection of words of hybrid ancestry which have passed into common use. What threatens to be the most unkindest cut of all, though, is the suggestion that henceforward a seller of wireless receiving sets shall be styled not a wireless dealer or a wireless retailer, but a RADIOTICIAN. The father and only begetter of this appalling word explains that the average wireless salesman has no qualifications such as would entitle him to call himself an engineer. The radiotician is described as one who knows the standard of efficiency of receivers, can spot a defective set, and is able to remedy most normal faults. If every dealer were as well equipped as this I could think of many kinder terms for him than radiotician. For the pliers-cum-screwdriver-cum-five-shilling-voltmeter type of service man could we not omit the "ician"? We should then have Radio-idiot in the neat portmanteau form Radiot!

All-British Wireless

THOUGH I am no business man, and high finance will ever be a mystery to me, I am very glad to see that our biggest manufacturing concern of wireless receivers is shortly to become all-British. Hitherto something over two millions of the capital of Electric and Musical Industries, which includes H.M.V., Marconiphone and Columbia, has been owned by the Radio Corporation of America. The company has long wished to purchase the American interest, but shortly after we went off the gold standard a ban was put upon such transactions by the Chancellor of the Exchequer. Consent has now been given for "Emmy" to carry out the deal, and in a short time this huge concern will be entirely British-owned.

Pruning the Valve List

A PLEA FOR RATIONALISATION

By M. G. SCROGGIE, B.Sc., A.M.I.E.E.

WHILE admitting that a drastic reduction in the number of valve types might impose hardship on a few wireless users with highly specialised requirements, the author urges that such a move would be to the ultimate good of the majority. Constructive suggestions as to how reductions may best be made are offered.

EACH autumn, when *The Wireless World* Valve Data Supplement appears, the veteran reader can hardly fail to contrast it with the valve list of 1921, the eve of broadcasting. It was not a long list. It consisted of one entry—the French "R" valve. Filament volts: about 4. Filament current: about 0.7 amp. Amplification factor: not specified; but measurement showed it to be between 5 and 10. Mutual conductance: unheard of; but is found to have approximated to 0.3 milliamp. per volt.

There were a few other types, left over from the War, but they were not generally available, except, perhaps, the V24, with its curious shape, designed to reduce inter-electrode capacities. In any case, the general type of them all was the same as that of the "R," viz., battery triode of incredibly low efficiency.

In the intervening years not only has the efficiency of valves been doubled many times, but the variety has multiplied almost without limit. The Data Supplement being in front of one, further evidence of this fact is needless. There is now a type of valve for every purpose.

That in itself—as well as the vastly increased efficiency—may be welcomed as a product of progress. The comparison is like that between the business prospects of a raw and clumsy individual—a Jack of all trades—and a large staff of trained specialists. The results—the humble village shop and the mammoth department store—reflect the difference.

New Valves and More New Valves

But commerce came to a stage when it realised that mere multiplicity was no sign of efficiency, but rather the reverse; and there was much heart-searching when the emphasis was shifted to rationalisation, with the weeding out of the surplus employees and establishments.

To some extent that condition may be said to have already begun in the valve world. Two years ago the season brought forth such an amazing crop of new valve types that the makers realised that there was such a thing as excessive progress. In Germany they went so far as to proclaim a valve design holiday. Action was less drastic here, but there has been an appreciable slowing down in the issue of new valve types, and an increased withdrawal of old ones.

Our valve manufacturers looked with some envy at their American brethren, who had confined themselves to a minimum of types, retained year after year, even although conservative in characteristics. But, as this policy allowed them to be produced at a fraction of the cost of British types, who worried about having to use a few more of them to get the required results?

Quaintly enough, just as the wisdom of this seems to have been having some influence in our market, the Americans appear to have succumbed to an orgy of new designs.

Some of the advantages of standardising a minimum number of valve types have been hinted at. The number of each to be manufactured is correspondingly a maximum, and the factory can be organised to turn them out more economically and with less likelihood of troubles due to continually having to change round the machines and operatives to new specifications. Sales and service organisations are simplified—dealers are not forced to the alternative of stocking stupendous quantities of valves or of replying "I can order it for you, Sir." In brief, valves can be made cheaper, more reliable and easier to get. What more can one want?

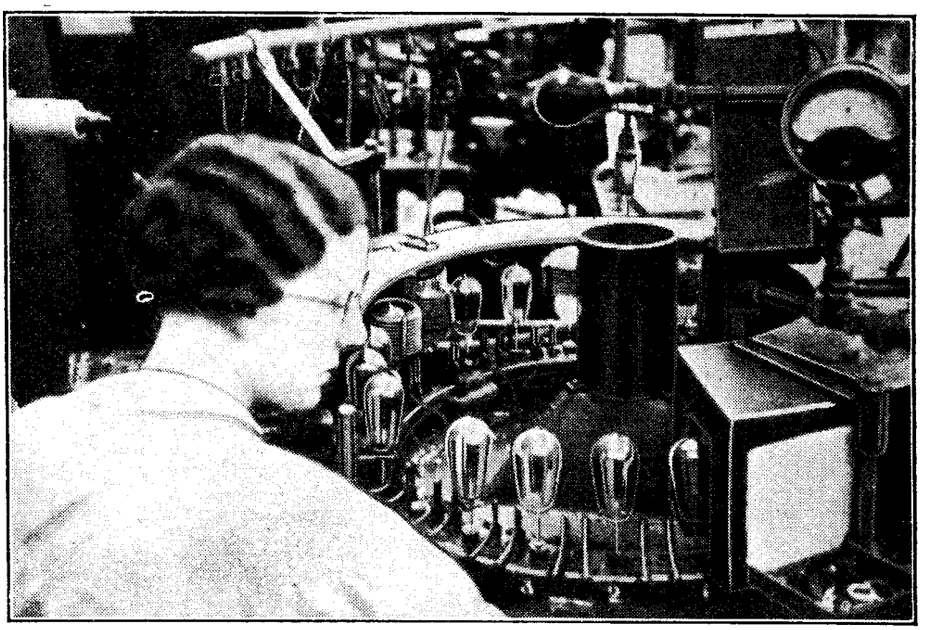
Against this, there is the argument that such conservative policy deprives one of the advantages of frequent improvements in characteristics, and perhaps of some developments altogether. The ardent experimenter, keen on setting up new records of amplification per valve, is hit. The general public, who want trouble-free radio, and don't care whether the results are gained with one valve or twenty so long as the price is right, benefit.

Wasteful Multiplicity of Types

There are several ways in which standardisation can be tackled. One is to weed out types, or even whole classes, of valves that can no longer justify their existence. It is very nice for the designer to be able to pick *exactly* the specification he wants—"three sleeve lengths to every collar size," as it were—out of a gargantuan list; but it is sheer laziness.

In this day of specialisation is there really any excuse for a multiplicity of general-purpose triodes? Most of the duties that once had perforce to be undertaken by them can now be performed far better by special types. The disadvantage of the triode is that it does not fully possess the chief attribute of the valve—the one-way action that is so valuable in radio circuits; some of the output strays back to the input through the anode-to-grid capacity.

The screen grid valve was devised to eliminate this imperfection, or at least to



Removing the final trace of gas from Ferranti valves by means of induced high-frequency currents.

Pruning the Valve List—

reduce it to an inappreciable amount. The screen grid valve itself in turn was found to suffer from certain minor flaws as circuit design advanced, and was succeeded by the high-impedance pentode. It is still unexcelled, however, for low anode-grid capacity; in fact, the general run of them are better in this one respect than the latest pentodes. This is not necessarily so; it is a matter of a compromise to achieve the best all-round characteristics. In all other normal respects the pentode is as good or better. The pentode is useless as a dynatron, of course, but the very few who are interested in dynatrons might well be content to have to order them specially, if the masses thereby obtained the rationalisation benefits of sweeping the lists clear of screen grid valves.

The surviving HF pentodes could then be further reduced by a half. The number of occasions when a non-variable-mu valve is used and a variable-mu type could not be substituted with negligible discomfort is so small as hardly to justify their retention in the catalogue of standard valves.

Standardised Output Valve

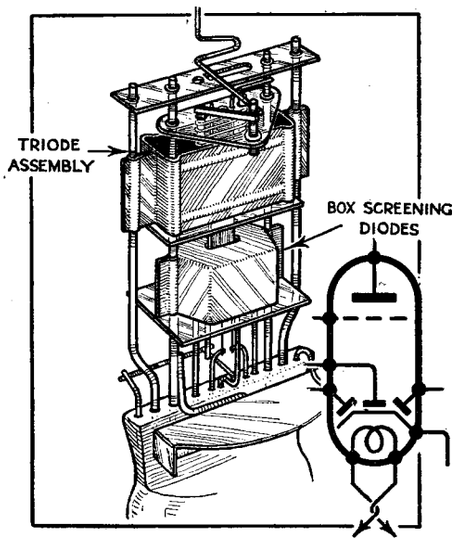
The high-slope pentode (with AC and "universal" heaters) has now emerged as the most useful type of output valve, and could well be standardised in this department. So far we are doing rather well; we have kept only two types of valve, for mains drive at least. The battery position is not so clearly defined; battery power being so costly it might be necessary to have two sizes of output pentode, one where economy is paramount and one where a greater output can be paid for. In addition, there are the special systems—QPP and Class "B." Both of these, in varying subdivisions, have their advocates. It does look as if we are still waiting for the valve designers to settle the matter by producing a quiescent valve that is undeniably the best.

And that reminds us that we have not yet fully examined the case for and against the triode. There is still a function for it in a stage of amplification between the diode detector and output valve. The latter having already been settled as a high-slope pentode, requiring only 2 or 3 volts grid swing to drive it fully, it is questionable whether there is any real need for LF amplification. The diode works best when handling a fair number of volts. And this is needed for AVC anyway. Still, it might be a hardship to deprive designers of a source of moderate LF "mag," particularly in short-wave or all-wave receivers, and for amplified AVC. And the same type of triode would do for Colebrook HF amplifiers. But there is a great difference between this solitary survivor (or, at most, two) and the host of miscellaneous triodes still listed.

In the battery range such a type is still more necessary; in addition to the foregoing uses it is wanted as a driver. There is little technical justification for the triode as a detector in "straight" sets. The better the characteristics the more heavily it damps the preceding tuned circuit. The screened pentode cuts out this effect, and offers more amplification.

The triode is still unsurpassed as a high-quality output stage when one can afford to throw away most of the power supplied, particularly when it is used in push-pull. But this almost brings us into the realm of special sets; it seems quite probable that not more than one broadcast receiver in a hundred depends essentially on a triode output.

How about frequency changers? There are heptodes, octodes, triode-pentodes and triode-hexodes. Obviously, this department is not ripe for standardisation. But at least let us have an AVC grid base that matches that of the "standard" HF pentode.



Electrode assembly of a multiple valve (triple-diode-triode).

Rectifiers furnish an example of what has actually been done towards standardisation. There used to be an extremely miscellaneous lot. For several years now there have been three standard specifications. And instead of each manufacturer coming out with a different three, they have all agreed to keep to the same. It remains to be shown why this range is sometimes duplicated by offering each valve in directly and indirectly heated types. It is, of course, necessary to duplicate one of them to provide a "universal" rectifier, with low current heater.

But, you say, why have separate AC and "universal" types at all? If the "universal" lives up to its name, why not use it exclusively and abolish the separate AC types? This has been seriously considered, but the feeling is against it. For a number of reasons the running of heaters in series, for which the "universal" types are designed, is slightly less reliable and satisfactory than parallel connection. It is not very much less, but when only a very small proportion of people are confined to DC mains—and that number is in process of disappearing altogether—it would be rather foolish to impose even a slight handicap on the vast majority. It would look particularly foolish to our descendants, when DC is no more. One might run "universal" valves in parallel in AC models; but should a thoroughly well established (and technically sound) standard be thrown over for the sake of a dwindling minority? The "universal" valves, then, are a temporary expedient. That is fortunate, for their universality was doomed from the start by the makers adopting diverse current ratings.

Scrap the Multiple Valves?

No mention has been made of the numerous combination types—double-diode-triodes, double-diode-pentodes (HF and output), triple-diode-triodes, driver-Class "B" valves, and others. That is because it would be quite a good idea to make a clean sweep of the lot. A small separate diode, or multiple diode, is wanted in any case for certain purposes. What need, then, to add numerous further types of valve that do no more than those already available? They only complicate design and production and mean that if one part fails the whole must be renewed.

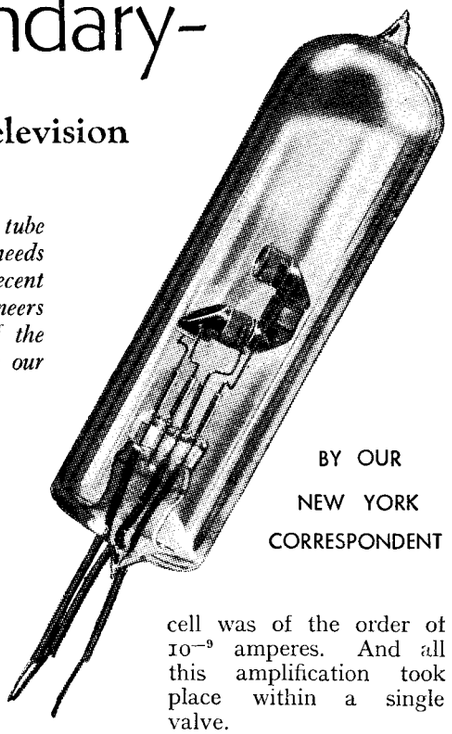
If the valve business were being started all over again, no doubt the socket arrangements would be made rather more consistent. Considering the many stages in the evolution of the valve, we might actually have done far worse. We have got over the side-terminal affair quite nicely. There is still a little trouble with valves that were originally fitted with five pins and then went on to seven. And it is generally held that the Americans were right when they made the top terminal the *grid*. This has been done with all the more recent types, so now it is only the HF pentodes (and their SG predecessors) that have their anodes brought out here. The grid is the most sensitive electrode, and the one to be kept apart from the others. Even some output pentodes have their grids at the top now. It helps in avoiding hum. And it may be very useful for television.

Lastly, the identification of valves: if the subject can be touched on without risk of apoplexy. If readers select any particular class of valve common to most manufacturers—say the AC triode with an amplification factor of about 30—and run through the lists, making a note of the names under which it appears, further comment is needless. Some of the names have a hint of rational purpose in them; others have not. No intelligent being would suspect that they all denoted substantially the same article, with only the trifling difference of birthplace. To remember all the Q4s and AC/PG465-SSs is like trying to memorise the London Telephone Directory. Would it not be delightful if, first, all but a handful of approved valve types were abolished or consigned to replacement on special lists; and, secondly, if each type were given a fixed name or number chosen intelligently to indicate its purpose, such name to be beyond the power of any individual valve manufacturer to "improve"?

The Secondary-Emission Multiplier

A Step Towards Better Television

A NEW type of electron multiplier tube specially suitable for television needs was described and demonstrated at a recent meeting of the Institute of Radio Engineers in America. A general description of the valve and its possibilities is given by our correspondent in this article



BY OUR NEW YORK CORRESPONDENT

A SIGNIFICANT advance in television technique was disclosed and demonstrated before the I.R.E. in New York, October 23rd, 1935, by Dr. V. K. Zworykin, Dr. G. A. Morton and Mr. L. Malter, of the Electronic Research Laboratory of R.C.A.-Victor in Camden, New Jersey. This advance, heralded as placing high intensity high detail television images one step nearer realisation, is a new valve that may ultimately rival the thermionic valve used to-day in such vast numbers. This new valve uses secondary emission for purposes of electron multiplication, which is not new. In this case, however, a new technique has been worked out in such a way that the electrons are under complete control to such an extent that valves in quantity may be constructed with the knowledge that they will be interchangeable.

These valves may have a voltage amplification of several million in a single envelope with a signal-to-noise output that is from 60 to 100 times better than any existing amplifier. Furthermore, such an amplifier has a very wide frequency response, making it valuable for television.

The Demonstration

Dr. Zworykin, already well known for his kinescope and iconoscope, cathode-ray devices used in transmitting and reproducing moving images, demonstrated a combined photocell and amplifier capable of replacing present-day complicated high-gain amplifier systems of many stages. The valve was not much larger than the ordinary receiving valve, and its output was much quieter than an amplifier made up with an equivalent gain with existing apparatus.

In demonstration the authors of the papers picked up and focused on the new valve a beam of light modulated by phonograph music. The source of light was a glow tube. It was placed perhaps 20ft. from the lens that focused the beam on to the new valve. The output of this single valve operated a loud speaker at such an intensity that all in the largest auditorium of the Engineers' Society Building could hear plainly. Its output was of the order of 8 milliamperes, the output of the photo-cell was of the order of 10^{-9} amperes. And all this amplification took place within a single valve.

When the light beam was cut off there was no sound from the loud speaker, indicating that no noise was generated within the valve itself. Anyone who has built and operated an amplifier with a voltage gain of one million (120 db) knows the output noise produced by the "shot" effect in the input plus the interstage coupling impedance noises all along the line of amplification. There is so little noise in this new valve because there are no coupling impedances; the total noise output is that produced in the input due to shot effect.

Although the immediate application of the valve is to television, or sound movies, where a light source is the actuating impulse, Dr. Zworykin stated that thermionic cathodes can be used as well as photo cathodes. Thus it can be seen that the new valve may become a rival of the thermionic amplifier.

In television this amplifier would enable engineers to pick up cleaner signals from the transmitter cathode ray tube and on the output to reproduce the images with less background visible "noise." The amplifier would be simple in that it would have but a single valve, which would be about the size of modern receiving valves; it would be noise free, and it would have a wide frequency response. It seems, therefore, fair to suggest that Zworykin and his associates have produced a new device of most significant possibilities. A new technique of low intensity electronics may result; certainly television is brought one step nearer for the man in the street.

How the Tube Works

Consider any sort of cathode, or electron emitter, say, a photocathode for simplicity. Supply an anode on which electrons released from the photo surface may strike. Each electron, if it has the proper accelerating potential between cathode and anode, will liberate several other electrons when it strikes the anode. As many as eight or ten may thus be liberated. In the usual tube, a triode, for example, these new electrons (known as secondaries) immediately fall back upon the anode because there is nothing else for them to strike—this anode is the most positive surface within the field.

In a four-element valve in which the plate may at some instant have a potential less than that of another element, the screen grid for example, these secondary electrons may not go to the anode but to the screen grid, with the familiar result of a dynatron characteristic. A decrease in plate current is produced by an increase in grid voltage.

Theory of Operation

Now, in this new type of valve, suppose we place a second anode with a potential somewhat higher than that of the first anode. Suppose, too, that the first anode is specially coated so that it is a good emitter of electrons. Now, when the first electron strikes the first anode, secondaries are produced, say, eight of them. These eight electrons may be attracted toward the second anode, and upon striking it produce eight new ones for each of the eight original secondaries. Thus the current from the second anode is of the order of 8^2 or sixty-four. If there are ten such anodes, each emitting secondary electrons, the gain of the tube, that is, the electrons in the final anode circuit produced by the single electron leaving the photocathode at the input, would be 8^{10}, a very great number.

This is the fundamental process involved in the new valve. In practice, of course, the process is not so simple as this. For one requirement is that the surfaces upon which the electrons strike and which become new cathodes for the following anodes, must be good producers of secondary electrons. And all efforts up to the present time have been towards the development of surfaces which emit few secondary electrons, for in modern valves these secondaries are a nuisance and are to be avoided.

The surfaces worked out to the best advantage by Zworykin and his associates do not seem to differ much from those in high vacuum photocells used industrially or in the sound moving talking picture theatre. Cesium on an oxidised plate of silver seems to be as good an emitter as

The Secondary-Emission Multiplier—

any. Such a surface will emit as many as 8 to 10 secondary electrons for each primary striking it at voltages of the order of 400 to 600.

Now having secured a good source of secondary electrons it is necessary to make them go where they are to perform their function of producing still more secondary electrons. Here the knowledge gained in making cathode-ray tubes work comes into play. The new art of electron optics is most important in this phase of the multiplier tube of Zworykin.

The electrons must be directed into a beam by electron lenses and then aimed at the proper emitting surface which acts as anode for the first stage and as cathode for the second. This focusing of the diverse emission into a beam may be carried out by electrostatic means, by electromagnetic fields or by combinations of these two effects. An electrostatic type

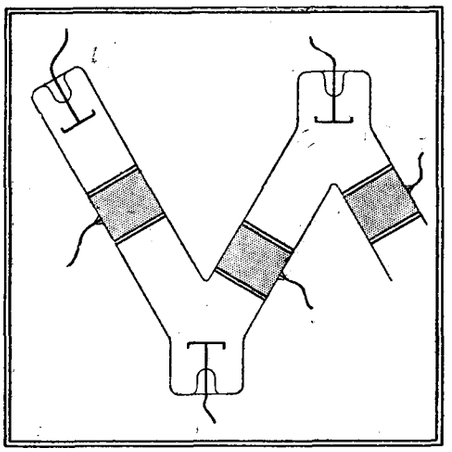


Fig. 1.—Diagram to illustrate the general arrangement of electrodes and focusing cylinders in an electrostatic type of tube.

of tube is shown in Fig. 1. Here primary electrons are drawn to the first target. The secondaries are focused into a beam by cylinders to which the proper potentials are applied, and then strike the second anode or target.

Progress in Design

In another type of valve, more recent than that of Fig. 1, the targets themselves are given such shape and orientation and voltage that they do their own focusing. Such a valve is structurally simpler, naturally, and is the type that will come into active service.

In still another type both electrostatic and electromagnetic fields are used to focus the electrons to force them to their proper anodes. Acting on the suggestion of Slepian, who in 1919 developed a structure shown in Fig. 2 for the purpose of getting a high current cathode, Zworykin and his co-workers have made valves of great interest and scientific value. In this valve there are two rows of parallel surfaces. The lower surfaces are coated and act as emitters or sources of secondary electrons. The top plates are merely deflecting surfaces which, with the aid of an external electromagnetic field, force the electrons to traverse a curved path, first toward the upper deflecting plate and then downward to the appropriate anode (which then becomes a cathode).

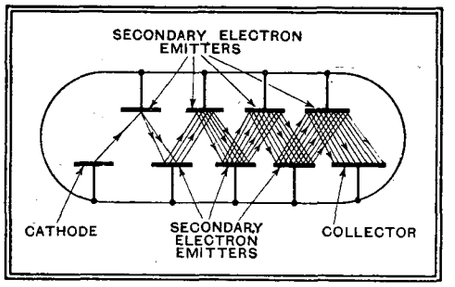


Fig. 2.—Arrangement of electrodes where the target electrodes are self-focusing.

Each time an electron strikes one of these surfaces it liberates 8, say, secondaries, and thus if there are 10 such stages the amplification of the tube will be 8^{10}. Actually valves have been made in which gains of several million have been attained.

The lack of noise in such an amplifier is due to the fact that no coupling impedances exist in it, and, contrary to conditions existing in the conventional multistage amplifier, no noises additional to the shot effect originating in the input are added as the amplification is built up, stage by stage. Practically, the signal-to-noise ratio in these valves seems to be better by 100 times than that in present-day amplifying circuits. The virtue of this feature in a television scheme cannot be over-emphasised, in fact it seems to be the most important feature of the new valves.

The frequency response of this amplifier seems to be essentially flat over an extremely wide range, sufficient for high-fidelity television systems. The upper limit seems to be that controlled by the transit time of the electrons.

Valves shown by Zworykin about the size of ordinary receiving valves had an output sensitivity of 10 amperes per lumen of light input—compared with the output of a good vacuum photocell of about 10 microamperes per lumen. The characteristics of the valves are such that they can be made to oscillate, detect, amplify, or modulate.

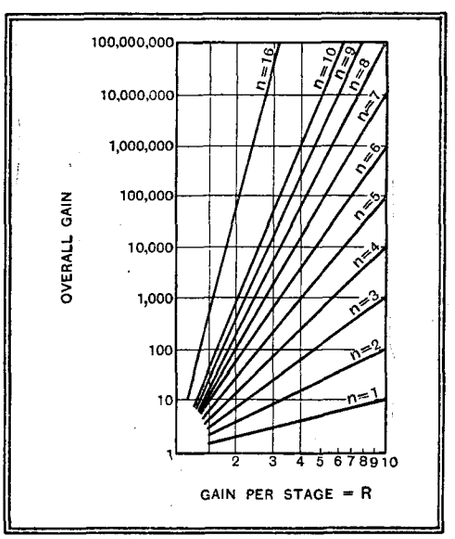


Fig. 3.—Characteristic stage gain where n = number of stages of multiplication. $G = R^n$.

At the Transmitting End

Technical Criticisms of Recent Broadcasts

More Microphones Needed?

A retrospective comparison of transmissions from the technical aspect seems to leave one with the feeling that the oft-recurring Variety Programme does not receive the lavish care accorded to, say, a Wagner night at the Queen's Hall, and yet it is probably safe to assume that Variety gets in—or over—with a large majority every time.

It is well known that a multiplicity of microphones is necessary to cope with a large orchestra, and it is possible that this scheme could be more generally applied to studio transmissions to obtain a more complete control of balance.

The "Rhythm Brothers" dance band, playing in the "Tune and Tempo" programme (London National, November 9th) sounded very flat and uninteresting at times, due to a weakness in the bass—a fault which could have been immediately remedied at the mixing panel had a number of microphones been in use.

Doubtful "Effects"

The epic story of Scott in the Antarctic, retold in the National programme, November 11th, was a really fine broadcast, though it depended more on its excellence of material and speaking voices than any technical consideration.

Perhaps there was just a little scrappiness due to the too-frequent musical interlude, whilst the sound effects of a small ship labouring in a howling gale left much to be desired. H. C. H.

Mullard Special Transmitting Valves

A New Series for Use on Short and Ultra-short Waves

THE design of transmitting valves for use on the short and ultra-short waves has for some time past been the subject for research by the Mullard Wireless Service Co., Ltd., with the result that several new valves developed especially for use on wavelengths as low as five metres have been introduced.

Whilst these are primarily intended for medium-power commercial transmitters and the like, some are, nevertheless, suitable for amateur use since the series includes valves of from 75 to 750 watts power output. These are exemplified by the types TZ1-75, TX4-400, and TX4-750.

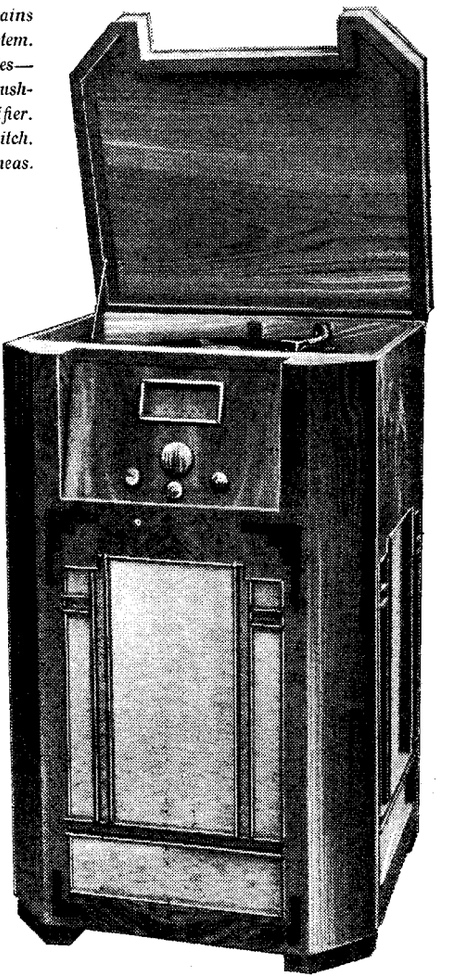
In order to facilitate short leads in the oscillating circuit, both grid and anode connections are brought out on one side of the valve in the TX4 models, but on the top in the TZ1 type. Other features of interest are low grid-anode capacity and very sturdy construction.

These operate at from about 1,000 to 4,000 volts on the anode, but on the ultra-short waves a slightly lower potential is advised. For the TZ1-75, for example, 800 volts is the maximum advised at five metres, while at 25 metres 1,200 volts can be employed. This valve is fitted with a 10-volt filament taking 1.6 amps. It has an amplification factor of 25, an AC resistance of 5,000 ohms, and its mutual conductance is 5 mA. per volt. H. B. D.

Prism Radio-Gramophone

Unique Acoustic System Provides Non-directional Radiation and Deep Bass

FEATURES.—*Type.*—*Radio-gramophone for AC mains with "straight" receiver circuit and special loud speaker system.* ***Circuit.*—***Two tuned HF stages with var.-mu pentodes—pentode anode bend detector—triode 1st LF amplifier—push-pull triode output valves. Full-wave valve valve rectifier.* ***Controls.*—***(1) Tuning. (2) Volume and on-off switch. (3) Tone. (4) Waverange.* ***Price.*** *— 45 guineas.* ***Makers.*—***Prism Manufacturing Company.*



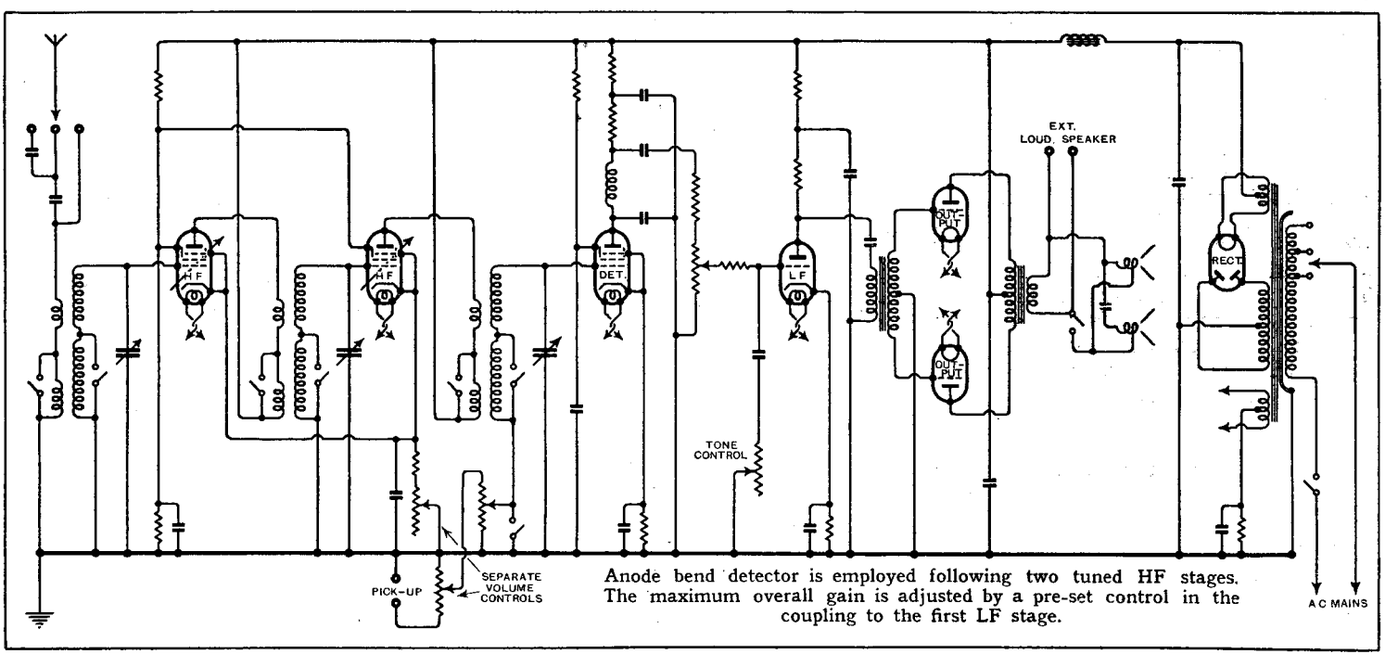
BOTH in conception and treatment this instrument reveals a refreshing originality of outlook on the part of the designers. The majority of radio-gramophones are built round the receiver chassis, which as often as not is identical with that used in one of the firm's current table models. In the Prism radio-gramophone, on the other hand, the nucleus of the equipment is the loud speaker and its associated acoustic system. Starting from this point the makers have chosen a type of circuit which they regard as best suited to provide the necessary electrical input and finally a cabinet design, which, although imposing, is no more than is necessary to house the equipment provided.

In evolving the acoustic system the loud speaker is used not so much for its direct radiation as for a driving force actuating an arrangement of tuned baffle boards which, to quote the makers' own words, "refine, amplify and render non-directional the sound waves which they receive." Two permanent magnet moving-coil units are used, and these are mounted with their backs to the front of the instrument. The first result of this is that focusing of high notes in a beam from the forward angle of the cone is eliminated, at least as far as the radiation from the front of the cabinet is concerned. Inside the cabinet the beam is scattered, first by an arrangement of vanes in the form of what is perhaps best described as a stationary fan, and then by reflection from the main baffle boards. These are made from specially selected wood and are of varying thickness, so that the reinforcement which they give to the bass by virtue of their natural periods is not confined to any one particular frequency.

Sound Distribution

The exceptionally broad and deep bass response and the apparently ubiquitous presence of sound, give the reproduction from this instrument a quality which is a welcome change from the stereotyped reproduction to which we have become accustomed from conventional loud speaker arrangements. The sense that the performers are in the room itself will go far to commend this instrument to the music lover, and the absence of a harsh high-frequency response and background noises in general should remove the well-known prejudices of this class of listener against what they choose to term "canned music."

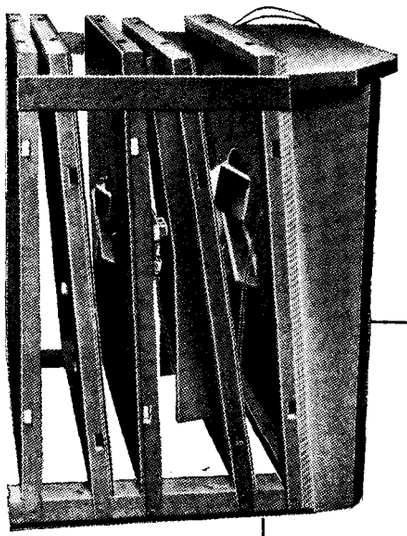
The choice of circuit has contributed in no small measure to the reduction of background noise. Instead of the more usual superheterodyne, a straight circuit with two stages of high-frequency amplification has been adopted. This gives ample range and selectivity for all those stations capable of providing a programme worthy



Anode bend detector is employed following two tuned HF stages. The maximum overall gain is adjusted by a pre-set control in the coupling to the first LF stage.

Prism Radiogramophone—

of reproduction by this instrument. There are, of course, no second-channel whistles or other self-generated heterodynes on either waveband, and the intrinsic background noise of a straight circuit is, if anything, lower than that of a superheterodyne. In the case of the Prism receiver it is possible to adjust the overall amplification to suit local conditions so that background noise can, if necessary, be reduced still further.



(Above) Loud speaker unit removed from the cabinet. Note the deflectors for breaking up the radiation from the front of the loud speaker diaphragm.
(Right) A massive aluminium casting forms the foundation of the receiver unit.

The two high-frequency amplifiers are transformer-coupled, and are of the variable-mu pentode type. There is no AVC, but its place is taken by the manual radio volume control which consists of a variable resistance common to the cathode return circuit of both valves. The detector stage also contains an HF pentode, though this is not of the variable-mu type. This valve functions as an anode bend detector, and the input from the gramophone pick-up is injected in series with the coils associated with the tuned grid circuit. The manual volume control for the pick-up is situated on the motor board, and an additional pre-set volume control designed to prevent overloading, even on the loudest types of record, is fitted in the set itself.

The detector is coupled to a triode amplifier through a resistance-capacity arrangement. Here again a pre-set control has been incorporated to adjust the magnification of radio response to suit individual requirements. The output valves are triodes arranged in push-pull, the input transformer being parallel fed. The output is sufficient to work one or more external loud speakers in addition to those provided in the set. These are connected in parallel across the secondary of the output transformer, the smaller high-frequency speaker being fed through a large capacity condenser.

Range and Selectivity

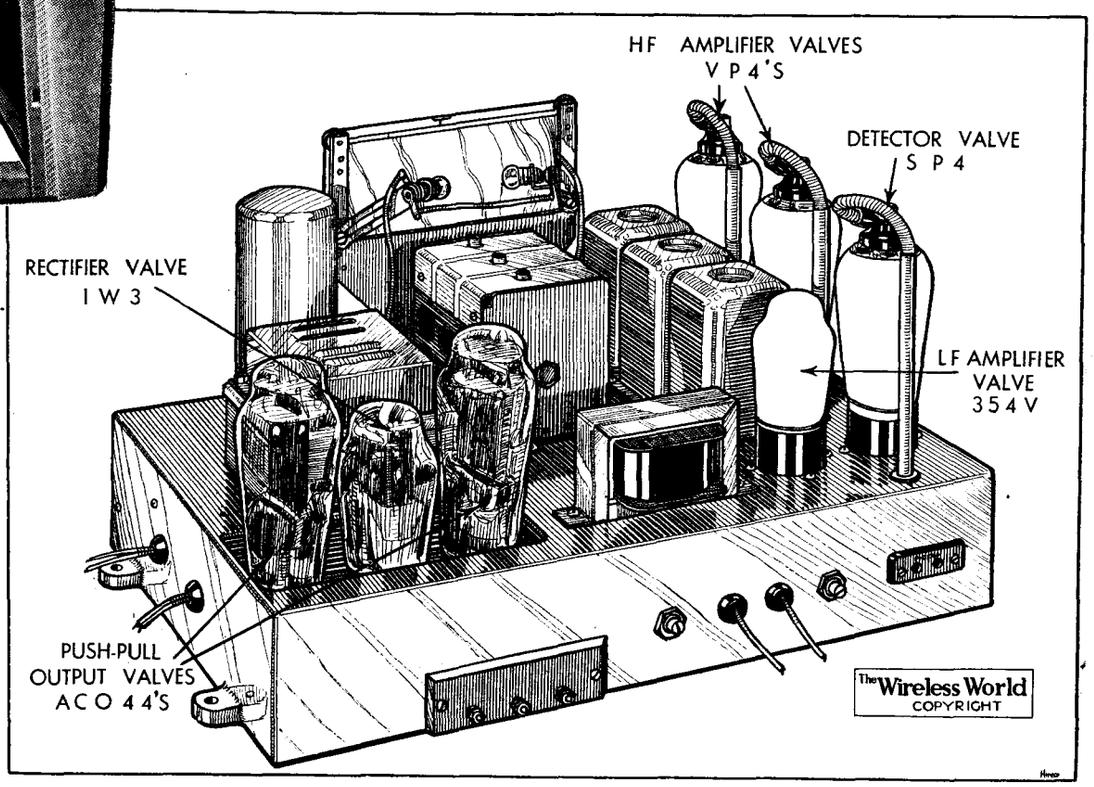
One consequence of the low background level is that the set at first is apt to give an erroneous impression as regards its sensitivity. Further investigation, however, shows that on a normal aerial all those European stations which are generally relied upon for continuous programme working will be received with an ample reserve in hand. There are three alternative aerial tappings, and with a full-size aerial connected to the most selective of these, it was found possible in Central London, to tune clear of the Brookman's Park transmitters with a margin of approximately two channels on either side. All the worth-while long-wave stations are easily separated.

The set is provided with a tone control which consists of a resistance-capacity filter across the input of the first LF stage. The values here have been carefully chosen, and while the range is sufficient to make an appreciable difference to the high-note response, it does not reduce this part of the frequency range to the point where reproduction could be described as muffled.

Some care was found to be necessary when manipulating the radio volume control as there was a tendency for the range of the control to be concentrated near the top end. Further, the anode bend detector can be overloaded on the local station if the manual volume control is tuned up too far. However, errors of adjustment which might arise from this cause will not occur if the station is accurately tuned first with the volume control turned down.

A happy balance has been achieved in the reproduction of gramophone records, and while there is ample top response it does not go high enough to bring in surface noise. The bass response is far better than one has been accustomed to expect from records, and instead of merely suggesting their presence the instrument reveals the double basses in their true function as the foundation of the orchestra.

One interesting result of the acoustic design is that while the sound in a small room is never oppressive, it seems to possess great carrying power when used, say, in a small hall. The makers are to be congratulated on their courage in breaking away from conventional design, and judging by the results, we would say that they have estimated to a nicety the predilections of the majority of listeners in the matter of tonal balance.



Next Set Reviews:—

R. G. D. 7 0 4
Radiogramophone

AIR KING 213
Superheterodyne

The Variable-Selectivity IV.

An extension rod and coupling link for the variable-selectivity IF transformer control of this receiver obtainable from Sound Sales should be added to the list of parts.

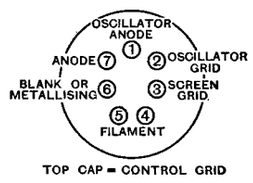
A GUIDE TO VALVE BASES AND SYMBOLS

Arranged in Order of Types

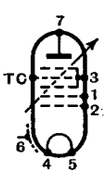
THE multiplicity of modern valve types renders it difficult to memorise the base connections of all but a few of the commoner valves. In these pages are given the base connections for all valves in general use together with the symbols employed in theoretical diagrams. It is important to note that the view is of the valve base itself or the underside of the valveholder

VALVE symbols employed in all circuits in *The Wireless World* are included with the valve bases in order to facilitate the rapid correlation of symbol and base. In all cases where metallising is connected to a separate pin it is indicated on the symbol, but not, as in many 4-pin and 5-pin types, where in the actual valve it is internally connected to the filament or cathode. An arrow through a valve symbol always means that it has variable-mu characteristics, but as valves of the screen-grid, H.F. pentode, and some multiple-diode types are available in both "straight" and variable-mu types, only the symbols for the former are shown here. Those for the latter are identical save for the addition of the arrow. The numbering of valve pins adopted is the standard adhered to by all British manufacturers; an exception is the case of the Midget valves where the numbering is purely arbitrary. It is convenient to remember that with 7-pin and 9-pin valves, pins 4 and 5 are always the filament or heater, and in indirectly heated types pin 6 is the cathode. Uniformity with the other electrodes, however, is not sufficiently consistent to enable any useful rule to be drawn up.

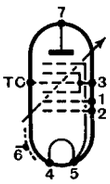
FREQUENCY-CHANGERS



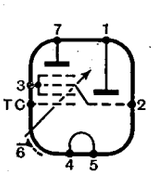
Battery.



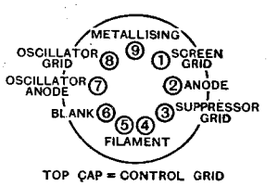
Heptode.

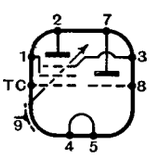


Octode.

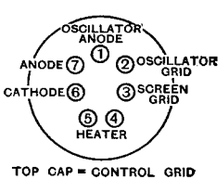


Triode-Hexode.

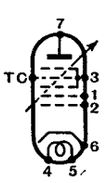




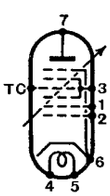
Battery Triode-pentode.



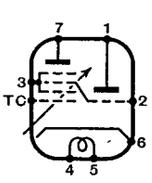
Indirectly Heated.



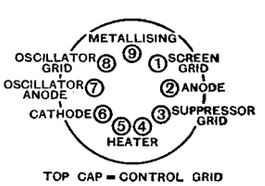
Heptode.

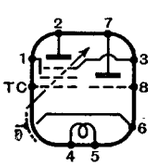


Octode.



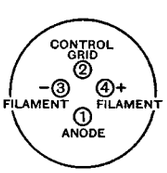
Triode-hexode.



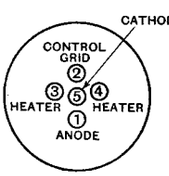


IH Triode-pentode.

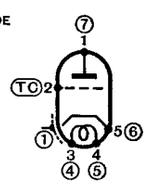
TRIODES



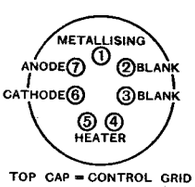
Battery or DH Mains Triode.



(5-pin type).

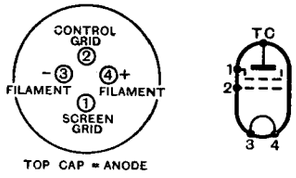


IH Triode.

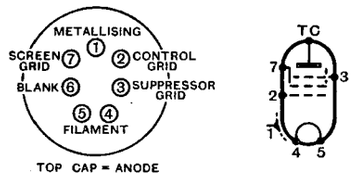


(7-pin type).

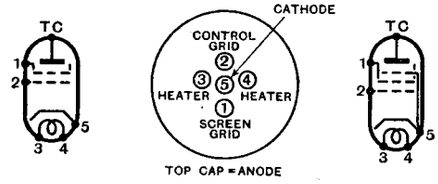
SCREEN-GRID AND HF PENTODES



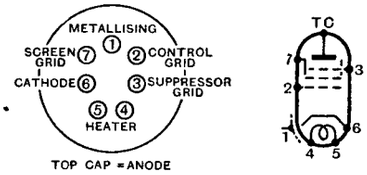
Battery SG Valve.



Battery HF Pentode.

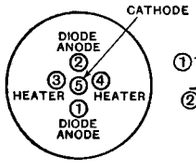


IH SG Valve or HF Pentode.

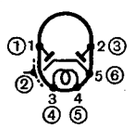


IH HF Pentode (7-pin type).

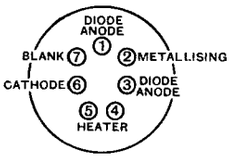
DIODE TYPES



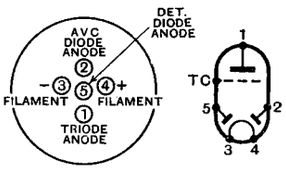
(5-pin type)



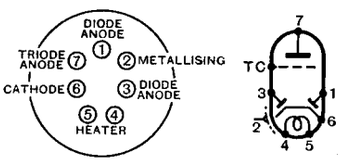
IH Duo-diode.



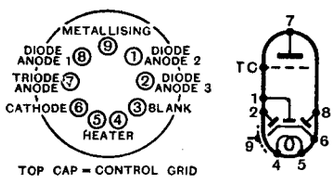
(7-pin type)



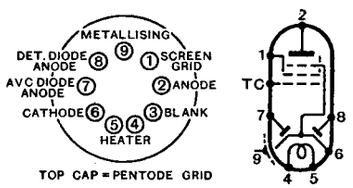
Battery Duo-diode-triode.



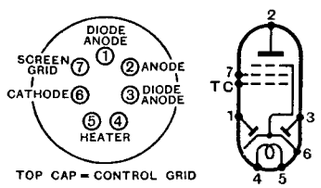
IH Duo-diode-triode.



IH Triple-diode-triode.

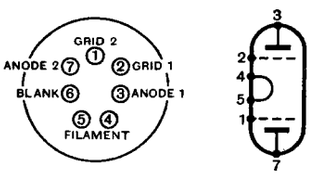


IH Duo-diode-HF Pentode.

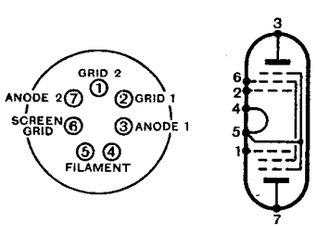


IH Duo-diode-output Pentode.

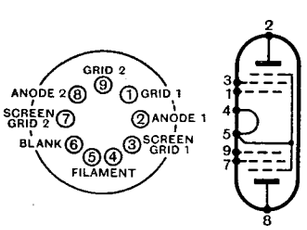
QUIESCENT OUTPUT VALVES



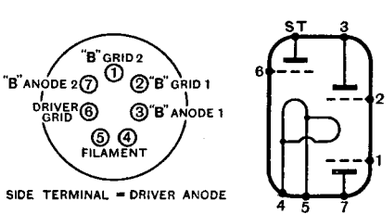
Battery Class "B" Valve.



Battery QPP Valve (7-pin type).

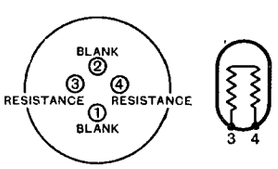


Battery QPP Valve (9-pin type).

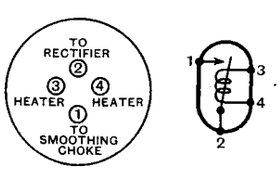


Driver and Class "B" Valve.

MISCELLANEOUS

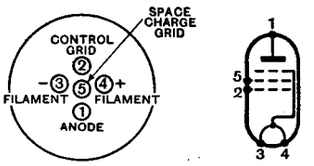


Barretter.

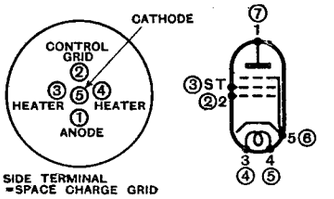


Thermal Delay Switch.

OUTPUT PENTODES

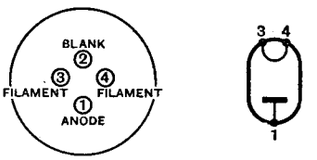


Battery or DH Output Pentode.

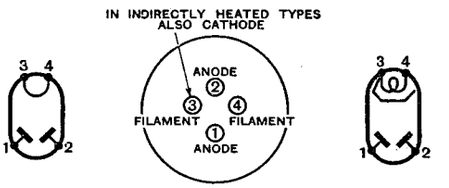


(5-pin type) IH Output Pentode. (7-pin type)

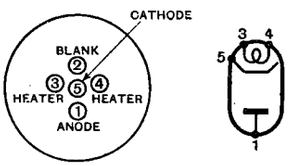
RECTIFIERS



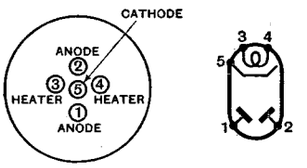
DH or Gas-filled HW Rectifier.



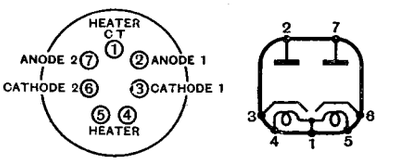
(DH) FW Rectifier. (IH)



IH Half-Wave Rectifier.
(Separate cathode type.)

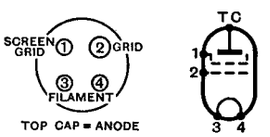


IH Full-Wave Rectifier.
(Separate cathode type.)

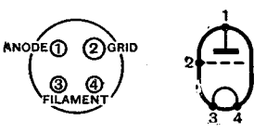


IH Full-Wave or Voltage-Doubler Rectifier.

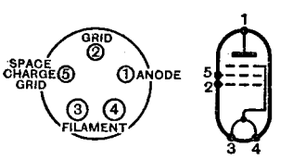
HIVAC MIDGETS



Battery SG Valve.

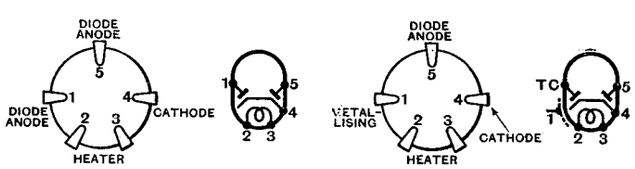


Battery Triode.

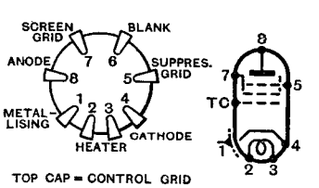


Battery Output Pentode.

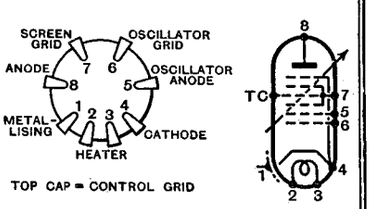
MULLARD SIDE CONTACT TYPES (UNIVERSAL)



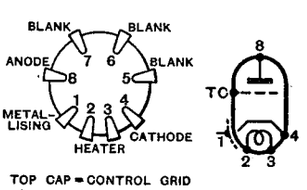
IH Duo-diodes.



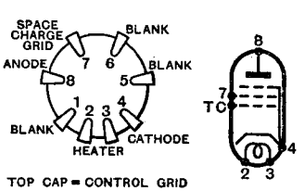
IH HF Pentode.



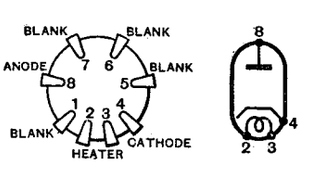
IH Octode



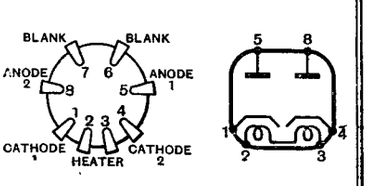
IH Triode.



IH Output Pentode.



IH Half-Wave Rectifier.



IH Voltage-Doubler.

CURRENT TOPICS

Events of the Week in Brief Review

More Licences

BRITISH wireless licences in force at the end of October totalled 7,274,482, an increase during the year of 724,388.

No Television for Denmark?

THE Danish Radio Board has accepted plans for the construction of a new Broadcasting House in Copenhagen, costing seven million Kroner. Space for television broadcasts is not included.

Live *v.* Recorded Programmes

SURPRISING results followed a test recently carried out by the Cuban Broadcasting Company. Fifteen songs were broadcast, and listeners were asked to say whether these were original performances or records.

Actually five of the songs were given at the microphone by well-known singers, while the other ten were radiated from records made previously by the same artists. Ninety per cent. of the audience considered that the whole transmission was of "live" music.

The Last Round-Up

THE world's greatest radio "pirate chaser" must be M. Mandel, the French P.M.G., who, in three months, has induced half a million of his countrymen to take out licences. The "drive" began at the end of August, when grave warnings brought delinquents to the Post Offices with their licence fees. The crowning attack came six weeks ago when it was announced that detected "pirates" would be charged double fees.

Every receiver must now display a small tablet indicating that it is licensed.

The result of the campaign is that a supplementary radio fund of 20 million francs has been built up, and is now available for programme expansion.

"Does Broadcasting Serve Britain?"

MR. LESLIE BAILY'S fifth article in the above series will appear in our issue of November 29th. The article will describe the author's privileged visit to the B.B.C.'s new transmitter for Northern Ireland at Lisburn, near Belfast.

French Anti-Static War

THE French anti-static campaign continues. During October 4,251 P.O. investigations—906 more than in September—revealed 13,667 sources of interference. Prosecutions numbered 60, and several fines were levied.

Standardising Receiver Performance

MR. R. L. SMITH ROSE, Ph.D., D.Sc., will open a discussion on "Standardising Performance of Broadcast Radio Receivers" at an informal meeting of the Institution of Electrical Engineers on Tuesday next, November 26th, at 6.30. The meeting will be held in the Institution, Savoy Place, Victoria Embankment, W.C.2.

America as Amateurs' Champion?

"KEEP your feet on the ground" were the words used by Mr. Irvin Stewart, Chairman of the Telegraph Division of the United States Federal Communications Commission, in a warning to radio amateurs not to be excessive in their pleas for more frequencies. Mr. Stewart hinted that other countries might try to reduce the amateur short-wave bands to relieve congestion on the commercial channels. He added that the United States would fight for the cause of the amateurs, though the fight might be a lone one.

Dramatised Radio News

STRONG protests have been received by the Australian Broadcasting Commission as a result of attempts to dramatise the news of the outbreak of war in Abyssinia. The national stations gave the Press reports with sound effects of bombing, gunfire, and the shouts of combatants, and the broadcast, it is stated, had a distressing effect on many listeners.

The Postmaster-General has pointed out that he has censorship powers over all broadcasting stations, but has not until now considered exercising this authority over the Australian Broadcasting Commission.

Attempts by the B.B.C. to dramatise news items have been made from time to time, but have met with no public response.

Japanese Television

REGULAR television transmissions are to begin at Tokio in the spring of 1936.

Transatlantic 5-metre Tests

TESTS on 5 metres are being arranged between the Portsmouth Municipal College (G6PU) and the U.S.A. Station G6PU will use vertical and horizontal aerial arrays with a power of 10 watts, and the following schedule has been arranged:

Friday, December 13th, 10 p.m. to 1 a.m.

Saturday, December 14th, 10 a.m. to 11 a.m., 10 p.m. to 1 a.m.

All times are G.M.T.

Morse and 'phone will be used, and the call will take the following form: TEST U.S.A. de G6PU.

Sending periods of ten minutes duration will alternate with five-minute listening periods throughout the schedule. Mr. Albert Parsons, who is conducting the tests, states that they are the outcome of 1/7 second echoes during tests recently carried out on Portsdown Hill. The frequency will be maintained as closely as possible to a wavelength of 5.1805 metres. Reports from amateurs at home and abroad will be gratefully received.

RADIO ON "OLD CROCK." Mr. E. A. Marshall, of Edgware, with his 1904 De Dion Bouton which he equipped with a Marconi car radio set for the Old Crocks' run to Brighton on Sunday last. The aerial was placed beneath the running board.

Collins' Wireless Diary

HANDY information on all radio matters is included in Collins' Wireless Diary for 1936, just published.

The 146 pages preceding the diary proper (three days to a page) include broadcasting wavelengths, glossary of technical terms, useful formulæ and a number of reception hints. The Diary is available in various styles from 1s. 3d. to 7s., and is obtainable from all booksellers and stationers.

Money Prizes for Radio Merit

ANNUAL awards for outstanding radio work—similar to the Pulitzer literary prizes—are being devised by America's broadcasting and radio manufacturing organisations. The plan (writes our Washington correspondent) is to make awards for outstanding public service. There would, for example, be an annual award to the broadcasting station performing the greatest single service to its community, such as by the radiation of relief information during a hurricane or flood.

The most meritorious series of programmes might be duly recognised with individual awards to the outstanding announcer and programme producer. In the technical realm awards might be conferred for the greatest single engineering feat such as a stunt broadcast from 'plane or submarine, or for an emergency "hook up" to describe a fire, explosion, 'plane crash or other catastrophe. A station or engineer making an outstanding scientific contribution to radio would also be rewarded.

Additional interest is lent to the scheme by the fact that cash prizes as well as medals are under consideration. The Radio Manufacturers' Association of America has intimated that it will contribute from 25,000 to 30,000 dollars towards the Foundation.

THE WIRELESS WORLD

Valve Data Supplement

IT cannot be expected that a wireless receiver will function correctly unless suitable types of valve are chosen for use in it. The multiplicity of types now available makes this task one of considerable difficulty if the necessary information concerning the specimens is not conveniently available. As in previous years, therefore, *The Wireless World* Valve Data supplement provides this information in a compact form for all the chief receiving valves. Owing to the vast number now listed by the makers it has been found necessary to delete those types which must be considered as obsolete. The guiding principle here has been one which it is believed will commend itself to all users of the supplement—4-volts and 6-volts battery valves have not been listed, nor have other types where later specimens are available with characteristics so similar that they can be used as replacements.

FACTS AND FIGURES ON THE 1935—1936 TYPES

Frequency-changers

The widespread use of the superheterodyne has led to the development of numbers of special valves designed to operate as frequency-changers, so these now occupy a section to themselves. Without exception these valves perform two functions and even if they are not always two valves built into one bulb, they have the equivalent number of electrodes. Each valve, therefore, occupies two lines in the tables—one for that section functioning as the first detector or mixer and the other for the oscillator portion.

The triode-pentode is a multiple valve and consists of an HF pentode and a triode mounted in a single glass envelope. The two valves are quite separate save for a common cathode and external oscillator coupling must be provided. The valve exactly replaces the now obsolete two-valve frequency-changer.

The heptode, on the other hand, is a multi-electrode valve which functions differently, for although it is provided with oscillator electrodes and acts as a mixer, it cannot be described as a double valve. The various electrodes are arranged concentrically and the nearest description in terms of ordinary valves would be a triode and a screen-grid valve connected in *series*. The tetrode section has variable-mu characteristics and the oscillator coupling is internal and electronic. The octode is a modification of the heptode, and if it be allowable to describe the latter as a combination of a triode and tetrode, the octode must be termed a composite triode and pentode—in other words, the octode is to the heptode as the HF pentode is to the screen-grid valve.

A recent addition to frequency-changers is one which is widely used on the Continent—the triode-hexode. This consists of two separate electrode assemblies—a triode and a hexode, with a common cathode. The triode functions as an oscillator and its grid is internally joined to one of the hexode grids to provide internal coupling. Mixing takes place in the hexode and is entirely electronic. The valve is claimed to be particularly good for short-wave receivers.

Screen-grid Valves

The screen-grid valve is now rarely used as an HF amplifier, having been largely displaced by the variable-mu type, and it has been superseded even in the frequency-changer of a superheterodyne. As an amplifier, the grid bias applied is usually about 1.5 volts in mains sets in order to avoid a flow of grid current which would damp the tuned circuits, but no bias is necessary in a battery model.

When the valve is used as an amplifier with a 1-1 ratio intervalve coupling, the amplification is readily calculable provided that the dynamic resistance of the tuned circuit is low compared with the internal AC resistance of the valve, for it is equal to the product of the mutual conductance and the dynamic resistance divided by 1,000. In cases where a step-up ratio is used, the amplification is calculated as above, but is *divided* also by the ratio.

When the valve is used as a first detector in a superheterodyne, it is usually biased more highly so that its AC resistance is increased. The conditions are not easily calculable, but it is convenient to remember that the effective amplification obtainable is usually about one-third of that given by the same valve acting as an amplifier.

As a detector-oscillator the valve must be carefully selected, and it is usually wise to choose a screened HF pentode with a high mutual conductance. The HF pentode has the advantage over the screen-grid tetrode in not possessing a negative resistance kink in its characteristic, and it is consequently capable of giving a larger undistorted output.

Variable-mu Valves

For amplification purposes variable-mu valves are now almost universal. The stage gain obtainable at minimum and maximum bias is calculated in exactly the same manner as for screen-grid valves, and when operating at minimum bias they function in an identical manner.

The amplification, however, can be varied within wide limits, without introducing distortion or upsetting the tuning, by the simple expedient of varying the grid bias. In a mains set with manual control the variation of bias is usually obtained with the aid of a potentiometer in the HT circuit, to the slider of which the valve cathode is connected. In a battery set, however, a potentiometer must be connected across the bias battery and the grid return lead taken to the slider. Automatic volume control has now become a standard fitting, however, and no manual control of bias is then needed, so that the grid return leads of the variable-mu valves are taken through suitable filters to the AVC bias source, which is usually the detector.

The maximum bias required to effect a given reduction in signal strength becomes a matter of some importance. The smaller the bias required to effect a given change in mutual conductance the better will be the action of AVC, or in the case of a battery set with manual volume control, the smaller will be the necessary bias battery. It is unwise to proceed too far in this direction, however, in cases where the set must be used near a local station, for the input handling capacity of low bias valves is usually much less than that of types requiring a large bias, and serious distortion may occur on a strong signal. In this connection it should be pointed out that variable-mu screened HF pentodes have some advantage over the ordinary types in that a larger output can be obtained.

Valve Data Supplement—

Diodes

Diode valves specially designed for detection and AVC purposes are now fairly common. The valves usually contain two diodes with a common cathode, but while the connections are both often brought out to pins in the base, in some cases only one of the anodes is taken to the base and the other is joined to a top cap. These valves are rated to operate with a much larger signal input than the diodes usually fitted to the multiple valves, and can safely pass a heavier current. Westectors will be found in this section, since they fulfil the same functions as diodes of the thermionic type.

Multiple Diode Types

The multiple diode class of valve has spread so widely that a special section is no longer feasible. Valves of this type, therefore, are listed in the section appropriate to the amplifying electrodes. A duo-diode-triode will thus be found under "Triodes with AC resistance greater than 7,000 ohms," a duo-diode-HF pentode under "Variable-mu Valves," while a duo-diode-output pentode is listed as an "Output Pentode."

The uses of these valves are many and varied, but they find their chief application in the provision of automatic volume control. A duo-diode-triode can provide detection, delayed AVC and first stage LF amplification, while a triple-diode-triode can give, in addition to detection and LF amplification, quiet delayed amplified AVC. Two types of duo-diode-pentode are to be found. One embodies a pentode of the variable-mu type, and this is intended to act as an HF, IF, or LF amplifier, while the diodes give detection and AVC. In the other type the pentode has the characteristics of an output valve, and no additional LF amplification is needed.

Triodes

Triodes with internal resistances greater than 7,000 ohms find their chief application as grid or anode-bend detectors, first-stage LF amplifiers and oscillators for superheterodyne frequency-changing purposes. For a grid or power grid detector it is usually best to choose a valve with an internal resistance of some 10,000 ohms, and with a moderately high amplification factor.

In the LF amplifier, a similar type of valve is usually best, and with normal designs a resistance of about 10,000 ohms leads to the most even frequency response. In cases where quality is the first consideration, the trend should be towards a valve in the 7,000/10,000 ohms range, while small sets where amplification is at least as important as quality will be best served by the choice of a valve with a resistance between 10,000 ohms and 20,000 ohms. The basis of choice, of course, assumes that the valves have similar values of mutual conductance.

The selection of an oscillator valve is in no way difficult, for almost any valve will function. In general, however, one with an internal resistance of some 10,000 ohms and a mutual conductance of some 1.5/2.5 mA/V is the best.

Output Triodes

Those valves with resistances less than 7,000 ohms are chiefly of the output type. The few specimens which come into this section and which have resistances above about 4,000 ohms are usually more suitable for acting as low-gain LF amplifiers in ultra-high quality receivers.

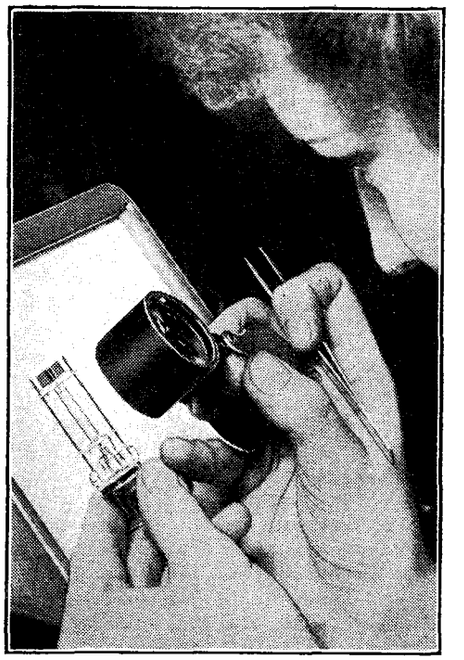
The most important characteristic of an output valve is the power output, for unless this be sufficient it is impossible to obtain good quality reproduction at reasonable volume. For ordinary room strength at good quality some 2,000 milliwatts is necessary, but where the very best quality is desired, and particularly when the high and low frequency responses are unusually well maintained, some 4,000 milliwatts should be allowed. So much depends upon the efficiency of the loud speaker, however, and even upon the characteristics of the room in which it is used, that experience is the best guide for any particular conditions.

The output is calculated upon a basis of 5 per cent. second harmonic distortion, and this involves the statement of the optimum value of load impedance. Since it is unlikely that the speaker will have the correct impedance, a transformer must normally be used for matching, and its ratio can be calculated by dividing the required load impedance by the speaker impedance and taking the square root of the result. In all cases where the speaker impedance is less than the valve load, the transformer will be of the step-down type. In certain cases, figures are given for a pair of valves operated in push-pull. These refer neither to ordinary push-pull nor to Class "B" operation, but to the new "low-loading" system which is to be recommended where very large output is desired.

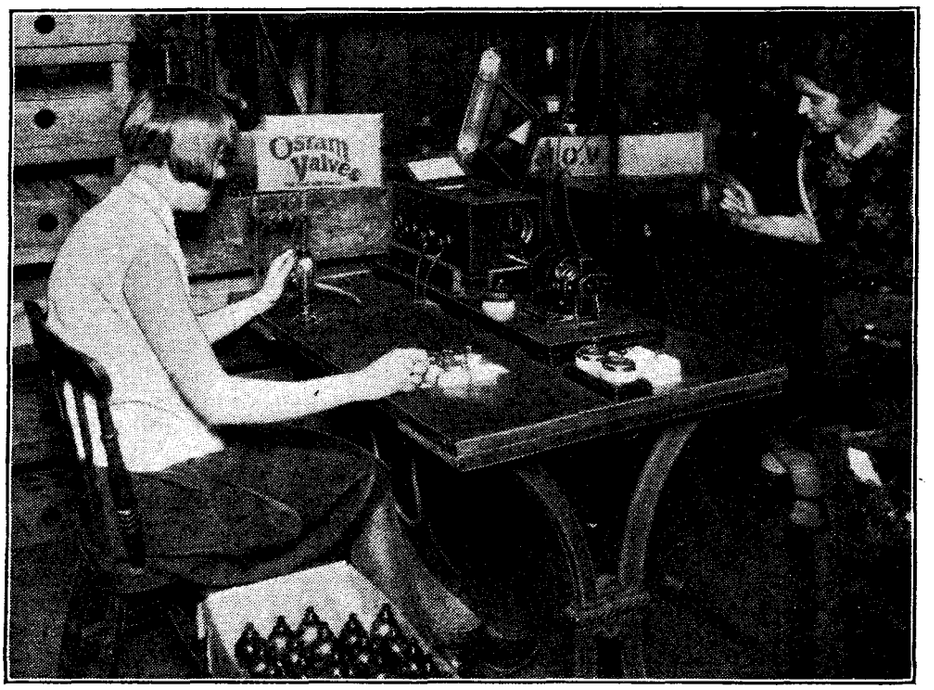
Output Pentodes

The chief advantages of the pentode over the triode are its increased efficiency and sensitivity—a greater output is obtainable for a given expenditure of energy from the HT supply, and a smaller signal input is required. To counterbalance this, however,

(*Concluded on page* xxiv.)



The electrode assembly of Mullard valves is critically examined with a magnifying glass against an illuminated opal glass background.



Testing Osram valves for insulation.

FREQUENCY-CHANGERS

	Type.		Filament. Volts.	Filament. Amps.	A. Normal Anode Volts.	B. Normal Screen Volts.	Anode Current (mA.).	Screen Current (mA.).	AC Resistance at A, B & C (Ohms).	Max. Conversion Conductance at A, B & C (mA/V.).	Min. Conversion Conductance at A, B & D (mA/V.).	C. Min. Grid Bias.	D. Max. Grid Bias.	Opt. Osc. Volts on Osc. Grid (Peak).	Pins in Base.	Price.
BRIMAR ..	15 A2 (H)	.. tet.	4.0*	0.65	250	100	3.5	2.0	300,000	0.6	0.002	—3.0	—40.0	—	7	20/-
	„	.. osc.			200	—	—	—	—	0.75	—	—	—	—		
	15 D1 (H)	.. tet.	13.0*	0.2	250	100	3.5	2.0	300,000	0.6	0.002	—3.0	—40.0	—	7	20/-
	„	.. osc.			200	—	—	—	—	0.75	—	—	—	—		
COSSOR ..	210 PG (H)	.. tet.	2.0	0.1	150	55	—	—	—	0.45	0.002	0	— 9.0	7.0	7	18/6
	„	.. osc.			150	—	—	—	—	—	—	—	—	—		
	41 MPG (H)	.. tet.	4.0*	1.0	250	80	1.0	3.0	—	1.5	0.002	—1.5	—10.0	8.5	7	20/-
	„	.. osc.			100	—	6.0	—	—	—	—	—	—	—		
	13 PGA (H)	.. tet.	13.0*	0.2	250	65	1.0	3.0	—	0.75	0.002	—1.5	—20.0	8.5	7	20/-
	„	.. osc.			200	—	6.0	—	—	—	—	—	—	—		
DARIO ..	TK 24 (O) ..	.. pent.	4.0*	0.65	250	70	1.3	3.0	1,500,000	0.6	0.002	—1.5	—25.0	11.3	7	15/6
EVER-READY	K 80 A (O)	.. pent.	2.0	0.125	150	70	0.8	0.75	—	0.2	0.002	0	—20.0	13.0	7	18/6
	„	.. osc.			—	—	—	—	—	—	—	—	—	—		
	A 80 A (O)	.. pent.	4.0*	0.65	250	70	1.6	3.8	—	0.6	0.002	—1.5	—20.0	12.0	7	20/-
	„	.. osc.			90	—	—	—	—	—	—	—	—	—		
FERRANTI ..	VHT 2A (H)	.. tet.	2.0	0.1	150	70	1.0	2.0	750,000	0.3	—	0	—20.0	7.0	7	18/6
	„	.. osc.			70	—	0.75	—	—	—	—	—	—	—		
	VHT 4 (H)	.. tet.	4.0*	1.0	200	100	4.0	5.3	500,000	0.7	—	—3.0	—22.0	16.0	7	20/-
	„	.. osc.			100	—	1.7	—	—	—	—	—	—	—		
	VHT A (H)	.. tet.	13.0*	0.2	250	100	3.5	6.0	500,000	0.7	—	—2.0	—22.0	12.0	7	20/-
	„	.. osc.			100	—	1.4	—	—	—	—	—	—	—		
HIVAC ..	TP 230 (TP)	.. pent.	2.0	0.3	120	60	1.1	0.35	—	0.325	0.001	0	—12.0	3.5	9	15/6
	„	.. osc.			120	—	0.75	—	—	—	—	—	—	—		
LISSEN ..	FC 2 (TH)	.. hex.	2.0	0.2	150	70	1.2	1.2	500,000	0.4	0.005	0	—10.0	—	7	18/6
	„	.. osc.			100	—	0.8	—	12,500	—	—	—	—	—		
	ACFC (TH)	.. hex.	4.0*	1.4	250	100	2.5	3.5	500,000	0.65	0.006	—1.5	—20.0	—	7	20/-
	„	.. osc.			150	—	1.6	—	10,000	—	—	—	—	—		
MARCONI and OSRAM.	X 21 (H)	.. tet.	2.0	0 1	150	50	0.45	0.6	1,500,000	0.2	0.002	0	— 9.0	10.0	7	18/6
	„ ..	.. osc.			50	—	0.6	—	—	—	—	—	—	—		
	MX 40 (H)	.. tet.	4.0*	1.0	250	80	2.75	2.0	500,000	0.5	0.0025	—3.0	—30.0	10.0	7	20/-
	„	.. osc.			150	—	2.1	—	—	—	—	—	—	—		
	X 41 (TH)	.. hex.	4.0*	1.2	250	80	1.0	1.3	2,000,000	0.55	0.002	—1.5	—20.0	12.0	7	20/-
	„	.. osc.			150	—	2.2	—	—	—	—	—	—	—		
	X 31 (TH)	.. hex.	13.0*	0.3	250	80	1.0	1.3	2,000,000	0.55	0.002	—1.5	—20.0	12.0	7	20/-
	„	.. osc.			150	—	2.2	—	—	—	—	—	—	—		
	X 30 } (H)	.. tet.	13.0*	0.3	250	80	4.0	2.0	200,000	0.8	0.002	—3.0	—30.0	10.0	7	20/-
	X 32 }	.. osc.			150	—	3.0	—	—	—	—	—	—	—		

REFERENCES.

[1] Also Type FC 13 with side-contact base.
[2] Top grid.
[3] Also Type SP 13 with side-contact base.
[4] Also Type 2 D 13A with side-contact base.
[5] Also Type HL 13 with side-contact base.
[6] Also available with 13 volts 0.6 ampere heater.
[7] Also Type UR 1 with side-contact base.

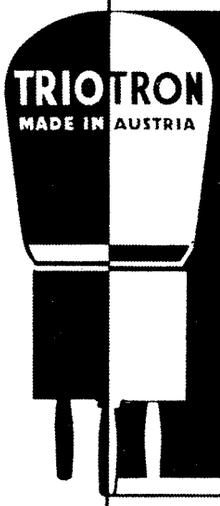
† Per pair in push-pull.
* Indirectly heated.
(M) Metal Rectifier.
(P) HF Pentode.
(SD) Single Diode.
(DD) Duo-diode.
(TD) Triple-diode.
(B) Class " B."
(Q) QPP.
C Continental type base.
SC Side-contact base.

FREQUENCY-CHANGERS—(*Continued*)

	Type.		Filament. Volts.	Filament. Amps.	A. Normal Anode Volts.	B. Normal Screen Volts.	Anode Current (mA.).	Screen Current (mA.).	AC Resistance at A, B & C (Ohms).	Max. Conversion Conductance at A, B & C (mA/V.).	Min. Conversion Conductance at A, B & D (mA/V.).	C. Min. Grid Bias.	D. Max. Grid Bias.	Opt. Osc. Volts on Osc. Grid (Peak).	Pins in Base.	Price.
MAZDA ..	TP 22 (TP)	.. pent.	2.0	0.25	150	60	1.2	0.4	1,600,000	0.5	0.008	—1.5	—20.0	3.0	9	18/6
	„	.. osc.			150	—	0.7	—	24,000	1.4	—	—	—	—		
	ACTP (TP)	.. pent.	4.0*	1.25	250	200	6.5	2.5	900,000	0.7	0.008	—5.0	—41.0	3.0	9	20/-
	„	.. osc.			200	—	1.5	—	21,500	1.4	—	—	—	—		
	TP1340 ..	.. pent.	13.0*	0.4	250	200	6.5	2.5	900,000	0.7	0.008	—5.0	—41.0	3.0	9	20/-
	„ ..	.. osc.			200	—	1.5	—	21,500	1.4	—	—	—	—		
	TP 2620 (TP)	.. pent.	26.0*	0.2	200	200	6.5	2.5	900,000	0.65	0.008	—5.0	—37.0	3.0	9	20/-
	„	.. osc.			200	—	1.5	—	21,500	1.4	—	—	—	—		
MULLARD ..	FC 2 (O) ..	.. pent.	2.0	0.125	150	70	0.8	0.75	—	0.2	0.002	0	—20.0	13.0	7	18/6
	„ ..	.. osc.			—	—	—	—	—	—	—	—	—	—		
	FC 4 (O) ..	.. pent.	4.0*	0.65	250	70	1.6	3.8	1,600,000	0.6	0.002	—1.5	—25.0	12.0	7	20/-
	„ ..	.. osc.			90	—	2.0	—	—	—	—	—	—	—		
	TP 4 (TP)..	.. pent.	4.0*	1.25	250	150	3.0	0.75	—	0.65	0.002	—5.0	—30.0	—	9	20/-
	„ ..	.. osc.			150	—	—	—	31,000	—	—	—	—	—		
	FC 13C[1] (O)	.. pent.	13.0*	0.2	200	70	1.6	3.8	1,600,000	0.6	0.002	—1.5	—25.0	12.0	7	20/-
	„	.. osc.			90	—	2.0	—	—	—	—	—	—	—		
OSTAR-GANZ .	G 5 (H) ..	.. tet.	100/250*	0.024	250	75	3.5	4.5	1,500,000	0.6	0.01	—1.0	—40.0	—	7	19/6
	„ ..	.. osc.			140	—	3.0	—	—	—	—	—	—	—		
362	ACFC 4 (H)	.. tet.	4.0*	1.0	250	80	7.0	—	—	—	—	—1.0	—10.0	—	7	15/-
	UFC (H) ..	.. tet.	6.5*	0.3	250	150	4.0	—	—	—	—	—1.0	—10.0	—	7	15/-
TRIOTRON ..	O 202 (O) ..	.. pent.	2.0	0.14	135	45	0.6	2.5	2,500,000	0.25	0.002	0	—12.0	11.3	7	13/6
	O 406 (O) ..	.. pent.	4.0*	0.65	250	70	1.3	3.0	1,600,000	0.6	0.002	—1.5	—25.0	11.3	7	15/6
	O 1307 (O)	.. pent.	13.0*	0.2	200	70	0.8	3.0	1,500,000	0.6	0.002	—1.5	—25.0	11.3	7	15/6
TUNGSRAM ..	MH 206 (H)	.. tet.	2.0	0.06	180	66	1.3	2.4	500,000	0.3	0.004	—3.0	—22.5	—	7	15/-
	„ ..	.. osc.			135	—	2.3	—	20,000	1.0	—	—	—	—		
	VO 2 (O)	.. pent.	2.0	0.13	135	90	0.5	0.9	2,500,000	0.3	0.002	0	—12.0	—	7	15/-
	„ ..	.. osc.			135	—	1.7	—	—	—	—	—	—	—		
	MH 4105 (H)	.. tet.	4.0*	1.0	200	100	5.0	1.1	600,000	0.52	0.0015	—3.0	—45.0	—	7	16/-
	„	.. osc.			150	—	4.0	—	22,000	1.4	—	—	—	—		
	VO 4 (O) ..	.. pent.	4.0*	0.65	250	70	1.6	3.8	1,000,000	0.6	0.001	—1.5	—25.0	—	7	16/-
	„ ..	.. osc.			90	—	2.5	—	—	—	—	—	—	—		
	MH 1118 (H)	.. tet.	10.0*	0.18	200	100	3.5	2.3	700,000	0.47	0.0015	—3.0	—45.0	—	7C	16/-
	„	.. osc.			150	—	3.0	—	22,000	1.4	—	—	—	—		
	VO 13 (O)..	.. pent.	13.0*	0.3	250	70	1.6	3.5	1,000,000	0.6	0.001	—1.5	—25.0	—	7	16/-
	„ ..	.. osc.			90	—	2.5	—	—	—	—	—	—	—		

SCREEN-GRID VALVES

	Type.		Filament. Volts.	Filament. Amps.	Normal Anode Volts.	Normal Screen Volts.	Anode Current (mA.).	Screen Current (mA.).	AC Resistance (Ohms).	Mutual Conductance (mA/V.).	Grid-Anode Capacity (mmfds.).	Pins in Base.	Price.
BRIMAR ..	8 A1 (P)		4.0*	1.0	250	100	3.5	1.2	600,000	4.0	—	5	17/6
	8 D2 (P)		13.0*	0.2	250	175	9.0	3.0	600,000	1.9	—	7	17/6
CLARION ..	SG 2		2.0	0.11	150	80	2.5	0.75	300,000	1.0	—	4	3/9
	ACSG		4.0*	1.0	200	85	3.0	1.0	350,000	1.4	—	5	4/6
	ACHP (P)		4.0*	1.0	200	100	4.5	1.3	—	2.5	—	7	6/6
	ADHP (P)		20.0*	0.18	200	100	5.0	2.0	—	2.8	—	7	6/6
COSSOR ..	215 SG		2.0	0.15	150	80	0.7	—	300,000	1.1	—	4	12/6
	220 SG		2.0	0.2	150	80	0.7	—	200,000	1.6	—	4	12/6
	210 SPT (P)		2.0	0.1	150	80	2.0	—	600,000	1.3	—	4 or 7	13/6
	MSGHA		4.0*	1.0	200	100	2.0	—	500,000	2.0	—	5	17/6
	41 MSG		4.0*	1.0	200	80	0.8	—	400,000	2.5	—	5	17/6



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FREQUENCY CHANGER.	A.C. TYPES. O. 406.	UNIVERSAL TYPES. O. 1307.
Heater voltage	4 volts	13 volts
Heater current	0.65 amp.	0.2 amp.
Max. anode voltage	250 volts	200 volts
Optimum screen voltage	70 volts	70 volts
Conversion conductance	0.6 mA/V	0.6 mA/V
Type of base	7-pin	7-pin or side contact

DOUBLE-DIODE TRIODE.	DT. 436.	DT. 1336.
Heater voltage	4 volts	13 volts
Heater current	0.65 amp.	0.2 amp.
Max. diode current	0.8 mA	0.8 mA
Max. triode anode voltage	250 volts	200 volts
Triode slope	3.6 mA/V	3.6 mA/V
Type of base	7-pin	7-pin or side contact

HIGH-SENSITIVITY PENTODE.	P. 495.	P. 2060.
Heater voltage	4 volts	20 volts
Heater current	1.5 amp.	0.2 amp.
Max. anode voltage	250 volts	200 volts
Screen voltage	250 volts	100 volts
Max. slope	9.5 mA/V	8 mA/V
Max. undistorted output	3,500 mW	3,500 mW
Type of base	7-pin	7-pin or side contact

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SCREEN-GRID VALVES—(*Continued*)

Type		Filament. Volts	Filament. Amps.	Normal Anode Volts.	Normal Screen Volts.	Anode Current (mA.).	Screen Current (mA.).	AC Resistance (Ohms).	Mutual Conductance (mA/V.).	Grid-Anode Capacity (mmfds.).	Pins in Base.	Price.
COSSOR—contd.	MSGLA	4.0*	1.0	200	100	5.2	—	200,000	3.75	—	5	17/6
	MS/Pen (P)	4.0*	1.0	200	100	4.5	1.3	800,000	3.5	—	5 or 7	17/6
	MS/Pen A (P)	4.0*	1.0	200	150	9.0	5.0	90,000	4.0	—	5	17/6
	13 SPA (P)	13.0*	0.2	200	100	5.0	1.3	1,000,000	2.5	—	7	17/6
DARIO	PF 462 (P)	2.0	0.18	150	150	3.0	1.0	600,000	1.85	0.003	7	10/-
	TB 622	2.0	0.18	150	90	2.0	0.5	400,000	1.4	0.008	5	9/6
	TE 424	4.0*	1.0	200	100	1.5	0.6	800,000	0.9	0.002	5	12/6
	TE 524	4.0*	1.0	200	100	3.0	1.0	450,000	2.0	0.002	5	12/6
	TE 464 (P)	4.0*	1.1	200	100	3.0	1.5	2,000,000	2.5	0.001	5 or 7	12/6
	TE 444 (SD)	4.0*	1.1	200	33	0.35	0.25	3,000,000	3.0	0.003	7C	13/6
EVER-READY	A 50 A (P)	4.0*	1.0	200	100	3.0	1.2	2,200,000	2.3	0.002	5	17/6
GRAHAM-FARISH.	SG 2	2.0	0.15	150	80	—	—	250,000	1.0	0.002	4	12/6
	SX 2	2.0	0.2	150	80	—	—	330,000	1.5	0.002	4	12/6
	SWG 2	2.0	0.2	150	80	—	—	330,000	1.5	0.002	4[2]	13/6
	HP 2 (P)	2.0	0.15	150	70	—	—	—	1.2	—	7	13/6
HIVAC	XSG (Midget)	2.0	0.06	120	60	1.75	0.2	600,000	0.6	0.02	Special	15/6
	SG 215	2.0	0.15	150	70	2.0	0.75	250,000	1.1	0.002	4	10/6
	SG 220	2.0	0.2	150	70	2.25	0.6	333,000	1.5	0.002	4	10/6
	HP 215 (P)	2.0	0.15	150	70	1.5	0.3	500,000	1.2	0.004	4 or 7	10/6
	AC/SL	4.0*	1.0	200	80	2.4	0.3	225,000	3.3	0.002	5	13/6
	AC/SH	4.0*	1.0	200	80	4.5	0.5	800,000	3.5	0.002	5	13/6
	AC/HP (P)	4.0*	1.0	200	100	3.0	1.0	850,000	3.2	0.004	5 or 7	13/6
LISSEN	SG 215	2.0	0.15	150	60	1.5	0.25	900,000	1.1	0.001	4	12/6
	SP 2 (P)	2.0	0.1	150	80	2.5	0.6	500,000	1.0	0.001	7	13/6
	ACSG	4.0*	1.0	200	80	7.0	0.5	340,000	4.0	0.001	5	17/6
	ACSP (P)	4.0*	1.0	250	100	3.0	1.0	1,000,000	3.0	0.001	7	17/6
MARCONI and OSRAM.	S 23	2.0	0.1	150	70	1.4	0.8	300,000	1.1	0.006	4	12/6
	S 24	2.0	0.15	150	70	1.4	1.0	300,000	1.4	0.006	4	12/6
	MS 4	4.0*	1.0	200	70	2.4	0.3	500,000	1.1	0.002	5	17/6
	MS 4 B and Catkin	4.0*	1.0	200	80	3.4	1.2	350,000	3.2	0.002	5	17/6
	MSP 4 (P)	4.0*	1.0	200	100	3.0	1.0	1,000,000	4.0	0.01	5 or 7	17/6
MAZDA	SG 215	2.0	0.15	150	60	1.5	0.25	455,000	1.1	—	4	12/6
	S 215A	2.0	0.15	150	60	1.9	0.3	720,000	1.1	—	4	12/6
	S 215B	2.0	0.15	150	80	1.5	0.3	410,000	1.7	—	4	12/6
	SP 215 (P)	2.0	0.15	150	80	2.1	0.7	800,000	1.6	0.007	7	13/6
	ACS G	4.0*	1.0	200	60	4.5	0.8	895,000	1.9	—	5	17/6
	ACS 2	4.0*	1.0	200	80	7.0	0.8	600,000	5.0	—	5	17/6
	ACS 2 Pen (P)	4.0*	1.0	250	100	6.5	2.2	1,500,000	5.5	0.007	7	17/6
	SP 1320 (P)	13.0*	0.2	250	100	4.5	0.9	1,000,000	2.5	0.007	7	17/6
MULLARD	PM 12 A	2.0	0.18	135	90	2.0	0.4	400,000	1.3	0.008	4	12/6
	PM 12	2.0	0.15	135	75	4.0	1.0	180,000	1.1	0.008	4	12/6
	SP 2 (P)	2.0	0.18	135	135	3.0	1.25	—	1.9	0.01	7	13/6
	S 4 V A	4.0*	1.0	200	110	2.75	0.7	500,000	2.0	0.003	5	17/6
	S 4 V B	4.0*	1.0	200	110	3.0	0.7	450,000	2.0	0.003	5	17/6
	SP 4 (P)	4.0*	1.0	200	100	3.0	1.2	2,200,000	2.3	0.002	5 or 7	17/6
	SP 4 B (P)	4.0*	0.65	250	250	6.0	2.4	—	3.5	0.003	7	17/6
	SP 13C[3] (P)	13.0*	0.2	200	200	3.5	2.0	—	3.0	0.003	7	17/6
OSTAR-GANZ	S 25	100/250*	0.024	250	100	4.0	0.4	250,000	3.8	0.001	7	17/-
	S 100	100/250*	0.024	250	100	1.0	0.2	1,000,000	4.0	0.001	7	17/-
	H 3 (P)	100/250*	0.024	250	100	3.5	1.5	1,500,000	3.5	0.001	7	17/6
PIX	25	2.0	0.15	150	75	2.5	0.5	230,000	1.0	—	4	8/6
	450 AC	4.0*	1.0	200	100	3.5	0.75	200,000	3.0	—	5	10/6
362	SG-2	2.0	0.2	150	60	4.0	1.0	400,000	1.5	0.004	4	7/6
	ACSG 4	4.0*	1.0	250	40	4.0	1.0	400,000	2.5	0.0015	5	12/6
	ACHM 4 (P)	4.0*	1.0	250	100	10.0	4.0	—	2.5	0.004	5	13/-

SCREEN-GRID VALVES—(*Continued*)

Type.		Filament.		Normal Anode Volts.	Normal Screen Volts.	Anode Current (mA.).	Screen Current (mA.).	AC Resistance (Ohms).	Mutual Conductance (mA/V.).	Grid-Anode Capacity (mmfds.).	Pins in Base.	Price.
		Volts.	Amps.									
TRIOTRON ..	S 218 (P)	2.0	0.18	150	150	3.0	1.0	550,000	1.85	0.002	7	10/–
	S 210 (P)	2.0	0.05	135	135	2.6	1.0	1,000,000	0.8	0.001	7	10/–
	S 215	2.0	0.15	120	100	2.5	0.25	333,000	1.5	0.05	4	10/–
	S 435 N (P)	4.0*	1.1	200	100	3.0	0.5	1,450,000	3.5	0.002	5 or 7	12/6
	S 410 N	4.0*	1.0	200	100	4.0	0.5	400,000	1.0	0.02	5	12/6
	B 430 N (SD)	4.0*	1.0	200	33	0.35	0.25	3,333,000	3.0	0.003	7C	13/6
	S 1328 (P)	13.0*	0.2	200	100	3.0	1.0	1,500,000	3.0	0.002	7	12/6
	S 2035 N (P)	20.0*	0.18	200	100	3.0	0.25	1,450,000	3.5	0.002	5	12/6
TUNGSRAM ..	S 210	2.0	0.12	200	100	1.5	0.2	333,000	1.2	—	4	10/–
	SS 210	2.0	0.12	150	75	1.4	0.2	1,000,000	1.4	—	4	10/–
	HP 210 (P)	2.0	0.12	150	150	1.9	0.7	2,500,000	1.9	—	4 or 7	11/–
	AS 4120	4.0*	1.0	200	100	3.0	0.8	300,000	3.0	—	5	14/–
	HP 4101 (P)	4.0*	1.0	200	100	3.5	0.6	2,000,000	3.5	—	5 or 7	14/–
	HP 1018 (P)	10.0*	0.18	250	150	2.3	0.6	1,500,000	1.25	—	6C	14/–
	SP 13 (P)	13.0*	0.2	250	100	3.0	1.2	1,500,000	2.4	—	7	14/–
	HP 2018 (P)	20.0*	0.18	200	100	4.0	1.2	1,400,000	3.5	—	5 or 7	14/–

VARIABLE-MU VALVES

Type.		Filament.		A. Normal Anode Volts.	B. Normal Screen Volts.	Anode Current (mA.).	Screen Current (mA.).	AC Resistance at A, B & C (Ohms).	Max. Mutual Conductance for A, B & C (mA/V.).	Min. Mutual Conductance for A, B & D (mA/V.).	C. Min. Grid Bias.	D. Max. Grid Bias.	Grid-Anode Capacity (mmfds.).	Pins in Base.	Price.
		Volts.	Amps.												
BRIMAR ..	9 A1 (P)	4.0*	1.0	250	100	5.0	2.0	600,000	4.25	0.001	—1.5	—35.0	—	5	17/6
	9 A3 (P)	4.0*	0.65	250	125	10.0	3.0	600,000	1.8	0.001	—2.0	—40.0	—	7	17/6
	9 D2 (P)	13.0*	0.2	250	125	10.0	3.0	600,000	1.8	0.001	—2.0	—40.0	—	7	17/6
CLARION ..	VS 2	2.0	0.11	150	80	4.5	1.2	—	1.2	0.1	0	—15.0	—	4	3/9
	VHP 2 (P)	2.0	0.15	150	60	3.5	0.75	—	1.0	0.01	0	—10.0	—	7	4/6
	ACVS	4.0*	1.0	200	90	7.0	1.5	—	2.0	0.1	—1.5	—36.0	—	5	4/6
	ACV HP (P) ..	4.0*	1.0	200	100	4.5	1.5	—	2.2	0.05	—1.5	—18.0	—	7	6/6
	ADV HP (P) ..	20.0*	0.18	200	100	5.5	2.3	—	2.5	0.05	—1.5	—18.0	—	7	6/6
COSSOR ..	220 VS	2.0	0.2	150	80	1.6	—	400,000	1.6	0.06	0	— 9.0	—	4	12/6
	220 VSG	2.0	0.2	150	80	2.6	—	110,000	1.6	0.06	0	—15.0	—	4	12/6
	210 VPT (P) ..	2.0	0.1	150	80	2.9	0.75	600,000	1.1	0.06	0	— 9.0	—	4 or 7	13/6
	MVSG	4.0*	1.0	200	80	7.8	0.75	200,000	2.5	0.05	—1.5	—35.0	—	5	17/6
	MVS/Pen (P) ..	4.0*	1.0	200	100	4.2	1.3	600,000	3.0	0.03	—1.5	—20.0	—	5 or 7	17/6
	13 VPA	13.0*	0.2	200	100	9.0	2.2	800,000	1.8	0.03	0	—30.0	—	7	17/6
DARIO	PF 472 (P)	2.0	0.18	150	150	2.5	0.5	500,000	1.7	0.01	—0.5	—16.0	0.002	7	10/–
	TB 452	2.0	0.15	150	70	2.0	0.4	200,000	1.5	0.014	0	— 9.0	0.002	4	9/6
	TE 474 (P)	4.0*	1.1	200	100	4.5	2.0	1,000,000	2.0	0.02	—1.5	—30.0	0.001	5 or 7	12/6
	TE 554	4.0*	1.0	200	100	3.0	1.0	300,000	3.0	0.01	—2.0	—40.0	0.002	5	12/6
EVER-READY .	K 40 N	2.0	0.18	150	90	2.5	0.5	—	1.4	0.014	0	— 7.0	—	4	12/6
	K 50 M (P)	2.0	0.18	150	150	3.7	0.5	—	1.7	0.017	0	— 7.0	—	7	13/6
	A 50 N	4.0*	1.2	200	100	3.0	2.3	—	3.2	0.025	—1.5	—20.0	—	5 or 7	17/6
	C 50 N (P)	13.0*	0.2	200	200	9.5	2.7	—	2.0	—	—2.0	—30.0	—	7	17/6
FERRANTI ..	VPT 4 (P)	4.0*	1.0	200	100	5.5	2.0	1,000,000	2.0	0.01	—3.0	—28.0	0.002	5	17/6
	VPTA (P)	13.0*	0.2	250	100	4.2	2.0	1,000,000	2.0	0.01	—2.0	—28.0	0.002	7	17/6
GRAHAM-FARISH.	VS 2	2.0	0.15	—	—	—	—	110,000	1.0	0.075	0	—14.0	0.002	4	12/6
	VP 2 (P)	2.0	0.15	150	70	3.75	0.75	—	1.25	0.005	0	—	—	7	13/6
HIVAC	VS 215	2.0	0.2	150	75	6.0	1.5	110,000	1.0	0.075	0	—14.0	0.002	4	10/6
	VP 215 (P)	2.0	0.15	150	75	2.9	0.7	400,000	1.25	0.005	0	— 9.0	0.004	4 or 7	10/6
	AC/VS	4.0*	1.0	200	80	5.0	0.7	400,000	3.0	0.025	—1.5	—40.0	0.002	5	13/6
	AC/VP (P)	4.0*	1.0	200	100	6.0	2.0	1,000,000	3.0	0.004	—1.5	—30.0	0.004	5 or 7	13/6

VARIABLE-MU VALVES—(*Continued*)

Type		Filament. Volts.	Filament. Amps.	A. Normal Anode Volts.	B. Normal Screen Volts.	Anode Current (mA.).	Screen Current (mA.).	AC Resistance at A, B & C (Ohms).	Max. Mutual Conductance for A, B & C (mA/V.).	Min. Mutual Conductance for A, B & D (mA/V.).	C. Min. Grid Bias.	D. Max. Grid Bias	Grid-Anode Capacity (mmfds.).	Pins in Base.	Price.
LISSEN ..	SG 2 V	2.0	0.15	150	80	4.0	0.25	400,000	1.2	0.01	0	—10.0	0.001	4	12/6
	SP 2 V (P)	2.0	0.1	150	80	3.0	0.8	500,000	1.1	0.01	0	—10.0	0.001	7	13/6
	AVC 2 (SD)	2.0	0.15	150	100	2.0	0.5	500,000	1.0	—	0	—	0.1	4	17/6
	ACSGV	4.0*	1.0	200	80	6.0	0.5	300,000	4.0	0.01	—1.5	—20.0	0.001	5	17/6
	ACSPV (P) ..	4.0*	1.0	250	100	4.0	1.3	1,000,000	3.0	0.04	—1.5	—20.0	0.001	7	17/6
	ACAVC (SD) ..	4.0*	1.0	200	150	3.0	1.0	500,000	2.0	—	—1.5	—	0.1	5	20/-
MARCONI and OSRAM.	VS 24 and VS 24/K .	2.0	0.15	150	75	4.4	0.3	250,000	1.5	0.016	0	— 9.0	0.006	4	12/6
	VP 21 (P)	2.0	0.1	150	60	2.8	0.7	1,000,000	1.1	0.008	0	— 9.0	0.02	7	13/6
	VMS 4	4.0*	1.0	200	80	12.0	2.0	250,000	2.2	0.04	—0.5	—40.0	0.002	5	17/6
	VMS 4 (Catkin) ..	4.0*	1.0	200	80	10.0	2.0	250,000	2.6	0.03	—0.5	—30.0	0.002	5	17/6
	VMS 4 B	4.0*	1.0	200	80	6.7	1.3	250,000	2.9	0.04	—0.5	—15.0	0.002	5	17/6
	VMP 4 (P)	4.0*	1.0	200	100	5.5	1.6	1,000,000	3.5	0.004	—1.0	—30.0	0.01	5 or 7	17/6
	VMP 4 K (Catkin) (P)	4.0*	1.0	250	100	8.0	4.0	1,000,000	2.9	0.004	—0.5	—30.0	0.002	7	17/6
	VMP 4 G (P) ..	4.0*	1.0	250	100	8.0	5.0	1,000,000	2.7	0.01	—2.0	—20.0	0.0026	7	17/6
	WD 40 (DD) (P) ..	4.0*	1.0	250	100	7.7	4.7	1,000,000	2.6	0.03	—1.0	—30.0	0.004	9	20/-
	W 30 (Catkin) (P) ..	13.0*	0.3	250	250	12.0	6.0	1,000,000	4.0	0.01	—1.0	—30.0	0.002	7	17/6
	W 31 (P)	13.0*	0.3	250	100	8.0	5.0	1,000,000	2.7	0.01	—2.0	—20.0	0.0026	7	17/6
	WD 30 (DD) (P) ..	13.0*	0.3	250	100	7.7	4.7	1,000,000	2.6	0.03	—1.0	—30.0	0.004	9	20/-
MAZDA ..	S 215 VM	2.0	0.15	150	60	1.0	0.15	500,000	1.4	0.01	0	— 8.0	0.002	4	12/6
	VP 215 (P)	2.0	0.15	150	80	2.5	0.8	800,000	1.25	0.005	—1.5	—12.0	0.007	7	13/6
	ACS 1 VM	4.0*	1.0	200	75	5.7	1.0	545,000	1.1	0.005	—1.5	—40.0	0.001	5	17/6
	ACSG VM	4.0*	1.0	200	60	5.8	0.9	700,000	2.0	0.005	—2.0	—35.0	0.001	5	17/6
	ACVP 1 (P)	4.0*	0.65	250	250	8.8	2.2	1,000,000	2.0	0.01	—4.0	—43.0	0.003	7	17/6
	VP 1320 (P) ..	13.0*	0.2	250	100	5.0	1.25	2,000,000	2.0	0.01	—1.7	—23.0	0.005	7	17/6
	VP 1321 (P) ..	13.0*	0.2	250	250	8.8	2.2	1,000,000	2.0	0.01	—4.0	—43.0	0.003	7	17/6
MULLARD ..	PM 12 M	2.0	0.18	135	90	1.8	0.4	—	1.2	0.014	0	— 7.0	0.008	4	12/6
	VP 2 (P)	2.0	0.18	135	135	3.0	1.25	—	1.5	0.002	0	— 7.0	0.007	7	13/6
	MM 4 V	4.0*	1.0	200	110	6.0	0.8	—	2.5	0.01	—1.5	—40.0	0.003	5	17/6
	VM 4 V	4.0*	1.0	200	100	6.0	1.0	—	1.2	0.005	—1.5	—40.0	0.003	5	17/6
	VP 4 (P)	4.0*	1.0	200	100	5.0	2.4	—	2.1	0.002	—1.5	—40.0	0.0025	5 or 7	17/6
	VP 4 A (P)	4.0*	1.2	200	100	5.5	2.3	—	3.27	0.005	—1.5	—20.0	0.0025	5 or 7	17/6
	VP 4 B (P)	4.0*	0.65	250	250	11.5	4.25	—	2.0	0.002	—3.0	—40.0	0.0023	7	17/6
	VP 13 C (P) ..	13.0*	0.2	200	200	9.5	2.7	—	2.0	0.002	—2.0	—30.0	0.0023	7	17/6
	VP 13 A (P) ..	13.0*	0.2	200	100	4.5	1.5	—	2.2	0.005	—2.0	—20.0	0.003	SC	17/6
OSTAR-GANZ ..	MS 18	100/250*	0.024	250	100	5.0	4.0	500,000	3.0	—	—1.0	—20.0	—	7	17/-
	MS 70	100/250*	0.024	250	100	4.0	2.5	500,000	3.0	—	—2.0	—40.0	—	7	17/-
	V 3 (P)	100/250*	0.024	250	100	4.0	1.8	1,500,000	3.0	—	—1.3	—20.0	—	7	17/6
362	VS 2	2.0	0.2	150	60	3.0	1.0	500,000	1.2	0.1	0	—25.0	0.004	4	7/6
	VP 2 (P)	2.0	0.2	150	60	4.0	1.5	400,000	1.2	0.2	0	— 9.0	0.003	4 or 7	9/-
	ACVS 4	4.0*	1.0	250	50	6.0	2.0	400,000	2.0	0.1	—1.0	—40.0	0.0015	5	12/6
	ACVP 4 (P)	4.0*	1.0	250	100	6.0	2.0	400,000	3.0	0.2	—1.0	—20.0	0.001	7	13/-
	UVP (P)	6.5*	0.3	250	150	8.0	2.0	300,000	2.0	0.1	—1.0	—10.0	0.001	7	13/-
TRIOTRON ..	S 217 (P)	2.0	0.18	150	150	2.5	0.5	500,000	1.7	0.01	—0.5	—16.0	0.002	7	10/-
	S 209 (P)	2.0	0.05	135	135	2.0	0.6	1,000,000	0.65	0.002	—0.5	—15.0	0.002	7	10/-
	S 213	2.0	0.18	150	90	3.0	0.3	300,000	1.3	0.01	—0.5	—12.0	0.05	4	10/-
	S 434 N (P)	4.0*	1.1	200	100	5.5	0.01	600,000	3.5	0.01	—2.0	—35.0	0.002	5 or 7	12/6
	S 415 N	4.0*	1.1	200	100	6.0	1.0	300,000	1.2	0.001	—2.0	—40.0	0.003	5	12/6
	S 1323 (P)	13.0*	0.2	200	100	4.5	1.0	1,000,000	2.8	0.01	—2.0	—22.0	0.003	7	12/6
	S 2034 N (P) ..	20.0*	0.18	200	100	5.5	0.01	600,000	3.5	0.01	—2.0	—35.0	0.002	5	12/6
TUNGSRAM ..	HP 211 (P)	2.0	0.12	150	150	2.6	0.6	2,000,000	1.7	0.0015	0	— 7.0	—	4 or 7	11/-
	HP 4106 (P).. ..	4.0*	1.0	200	100	5.0	1.2	200,000	3.5	0.02	—2.0	—35.0	—	5 or 7	14/-
	HP 4115 (P).. ..	4.0*	1.1	200	100	4.3	1.5	1,000,000	3.2	0.005	—2.0	—25.0	—	5 or 7	14/-
	AS 4125	4.0*	1.2	200	100	3.0	0.8	250,000	3.0	0.05	—1.5	—24.0	—	5	14/-
	HP 1118 (P).. ..	10.0*	0.18	250	150	10.5	3.0	1,000,000	1.65	0.01	—3.0	—52.0	—	6C	14/-
	VP 13 (P)	13.0*	0.2	250	100	8.0	2.7	800,000	2.8	0.002	—	—	—	7	14/-
	HP 13 (P)	13.0*	0.2	200	100	8.0	2.9	—	3.5	0.02	—	—	—	7	14/-
	HP 2118 (P).. ..	20.0*	0.18	200	100	5.0	1.1	500,000	3.5	0.02	—2.0	—35.0	—	5 or 7	14/-

DIODES

Type.	Filament. Volts.	Filament. Amps.	Max. Input Volts (RMS.)	Max. Rect. Current per Diode (mA.).	No. of Diodes in Assembly.	Pins in Base.	Price.
CLARION .. .. .. ACD	4.0*	1.0	200	0.8	2	5	2/9
COSSOR .. .. .. 220 DD	2.0	0.2	—	—	2	5	5/6
DD 4	4.0*	0.75	—	—	2	5	5/6
DARIO .. .. .. TB 24	4.0*	0.65	200	0.8	2	5	4/6
EVER-READY .. .. A 20 B	4.0*	0.65	200	0.8	2	5	5/6
HIVAC .. .. .. ACDD	4.0*	1.0	—	—	2	5 or 7	4/6
MARCONI and OSRAM .. D 41	4.0*	0.3	25	0.13	2	5	5/6
MAZDA .. .. .. V 914	4.0*	0.3	—	1.0	2	5	5/6
DD 620	6.0*	0.2	—	1.0	2	5	5/6
MULLARD .. .. .. 2 D 4 A	4.0*	0.65	200	0.8	2	5	5/6
2 D 13 C[4]	13.0*	0.2	200	0.8	2	7	5/6
OSTAR-GANZ .. .. B 2	100/250*	0.024	200	15.0	2	7	15/9
TRIOTRON .. .. .. D 200	2.0	0.1	125	0.5	2	5	3/6
D 400	4.0*	0.65	200	0.8	2	5	4/6
D 1300	13.0*	0.2	200	0.8	2	5	4/6
TUNGSRAM .. .. D 418	4.0*	0.18	100	1.5	1	3	4/–
DD 465	4.0*	0.65	100	1.5	2	5	4/6
DD 4	4.0*	0.65	50	0.8	2	5	4/6
DD 818	8.0*	0.18	100	1.5	2	5	4/6
DD 13	13.0*	0.2	200	0.8	2	5	4/6
WESTINGHOUSE .. .. W 4 (M)	—	—	17.0	0.25	1	—	7/6
W 6 (M)	—	—	25.5	0.25	1	—	7/6
WM 24 (M)	—	—	17.0	0.25	2	—	10/–
WM 26 (M)	—	—	25.5	0.25	2	—	10/–
WX 6 (M)	—	—	25.5	0.12	1	—	7/6

TRIODE VALVES (AC Resistance greater than 7,000 ohms.)

Type.	Filament. Volts.	Filament. Amps.	A. Normal Anode Volts.	Anode Current for A & B (mA.).	At Zero Grid Volts and 100 v. HT: AC Resistance (Ohms).	Mutual Conductance (mA/V.).	Amplification Factor.	B. Grid Bias for A.	Pins in Base.	Price.
BRIMAR .. HLA 2	4.0*	1.0	200	6.0	9,000	5.5	50	—2.5	5	13/6
11 A 2 (DD)	4.0*	1.0	200	3.0	18,000	2.8	50	—2.0	7	15/6
11 D 3 (DD)	13.0*	0.2	250	0.8	84,000	1.2	100	—2.0	7	15/6
CLARION .. H 2	2.0	0.11	150	2.5	20,000	1.0	20	—1.5	4	1/9
HL 2	2.0	0.11	150	4.0	10,000	1.0	10	—4.5	4	1/9
ACHF	4.0*	1.0	200	3.0	14,000	2.5	35	—3.0	5	3/3
ADHF	20.0*	0.18	200	5.0	10,000	3.5	35	—3.0	5	3/3
COSSOR .. .. 210 RC	2.0	0.1	150	0.85	50,000	0.8	40	—1.5	4	5/6
210 HL	2.0	0.1	150	1.6	22,000	1.1	24	—3.0	4	5/6
210 HF	2.0	0.1	150	1.6	15,800	1.5	24	—3.0	4	5/6
210 DET	2.0	0.1	150	3.0	13,000	1.1	15	—4.5	4	5/6
210 LF	2.0	0.1	150	4.8	10,000	1.4	14	—4.5	4	5/6
41 MH	4.0*	1.0	200	3.2	18,000	4.0	72	—1.5	5	13/6
41 MHF	4.0*	1.0	200	3.0	14,500	2.8	41	—3.0	5	14/–
41 MHL	4.0*	1.0	200	4.0	11,500	4.5	52	—3.0	5	13/6
41 MLF	4.0*	1.0	180	9.0	7,950	1.9	15	—5.5	5	14/–
DDT (DD)	4.0*	1.0	200	3.0	17,000	2.4	41	—3.0	7	15/6
13 DHA (DD) ..	13.0*	0.2	250	1.0	83,300	1.5	125	—1.5	7	15/6

TRIODE VALVES—(*Continued*) (AC Resistance greater than 7,000 ohms.

Type		Filament.		A	Anode Current for A & B (mA.).	At Zero Grid Volts and 100 v. HT			B.	Pins in Base.	Price.
		Volts.	Amps.	Normal Anode Volts.		AC Resistance (Ohms).	Mutual Conductance (mA/V.).	Amplification Factor.	Grid Bias for A.		
DARIO	TB 282	2.0	0.1	150	2.0	23,000	1.3	28	—1.5	4	3/6
	TB 172	2.0	0.1	150	4.0	13,000	1.4	17	—4.5	4	3/6
	TB 102	2.0	0.1	150	5.0	8,000	1.25	10	—4.0	4	3/6
	TE 244	4.0*	1.0	200	6.0	10,000	2.4	24	—3.5	5	8/6
EVER-READY	K 30 A	2.0	0.1	150	1.5	22,500	0.8	18	—3.0	4	5/6
	K 30 C	2.0	0.1	150	2.0	20,000	1.4	28	—1.5	4	5/6
	K 30 B	2.0	0.1	150	4.0	12,000	0.9	11	—7.5	4	5/6
	K 30 D and K 30 E	2.0	0.1	150	4.0	12,000	1.5	18	—4.5	4	5/6
	K 23 B (DD)	2.0	0.12	150	1.4	26,000	1.2	31	—1.5	5	9/–
	A 30 B	4.0*	0.65	200	1.8	34,000	2.2	75	—2.0	5	13/6
	A 30 D	4.0*	0.65	200	4.0	12,500	3.2	40	—4.0	5	13/6
	A 23 A (DD)	4.0*	0.65	200	7.0	10,300	2.9	30	—3.5	7	15/6
	C 30 B	13.0*	0.2	200	4.0	12,500	3.2	40	—4.0	SC	13/6
FERRANTI	D 4	4.0*	1.0	200	4.0	12,500	3.3	41	—3.0	5	13/6
	H 4 D (DD)	4.0*	1.0	200	4.5	14,500	2.7	39	—3.0	7	15/6
	DA	13.0*	0.2	200	2.8	14,600	3.5	51	—3.0	7	13/6
	HAD (DD)	13.0*	0.2	200	2.5	17,600	2.9	51	—3.0	7	15/6
GRAHAM-FARISH.	DX 2	2.0	0.1	150	—	12,000	1.4	16	—	4	5/6
	LF 2	2.0	0.1	150	—	7,500	1.6	12	—	4	5/6
HIVAC	XD (Midget)	2.0	0.06	75	0.5	23,000	0.75	16	—1.5	Special	10/6
	XL (Midget)	2.0	0.06	75	1.5	14,000	0.85	12	—1.5	Special	10/6
	H 210	2.0	0.1	150	1.0	22,000	1.15	25	—3.0	4	3/9
	D 210	2.0	0.1	150	3.5	12,000	1.35	16	—3.0	4	3/9
	L 210	2.0	0.1	150	2.5	7,500	1.6	12	—6.0	4	3/9
	DDT 220 (DD)	2.0	0.2	150	3.0	12,500	1.6	20	—3.5	5	7/–
	ACHL	4.0*	1.0	200	5.0	10,000	3.5	35	—3.0	5	9/6
	ACDDT (DD)	4.0*	1.0	200	3.5	15,000	2.3	35	—3.0	7	12/6
LISSEN	H 2	2.0	0.1	150	1.0	45,000	1.1	50	—1.5	4	5/6
	HL 2	2.0	0.1	150	1.5	22,000	1.6	35	—3.0	4	5/6
	L 2	2.0	0.1	150	2.0	10,000	2.0	20	—4.5	4	5/6
	L 2 D (SD)	2.0	0.1	150	2.0	12,000	1.5	18	—4.5	5	10/6
	ACHL	4.0*	1.0	200	3.0	10,000	4.0	40	—4.5	5	13/6
MARCONI and OSRAM.	H 11	1.0	0.1	100	0.6	30,000	0.5	15	—2.0	Special	15/–
	L 11	1.0	0.1	100	2.8	12,500	0.4	5	—12.0	Special	15/–
	HL 2 and HL 2/K	2.0	0.1	150	1.8	18,000	1.5	27	—3.0	4	5/6
	L 21	2.0	0.1	150	2.2	8,900	1.8	16	—6.0	4	5/6
	HD 22 (DD)	2.0	0.2	150	2.0	18,000	1.5	27	—3.0	5	9/–
	MH 4 and Catkin	4.0*	1.0	200	4.5	11,000	3.6	40	—3.0	5	13/6
	MH 41	4.0*	1.0	200	5.0	13,300	6.0	80	—1.5	5	13/6
	MHL 4	4.0*	1.0	200	7.0	8,000	2.5	20	—6.0	5	13/6
	MHD 4 (DD)	4.0*	1.0	200	3.0	18,200	2.2	40	—3.0	7	15/6
	H 30	13.0*	0.3	250	5.5	13,300	6.0	80	—1.7	7	13/6
	DH 30 (DD)	13.0*	0.3	200	3.8	18,000	4.5	80	—1.7	7	15/6
MAZDA	H 2	2.0	0.1	150	2.5	59,000	0.8	47	0	4	5/6
	HL 2	2.0	0.1	150	2.7	21,000	1.5	32	—1.5	4	5/6
	L 2	2.0	0.1	150	5.3	10,000	1.9	19	—3.0	4	5/6
	L 2 DD (DD)	2.0	0.1	150	1.9	10,000	1.6	16	—6.0	5	9/–
	HL 21 DD (DD)	2.0	0.15	150	2.0	21,000	1.5	32	—2.0	5	9/–
	L 21 DD (DD)	2.0	0.15	150	2.3	10,000	1.9	19	—5.0	5	9/–
	AC HL	4.0*	1.0	200	5.0	11,700	3.0	35	—3.5	5	13/6
	AC 2 HL	4.0*	1.0	200	6.2	11,500	6.5	75	—1.5	5	13/6
	AC HLDD (DD)	4.0*	1.0	200	4.3	13,800	2.6	36	—3.0	7	15/6
	AC HL DDD (TD)	4.0*	1.0	200	4.9	13,000	2.7	35	—3.0	9	16/6
	HL 1320	13.0*	0.2	250	7.5	10,000	3.0	30	—4.5	7	13/6
	HL DD 1320 (DD)	13.0*	0.2	200	4.3	15,000	2.0	30	—3.0	7	15/6
MULLARD	PM 1 HF	2.0	0.1	135	1.5	22,500	0.8	18	—3.0	4	5/6
	PM 1 LF	2.0	0.1	135	3.25	12,000	0.9	11	—6.0	4	5/6
	PM 1 HL	2.0	0.1	135	2.0	20,000	1.4	28	—1.5	4	5/6
	PM 2 DX	2.0	0.1	135	2.0	12,000	1.5	18	—4.5	4	5/6
	PM 2 DL	2.0	0.1	135	2.0	12,000	1.5	18	—4.5	4	5/6

TRIODE VALVES—(*Continued*) (AC Resistance greater than 7,000 ohms.)

Type.		Filament.		A.	Anode Current for A & B (mA.).	At Zero Grid Volts and 100 v. HT			B.	Pins in Base.	Price.
		Volts.	Amps.	Normal Anode Volts.		AC Resistance (Ohms).	Mutual Conductance (mA/V.).	Amplification Factor.	Grid Bias for A.		
MULLARD—contd.	TDD 2 A (DD)	2.0	0.12	135	1.0	26,000	1.2	31	—1.5	5	9/-
	TDD 2 (DD)	2.0	0.1	135	2.0	12,000	1.4	16.5	—4.5	5	9/-
	904 V	4.0*	0.65	200	1.8	34,000	2.2	75	—2.0	5	13/6
	354 V	4.0*	0.65	200	4.0	12,500	3.2	40	—4.0	5	13/6
	244 V	4.0*	0.65	200	5.5	9,000	2.8	25	—5.5	5	13/6
	TDD 4 (DD)	4.0*	0.65	200	7.0	10,300	2.9	30	—3.5	7	15/6
	HL 13 C5	13.0*	0.2	200	4.0	12,500	3.2	40	—4.0	7	13/6
	TDD 13 C (DD)	13.0*	0.2	200	7.0	10,300	2.9	30	—3.5	7	15/6
OSTAR-GANZ	A 520	100/250*	0.024	250	4.0	8,800	2.5	22	—6.0	5 or 7	15/-
	D 130	100/250*	0.024	250	2.0	40,000	3.5	100	—1.0	7	15/9
	BA 1 (SD)	150/250*	0.024	250	2.0	40,000	2.5	100	—1.0	7	18/3
	BA 5 (SD)	150*	0.024	250	4.0	10,000	2.5	25	—6.0	7	18/3
PIX	2	2.0	0.1	150	1.5	20,000	1.0	20	—4.0	4	2/6
	3	2.0	0.1	150	3.4	12,000	0.9	11	—7.5	4	2/6
	4	2.0	0.1	150	1.0	37,000	0.9	33	—1.0	4	2/6
	90 AC	4.0*	1.0	200	3.0	23,000	1.7	40	—1.5	5	8/6
	100 AC	4.0*	1.0	200	5.0	7,500	2.0	15	—6.0	5	9/6
362	H 2	2.0	0.1	150	2.0	32,000	1.0	32	—1.5	4	3/6
	HL 2	2.0	0.1	150	3.0	16,000	1.5	24	—3.0	4	3/6
	L 2	2.0	0.1	150	4.0	12,000	1.2	15	—4.5	4	3/6
	ACHL 4	4.0*	1.0	250	5.0	10,000	3.3	33	—5.0	5	7/6
	ACHL 4 dd (DD)	4.0*	1.0	250	7.0	16,000	2.5	38	—3.0	7	9/-
	UHL	6.5*	0.3	250	6.0	16,000	2.0	32	—4.0	5	7/6
	UH dd (DD)	6.5*	0.3	250	5.0	20,000	2.0	40	—3.0	7	9/-
TRIOTRON	W 213	2.0	0.1	150	1.0	24,000	1.2	28	—2.0	4	3/6
	HD 2	2.0	0.08	200	5.0	15,000	1.0	15	—5.0	4	3/6
	SD 2	2.0	0.1	200	7.0	12,000	1.5	18	—5.0	4	3/6
	A 214	2.0	0.1	150	4.0	10,000	1.4	14	—4.0	4	3/6
	TD 2	2.0	0.08	150	7.0	10,000	0.9	9	—7.0	4	3/6
	A 440 N	4.0*	1.0	200	0.2	30,000	4.0	120	—1.5	5	8/6
	A 2040 N	20.0*	0.18	200	0.2	30,000	4.0	120	—1.5	5	8/6
TUNGSRAM	HR 210	2.0	0.1	200	2.0	23,000	1.3	30	—1.5	4	3/9
	LD 210	2.0	0.1	150	3.0	14,000	1.3	18	—3.0	4	3/9
	DDT 2 (DD)	2.0	0.1	150	1.4	21,400	1.4	30	—3.0	7	7/-
	AR 4101	4.0*	1.0	200	3.0	13,500	3.0	40	—2.5	5	10/6
	HL 4	4.0*	1.0	200	4.0	11,500	3.5	40	—3.0	5	10/6
	DDT 4 (DD)	4.0*	1.2	200	4.0	15,000	3.6	30	—	7	12/6
	HL 13	13.0*	0.2	200	4.0	12,000	3.5	42	—3.0	7	10/6
	R 2018	20.0*	0.18	200	2.5	13,300	3.0	40	—2.5	5	10/6

TRIODE VALVES (AC Resistance less than 7,000 ohms.)

Type.		Filament.		A.	B.	C.	Max. Anode Watts.	At Zero Grid Bias and 100 Volts HT		D.	E.	F.	Pins in Base.	Price.
		Volts.	Amps.	Normal Anode Volts.	Anode Current (mA.).	Grid Bias (for A).		AC Resistance (Ohms).	Mutual Conductance (mA/V.).	Optimum Load (for A, B & C) (Ohms).	Power Output (for A, B, C & D) (Milliwatts).	Bias Resistance (for A, B & C) (Ohms).		
BRIMAR	PA 1	4.0*	1.0	200	40.0	— 10.5	10.0	1,050	12.0	4,000	1,250	260	5	16/6
CLARION	LP 2	2.0	0.11	150	8.0	— 9.0	—	5,500	1.1	12,000	75	—	4	1/9
	P 2	2.0	0.22	150	12.0	— 18.0	—	2,850	1.4	7,500	200	—	4	2/6
	PX 2	2.0	0.22	150	22.0	— 22.0	—	1,850	1.5	5,000	400	—	4	2/6
	ACG	4.0*	1.0	200	8.0	— 7.5	—	6,000	2.7	12,000	200	1,000	5	3/3
	ACL	4.0*	1.0	200	18.0	— 12.0	—	3,000	3.0	7,000	500	700	5	3/3
	ACP	4.0	1.0	200	19.0	— 21.0	—	2,000	3.0	4,500	700	1,100	4	4/-
	ADG	20.0*	0.18	200	10.0	— 10.0	—	5,700	3.5	10,000	275	1,000	5	3/3
	ADL	20.0*	0.18	200	20.0	— 13.0	—	2,750	3.0	5,000	550	650	5	3/3

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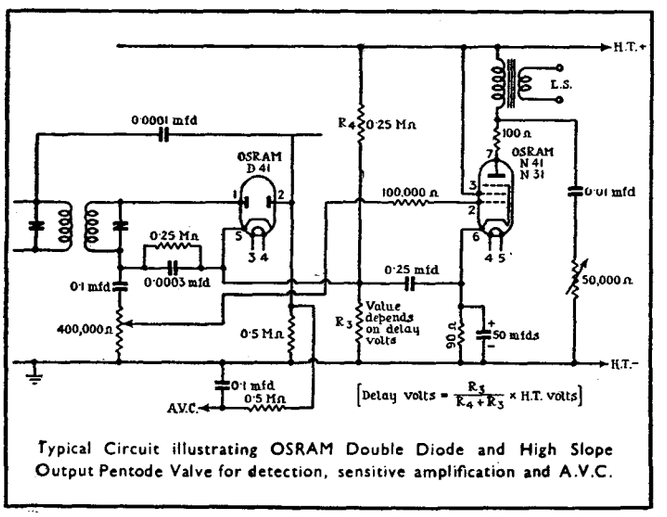

Typical Circuit illustrating OSRAM Double Diode and High Slope Output Pentode Valve for detection, sensitive amplification and A.V.C.

HEATER CHARACTERISTICS

	D41	DN41	MHD4	DH30	WD40	WD30
Heater Volts	4.0	4.0	4.0	13.0	4.0	13.0
Heater Current	0.3 amp	2.3 amps	1.0 amp	0.3 amp	1.0 amp	0.3 amp
Price each:	**5/6**	**21/-**	**15/6**	**15/6**	**20/-**	**20/-**

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Where adequate signal voltage is available, a diode such as the OSRAM D41 is the ideal Detector as it provides practically perfect undistorted detection. The double diode facilitates also supply of D.C. voltage for Automatic Volume Control. In addition, the advantages of Diode Detection are available in combination with amplifying valves as follow:

TYPE DN41

A Double Diode-High Slope Output Pentode to combine Detection, A.V.C., and sensitive High Power Output.

TYPE MHD4

A Double Diode-Triode Valve to combine Detection, A.V.C., and audio frequency amplification.

(Type DH30 for DC—AC, and Car Radio)

TYPE WD40

A Double Diode-Screen Pentode to combine Detection, A.V.C., and H.F. or I.F. amplification, or high gain audio frequency amplification.

(Type WD30 for DC—AC, and Car Radio)

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

TRIODE VALVES—(*Continued*) (AC Resistance less than 7,000 ohms.)

Type.		Filament.		A.	B.	C.		At Zero Grid Bias and 100 Volts HT		D.	E.	F.		
		Volts.	Amps.	Normal Anode Volts.	Anode Current (mA.).	Grid Bias (for A).	Max. Anode Watts.	AC Resistance (Ohms).	Mutual Conductance (mA/V.).	Optimum Load (for A, B & C) (Ohms).	Power Output (for A, B, C & D) (Milliwatts).	Bias Resistance (for A, B & C) (Ohms).	Pins in Base.	Price.
COSSOR ..	215 P..	2.0	0.15	150	10.0	— 7.5	1.5	4,000	2.25	9,000	150	—	4	7/-
	220 P..	2.0	0.2	150	11.0	— 7.5	1.65	4,000	2.25	9,000	190	—	4	7/-
	220 PA	2.0	0.2	150	10.0	— 4.5	1.5	4,000	4.0	9,000	180	—	4	7/-
	230 XP	2.0	0.3	150	22.0	— 18.0	3.3	1,500	3.0	3,500	450	—	4	12/-
	41 MP	4.0*	1.0	200	24.0	— 7.5	4.8	2,500	7.5	3,000	1,250	320	5	14/-
	41 MXP	4.0*	1.0	200	40.0	— 12.5	8.0	1,500	7.5	2,500	2,000	300	5	16/6
	4 XP	4.0	1.0	250	48.0	— 28.5	12.0	900	7.0	3,000	—	600	4	16/6
	680 XP	6.0	0.8	400	25.0	—125.0	10.0	2,750	1.1	5,700	2,500	5,000	4	25/-
	620 T..	6.0	2.0	400	62.5	— 95.0	25.0	1,300	2.3	4,000	5,000	1,500	4	30/-
	660 T..	6.0	4.5	500	120.0	—120.0	60.0	900	2.3	2,400	11,000	1,000	4	105/-
DARIO	TB 062	2.0	0.18	150	13.0	— 10.5	—	3,000	2.0	3,500	350	—	4	4/6
	TB 122	2.0	0.2	150	6.0	— 4.5	—	3,600	3.5	7,000	150	—	4	4/6
	TB 052	2.0	0.15	150	7.0	— 15.0	—	4,200	1.2	10,000	200	—	4	4/6
	TB 032	2.0	0.19	150	12.0	— 30.0	—	2,000	1.5	6,000	450	—	4	4/6
	TE 094	4.0*	1.0	200	12.0	— 16.0	—	7,000	1.3	7,000	600	850	5	8/6
EVER-READY .	K 30 G	2.0	0.2	150	6.0	— 7.0	—	3,600	3.5	7,000	150	—	4	7/-
	S 30 C	4.0	1.0	250	48.0	— 29.0	12.0	950	6.8	2,500	2,700	600	4	16/6
FERRANTI ..	L 2	2.0	0.1	150	6.5	— 6.0	—	6,800	1.6	13,600	150	—	4	7/-
	LP 4	4.0	1.0	250	48.0	— 36.0	12.0	870	5.4	2,500	2,500	750	4	16/6
GRAHAM-FARISH.	LP 2	2.0	0.15	150	8.0	— 12.0	—	3,600	2.2	10,000	150	—	4	7/-
	MP 2	2.0	0.2	150	12.5	— 12.0	—	2,300	3.0	5,000	—	—	4	12/-
	XP 2	2.0	0.3	150	17.5	— 15.0	—	1,850	3.5	4,000	450	—	4	12/-
HIVAC	XP (Midget).. ..	2.0	0.06	75	4.0	— 4.5	—	5,000	1.0	10,000	—	—	Special	12/6
	P 220..	2.0	0.2	150	6.0	— 6.0	—	4,700	3.0	9,000	175	—	4	5/6
	PP 220	2.0	0.2	150	12.5	— 12.0	—	2,300	3.0	5,000	250	—	4	6/6
	PX 230	2.0	0.3	150	17.5	— 15.0	—	1,850	3.5	4,000	450	—	4	7/6
	AC/L	4.0*	1.0	200	18.0	— 14.0	—	2,350	4.25	6,300	675	780	5	12/6
LISSEN	LP 2	2.0	0.2	150	9.0	— 6.0	1.5	3,500	3.5	9,000	200	—	4	8/9
	P 220..	2.0	0.2	150	7.6	— 13.5	1.5	4,000	1.75	10,000	160	—	4	7/3
	PX 240	2.0	0.4	200	25.0	— 32.0	5.0	1,500	3.0	5,000	800	—	4	8/-
MARCONI and OSRAM.	LP 2	2.0	0.2	150	11.5	— 4.5	—	3,900	3.85	7,000	150	—	4	7/-
	P 2	2.0	0.2	150	19.0	— 10.5	—	2,150	3.5	4,500	300	—	4	12/-
	ML 4	4.0*	1.0	200	20.0	— 9.0	5.0	2,860	4.2	7,000	500	400	5	14/-
	PX 4	4.0	1.0	250	48.0	— 34.0	12.0	830	6.0	3,200	2,500	750	4	16/6
	PX 25	4.0	2.0	400	62.5	— 31.0	25.0	1,265	7.5	3,200	5,500	530	4	25/-
	PX 25 A	4.0	2.0	400	62.5	—100.0	25.0	580	6.9	{4,800 {2,800†	{8,400 {32,000†}	1,600	4	25/-
	DA 30	4.0	2.0	500	60.0	—134.0	30.0	580	6.9	3,400†	44,000†	—	4	30/-
	DA 60	6.0	4.0	500	120.0	—135.0	60.0	835	3.0	3,000	10,000	1,150	Special	110/-
MAZDA ..	P 220..	2.0	0.2	150	5.5	— 7.0	—	3,700	3.4	10,000	180	—	4	7/-
	P 220 A	2.0	0.2	150	15.0	— 14.0	—	1,850	3.5	4,100	350	—	4	12/-
	AC P	4.0*	1.0	200	17.0	— 13.5	—	2,650	3.75	6,000	650	800	5	14/-
	AC P 1	4.0*	1.0	200	24.0	— 28.0	—	1,450	3.7	5,000	1,000	1,200	5	16/6
	PP 3/250	4.0	1.0	250	40.0	— 30.0	12.0	1,000	6.5	2,300	2,800	715	4	16/6
	PP 5/400	4.0	2.0	400	62.5	— 32.0	25.0	1,500	6.0	2,700	5,900	510	4	25/-
	PP 3521	35.0*	0.2	200	70.0	— 25.0	15.0	660	9.0	3,000†	5,500†	360	7	16/6
MULLARD ..	PM 2	2.0	0.2	135	6.0	— 10.5	—	4,400	1.7	9,000	150	—	4	7/-
	PM 2 A	2.0	0.2	135	5.0	— 6.0	—	3,600	3.5	7,000	150	—	4	7/-
	PM 202	2.0	0.2	135	14.0	— 10.5	—	2,000	3.5	3,700	350	—	4	12/-
	104 V	4.0*	1.0	200	17.0	— 12.0	4.0	3,000	4.0	6,000	550	550	5	14/-
	AC 044	4.0	1.0	250	48.0	— 29.0	12.0	950	6.8	2,500	2,700	600	4	16/6
	DO 24	4.0	2.0	400	63.0	— 34.0	25.0	1,390	6.5	4,000	5,500	540	4	25/-
	DO 26	4.0	2.0	400	63.0	— 92.0	25.0	600	6.3	4,000	7,500	1,500	4	25/-
	DO 25	6.6	1.1	400	63.0	—112.0	25.0	800	3.75	4,000	7,000	1,780	4	30/-
	MZ05-60	6.0	1.65	500	120.0	— 95.0	60.0	925	3.25	1,500	10,000	790	Special	110/-
	MZ1-75	10.0	1.1	1,000	75.0	— 80.0	75.0	2,500	4.0	8,000	20,000	1,050	Special	160/-

TRIODE VALVES—(*Continued*) AC Resistance less than 7,000 ohms.

Type	Filament. Volts.	Filament. Amps.	A. Normal Anode Volts.	B. Anode Current (mA.).	C. Grid Bias (for A).	Max. Anode Watts.	At Zero Grid Bias and 100 Volts HT: AC Resistance (Ohms).	At Zero Grid Bias and 100 Volts HT: Mutual Conductance (mA/V.).	D. Optimum Load (for A, B & C) (Ohms).	E. Power Output (for A, B, C & D) (Milliwatts).	F. Bias Resistance (for A, B & C) (Ohms).	Pins in Base.	Price.
OSTAR-GANZ .. U 920	100/250*	0.024	300	7.0	— 7.0	6.0	3,700	3.0	10,000	750	1,000	5	15/-
L 1525	100/250*	0.024	300	20.0	— 20.0	6.0	1,850	3.0	5,000	900	1,000	5	15/6
K 3560	100/250*	0.024	220	50.0	— 50.0	10.0	500	6.0	1,200	4,000	1,000	5	23/-
K 2050	100/250*	0.024	300	40.0	— 40.0	10.0	1,000	5.0	1,800	3,500	1,000	5	23/-
PIX 20	2.0	0.15	150	5.0	— 5.0	—	4,600	1.2	8,000	150	—	4	4/6
120	2.0	0.2	150	12.0	— 12.0	—	3,900	1.8	6,000	200	—	4	6/6
230	2.0	0.3	150	18.0	— 20.0	—	2,300	3.0	4,000	300	—	4	10/6
362 .. .. LP 2	2.0	0.2	200	8.0	— 9.0	2.0	5,000	3.0	10,000	500	—	4	4/-
P 2	2.0	0.2	200	13.0	— 15.0	3.0	3,000	3.0	6,000	900	—	4	4/6
ACPX 4	4.0*	1.0	250	30.0	— 18.0	12.0	2,000	4.0	3,000	2,500	600	5	9/-
ACPX 4a	4.0	1.0	250	50.0	— 25.0	15.0	1,200	5.0	2,500	3,000	500	4	9/-
PX 25	4.0	2.0	400	65.0	— 50.0	30.0	1,000	6.0	3,000	7,000	800	4	30/-
PX 50	6.0	2.0	500	100.0	— 70.0	60.0	800	6.0	7,500	13,000	800	Special	50/-
PX 100	6.0	3.0	1,000	100.0	—140.0	100.0	1,000	6.0	7,000	35,000	1,400	Special	100/-
CLP	6.5*	0.6	250	27.0	— 20.0	8.0	2,000	4.0	3,000	1,500	700	5	9/-
ULP	13.0*	0.3	250	27.0	— 20.0	8.0	2,000	4.0	3,000	1,500	700	5	9/-
UPX	25.0*	0.3	250	38.0	— 34.0	9.5	800	7.0	3,500	3,000	900	5	13/-
TRIOTRON .. ZD 2	2.0	0.15	150	10.0	— 15.0	2.0	5,000	1.0	13,000	150	—	4	4/6
UD 2	2.0	0.22	150	15.0	— 15.0	3.0	2,700	2.0	5,000	500	—	4	4/6
E 235	2.0	0.33	200	18.0	— 12.0	4.0	3,600	3.0	8,000	550	—	4	4/6
E 430 N	4.0*	1.0	200	15.0	— 15.0	3.0	3,000	3.0	10,000	350	1,000	5	8/6
K 435/10	4.0	0.65	250	40.0	— 40.0	10.0	1,000	3.5	1,500	2,500	1,000	4	12/6
K 480	4.0	2.0	550	45.0	— 36.0	25.0	2,500	8.0	3,000	5,000	800	4	22/6
K 450/50	4.0	3.0	400	120.0	— 50.0	50.0	1,250	5.0	1,500	12,000	500	4	45/-
TUNGSRAM .. P 215	2.0	0.15	150	10.0	— 9.0	—	3,300	1.5	7,000	260	—	4	4/9
SP 220	2.0	0.2	150	15.0	— 15.0	—	2,200	3.0	6,700	360	—	4	4/9
LP 220	2.0	0.2	150	5.0	— 4.5	—	3,900	3.5	7,500	200	—	4	—
O-15/400	4.0	1.0	450	40.0	— 37.0	18.0	1,600	5.0	6,000	3,500	900	4	14/-
P 25/400	6.0	1.1	400	70.0	—112.0	25.0	800	3.75	4,000	7,000	1,500	4	20/-
P 60/500	6.0	4.0	600	110.0	—110.0	60.0	1,000	3.5	2,600	15,000	1,000	Special	88/-
OQ 70/1000	10.0	1.5	1,000	75.0	— 22.0	75.0	5,000	5.0	10,000	18,000	300	Special	—
OP 70/1000	10.0	1.5	1,000	60.0	— 75.0	75.0	2,200	4.5	7,000	18,000	1,250	Special	128/-
O-40/1000	10.0	1.0	1,000	50.0	— 90.0	40.0	2,800	3.0	7,000	8,500	1,800	Special	84/-
O-75/1000	10.0	3.0	1,250	60.0	— 80.0	75.0	2,800	5.0	9,200	19,700	1,300	Special	128/-
P 2018	20.0*	0.18	200	20.0	— 18.0	50.0	2,500	4.0	5,000	900	—	5	13/-

OUTPUT PENTODE VALVES

Type.	Filament. Volts.	Filament. Amps.	A. Normal Anode Volts.	B. Normal Screen Volts.	C. Anode Current (mA.).	D. Screen Current (mA.).	E. Grid Bias (for A & B).	F. Optimum Load (for A, B, C, D & E) (Ohms).	Max. Undistorted Output (for A, B, C, D, E & F) (Milliwatts).	Bias Resistance (for A, B, C, D & E) (Ohms).	Max. Anode Watts.	Pins in Base.	Price.
BRIMAR .. .. Pen B 1	2.0	0.2	150	150	8.0	1.8	— 4.5	18,000	500	—	—	5	13/6
Pen A 1	4.0	1.0	250	250	32.0	7.0	—16.0	8,000	2,850	450	8.0	5	18/6
7 A 2	4.0*	1.2	250	250	32.0	8.0	—17.0	8,000	3,200	330	8.0	7	18/6
7 A 3	4.0*	2.0	250	250	32.0	8.0	— 6.0	8,500	4,000	140	8.0	7	18/6
7 D 8	13.0*	0.2	250	250	32.0	8.0	— 6.0	8,500	4,000	140	8.0	7	18/6
7 D 6	40.0*	0.2	250	250	32.0	8.0	— 6.0	8,500	4,000	140	8.0	7	18/6
7 D 3	40.0*	0.2	150	150	40.0	10.0	—22.5	3,750	2,500	450	6.0	7	18/6
CLARION .. PN 2	2.0	0.22	150	150	6.0	0.75	— 7.5	18,000	500	—	—	5	3/9
ACPN	4.0*	1.0	250	200	22.0	8.0	—12.0	9,000	2,000	400	—	5	4/6
ADPN	20.0*	0.18	250	200	22.0	8.0	—15.0	9,000	2,200	500	—	5	4/6

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FERRANTI
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OUTPUT PENTODE VALVES—(*Continued*)

Type		Filament		A	B.	C.	D.	E.	F.	Max. Undistorted Output	Bias Resistance	Max.	Pins	Price.
		Volts.	Amps.	Normal Anode Volts.	Normal Screen Volts.	Anode Current (mA.).	Screen Current (mA.).	Grid Bias (for A & B).	Optimum Load (for A, B, C, D & E) (Ohms).	(for A, B, C, D, E & F) (Milli-watts).	(for A, B, C, D & E) (Ohms).	Anode Watts.	in Base.	
COSSOR	230 PT	2.0	0.3	150	150	14.0	3.0	—15.0	10,000	1 000	—	—	4 or 5	16/6
	220 PT	2.0	0.2	150	150	19.0	4.0	— 9.0	7,500	1,000	—	—	4 or 5	13/6
	220 HPT	2.0	0.2	150	150	8.0	1.5	— 4.5	17,000	500	—	—	4 or 5	13/6
	MP/Pen	4.0*	1.0	250	250	30.0	6.0	—16.0	10,000	3,500	450	8.0	5 or 7	18/6
	42 MP/Pen ..	4.0*	2.0	250	250	32.0	6.0	— 5.5	8,000	3,100	140	8.0	7	18/6
	PT 41	4.0	1.0	250	200	30.0	6.0	—12.5	8,000	2,600	350	7.5	5	18/6
	PT 41 B	4.0	1.0	400	300	30.0	6.0	—40.0	8,000	3,600	1,200	12.0	5	22/6
	40 PPA	40.0*	0.2	150	150	36.0	6.0	—25.0	4,000	2,300	570	8.0	7	18/6
DARIO	TC 432	2.0	0.2	150	150	9.5	2.0	— 4.5	15,000	420	—	2.5	4 or 5	10/–
	TE 434	4.0	1.1	250	250	36.0	7.0	—14.0	8,000	3,400	325	9.0	5	12/6
	TE 534	4.0*	1.1	250	250	24.0	7.0	—15.0	10,000	2,500	500	6.0	5	12/6
	TE 634	4.0*	1.35	250	250	36.0	9.0	—22.0	8,000	3,400	500	9.0	7	12/6
EVER-READY ..	K 70 B	2.0	0.2	150	150	9.5	2.5	— 4.5	15,000	425	—	—	5	13/6
	A 70 C	4.0*	1.95	250	250	32.0	—	— 5.8	8,000	3,800	145	8.0	7	18/6
	C 70 D	35.0*	0.2	250	250	32.0	—	—11.0	7,000	3,200	165	8.0	7	18/6
FERRANTI ..	PT 4 D (DD) ..	4.0*	2.0	250	250	32.0	7.0	— 6.0	6,500	3,500	140	8.0	7	21/–
	PTA	13.0*	0.3	250	250	32.0	5.0	—10.0	6,500	2,500	270	8.0	7	18/6
	PTZ	40.0*	0.2	200	200	40.0	7.0	— 5.5	6,000	3,500	120	8.0	7	18/6
GRAHAM-FARISH.	PT 2	2.0	0.2	150	150	11.5	—	— 4.5	12,000	500	—	—	5	13/6
	PP 2	2.0	0.2	150	150	18.0	—	— 9.0	7,600	750	—	—	5	13/6
HIVAC	XY (Midget) ..	2.0	0.12	75	75	2.0	—	— 3.0	25,000	—	—	—	Special	15/6
	Y 220 (Harries) ..	2.0	0.2	150	150	10.0	1.8	— 4.5	12,000	500	—	3.5	5	10/6
	Z 220 (Harries) ..	2.0	0.2	150	150	18.0	4.0	— 9.0	7,600	750	—	5.5	5	10/6
	ACY (Harries) ..	4.0*	1.0	250	250	32.0	4.3	—10.0	7,500	3,400	230	8.0	5 or 7	15/6
	ACZ (Harries) ..	4.0*	2.0	250	250	32.0	4.3	— 5.5	6,600	3,200	150	8.0	5 or 7	15/6
LISSEN	PT 225	2.0	0.2	150	150	8.0	2.0	— 6.0	18,700	400	—	1.5	4	12/6
	PT 2 A	2.0	0.2	150	150	18.0	3.0	—10.5	8,500	1,100	—	3.0	4	12/6
	PT 250	2.0	0.5	250	250	40.0	7.0	—15.0	7,000	2,500	—	10.0	5	16/–
	ACPT	4.0*	1.25	250	200	31.0	4.0	— 8.0	7,500	3,000	240	7.5	5 or 7	18/6
MARCONI and OSRAM.	PT 2 and PT 2/K ..	2.0	0.2	150	150	9.5	1.9	— 4.5	20,000	500	—	—	5	13/6
	PT 4	4.0	1.0	250	250	32.0	8.0	—16.0	7,500	2,500	420	8.0	5	18/6
	MPT 4	4.0*	1.0	250	200	32.0	5.0	—11.0	8,000	2,200	300	8.0	5 or 7	18/6
	MPT 4 (Catkin) ..	4.0*	1.0	250	250	32.0	6.0	—13.0	8,500	3,200	340	8.0	5 or 7	18/6
	N 41	4.0*	2.0	250	250	32.0	8.0	— 3.5	7,800	3,500	90	8.0	7	18/6
	DN 41 (DD) ..	4.0*	2.3	250	250	32.0	8.0	— 3.5	7,800	3,500	90	8.0	7	21/–
	PT 25	4.0	2.0	400	200	62.5	10.6	—22.0	6,000	10,000	330	25.0	5	45/–
	PT 25 H	4.0	2.0	400	400	62.5	12.5	—16.0	5,000	10,000	250	25.0	5	45/–
	N 30 (Catkin) and N 30 G	13.0*	0.3	250	250	32.0	8.0	—15.0	7,500	3,200	375	8.0	7	18/6
	N 31[6]	26.0*	0.3	200	180	40.0	10.6	— 4.4	5,500	2,500	87	8.0	7	18/6
MAZDA	Pen 220	2.0	0.2	150	150	9.0	1.6	— 4.5	14,000	600	—	—	5	16/6
	Pen 220 A	2.0	0.2	150	150	18.0	3.0	— 9.0	6,000	1,100	—	—	5	16/6
	AC/Pen	4.0*	1.0	250	250	32.0	5.0	—15.5	7,500	3,400	400	8.0	5 or 7	18/6
	AC 2/Pen	4.0*	1.75	250	250	32.0	6.0	— 5.3	6,700	3,500	140	8.0	7	18/6
	AC 2/Pen DD (DD)	4.0*	2.0	250	250	32.0	6.0	— 5.3	6,700	3,500	140	8.0	7	21/–
	Pen 1340	13.0*	0.4	240	240	41.0	8.0	— 8.6	5,500	4,000	175	—	7	18/6
	Pen DD 1360 (DD) .	13.0*	0.6	250	250	32.0	6.0	— 5.3	6,700	3,500	140	—	7	21/–
	Pen 3520	35.0*	0.2	250	250	53.0	9.0	—10.0	4,400	4,600	165	—	7	18/6
	Pen DD 4020 (DD) .	40.0*	0.2	250	250	43.0	8.5	— 7.75	5,000	4,100	165	—	7	21/–
MULLARD ..	PM 22 A	2.0	0.2	135	135	6.0	1.4	— 4.5	15,000	425	—	—	4 or 5	13/6
	PM 22	2.0	0.3	135	135	13.0	3.5	— 9.0	8,000	600	—	—	4 or 5	16/6
	PM 22 C	2.0	0.3	135	135	23.0	—	—16.0	5,000	1,450	—	—	5	13/6
	Pen 4 VA	4.0*	1.5	250	250	32.0	—	—22.0	8,000	3,400	500	8.0	5 or 7	18/6
	Pen 4 VB	4.0*	1.95	250	250	32.0	—	— 5.8	8,000	3,800	145	8.0	7	18/6

OUTPUT PENTODE VALVES—(*Continued*)

Type		Filament. Volts.	Filament. Amps.	A. Normal Anode Volts.	B. Normal Screen Volts.	C. Anode Current (mA.).	D. Screen Current (mA.).	E. Grid Bias (for A & B).	F. Optimum Load (for A, B, C, D, E & F) (Milli-watts).	Max. Undistorted Output (for A, B, C, D & E) (Ohms).	Bias Resistance (for A, B, C, D & E) (Ohms).	Max. Anode Watts.	Pins in Base.	Price.
	PM 24 M	4.0	1.0	250	250	30.0	7.0	—18.0	8,000	3,000	500	8.0	5	18/6
	PM 24 D	4.0	2.0	500	200	50.0	9.0	—35.0	7,000	10,000	750	25.0	5	45/-
	Pen 13 C	13.0*	0.5	250	250	32.0	—	—11.0	6,400	3,600	250	8.0	7	18/6
	Pen 26	24.0*	0.2	200	100	40.0	—	—19.0	9,000	3,500	420	8.0	SC	18/6
	Pen 36 C	35.0*	0.2	200	200	40.0	—	— 9.0	4,000	3,250	165	8.0	7	18/6
OSTAR-GANZ	PT 3	100,250*	0.024	250	250	20.0	4.0	—16.0	10,000	2,000	1,000	6.0	7	17/6
	M.43	100,250*	0.037	250	250	40.0	8.0	—24.0	6,600	3,500	500	8.0	7	18/6
362	ME 2	2.0	0.2	200	200	13.0	4.0	—12.0	7,000	1,000	—	3.0	5	10/-
	ME 2a	2.0	0.2	200	200	13.0	4.0	—12.0	7,000	1,000	—	3.0	4	10/-
	ACME 4	4.0*	1.0	250	250	26.0	12.0	—16.0	5,000	3,000	200	12.0	5	13/-
	ACME 4b	4.0	1.0	250	250	42.0	12.0	—22.0	3,000	3,500	400	15.0	4 or 5	13/-
	ACME 4c	4.0*	2.0	250	250	49.0	19.0	—16.0	3,000	3,500	400	15.0	7	13/-
	ME 25	4.0	2.0	400	400	60.0	19.0	—40.0	6,000	9,000	700	25.0	5	20/-
	CME	6.5*	0.6	250	250	32.0	9.0	—17.0	4,000	2,500	400	8.0	7	13/-
	UME	13.0*	0.3	250	250	32.0	9.0	—17.0	4,000	2,500	400	8.0	7	13/-
TRIOTRON	P 225	2.0	0.2	150	150	8.0	2.0	— 4.5	15,000	500	—	3.0	4 or 5	10/6
	P 215	2.0	0.25	150	150	15.0	2.0	—15.0	10,000	500	—	3.0	4 or 5	10/6
	P 435	4.0	1.1	250	250	45.0	5.0	—15.0	7,000	2,800	400	9.0	5	13/6
	P 440	4.0	2.0	550	200	45.0	10.0	—40.0	7,000	7,000	730	25.0	5	30/-
	P 440 N	4.0*	1.1	250	250	24.0	5.0	—15.0	7,500	2,000	500	6.0	5 or 7	12/6
	P 441 N	4.0*	1.35	250	250	36.0	3.2	—22.0	9,000	2,800	540	9.0	7	13/6
	P 495	4.0*	1.5	250	250	32.0	3.0	— 6.0	8,000	3,500	175	9.0	7	13/6
	P 2460	24.0*	0.18	200	100	40.0	5.0	—19.0	7,500	3,500	400	9.0	5	13/6
	P 2060	24.0*	0.2	200	100	40.0	5.0	—19.0	7,000	3,500	400	9.0	7	13/6
TUNGSRAM	PP 222	2.0	0.22	150	150	6.0	2.0	— 6.0	14,000	600	—	—	4 or 5	10/-
	PP 230	2.0	0.3	150	150	12.0	2.5	—16.0	11,000	600	—	—	4 or 5	10/-
	PP 4101	4.0	1.1	250	250	36.0	7.0	—22.0	7,500	2,500	600	9.0	5	14/9
	APP 4120	4.0*	1.2	250	250	34.0	6.5	—18.0	7,500	3,400	500	10.0	5 or 7	14/9
	APP 4b	4.0*	1.5	250	250	32.0	6.0	— 5.0	6,500	3,400	140	—	7	14/9
	PP 2018	20.0*	0.18	200	200	20.0	5.0	—18.0	8,800	1,400	750	7.5	5	14/9
	PP 35	35.0	0.2	200	200	40.0	8.0	— 8.0	4,500	3,000	150	—	7	14/9
	PP 4118	40.0*	0.18	180	180	35.0	7.0	—10.0	5,000	3,000	250	7.5	6C	14/9

QUIESCENT OUTPUT VALVES

Type		Filament. Volts.	Filament. Amps	A. Normal Anode Volts.	Quiescent Anode Current (Total) (mA.).	Anode Current under Average Signal Conditions (mA.).	Input Impedance (Grid to Grid) (Ohms)	B Grid Bias (for A).	Optimum Load Resistance (Ohms) (for A & B) (Anode to Anode).	C. Recommended Driver Valve.	Recommended Driver Trs. Ratio with (C) (Whole Primary to Whole Secondary).	Power Output (for A) (Milli-watts).	Pins in Base.	Price.
CLARION	B 22 (B)	2.0	0.22	150	1.3	5.0	9,000	0	13,000	HL 2	1.5—1	1 200	7	4/6
	B 24 (B)	2.0	0.44	150	1.8	7.0	7,200	0	9,000	LP 2	1.5—1	2,000	7	5/6
COSSOR	220 B (B)	2.0	0.2	120	2.5	6.0	3,000	0	12,000	210 LF	1.7—1	1,100	7	14/-
	240 B (B)	2.0	0.4	120	3.0	8.5	2,500	0	8,000	215 P	1.5—1	2,000	7	14/-
DARIO	TB 402 (B)	2.0	0.2	150	3.0	6.0	4,000	0	14,500	TB 172	1.5—1	1,500	7	10/6
EVER-READY	K 77 A (Q)	2.0	0.5	150	4.0	—	—	—13.5	16,000	—	—	1,400	9	22/6
	K 33 A (B)	2.0	0.2	150	3.0	—	3,000	0	14,000	K 30 E	—	1,250	7	14/-
	K 33 B (B)	2.0	0.2	150	3.0	—	3,000	— 4.5	14,000	K 30 E	—	1,250	7	14/-

QUIESCENT OUTPUT VALVES—(*Continued*)

Type.		Filament.		A.	Quiescent Anode Current (Total) (mA.).	Anode Current under Average Signal Conditions (mA.).	Input Impedance (Grid to Grid) (Ohms).	B.	Optimum Load Resistance (Ohms) (for A & B) (Anode to Anode).	C.	Recommended Driver Trs. Ratio with (C) (Whole Primary to Whole Secondary).	Power Output (for A) (Milliwatts).	Pins in Base.	Price.
		Volts.	Amps.	Normal Anode Volts.				Grid Bias (for A).		Recommended Driver Valve.				
GRAHAM-FARISH.	QP 2 (Q)	2.0	0.4	150	8.0	—	—	—	14,500	—	—	1,400	7	22/6
HIVAC	B 230 (B)	2.0	0.3	150	2.5	5.5	4,000	0	14,500	L 210	1.5—1	1,250	7	10/6
	DB 240 .. .. (B	2.0	0.4	150	2.5	5.5	4,000	0	14,500	—	1.5—1	1,250	7	15/6
	(B + D) .. .. (D			150	—	3.0	—	— 4.5	—	—	—	—		
	QP 240 (Q) ..	2.0	0.4	150	8.0	12.0	—	—18.0	14,500	—	—	1,400	7	19/6
LISSEN	BB 240 (B)	2.0	0.4	150	5.4	7.0	9,000	0	8,000	LP 2	1—1	3,500	7	14/-
	BB 240 A (B) ..	2.0	0.4	150	5.0	7.0	8,000	— 3.0	8,000	LP 2	1—1	3,500	7	14/-
	BB 220 A (B) ..	2.0	0.2	150	4.0	5.0	8,000	— 3.0	10,000	L 2	1—1	2,500	7	14/-
	QP 240 (Q) ..	2.0	0.4	150	4.0	5.0	—	—15.0	22,000	—	—	1,500	7	22/6
MARCONI and OSRAM.	B 21 (B)	2.0	0.2	150	2.2	7.5	36,000	— 6.0	12,000	L 21	1 5—1	2,000	7	14/-
	QP 21 (Q)	2.0	0.4	150	3.0	6.0	—	— 9.0	24,000	—	—	1,200	7	22/6
MAZDA	PD 220 (B)	2.0	0.2	150	0.8	7.0	3,300	— 1.15	11,500	P 220	1.5—1	2,850	7	14/-
	PD 220 A (B) ..	2.0	0.2	150	2.3	7.5	7,400	— 6.0	10,000	P 220	1.2—1	2,900	7	14/-
	QP 240 (Q)	2.0	0.4	150	3.8	6.0	—	—10.3	16,000	—	—	2,000	9	22/6
MULLARD ..	PM 2 B (B) ..	2.0	0.2	135	3.0	4.2	4,000	0	14,000	PM 2 DL	1.5—1	1,450	7	14/-
	PM 2 BA (B) ..	2.0	0.2	135	3.0	3.8	4,000	— 4.5	14,000	PM 2 DL	1.5—1	1,450	7	14/-
	QP 22 A (Q) ..	2.0	0.5	135	2.5	4.0	—	—12.0	16,000	—	—	2,000	9	22/6
362	BA 2 (B)	2.0	0.2	150	1.5	6.0	10,000	0	10,000	L 2	1.5—1	1,500	7	9/-
	BX 2 (B)	2.0	0.4	180	2.5	10.0	6,000	0	7,000	LP 2	1—1	3,000	7	9/-
	DB (B)	25.0*	0.3	250	20.0	40.0	—	0	10,000	ULP	—	5,000	7	20/-
TRIOTRON ..	E 220 B	2.0	0.3	150	3.0	7.0	6,500	0	18,000	YD 2	1—1.5	1,350	7	9/6
TUNGSRAM ..	CB 220 (B) ..	2.0	0.2	150	2.5	7.0	4,000	0	16,000	LP 220	1.5—1	2,000	7	11/-

RECTIFYING VALVES

Type.		Filament.		Type of Rectification.	Max. Anode Volts (RMS).	Max. DC Output.		DC Output at Half Current.		Pins in Base.	Price.
		Volts.	Amps.			Volts.	mA.	Volts.	mA.		
BRIMAR	R 1	4.0*	1.0	Full-wave	250—0—250	260	60	290	30	4	12/6
	R 2	4.0*	2.25	Full-wave	350—0—350	360	120	410	60	4	15/-
	R 3	4.0*	2.25	Full-wave	500—0—500	610	120	640	60	4	20/-
	1 A 7	4.0*	2.25	Full-wave	350—0—350	360	120	410	60	4	15/-
	1 D 5	40.0*	0.2	Half-wave	250	265	75	300	37.5	5	12/6
CLARION ..	UF 4	4.0	1.0	Full-wave	250—0—250	240	60	275	30	4	3/6
	UH 4	4.0	1.0	Half-wave	250	235	40	285	20	4	3/6
COSSOR	506 BU	4.0	1.0	Full-wave	250—0—250	230	60	270	30	4	12/6
	442 BU	4.0	2.5	Full-wave	350—0—350	350	120	400	60	4	15/-
	460 BU	4.0	2.5	Full-wave	500—0—500	520	120	600	60	4	20/-
	40 SUA	40.0*	0.2	Half-wave	250	210	75	280	37.5	5	12/6
DARIO	SW 1	4.0	1.0	Half-wave	400	400	60	450	30	4	6/6
	FW 1	4.0	1.0	Full-wave	250—0—250	245	60	280	30	4	7/6
	FW 2	4.0	1.0	Full-wave	350—0—350	320	120	370	60	4	9/6
	FW 3	4.0	2.0	Full-wave	500—0—500	500	120	570	60	4	12/-
	IFW 1	4.0*	2.0	Full-wave	500—0—500	500	120	570	60	4	12/-
EVER-READY ..	A 11 B	4.0*	2.4	Full-wave	350—0—350	395	120	418	60	4	15/-
	C 10 B	20.0*	0.2	Half-wave	250	210	75	265	37.5	5	12/6

RECTIFYING VALVES—(*Continued*)

Type.		Filament.		Type of Rectification.	Max. Anode Volts (RMS).	Max. DC Output.		DC Output at Half Current.		Pins in Base.	Price.
		Volts.	Amps.			Volts.	mA.	Volts.	mA.		
FERRANTI	R 4	4.0	2.5	Full-wave	350—0—350	275	120	350	60	4	15/-
	R 4 A	4.0	2.5	Full-wave	500—0—500	475	120	550	60	4	20/-
	RA	13.0*	0.3	Full-wave	250—0—250	290	50	325	25	5	12/6
	RZ	20.0*	0.2	Half-wave	250	230	75	290	37.5	5	12/6
HIVAC	UU 60/250	4.0*	1.25	Full-wave	300—0—300	310	75	355	37.5	4	8/6
	UU 120/350	4.0*	2.5	Full-wave	350—0—350	325	120	380	60	4	10/6
	UU 120/500	4.0*	2.5	Full-wave	500—0—500	530	120	610	60	4	15/-
LISSEN	UU 41	4.0	1.0	Full-wave	300—0—300	330	80	360	40	4	12/6
	UU 42	4.0	2.5	Full-wave	350—0—350	320	120	370	60	4	15/-
	UU 43	4.0	2.5	Full-wave	500—0—500	500	120	550	60	4	20/-
MARCONI and OSRAM.	U 10	4.0	1.0	Full-wave	250—0—250	260	60	300	30	4	12/6
	U 12	4.0	2.5	Full-wave	350—0—350	325	120	380	60	4	15/-
	U 14	4.0	2.5	Full-wave	500—0—500	540	120	620	60	4	20/-
	MU 12	4.0*	2.5	Full-wave	350—0—350	340	120	410	60	4	15/-
	MU 14	4.0*	2.5	Full-wave	500—0—500	540	120	600	60	4	20/-
	U 30	26.0*	0.3	Half-wave	180	136	120	175	75	7	15/-
				Voltage Doubler	220	425	75	480	45		
	GU 1	4.0	3.0	Half-wave Mercury Vapour.	1,000	1,100	250	1,150	125	4	25/-
MAZDA	UU 3	4.0*	2.0	Full-wave	250—0—250	253	60	290	30	4	12/6
	UU 120/350	4.0	2.5	Full-wave	350—0—350	355	120	380	60	4	15/-
	UU 120/500	4.0	2.5	Full-wave	500—0—500	575	120	610	60	4	20/-
	U 4020	40.0*	0.2	Half-wave	250	260	75	300	37.5	5	12/6
	MU 1	4.0	2.5	Half-wave Mercury Vapour.	1,000	—	250	—	—	4	25/-
MULLARD	I W 2	4.0*	1.2	Full-wave	250—0—250	220	60	260	30	4	12/6
	DW 2	4.0	1.0	Full-wave	250—0—250	250	60	275	30	4	12/6
	I W 3	4.0*	2.4	Full-wave	350—0—350	395	120	418	60	4	15/-
	DW 3	4.0	2.0	Full-wave	350—0—350	350	120	375	60	4	15/-
	I W 4	4.0*	2.4	Full-wave	500—0—500	550	120	600	60	4	20/-
	DW 4	4.0	2.0	Full-wave	500—0—500	500	120	575	60	4	20/-
	R 21—150	4.0	4.0	Full-wave	1,000—0—1,000	1,100	150	1,200	75	4	60/-
	UR 107	20.0*	0.2	Half-wave	250	210	75	265	37.5	5	12/6
	UR 3	30.0*	0.2	Full-wave	250—0—250	270	120	310	60	SC	15/-
OSTAR-GANZ	EG 50	100/250*	0.024	Half-wave	300	250	50	—	—	4 or 7	10/9
	EG 100	100/250*	0.024	Half-wave	300	200	120	—	—	4 or 7	13/6
	NG 100	200/250*	0.044	2 x Half-wave	300	200	100	—	—	7	21/9
	NG 50	200/250*	0.024	2 x Half-wave	300	250	50	—	—	7	20/9
PHILIPS	1881	4.0*	1.2	Full-wave	250—0—250	250	60	285	30	4	12/6
	1881 A	4.0*	2.4	Full-wave	250—0—250	250	60	290	30	4	12/6
	1867	4.0*	2.4	Full-wave	350—0—350	350	120	395	60	4	15/-
	1861	4.0*	2.4	Full-wave	500—0—500	500	120	590	60	4	20/-
	1821	4.0	1.0	Full-wave	250—0—250	250	60	280	30	4	12/6
	1807	4.0	2.0	Full-wave	350—0—350	350	120	390	60	4	15/-
	1561	4.0	2.0	Full-wave	500—0—500	500	120	585	60	4	20/-
PIX	40/250	4.0	0.6	Full-wave	250—0—250	230	40	260	20	4	6/6
	500	4.0	1.0	Full-wave	350—0—350	320	60	370	30	4	6/6
	120/500	4.0	2.0	Full-wave	500—0—500	500	120	570	60	4	12/6
362	RB 41	4.0	1.0	Full-wave	300—0—300	300	60	330	25	4	7/6
	RB 42	4.0	2.0	Full-wave	500—0—500	500	120	550	50	4	10/-
	RB 650/250	4.0	4.0	Full-wave	650—0—650	650	250	710	125	4	15/-
TRIOTRON	G 470	4.0	1.0	Full-wave	350—0—350	350	75	385	35	4	7/6
	G 4110	4.0	2.0	Full-wave	350—0—350	350	120	325	60	4	10/6
	G 4120	4.0	2.0	Full-wave	500—0—500	500	120	580	60	4	12/6
	G 4120 N	4.0	2.5	Full-wave	500—0—500	500	120	580	60	4	12/6
	G 4100	4.0	2.0	Half-wave	750	775	100	850	50	4	14/6

RECTIFYING VALVES—(*Continued*)

Type.		Filament.		Type of Rectification.	Max. Anode Volts (RMS).	Max. DC Output.		DC Output at Half Current.		Pins in Base.	Price.
		Volts.	Amps.			Volts.	mA.	Volts.	mA.		
TRIOTRON—contd.	G 2080	20.0*	0.2	Half-wave	250	250	80	270	40	4	9/6
	G 3060	30.0*	0.2	2 x Half-wave	2 x 125	125	120	250	60	7	10/6
	G 3412	33.0*	0.18	2 x Half-wave	2 x 125	125	120	250	60	7	10/6
TUNGSRAM ..	APV 4200	4.0*	2.0	Full-wave	350—0—350	350	120	380	60	4	12/–
	PV 4201	4.0	2.0	Full-wave	600—0—600	575	180	660	90	4	15/–
	V 2118	20.0*	0.18	Half-wave	250	250	75	270	35	5	10/–
	PV 3018	30.0*	0.18	Voltage Doubler	250	240	100	260	50	6C	10/–

METAL RECTIFIERS

Type.		Capacity (mfd.) of Voltage Doubling Condensers, 50 c/s Mains.	Peak Voltage Rating of Condensers (Working).	Type of Rectifier.	Max. Input Voltage (RMS).	Max. DC Output Unsmoothed.		Half-Current Output.		Price.
						Volts.	mA.	Volts.	mA.	
WESTINGHOUSE ..	HT 5	4 + 4	200	Full-wave, Voltage Doubler Half-wave	80 135	140	20	170	10	12/6
	HT 8	4 + 4	350	Full-wave, Voltage Doubler Half-wave	200 375	280	60	440	30	18/6
	HT 9	4 + 4	400	Full-wave, Voltage Doubler	240	330	60	515	30	21/–
	HT 10	8 + 8	250	Full-wave, Voltage Doubler Half-wave	150 250	225	100	350	50	21/–
	HT 11	6 + 6	500	Full-wave, Voltage Doubler	300	460	150	620	75	35/–
	HT 12	4 + 4	200	Full-wave, Voltage Doubler Half-wave	140 250	260	30	315	15	17/6
	HT 13	8 mfds. Reservoir	350	Half-wave	150	150	25	170	12	17/6

BARRETTERS

Type.		Normal Current (Amps.).	Range of Volts dropped across Barretter.	Pins in Base.	Price.
MARCONI and OSRAM ..	251	0.25	100—180	4	12/6
	301	0.3	138—221	Edison Screw	12/6
	302	0.3	112—195	Edison Screw	12/6
	303	0.3	86—129	Edison Screw	12/6
	304	0.3	95—165	Edison Screw	12/6
PHILIPS	1904	0.1	40—70	4	12/6
	1933	0.1	50—160	4	15/–
	1927	0.18	60—120	4	12/6
	1928	0.18	100—210	4	15/–
	C 2	0.2	40—100	SC	12/6
	C 1	0.2	90—230	4 or SC	10/–
	1920	0.25	40—70	4	12/6
	1934	0.25	85—195	4	15/–
	1941	0.3	100—240	4	15/–

REFERENCES.

[1] Also Type FC 13 with side-contact base.
[2] Top grid.
[3] Also Type SP 13 with side-contact base.
[4] Also Type 2 D 13A with side-contact base.
[5] Also Type HL 13 with side-contact base.
[6] Also available with 13 volts 0.6 ampere heater.
[7] Also Type UR 1 with side-contact base.

† Per pair in push-pull.
* Indirectly heated.
(M) Metal Rectifier.
(P) HF Pentode.
(SD) Single Diode.
(DD) Duo-diode.
(TD) Triple-diode
(B) Class "B."
(Q) QPP.
C Continental type base.
SC Side-contact base.

Valve Data Supplement (concluded from page ii)—the valve is much more critical in the matching to the loud speaker, and if undue accentuation of the high notes is to be avoided a tone-correction circuit is necessary. Although high-quality reproduction can be obtained with a pentode, it is more difficult than with a triode, and the latter is usually selected where quality is of prime importance. The pentode, however, is invaluable in the smaller class of receiver where sensitivity and cost are at least as important as quality.

In the case of receivers of the Universal type and those intended for operation from DC mains, the fact that a pentode requires a much smaller grid bias than a triode is of great importance.

It will be noted that columns are included for the self-bias resistance in both triode and pentode output valve sections. The watts rating of the resistance can be found by multiplying the resistance (in ohms) by the square of the sum of the screen and anode currents (in mA.) and dividing the result by 1,000,000.

Quiescent Output Valves

Development in battery valves has resulted in the production of a new range of output types combining large output with extreme economy of power drawn from the HT battery. The Class "B" valve is really two triodes mounted in the same bulb and operated in push-pull. It is worked with zero or only a small negative bias, and grid current flows during a large portion of the cycle of input voltage.

As regards the output circuit, matching to the loud speaker is obtained with a transformer, the ratio of which must be calculated in the same manner as for other output valves. It is, however, important that the component used should be of suitable type with a low DC resistance and a small value of leakage inductance. Since the characteristics of Class "B" valves are similar to those of pentodes, it will usually be found that a resistance-capacity tone-correction circuit across the primary of the output transformer is needed to avoid undue stressing of the upper register.

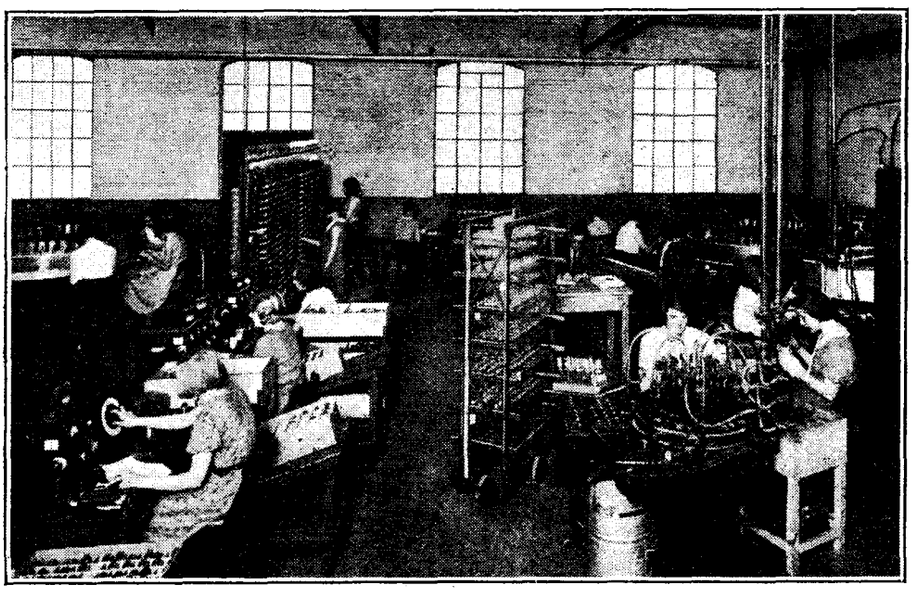
BY OPENING THE WIRE STITCHES IN THE CENTRE OF THE JOURNAL THE COMPLETE VALVE DATA SUPPLEMENT CAN BE REMOVED AND KEPT AS A HANDY REFERENCE LIST

Because of the grid current flow, the Class "B" valve has a low input impedance, and it is usually necessary to feed it from the preceding LF, or driver, valve through a step-down transformer. The ratio can be calculated by dividing the load required by the driver valve by the grid-to-grid input impedance of the Class "B" valve and taking the square root of the result.

In a few cases it will be found that this leads to a step-up ratio instead of the usual step-down, and it should be noted that the figures for transformer ratio in the columns are arranged to show this automatically. In every case the first figure refers to the primary; thus, 2-1 ratio means that the primary has twice as many turns as the secondary and that the transformer is of the step-down type. A ratio of 1-2, however, means that the primary has one-half the secondary turns and the transformer is of the step-up type.

Class "B" working is primarily intended for the battery user, and it does not go happily with mains operation as far as the smaller class of valve is concerned.

Class "B" amplification has a serious rival in the QPP valve; this consists of two pentodes built into the same bulb and operated in push-pull with a large grid bias so that the quiescent anode current is small. The requirements of the output circuit are not dissimilar to those of a Class "B" stage, but as grid current is not permitted, the input circuit can be of any standard push-pull type and it is customary to employ a transformer of high step-up ratio.



A corner of the Ediswan works where Mazda valves are made. On the left can be seen the testing gear with an ageing rack in the background.

Rectifying Valves

Little need be said about the rectifier for the HT supply in an AC receiver, since the questions arising are well known. It may be remarked, however, that indirectly heated cathode types are now common among the specimens rated for the higher voltages and that they are well worth consideration. By their use it is possible to avoid the necessity for including a thermal delay switch in order to ease the strain on the smoothing condensers. The figures given for output assume in all cases the use of a 4 mfd. reservoir condenser and this should in general be rated for working at not less than 1.4 times the RMS AC input voltage. Thus, the condenser used with a 500-volts transformer should be rated for at least 700 volts working.

Many new types of rectifier with high heater voltages are to be found and these are intended for use in Universal type sets in which the valve heaters are series-connected and no mains transformer is employed. Many of them are of the half-wave type, but some contain two anodes and two separate cathodes. These valves can be used as two separate half-wave rectifiers, as a full-wave rectifier, or a voltage doubler on AC supplies only.

Metal Rectifiers

In the case of metal rectifiers, the data given is essentially the same as that for valves, but columns are included giving also the capacity and working voltage of the condensers to be included in the voltage doubling circuit. These capacities, it should be noted, are for 50 c/s mains, and where the supply is of different frequency they must be appropriately altered. With 100 c/s mains the condensers must each be one-half the listed capacity and with 25 c/s double.

A glance through the supplement will show that no distinction has been made between AC and DC types of indirectly heated valve. Any such distinction would be rather artificial, and, in general, it may be taken that indirectly heated valves rated for 4 volts are intended by their makers for AC operation, and that all other voltages are primarily AC/DC mains valves. In the case of the latter, the usual ratings are for currents of 0.2 ampere or 0.3 ampere, but certain types of valves are rated at 0.18 ampere. The standard voltage for most types is 13 volts, but this is often exceeded in the case of output valves, and then alternatives with a 13-volts heater, but a heavier current consumption, are available for car receivers.

BROADCAST BREVITIES

BY OUR SPECIAL CORRESPONDENT

Television on Top

ONE of the television systems now installed at the Alexandra Palace is giving much better results than the other.

However, providing one of the systems works well Mr. Gerald Cock, the television chief, will be quite happy, for he will be able to proceed with those ambitious plans for making the tail wag the dog.

Last week he made it clear that ordinary broadcasting would ultimately take second place.

"Showrooms"

Meanwhile many obstacles lie in the way of establishing that chain of demonstration rooms which Mr. Cock would like to have within a twenty-five mile radius of the Alexandra Palace. I understand that when transmission tests begin in February next one television "showroom" may be opened in the neighbourhood of Broadcasting House.

Cable is So Expensive

At the outset practically all television transmission will be by ultra-short wave, though there will be about 1,000 feet of high-frequency cable for "shooting" scenes in the Alexandra Palace grounds.

The Post Office engineers are working hard already to find ways of cheapening this co-axial cable, which at present costs about £1,000 per mile.

Costly Pleasure

If Manchester wished to enjoy the Alexandra Palace tests the cable alone would cost about £180,000—the figure which the original Television Committee estimated would maintain the whole service until the end of 1936.

B.B.C. Buys the Gear

That the B.B.C. will give both the Baird and E.M.I. systems a good innings can be judged from the fact that the apparatus is being bought outright. The old 30-line gear at Broadcasting House was rented.

If the Ullswater Committee should recommend another £750,000 grant to the B.B.C. out of the licence funds, this would not be too much to operate the television service until the end of the year.

Expenses in the initial stages are proving to be enormous; people at the Alexandra Palace are beginning to wonder whether the Television Committee, in recommending the £180,000 grant, was looking through the wrong end of the telescope.

Christmas Programmes

CHRISTMAS broadcasting plans are already "in the air." This year there is to be a reversal of producers' duties. Felix Felton will handle the Christmas Day broadcasts, while Laurence Gilliam will deal with the New Year programme.

Reminiscences

In the latter case it should be *programmes*, as the reminiscences will be divided into two parts. On New Year's Eve there will be, from 11 to 12, a Town and Country feature, consisting of music and speech from the cities and shires, winding up at 11.45 with a service in St. Paul's Cathedral. This will be followed by the chimes of Big Ben, and scenes on the steps of the Cathedral and outside the Tron Church, Edinburgh.

"Memories"

But the real "memories" programmes will not be heard until January 12th. This will consist of electrical recordings of the past year's activities interspersed with dramatised scenes in the studio.

To enable him to perfect his schemes, Mr. Gilliam, like other producers, is being granted a term of semi-retirement

On Christmas Day

The Christmas Day programme will bear the title: "This Great Family" — a quotation from His Majesty's broadcast of last year. As in previous years, the programme will comprise items from various points in the home country and the Empire, though this time there may be fewer relays.

Probably there will be five home and five Empire transmissions arranged alternately, the total length of the feature being half an hour.

It is hoped to establish a family or occupational link between home and Empire. For instance, a chat by an English farmer may be followed by the remarks of a farmer in Canada.

Seasonable Items

The B.B.C. appears to be exercising more artistic restraint. Even Christmas Day does not now, as in previous years, altogether upset the carefully proportioned broadcasting day. This year there are enough, but not too many, Christmas items.

MODERNISING THE D.C. PANEL. Two new dramatic control panels which have just been installed in Berlin Broadcasting House. The sliding controls greatly facilitate the handling of multiple studio outputs by one man. Economy of space is another great advantage.

Carols from Cambridge

Ushering in the Yuletide broadcasts will be "The Stranger at St. Hilary's," a Cornish mystery play by Father Bernard Walke, which Filson Young is producing on Monday, December 23rd. As usual, carols will come from King's College, Cambridge, on the afternoon of Christmas Eve, and the B.B.C. Military Band will accompany the choir of St. Mary's, Whitechapel, in Christmas carols in the evening.

"Scrooge"

It is hoped that Seymour Hicks will take the name part in "Scrooge," to be broadcast on Boxing Day. A great Pickwick programme is scheduled for January 2nd.

Announcer's Oversight

EDINBURGH B.B.C. studios provided a minor thrill to the technically minded last week. In an interval between musical selections the voice of the announcer was strangely muffled. An attack of asthma? Failure of the ventilation system. Strangulation by microphone leads? None of these. The announcer, who was seated in a corner by himself, had forgotten to switch in his own mike. Result: listeners were hearing him *via* the orchestra microphones in the centre of the studio.

London Revisited

MAX BEERBOHM, the great caricaturist, whose retiring ways have given his name a legendary flavour, is one of the B.B.C.'s biggest "catches" of the Christmas season. He is to be heard in a talk on "London Revisited" on December 29th. "Max" has lived at Rapallo, Italy, for the last fifteen years, but his memories will take us back to the London of the nineteenth century.

A Snooker Commentary

CHESS and draughts must now be the only pastimes which have not bent the knee to the broadcast commentator. Billiards has already capitulated, and now the brazen eye of the microphone man is to roam the snooker table.

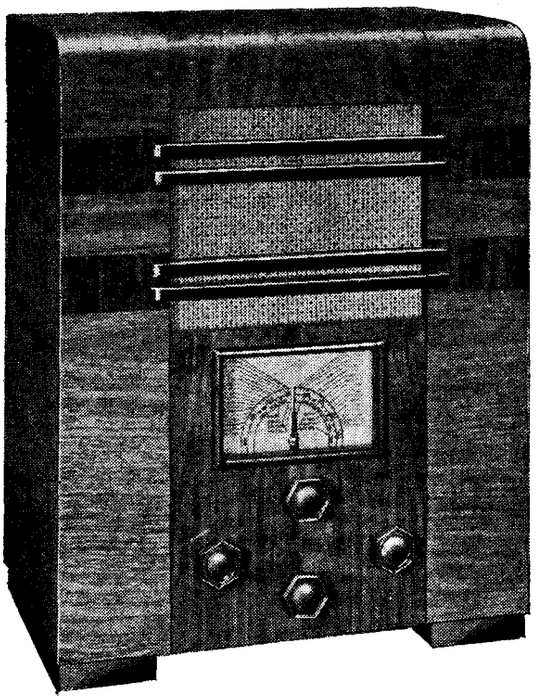
From Thurston's Hall, Leicester Square, on December 10th, Willie Smith will broadcast a description of the snooker match between Horace Lindrum, nephew of the world's champion billiards player, and Joe Davis, English billiards and snooker champion.

The commentator's box will be in one corner of the hall, and microphones will be placed so as to pick up the clicks of the balls, the applause, and the marker calling the score.

The marker, by the way, will be Charles Chambers, whom listeners heard earlier in the year in a talk on billiards.

Scrapheaps

I HAVE more than once commended the B.B.C. for its tolerance of jokes against itself. The supreme example of personal immolation on the shrine of humour is that of Leslie Baily, who will, I hear, shortly begin work on a parody of his own "Scrapbooks." He will call them "Scrapheaps."



Higgs Model A56R

Clear-cut Reproduction and Unusual Sensitivity in a Four-valve Superheterodyne

FEATURES.—***Type.***—*Table-model superheterodyne for AC mains.* ***Circuit.***—*Octode frequency-changer—var.-mu pentode and IF amplifier—double-diode second detector—pentode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Tuning. (2) Volume and on-off switch. (3) Tone. (4) Wave-range.* ***Price.***—*11½ guineas.* ***Makers.***—*Charlton Higgs (Radio) Ltd.*

A SUPERFICIAL examination of the circuit specification and a glance at the design and quality of the cabinet work should be sufficient to place this receiver at least among the "possibles" for anyone searching for a suitable set in the £12 category. Coming to the next and more important point—performance—it is safe to say that the investigator will be agreeably surprised at the range and clarity of reception, more especially if he has formed a mental picture of the performance from an examination of the type of circuit employed.

The range is, in fact, no less than one would expect from a superheterodyne with a signal-frequency HF amplifier preceding the frequency-changer. Upwards of fifteen Continental transmissions were received on the medium waveband in daylight, and the reception of long-wave stations seemed to have a clearer and brighter quality than usual. Although the type of QAVC control adopted has something to do with this there is no question that the overall sensitivity is definitely above the average for a four-valve superheterodyne.

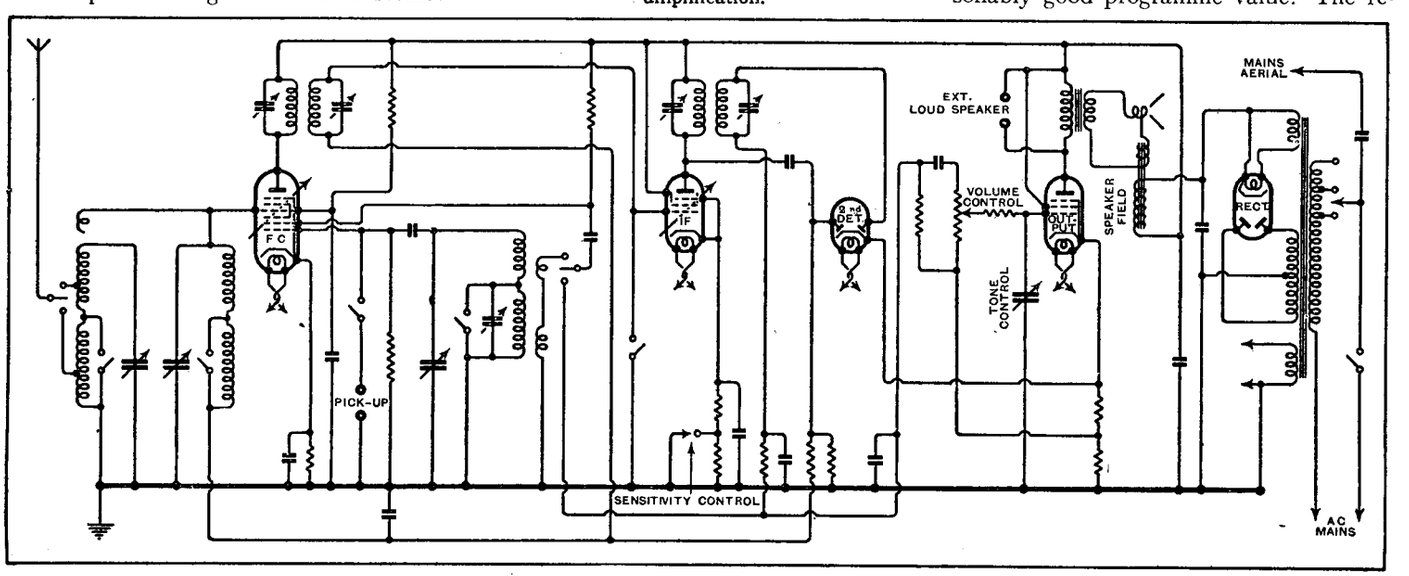
The first valve in the circuit is an octode frequency-changer. This is preceded by a two-element band-pass filter with "top-end" coupling consisting of a few turns which form a small capacity between the top of the aerial coil and the grid of the valve. Upon the performance of the band-pass filter as well as the intermediate amplifier couplings depends the behaviour of the set as regards selectivity. On the medium waveband under the standard conditions of test in Central London only one channel was lost on either side of the two local transmitters, while on the long waveband the Deutschlandsender was much clearer of interference from its neighbours than is usually the case. Neither was it necessary to use the tone control to reduce the interference on the German station.

For gramophone reproduction the oscillator section of the frequency-changer valve is made to do service as a stage of LF amplification.

An interesting point in connection with the frequency-changer stage is the use of the oscillator section as an amplifier when using the set with a gramophone pick-up. Switches are arranged to connect the pick-up to the grid of the oscillator and the anode of that valve through a resistance-capacity coupling to the grid of the output valve. During gramophone reproduction the grid circuit of the IF amplifier is short-circuited. In this stage a sensitivity limiter has been introduced in order that only those stations which are above a predetermined volume level will be received. The method adopted consists in increasing the negative bias of the IF valve. For normal reception this is reduced by inserting a shorting plug in a socket at the back of the chassis.

Inter-station Noise Suppression

The QAVC control is also of the sensitivity-limiting type, in which a negative bias is applied to the signal diode from a potential divider in the cathode circuit of the pentode output valve. This bias is just sufficient to suppress background noise without cutting off those weaker stations which are yet able to supply a signal of reasonably good programme value. The re-



Higgs Model A56R—

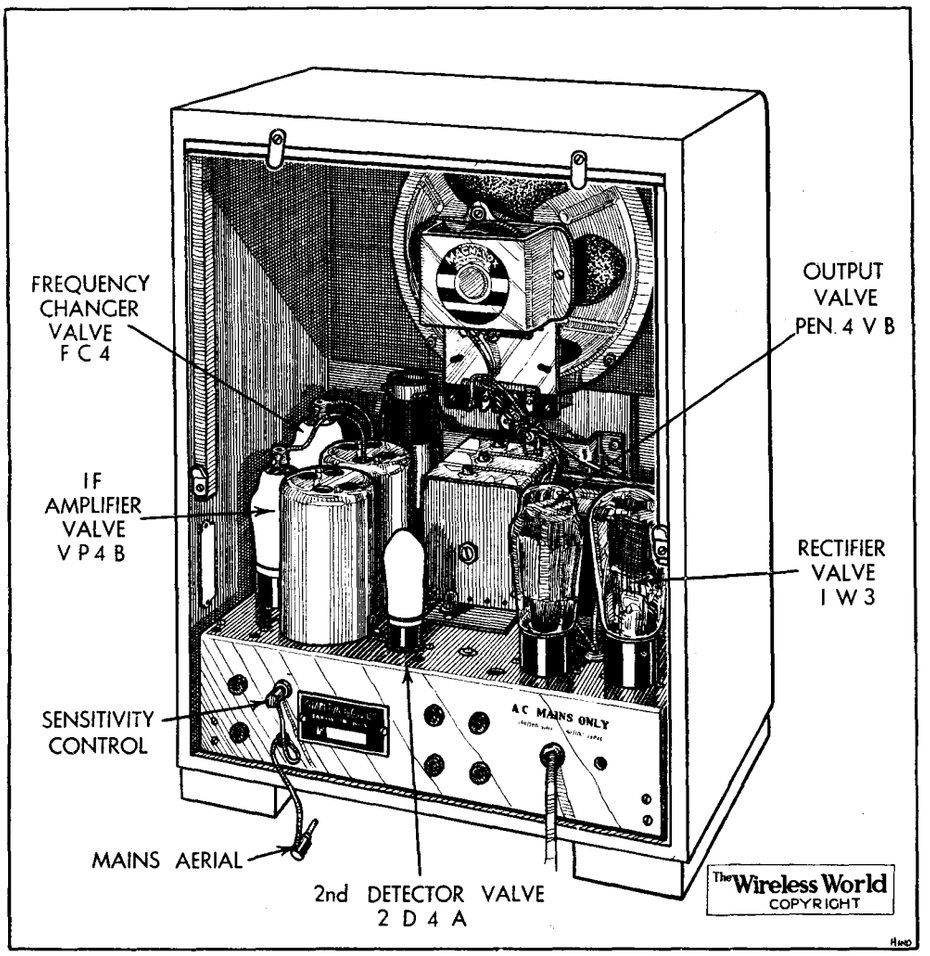
maining diode in the second detector stage supplies the AVC bias, and as the input for this is derived from the first winding of the second IF transformer the reception is free from side-band distortion when a station is passing into and out of tune.

The degree of AVC control is excellent, and combined with the high sensitivity of the set brings reception of the Scottish stations into the same category as the North, Midland and West transmitters as far as the London area is concerned. There are no self-generated whistles on the medium waveband, and only one of any consequence, on a wavelength of about 1,175 metres, was noted on the long waveband.

A Magnavox energised moving-coil loud speaker is responsible for the reproduction, which is notable, first for its brightness and clarity, and, secondly, for an ample body of tone in the middle and lower registers, which is capable of covering the normal range of the 'cello without any obvious reliance on a bass resonance. The loud speaker grille, incidentally, is of the woven material known as "Meshwood," which is acoustically dead and does not move like a subsidiary diaphragm on low passages as silk coverings sometimes do. A simple form of tone control consisting of a variable condenser shunt across the input to the pentode valve gives a suitably mellow tone for those who like it, without completely mutilating the high-note response.

A particularly lucid form of tuning scale has been adopted, in which a clock-hand type of indicator moves over a semi-circular scale calibrated in wavelengths. The station calibrations instead of being situated on the scale itself are arranged in vertical columns, one for the left and one for the right-hand quarter of the dial. Those on the left are arranged in ascending and those on the right in descending order of wavelength, and it is an easy matter to read off the station names by following the lines connecting the column with the tuning scale. It is unfortunate that the pointer works in the opposite direction to the tuning knob, but one becomes accustomed to this after a very short time.

The makers are to be congratulated in having extracted such an excellent performance from what is superficially a perfectly straightforward four-valve superheterodyne circuit. The range and sensitivity are backed up by adequate selectivity and the form of QAVC control adopted in conjunction with the clarity of reproduction combine to make each station stand out clearly from background noise.



General view of the interior of the set. Two flexible leads are provided at the back of the chassis, one for a mains aerial connection and the other to give a fixed reduction of sensitivity.

DISTANT RECEPTION NOTES

Wavelength Problems in France

REFERRING again to the original list of wavelength allocations under the Lucerne Plan, which was published on June 30th, 1933, I see that a channel was reserved for the Government station at Nice. This is on 253.1 metres and it is shared with Kharkov No. 2. Under the Lucerne Plan the Nice station is shown as being intended largely to serve Corsica. The new Nice station at La Brague is now using this wavelength, and, in consequence, a somewhat knotty problem has arisen for dwellers in and around Nice: Juan-les-Pins is working on 240.2 metres, only eight channels away, and owners of rather old-fashioned receiving sets, of which very many are in use in France, are finding that the two stations interfere badly with one another. It is pretty clear that Juan-les-Pins, if it is to continue in operation, will have to find another wavelength—and that may not be too easy. The 240.2-metre wavelength was originally assigned to Luxembourg when the Prague Conference gaily settled its hash by decreeing that its wavelength should drop from 1,200 to 240 metres and its power from 150 to 60 kilowatts. Luxembourg, however, declined to have its hash settled; it retained its position on the long waves by retaining and *using* its full output. The 240-metre channel was thus going a-begging, and France promptly borrowed it. Assuming that France can retain it by applying the principle *j'y suis, j'y reste,* it may be possible for her to contrive an exchange between Juan-les-Pins and another of her stations. Radio-Cité would seem to be the most suitable. It is a long way off and its present wavelength is 280.9 metres. If Radio-Cité went to 240.2 metres and Juan-les-Pins to 280.9, there would then be a thirteen-channel separation between the latter and Nice P.T.T.; owing to its small power and the great distance between Nice and Paris, Radio-Cité could cause no interference with Nice in any part of the Riviera, even if the most unselective of sets were in use.

Any day now the Delhi station may be opened. With its 20 kilowatts it will be far the most powerful in India. It should serve a considerable part of Northern India, but it is very unlikely that it will be heard in this country. The chief reason for this is that Indian time is five and a half hours ahead of ours; we shall thus not be able to wait for it until the "clearing of the ether" by the closing down of European stations, as we do when we start after midnight for America. Delhi will actually be closing down at about the time when every station in Europe is getting under way with its evening programme.

Other 20-kilowatt stations are to be erected as soon as possible in Bombay, Calcutta and Madras. I don't envy Mr. Lionel Fielden, the Controller of Indian broadcasting, for his job must be one of appalling difficulty. I can, for instance, think right away of half a dozen major languages (exclusive of dialects) spoken in the area that Delhi alone will serve. And there are certainly far more than half a dozen. The language question will be equally difficult for the other stations when they come into operation.

D. EXER.

Listeners' Guide for

ELISABETH WELCH, of "Glamorous Night" fame, comes from Drury Lane to-morrow night to take part in a Gala Variety programme (Nat. 8.)

VISITORS FROM ABROAD

WHERE orchestras are concerned there can be no bringing of coals to Newcastle. Every combination of players has something to teach others, some touch of originality which gladdens the ear of the listener who spends most of his time listening to one orchestra.

Thus the visit of the Czech Philharmonic Orchestra to this country is a musical event of the first importance, of which the B.B.C. is taking full advantage. The orchestra will be heard on both Sunday and Monday evenings. The conductor, Vaclav Talich, is one of the most prominent musicians of his country to-day, having graduated from the Berlin Philharmonic Orchestra. He has conducted a large number of concerts on the Continent, in London, Glasgow, and elsewhere. Under his energetic leadership the orchestra has reached a very high standard, and is particularly famous for the excellence of its strings.

In their concert on Sunday evening (Reg., 9.30) the orchestra will give Dvorák's Slavonic Dances; the big feature of their Monday concert at the Queen's Hall (Reg., 8.15) will be the same composer's "New World" Symphony. Vaclav Talich will conduct on both occasions.

TWO-PIANO TEAM

A REMARKABLE pianoforte pair who play back to back—Maryan Rawicz and Walter Landauer—are appearing twice in the programmes this week.

To-morrow (Saturday) they will be heard in Eric Maschwitz's November Gala programme (Nat., 8) and on Monday in the November Revue (Nat., 10.15).

Professors of music of the Vienna Conservatorium, they make the best of both worlds, for they specialise in classical as well as rhythm performances. Their exactitude and team work are astonishing. To-morrow they will play Dvorák's Slavonic Dances, and, in the November Revue, a *pot-pourri* of Kalman's works which they have called "Kalmaniana," together with a modern jazz *pot-pourri*. If they have time they hope also to give a medley based on the works of Jack Strachey, written for previous Monthly Revues.

"DR. LIVINGSTONE I PRESUME?" was all the American explorer Stanley could say at the conclusion of his search for Livingstone, whom he discovered at Ujiji. The life of the great missionary will be retold in radio-dramatic form on Sunday (Reg. 5.30).

MOUTH-ORGANIST SINGS

LARRY ADLER, the mouth-organ magician, will sing over the air for the first time in "Romance and Rhythm" on November 25th. The bill also includes the Carlyle Cousins and a double act, Sylvia Cecil and Percy Manchester, in modern numbers. This programme also marks the welcome return of the Western Brothers in one of their ten-minute broadcasts.

DANCING GIRL'S STORY

JOHN WATT takes the part of an impetuous journalist in "It Was in the Papers," his new musical story to be heard Nationally on November 26th (8.30) and Regionally on November 27th (8.15).

The story is of the private life of an English dancing girl whom the journalist, John Watt, and a Lancashire friend, discover in a Paris music hall. The two Englishmen rescue the girl from a rich admirer and take her to a nearby café, where the journalist succeeds in drawing forth her life story. The episodes of her career will be heard in the form of flash-backs much in the same way as "It Seems Only Yesterday." The music is by Harry Pepper.

SCOTS v. NEW ZEALAND

THE Scots team may be depended upon to use all their might to defeat the New Zealanders in the International Rugby match which is to be fought out to-morrow afternoon. Captain H. B. T. Wakelam is journeying to Edinburgh to give a running commentary (Nat., 2.10). This should be a magnificent broadcast.

TWO GREAT SCOTS

Two great Scotsmen of humble origin are featured in this week's programmes—Andrew Carnegie, millionaire and philanthropist, and David Livingstone, missionary and explorer.

"The Man Livingstone" is the title of John Gough's feature broadcast, which will be heard in the Regional programme on Sunday at 5.30. Though it is seventy years since Livingstone laboured among the neglected tribes of Central Africa, interest in his work shows no signs of flagging; crowds are daily visiting the Liverpool Missionary Exhibition to hear his daughter, Mrs. Livingstone Wilson, describe relics of her father.

Andrew Carnegie was born in 1835, and the centenary celebrations are now in full swing in his native city of Dunfermline, from which his benefactions are controlled. At 8.25 on Monday National listeners will hear the speeches at a commemorative dinner, the speakers including the Very Rev. Sir George Adam Smith and Mr. John Findley, Editor of the *New York Times*.

Carnegie is perhaps best remembered for the hundreds of libraries which he presented to communities throughout the world. He would give anyone half a church organ if they would raise the money for the other half. Mark Twain once asked Carnegie for half a dollar to buy half a hymn book. He got his half-dollar.

OPERA ABROAD

BELLINI'S "Norma" is once more making her bow from the Royal Opera House stage, this time at Budapest at 6.30 this evening (Friday).

Moscow (1) has chosen Tchaikowsky's "Mazeppa" for its 4.30 transmission to-morrow (Saturday). It will be relayed from the State Opera with a commentary in foreign languages. A novelty for opera lovers on Sunday will be Puccini's "La Bohème," sung in Flemish (Brussels No. 2 at 8).

the Week — Outstanding Broadcasts at Home and Abroad

HIGHLIGHTS OF THE WEEK

FRIDAY, NOVEMBER 22nd.

Nat., 7.30, "Young Ideas." 8, The Band Box. 10, "Lord Roberts," by Lt.-Gen. Sir William Furse.
Reg., 7, Stanelli's Stag Party. 9, "Scrapbook for 1911."
Abroad.
Vienna, 7, Lortzing and Muller Operas by Vienna Symphony Orchestra, State Opera Chorus and Soloists.

SATURDAY, NOVEMBER 23rd.

Nat., 2.10, Rugger: Scotland *v.* New Zealand. 8, Gala Variety Programme.
Reg., B.B.C. Symphony Orchestra. 9.30, Gramophone Records presented by B. Walton O'Donnell. ¶Henry Hall's Hour.
Abroad.
Hilversum (late Huizen), 7.25, Opera: "Ariadne and Bluebeard" (Dukas).

SUNDAY, NOVEMBER 24th.

Nat., B.B.C. Variety Orchestra. 5, Ion Swinley in "Father Noah." 9.30, Albert Sandler.
Reg., Band of H.M. Coldstream Guards. ¶"The Man Livingstone." 9.30, Czech Philharmonic Orchestra.
Abroad.
Hamburg, 8, Hans Pfitzner conducts his own compositions.

MONDAY, NOVEMBER 25th.

Nat., "The Rocky Mountaineers." 8.35, Andrew Carnegie Commemorative Dinner: Speeches. ¶November Revue.
Reg., Czech Philharmonic Orchestra. 9.15, Romance and Rhythm.
Abroad.
Brussels I, 8, Lyric Drama: "Yannick" (Beissier).

TUESDAY, NOVEMBER 26th.

Nat., Piano Recital by Angus Morrison. 8.30, "It Was in the Papers."
Reg., Northern Ireland Orchestra. 8.45, B.B.C. Organ Recital: G. D. Cunningham.
Abroad.
Munich, 7.10, Opéra-comique: "Don Pasquale" (Donizetti).

WEDNESDAY, NOVEMBER 27th.

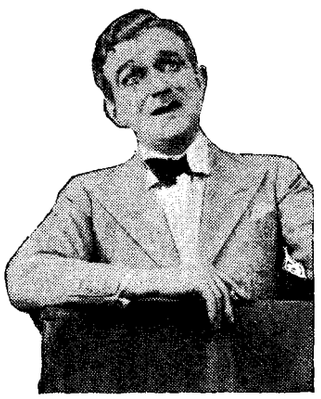
Nat., B.B.C. Dance Orchestra. 8.30, Myra Hess (pianoforte) in B.B.C. Symphony Concert. ¶Jack Payne and his Band.
Reg., Leslie Bridgewater's Harp Quintet. 8.15, "It Was in the Papers." ¶B.B.C. Military Band.
Abroad.
Strasbourg, 8.30, Municipal Theatre Concert.

THURSDAY, NOVEMBER 28th.

Nat., Viola Recital by Bernard Shore. 8.30, Pot-Pourri: "Round the World in 60 Minutes" (Julius Buerger).
Reg., Tunes from the Town. ¶Sir Dan Godfrey conducting B.B.C. Military Band. 8.10, "Devonshire Cream" (Eden Philpotts). ¶B.B.C. Dance Orchestra.
Abroad.
Berlin (Deutschlandsender), 7.15, Sibelius Concert.

OPERETTAS

FRANCHETTI'S light-hearted "Namiko San" comes from Rome at 8.45 on Saturday—a day which brings a full bag for lovers of light opera. There is also Suppé's "Die grosse Unbekannte" (The Great Unknown) from Munich at 6.5;



NELSON KEYS comes to the microphone in the November Revue at 10.15 on Monday. Here he is in a smart upstanding part.

Offenbach's "Monsieur Choufleuri" from Sottens at 8.25, and Künneke's ever-welcome "The Cousin from Nowhere," who arrives at Vienna at 6.20.

BRAHMS' "REQUIEM"

WITHOUT doubt the most notable classical item of the week will be the relay of the Brahms "Requiem" on Sunday at 4 by Berlin (Funkstunde) from the old Garrison Church. There will be soloists, the choir of the Academy of Singing, and the Station Orchestra, with Heitmann at the organ and Dr. Georg Schumann conducting.

MENDELSSOHN BANNED

THE anti-Jewish ban has resulted in the omission of Mendelssohn's incidental music from German performances of Shakespeare's "Midsummer Night's Dream." The broadcast of the play from Hamburg at 8.25 on Monday will include incidental music specially written by Girnatis.

TOSCANINI IN PARIS

De Greef is the pianoforte soloist in the Liége Conservatoire concert from Brussels No. 1 at 8.30 to-morrow.

A Jubilee Gala concert of the Prague Commercial Choir comes from the Czecho-slovakian capital at 7.5.

An important choral concert comes from Radio-Paris on Sunday at 5. César Franck's "Les Béatitudes" will be given by the choir, soloists and orchestra of the Pasdeloup Concerts.

Toscanini conducts an orchestral concert which will be heard *via* the Paris P.T.T. and other French stations at 9 on Tuesday.

ALL DAY IN COPENHAGEN

ENGLISH listeners will probably not need a knowledge of Danish to savour the "Street Symphony" which Kalundborg offers at 7.30 on Saturday. It will tell the tale in sound of life in Copenhagen throughout the twenty-four hours.

NATIONAL MUSIC

THE imaginative listener can "travel" far this week if he picks out the many concerts of national music.

To-day the German stations take us from one end of the Reich to the other. Leipzig gives us a picture of Central Germany at 5.40 with folk songs from Talbürgel; at 6 Stuttgart brings the Tyrol to our ears with a programme of folk music. Königsberg at 7.10 visits the fisher folk at Nemonien (Baltic Provinces). At 1.30 p.m. on Sunday Berlin (Deutschlandsender) gives us Bavarian and Swabian folk music electrically recorded at the recent Berlin Radio Show. Radio-Paris at 2.15 has a Latin folklore programme with the Sarrablo Tipica Orchestra. On Monday at 6.30 Strasbourg offers Czech music, and at 8 Leipzig has songs and dances from Carinthia.

NOVELTIES

ENGLISH talk on English, Scottish and Irish humour (Vienna, Saturday, 3.5).

Brussels Civic Day: Microphone tours of the capital (Brussels 1, Sunday, throughout day).

English interview with student at the State Institute of Cinematography (Moscow 1, Monday, 9.5).

"Promenade Concert in Vienna about 1800" (Berlin, Monday, 7.10).

MODERN ACOUSTICS

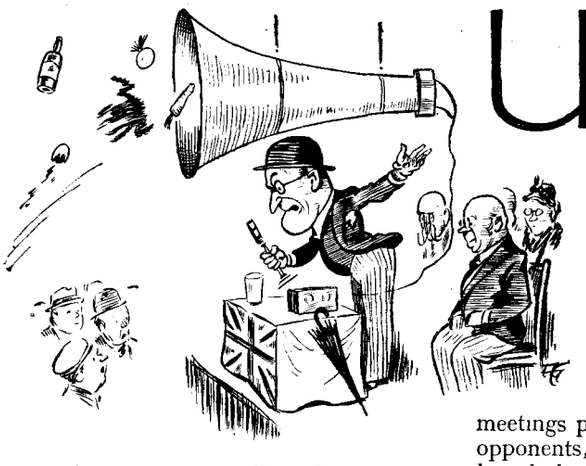
THE latest acoustic ideas have been incorporated in the Aalborg hall, Jutland, Denmark. From it the Aalborg Philharmonic Orchestra is to-night broadcasting Hartmann's Can-

REHEARSING FOR "NAMIKO SAN," Franchetti's two-act opera which Rome will broadcast at 8.45 to-morrow (Saturday). The cast includes Maria Huder, Bernardi, Mazziotti and Conti.

tato, "The Dryad's Wedding," under the direction of M. Georg Hoeberg (Kalundborg 8) THE AUDITOR.

UNBIASED

By FREE GRID



I called in science to my aid.

Vicious Circle

IT is, I think, very questionable whether scientific progress and the advance of civilisation do, after all, make for increased human happiness. Things seem to go round and round in rather vicious circles; as soon as one nation, more progressive than the rest, invents a new type of poison gas, some other nation of reactionary tendencies brings out a new kind of gas-mask to counteract it, and so the whole thing is brought to naught, and the dreary cycle of operations has to be begun all over again.

I am still feeling a little battered and worn as the result of my recent election campaign, and possibly that accounts somewhat for my attitude of mind, but during my meetings I received such a convincing demonstration of the sort of thing I have just mentioned that I think it does after all have some objective existence and is not merely a creation of my disordered mind, as Mrs. Free Grid has somewhat gratuitously suggested.

As many of you will have realised, I am strictly impartial in all things—politics, religion, morals or ethics—believing firmly that men in responsible public positions should stand aloof from all controversial matters. In fact, *audi alteram partem* is the motto by which I rule my life, and in order to illustrate how I carry it out I may mention that some years ago, when the outcry against certain objectionable types of cinema films was at its highest, I made it a rule to show on my home cine only films of a type to which Mrs. Grundy herself could have taken no exception. When the film trade had eventually been cleaned up, my strict adherence to my motto was again reflected in my home film programmes.

As a result of my opinions I always make it a practice during election campaigns to speak on behalf of all parties in an endeavour to satisfy none, and give offence to all. Apparently, however, the disinterestedness of my motives has been misconstrued by those of base mind, as a result of which I found myself shouted down in my recent campaign.

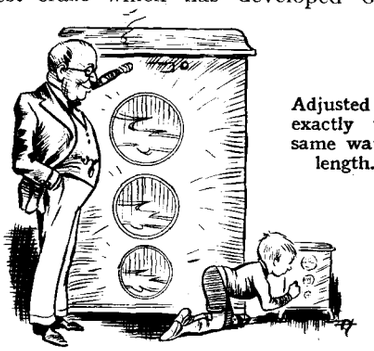
Naturally I called in science to my aid and soon settled my opponents' hash by producing an outsize in amplifiers and loud speakers. This resulted in several meetings passing off quite peaceably, my opponents, unable to make themselves heard above the loud speaker, contenting themselves with vulgar competitions as to who could toss the maximum number of deceased members of the animal and vegetable kingdom into the large bell-mouth of the loud speaker horn in a given time.

Things continued thus for several meetings until one evening I was astonished to find a solid phalanx of my audience marching in with soldiers' packs on their backs. Even had I not seen the loud speaker horn sticking out of the top of each pack, I should have soon learned that they contained powerful battery-operated amplifiers by the roar of cat-calls which greeted me as soon as I commenced my speech.

The following night I outwitted my opponents by appearing with a truly gargantuan public address outfit, but two nights later they capped it by bringing in mules laden with amplifiers of brobdingnagian proportions. I increased my power once more, only to be countered with loud speaker-equipped army tanks, and the eventual result was complete stalemate, the meeting hall being so filled with amplifying gear that there was no room for myself, to say nothing of my audience.

Dr. Johnson Up-to-date

THE minds of our cousins across the water seem to work in a truly astonishing manner, as can be seen by the latest craze which has developed over



Adjusted to exactly the same wavelength.

there for what are known as children's wireless sets. The cabinet work is gaily painted with representations of Mickey Mouse, Mae West, and other fairies who seem to have taken the place of the more conventional ones of my own childhood, while co-respondents and gangsters fulfil the rôle formerly held by wicked uncles and ogres.

The thing which takes the conventional biscuit, however, is the fact that these sets are supposed to be used side by side with the family receiver, the instructions for operating explaining the necessity of carefully tuning both sets so that they are adjusted to exactly the same wavelength in order to avoid mutual marring of reproduction.

Although not exactly analogous, the mentality behind the thing is strongly reminiscent of that of the learned Dr. Johnson, who possessed a pet cat which constantly interrupted his labours by plaintive requests to pass in and out of the room, making it necessary for him to rise repeatedly to open and close the door.

He wisely sent for a carpenter and had a suitable hole cut in the lower part of the door. Later the cat presented him with a kitten and the good man, still mindful of his own comfort, again sent for the carpenter commanding him to cut a smaller hole beside the first.

"Broad" Humour

I HAVE for some considerable time now been seriously considering the question of applying to the B.B.C. for the position of Corrector-in-Chief to their programme staff in things geographical, historical, medical, theological, and I don't know what else besides. Time and again I have observed the most glaring inaccuracies in these respects while listening to their so-called programmes, and have not failed to call due attention to them in these columns. While some of the errors are, perhaps, pardonable, others are intolerable and would bring a blush of shame to the hardened cheeks of a first year kindergarten pupil.

The other evening, for instance, my whole enjoyment of the excellent little psychological playlet in the B.B.C.'s "decision" series was completely marred by a truly glaring instance of this sort of thing. When I learned in the course of the play that the absent husband was holiday making on the Norfolk Broads my mind was filled with pleasant reminiscences of long, lazy days which I had once spent there myself, floating sybaritically on the broad bosom of the Broads.

I was, however, brought back to earth with a rude shock and experienced a distinct feeling of nausea, to say nothing of suffolkcation, when I heard the good wife put in a trunk call to her husband at an Aldeburgh number.

The Wireless World

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Editorial Comment

Should the B.B.C. Advertise ?

Need for Advance Publicity

THE title of this comment might suggest that we were prepared to open up again the old question of sponsored programmes—but that is not our intention. What we have in mind is that whether the B.B.C. spends thousands of pounds on a single night's broadcast or fills up the evening with broadcasts of quite inferior material, no assistance is given to the general public to discriminate between the two in advance. Nothing is done to bring it home to the general public when a gala programme is to be presented. No wonder that many people regard the programmes as monotonous—they certainly are, judged from the standpoint of any advance publicity they may receive.

This is no new point of view for us to take up. We have expressed this opinion in different ways many times before. As long ago as February 1933, under the title of "Headlines for the B.B.C.," we said that if we opened our daily paper one morning to find no headlines to any articles and the same size type throughout, we should be annoyed at the difficulty we should experience in sorting out what was important from what was trivial in character.

It cannot be expected that the B.B.C. can fill up all the hours of broadcasting with first-class programmes. The listener is forming the habit of switching on when he has spare time to listen instead of finding time for important programmes.

In the rush of modern activity we have come to expect that matters of first rate importance will be brought to our notice in the Press or in advertising, in some way which will arrest our attention. The B.B.C. does little to arrest our attention in advance and encourage us to a special interest in anything that is broadcast. No wonder that last night's broadcast has ceased to be a topic of conversation, as it used to be in the early days.

Home Recording

Revival of Public Interest

A YEAR or two ago a number of firms produced cheap home recording apparatus for the amateur. We believe that it is no secret that the sales were then not sufficient to encourage manufacturers to continue, and to-day either manufacture has ceased or the apparatus is being supplied only on order to a small number of purchasers who know where to go for it.

Correspondence which we have had recently suggests that the demand for equipment of this kind is beginning to grow. It may be that the public has become better educated as to its potentialities as a result of publicity given to allied subjects such as public address equipment.

It would be of interest to hear from readers as to what success they are having with different makes of home recording outfits still available to the public.

There are, of course, several sources of supply for rather elaborate and expensive recording equipment, but this is mostly too costly for the requirements of the amateur who is only experimenting for his personal interest.

A S C

AUTOMATIC SELECTIVITY CONTROL

Incoming Signals Treated on Their Merits

By B. D. CORBETT

IN the ASC system described in our issue of October 4th, the band-width of the receiver was automatically widened in proportion to the strength of incoming signals. This becomes a subsidiary effect of the more complex method of control described in the present article; the band-width is restricted in proportion to the prevailing interference level.

THE modern receiver is still not entirely foolproof, in spite of station-name calibration, visual tuning indicators and QAVC. Take, for instance, the selectivity control to be found on all the most ambitious receivers nowadays. The non-technical operator finds difficulty in understanding the relationship between selectivity and "tone," and, having failed fully to digest the instruction book, generally forgets to turn this control to the wide-band-width position when tuning in the local station.

It occurred to the writer recently that it might be possible to vary the selectivity automatically, so that reproduction would always be as good as interference conditions permitted on the particular station tuned in. As is usual in variable selectivity receivers, this variation would be accomplished in the IF amplifier, and the system would naturally be termed Automatic Selectivity Control, or "ASC."

The apparatus required for an ASC system may be divided into three parts:—

(1) An amplifier with intervalve couplings designed to reject the IF itself, but to pass frequencies in neighbouring bands likely to cause interference. The input filter of this amplifier is coupled to that point in the IF chain where the interference level is highest, namely, the anode circuit of the frequency-changer. This will be known as the ASC amplifier.

(2) A rectifier connected to the output of the ASC amplifier, whose function is to produce a steady negative potential proportional to the interference level. This potential will be referred to as the ASC voltage.

(3) A device controlled by the ASC voltage in such a way as to lower the decrement of the IF tuned circuits as the interference level increases.

The first and most important problem to be solved is the design of the ASC amplifier couplings. The requirements are as follows: First, the response at the IF, and to a small band on either side thereof, should be as low as possible. The small band is necessary in order to allow for tracking errors in the frequency-changer, and also to prevent the heavier side-waves of the desired signal from influencing the selectivity. Secondly, the response, at frequencies on either side of the IF most likely to cause serious interference, should be high, and, moreover, it should tail off gradually at frequencies further removed from the IF. Thirdly, frequencies practically outside the interference range, that is to say, removed from the IF by more than 16 kc/s, should be rejected. In this matter a compromise is desirable, since generally a programme is more acceptable when slight upper side-band interference is allowed than when the selectivity is adjusted until no interference is perceptible.

The ideal response curve for the ASC amplifier is shown in Fig. 1. Notice that, although it is the side-bands of the interfering station that are responsible for the interference, the neighbouring carrier (or, rather, its IF equivalent) is utilised to provide the ASC voltage. The peaks are fixed at about 8 kc/s from the IF, since this will allow the system to cope with the normal 9 kc/s separation, and also with "wavelength wanderers" and the more crowded parts of the broadcast band.

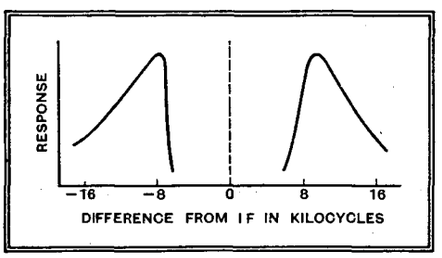


Fig. 1.—The ideal response curve required for the ASC amplifier.

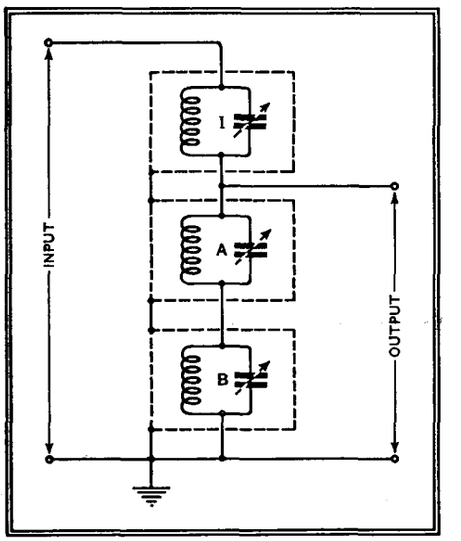


Fig. 2.—Rejector circuit filter employed in the ASC amplifier.

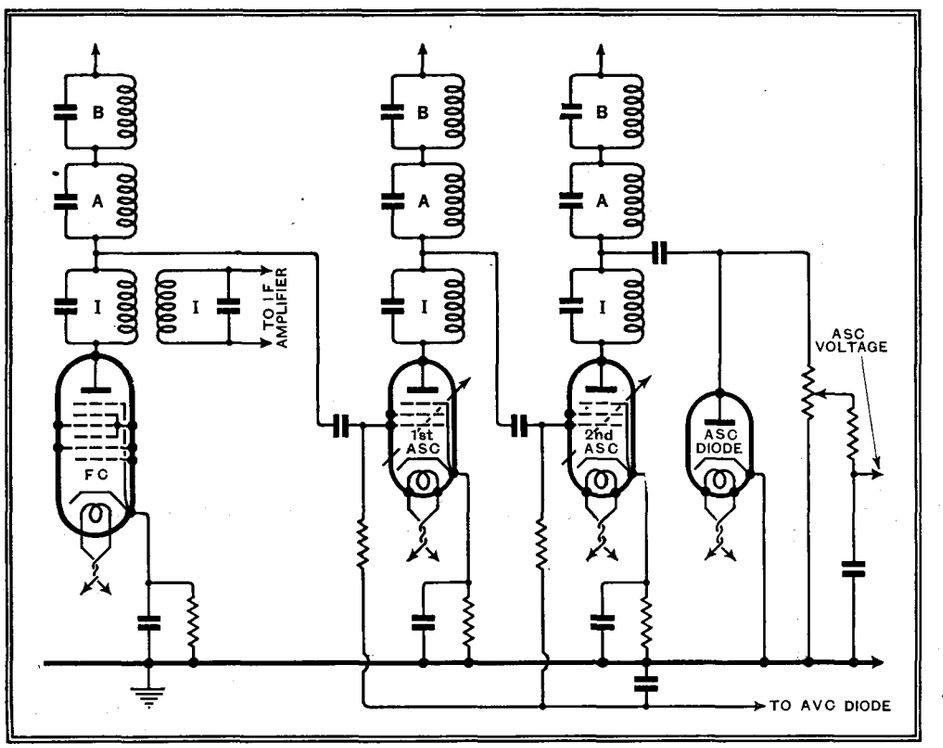


Fig. 3.—The ASC amplifier, showing how it is coupled to the frequency-changer. The ASC voltage controls the selectivity-modifying circuits, which are not shown here.

A S C—

The actual couplings might possibly take the form of band-pass filters coupled in such a way as to give a very exaggerated double-hump response. The writer, however, has found that the rejector circuit filter shown in Fig. 2 is promising. The circuit marked I is very sharply tuned to the IF, while those marked A and B are less sharply tuned to frequencies 8 kc/s above and 8 kc/s below the IF respectively. All three circuits must be very thoroughly screened from one another.

An ASC amplifier employing these filters is shown in Fig. 3, together with the diode producing the ASC voltage. Such an amplifier is fairly easily trimmed, provided a calibrated oscillator is used. An indicator, consisting of a variable-mu valve with a milliammeter in its anode circuit, has its grid return connected to the ASC line. All the "A" circuits are then trimmed for maximum output at the appropriate frequency. The "B" and "I" circuits are then trimmed, the latter, of course, for minimum deflection of the indicator. Finally, all three sets of circuits are retrimmed, the "I" circuits being dealt with last.

So far no mention has been made of the fact that, for a given interference level, less selectivity is required when the strength of the desired signal is high. This is allowed for by joining the grid returns of the ASC amplifier valves to the AVC line. A powerful station causes a high negative AVC voltage, which lowers the effectiveness of the ASC amplifier. Consequently, only a small selectivity-operating voltage appears at the ASC diode, even if the interference level is intrinsically high.

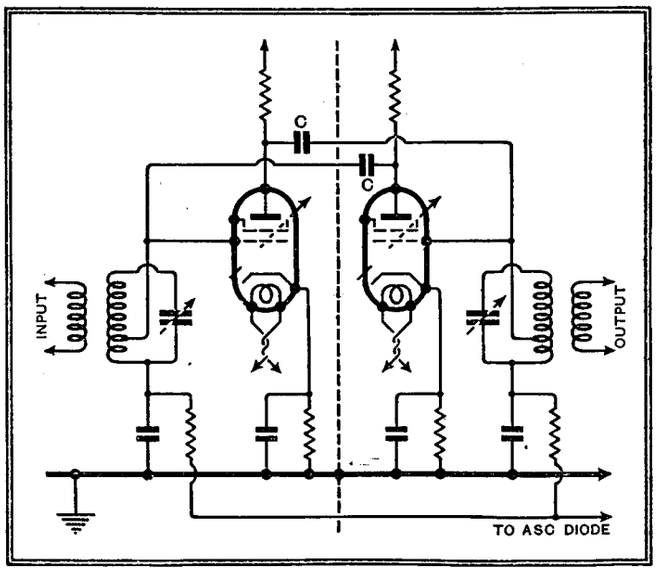


Fig. 4.—Valve-coupled band-pass filter. The coupling condensers CC are of very low capacity, and screening is very thorough.

The last link in the ASC chain is the selectivity-modifying device controlled by the ASC voltage. A number of schemes occurred to the writer, one of which employed valve-coupled band-pass filters in the IF amplifier. Each filter required two variable-mu valves whose amplification was controlled from the ASC line, as shown in Fig. 4. This method was rejected, since it was found extremely difficult to obtain the required minimum degree of inter-circuit coupling, and, in any case, it seems to be too elaborate.

Valve as Variable Resistance

Another system tried made use of a triode as a variable damping resistance. Unfortunately, a full-wave rectifier is also desirable, in order to avoid the distortion that would be caused by a heavy unilateral load. Fig. 5 shows an example of this arrangement. The double-diode rectifier, which must be of low resistance, is connected to a centre-tapped tertiary coupled to the IF transformer. The circuit is that of the normal full-wave valve-rectifying arrangement, the load being provided by the anode-cathode resistance of the triode valve. When interference is low this valve works with positive grid bias, and the damping imposed upon the IF transformer is high. Interference, however, causes a negative ASC voltage to be applied to the grid, increasing considerably the anode-cathode resistance. In this way the original high selectivity of the tuned circuit is restored.

This circuit is on the whole unsatisfactory, because, in the first place, two valves are required for every controlled tuned circuit, and, secondly, the tertiary winding, which must be tightly coupled and have many turns, is likely to introduce considerable losses into the IF amplifier on its own account.

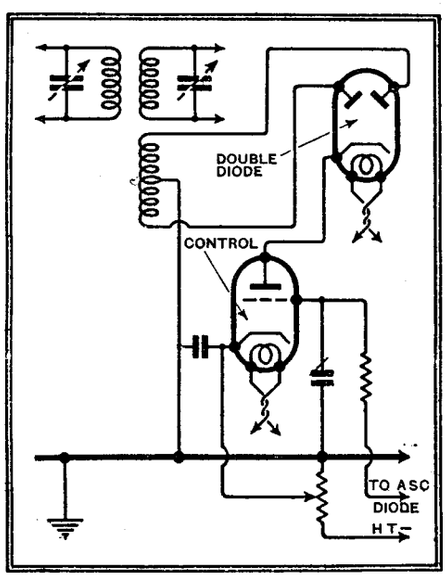


Fig. 5.—Variable-damping selectivity control, using a triode and full-wave rectifier.

The best system yet investigated employed variable-mu anti-reaction valves, arranged to feed anti-phased currents into the controlled circuits at low interference levels. As shown in Fig. 6, a portion of the IF signal is applied to the grid of the anti-reactor, whose amplification is controlled by the ASC voltage. The anti-reaction coil is coupled to the controlled IF transformer in such a way that, under initial bias conditions, the damping is sufficient to ensure good-quality reproduction. A large negative ASC voltage lowers the effectiveness of the anti-reaction valve, and the selectivity of the controlled circuit is improved. A skeleton diagram of a receiver embodying two stages of anti-regenerative ASC is shown in Fig. 7.

Pro-reaction Control

A variant of this method is to use IF tuned circuits of low initial efficiency, together with variable-mu reaction valves to lower the decrement when interference conditions demand. This, however, is not satisfactory, since not only is the peak selectivity an uncertain quantity, but also there is danger of heavy interference causing oscillation of the controlled circuits.

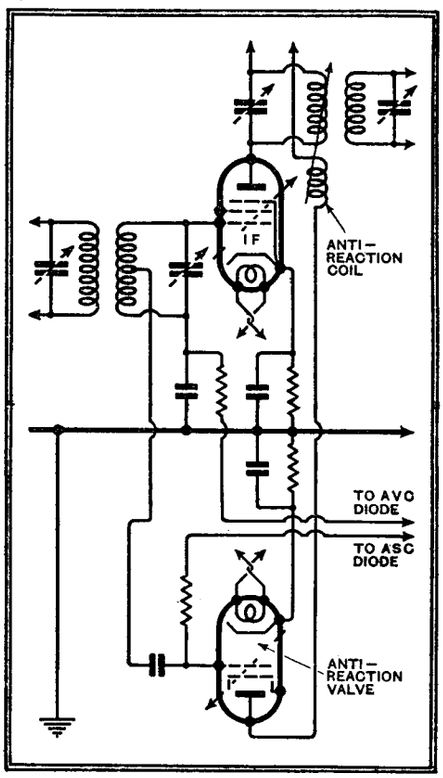


Fig. 6.—Selectivity control using a variable-mu valve for anti-regeneration.

There remains but one other system to be described. In effect, it is ASC, but it might perhaps be better described as "ATC" (Automatic Tone Control). According to this scheme, the selectivity of the IF amplifier is fixed at the highest level required; the ASC amplifier is retained, however, its function being to vary the amplification of a tone-correcting valve in the

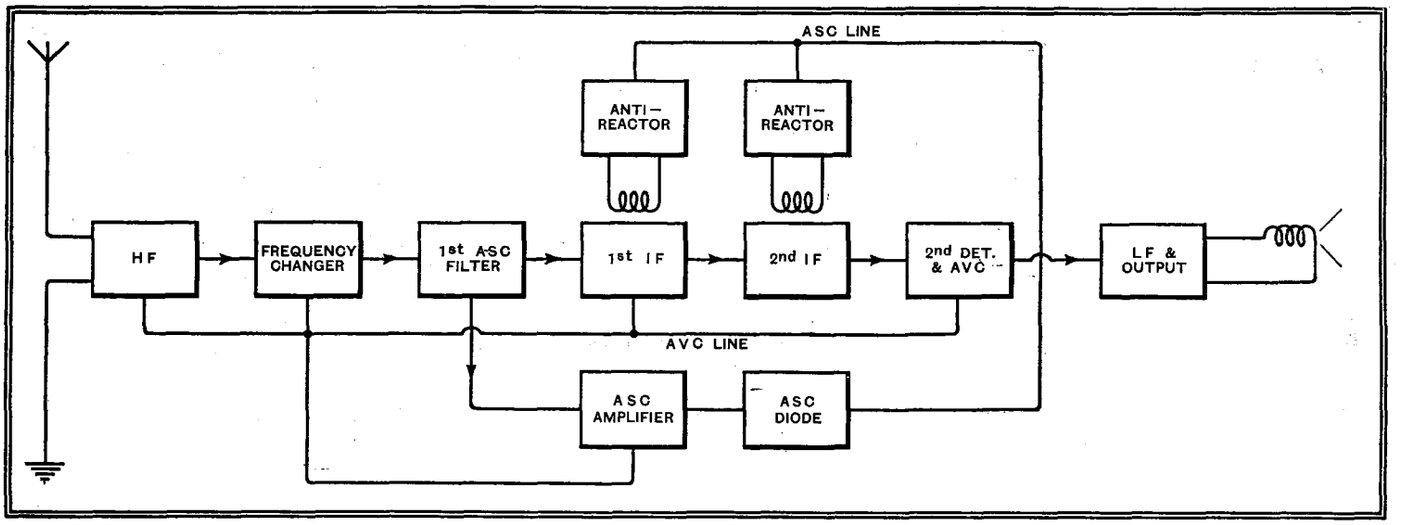


Fig. 7.—Superhet embodying two stages of anti-regenerative ASC. In all, four extra variable-mu valves and a diode are necessary.

LF amplifier. The manner in which ATC may be achieved is demonstrated in Fig. 8, and is somewhat reminiscent of the "ABC" system described in *The Wireless World* recently. As initially biased, the tone-correcting valve is arranged to compensate as far as possible for the losses occurring in the selective IF circuits. The ASC voltage then operates to reduce the degree of high-note correction, in order that any interference present may be rendered innocuous.

In conclusion, it would appear at present that ASC, with its array of extra valves and tuned circuits, is a complicated business. In fact, if asked whether it were worth while in even the most expensive receivers, the writer would probably answer in the negative. Nevertheless, it is amusing to investigate little problems such as this.

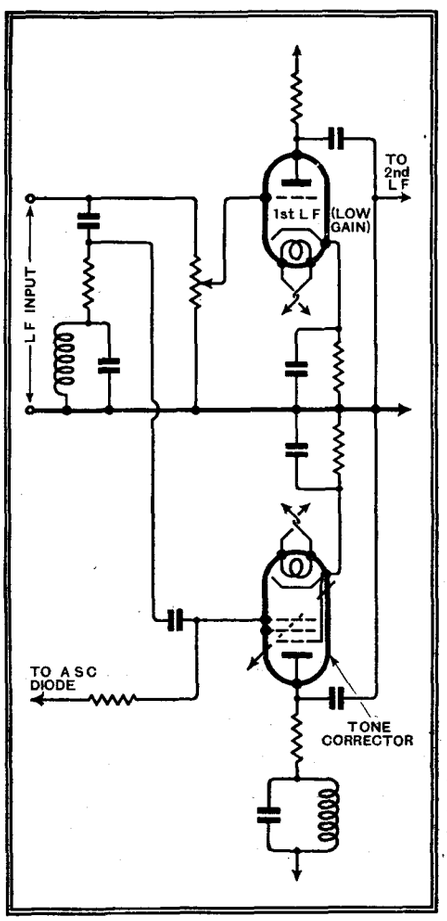


Fig. 8.—A stage of "ATC," a form of ASC accomplished wholly in the LF amplifier.

Short-wave Broadcasting

A BRIDGEND reader reports reception of the Addis Ababa station on a wavelength just below Rome (25.4 metres). A rather noisy carrier-wave was picked up at about 10 p.m., and a talk from an American correspondent, obviously directed to the American stations, was in progress. By 10.15 p.m. reception was very good and the carrier-wave was quieter.

On another evening, at 9.15 p.m., the same station was heard and held for thirty minutes, all the talk then being in French. This is quoted to show that reception of "the elusive Addis Ababa" is by no means impossible in this country.

Another reader reports good reception of the new Bowmanville (Canada) station CRCX, on 49.22 metres. This station does not seem to be operating to any regular schedule, but may generally be heard from 11 p.m. onwards, and it appears to peak at about 1 a.m.

The same reader is trying to identify a Colombian station heard a little higher on the dial. Between 49.22 and 50.6 metres, however, there are no fewer than eight Colombians, so that verification is practically impossible.

With conditions still abnormally good on 10 metres, it is natural that the higher frequencies should be more used nowadays, and there already seems to have been a marked increase in the number of commercial stations working below 16 metres.

On some afternoons one can tune downwards from the 16-metre band and hear either the Columbia or the N.B.C. programme coming in in about eight different places. In most cases it is being re-radiated by commercial telephony stations carrying out lengthy tests.

W8XK, on 13.93 metres, has, on occasions, been stronger than any of the 16- or 19-metre transmissions; and WKK, Lawrenceville, on 14.01 metres, has been heard at colossal strength more than once.

On about 11 metres there are some mysterious transmissions that appear to come from American police stations. The carrier-waves are very rough and unstable, but the telephony, when reaction is slacked well off, is quite good.

Curious echo effects are being logged on some stations between 25 and 16 metres. A severe echo, naturally, is more noticeable on a CW telegraphy station than one that is putting out speech or music, but even some of the high-powered broadcast stations have been rendered almost unintelligible on occasions.

It is a great pity that there are no high-powered short-wave broadcasters on the west coast of the U.S.A., since all the amateurs from that quarter seem to come in with a most intriguing "watery" effect on their signals. Any amateur transmitter in this country will confirm that it is possible to identify an American station in the sixth or seventh district without waiting to hear his call-sign.

Only on 10 metres is this effect absent, and many W6 and W7 stations have been missed on that wavelength for this very reason!

VK2ME seems to have suffered a slight relapse during the last few weeks. He is still easily audible every Sunday morning, but the R7 and R8 reports that one used to be able to give in the summer would be a mild exaggeration nowadays.

VK3LR, 31.32 metres, on the other hand, seems to be as good as he ever was—weaker, that is to say, than VK2ME at his best, but nevertheless extremely reliable.

W2XBJ, Rocky Point, on 33.52 metres, is a commercial station well worth listening to. He is usually stronger than the American broadcasting in the 31-metre band, but relays one of the programmes that is to be heard on 31 metres.

MEGACYCLE.

New G.E.C. Battery Receiver

DESCRIBED as the "Superhet. Battery 4," this receiver has a QPP output stage giving a power output of approximately 1½ watts, and is therefore capable of a performance comparable with mains-operated sets. Delayed AVC is included, and there is provision for an extension loud speaker as well as for a gramophone pick-up. The price is 12 guineas.

The Phono-Reel

Talking Film Technique for Home Entertainment

By W. E. SCHRAGE

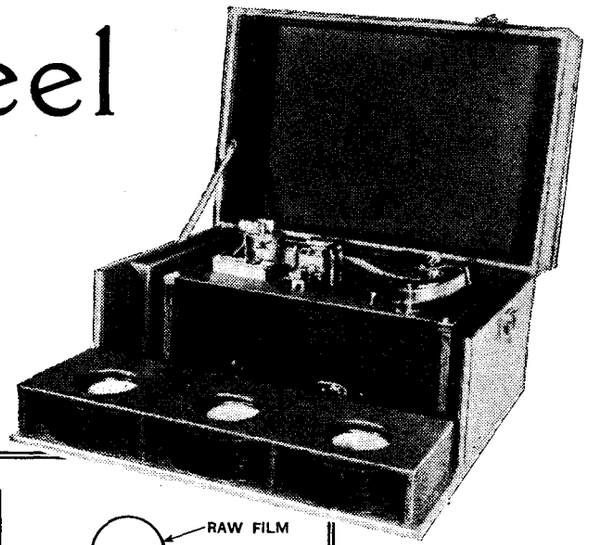
IT is easy to understand why gramophone reproduction has taken second place to broadcasting as a medium of popular entertainment. Broadcast reception can give hour after hour of music or speech through the mere turning of a knob, whereas the record-changing gramophone needs a certain amount of attention, besides being expensive.

Small wonder, then, that the gramophone world has sought around for means of providing long, continuous records. Perhaps the end of the search is in sight, for serious attention is being paid to an invention of Denes von Mihaly, a Hungarian scientist, whose device, already on the German market, not only introduces talkie technique into home reproducing apparatus but offers an efficient method of "parking" sound for broadcasting purposes.

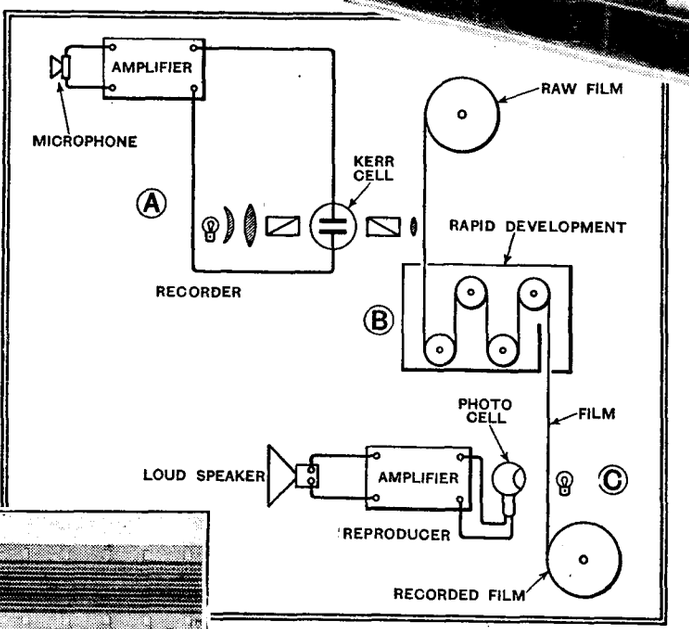
By using the sound strip of the talking film, von Mihaly can produce records lasting an hour or more. All frequencies from 30 to 10,000 cycles per second can be reproduced when the strip travels at a speed of about 90 ft. per minute. By employing a rapid development and fixing process, the sounds can be played back within 15 to 25 minutes with very little loss of quality and, of course, no needle scratch.

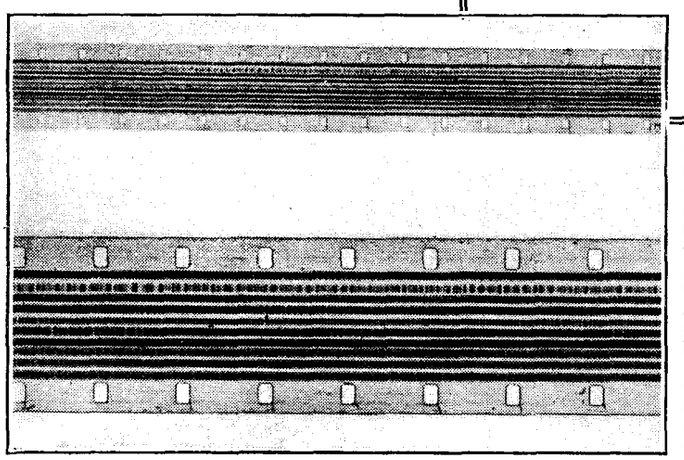
Instead of using one long track, the Phono-Reel accommodates ten tracks side by side on a 16 mm. film, and, by means of an ingenious device, there is no interruption when transferring from one track to the next. A film length of 150 feet moved at a speed of approximately 38 ft. per minute lasts about 40 minutes—as long as five double-sided 12 in. discs.

A film of this length, composed of a new cellophane material known as "Ozofan," costs about 2s. Since artists' royalties and other "extras" would not be included in this figure the retail price of such a reel might amount to 5s.



The Phono-Reel ready for use. Note the three reels in the storage cabinet.





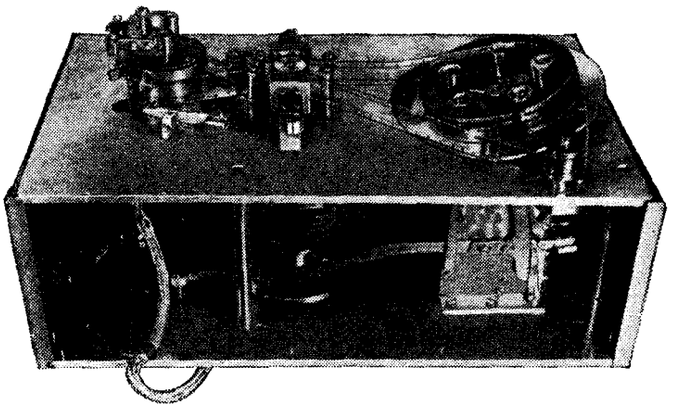
The diagram shows how the Phono-Reel, by means of rapid development process, can "play back" a performance within 15 to 25 minutes of the actual recording. On the left is a strip of sound track, original size and magnified. The Phono-Reel reproducer, seen below, includes a sound pick-up in the form of a small electric lamp and photo-electric cell mounted between the film guides in the centre of the top panel.

What are the advantages of these "reel records"? First must be placed the excellent quality of reproduction. Secondly, no matter how often they are played quality does not deteriorate, for there is no needle. Thirdly, they weigh little and take up a small amount of space; consequently a large number of dance tunes or orchestral selections, or even complete operas, can be sent by post to lending libraries at a very low cost.

The operation of the reproducing machine is remarkably simple. A reel of 16 mm. film carrying ten sound tracks is inserted on the right-hand drum seen in the picture below. From here it is led through the centre guides, in which the photo-cell and lamp are housed, to the smaller drum on the left. The film then returns to the large drum and, being joined up to form an endless ribbon, is made to rewind itself. At the end of each sound track the light beam is automatically focused on to the next so that reproduction is continuous.

The initial threading of the film is the only operation calling for care; in all other respects the reproducer is so simple that it can be handled by a child.

At present a Phono-Reel reproducer with storage accommodation for six 150 ft. reels costs from £16 to £20—not a large sum when we consider the high prices of receivers in the early days of the radio industry.



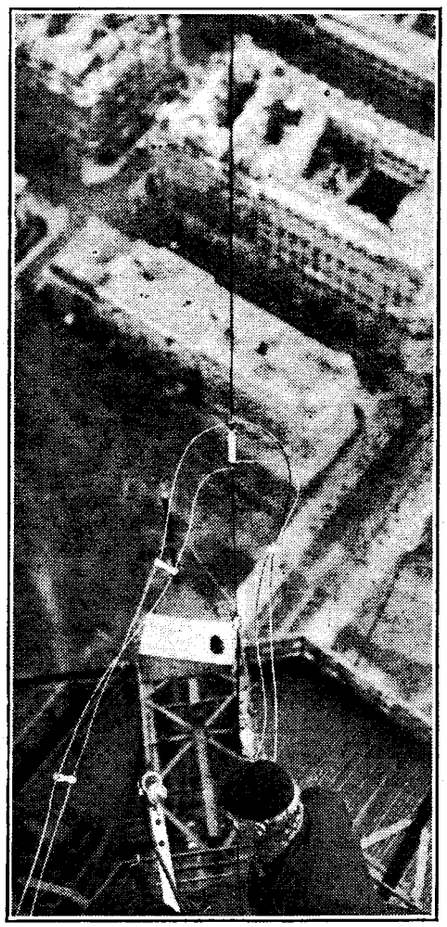


Fig. 1.—The feeder system to one of the aerials on the summit of the Eiffel Tower is clearly shown in this illustration.

EIFFEL TOWER TEL

Details of the Latest French Television Broadcasting

BY OUR PARIS CORRESPONDENT

Wavelength—8 Metres

Lines per picture—180

Pictures per second—25

Direction of Scanning—Horizontal

Picture Ratio—1·165 : 1

Line Synchronisation—Short Pulse at the end of each line

Frame Synchronisation—Suppression of line pulse in the penultimate line

Duration of Synchronising Pulse—0·01-0·02 sec.

THE new French television broadcasting station at the Eiffel Tower was opened by M. Georges Mandel on November 17th, and as a result France is now one of the few countries which can look forward to having a regular television service in the immediate future. It will be remembered that as far back as last April transmissions of fairly low definition were started. Only 60 lines were used, however, and the transmitter had a power of no more than 200 watts. As a result of the experience gained in its operation it was decided in September to install a system of higher definition and greater power, and the short period in which this has been done—seven weeks—probably constitutes a record in the development of such apparatus.

Power to be Increased

The new transmitter operates on a wavelength of 8 metres, and at present with an aerial power of 1 kilowatt, although this is shortly to be raised considerably. The aerial system, which consists of a four-wire arrangement in two rectangular planes, is mounted on the summit of the Eiffel Tower and connected to the transmitter in the base by means of a concentric type feeder, consisting of a copper tube of 10 cms. diameter containing a second insulated tube of about 2.5 cms. diameter. The total length of the feeder is some 320 metres, and for part of the way it is contained in one of the lift shafts. It is connected to the aerial by means of a transformer.

The transmitter and modulation system are housed in the base of the tower, but the studio is at some considerable distance away and the two are connected by cable. A special design of cable was necessary in order to prevent attenuation of the high frequencies involved, and its total length is 2.5 kilometres.

The studio is situated at 103, rue de Grenelle, Paris, and special precautions have been taken in the matter of ventilation owing to the large amount of heat generated by the lighting system. A mechanical method of scanning is used, the system being Barthélemy's *Camera de prise de vue directe de télévision*. The artists are subjected to intense illumination. A battery of six 5-kilowatt projectors is employed for general lighting, two being used for the foreground and four for illuminating the background. In addition, twelve 1-kilowatt projectors are provided for illuminating the artistes and are supported by a bridge. The arrangement of these projectors can be clearly seen in the photograph of Fig. 4. Further projectors at ground level are also used.

Since the total power expended is no less than 48 kilowatts, a very large amount of heat is generated, and to prevent this from affecting the artistes, elaborate cooling and ventilating systems have been installed. Without these arrangements the temperature in the studio would reach no

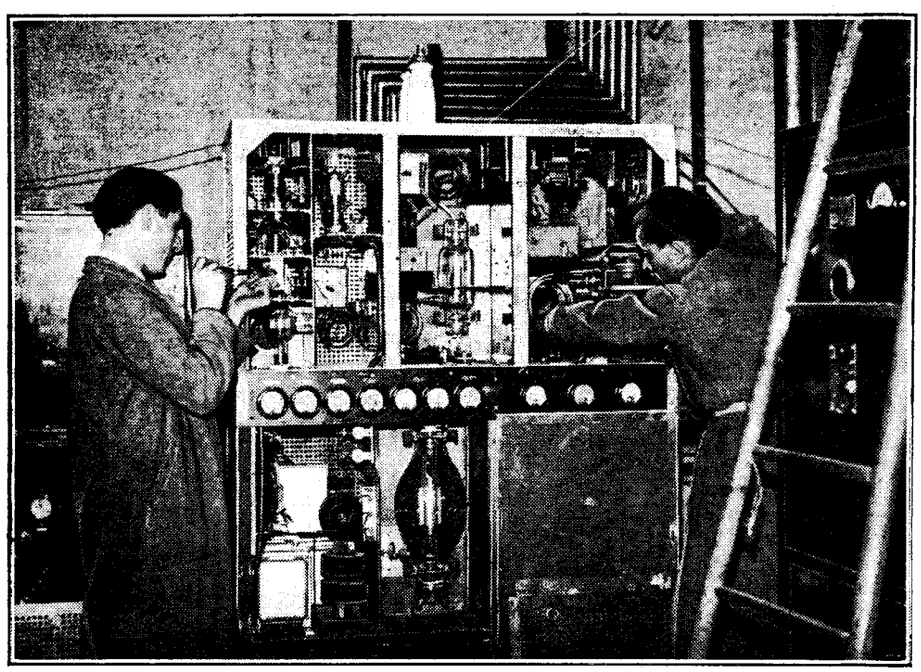


Fig. 2.—A view of part of the transmitter during the later stages of the installation.

EVISION TRANSMISSIONS

less a figure than 136 deg. F., but the cooling system keeps the temperature down to some 80 deg., which may be considered rather high for comfort, but is no more than the temperature reached on a hot summer day.

Studio Ventilation

Cooling is effected by means of a refrigerating plant which cools water in a circulating system to a suitable degree. Pumping apparatus keeps a constant current of air moving through the studio, the inlets and outlets being the "ship-type" ventilators visible in Fig. 4. The air pumped into the studio is cooled by passing it through a chamber connected with the water system, so that artificial rain is produced and the humidity of the air can be controlled.

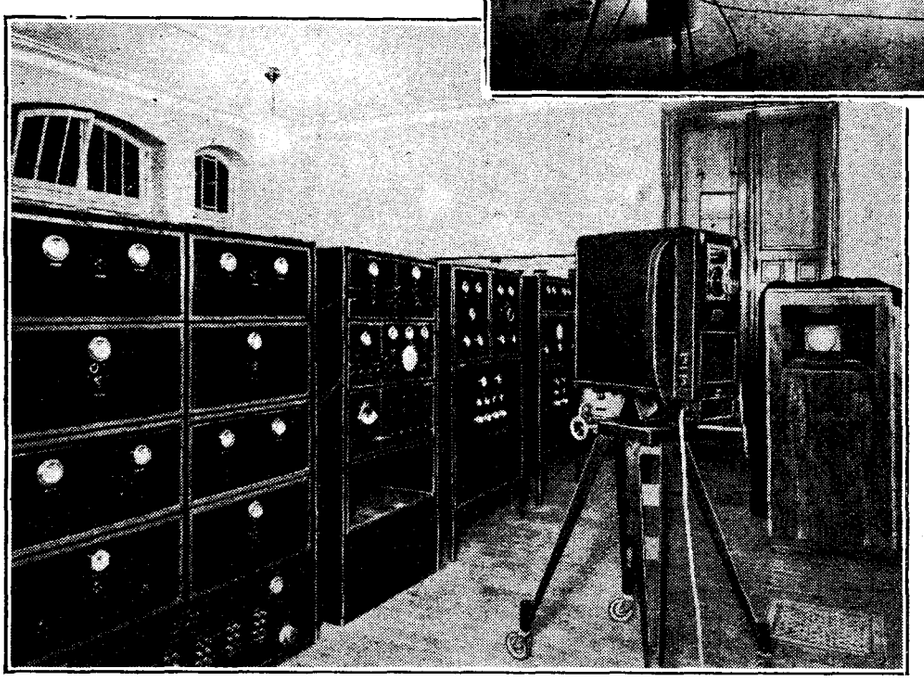


Fig. 3.—In this photograph the transmitting gear can be seen on the left with the control receiver on the right. The television camera is in the centre.

Great care has been taken to ensure that the various motors associated with this apparatus do not cause electrical interference, and all piping is lined with asbestos, probably as much to prevent the accumulation of static charges as to prevent the air being warmed by conduction on its way to the studio.

Mention has already been made of the cable connecting the studio with the transmitter, and it is of the concentric type. It does not, however, carry the modulation currents themselves, for a carrier system is used. The output of the photo-cells in the camera is amplified and used to modulate an oscillator operating at a frequency of 2 mc/s, and it is this modulated current which is carried by the cable. At the transmitter the modulation frequency currents are obtained by rectifying the received carrier, and after further amplification they modulate the transmitter.

Demonstrations of reception which have already been given are stated to have reached a high standard of clarity, and in order to popularise television it is intended to instal receiving apparatus at a number of public places throughout Paris. It is expected that these will be in operation by the end of this month, and a regular service of transmissions inaugurated.

As yet no details of the receivers employed in the demonstrations are available. Much of the success of television naturally depends upon the receivers being reasonably simple and reliable.

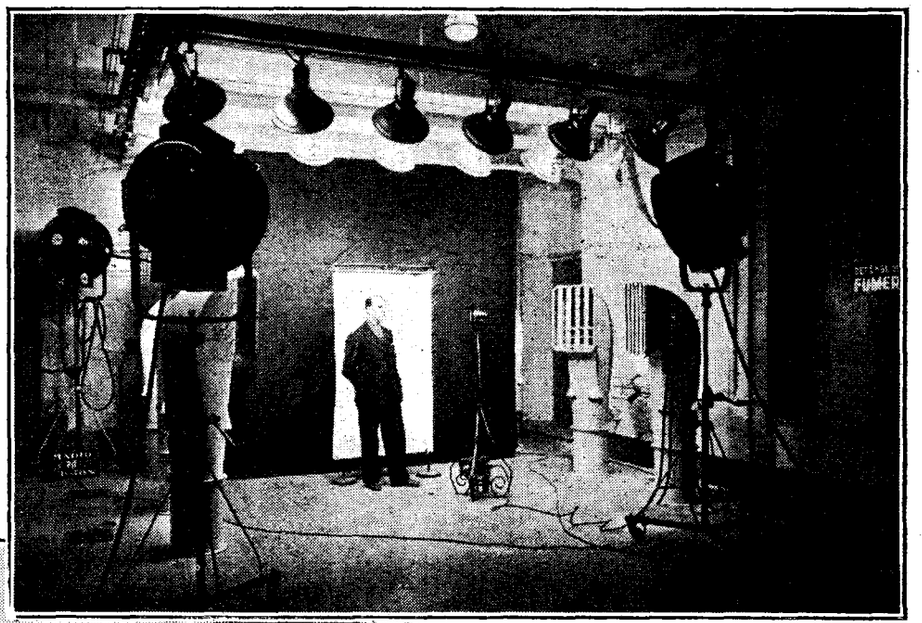


Fig. 4.—This view of the studio clearly shows the lighting system. Owing to the large amount of heat generated thorough ventilation is essential, and the "ship-type" ventilators are clearly shown.

At the Transmitting End

Technical Criticisms of Recent Broadcasts

Atmosphere

How well "The Boomerang Bet" (London National, November 18th) brought home to us the awful thought of a year's solitary confinement!

The play was extremely well done and calls for little criticism beyond the suggestion that the descent of the party down to the cell would, perhaps, have been better emphasised by the introduction of a small amount of echo. Rachmaninoff's famous Prelude was inspired by a similar, if grimmer, story, and provided an admirable atmosphere which would have been more effective had it not been a very obvious gramophone record.

On the subject of atmosphere, what an improver it can be when administered in the right doses! The flattest variety performance becomes almost entertaining when played before an audience, and, similarly, the late dance music relayed from various hotels invariably sounds much more attractive than the studio performances of Henry Hall, whether one dances or just listens.

Even the debate between Bertrand Russell and G. K. Chesterton as to whether parents are fitted by nature to bring up their children (London Regional, November 16th) came over with greater effect than would have been the case had there been no audience.

Dr. Burt's summing up was cut off very abruptly, and, although we have no legimate grouse, as he had exceeded his time, the B.B.C. might have favoured us with the usual fade-out, which would, at least, have avoided speculation as to which valve had died. H. C. H.

Peter Montgomery conducts Belfast's lighter music; at 25 he is probably the youngest conductor in the B.B.C.

Does Broadcasting

A REGIONAL TOUR OF INVESTIGATION

By LESLIE BAILY

IRELAND'S "super" station—now nearing completion at Lisburn—was Mr. Baily's main objective when he crossed St. George's Channel. He here describes the revolutionary departures from B.B.C. practice which are a feature of the new station. The prevalent notion that Belfast is a minor outpost of the B.B.C. is now finally exploded.

V.—Over to Northern Ireland

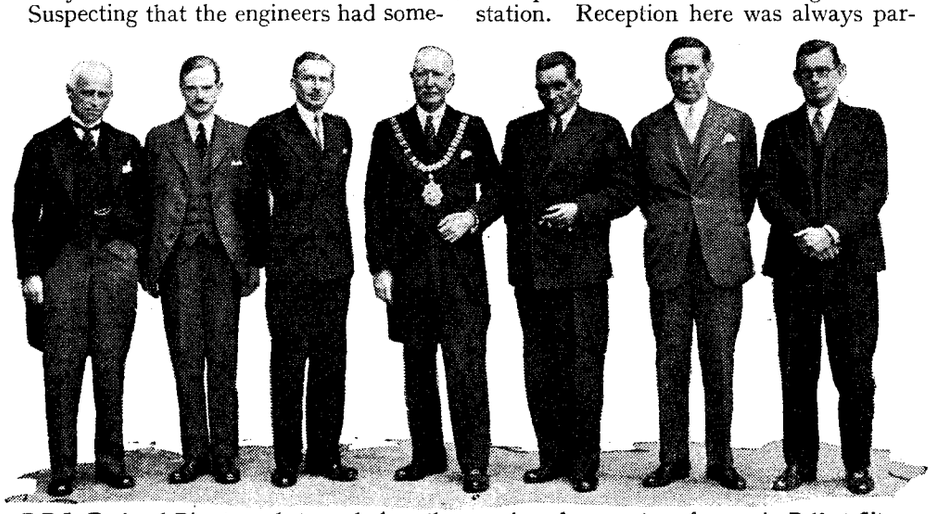
NEVER has the Engineering Division of the B.B.C. had so busy a time as the present. In a dozen or so places up and down the country, as my tour of investigation is revealing, they are erecting new studios and transmitters, and this "Renaissance of the B.B.C.," as it may well be called, offers admirable opportunities to try out new ideas in transmission and studio technique. The new Northern Ireland Regional transmitter, at Lisburn, near Belfast, has been chosen, in particular, as a suitable trial-ground for the latest notions of the B.B.C. Station Design Department. When this station starts testing, early in the New Year, its performance will be watched with exceptional interest—and not only because of the alleged anti-fading properties of its "mast-aerial." Lisburn is in almost every respect revolutionary.

Suspecting that the engineers had something like this up their sleeves, I voyaged to Ireland with the keenest expectations, but before embarking I took the opportunity to make some enquiries in Liverpool, one of those cities which were given local transmitters and studios during the first big provincial "drive" by the B.B.C. in 1924, only to lose them in 1931, when the Regional Scheme came along. This was resented by the public in some places, at Nottingham, for instance, but I had never heard of complaints at Liverpool, and so I asked a director of Claude Lyons, Ltd. (the kind of firm that has its finger on the public pulse in these matters) whether Liverpudlians are a satisfied race.

He said that reception of North Regional, 47 miles away, was quite satisfactory, but the same could not be said of North National, which fades badly. Droitwich, however, gives excellent reception here.

"Quite frankly," said Mr. L. M. Lyons, "I think that Liverpool is fortunate in having no local station. Reception here was always particularly poor when there was a small-power transmitter. There may be isolated instances of dissatisfaction at Liverpool not being 'on the map,' but this is not general. With regard to there being no studio now, I do not think this is of much importance. Programmes are frequently relayed from local places, such as Liverpool Empire; and at least two items of interest here are broadcast from North Regional every night, the American cotton closing price and the American rate of exchange, both of vital interest to Liverpool people. So I don't think we are completely neglected."

The Belfast studio building "still looks like a boarding-house," and is externally the least attractive of B.B.C. properties.

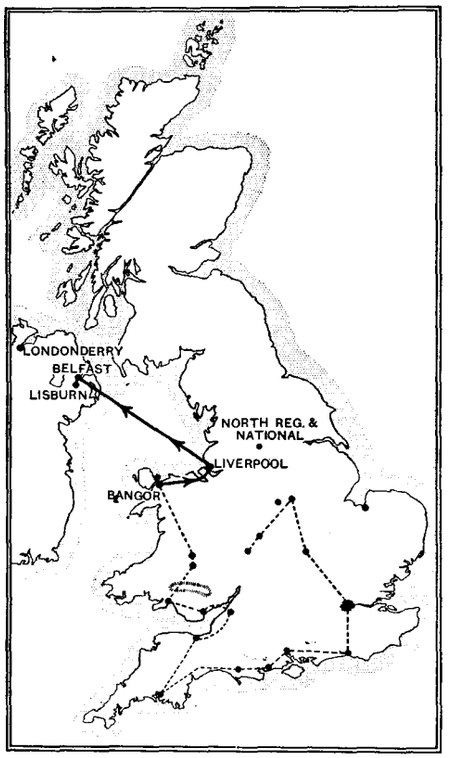


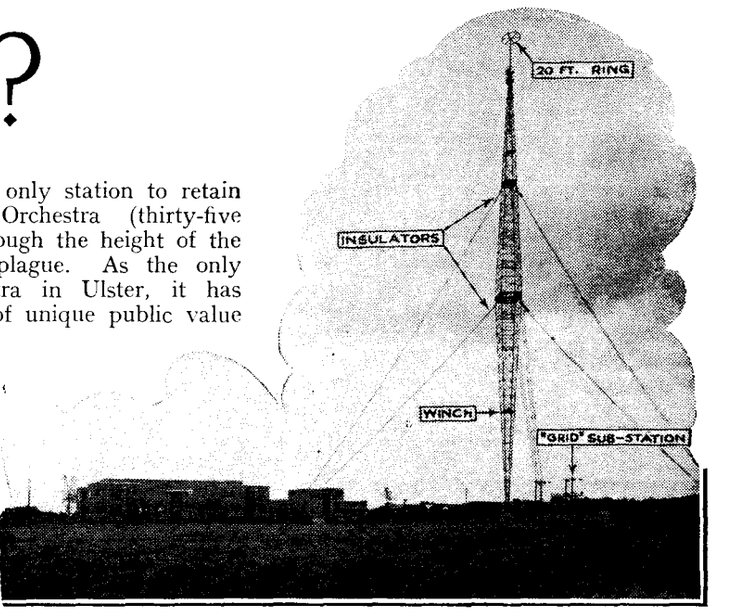
B.B.C. Regional Directors photographed on the occasion of a recent conference in Belfast City Hall. Left to right: Mr. John Archer (Town Clerk); Mr. M. Dinwiddie (Scottish); Mr. E. Liveing (North); the Lord Mayor of Belfast (Sir C. McCullagh, Bt.); Mr. Percy Edgar, O.B.E. (Midland); Mr. G. L. Marshall (Northern Ireland), and Mr. C. A. Siepmann (Director of Regional Relations).

11-Year-old Transmitter in Hut

And so to Belfast. I confess to a personal affection for Belfast; it happened to be the station that broadcast the first of my own radio plays, way back in '24. Eleven years later I find that the same transmitter and the same studio building are in use, and the latter still looks like a boarding-house. It stands in an ugly street of warehouses, and is externally the least attractive of B.B.C. buildings. Inside, the studios and offices have been modernised and extended. But the transmitter, in a wooden hut a quarter of a mile away, is much the same as in '24, with its

Serve Britain?





Lisburn's mast-aerial has roused hopes in Derry that fade-free reception may at last be possible. The mast is 475 ft. high and is surmounted by a 75 ft. tubular extension with winch adjustment for tuning purposes.

Belfast was the only station to retain a full Station Orchestra (thirty-five players), even through the height of the "centralisation" plague. As the only symphony orchestra in Ulster, it has assumed a place of unique public value under the conductorship of Mr. Godfrey Brown, the Music Director here. He and Mr. Williams are the only old-stagers of "2BE" days; the Regional Director, Mr. G. L. Marshall, came here from Edinburgh and Newcastle in 1933, and has lately been augmenting his staff with several new young men, mostly Irish. Under the veteran Godfrey Brown, for instance, works Peter Montgomery, conducting lighter music; at 25 he is probably the youngest conductor in the B.B.C.

The notion prevalent "across the water" that Belfast is a minor outpost of the B.B.C. is, of course, quite wrong. The Belfast transmitter broadcasts a mixture of Regional items relayed from England or Scotland, plus a strong ingredient of local material, and the total staff maintained here (including orchestra) is actually eighty-two.

Adjoining property was lately acquired to accommodate new staff and for an extra studio, making five in all. Thus, the expansion that I observed at Bristol, and again at Cardiff, is also afoot here in Ireland. Vigorous John Sutthery, a man of varied B.B.C. experience, came here as Programme Director a year ago, and has especially striven to get the microphone out into the highways and byways of Ulster. The number of outside broadcasts has trebled since Mr. Sutthery's advent, and feature programmes reflecting the life and lore of these fascinating Six Counties are to be pushed henceforth.

All Eyes on Lisburn.

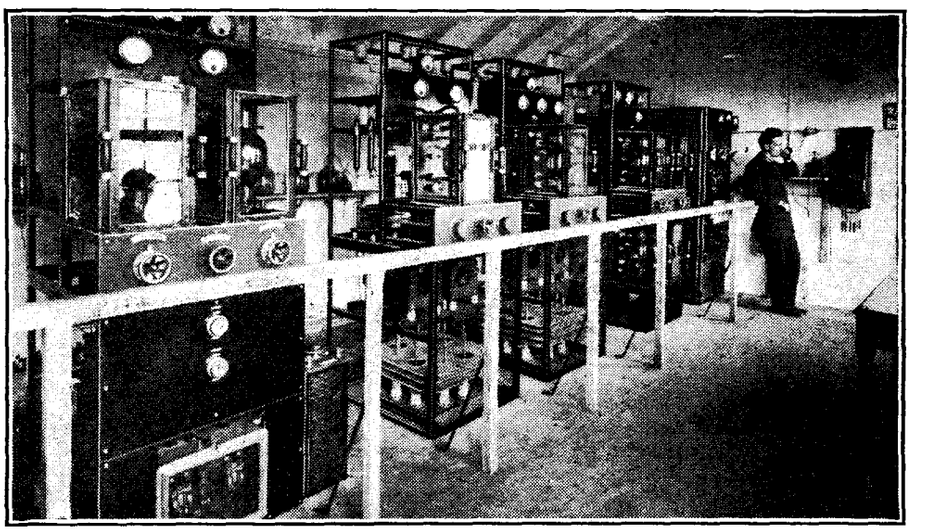
A great deal of Irish interest has been aroused by a monthly series under the title, "Provincial Journey." The microphone visits the Town Hall, or other rendezvous, in a town anywhere in Ulster, and all the local worthies of any and every type are there to do their stuff. Each town strives to beat the others. "I thought," said Mr. Sutthery, "it would be a good thing to stimulate local pride, but the results are more than that—we know, for instance, that these programmes have stimulated the local wireless trade."

Until Lisburn is in action, however, little attempt is being made to exploit programme possibilities in the Londonderry district, because this is beyond the range of the present transmitter. Roughly a third of the population of Northern Ireland is in Belfast, so the "Q" set's one-kilowatt suffices to reach quite a large populace; the question now is how many of the remaining two-thirds will be brought into the Regional fold by Lisburn's 100 kilo-

sausage aerial slung to the tall chimney of an electric power station.

The transmitter has acquired a Parkin Drive, to maintain its frequency constant within plus or minus ten cycles, and there are a few other small modifications, but, basically, it remains the famous Marconi "Q" set as installed at all the original "main" stations. Now its days are numbered.

Mr. Williams, who has been Engineer-in-Charge of Belfast studios and transmitter since 1924, has been transferred to take charge at Lisburn, and is succeeded by Mr. Basebé, who has a staff of a dozen engineers. The lines from England come now from Glasgow, the submarine section being between Portpatrick and Donaghadee. Better quality is achieved than by the earlier route, via the Isle of Man to Manchester, and this has resulted in the B.B.C. Northern Ireland Orchestra being relayed more often lately across to other stations.



The famous Marconi "Q" transmitter at Belfast, which will continue to handle the Northern Ireland programmes until the high power station at Lisburn supersedes it.

Does Broadcasting Serve Britain?

watts (for National programmes everyone in Ulster is supposed to be able to get satisfactory reception from Droitwich). The wireless licence figure for all Ulster is about 75,000. Lisburn should increase that greatly.

Londonderry, a town of 45,000 inhabitants, is 60 miles from Lisburn, with the Sperrin Hills rising to over 2,000ft. in between. The liveliest speculation about that impressively gigantic mast-aerial which I saw at Lisburn is whether it will give fade-free reception over in 'Derry. This type of mast is a new venture for the B.B.C. It is a cigar, 26ft. across at the middle and about 4ft. across at top and bottom. It is 475ft. high, surmounted by a tubular extension (for tuning). This 75ft. tube may be raised or lowered by the winch indicated in our illustration; the "cartwheel" at its top is 20ft. in diameter, and was no small proposition to get up there! The entire mast and its guys are elaborately insulated from earth, since the high-frequency energy is fed directly into the steel-work.

Other departures at Lisburn from conventional Regional station practice are:—

1. Connection from transmitter to aerial transformer house, at base of mast, by "concentric feeders"—copper tubes standing 3ft. above ground with live-wire insulated inside (as used at Daventry short-wave station).

2. Transmitter circuit is of series-modulation type first tried at Droitwich National, with improvements resulting from experience there.

3. Instead of separate units, all transmitter gear is in one giant panel, 45ft. long by 8ft. high.

4. The station will not generate its own power. This will be taken from 33,000 volts "grid," stepped down to 415 volts A.C. at nearby transformer station (see picture), but an emergency generating plant (a gigantic 600 h.p. Diesel driving a 395-kilowatt alternator) could run the station at decreased power.

5. Diesel exhaust gases being unavailable for heating premises, a 10,000-gallon hot-water storage tank has been installed, the water being heated by an electrode boiler.

6. All-mains control room.

The building itself appears to be even more "modern" in style than B.B.C. buildings usually are, with its steel corner-windows, and it has been most attractively carried out in a lovely brownish brick specially imported from England.

Indeed, in appearance, with its towering cigar mast, Lisburn beats all the older Regional stations; the radio and constructional engineers and the architects have combined to make this the B.B.C.'s "super" station—and this is a legitimate use of that much-abused word.

(**Next Tour:** *Glasgow and the Highlands.*)

Random Radiations

By "DIALLIST"

Wired Homes

THE latest survey of the number of homes in this country that are wired for electric light was completed in September, and very interesting reading it makes. In the country there are 11,336,376 homes of which 6,073,706 have supplies of electricity. This represents 53.6 per cent. of the total, and it may surprise readers to know that this percentage is amongst the lowest in Europe. In Switzerland, for example, 99 per cent. of homes have electric light; in France, 93.6 per cent.; in Sweden, 84.5 per cent. In Austria (59.5 per cent.) and Italy (56 per cent.) the figures are somewhere near our own, and Hungary, with 34.4 per cent., is worse off even than we are. Still we are progressing for, as the survey shows, the average annual increase in wired homes for the past three years has been well over half a million.

Higgledy-Piggledy

There are still no less than 1,037,729 homes served by DC supplies as against 5,035,977 which have AC. But despite the progress made by the Grid system the diversity of voltages and periodicities in this country is something almost beyond belief. Looking down a list showing the supplies of the larger towns in Great Britain, I find that DC ranges from 100 to 250 volts with figures such as 105, 110, 130, 200, 210, 220, 230 and 240 in various districts. The AC supplies are even crazier. They run from 100 volts, 50 cycles, to 250 volts, 40 cycles, with curiosities such as 110 volts, 25 cycles; 100 volts, 100 cycles; 100 volts, 40 cycles; 115 volts, 50 cycles; 200 volts, 83 cycles; 200 volts, 100 cycles; 220 volts, 25 cycles; 230 volts, 25 cycles; and 240 volts, 40 cycles in between. Even in London the DC voltages vary from 100 to 240 and the AC supplies from 100, 104, 105 and 110 volts at 50 cycles to 200, 205, 220, 230 and 240 volts at 50 cycles.

The strangest cases are those of towns with a pretty wide selection of supplies. In Prescot, for example, you may have 240 volts DC or 115 volts, 50 cycles AC or 230 volts, 50 cycles AC. Newcastle-on-Tyne offers you 230 volts DC, 100 volts, 40 cycles AC, 240 volts, 40 cycles AC, or 250 volts, 40 cycles AC. At Torquay the selection includes DC 100 volts, DC 240 volts, AC 200 volts, 50 cycles, AC 240 volts, 50 cycles. I have even heard of cases where the odd numbered houses on one side of the street have AC, whilst the evens on the other side are served by DC. One can see now why it is that the AC/DC set is so popular amongst Britons.

Election Night

LIKE most of you, I expect, I sat up into the small hours on election night listening to the results. A thrilling business it was, for no one seemed to have an idea beforehand of the way in which things were going to go. I should like to congratulate the B.B.C. on the way in which the results were given. I found that I had just time comfortably to fill in the figures and so on in the newspaper list of constituencies whose results were to be announced that night. In 1931 the announcemens were rather too long drawn out, and this year's method was, to my mind, a very big improvement. I couldn't help thinking of my listening to the results in 1929. On that occasion I was in hospital, due for a biggish operation at nine o'clock the next morning. I took with me a specially made portable with head-phones, and listening to the results as they came in helped to pass the time away.

Television in February

AT long last we are told that the London high-definition television service is likely to start its test transmissions next February. However, lest our expectations should be raised too high, we are warned that regular programmes will not be sent out until completely satisfactory results have been obtained from the tests, a business which may take some weeks or even months. Myself, I hardly expect to see the service in full swing much before the summer, though the tests will be very useful to experimenters, so long as the times at which they will take place are duly announced beforehand. It is good news that the B.B.C. intends to have viewing rooms in various parts of London in which the public will be able to see just what television can and cannot do.

Progress in France

Meantime M. Mandel is very busy with the French television service. It is claimed that the 180-line transmitter installed in the Eiffel Tower represents a very big advance on anything that has yet been seen. It is a pity that the Paris transmissions will not provide a service in the ordinary way in this country, for it would be most interesting if one could make comparisons between our brand and the French.

Wireless for Novelists

IN a novel the other day I found the hero engaged in sitting at the controls of his receiving set and "burning the midnight ohm!" Curious—isn't it?—how few of those who write seem to know the first thing about electricity in general and wireless in particular. When the villain flicks over the switch the heroine is aghast (as well she may be) to see that a current of a million microfarads a second is flowing through the voltmeter. Or, as the ship sinks, the gallant wireless operator stays nobly at his post, working tapping keys with both hands, and at every tap sparks fly from the aerial. One of the few writers who has dealt faithfully with wireless is Kipling. The other day I picked up one of his books—*Traffics and Discoveries* I think it was, though I am not sure—and, turning over the pages, I came across a short story entitled "Wireless" which was written in the very early nineteen hundreds. It is particularly interesting, for it shows that Kipling not only understood what was going on during the experiment of which he was a witness, but also realised in a remarkable way the enormous part that wireless was going to play in the world within a very few years. You will find the story well worth reading if you can get hold of it.

CURRENT TOPICS

EVENTS OF THE WEEK IN BRIEF REVIEW

Studio in a Garden

CRACOW'S new broadcasting centre occupies a residential villa, the garden of which is to be used as an outdoor studio in the summer. It is surrounded by trees and other gardens shielding it from street noises.

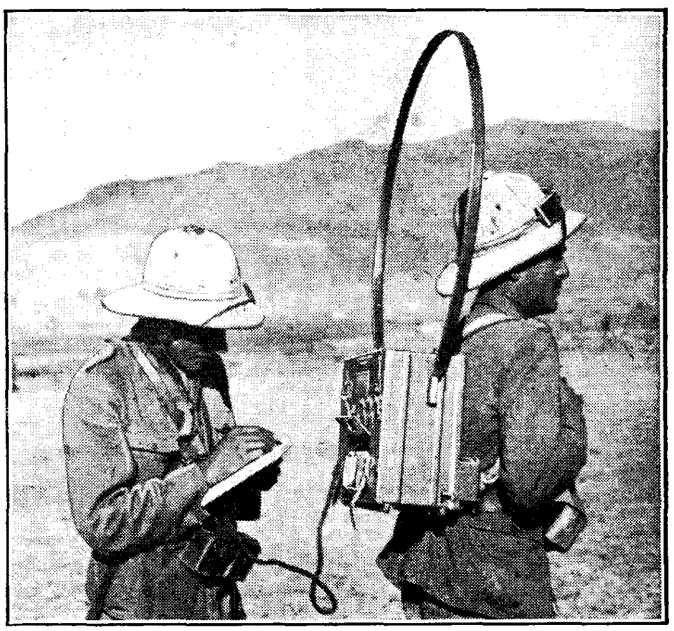
Radio Parasites : New Version

THE anti-static war in France has yielded a harvest to "fly-by-night" radio concerns manufacturing cheap appliances guaranteed to stop all forms of interference. The *Chambre Syndicale des Industrie Radioelectriques* warns the public to be on its guard.

Aircraft Radio Demonstrations at Science Museum

VISITORS will be able to work wireless demonstration gear at the Imperial Airways' Exhibition which the Secretary of State for Air is opening at the Science Museum on Thursday next. The display will be open to the public from December 6th to January 31st.

Designed to illustrate the development of air communication within the Empire, the exhibition will include models of every type of air liner owned by the company since its inception. There will also be working models showing the part which wireless plays in the control of aircraft when flying in fog or above cloud; visitors, by pressing a button, will be able to hear the voice of the captain calling for his position and the replies from ground stations.



A REAL FIELD DAY. The Italian troops in Abyssinia are making full use of wireless, and portable sets of the type shown above are in constant operation during advances over difficult country.

Reinartz Again

THAT pioneer of short-wave research, John L. Reinartz, offers listeners an opportunity to test for themselves the rapidly improved conditions on the 28 mc. (10 metre) band. He is transmitting from U.S. on that frequency every day at 17.30 G.M.T. and on Saturdays at 15.00 and 17.30 G.M.T. On Sundays—the best period for most listeners—he will be on the air at 15.00 to 16.00 G.M.T.

Two Million Radio Cars

PRACTICALLY all America's new season cars make provision for radio equipment, according to a Washington correspondent, who states that it is estimated in trade circles that two million "auto radios" will have been sold by the end of 1935 as compared with one million during 1934.

"Low Power"

"NO member shall use more than 150 watts input" is the cardinal rule of a proposed low-power transmission club proposed by an American amateurs' magazine. The suggestion has caused amusement in European amateur circles, where 150 watts is considered to be really high power. In fact, the average input on this side of the Atlantic is only 10 watts.

Studio Design

"THE Acoustical Design of Broadcasting Studios" is the title of a paper by Mr. H. L. Kirke and Mr. A. B. Howe, M.Sc., which will be read at a meeting of the Wireless Section of the Institution of Electrical Engineers on Tuesday next, December 3rd, at 6 p.m. at the Institution, Savoy Place, W.C.2.

High Fidelity Transmission

ANOTHER high fidelity (or "hi-fi") station has just made its appearance on the U.S. ether. It is W2XR on Long Island, and is radiating transmissions with an audio range up to 10,000 kc. Operated by a pioneer firm of radio advertisers, it does not use the normal broadcast channel; its wavelength of 193 metres permits "hi-fi" transmission without sideband interference.

Lucky Hungarian Listeners

TO mark the tenth anniversary of Hungarian broadcasting, the authorities are granting exemption from wireless taxes during the next three months to all those persons who became subscribers during the period July 1st to September 22nd last. A broadcasting library is also being organised, and a propaganda film is in production.

Hungary's first big radio exhibition will be held next year.

Winding Up the Wireless League

AT an extraordinary general meeting of the Wireless League at 3.15 on Friday next, December 6th, members will consider and, if thought fit, pass a resolution authorising the Committee to take steps for the purpose of winding up the League. Preceding this meeting, which will be held at the Royal Automobile Club, Pall Mall, London, S.W.1, will be the eighth annual general meeting, for the purpose of considering the report and the accounts of the committee for the past year and electing new committee members.

Danish Amateurs Encouraged

MANY valuable concessions from the P.M.G. have been obtained just lately by Danish amateur transmitters. Among the most important is that which reduces the annual licence fee to 10 kroner. Another permits experimenters who are only sixteen years old to possess transmission licences.

U.S. President's New "Mikes"

TWO new microphone stands, one a portable for train broadcasting and the other a permanent arrangement, have been built for President Roosevelt by the Columbia Broadcasting System's engineers.

The permanent stand replaces a two-year-old desk contrivance which has undergone the rigours of more than one hundred Presidential speeches and is becoming wobbly. Both the new stands have microphone racks prominently displayed. The old stand concealed the microphones because the former President Hoover objected to having them on view. President Roosevelt, however, prefers an exposed microphone, so that station emblems are plainly displayed to the audience present.

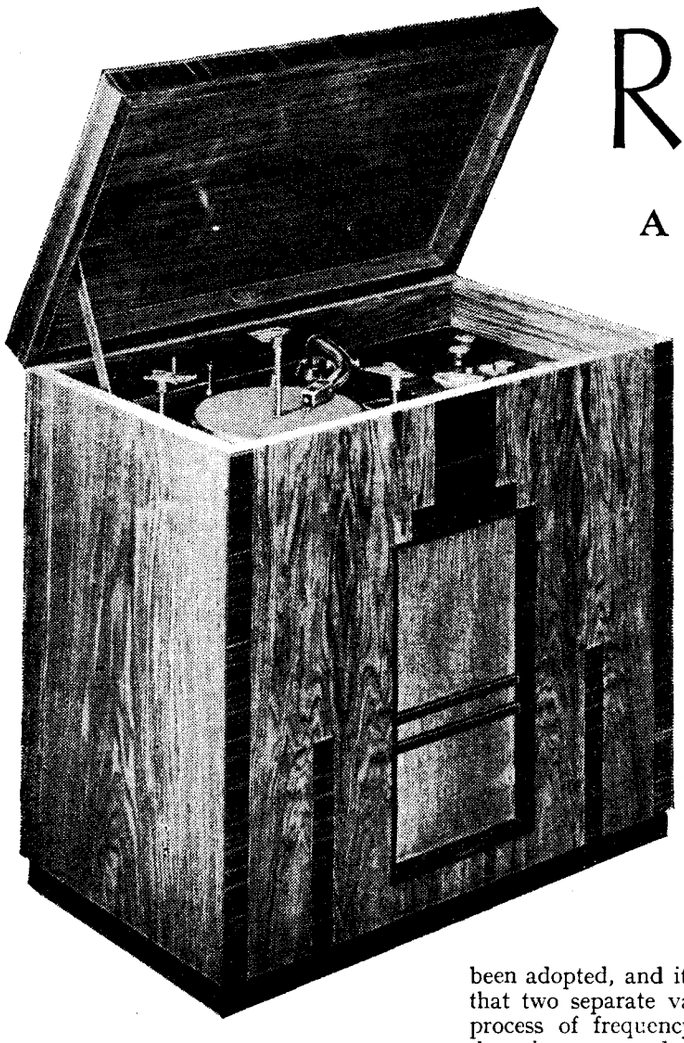
Quick Work

RADIO servicing by 'plane is the new fashion set by G. Scott Sessions and Co. Following the receipt of an urgent telegram from an Isle of Man customer, a service engineer last week took 'plane from Heston to Douglas, arrived there within a few hours, repaired the receiver, and returned to London in record time.

SET SERVICING BY AIR. The service engineer sets forth, as described above.

R.G.D. Model 704

A Medium-priced Quality Radio-gramophone



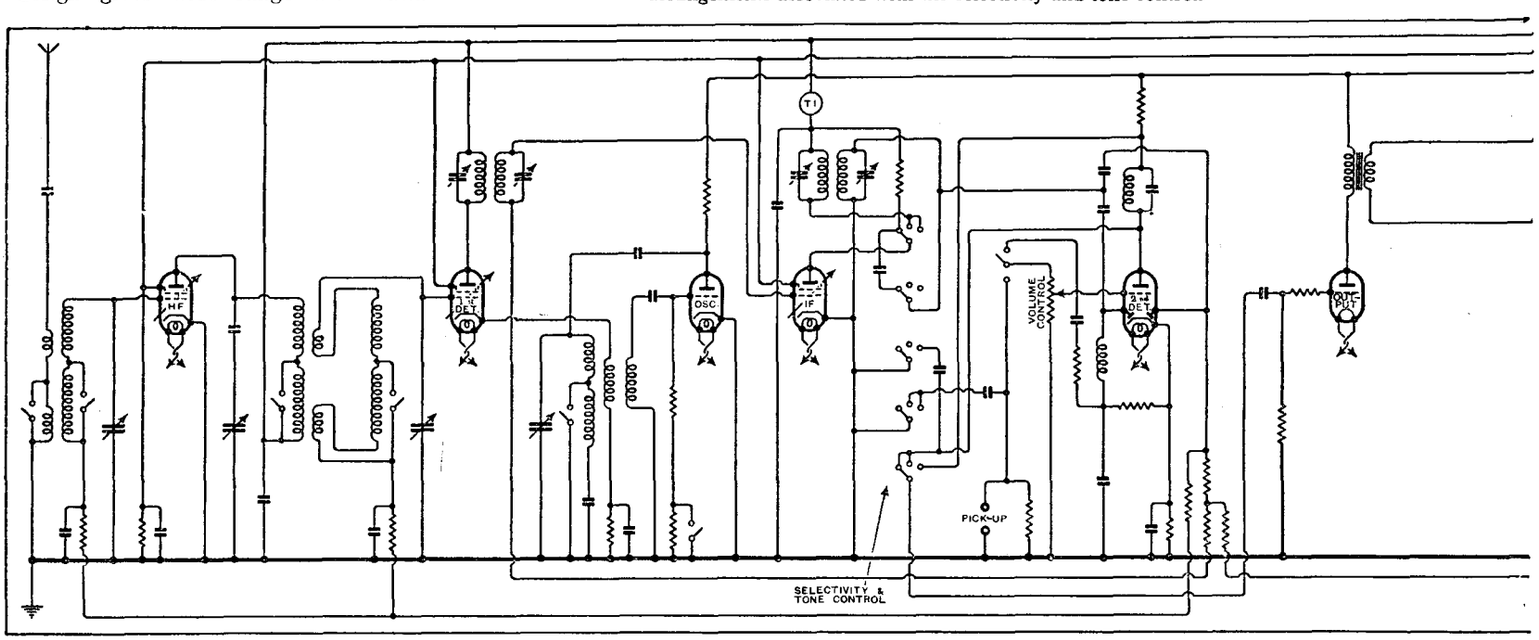
FEATURES.—***Type.***—*Radio-gramophone with automatic record changer for operation from A.C. mains.* ***Circuit.***—*Screened grid HF amplifier—screened grid "mixing" valve—separate triode oscillator—screened grid IF amplifier—double-diode-triode second detector—triode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Tuning (with meter type indicator). (2) Volume and on-off switch. (3) Variable selectivity and tone control. (4) Waverange switch.* ***Price.*** *— 55 guineas.* ***Makers.*** *— Radio Gramophone Development Co., Ltd.*

ALTHOUGH moderate in price by comparison with some of the more ambitious products of this firm, the Model 704 nevertheless incorporates most of the features upon which the R.G.D. reputation has been built. A radio receiver chassis of advanced design gives wide range with variable selectivity; volume and quality are in keeping with the imposing dimensions and solidity of the cabinet, and as much care and thought have been put into extracting the best possible performance from gramophone records as have been devoted to the perfecting of the radio side.

A superheterodyne circuit has been adopted, and it is interesting to note that two separate valves are used in the process of frequency-changing. One of these is a screened grid "mixing" valve and the other a triode oscillator. A signal-frequency HF amplifier precedes the mixing stage, and the band-pass filter is situated in the coupling between the stages instead of in the aerial input circuit as is usual. The single IF stage includes a maximum of four tuned circuits, but the number is reduced to three in the "high fidelity" position of the selectivity and tone control switch. A double-diode-triode is used in the second detector stage, the diodes being connected in parallel for both signal rectification and the supply of AVC bias. The triode amplifying portion of this valve includes a tuned LF filter in its anode circuit. The resistance-capacity coupling to the large triode output valve may be taken from either end of this filter so that it functions either as an acceptor or a rejector of the higher frequencies. The circuit arrangements of the combined selectivity and tone control on radio may be briefly summarised as follow:—In position 1, a resistance load replaces the tuned primary of the output IF transformer. The secondary winding then functions as a "tuned grid" circuit, except that in this case the circuit actually feeds into the diode. The LF coupling condenser to the triode output valve is connected to the bottom of the filter circuit in the anode of the second detector valve to give a high-note lift.

In position 2, the switch restores the

The circuit is notable for the employment of a separate oscillator valve and for the switching arrangements associated with the selectivity and tone control.

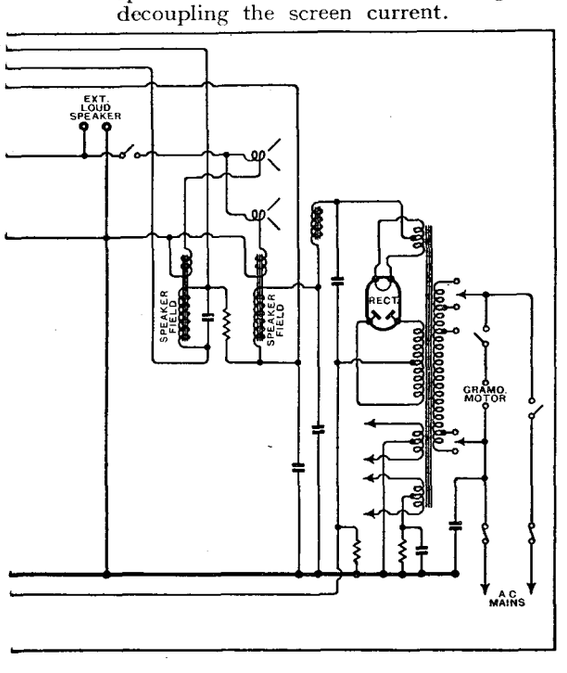


normal output transformer connections, which increases selectivity at the expense of slight side-band cutting; but the LF circuits remain the same as in position 1.

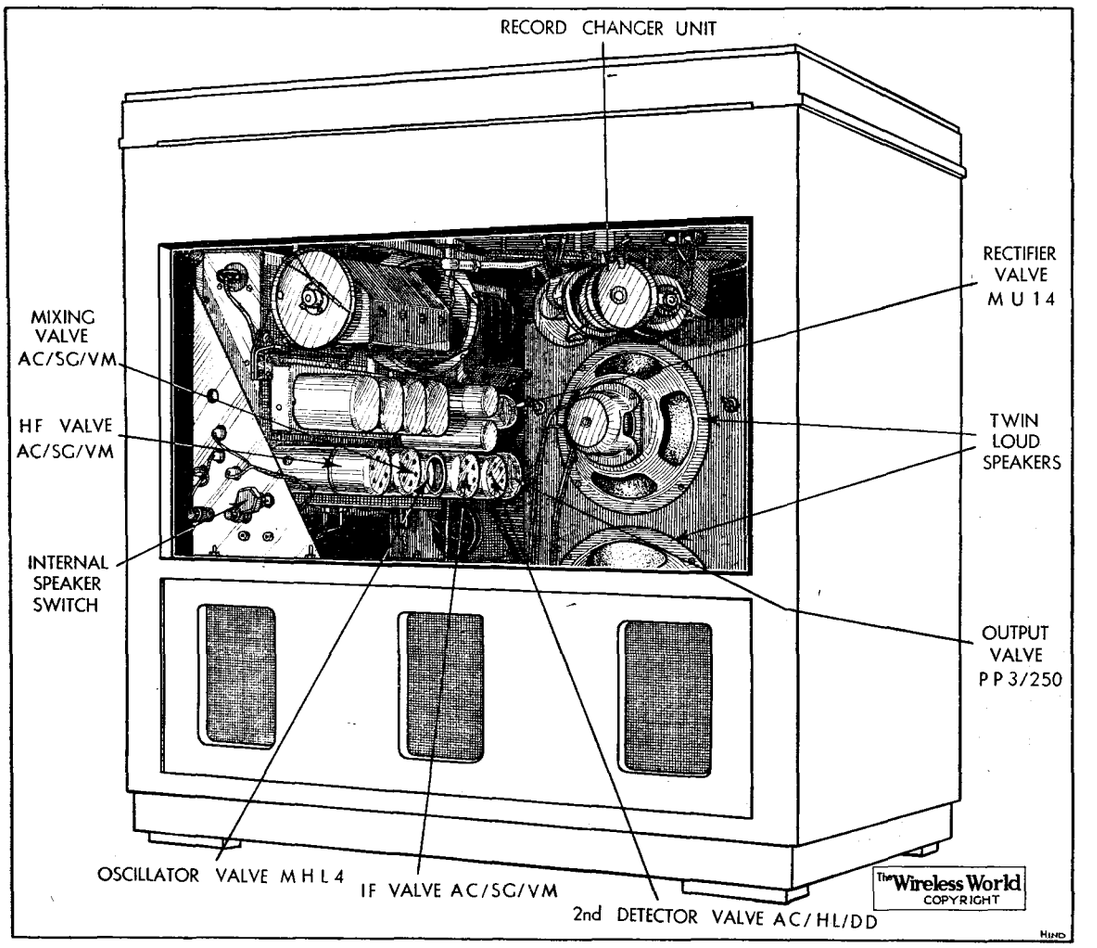
In positions 3 the IF circuits remain the same as in position 2, but the LF coupling condenser is transferred to the top of the filter, which now acts as a rejector for the higher frequencies. At the same time an additional by-pass condenser is connected between the anode and earth.

On the gramophone side positions 1 and 2 both give a boost to the higher frequencies, but in position 2 this is less as a condenser is shunted across the volume control potentiometer. In position 3 this shunt still remains in operation, but the LF coupling is changed to convert the filter into a rejector for the higher frequencies. The twin loud speakers, which are both energised, have their speech coils connected in parallel. The diaphragms are of different diameters in order to cover as wide a frequency range as possible. Provision is made for the addition of an extension loud speaker, and a switch is incorporated to cut out the internal loud speakers if desired.

The smoothing of this set is very thorough, the first stage being a separate choke in the chassis and the second a field coil on one of the loud speakers. The other loud speaker field is used for smoothing and decoupling the screen current.



The range is exceptionally good, even taking into account the inclusion of a signal-frequency HF stage. It is no exaggeration to say that the performance on medium waves in daylight is equal to that of the majority of four-valve sets under the far more favourable conditions of night reception. Though there is naturally some improvement in the matter of background noise on the weaker Continental stations after dark, the automatic volume control, combined with the high sensitivity, goes far to level the difference between day and night conditions.



The chassis is mounted at the side of the cabinet with the controls passing vertically through the motor-board. Twin loud speakers of different diameters are used to cover the frequency range.

High Selectivity.

The selectivity necessary to make full use of the range on distant stations is provided by position 3 of the selectivity and tone control switch. This gave easy adjacent channel separation for all stations except the local Brookmans Park transmitters, and even here the spread was considerably less than one channel on either side. Furthermore, the range and selectivity were maintained at both ends of the dial, where it is a common experience to find some falling away. Second-channel whistles have not been permitted to deduct marks from an otherwise 100 per cent. radio performance.

The effect on quality of each successive step in the variable selectivity control is well defined. In position 3, the setting for highest selectivity, top response has been somewhat ruthlessly sacrificed, and the bass, which at all times is ample, is rather overpowering and inclined to invest the lower strings with the qualities of the tympani. Position 2 gives greater clarity with a strong upper middle register, and a further turn to position 1 extends the response in the top to the point where station heterodynes are audible. The extreme top, however, is not strong enough to pull much weight against the vigorous upper middle register, and most people will prefer to use position 2, except possibly for the local stations. Pianoforte reproduction is excellent, and if there is any tendency for speech to be "chesty," this may be taken as an indication that the volume has been turned up too high.

In the reproduction of gramophone records a similar range of tonal qualities is available. The pick-up is of the piezo-electric type, which is notable for the light load it imposes on the record groove.

The cabinet, which is finished in dark figured walnut and macassar ebony, measures 31¼in. × 32in. × 19in. The design is simple and dignified, and the heaviness of its construction conforms to the established R.G.D. standard. Not the least attractive feature is the weight compensated lid, which is easily raised and can be released at any angle without fear of slamming.

UNBIASED

By FREE GRID

So Simple

APPARENTLY there are people in the world apart from women and wireless manufacturers in whom wisdom and understanding concerning matters relating to wireless are at a discount.

I happened to be returning home in the small hours of the morning recently after a rather heavy night at the local wireless society in which tempers had risen somewhat concerning the quality of the refreshment provided by the committee. My homeward way lay, for some distance, in the same direction as that of a newly joined member of the society, and accordingly we accompanied each other as far as his house into which I stepped for a moment to partake of a friendly dose of cod-liver oil which he informed me he had found invaluable for keeping out the chill of the night air.

Had the misfortune to trip over the bottle of milk.

I felt that it would, to say the least, have been boorish and unmannerly of me not to return his hospitality, and accordingly we both went on to my house to partake of some warm milk. Unfortunately my new friend had the misfortune to trip over the bottle of milk which the early morning lactitian had left upon the door-step, and thus deprived us of the refreshment we so sorely needed. There was nothing for it therefore but to return to his abode and seek the bottle which would by now have been left upon my friend's door-step. In addition, of course, I had to go with him in order to retrieve my spare pair of socks which I had lent him in place of his own milk-soaked ones.

Our conversation during these peripatetic nocturnal perambulations naturally turned on the subject of wireless, and I learned with interest that my friend was a complete novice at the game. He was, in fact, a newly-made convert who had for many years detested broadcasting and all its ways, but had at length been forced to buy a wireless set in order to be able to defend himself by means of reprisals against the steadily rising tide of noise emanating from the houses of his neighbours. He had, so he informed me, learned the effectiveness of the mere *threat* of reprisals as a result of his service in the Air Force during the war.

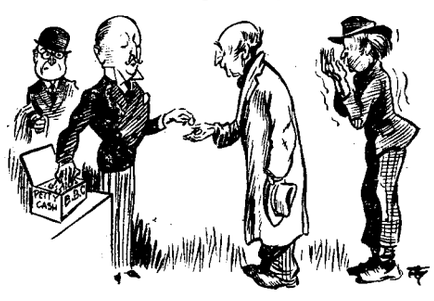
I found, however, that he was exceedingly embittered against the powers that be, more especially the B.B.C., whose apathy in the matter had, he declared, forced him to take these drastic and expensive steps to protect himself and his family from the blare of noise on either side of him.

"The whole matter of excessive loud speaker volume late at night keeping respectable people awake could be easily settled by the B.B.C.," he declared angrily as we stood in his porch. "All that is necessary is for the Corporation to cut down the power of its transmitters by half or even more at 10 p.m. each night"!

Alternative Programmes

ALTHOUGH I feel it incumbent upon me to offer just criticisms from time to time of the activities of the B.B.C. I am always ready to live up to my family motto of *audi alteram partem* and to bear in mind any extenuating circumstances which may be pleaded as justifications for its misdemeanours.

I often think that one of the worst of the B.B.C.'s faults is its policy of diagonalising the programmes whereby we have a certain play or concert from the National transmitter one night and the same thing repeated on the Regional wavelength on a subsequent night. Please do not misunderstand me. I think the scheme perfectly sound in the case of programmes of outstanding merit as it gives an opportunity for more people to hear them than if the programme were confined to one night only. But I have often asked myself why it is done so often in the case of quite unimportant items. In the past I have, I fear, frequently been guilty of speaking in my haste like David of old, and have unjustly condemned the B.B.C. without a hearing as, in my ignorance, I could never see why this diagonalising business was necessary.



Poor authors are paid such niggardly sums.

Until recently I could never see that much advantage accrued to the B.B.C. by this method. The B.B.C. could not, I argued, be doing this sort of thing on the grounds of economy, since in any case the artistes had to be paid for two evening's work and so they might as well broadcast new material. True, the same play could be made to serve for two evenings and thus the expense of buying the copyright of a new one avoided but, as is well known, poor authors of plays are paid such niggardly sums compared to the stars who do the performing that such a saving would be negligible.

I was expressing these views somewhat strongly the other evening in the privacy of my home circle during the broadcasting of a certain play—the second dose of it that week—when a friend well known in theatrical and broadcasting circles was ushered in. After the play had dragged on wearily to its painful close my friend, after remarking—somewhat irrelevantly, I thought—upon the increasing skill of the B.B.C.'s engineering staff at this sort of thing, concluded by saying, "Why, you could scarcely hear the needle scratch at all."

I immediately demurred at the base suggestion against the B.B.C. which was implied in his remark. So far from feeling ashamed, however, my friend expressed astonishment both at my opinion that there was anything base about the B.B.C.'s conduct and at my ignorance of the fact that the B.B.C., compelled to exist on a mere pittance by the grasping nature of P.M.G., who collars the cream of the licensing fees, was compelled to save artistes' fees by recording the first night's performance of a diagonalised programme and using the result to provide the second night's entertainment.

Well, well, we live and learn and I can only make what amends I can by removing headgear as a tribute to the B.B.C.'s courage in striving to carry on valiantly in the face of grave pecuniary difficulties and to the ingenuity displayed in thus endeavouring to make both ends meet.

Pneumonia Plays

I MUST ask you to forgive me if I seem a little out of humour this week, but, as a matter of fact, I am in bed, suffering from a slight chill. This is the direct result of listening to the rather considerable number of pneumonia plays which the B.B.C. have been putting over lately. I am usually fairly well fortified against this sort of thing, as during the winter months I take my little daily dose of cod-liver oil with unfailing regularity. Some of the B.B.C.'s plays lately have been so humid, however, that they have penetrated even my elaborate defences and I have, on medical orders, been compelled to give up listening until I am fully recovered once more.

Subterranean Aircraft Beacon

EXPERIMENTAL BLIND-LANDING SYSTEM AT CROYDON

WIRELESS aids to navigation, and particularly wireless direction finders, have already done much to minimise the terrors of fog, although it is still the airman's greatest enemy. By existing and well-tried methods, an aircraft may be guided to the aerodrome of destination, but, having got so far, the pilot is in a truly unenviable position if, in conditions of "zero visibility," he is still unable to land safely.

Supplementary guiding systems, devised with the object of leading an approaching aircraft right down to earth in such conditions, have already been developed; the Lorenz system, described in our issue of April 5th, 1935, has already passed beyond the experimental stage.

The Wireless World was recently privileged to examine the working of another blind-landing system, developed by Mr. D. Sharman, B.Sc., and now installed experimentally at Croydon Aerodrome by special permission of the Air Ministry.

Flying Down the Beam

A short-range directive beacon might be set up on the lines shown in Fig. 1*a*, which represents the radiation of two closely adjacent transmitters, one sending out the letter A and the other the letter N in morse code. An aircraft fitted with a suitable receiver, and slightly to the westward of its proper course, on approaching the

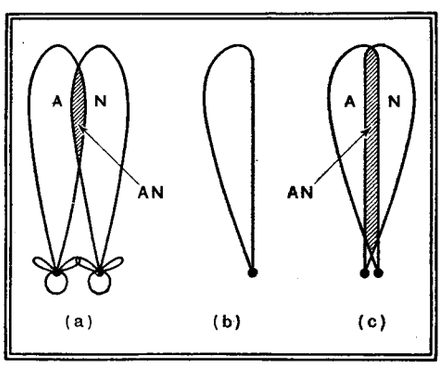
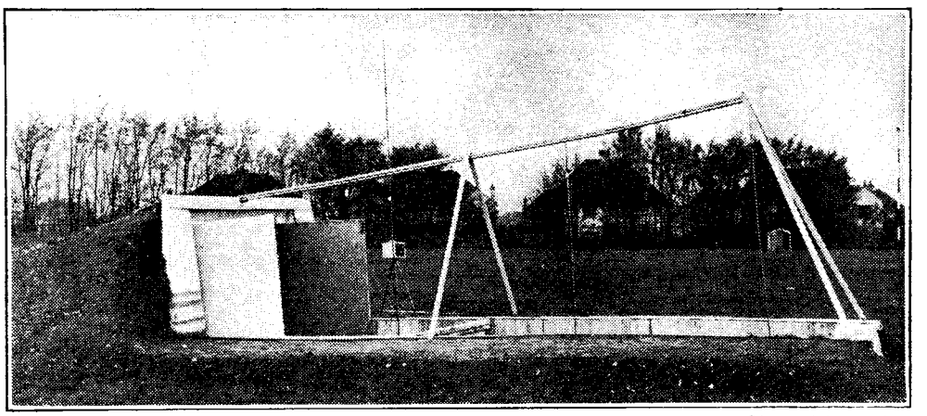


Fig. 1.—Polar diagrams illustrating the overlapping of fields of radiation from adjacent beacon stations.

beacon would first pick up the "A" transmission and would accordingly edge in towards the eastward until it reached the area corresponding to the shaded portion of the diagram. Here it would come into the field of radiation of the "N" transmitter; both A's and N's would be heard at substantially equal strength, and the overlapping morse symbols for these letters would be audible as a continuous note. Hearing this note the pilot would know that he was on his correct course, but a preponderence of the "A" or "N" signal would indicate deviation to right or left respectively, and the need for applying the appropriate correction.



["*Flight*" *photograph*

Fig. 2.—The experimental beacon at Croydon Aerodrome. Two of the "director" rods can be seen; on the tripod is mounted apparatus for measuring the field strength of the transmitted beams.

Although Mr. Sharman's system works on this general principle he has aimed at producing beams with the overlapping sides more nearly parallel than those of dia. *a*, and also to eliminate back-radiation. His transmitter is installed in an underground chamber, with metallically shielded back, floor, sides and top. At the open front of this chamber is a vertical half-wave aerial, and, at intervals along the inclined path leading from it, three upright "director" rods are mounted; in this respect the directional aerial array is reminiscent of the "wave canal" system of Yagi and Uda. The resonant frequency of the directors is apparently higher than that of the radiating aerial. Back-radiation is prevented both by the artificial and natural screening of the buried transmitting chamber.

Flat-sided Beams

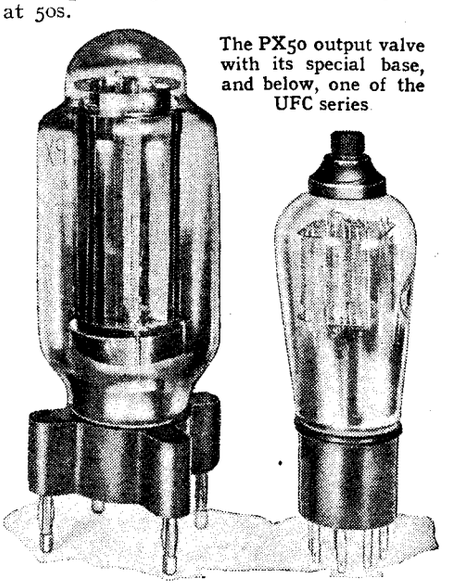
Another series of vertical reflector rods, fitted at the side of the tunnel giving access to the transmitting chamber, deform the polar diagram of the radiation to something approaching that of Fig. 1*b*. A pair of such transmitters, suitably arranged to give a combined polar diagram like that of Fig. 1*c*, act as a guide to approaching aircraft in the manner already described.

Turning from the horizontal to the vertical plane, the beams are normally inclined at an angle of 7 deg. to the horizontal, but this angle can easily be adjusted as required. Methods of guiding the approaching pilot's movements in this plane will be the subject of further experiments, and the transmitter is being moved to a more suitable site on the aerodrome with this object in view.

NEW 362 VALVES

High-power Triode and Heptode

ADDITIONS to the range of valves marketed by The 362 Radio Valve Co., Ltd., of Stoneham Road, Northwold Road, Upper Clapton, London, E.5, are the PX50 and UFC valves. The former is a large output triode having a filament rated for 6 volts at 2 amperes. It is intended for operation with an HT supply of 500 volts, and with a grid bias of 70 volts it consumes an anode current of 100 mA. Its internal AC resistance is 800 ohms and it has a mutual conductance of 6.0 mA/V. When operated with a load impedance of 7,500 ohms, the makers claim an output of 13 watts. The valve is priced at 50s.

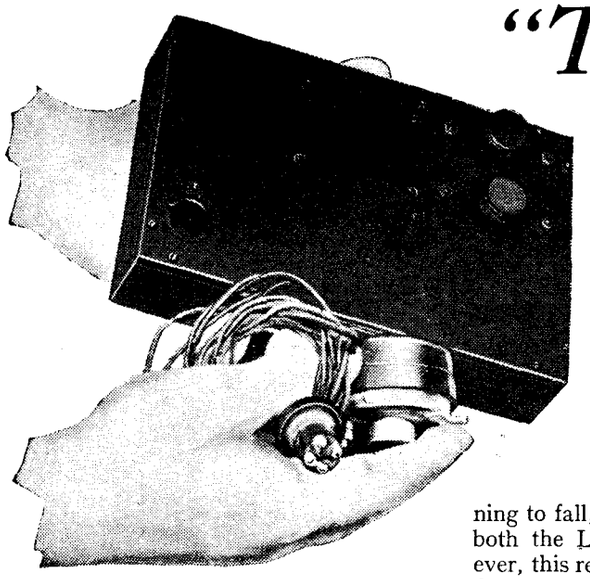


The PX50 output valve with its special base, and below, one of the UFC series

The UFC valve is a heptode frequency-changer of the Universal type. It is especially interesting in that its heater rating of 6.5 volts at 0.3 ampere enables it to be used in car radio sets where only a 6-volt accumulator is available. It is fitted with a 7-pin base and priced at 15s.

FURTHER TESTS WITH "The Radio Companion"

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



IN "The Wireless World" of October 25th, 1935, a description was published of a three valve portable phone set of pocket dimensions. The set has attracted a great deal of interest and the designer here gives some further notes of value to those who are making it.

A NUMBER of letters have been received in connection with the Pocket Radio Receiver recently described. Several of these have raised the question of the range of the receiver.

In the original article I quoted a range of fifty miles. This was a conservative figure. Actually, my own model received stations at greater distances than this, and, particularly after dark, it was possible to tune in several foreign programmes. As a test in any particular locality, however, is liable to be misleading, I took the opportunity of trying out the receiver during a business trip to the North and West Country.

My journey took me first to Leeds and I made the first test, somewhat to the surprise of my fellow passengers, when the train was some fifty or sixty miles north of London. The signal strength was loud and clear, but it was marred by an interference which I had momentarily overlooked—that arising from the battery-charging dynamo situated underneath the carriage. This interference, as one might expect, varied according to the position in the carriage, but it was usually too strong to render the reception satisfactory.

Tests on the Journey

I therefore decided to test the receiver at the stopping places *en route*. The first of these was at Peterborough where both the London stations were received excellently, Midland Regional was strong and North Regional was fair. I found that I could just tune in the latter station at the extreme top of the scale, with the frame in use which was that specified in the main drawing accompanying the description. As I mentioned in the earlier article, readers who wish to use the set in northern districts would be well advised to add a few more turns to the frame in accordance with the alternative specification given.

At Doncaster darkness was just beginning to fall, and I was just able to tune in both the London stations. Since, however, this represents a range of rather more than 130 miles, I was not disappointed. Midland Regional and North Regional were both strong and quite at programme value.

The same two stations were also well received at Leeds, where I spent the night, and one or two foreign stations were also available.

From Leeds my journey progressed westwards to Gloucester, *via* Sheffield and Birmingham, and, of course, on this run we passed quite close to the Midland Regional transmitter, so that I did not bother testing until I reached my destination. Here I was considerably surprised, for I found that not only Midland Regional but both the London transmitters were coming in at excellent strength. Since the distance from London is approximately eighty miles, it seems that a range of 100 miles can be expected.

This reception, incidentally, was by day, the test being actually made at about three o'clock in the afternoon. North Regional could also be heard, but somewhat faintly. The same evening, in bed, I was able to beguile myself with the dance music from London by resting the telephone earpiece on the bedside table and using it as a loud speaker. Not that it would have caused anybody any serious annoyance!

On the whole, therefore, I felt that the little set had acquitted itself very satisfactorily. My further experience with it has indicated that it stands up to its work well, the principal point being that the LT battery must be well charged. The receiver is sensitive to any serious drop in the accumulator voltage. Moreover, with these very small accumulators it is desirable to pay particular attention to the charging, especially during the first two or three periods of use the cell should be charged and discharged frequently. This may be achieved by using the set as much as possible at first, and making sure that it is adequately recharged as soon as it shows signs of a fall in voltage. Be careful to recharge the cell at the correct rate, which is only 0.1 amp., and to maintain the charge till the cell is fully up.

These remarks may seem rather laboured, but the production of a really small cell of this type is a matter of some difficulty, and we must expect to treat it with a little more care than the ordinary accumulator which, at the best of times, is a piece of apparatus which thrives on correct treatment and rapidly deteriorates if not properly handled.

The other queries have been concerned with the reception of long waves. I had no doubt that quite a useful performance could be obtained on the long-wave band, but in order to obtain definite data the medium-wave frame was removed and replaced by a long-wave one. The results at once proved very satisfactory, giving, in fact, better reception than I had anticipated.

Long Waves

Droitwich was receivable with the greatest of ease, while both Radio Paris and Luxembourg were obtained at good programme value. Indeed the ease with which these two latter stations were tuned in seemed to indicate that reliable reception from Droitwich could be obtained at any part of England.

The selectivity arising from the use of the small frame aerial is, of course, very apparent, for there is not the slightest difficulty in separating Radio Paris from Droitwich, and actually I was able to go better than this and tune in Zeesen quite free of interference, although somewhat weak.

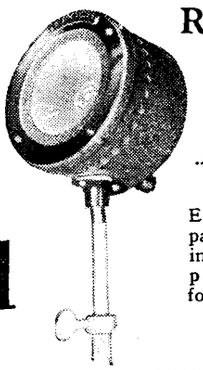
The windings used were as follows: as before, the reaction winding was put on first and comprised thirty turns of 40 d.s.c. wire; a layer of Empire cloth was then wound over and the tuned winding, consisting of seventy turns of the same gauge of wire, was wound on. The directions of the windings and the connections are exactly the same as for the medium-wave frame originally specified.

Owing to the lower radio frequency involved a little difficulty may be experienced, due to insufficient bypassing of the high-frequency current following the detector. This gives rise to a small growl after the set has gone into oscillation. Since the set is not used in this condition the effect is not a troublesome one and it is possible to work right up to the edge of the reaction without difficulty.

All told, therefore, it seems that this set can always be relied upon to produce at least one station of good programme value, and usually several alternative programmes. Whether the wave range is to lie within the medium- or long-wave band is a matter which can be left to the personal preference of the constructor.

New Apparatus Reviewed

Recent Products of the Manufacturers



Epoch new pattern moving coil microphone and folding floor stand.

EPOCH MICROPHONE

WHILST fundamentally the same as the earlier pattern, the new Epoch type 55 moving coil microphone is definitely a better instrument, as it has a wider frequency response and is considerably more sensitive. These improvements are largely accounted for by the new magnet now employed. It is, of course, a permanent magnet and does not require an energising battery.

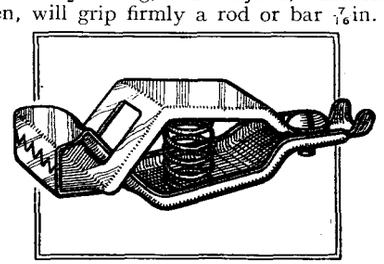
An outstanding feature of this style of microphone is the exceptionally quiet background, but the mean level of the ouput is somewhat lower than that of the carbon type used for public address work, yet the additional amplification needed is realisable with a good three-stage amplifier.

The bass response of the microphone is exceptionally good, the output at 50 c/s being of the same order as at 5,000 c/s. Thus the reproduction is rich in low notes, yet the bass is not over accentuated, for the good treble response maintains a satisfactory balance. Above 7,000 c/s, however, there is a marked falling off in the output. Our tests did not reveal any pronounced resonances throughout this range of frequencies. It gave a clear and realistic response on orchestral and vocal tests, and on the whole is particularly well suited for all public address work.

A small pre-amplifier unit is available if required, and its price is £2 2s. complete, including an input transformer. A shielded transformer in a massive case costs £1 1s., and the microphone mounted in a new pattern folding stand, finished in chromium, costs £6 6s. In a table stand the price is £5 5s. This apparatus is obtainable from the Radio Development Co.

GOLTONE BULL-DOG CONNECTORS

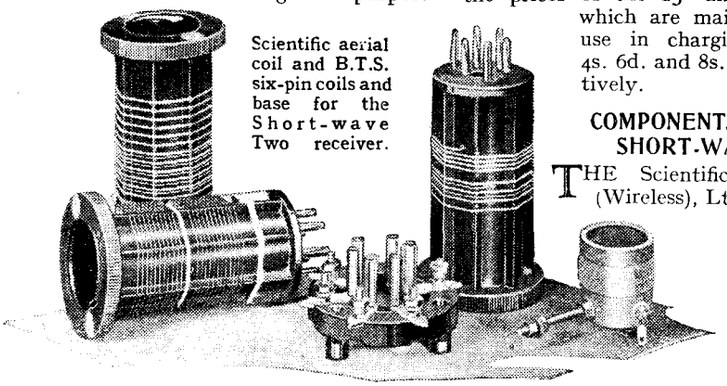
INCLUDED in the range of spring connectors made by Ward and Goldstone, Ltd., is a series described as the Bull-Dog type. They are available in three sizes, rated at 5, 25, and 50 amps. respectively, and of these perhaps the smallest will be found the most suitable as a general-purpose spring-clip connector by the amateur experimenter.



New pattern Goltone 5- to 10-amp. Bull-Dog Spring connector.

Whilst the design and appearance remain ostensibly unchanged, several improvements have been effected in the latest patterns. The small 5-amp. size, of which specimens have been received for examination, measure 1½in. long, and the jaws, when fully open, will grip firmly a rod or bar $\frac{7}{16}$in. in diameter. They are very robust and should stand up to hard wear. The connectors are heavily coated to resist corrosion, so that they can be used on HT and LT accumulators.

The 5- to 10-amp. size, to give them their correct description, cost 2s. 3d. per dozen; the prices of the 25- and 50-amp. type, which are mainly intended for use in charging stations, are 4s. 6d. and 8s. per dozen respectively.



Scientific aerial coil and B.T.S. six-pin coils and base for the Short-wave Two receiver.

COMPONENTS FOR THE SHORT-WAVE TWO

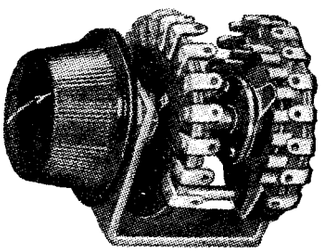
THE Scientific Supply Stores (Wireless), Ltd., has submitted for examination an aerial coil for the Short-wave Two described in the issue of November 15th last. This is wound with the correct number of turns, and is of the required diameter; it is fitted also with the mounting support, and is complete with nuts and washers. It differs only in that the two connecting tags are located at the same end of the former, but this is a minor detail and has no bearing on the suitability of this coil for use in the set. Its price is 1s.

We have received, also, a set of six-pin coils from British Television Supplies, Ltd., which the makers suggest would be suitable for use in this set.

They have been tested and are quite satisfactory. The pin connections are the same as on the coils specified, so that no alterations whatsoever have to be made to the winding. The three coils have a nominal range of 13 to 96 metres. In the Short-wave Two the SPA coil tunes from 11.2 to 24.7 metres, the SPC from 21.7 to 49 metres, and the SPD from 39.5 to 89 metres. Reaction is quite satisfactory throughout the whole waveband. They cost 13s. 6d. the set of three, and a six-pin base is available at 2s.

KABI GANGED SWITCHES

THE Kabi multi-contact switches are now available made up in ganged units, and any number of sections can be linked together in this manner, though when more than three are needed only those with up to ten contacts can be ganged. Rarely, however, are ganged switches with more than this number of contacts needed, and, as a rule, five or six contacts suffice for most purposes.



Kabi double-gang multi-contact switch.

These switches are made with as many as nineteen contacts, and for each there is a definite locating position. Each unit is a single-pole circuit selecting switch, the principal dimensions being 1⅞in. in diameter and ¾in. deep.

They are obtainable either with brass or with German silver contacts. A double-gang five-contact model with brass contacts costs 6s. 6d. and a triple gang 16s., while with the alternative style of contacts these would cost 9s. 6d. and 24s. respectively. They are soundly made switches, and should prove entirely reliable in use.

The Radio Industry

A NEW catalogue of Ferranti receivers (No. Rc. 100) is now available from Ferranti, Ltd., Moston, Manchester, 10.

◇ ◇ ◇

Burne-Jones and Co., Ltd., of 309-317, Borough High Street, London, S.E.1, have received further orders for special receivers for the use of the blind. These sets are of new design, with two and three valves, and employ a tuning system marked in Braille characters.

◇ ◇ ◇

Mr. G. L. d'Ombrain, A.C.G.I., D.I.C., B.Sc. (Hons.), who is in charge of the technical side of Kingsway Radio, Ltd., has been awarded the Doctorate of Philosophy of London University in the Faculty of Engineering.

Listeners' Guide for

MARK TWAIN in a characteristic pose at his study window. The centenary of the great humorist's birth will be celebrated in a feature programme on Sunday (National, 6.45).

COMIC PROGRAMME ON SUNDAY

IT is easy to imagine Mark Twain hugging himself with glee in the Elysian Fields at the thought of the B.B.C. celebrating his centenary on a Sunday. This is the day when naughty little boys are made to study the lives of great and good men—the immortal Mark deserved both epithets—but a day on which a line has to be drawn. Mark Twain's title to greatness lies in his fun and boisterous spirits. His attitude to Sunday is made clear in "The Innocents Abroad," and one wonders whether the B.B.C. in its more strait-laced days would ever have attempted a Sabbath presentation of the good man's career.

Alistair Cooke is handling the Centenary programme, "The Innocent at Home and Abroad," on Sunday next (Nat., 6.45). The great novelist and humorist will be seen through American eyes, and the programme will be illustrated in various novel ways.

DIVORCE, OR . . .?

WHETHER lunacy is an adequate reason for divorce is the vexed question dealt with in Clemence Dane's famous drama, "A Bill of Divorcement," which Val Gielgud is producing in a broadcast version on Monday (Nat., 8.) and Wednesday (Reg., 8.15), with Malcolm Keen and Edna Best in the parts they played in the revived version of 1929. The play, which was first produced in 1921, has also been filmed, providing Katharine Hepburn with her first big part.

The B.B.C. is anxious to point out that in broadcasting this play no propaganda is intended; it is selected simply as a consummate example of Miss Clemence Dane's art. The audience is asked to suppose that the majority report of the Royal Commission on Divorce *v.* Matrimonial Causes (which is that lunacy is sufficient ground for divorce) has become the law of the land. The problem of a woman whose husband returns from an asylum when she is about to be married to someone else is skilfully and dramatically presented.

A WALTZ DREAM

THE famous Gertie Millar played Franzi in the first London presentation, in 1908, of that gay and melodious musical comedy, "A Waltz Dream," with music by Oscar Strauss. "A Waltz Dream" has since been filmed, and the cinema-going public know it as "The Smiling Lieutenant," featuring Maurice Chevalier and Jeanette Macdonald. Eric Maschwitz is producing a broadcast version which we shall hear on Thursday (Nat., 8) and Regionally on Friday, and the cast will include Jan van der Gucht and Horace Percival.

The story at first deals with amusing intrigue and stolen kisses in Vienna. Later the scene moves to the little independent Duchy of Flausenthurn, where State balls, music, moonlight, and even a maze, all play their part in complicating an already involved plot.

SOMETHING NEW

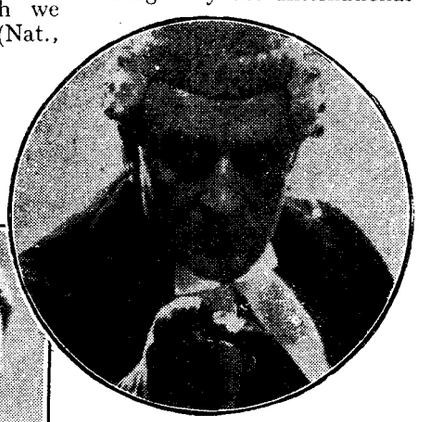
NOVELTY is the keynote of Ernest Longstaffe's variety hour, "More Light Fare," included in the Regional programme on Monday at 8.30. Hal Bryan, a raconteur new to broadcasting, will take part, as well as a boy virtuoso pianist, Wilfred Worden. Joan Miller, a Canadian raconteuse, has been recruited from the Empire transmissions, in which she has developed quite a reputation; she was originally a telephonist.

A new musical combination will be heard, "Harry Chapman and His Music Lovers"; they form a band consisting of harp, violin, accordion, 'cello and flute.

POLAND ENTERTAINS EUROPE

To Poland falls the honour next week of providing the European concert in the series arranged by the International Broadcasting Union, and the B.B.C. will relay the event at 8 on Tuesday (Reg.). The Polish Broadcasting Symphony Orchestra, conducted by Grzegors Fitelberg, is offering a programme strongly national in character. In includes a contemporary symphonic poem, "Episode au Bal Masque," by M. Karlowicz, followed by Chopin's Fantasy on Polish National Songs.

EDNA BEST and Malcolm Keen take leading parts in next week's broadcast version of Clemence Dane's great stage play "A Bill of Divorcement."



BONNIE PRINCE CHARLIE

AN interesting Scots programme is being given from the Midlands on Monday evening. This is a "Young Chevalier" concert, by the Choir of Dean Close School, Cheltenham, and consists of special arrangements of the various songs associated with the last days of Prince Charlie in the Highlands. (Midland, 7.30.)

AN OLD TIME BALLAD CONCERT, with the B.B.C. Theatre Orchestra is promised for Tuesday (Nat. 8). Above is an actual photograph taken in a Victorian drawing room in the 'sixties.

THE SCOT ABROAD

THE St. Andrew's Day programme to-morrow (Nat., 8.30) will testify to the fact that Scotland's annual celebration is observed more enthusiastically by Scots abroad than Scots at home. The celebrations will be viewed imperially, stress being laid on the work of Scotsmen in each of His Majesty's Dominions.

It was a South African statesman who recently remarked that when members of certain nationalities met together he wondered what mischief they were up to, but when Scots forgathered he never had the slightest misgivings.

the Week

Outstanding Broadcasts at Home and Abroad

HIGHLIGHTS OF THE WEEK

FRIDAY, NOVEMBER 29th.

Nat., 8, "Devonshire Cream" (Eden Phillpotts). 9.20, The Vagabond Lover. 10.20, B.B.C. Contemporary Music Concert.

Reg., 7, "World Tour" (Julius Berger). 8.45, Variety. 9.30, "Nocturne"—gramophone records.

Abroad.

Radio-Paris, 8.45, Operettas: "The Drum-major's Daughter" and "The Grand Duchess of Gerolstein" (Offenbach).

SATURDAY, NOVEMBER 30th.

Nat., Five Hours Back (from U.S.A.). 8.30, St. Andrew's Day Programme. ¶Spanish Light Music.

Reg., 8.30, Jack Payne's Radio Party. ¶Violin Recital by Dea Gombrich. ¶Ambrose and his Embassy Club Orchestra.

Abroad.

Milan, 8, Opera: "Don Carlos" (Verdi).

SUNDAY, DECEMBER 1st.

Nat., Violin Recital by Boris Pecker. 6.45, Mark Twain Centenary Programme. ¶Hastings Municipal Orchestra.

Reg., 3, Scottish Festival Service (St. Columba's, Pont Street). ¶Serge Krish Septet. 8.45, Infants' Hospital Appeal by Sir Gomer Berry. ¶Sunday Orchestral Concert.

Abroad.

Hamburg, 7, Symphony Concert from the Conventgarten.

MONDAY, DECEMBER 2nd.

Nat., 8, Edna Best in "A Bill of Divorcement" (Clemence Dane).

Reg., B.B.C. Military Band. 8.30, "More Light Fare."

Abroad.

Paris P.T.T. 9, Czech Philharmonic Orchestra at Gala Concert attended by President Lebrun.

TUESDAY, DECEMBER 3rd.

Nat., 8, Old Time Ballad Concert. ¶Piano Recital by Katharine Goodson. ¶B.B.C. Orchestra.

Reg., 8, European Concert (from Poland). ¶"The Red Sarafan."

Abroad.

Leipzig, 9.20, "Poetry to Music"—programme by Leipzig Symphony Orchestra.

WEDNESDAY, DECEMBER 4th.

Nat., B.B.C. Dance Orchestra. 9, "Meet Mickey Mouse." ¶Chamber Music by the Trio de la Cour de Belgique.

Reg. 3.15, England *v.* Germany Soccer Match. 8.15, "A Bill of Divorcement."

Abroad.

Strasbourg, 8.10, Comic Operas: "Les Charmeurs" (Poise) and "Le Bal Masqué" (Poulenc).

THURSDAY, DECEMBER 5th.

Nat., 8, "A Waltz Dream" (Oscar Strauss). ¶Piano Recital by John Wills.

Reg., 8, Reed Orchestra. Conductor: Fritz Busch (from Scottish). ¶Unrehearsed Debate: Oliver Baldwin and G. M. Boumphrey. ¶Turner Layton and his Piano.

Abroad.

Leipzig, Luxembourg, 6.35, Gewandhaus Concert.

OPERA ABROAD

ONLY two good opera programmes occur to-day. Moscow No. 1 is relaying Rimsky-Korsakov's "Golden Cockerel" from the State Opera at 4.30, with a commentary in English, among other languages. Wagner's "Flying Dutchman" comes from Budapest No. 1 at 6.30.

To-morrow two Flotow operas are on the air—"Martha" from Stuttgart at 7.10, and "L'Ombre" from Radio-Paris at 8.45.

That Gounod, the great French master, could write in lighter vein is shown in his two-act "Philemon et Baucis," which Strasbourg offers at 8.30 on Monday.

OPERETTAS

OFFENBACH seems to be the only operetta composer featured to-day (Friday). At 8.45 Radio-Paris is offering two of his three-act works—"The Drum-major's Daughter" and "The Grand Duchess of Gerolstein." His "Rose de St. Flour" is in the Söttens programme at 7.40. Saturday's big operetta event is Schubert's "Lilac Time" from Brussels No. 2 at 8. A holder of the world's skating championship is the heroine of Snaga's "Weltmeisterin," which Berlin (Funkstunde) offers the same evening at 7.10.

On Sunday Brussels No. 2 is relaying Lehar's "Giuditta" from the Royal Flemish Opera, Antwerp, at 8. This operetta, first produced in Vienna as recently as January, 1934, was hailed as "brilliant."

WHISKY AND GIN

WHAT kind of music should compose "The Ballad of Whisky and Gin"? This musical play by Kunert-Kusche is in the Hamburg programme on Tuesday at 7.10.

NATIONAL MUSIC

ENGLISH country dances and Scots reels recorded in London will be heard in the Berlin (Deutschlandsender) programme at 1.30 on Sunday. On the same day all German stations relay pictures in music from the Erzgebirge at 6, portraying a typical winter's day of a German peasant.

Munich is bringing various villages to the microphone, and on Tuesday at 6 the mountain hamlet of Bergen-am-Hochfelln will be featured. Villagers will sing, yodel and play folk music.

BACK TO VIENNA. The glamorous Austrian capital again figures largely in the week's broadcasts, notably in Oscar Strauss's "Waltz Dream" on Thursday and Friday. Here is a view of the Helderplatz.

CONCERTS

THIS is a great week for concerts. To-night the Dutch String Orchestra will be heard on Hilversum (Kootwijk) at 8.10; the Bremer Stautmusikanten on Hamburg at 9.45, and the Maastricht Municipal Orchestra on Hilversum (late Huizen) at 7.55.

ANDRE BALBON, singing in "The Drum-major's Daughter" at Radio Paris to-night (Friday) and in Ferrand's comic opera, "Chirurgie," to be broadcast from Paris P.T.T. on Tuesday.

To-morrow (Saturday) Beromunster is relaying a Jubilee Concert by the "Frohsinn" Male Voice Choir from St. Martin's Church, Basle. Munich at 7.10 on Monday brings something new in a sequence of "Classical Music of the Soil," with the Station Chamber Choir and Orchestra.

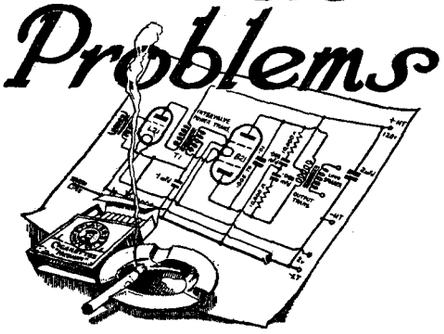
Sibelius and Greig works will be heard in Thursday's Kalundborg concert at 7.10, given by the Radio Symphony Orchestra conducted by Malko.

RECORDED OPERAS

AN interesting opportunity to compare "live" with recorded programmes occurs this week. On Sunday at 7 Frankfurt is giving two one-act comic operas by Gounod and Mozart respectively. At 11 on Tuesday Stuttgart will give an electrical recording of the same programme.

THE AUDITOR.

Readers' Problems



THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

Back to Front

A READER asks us, in effect, to explain the basic practical difference between a valve receiver and a valve transmitter. He knows from experience that the radiation from an oscillating receiver affects other receivers at considerable distances, and assumes that, except for the question of power, there is little real difference between the two.

It is true enough to say that there is a very close relationship between the simplest type of receiver and transmitter. The most obvious difference is that, in the receiver, arrangements are made to apply the signal energy picked up by the aerial as effectively as possible to the valve grid, while in the transmitter the object is to transfer the amplified oscillatory energy in the anode circuit to the aerial, whence it is ultimately radiated. The basic circuit of a valve transmitter is given in Fig. 1; to this simple nucleus must be added, for telegraphic

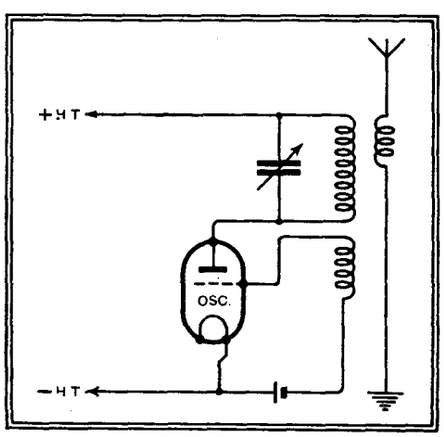


Fig. 1.—Basic valve transmitting circuit.

transmission, some means of keying or interrupting radiation; or, for telephony, of modulating the carrier wave oscillations. Several other refinements such as automatic bias for the oscillating valve are usually included.

Isolated from HT

IN ordinary circumstances, a coupling condenser used as a link between two valves usually has to withstand the full HT voltage applied to the anode of the preceding valve; any leakage which is present will affect the operating conditions of the succeeding valve, and, in addition, the usual consequences of a complete breakdown must be faced. For these reasons mica condensers are usually preferred for intervalve couplings to those of the paper type.

In the case of a condenser used as a coupling between a diode detector and a succeeding amplifier the preceding statements no longer hold good, as HT voltage is not applied. A reader who asks for information as to the proper rated working voltage for a condenser to perform this function will be safe in using any reasonably well-made component; the lowest voltage rating available would be more than adequate.

Checking the IF

EVEN though all the intermediate-frequency circuits of a superheterodyne be accurately tuned to the same frequency, it obviously does not follow that the amplifier is necessarily tuned to the correct frequency for which the set as a whole is designed. Unless this condition is satisfied, best results cannot be expected.

Bearing these facts in mind, the user of a 1936 Monodial AC Super thinks that there is a possibility that his IF amplifier has been aligned at an incorrect frequency, and asks how, without a calibrated oscillator, he may reassure himself on this point.

Fortunately, a fair idea of the actual intermediate frequency can be obtained by deliberately provoking feed-back by running the aerial lead-in wire in close proximity to the second-detector circuits. A well-defined whistle should then become evident when the set is tuned to a station operating on twice the intermediate frequency.

The 1936 Monodial is designed to operate on an IF of 465 kc/s, and so the loudest whistle should be heard when tuned to $465 \times 2 = 930$ kc/s. This corresponds roughly to Brussels No. 2.

Both Sides "Live"

THANKS to the fact that it requires fewer and simpler components than any other comparable arrangement the Hartley detector-oscillator circuit still retains its popularity, and is probably the first of its kind to come to mind when the need arises to improvise a receiver in a hurry. A single centre-tapped winding combines the functions of tuning and reaction coils, while reaction is controlled by means of a tiny variable condenser of a few micro-microfarads.

But, as a querist has already found out for himself, this circuit is abnormally susceptible to hand-capacity effects, especially when full use is made of reaction. It has been found that a reversal of connections to fixed and moving vanes of the tuning condenser does nothing to improve matters, and we are asked both to explain why hand-capacity should be so troublesome and how it can be overcome.

In an ordinary reacting detector tuning circuit, the rotor of the variable condenser may be directly earthed, and so is at the same potential as the body of the user. Consequently, no change in effective capacity across the tuned circuit is introduced when the user's hand comes into close proximity to the earthed rotor shaft or frame of the condenser.

But in the Hartley circuit (see Fig. 2) the condenser cannot be earthed, and when the hand approaches either side of it extra capacity is added across the circuit as indicated by dotted lines. Tuning is consequently disturbed.

One way out of the difficulty is to set the condenser back from the control panel

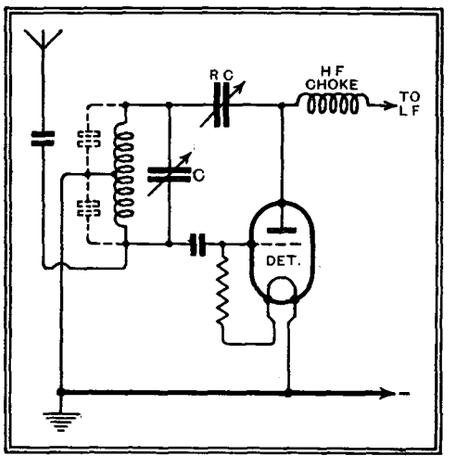


Fig. 2.—Showing why special measures are necessary to overcome hand-capacity effects in "single-coil" reaction circuits.

and to fit an insulated extension as a link between the spindle and tuning dial. A similar result is obtained by employing a condenser with a loose spindle and replacing the normal steel spindle by a rod of insulating material. Another plan is to use a slow-motion drive having a disc insulated from the spindle and driven by a friction disc working on its periphery.

Satisfactory Makeshift

A CORRESPONDENT who is carrying out reception tests on very long wavelengths finds that the standard tuning condenser of 0.0005 mfd. is of inconveniently small capacity, and asks whether anything larger is obtainable commercially.

A capacity of 0.001 mfd. is about right for long-wave work, but such condensers seem to be only obtainable as laboratory instruments at a correspondingly high price. We therefore suggest the use of a standard two-gang condenser with both rotors and stators connected in parallel.

The Wireless World INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

Electronics

From Vague Theory to Applied Science

By
"CATHODE RAY"

A GENERATION ago one heard and read about the electron *theory*. It took its place among various other theories of electricity; and like them was permeated by a flavour of unreality. One theory seemed about as good as another, so far as the practical man was concerned; it didn't matter to him what names the theorists gave to an electric current—it worked just the same. It didn't even matter to the electrical engineer which way the current ran; for the sake of uniformity everybody agreed to paint the carbon pole of a battery red and say the current flowed from that terminal through the circuit to the other. As it happened, they guessed wrong. But who cared? Only a few highbrow scientists who never "did" anything.

Now we treat electrons with as much imagination as we would a pound of tea. And it does not occur to anyone to doubt that they move in the opposite direction to that which they were once supposed to take, for with a little trouble our scientists can arrange to show them to us on the move.

You may question whether this statement is strictly true, when everybody knows that an electron is far too small to be seen through even the most powerful microscope. It is just as true and as untrue as it would be to say that you had seen Campbell Black flying over at a height of 2,000 feet. To be strictly accurate, it would be his aeroplane that you saw.

An astronomer on Mars might discern irregular lines scattered over the land surface of this globe, and publish a theory of water circulation and drainage on the planet Earth. But it is more convincing when one puts up hydro-electric power stations and gets real work done by virtue of these movements of rivers.

Electrons Set Free

If electrons had remained a theory, kept bound in wires and cables, there would have been very little new development in electricity during the twentieth century. There would have been bigger and better dynamos and motors, more numerous telephones, and more elaborate telegraphs than there were in the nineteenth. But broadcasting, "talkies," and particularly television, are among a growing list of new things that depend on electrons released to fly about in clouds, though still under strict discipline through the medium of controlling voltages applied to grids or similar electrodes.

Think of all the different sorts of valves; and there are hundreds of ways in which they are used, quite outside radio. Cathode ray tubes: for television and for an extraordinary variety of research—they are used very effectively in studying the petrol engine, for example. Photo-electric cells: not only for television and talkies, but for exposure meters, colour matching, automatic street lighting control, burglar alarms, counting bales of newspapers or visitors to an exhibition. In addition to these electronic devices a whole group of special types have been invented for television—iconoscopes, electron multipliers, image dissectors, and others.

These may be merely the forerunners in an electronic age. There seems to be no limit to the dances that electrons can be persuaded to perform. So long as they are chained to conductors they comprise a sort of Caliban, a hewer of wood and drawer of water (or, less poetically, a Board of Trade Unit to use as lighting, heating, cooking, or power, as our needs demand); but liberated in an electronic device they can only be compared with the fleet and dainty Ariel.

Heat as the Liberator

Pursuing this analogy: it seems that, apart from an altogether undesirable display of brute force, the transformation into the more airy slave can be effected only by some sort of magic spell. The older cathode ray tubes bullied electrons into the open with 100,000 volts. X-ray tubes were the scenes of similar punishment. So long as that was necessary there was no possibility of a radio valve industry. Then it was discovered that heat was an alternative liberator and a much more domestically practicable one. So we got the filament. As a result of more subtle incantations—oxide coatings and whatnot—we now obtain dense masses of electrons with what is comparatively no more than gentle warmth. So the blazing "lamps" of 1920 cooled down into the dull-emitters of 1930.

Meanwhile, white magicians had succeeded in conjuring up a few valuable electronic sprites by the force of light; and black magicians did the same under cover of darkness, using infra-red or ultra-violet beams. That gave us a range of photo-electric cells.

And so, by less and less violent methods, clouds of electrons have been obtainable. After we have got them all sorts of stage apparatus—grids, screens, guns, deflector plates, anodes—can be erected for producing the show.

Another essential is a more or less rarefied atmosphere. The lightest air we can breathe is more congested for electronic activities than the Underground at 5 p.m. for ice hockey. Some sort of evacuated tube must be prepared for them. They are willing to co-operate with the heavier and more sluggish air particles if the number is strictly limited.

In controlled gas rectifiers, "thyratrons" for example, the flock of electrons scurrying across the field arouses and excites the ponderous gas molecules and creates a stampede among them that is much less easily quelled.

Allowing for progress on the snowball principle, who will dare to say what will be embraced in the science of electronics in 1950?

Tungsram Output Valve

A NEW valve in the Tungsram range is the APP4C. It is a pentode with a heater rated for 4 volts at 1.9 amperes, and it is intended for operation with anode and screen supplies of 250 volts with which a grid bias of −6 volts is required. The anode current is 36 mA., and the screen current 4 mA., and an output of 3.6 watts is claimed. An unusual feature is that the suppressor grid is brought out to a pin on the base, and it is recommended that a bias of −6 volts be applied to this grid. It is claimed that this renders the valve much less prone to parasitic oscillation, and that the usual grid and anode stopping resistances can consequently be omitted.

The valve is priced at 14s. 9d., and a Universal counterpart, the PP36, with a heater rated for 35 volts at 0.2 ampere, is available. The makers are Tungsram Electric Lamp Works, Ltd., 72, Oxford Street, London, W.1.

A Radio Index

Reference to Technical Articles of the Year in all Publications of the World.

THE December issue of *The Wireless Engineer* will be of great importance to all those who require to keep themselves fully informed on recent developments in radio throughout the world. This number contains the complete annual index to abstracts of technical articles published. Those who are specialists in any particular branch of radio will find this index particularly valuable as it will give them references to everything published on their subject during 1935.

The Wireless Engineer is not ordinarily on sale at bookstalls, but should be ordered in advance. Readers unfamiliar with *The Wireless Engineer* should not take the December number to be a representative issue, since much of the space normally devoted to articles is, in this issue, occupied by this annual index, and the usual monthly abstracts are also absent.

Letters to the Editor

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

Contrast Expansion

I WAS particularly interested in "Cathode Ray's" article on "Contrast Expansion" because, when listening to a symphony orchestra on my portable battery set, I frequently augment the B.B.C. control. If I did not, soft passages would be lost in background unless the volume were turned up so much that loud passages were badly distorted. This leads me to suggest that except in powerful receivers with very little background noise of their own making, and in very quiet surroundings, contrast expansion is undesirable. A similar psychological effect is produced by harmonic distortion of loud passages and the difficulty of hearing soft ones above the prevailing background. Consequently I wonder if anything would be lost if automatic compression were used instead of the B.B.C. manual control. DAVID W. ASHWORTH.

Stonehouse, Glos.

MR. HARTLEY would appear to follow a line of thought that we are all trying to avoid. (Doubtless "Cathode Ray" will reply on this point.) He supposes that contrast expansion implies a reproduction of the full intensity of the original, whereas it is adequate only to create an illusion of the original range; nobody seriously suggests more than 18 watts of efficient output for the average living room. Mr. Hartley's figures are both interesting and authoritative, and the real problem is to have an æsthetically satisfying control between the limits given. The present manual control compromise is not good enough, nor, in the writer's opinion, should an expansion system designed for the reproduction of records serve for radio purposes. GERALD SAYERS.

Ware, Herts.

The Renode

AS I found the account of this new Danish valve in *The Wireless World* of November 8th both interesting and puzzling, I hope you may be able to quote a reference as soon as the inventor has published a complete account of it.

It is claimed that as an HF amplifier it damps a tuned circuit to a less degree than an HF pentode; this is probably true of the *anode* circuit, since it is clear from the construction that the potential on the final anode will have little effect on the magnitude of the electron stream, which is mainly controlled by the cathode shield and auxiliary anode, so that the anode impedance is high. But flow of current in the input circuit, *via* the deflecting plates, which is equivalent to grid current in a normal valve, is essential to linear operation, and this must damp the *input* circuit. If it be said that this current is negligibly small, owing to the very small value of the total current in the electron beam, then it follows that the output from the valve is correspondingly limited.

A further difficulty is that in the text it is said that Fig. 4 gives the input-output characteristic as an *amplifier*, whereas the caption of Fig. 4 reads "The detector characteristic . . ." I believe the caption is correct, not the text, for I cannot imagine an HF pentode giving the characteristic of Fig. 4, curve B, unless the measurements were made under conditions of grid current, which would hardly be a fair test. For my own measurements on an early tetrode (see "Investigation of Valve Performance by an Electrodynamometer Method," J.I.E.E., April, 1935) showed linearity of characteristic down to 2.5 millivolts (0.0025 volt) and up to a volt or so, the upper limit depending on the nature of the anode circuit.

On the whole, it seems that this valve is likely to be of more use as a small-amplitude detector than as an HF amplifier.

Chelmsford, Essex. D. A. BELL.

Three-in-One Portable

WITH reference to the article in your issue of September 13th, 1935, describing the construction of the "Three-in-One" portable, there appears to be an error in the specification which requires "2 oz. No. 26 DSC wire for frame aerial"; it should be a little over 3 oz.

About four years ago you described the construction of a two-valve portable of very similar type, and I was intending to write you to ask if a design for a more powerful set could be given, when the article of September 13th appeared.

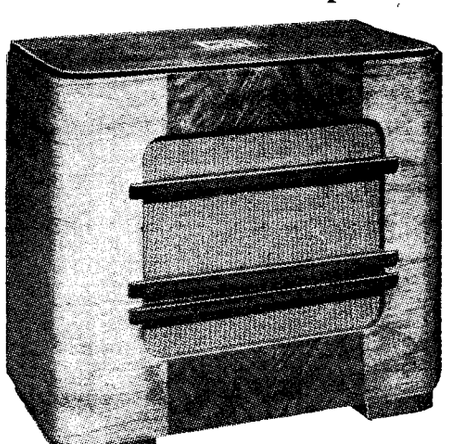
I wonder if many people realise how useful an additional set of this type can be? I have carried the two-valver referred to around the country—from the north of Scotland down to London and across to Ireland,—and it has been a faithful companion to me when I have felt lonely in hotels and other places. It has been frequently on loan to friends in hospitals and nursing homes, when it has provided a choice of programmes not available in these institutions, where the patient must take what is given him, and very often it has provided better quality of reproduction. Some hospital installations are extremely poor in this respect, which I believe to be due to non-renewal of old valves and other components subject to depreciation rather than any fault in design.

I hope to have as much pleasure out of the new set as I had out of the old one.

JAS. HOWAT.

Greenock, Renfrewshire.

New H.M.V. Loud Speaker



Designed as an extension speaker for H.M.V. sets, this new 3-guinea model includes a volume control, universal matching transformer, and nickel-aluminium alloy magnet.

An Old Grouse

YOUR Editorial Comment under the above heading and Mr. H. A. Hartley's letter in your issue of November 8th will probably find an answer in a chatty little article, "Zero Level," in *Electronics* of October, 1935. The forenote to the article is thus: "A conversation piece anent the ins and outs of broadcast control room problems, in which is questioned the present methods of 'riding gain,' indicating volume level, suggesting compressors and expanders, new 'VI's,' wider volume range."

Anyway, suppose all we music lovers write to the "common enemy," the B.B.C., and demand a station working about 20,000 metres or anywhere else where we can have freedom from other stations, then give us a band of at least 50 kc/s wide and a programme range of 100 db. and all those other nice things we often dream about. Then, when we get it, what will we grumble about then? Well, if it is about 20,000 metres maybe Mr. Hartley will ask for permission to do away with Morse interference.

R. E. BLAKEY, D.Sc. (ENG.).

London, N.W.9.

Applications for PA Equipment

PASSENGERS travelling on buses running on suburban routes, at night and especially in wet weather, have difficulty in determining their "stops." This inconvenience could be removed if a low-powered PA apparatus were installed: a small speaker on each deck, microphone arranged handy for the driver, who would be required to announce each stop. (Often the conductor is in the same position as the passengers.)

Liverpool, 4. JOHN B. TRUEMAN.

The Life of Valves

ON reading a paragraph in "Random Radiations," wherein "Diallist" describes the boast of listeners concerning the number of years they have employed one set of valves, I feel tempted to endorse his remarks by recounting my own similar experiences.

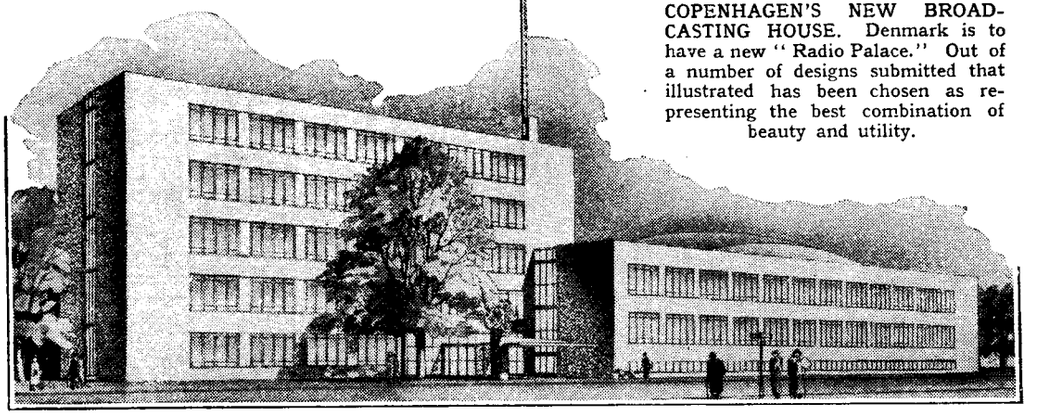
I could quote many cases, but will content myself with just one example. Quite recently I was called in to doctor a set. It had, I was informed, developed the most alarming symptoms, crackling, popping, and generally misbehaving. On examination I had to report dud valves. The owner became quite indignant about his misfortune. "I've only had them three years," he wailed. I informed him that he couldn't in all justice complain, because three years was a very long time, whereupon he replied that the "chap next door had still in use the original valves that were in the set which he had purchased *five years* before, *and* they were still as good as new!"

A new set of valves proved my client's error, and at a not very later date a new set of valves in the set next door gave both gentlemen the surprise of their lives.

Macclesfield. J. P. GREEN.

Broadcast Brevities

By OUR SPECIAL CORRESPONDENT



COPENHAGEN'S NEW BROADCASTING HOUSE. Denmark is to have a new "Radio Palace." Out of a number of designs submitted that illustrated has been chosen as representing the best combination of beauty and utility.

Silent Departure

NO trumpets played last week when Mr. Felix Greene silently stole away from Southampton *en route* for New York. This most modest member of the B.B.C. staff had nobly declined a Press interview, believing that it is better to get things done and to talk about them afterwards.

New York Reporters

It looks as if he has also avoided the New York reporters, thus conserving his opinions on the modern girl, speakeasies, relativity and the Monroe Doctrine until embarking on the voyage homeward.

Mr. Greene's Appointment

It was *The Wireless World* that first suggested that the B.B.C. should establish agencies abroad, and Mr. Greene's appointment as the Corporation's representative in New York may be the precursor of similar appointments in the Dominions and Colonies.

U.S. Men in London

For some years past the N.B.C. and Columbia networks of America have been served by energetic "contact men" in London, which is one reason why the United States have participated to a much larger extent in European broadcasting than we have in the varied offerings of the American stations.

Missed Opportunities

The Columbia network has been especially active in arranging vivid and ingenious relays from the odd corners of Europe—relays which the British public rarely gets to hear about. An example was the recent broadcast from the crater of Vesuvius, with running commentary, which passed over our heads to America while we were probably slaking our thirst for the novel and bizarre in the Foundations of Music or a talk on birds' nests.

Breaking the News

I believe Mr. Felix Greene is going to alter all this. The process may take some months, for Mr. Greene must break the news very gently to our American friends; they are not accustomed to shocks from the Old World and may not take him seriously.

Actuality Broadcasts

Actually, however, the Old World is almost pathetically interested in what the New World is doing, and one way of appeasing this mental hunger lies in the actuality broadcasts which it is Mr. Greene's business to bring about.

Taking Notes

In the early stages, at least, his instructions are to further the good relations already existing between the British and American broadcast authorities. He will also study the broadcasting position on Canada and look after the interests of the B.B.C. and British listeners in whatever way American radio can affect them.

Good luck, Mr. Greene!

SOS from Malay

B.B.C. men seem to be in demand all over the world in connection with the organisation of new broadcasting services. Lionel Fielden is now at the helm of Indian broadcasting, and R. A. Rendall is giving a helping hand in the development of the new service in Palestine.

I hear that the latest S O S has come from the Malay Broadcasting Company, which needs the services of another Sir John Reith to build up an efficient service in the Archipelago. The job waiting is that of General Manager, and one of the lucky B.B.C. boys will get it.

On the Spot

THE lamented death of Edgar Wallace robbed the microphone of one of the best radio writers. Fortunately we still have his thrillers, many of which have not yet been drawn upon for radio plays.

"On the Spot," the great Chicago gangster yarn, is one of these, and we shall hear a broadcast version next week, with the part of Tony Pirelli, the gang leader, taken by Arthur Gomez, Charles Laughton's understudy in the London production.

The Electric "Chair"

Florence McHugh will play the part of Min Lee, the tragic half-Chinese girl who, at the cost of her own life, brings Pirelli to the electric chair. Wilfred Essex will be heard as Kelly, Chief Detective Commissioner, and the sworn foe of all gangsters.

The "Effects" Department is getting busy.

How to Tour Broadcasting House

ESCORTED tours of Radio City, the palatial New York headquarters of the National Broadcasting Company, are all the rage at the present time; in fact, some 125 guides are kept permanently busy.

What a different state of affairs obtains at Portland Place! Even artists occasionally experience difficulty in getting into the Big House for broadcasting purposes. Some slight hitch on the question of identification, and those eagle-eyed receptionists will keep a perspiring artist on tenterhooks until a blood-relation or close friend recognises the near-corpse.

Smash Up Your Set

I know the leader of a well-known orchestral combination, broadcasting two or three times a week, who apologises to his brother for the fact that it is impossible to get him a permit to view the building.

The rule at the moment is that people admitted to this holy of holies "must be interested in broadcasting other than from the listener's angle."

So smash up your set, tear up your licence, and evince an interest in futurist furniture, and you may get in.

Anti-listening Propensities

If your anti-listening propensities are good enough, you will be asked to report yourself at 2 p.m. on the appointed day to the receptionists in the Entrance Hall. Major Menzies is usually the guide on these fascinating tours, which begin in the sub-sub-basement, three floors below ground level, and eventually land one on the eighth floor at about 4.30 p.m.

Even now, when so much B.B.C. work is carried on at Maida Vale and other "outside" establishments, there is a tremendous amount to be seen at Broadcasting House, which remains the hub of British broadcasting.

Mass Audition

SHOULD any one dance band broadcast for more than thirty consecutive minutes? "No," says Eric Maschwitz, hence the big audition at Maida Vale last week, in which more than thirty lesser-known dance combinations took part.

Paul Askew, Dance Music Assistant, was in charge of balance and control at the Maida Vale end; Mr. Maschwitz listened to the results *via* loud speaker in St. George's Hall.

New Blood

The aim of the new policy, I understand, is not only to infuse new blood into the dance music sessions, but to give the lesser bands a chance. Actually, only a few of the bands so far tried have been considered worthy of broadcasting—far fewer than had been expected.

The new scheme of shorter dance band sessions will come into operation early in the New Year, though one or two of the bands already chosen may be heard at odd periods between now and Christmas in order to acclimatise them to studio conditions.

It is hoped that listeners will be warned in advance so that they, too, can acclimatise themselves.

Recent Inventions

The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each

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

MODULATING SYSTEM.

LOW-FREQUENCY signals are applied to an impedance, such as a capacity, inductance, or resistance, bridged across a pair of Lecher wires carrying the high-frequency currents to be modulated. For instance, carbon rods are inserted at a voltage loop in the Lecher circuit, and are bridged by a light carbon leaf which acts as a microphone. Or a light metal band is slightly spaced apart from the Lecher wires, so as to form a shunt capacity, the effective value of which is varied by applied speech. Or a thermionic valve or glow-discharge tube may be used as a shunt impedance, the value of which is controlled by signal voltages applied to the grid or control electrode

Patent issued to A. Esau. Convention date (Germany) 11th August, 1933, No. 429454.

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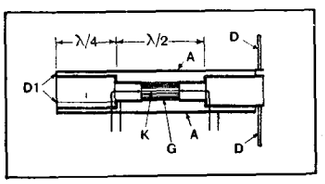
SHORT-WAVE VALVE.

THE valve shown can be used as a short-wave generator or amplifier. The cathode *K* is surrounded by a grid *G* which is extended on both sides to form a "stepped" cylinder. The outer cylinder *A* forms the anode. The two cylinders form a Lecher



Details of short-wave valve construction.

resonator system which is closed with the exception of a narrow gap. The valve is connected at one end to dipole aerial *D*. The diameters of the grid and anode tubes are graduated so that the wave resistance of the system is practically zero at the end *D1* where no energy is radiated.

Patent issued to N. V. "Meaf." Convention date (Germany) 21st July, 1933, No. 429863.

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MULTIPLE SIGNALLING.

TWO or more different messages are transmitted simultaneously, and are received separately on receivers controlled by synchronising-currents supplied from the same electric mains that feed the transmitter. The synchronising currents are supplied in succession to the anodes of two or more valves connected to the receiver so as to render them conductive only during consecutive portions of one or other of the transmitted signals. The signal voltages are applied to the grids of the receiving valves at the appropriate intervals. The invention is also described as applied to a method for measuring the density of fog or smoke at a distant point.

Patent issued to N. V. "Meaf." Convertion date (Germany) 3rd January, 1933, No. 429783.

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PHOTO-SENSITIVE VALVE.

A PHOTO-ELECTRIC relay-valve comprises an ordinary straight filament in close proximity to a photo-electric cathode, a grid-like electrode being placed between the two. The three electrodes are mounted in a glass bulb containing argon or other suitable gas at a pressure of 100 to 125 microns. The potential difference between the "grid" and the filament is less, and that between the former and the photo-electric cathode greater than the ionisation potential of the gas filling. Under these conditions any ionisation produced by photo-electric action leads to an increase of the discharge stream through the valve, and, in effect, produces a large amplification of the initial photo-electric current.

Patent issued to Marconi's Wireless Telegraph Co., Ltd. Convention date (U.S.A.) 19th September, 1933, No. 429725.

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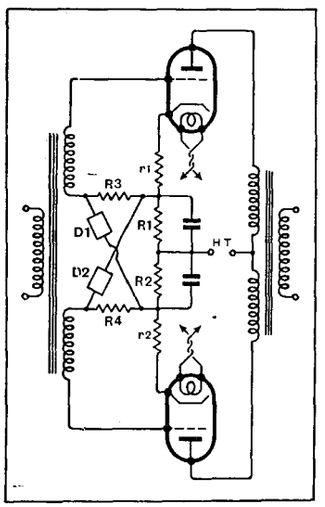
PUSH-PULL AMPLIFIER.

IN order to balance the anode currents of two push-pull valves automatically, *i.e.* without a prior adjustment of the operative grid bias, two equal resistances *R1*, *R2* are inserted in addition to the usual grid-biasing resistances *r*, *r1*. They are combined with rectifiers *D1*, *D2* and



Push-pull amplifier circuit.

resistances *R3*, *R4* in such a way that any excess in the anode current of one valve automatically decreases the grid-bias of the valve taking the smaller current, until a state of equilibrium is reached and maintained. The rectifiers *D1*, *D2* may be diode valves, or of the metal contact type.

Patent issued to Standard Relay Services, Ltd.; G. M. O. Jenkins; and P. Adorjan. Application date 5th January, 1934, No. 429630.

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TONE CONTROL.

THE response of a set to high notes is automatically regulated by varying the impedance of a valve shunted across the tuned input circuit. AVC voltage is applied to the grid of the control valve so as to increase its effective impedance with increase of signal strength, thus making the tuned input circuit more selective and reducing the high-note response. As signal strength diminishes, the tuned input is damped so as to maintain, automatically, a correct balance between the high notes and low.

Patent issued to General Electric Co., Ltd.; N. R. Bligh and C. N. Smyth. Application date 5th January, 1934, No. 430507.

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TUNING SCALES.

A SCREEN is located in or across the mouth of the loud speaker and a scale of wavelengths, with or without station names, is projected by an optical

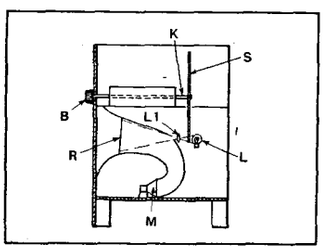

Diagram of tuning scale.

system on to the screen. As shown in the Figure, a disc *S* of celluloid or similar transparent material is mounted on the rear end of a shaft *K* so as to be rotated with the tuning control knob *B*. The lower part of the disc passes in front of a lamp *L*, which projects the corresponding scale-marking through a lens *L1* and a cut-away aperture in the horn of the loud speaker *M* on to a screen *R*, where it is visible from the front of the cabinet.

Patent issued to E. K. Cole; L.D., and A. R. Knipe. Application date 27th February, 1934, No. 430679.

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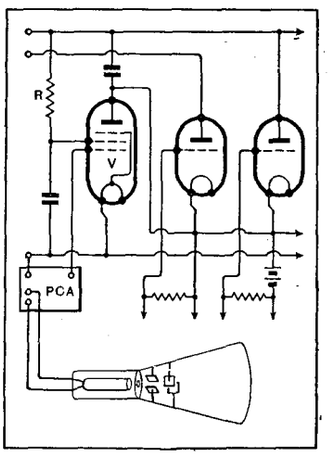
TELEVISION TRANSMITTER.

RELATES to a velocity-modulated system in which the condenser controlling the line-scanning potentials is arranged to discharge at constant voltage so that the "flyback" occurs immediately at the end of each line. It is found that this arrangement upsets the uniformity of the scanning frequency and so leads to variations in the total brightness of the picture. According to the invention the charging valve *V* is



Circuit of television transmitter.

of the Pentode type, and the screening grid is fed through a high resistance *R*. This maintains the anode current at a constant mean value, which, in turn, keeps the average scanning-frequency steady, in spite of variations in the light content of the picture.

Patent issued to W. R. Bullimore; L. H. Bedford; and A. C. Cossor, L.D. Application date 4th January, 1934, No. 430179. (Patent of addition to No. 399469.)

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TELEVISION SYSTEMS.

THE radiated energy required to transmit television signals is mainly concentrated in frequency-bands occurring at or near the scanning-line frequency and at harmonics thereof. It is stated that satisfactory results can be obtained by transmitting only these sub-bands up to and including the 20th harmonic. The picture signals are accordingly heterodyned with a wave which is rich in harmonics but has a fundamental frequency near that of the line-scanning frequency. This produces a fundamental and harmonic "difference" frequencies, the highest of which is less than the line frequency. The resulting wave is passed through a square-law rectifier which yields a comparatively narrow band for transmission through the ether. The incoming signal is heterodyned at the receiving end to restore the original frequencies.

Patent issued to Marconi's Wireless Telegraph Co., Ltd.; H. M. Dowsett; and L. E. Q. Walker. Application date 6th December, 1933, No. 430161.