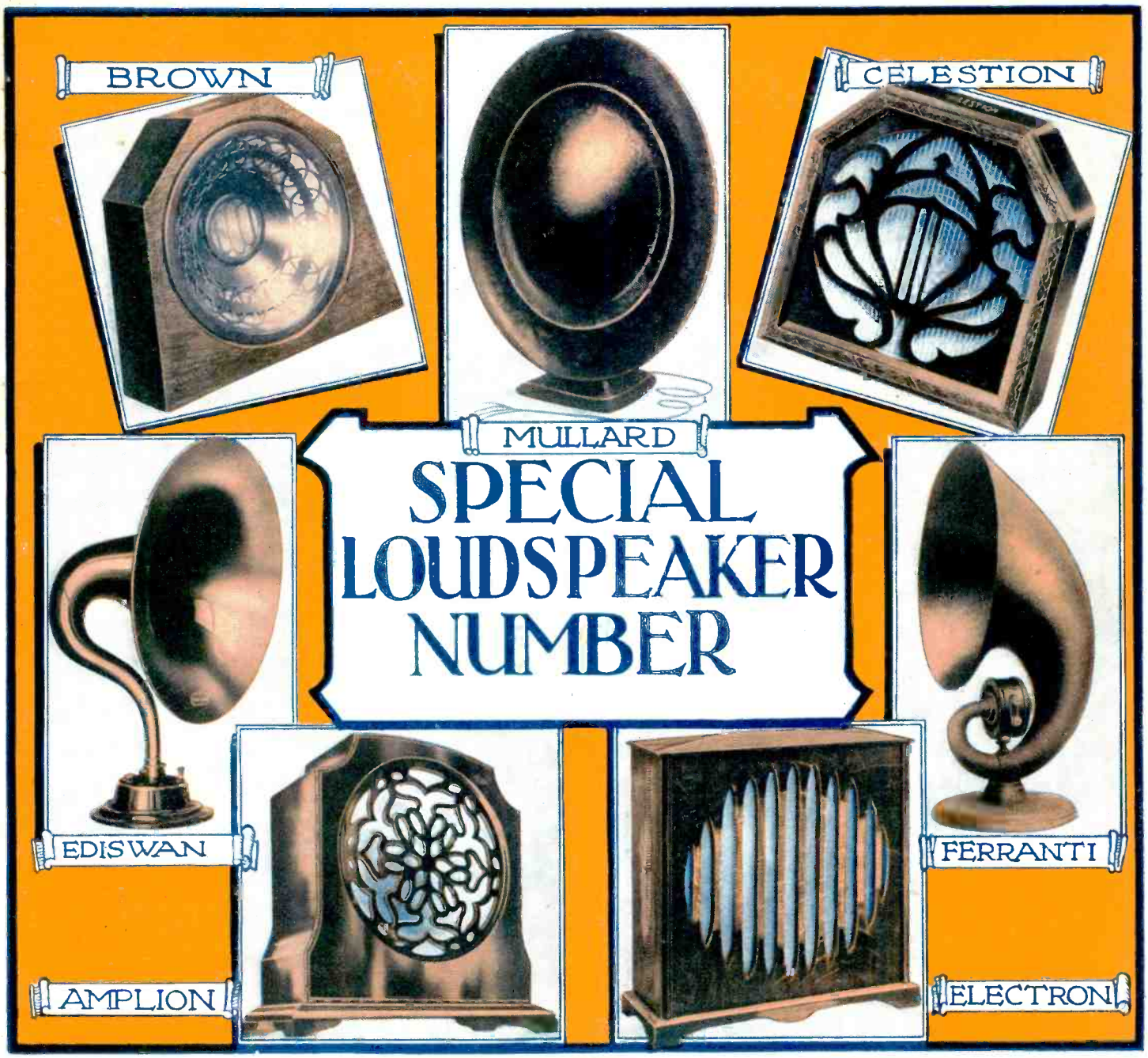
CHOOSING AND USING LOUD SPEAKERS

MODERN WIRELESS

1/- MONTHLY

Edited by
NORMAN EDWARDS

Vol. X. No. 20. AUGUST, 1928.



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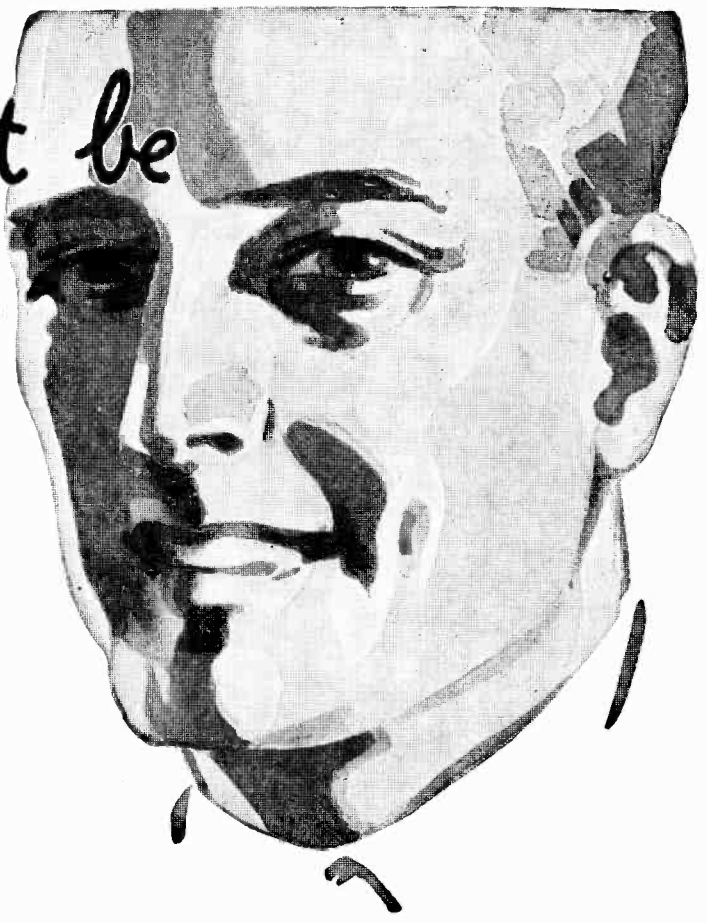
I would not be without them



I'M talking of radio valves. Mullard P.M. Radio Valves with the wonderful P.M. Filament. The wife and the children think the same, and you know kids, as a rule, have very keen ears . . . . . It was a long time ago, shortly after people first started talking about these Mullard P.M. Filament valves, that I bought one as a try-out, since all valves they said were pretty much of a muchness. Well, believe me! The improvement *that* Mullard valve made in my set plainly showed that there was only one thing to do—fit Mullard all through . . . . . I wouldn't be without them now and so many others think the same, it kind of gets you interested in the reason why.

Anyway, the secret of the whole business lies in the Mullard P.M. Filament. First of all it has a greater emission surface, in other words *there's more of it.* The remarkable length and thickness of the Mullard P.M. Filament is really amazing, and it results in a greater flow of electrons from the filament to the specially constructed plate. This increased flow is perfectly controlled by a grid designed in keeping with the Mullard Matched Electrode System of valve construction.

There are many other interesting points about this filament. It operates at such low temperature that there is no question of the filament losing its original nature, it remains tough. Why! . . . You can tie it in a knot long after a thousand hours of life, and again its low current consumption (.075 amps) is very, very easy on the L.T. Accumulator.

I'd advise you to put a Mullard P.M. Valve in every valve holder on your set. However, try a couple and you'll realise the truth of what I've told you. They are the easiest valves to buy—every radio dealer in the country sells MULLARD.

Mullard

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As some of the arrangements and specialities described in this Journal may be the subject of Letters Patent, the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

Edited by NORMAN EDWARDS.

Technical Editor: G. V. DOWDING, Grad.I.E.E.

Scientific Adviser: J. H. T. ROBERTS, D.Sc., F.Inst.P.

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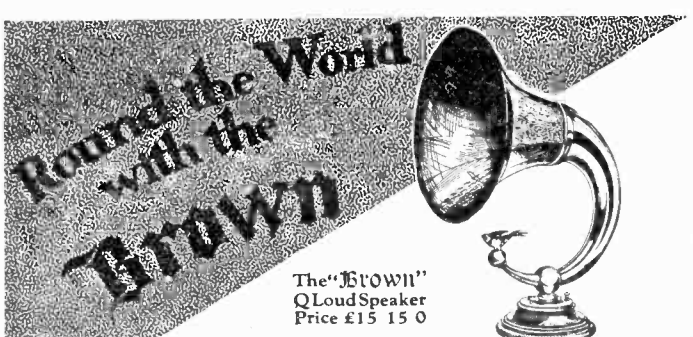

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MODERN WIRELESS

Vol. X. No. 20. August, 1928.

Sets of the Month—Valve Nomenclature—The Depths of Dullness.

Sets of the Month

IN this issue of MODERN WIRELESS we present to our readers a special loud-speaker supplement which has been prepared by Mr. A. Johnson-Randall, of the MODERN WIRELESS Technical Staff.

In connection with this supplement we also publish a long illustrated article by Mr. Percy W. Harris, M.I.R.E., on Loud-Speaker Coupling Circuits, bringing in exhaustive details about output transformers, chokes, and fixed condensers.

We feel sure that our readers will find this supplement of great practical value, inasmuch as the information is not relative to one particular type of loud speaker and one particular output circuit, but covers the general field in a way which should meet the desires of all classes of readers who wish to operate their loud speakers to the best advantage.

Three of the sets published in MODERN WIRELESS this month incorporate wave-change schemes in deference to modern requirements. For instance, the "London-Daventry Crystal Set" is a simple, inexpensive wave-change receiver, which will give efficient results on both long and short wave-lengths.

The "M.W. de Luxe H.F. Unit" is a special design of the MODERN WIRELESS Research and Construction Department. It embodies a scientific and simple wave-change system. This is operated by means of a single switch. The unit can be hooked on to practically any set, and it will be found eminently suitable for long and ordinary wave-lengths.

The "Twin-Wave" Four is a powerful long-distance receiver, also incorporating an efficient yet simple wave-change scheme which is controlled by a panel switch, allowing both the wave-bands to be covered without the necessity of coil changing or internal alterations to the receiver.

In addition, Mr. Kelsey publishes a description of a very excellent two-valve short-wave receiver which, in view of the increasing popularity of short-wave reception, should make a very wide appeal to our readers.

Valve Nomenclature

IT was pointed out in the "Morning Post" the other day by the Wireless Correspondent of that journal that there are 1,200 different types of valves on the market. This is rather an astounding figure, and the tyro may be excused for feeling a little puzzled when he tries to make up his mind which type to choose.

It is all the more difficult for the novice because many of the valves which he purchased, say, a year ago, and which have given him excellent service, are now more or less obsolete, and he has to make up his mind to replace his old valves with their modern prototypes, taking note of their various characteristics and the improvements which have been made, as well as a multitude of other little technical points.

We have long advocated that the 4-volt valves, for instance, could be abolished. By doing this manufacturers would considerably simplify the problem for the amateur, and, incidentally, for themselves.

And, again, we are in entire agreement with the "Morning Post" Wireless Correspondent when he suggests that the various valves should be given names. There is no particular reason at all why valves of various types should have numbers and initials. Supposing a potential purchaser of a Rolls-Royce had to ask for motor-car type 206 R.R., and supposing a Baby Austin was given a type number of, say, 266 B.A., it is easy to see that a certain amount of confusion might arise and the prospective purchaser would very easily find it a matter of some difficulty to remember such complicated titles.

The Depths of Dullness

A WRITER in one of the evening papers recently announced that he had bought a wireless set, and since then had, night after night, crouched before the loud speaker in an attitude of "humble expectation." But his expectations never seemed to be fulfilled, for he reckoned that the B.B.C. programmes "plumbed the depths of dullness!"

The programme question will always be with us, and it is becoming increasingly difficult, as the B.B.C. licence numbers increase, for the programme directors at Savoy Hill to find a happy medium—that is, to provide programmes which will more or less please everybody. The task, of course, is really hopeless; but although a lot of publicity is given to those disgruntled ones who perhaps for four or five nights in the week fail to get satisfactory enjoyment when listening-in, there are admittedly hundreds and hundreds of thousands of people in this country who, on the whole, feel that the B.B.C. is doing its job very well these days as regards programmes.

There are, perhaps, two main points of criticism:

1. The excessive number of talks, and the excessive dullness of the subjects chosen.

2. The dullness of the Sunday programmes.

If the B.B.C. would pay a little more attention to these two points we feel sure it would raise the level of the programmes and please many more listeners who are at present feeling dissatisfied.

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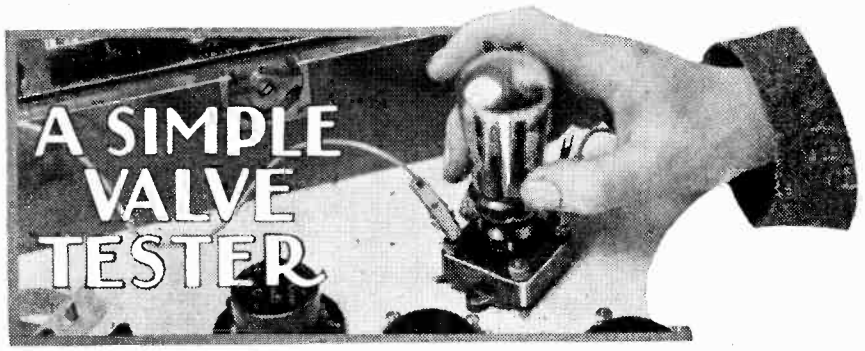


A useful instrument for the experimenter.

By J. F. CORRIGAN, M.Sc., A.I.C.

MODERN valves are very seldom found in a defective condition, but nevertheless amateurs who may be working with one or more of the older valves, or with a valve obtained from one of the many surplus stores, may have detected faults in these articles.

For instance, faulty connections may often be come across in old valves, the faults being localised within the base of the valve, or at the valve pins. Again, if an early dull-emitter is still being employed it may be found to be inefficient owing to the fact of its filament having lost a goodly proportion of its electron-emitting properties.

The Essential Parts

Faults such as the above—some of which are remediable, and some of which are not—can readily be detected by rigging up a little piece of apparatus according to the circuit shown in the diagram.

Primarily, for the construction of this simple valve tester, a milliammeter having a full scale reading of a few milliamps is needed. This is mounted on a suitable baseboard, together with a valve holder. One side of the milliammeter is connected to the anode leg of the valve holder, the other side being placed in series with the positive terminal of a 20-volt (or thereabouts) battery. The negative pole of this battery is connected through a switch or tapping key to the valve filament, as shown in the illustration.

Filament Regulation

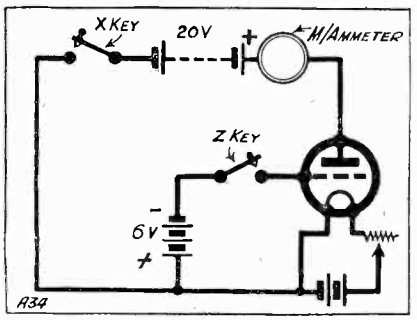
The second battery connected in series with the grid of the valve should have an E.M.F. of approximately 6 volts, its negative terminal being connected to the valve grid through a switch or key. Finally, a small accumulator together with a suitable rheostat is provided for filament-heating purposes.

Now for the use of the instrument. A valve is inserted in the vacant holder. The key marked X is then depressed, after, of course, the filament heating current has been turned on.

Effect of Grid Bias

This will complete the anode circuit, with the result that the electron emission from the filament will give rise to a deflection of the milliammeter needle. Keeping this key or switch depressed, the second key marked Z is now brought into operation.

This will have the effect of imparting a negative potential to the grid of the valve, and the result will be a partial stoppage of the electrons passing from the filament to the anode. Consequently, the milliammeter needle will tend to swing back, denoting a reduction of the anode current.



If the grid connection to the valve is not faulty the milliammeter needle will swing back almost to zero under these conditions. If, however, the connection of the valve leg to the grid is in any way at fault there will be little or possibly no backward deflection of the needle at all.

Testing Connections

Naturally if any slight contact exists between the valve filament and the grid, the same result will occur under the above conditions, for the current from the battery marked Z will simply flow through the filament and escape from the valve in that manner.

A valve the filament of which has lost a good deal of its emissive properties will not answer to any of these tests, or, at the best, only in a slight degree. In an event such as this, it is a good plan to increase the filament current whereby a small electronic emission will generally take place, causing sufficient current to flow to give some slight indication on the milliammeter.

Almost any possible test for the electrical soundness of the valve's inner connections and insulation may be carried out by means of the apparatus, and on this account its construction may be recommended to enthusiasts who, for one reason or another, have a number of valves to test out in this manner.

ODD ITEMS

Using the Universal Short-Wave Receiver described in MODERN WIRELESS for February, 1928, a Ripon reader reports the reception without aerial or earth of 2 X A F, K D K A, and various other long-distance transmissions.

* * *

In Germany the broadcast licence fee is much higher than in this country, and the German pays for his licence roughly two and a half times as much as the British listener.

An easy method of determining the polarity of D.C. mains is to bring leads from a lamp to a glass of water and immerse the ends. When the current is switched on bubbles will rise to the surface. One wire will give off far more bubbles than the other, and this excessive bubbling will always take place at the negative lead.

* * *

Do not allow the small holes in the vent plugs of an accumulator to become choked or blocked up in any way, as an air passage here is vital to the proper functioning of the accumulator.

* * *

It is reported from East Africa that a short-wave broadcasting station has been erected at Nairobi.

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RADIO IN THE OPEN

Many interesting open-air radio experiments can be carried out by the amateur with even the simplest kind of apparatus. The following article gives an indication as to how pleasant evenings and week-ends can be spent in this manner.

By R. GOODE.

IT is the exception rather than the rule to find, nowadays, a radio amateur who combines the pleasures of the countryside with those of radio. "Radio in the Open" implies generally nothing more than the transportation of a good portable set, a frame aerial, and a set of 'phones or a loud speaker to some rural spot, and the obtaining of broadcast programmes under such circumstances for purposes of entertainment only.

"Numerous Experiments"

There is, however, a great deal more to be got out of this "rural radio," if we may so term it. Even with the simplest apparatus, the amateur can perform numerous experiments upon conditions of reception, and the part played in such reception by the various conditions of atmosphere, vegetation, and general "layout" of the countryside.

Thus during the long evenings which are now with us, and the still more pleasant week-ends which are available for most town workers, there is a good opportunity for the really interested radio worker to obtain detailed and first-hand information about the reception conditions which prevail in one or more of his favourite country spots.

As mentioned above, the simplest of apparatus will suffice for these rural radio experiments. A two-or three-valve portable of efficient design and construction, a hundred feet or so of insulated aerial wire, a ball of string, one or two porcelain insulators, an earth tube or plate, and a pair of headphones can conveniently comprise all the apparatus required.

Armed with radio tackle of the above nature, one may proceed to some favoured country area, and an afternoon's or an evening's experimental work may be assured. The illustration shown at Fig. 2 depicts an experiment which ought to be one of the first to be tried out with the apparatus.

Sling the 100-ft. length of insulated wire between two trees, and at a height of about 15 ft. If possible,

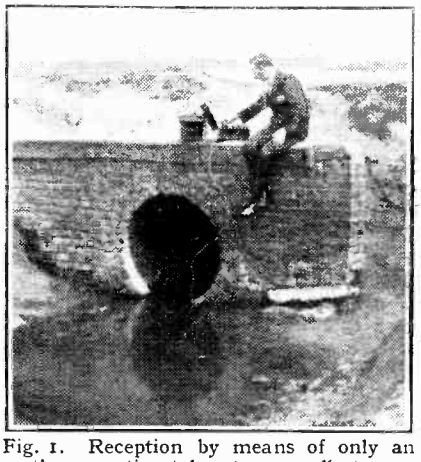

Fig. 1. Reception by means of only an earth connection taken to a small stream.

have the down lead of the aerial situated at the end of the stretch of wire nearest to the broadcasting station which it is desired to receive.

Provide a tubular or plate earth connection to the set, and then tune in. Having obtained some degree of reception, get an assistant gradually to increase the height of the aerial wire above the ground. Note the degree of improvement in reception, and note, also, that it does not increase proportionally with the height of the aerial, as one would be inclined to suppose.

Satisfactory Earths

Thick-foliaged trees ought not to be selected for these experiments, because they absorb a considerable amount of the radio energy. Ash trees form the best aerial supports for the above purpose, as also do sparse old oaks which are beginning to fall into decay.

Fig. 3 shows a most satisfactory way of earthing a set during rural experimental work with a portable. It consists in sticking an earth tube into the bottom of a small stream or brook. Good earth contact will thus be effected, particularly in the hot and dry summer weather.

Naturally, it will not always be possible to effect this type of earth connection, but, nevertheless, when there is any chance of doing so, it will be found worth while to run as

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much as 25 ft. of insulated wire to form an "earth" of this nature.

While on the subject of earths, it should perhaps be pointed out that quite a number of interesting countryside experiments can be performed in reception by earth alone. Fig. 1 illustrates a suitable experiment of this nature.

Here, a short length of wire has been tightly hammered round a copper plate, the latter being subsequently dropped on to the bed of a running stream, a pond, or some other stretch of water.

Fence Aerials

Reception under these conditions may or may not be obtained. It all depends upon the sensitivity of the set, its distance from the local station, and the many directional influences associated with the stream or pond.

Generally, within ten miles or so from a main station, some sort of result will be obtained by an experiment of this nature, particularly if the stream or pond is situated in the open, and away from wooded areas and hills.

Fences in the country are generally capable of forming excellent aerials for broadcast reception. They can be used with or without earth connections, and in this respect they may be considered to form gigantic frame aerials.

The fences, however, must be employed in dry weather only, otherwise the results will be almost negative, owing to the leakage of energy to earth via the layer of moisture on their surfaces. Moreover, only fences which consist of wire supported on wooden stakes are suitable. Metal railings provide a direct path to earth, and are obviously of little use for radio reception.

Fig. 3. A very good earth connection can be obtained by driving a metal rod or pipe into a running stream.

Strongly Directional

It should be remembered, too, that all fences, owing to the frame-like behaviour, have strongly directional properties. A fence which cuts the direction of the radio waves at right-angles will give poor, or probably negative, results, while, on the other hand, a well-insulated wire fence which runs parallel to the direction of travel of the radio waves will give excellent results.

A "fence aerial" used in conjunction with a direct tubular earth connection to the set is illustrated at Fig. 4.

Wooden gates which have plenty of barbed wire strung across them are highly interesting for radio experimental work in the country. They may be used as frame aerials without earth connection to the set, and by slowly swinging open the gate the effect on the reception can be noted and studied at will.

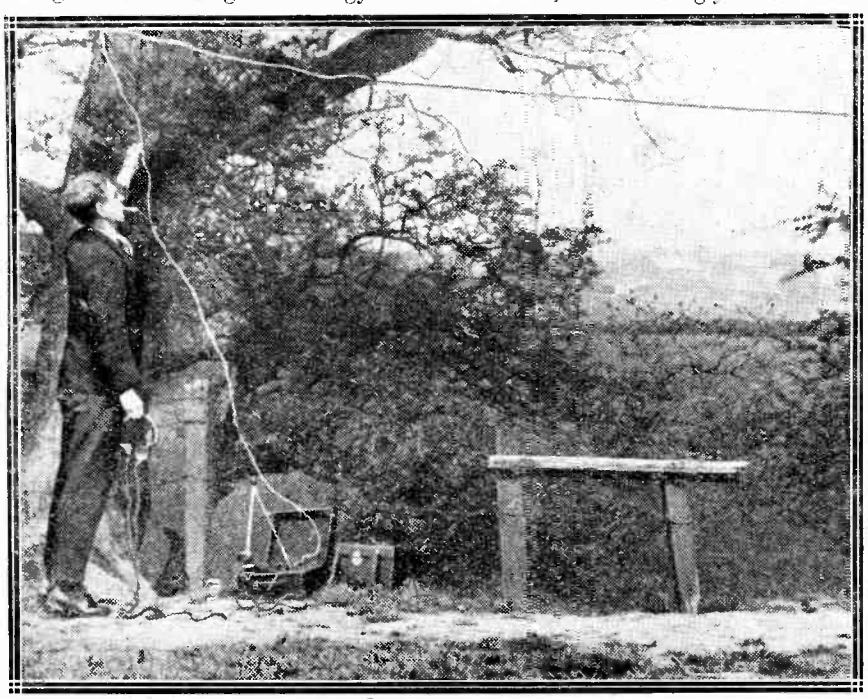

Fig. 2. Quite a good aerial can be erected merely by slinging an insulated wire between two trees, the wire being thrown up across the highest possible branches.

Sandy Soil Best

Naturally, a frame aerial of the conventional type is always a most useful and interesting adjunct to countryside experimental work. A four- or five-valve portable is usually required for work with them, however. Moreover, the frame aerial has to be of the folding type, or else it becomes most inconvenient to carry for any distance.

Frame-aerial reception experiments in country regions concern themselves generally with the investigation of the reception strength obtained at different spots. For instance, reception will be very bad in a wood on account

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of the strong absorption of the radio waves by the trees. Sandy districts favour this type of reception the most, owing to the very small absorption of the ground.

Effect of Screening

Again, during countryside experiments there is the interesting influence of screening to be investigated. Some trees will be found to act as more powerful screens than others. If hills are present in the neighbourhood, their screening influence will quickly be noticed, and it will be interesting to note the difference in signal strength if a series of trials can be carried out at various altitudes on the hill-slopes.

With regard to the type of receiver most convenient for rural radio work, a two- or three-valve portable has been mentioned in the opening paragraphs. Seldom are more elaborate

Fig. 4. A wire fence used as a "frame aerial" without a direct earth connection to the set.

sets required at reasonable distances from a station.

Convenient Receiver

For a set of this nature, one of the many types of ex-W.D. spark transmitters which are to be obtained very cheaply from army surplus dealers forms an excellent basis for construction. The interior fittings should be removed. It will be found that the case is really a double-walled one, containing a lining of rubber composition between the two walls.

Such a construction renders the contents of the case very immune from shocks. Old transmitter cases of this description are roomy enough to fit any two- or three-valve hook-up in, and batteries can be stored in the lid.

A small portable of this description, roughly hooked up for use with a frame aerial, is shown "in action" at Fig. 5. This was used experimentally throughout the spring for seashore experiments at Blackpool, and it

Fig. 5. A frame-aerial experiment on the sand hills at Blackpool. The receiver is built into an old W.D. spark-transmitter case. Results were remarkably good.

seldom failed to give Manchester (some 50 miles away) at good strength with three valves, and occasionally on two valves.

IS IT YOUR SET?

By D. G.

If your loud speaker and telephone receivers suddenly start to emit crackling, grating, or other noises, do not pre-suppose that your set is at fault. It may even be a sudden attack of atmospherics. You can easily test for this by disconnecting your aerial and earth leads. If the trouble ceases, then you can fairly safely assume that static is at the bottom of it.

Generally speaking, however, B.B.C. transmission distortion is due to the use of faulty landlines.

"Pot Luck"

Landlines are at a premium during the more important sports meetings, and it seems that the B.B.C. has to take "pot luck" on the occasions of the broadcasting of events such as the Derby; and, therefore, landline noises frequently accompany the transmissions of outside broadcast. Here the ideal conditions of previous balancing and experimentation are not always possible as in the case of the landline used to link the broadcasting stations for ordinary simultaneous broadcasts.

It is landline trouble which usually makes the transmissions sound harsh and metallic, and with a "cut off" of bass notes. 5 G B and 5 X X make a greater use of landlines than most other stations. Many of their programmes are performed in London, the transmitters being, of course, at Daventry.

Noisy Broadcasts

Not long ago the transmission from 5 G B was accompanied by a low, growling noise. There was also considerable roughness. On one occasion, when the results were worse than usual, the announcer informed listeners; but this is not by any means a usual practice. Listen carefully the next few times that there are transmissions of a descriptive nature from unusual or distant quarters of the country. A commentary from Cornwall or the Lake District, or from the North of Scotland.

This is the broadcasting studio recently built at the Berlin Conservatoire for experimental and training purposes. Pupils are enabled to acquire broadcasting technique under the actual conditions of studio atmosphere.

On the other hand, the noises or distortion may be due to the transmitting station. Transmitters can develop faults just as well as receivers

You will soon learn to detect the distortion due to landlines, and will be able to recognise it immediately it mars your reception.

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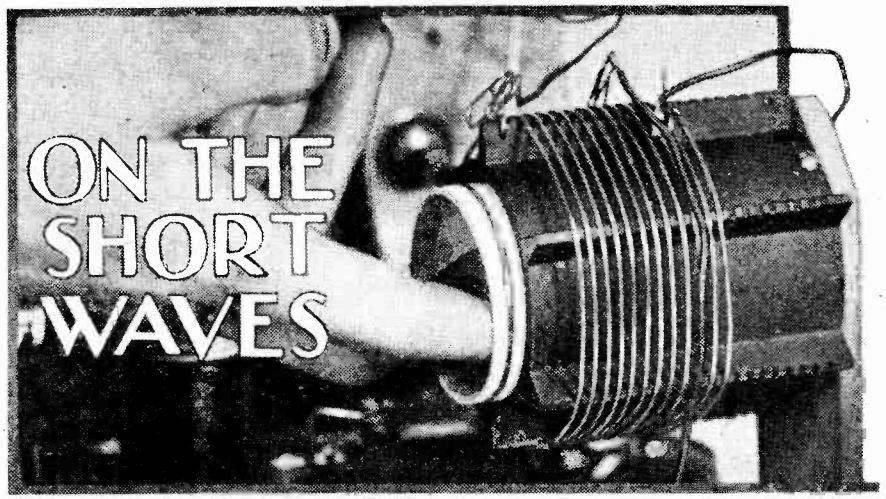


Notes of Interest on Short-Wave Receivers and Reception Conditions.

By W. L. S.

THE summer is (at the time of writing!) really and truly with us, and the atmospheric nuisance is in full swing. It is at this period of the year that the short-wave enthusiast gives up all thought of D.X. reception, and either turns to tennis or kindred pursuits or, if he is really keen, starts an annual "rebuild" in readiness for the coming season.

I am afraid I never think seriously of rebuilding my own outfit until someone else tells me in a very loud voice that the D.X. season has really started and that I am missing good things simply through the inefficiency of my own receiver! However, this year's set does really seem to be delivering the goods in particularly good fettle even now, so that I have no immediate cause to worry.

A Loud Station!

It does us all good to give up the more strenuous parts of our various hobbies for a little while, and I certainly feel at times that I should be perfectly content to sit and listen to sweet melody from 2 X A D for ever, instead of continually scouting round the short waves to provide material for these brief notes. These periods do not last long, however, as, for one thing, visitors are continually worrying me to produce something new, as if I can conjure up "fresh sigs. and stations new" ad lib.

A few nights back I really managed to live up to the reputation, however, and on searching idly round the wave-band ranging from 10 metres to about 16 metres came across a loud telephony station which turned out to be the American end of the trans-atlantic telephone.

The two ends of the transatlantic 'phone, incidentally, live about two metres apart, and apparently one is louder than the other for two hours or so, after which the conditions change over. I have been told several times that the transmissions are of a nature which prevents the conversations from being understood by the ordinary listener. The only obstacle to perfect understanding in my case is the American accent, which can be cut with a knife! I have never yet met anything that sounds like "secret transmission" of this 'phone service on the short waves.

Sounds of Pictures!

If you are ever mystified by a station that sounds as if it is simply sending a meaningless jumble of dots and dashes at a rather high speed, it is probably an American station transmitting photos. There are four or five such stations "on the air" below thirty metres, and some of them are rather amusing to listen to. I have not yet tried to construct a "picture receiver" to receive these with, but, judging from the extraordinary sounds they conjure forth, they would be rather fearsome affairs! We shall, I suppose, ultimately be able to recognise well-known buildings and persons by *sound!*

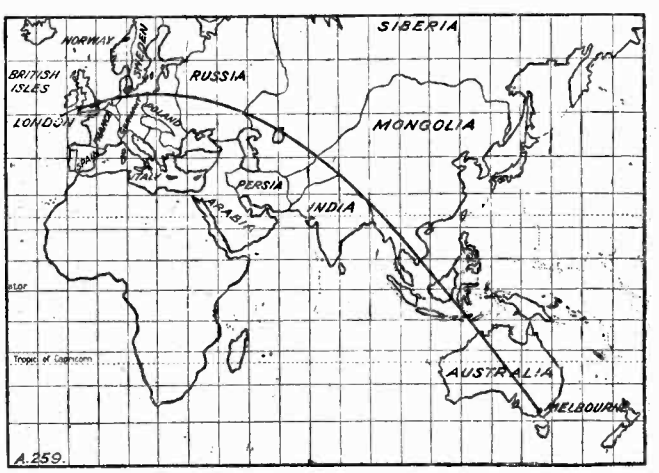
Have any of my readers succeeded in piecing together, from the times at which 2 X A D and 2 X A F are to be heard, a regular time-table for these two stations? I have an idea that it may be possible, although to the uninitiated it seems as if they are both hopelessly irregular. 2 X A D's "lunch-time programme" used to be quite a regular feature on three days per week. Now it can hardly be counted upon at all, unless I am in a dead spot.

Hyper-Short Waves

All the exciting phenomena observed by the G.E.C. and R.C.A. laboratory staffs concerning the "hyper-short-wave" oscillators which have been constructed recently in the United States seem to have had the effect of scaring people over here with respect to work even on 10 metres. One old lady assured me in all seriousness that these short waves were dangerous and that I should burn myself to death! In view of the fact that she almost certainly would not have known the difference between a centimeter and a kilowatt, I could make no attempt to reason with her, but for the benefit of any readers who are interested I may state that the conditions under which these startling manifestations were observed were as follows: Wave-length, below 6 metres; power, at least 25 kilowatts! If any reader is using more than 25 kilowatts below 6 metres, he had better proceed with extreme caution!

WHICH WAY DO SHORT WAVES TRAVEL ROUND THE WORLD?

The shortest route to Australia is via Russia, and follows the line shown in this map. This line indicates what is known as a "great circle" round the world, and is a good illustration of how misleading an ordinary map can be in certain respects.



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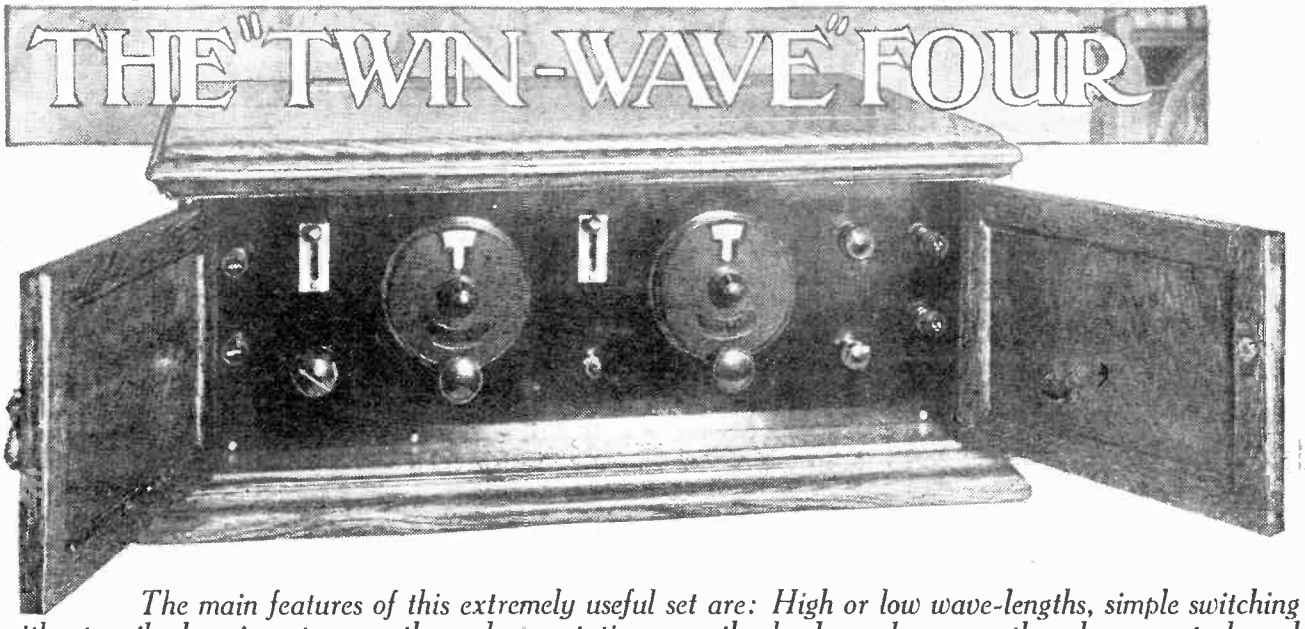
THE "TWIN-WAVE" FOUR



The main features of this extremely useful set are: High or low wave-lengths, simple switching without coil changing, two or three dozen stations on the loud speaker, smooth volume control, and rock-bottom stability.

Designed and Described by G. V. COLLE.

FROM a rough census recently taken of the popular types of radio receivers, it has been discovered the ordinary three-valver takes the foremost place, with the four-valver a good second.

This is not difficult to understand when one remembers the "boost" the three-valve receiver has had at the hands of certain manufacturers, although it must be admitted the ordinary Det. and 2 L.F. (which circuit these sets utilise) has always had a good following.

Looking deeper into the question, one discovers the demand for sets incorporating arrangements which allow, by the turn of a switch, change from low to high wave-lengths; and therein lies the secret. For most of these popular receivers have incorporated, in some form or another, a wave-length change scheme whereby the use of plug-in coils has been avoided.

Many Stations Available

Unfortunately, these switching schemes are not easy to design, and since the popular Det. and 2 L.F. most readily lent itself to alterations, it was the first to be attempted.

With the four-valve receiver described hereunder the author has attempted the same thing, but on a bigger scale, for the benefit of the more advanced constructor.

The usual three-valver is, in effect, a three- or four-station set, whereas the "Twin-Wave" Four will, under the correct conditions, bring in some two- to three-dozen stations on the loud speaker.

"Finest Quality"

The reader should realise, however, that it was not the aim of the author to describe a set which brings in stations "galore," but rather which gives the finest quality of reproduction, with the chance of many alternative programmes.

In this connection, therefore, it will be interesting to observe what the set is capable of doing and why it could also be named "universal."

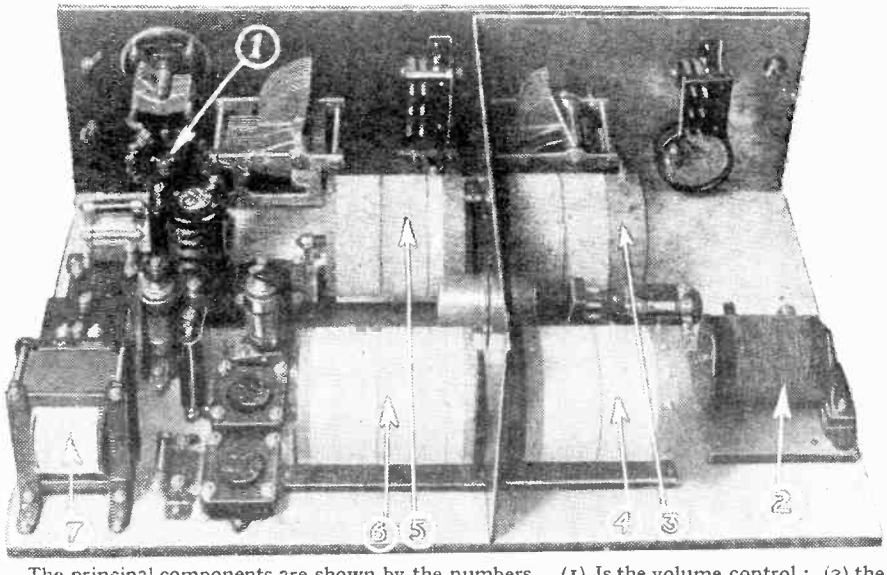
The following features are incorporated:

(1) It will easily operate a moving-coil loud speaker, since two valves are arranged in parallel in the last L.F. stage.

(2) High or low wave-lengths, by simple switching. Two-dial tuning only, with the use of a small reaction condenser for weak distant stations.

(3) Simple volume control.

(4) Stability in operation. (There is no neutralising, as a "screened" valve is employed in the H.F. stage.)



The principal components are shown by the numbers. (1) Is the volume control; (2) the wave-trap; (3) and (4) low and high wave-length aerial coils; (5) and (6) low and high wave-length anode coils; and (7) the output choke loud-speaker filter.

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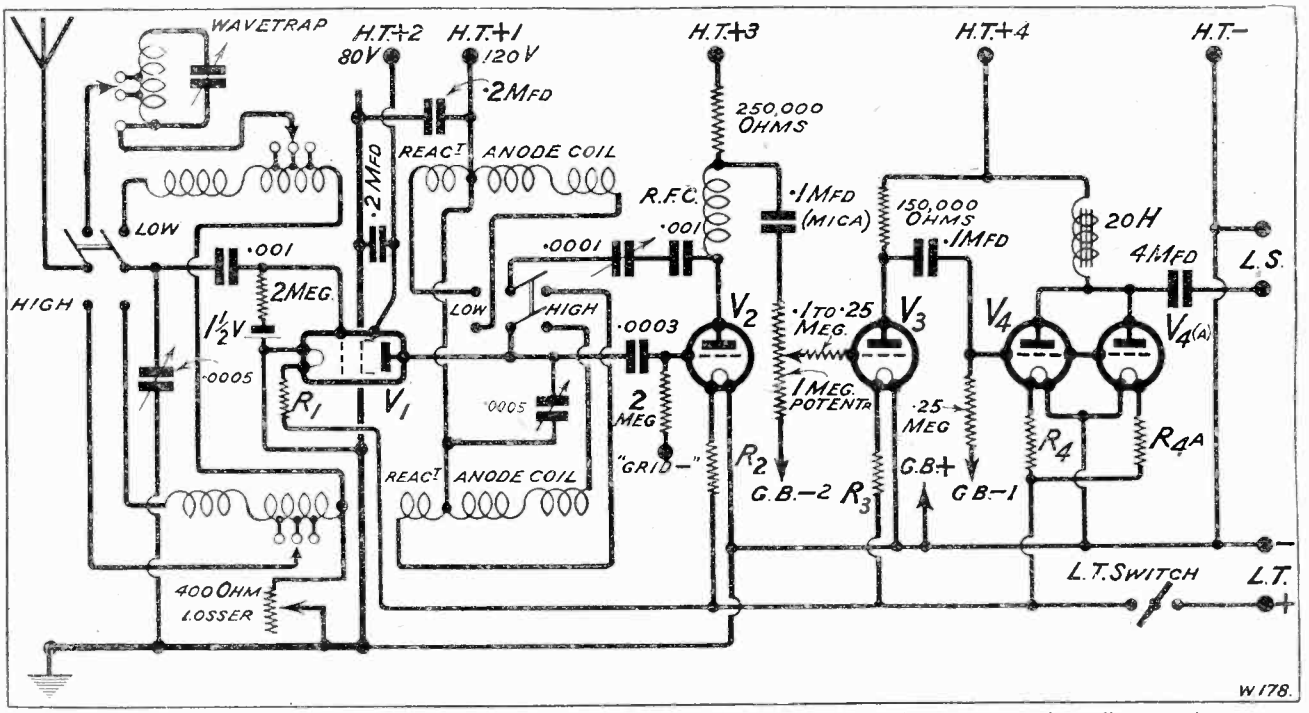
(5) A wave-trap is incorporated for eliminating the local station when this is not desired.

(6) The coils are of the single-layer type, wound astatically. (These can be wound by hand or purchased commercially from Peto-Scotts, Burne-Jones, or Wright and Weaire.)

Looking at the theoretical circuit of the set, it will be noticed the latter really employs five valves, the last two being in parallel. As, however, the use of two is to make up for the limitations of one power valve, the circuit is, to all intents and purposes, a four-valve one.

near it on its H.T. + end. The reaction is controlled by the ·0001-mfd. miniature variable condenser, which obtains its "feed" from the plate of the detector valve.

Astatically wound aerial coils are employed for tuning in the grid circuit of the H.F. valve, and these



Here is the full circuit, and it will be seen that it embodies practically all the latest improvements in radio reception.

With the exception of the coils, the rest of the components are quite standard and can be purchased from any dealer. Data relating to the construction of the coils is given elsewhere.

The H.F. valve as used in the original receiver was a 6-volt S.625, either Marconi or Osram. This valve is coupled to the detector by means of an astatically wound anode coil, which has a reaction winding arranged

operate on the "auto-coupled" principle, which reduces the damping of the aerial itself to some extent. The low tapping points on the aerial coils assist in sharpening the aerial tuning, three tapping points being provided

COMPONENTS AND MATERIALS

1 Panel, 21 × 7 × ¼ in. (Any good branded material).
1 Cabinet, 21 × 7 × 12 in. deep, complete with baseboard and ebonite strip for terminals, 13¾ × 1½ × ¼ in. (Any standard make).
2 ·0005 variable condensers (Cyldon. Any good make).
2 Vernier dials (Igranic "Indigraph" or other sound make).
2 Double-pole change-over switches (lever type). (Utility, Dubilier, etc.)
1 ·0001 miniature variable condenser (Peto-Scott). (Cyldon, Bowyer-Lowe, etc.)
1 1-megohm potentiometer (G.E.C.). This is known as a high-resistance potentiometer.
4 Sprung valve holders (Benjamin, Bowyer-Lowe, Burne-Jones, Igranic, Lotus, Marconiphone, W.B., etc.).
1 Special valve holder for screened-grid valve (Wearite).
1 Standard wave-trap (Burne-Jones, Lewcos, etc.).
5 Fixed resistances to suit valves, complete with holders (Peto-Scott in original. Any standard make).
2 ·001 fixed condensers, one with series grid-leak clip (Clarke, Dubilier, Igranic, Lissen, Mullard, T.C.C., etc.).
1 ·0003 fixed condenser, with series grid-leak clip (Clarke, Dubilier, Igranic, Lissen, Mullard, T.C.C., etc.).
2 2-meg. grid leaks (Dubilier, Igranic, Lissen, Mullard, etc.).
2 ·25-meg. grid leaks (Igranic, Dubilier, Lissen, Mullard, etc.).
2 Grid-leak holders (Dubilier, Igranic, Lissen, Mullard, etc.).
2 ·1-mfd. mica condensers (Dubilier, T.C.C., etc.).
1 H.F. choke (R.I.-Varley. Any good make).
1 Anode resistance for detector (see text) complete with upright holder (R.I.-Varley).
1 150,000-ohm anode resistance—upright type (R.I.-Varley).
1 4-mfd. Mansbridge condenser (Dubilier, Ferranti, Hydra, Lissen, Mullard, T.C.C., etc.).
2 ·2-mfd. Mansbridge condensers (see above).
1 20-henry L.F. choke (R.I.-Varley).
1 L.T. on-off switch (Benjamin, Lissen, Lotus, etc.).
2 3 in. dia. 3¼ in. long formers for low-wave coils (see below).
2 3 in. dia. 4 in. long formers for high-wave coils (see below).
50-yd. reel of 9/38 Litz wire (all silk) (see below).
2-oz. reel No. 40 S.S.C. wire, or, alternatively, these coils can be purchased complete from Peto-Scott, Burne-Jones, etc.
15 Insulated terminals, markings according to diagram. Alternatively, plain terminals can be used in conjunction with indicating tabs (Belling-Lee, Igranic, Eelex, etc.).
1 Siemen's "T" type 1½-volt cell.

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on each aerial coil, the lowest tapping giving the sharpest tuning, although not the loudest signal strength.

Greater selectivity and freedom from interference can be had by introducing the wave-trap, but, on the other hand, "flatter" (broader) tuning is obtainable by means of the 400-ohm "losser" (which is a potentiometer with one end of its winding left disconnected) and by making use of the highest tapping point on the aerial coil and placing the wave-trap out of circuit.

The Wave-Trap

Lastly, in respect to the wave-trap, it should be mentioned it is only effective on the lower broadcasting band, covering from about 350 to 500 metres. The switching is therefore arranged to place it out of circuit on the higher wave-lengths.

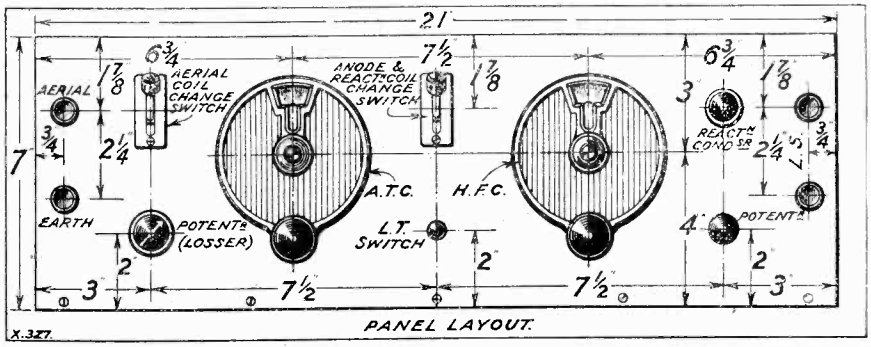
We then arrive at the L.F. end of the circuit, which consists of two stages, both resistance-capacity coupled. The values of anode resistances chosen are suitable for medium-impedance valves, whose anode impedances vary between approximately 15,000 and 30,000 ohms. From these figures it will be seen that valves of the H.F. types are suitable, although some of the present-day "general purpose" valves come within this category.

While these figures also relate to the detector valve, since this has an anode resistance in its plate circuit, yet it will be necessary to employ a value higher than 250,000 ohms if a valve of an impedance in excess of 30,000 ohms is employed

with anode-bend rectification arrangements.

More Critical

They give a bigger volume than an H.F. valve under the condition outlined above, but are rather more



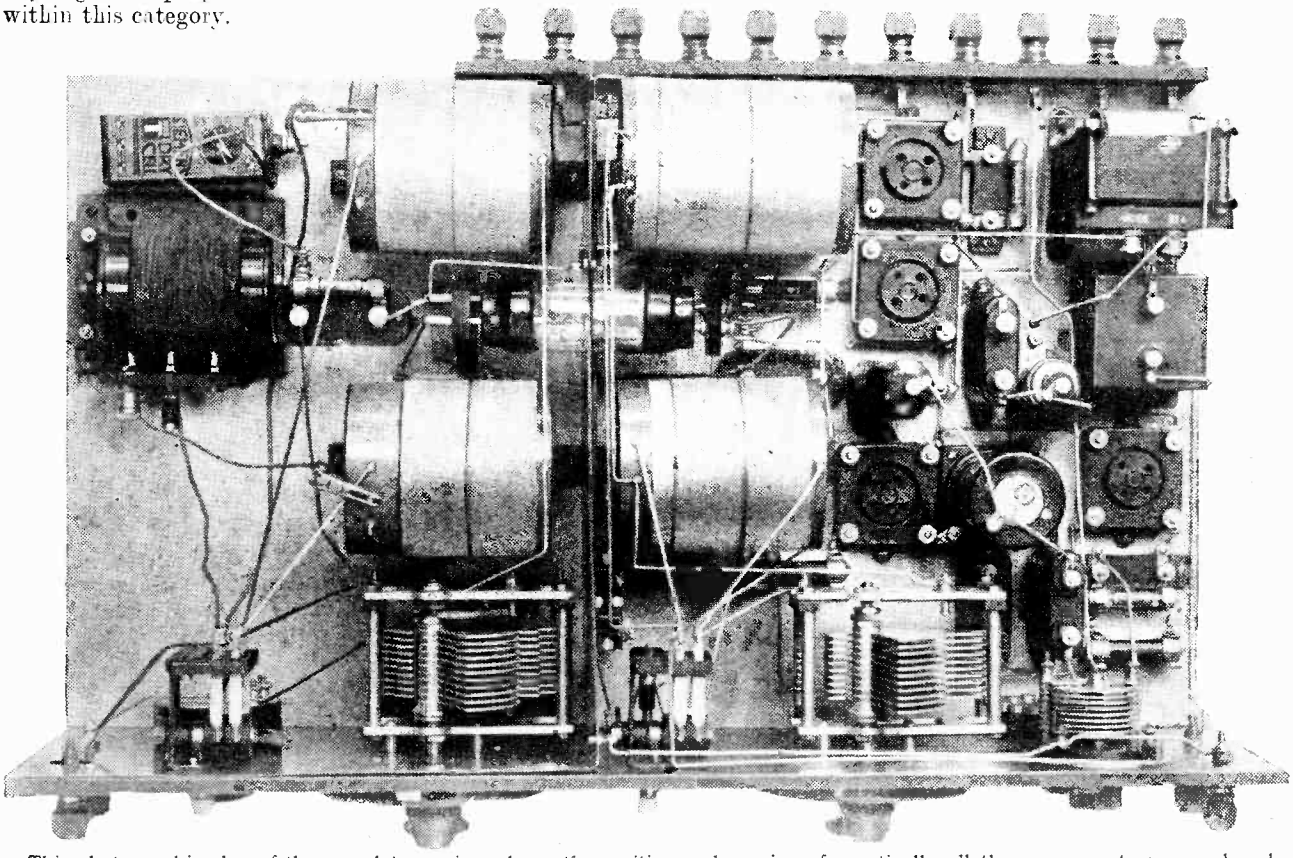
There is nothing difficult about the panel layout, which is pleasingly symmetrical.

For valves having impedances of 40,000 ohms upwards the anode resistance in the detector plate circuit can be 500,000 ohms, otherwise the full benefit of the higher "mu" (which goes hand in hand with the higher impedance) will not be felt. Such valves are classed as "resistance coupling valves," but as far as the writer is concerned he does not care to use them in R.C.C. stages, preferring to utilize them as detectors

critical in initial adjustments and some tend to be microphonic.

Both the H.F. and R.C.C. types of valves can be tried in this set under their best conditions, since provision is made for either anode-bend or grid rectification.

The volume control is arranged on the first L.F. stage and takes the form of a variable grid leak of 1 megohm in value. The one used in the original set was obtained from the G.E.C. and



This photographic plan of the complete receiver shows the position and spacing of practically all the components on panel and baseboard. Note how the screened valve sits in the centre of the coils to simplify spacing and allow of short wiring.

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was found to be very silent and perfectly reliable in action.

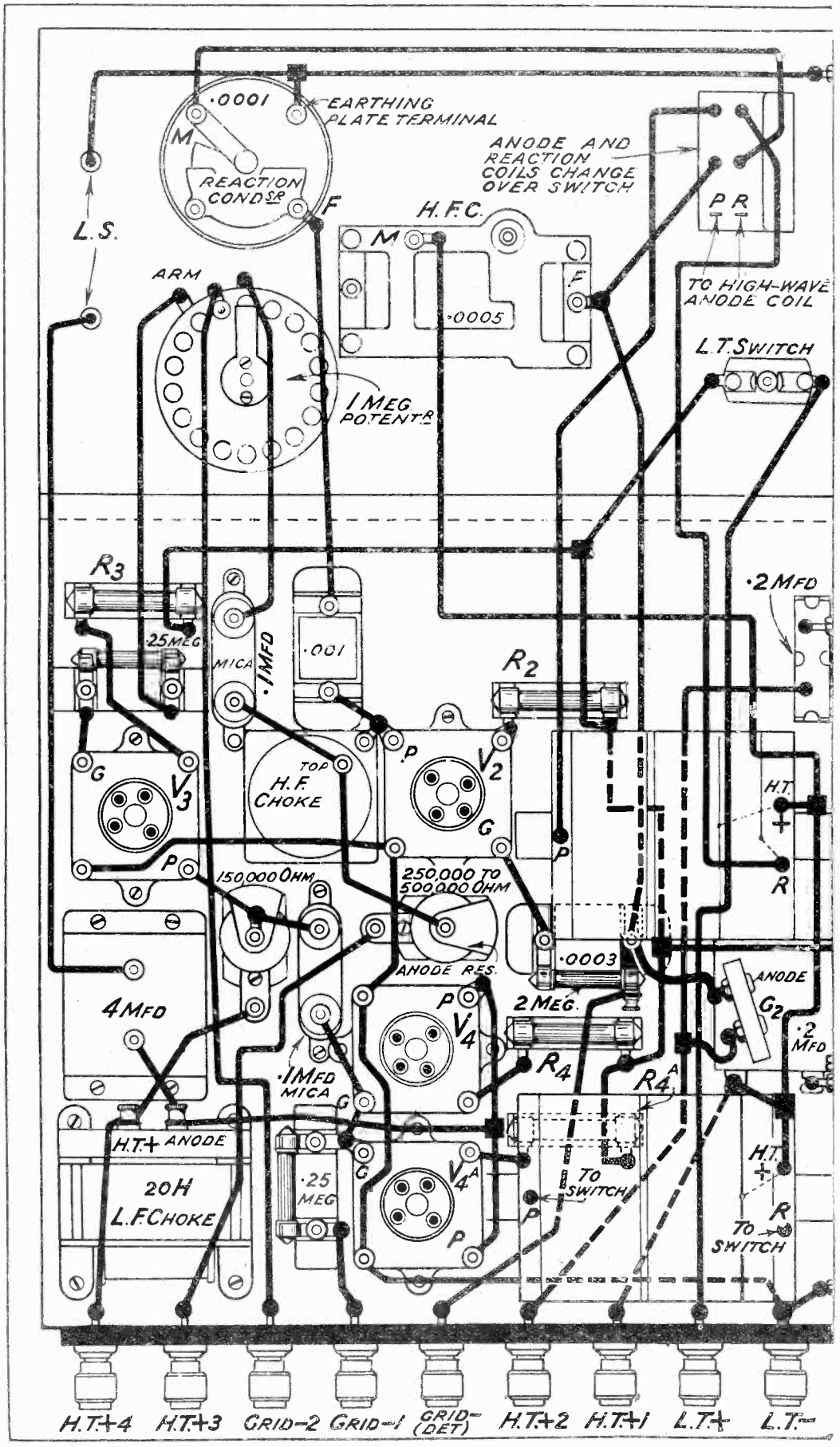
To prevent H.F. current leakages from the detector valve getting into the grid of the first L.F., and so causing instability or distortion, a grid leak of ·1 to ·25 megohm is arranged in series with the arm of the variable grid leak (volume control) and the grid of the first L.F. valve. The value of this "resistance" is not at all critical and can vary from the ·25 megohm of the Lissen or Dubilier down to ·1 megohm.

Suitable Valves

We then come to the last valves, which should be of very low impedance, 2,750 to 5,000 ohms approximately. The lower value is, of course, the best, but the valves that will actually be employed will depend on one's pocket and the amount of H.T. and L.T. available. Most constructors will try D.E.5A's, Cossor Stentor 6's, or Mullard P.M.256's, with 150-volt H.T. accumulators, or use mains eliminators with outputs of 150 to 250 volts.

Those more fortunately situated as regards A.C. mains supply will possibly use 300- to 400-volt rectified outputs with bigger power valves, such as Mullard D.F.A.7's, or Marconi or Osram L.S.5A's.

A choke-filter circuit was incorporated in the receiver



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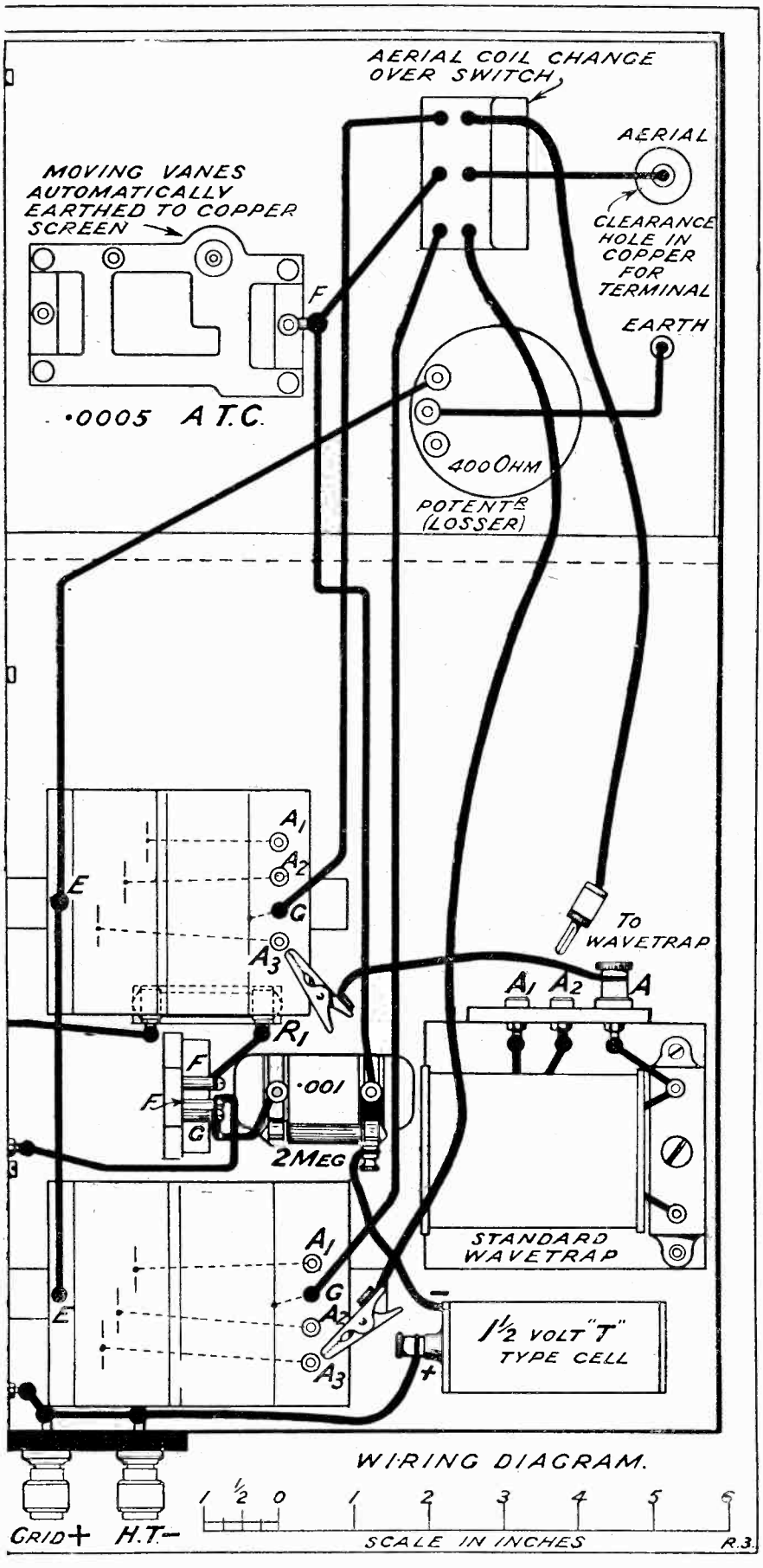

WIRING DIAGRAM.

to conform to modern requirements, as very few experimenters or constructors care to risk the fragile windings of their loud speakers in the plate circuits of the power valves, when considerable currents (20 milliamperes upwards) are going through them.

The choke protects the loud speaker windings, and, being of fairly low D.C. resistance, does not seriously restrict the plate current of the power

COIL DATA

LOW-WAVE AERIAL COIL.

FORMER.—3 in. dia. × 3½ in. long.

WIRE.—9/38 Litz (all silked).

TURNS.—80, 40 in opposite direction. The coil is wound astatically in two sections and more to one end of the former than the other, to allow room for the tapping points.

TAPPINGS.—Counting from the outside end of one section of the windings, a tapping is taken at the 15th turn, another at the 25th turn, and a third at the 35th turn, the winding continuing for another 5 turns, reversed, and then wound with another 40 turns in the reversed direction.

HIGH-WAVE AERIAL COIL.

FORMER.—3 in. dia. × 4 in. long.

WIRE.—No. 40 S.S.C. wire.

TURNS.—350, 175 in opposite direction. Wound as above but with tappings at 50th, 75th and 100th turns, the wire continuing for a further 75 turns, reversed, and then carried on for another 175 turns in the reversed direction.

LOW-WAVE ANODE COIL.

FORMER.—3 in. dia. × 3½ in. long.

WIRE.—9/38 Litz (all silked).

TURNS.—80, 40 in opposite direction to first 40 turns. The coil is wound to one end of the former, as in the case of the aerial coil, but this time to allow for the reaction turns.

REACTION.—35 turns No. 36 S.S.C. wire, wound in the same direction as the side of the anode coil to which it is coupled. The end of the reaction nearest the anode coil is joined to the end of that coil and the two leads (common) joined to H.T.+.

HIGH-WAVE ANODE COIL.

FORMER.—3 in. dia. × 4 in. long.

WIRE.—No. 40 S.S.C. wire.

TURNS.—400, 200 in opposite direction to first 200 turns. It is best to commence the winding of this coil as far over to one end of the former as it is possible to make it, so as to leave sufficient space for the reaction coil.

REACTION.—120 turns No. 40 S.S.C. wire, wound in the same direction as the portion of the anode coil to which it is coupled. It is possible the wire may not all go on in one layer, in which case it can be "banked" for the remaining turns on top of the first layer.

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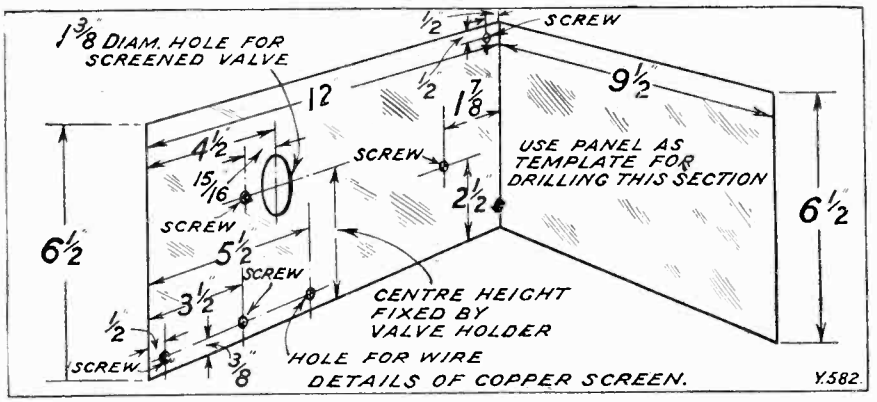
valves. Those constructors who intend using moving-coil loud speakers of low resistance, in conjunction with 25 to 1 ratio transformers, can connect the latter to the output of the set as it stands; it being quite a usual practice to employ a choke-filter and transformer together.

Mounting Components

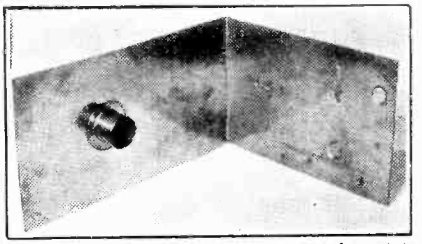
As with most receivers of the multi-valve type, it is best to commence the construction with the panel, which can be drilled according to the diagram.



Then all components on the L.F. side of the panel up to the L.T.— and change-over switches can be mounted in their respective positions. Do not mount the aerial tuning condenser or its subsidiary components, as the copper screen has yet to be drilled and the components mounted on it.

The dimensions of the screen are given on the diagram, with the positions of the necessary screws to solder leads. In this connection it must be remembered the position of the hole for the screened valve only holds good in its *height* from the baseboard when the Wright and Weaire special valve holder is employed. With other makes, such as the "Parex," it will be necessary to modify the height to suit the valve holder.

No dimensions are given for the holes through the copper where the components are mounted, because the position of these can be found in a very simple manner. Having arranged and cut the necessary holes in the copper for the valve, and screw-holes where leads are soldered to the projecting screws, the copper surface



The copper screen, dimensions of which are given on the sketch below. (The tube shown was not used in the finished receiver, the later experiments indicating that it was possible to make the set perfectly stable without this).

(*not* the one accommodating the valve) can be placed against the back of the ebonite panel in the position indicated in the photographs, so that its vertical edge is about $\frac{1}{16}$th in. away from the vertical edge of the panel.

Fixing the Screen

The remaining vertical edge of the same piece of copper, which is nearest to the centre change-over switch, should just clear this switch when in position, and the whole sheet should, of course, rest on the wood baseboard. While in this position and firmly pressed against the panel, a sharp

POINT-TO-POINT CONNECTIONS

One filament socket of each valve holder to one side of each of the respective fixed resistances.

Remaining sides of the resistances joined together and to one side of the L.T. switch.

Other side of the L.T. switch to the L.T.+ terminal.

Remaining filament socket of V_1 (screened valve) to a screw through the copper screen.

H.T.— terminal via a flexible lead to "+" of 1½-volt grid cell, to "Grid +" terminal and to a screw through the copper screen.

Other side of same screw to the L.T.— terminal, and to the remaining filament sockets of the valve holders.

Aerial terminal to centre right-hand contact on aerial change-over switch.

Top right-hand contact of switch to a plug (via a flexible lead) which engages with the sockets on wave-trap.

Bottom right-hand contact of switch to the tapping clip (via a flexible lead) for the high wave-length aerial coil.

Terminal on wave-trap to a tapping clip (via a flexible lead) for the low wave-length aerial coil.

Centre left-hand contact of switch to the fixed vanes of the ·0005 variable condenser (A.T.C.) and to the end of the ·001 fixed grid condenser NOT connected to grid leak.

End of ·001 common to grid leak, to the grid of V_1.

Free end of 2-meg. grid-leak holder to the "—" on the 1½-volt grid cell.

Top left-hand contact on switch to "G" (end of coil farthest from screen) on the low-wave aerial coil.

Bottom left-hand contact of switch to the "G" on the high-wave aerial coil.

Remaining ends of both aerial coils (marked "E") joined together and to one end of the 400-ohm "Losser."

Arm of "Losser" to the earth terminal, which is also tightly clamped direct to the copper screen.

Grid of V_2 to the side of the ·0003 fixed grid condenser common to the 2-meg. grid leak.

"Free" end of 2-meg. grid leak to the "Grid—" terminal.

Remaining side of the ·0003 fixed grid condenser to the anode socket of V_1 via a short flexible lead, to the fixed vanes of the ·0005 variable condenser marked H.F.C. and to the left-hand centre contact of the anode-coil change-over switch.

One tag of each of the ·2-mfd. Mansbridge type condensers to screws through the copper screen and which are adjacent to them.

G_2 socket of V_1 to the remaining tag of the ·2 condenser standing upright (near the L.T. switch) via a flexible lead and from there to the H.T.+2 terminal.

Moving vanes of the ·0005 "H.F.C." condenser to the H.T.+ connections on both anode coils, to the remaining tag of the ·2 condenser situated under the valve V_1 and to the H.T.+1 terminal.

Top loud-speaker terminal on panel to the earthing plate terminal on the ·0001 reaction condenser and to a screw through the copper screen.

Moving vanes of the ·0001 reaction condenser to the right-hand centre contact of the anode-coil change-over switch.

Top right-hand contact of this switch to the reaction-coil (marked "R") contact on the low-wave anode-coil former.

Bottom right-hand contact of same switch to the "R" contact on the high-wave anode-coil former.

Top left-hand contact on anode-coil change-over switch to the "P" contact (end of anode coil farthest from screen) on the low-wave anode coil.

Bottom left-hand contact on same switch to the "P" contact on the high-wave anode coil.

Plate of V_2 to one side of the H.F. choke and to one end of the ·001 fixed condenser.

Other side of the ·001 condenser to the fixed vanes of the ·0001-mfd. reaction condenser.

Top contact on H.F. choke to top contact on the 250,000-ohm anode-resistance holder and to one side of the 1st ·1-mfd. mica condenser.

Other side of the 1st ·1-mfd. to one end of the 1-meg. variable grid leak.

Other end of 1-meg. variable grid leak to the "Grid—2" terminal.

Arm of variable grid leak to one end of the ·25-meg. grid-leak holder.

Remaining side of ·25-meg. grid-leak holder to the grid of V_3.

Bottom contact on the 250,000-ohm anode resistance to the H.T.+3 terminal.

Plate of V_3 to the top contact on the 150,000-ohm anode resistance holder and to one side of the 2nd ·1-mfd. mica condenser.

Remaining side of this condenser to the grids of the valve holders V_4 and V_4 (A) and to one side of the ·25-meg. grid-leak holder adjacent to them.

Other side of the ·25-meg. grid-leak holder to the "Grid—1" terminal.

Bottom contact of the 150,000-ohm anode resistance holder to the "H.T.+" terminal on the 20-henry L.F. choke and to the H.T.+4 terminal.

Plates of the valve holders V_4 and V_4 (A) joined together, to the "Anode" terminal on the 20-henry L.F. choke and to one side of the 4-mfd. Mansbridge condenser.

Other side of this condenser to the bottom loud-speaker terminal on panel.

This completes the wiring.

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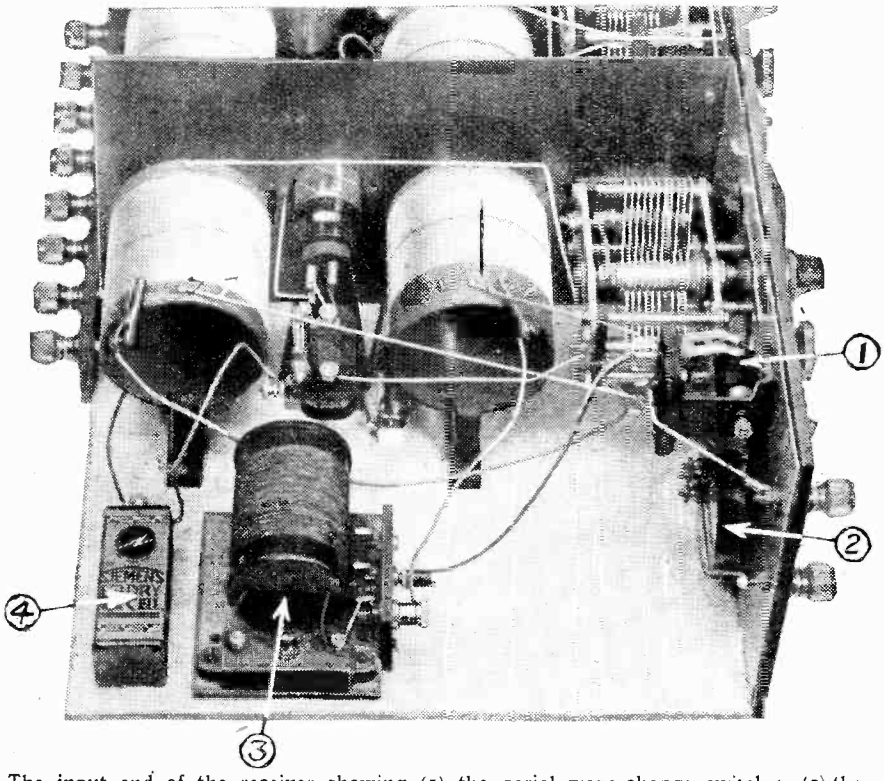
steel scriber or nail can be passed through the holes in the front of panel and their outlines scratched on the surface of the copper sheet.



The input end of the receiver showing (1) the aerial wave-change switch ; (2) the " losser " ; (3) the wave-trap, and (4) the H.F. grid bias battery.

It then only remains to cut the holes in the copper so as to correspond with those through the panel, with the exception of the aerial terminal, which hole must be made large enough to miss the terminal shank. Full details are given in an accompanying sketch.

Obtainable Ready Made

Many manufacturers and retailers are realising the present-day attitude of designers in arranging their receivers with simple forms of screening, and are therefore catering for the needs of those whose kits of tools do not include such things as expanding bits for cutting copper. Constructors will not, in the circumstances, lack the services of these firms, who supply the necessary screens with their sets of parts. The screens in most cases can be made either with copper or aluminium sheet, as connections are soldered to brass screws through the screens, and not direct to the metal surface itself.

With the completion of the screen, so can the rest of the constructional work be finished, as this is only a matter of screwing the remaining components to the panel via the copper and the remainder to the baseboard in the positions shown on the wiring diagram, which is correct to scale.

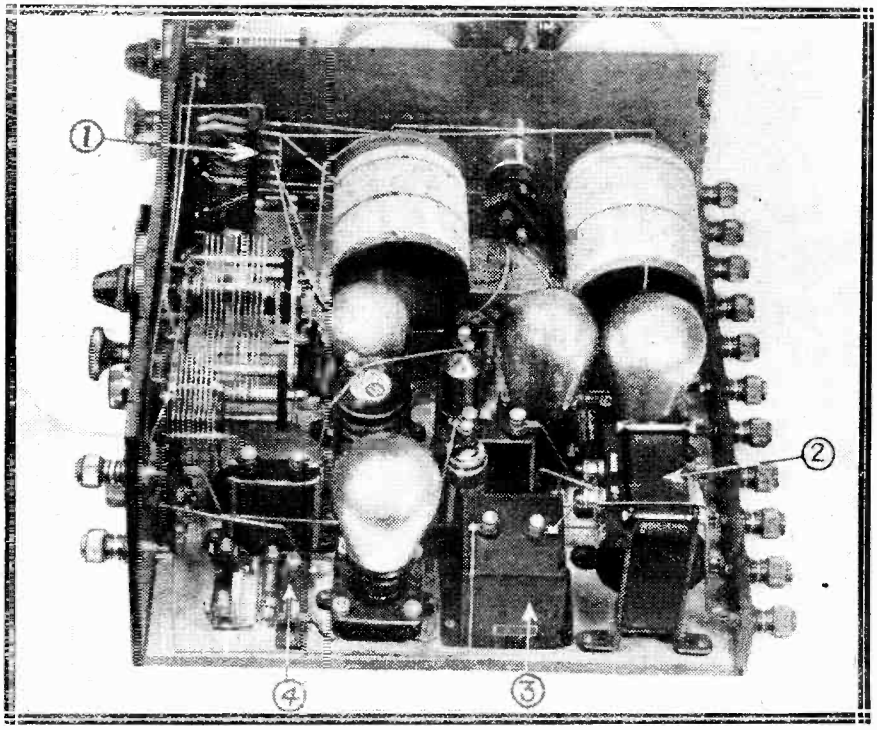
Many alternative methods suggest themselves in wiring, such as Glazite, Junit, bare wire, or bare wire and Systoflex. The original set was wired with No. 20 S.W.G. tinned copper wire and a special thin type of Systoflex. The writer does not recommend the old type of Systoflex, which is thick and clumsy.

H.T. Voltages

Finally, a few words about suitable H.T. voltages. The H.T.+1 terminal supplies the anode of the screened valve, and this will be 120 volts for most makes, with 80 volts on H.T.+2 for the screening grid.

H.T.+3 is the detector-valve tapping, and can in most instances take the same H.T. voltage as the anode of the H.F. valve (120 volts). In some cases, such as when employing a high-mu valve for detector, a higher voltage can be tried to advantage. The point to remember is that the voltage on this valve should be governed by reaction. Adjust the voltage so that it is just possible to make the valve oscillate when the reaction condenser is nearly at maximum and the tuning condensers are set to about 500 metres or over.

Reaction in turn will be governed by the method of rectification employed, so it is as well to determine this point beforehand. Anode-bend rectification can be obtained by either joining the " Grid — " terminal to either L.T. — direct or through — 1½ to — 3 volts on the grid-bias battery, according to the valve employed. For grid rectification the " Grid — " terminal will go to the L.T.+terminal



The low-frequency or output end of the receiver. The numbers indicate (1) anode wave-change switch ; (2) output filter choke, and (3) output filter condenser. At (4) is shown a resistance which acts as a " stopper " to ensure pure reproduction.

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WHAT READERS THINK

America on the Loud Speaker —The Regional Stations.

"America on the Loud Speaker"

SIR,—I was interested by the letter published in your June issue under the heading "America on L.S.," in which your correspondent claims reception of Schenectady "at loud-speaker strength" on April 13th, using only two valves.

With all due respect to Mr. Waley, and without detracting from the merits of the excellent receiver used by him, I venture to suggest that he did not receive America direct.

Speaking as one who has had considerable experience of trans-atlantic reception, I furthermore suggest that it is impossible to receive American broadcasting *at the strength claimed* (on the broadcast band) on any two-valver.

What most probably Mr. Waley did receive was *a relay* of Schenectady by one of the German stations, almost all of whom were working late nightly relaying W G Y round about the date mentioned specially to receive bulletins relating to the Atlantic flight (by Captain Koehl and his companions) which had just terminated successfully.

It *is* possible to receive America at loud-speaker strength on the short waves using two valves, but the set that could do it on the broadcast band has, in my opinion, yet to be constructed.

Yours very truly,
G. C. ALLEN.

South Bermondsey,
S.E.16.

Regional Stations

SIR,—Three years ago, according to my old log book, I was able to receive Manchester on the loud speaker with only a trace of London, the difference in wave being 10 metres and the distance from 2 L O being nine miles. The set in use was tuned-anode with detector and transformer-coupled L.F.

Now it is practically impossible to receive any station between 330 and 400 metres on a modern version of a similar circuit without 2 L O as a background, presumably because the power has been increased to 3 kw.

"Just Think!"

We old readers of your valued journal now read that, with regard to the regional stations, London is to have the first station with a power of not less than 25 kw.

Just think! 25 kw. Why, we can almost hear our aerials humming, and as for the B.B.C., it will be successful in providing loud-speaker reproduction from any one of the 19 crystal sets still remaining in London, including 18 new ones still for sale in Houndsditch.

Greater London has a population of, say, six million inhabitants, and I venture to suggest that three to four million of these own sets or are interested in wireless, which means that they have sets but the accumulator is always being charged. I also suggest that the majority of these sets are of the straight detector and 1 L.F. variety.

May I then ask this question?

What chance will these listeners have of hearing anything but 2 L O "all round the dial" when it is now practically impossible to receive any station between 330 and 400 metres on a modern set, incorporating a neutralised stage of high-frequency, without a trace of 2 L O.

Yet we are to rejoice at the prospect of 25 solid kilowatts over our house-tops.

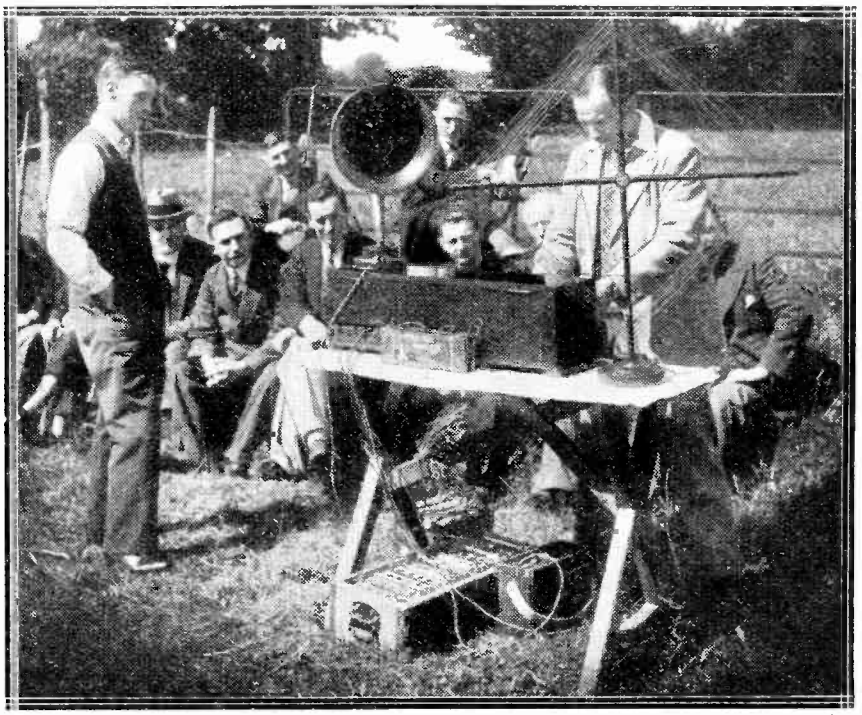
Might I suggest, sir, that this new station assumes the wave-length now occupied by 5 G B, and thus allow us the hope of hearing something between 200 and 400 metres, as I doubt the possibility of receiving any station above that.

I deeply appreciate the sympathy extended to distant listeners in the radius of 2 L O by Mr. Davis of Birmingham, for I am sure we shall all need it.

I am, sir,
Yours faithfully,
H. S. FORD.

Woodford Green, Essex.

RADIO RAMBLERS



Members of one of the London Radio Societies entertained by their favourite hobby whilst enjoying a "Field Day" in Essex.

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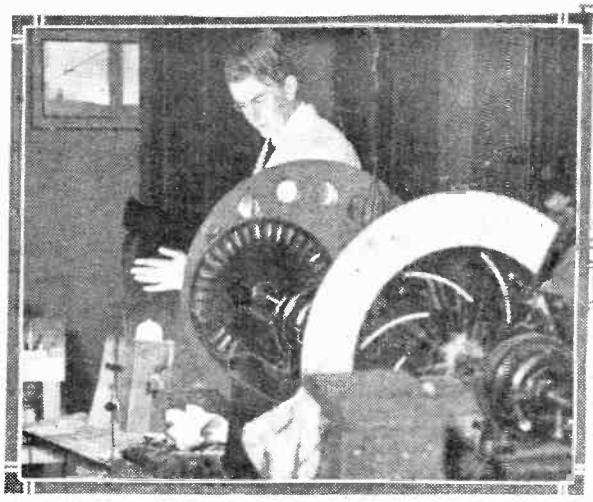

TELEVISION *in the* AUTUMN?

THE ATTITUDE OF THE B.B.C.

Does the B.B.C. intend to allow Television to develop on its own account without co-operation between broadcast sound and broadcast sight? Will the Post Office confine the B.B.C. and Television to separate spheres or will the two co-operate? Read this illuminative review of the position to-day.

By THE EDITOR.

PUBLICITY matter has appeared recently in various sections of the Press enthusiastically pointing out the advantages and the great possibilities of the Baird system of television, together with its attendant inventions of phono-vision, noctovision, etc., etc.

It was stated in the course of these publicity announcements that it was not difficult to visualise the not-far-distant date when we should be able to see the glories of Ascot, the excitement of Lords, etc., by television (either at home or at Sydney, Australia), and it was stated further that there was every likelihood of Baird televisor receivers being on sale to the public at the Wireless Exhibition at Olympia in September.

To Begin Shortly?

It was also stated that a television transmission service would be commenced in due course from the transmitting station belonging to the Baird Co. in Long Acre, London. Other publicity has also appeared reproaching the B.B.C., and Britain in general, for allowing a wonderful British invention to pass into the hands of America.

In a recent issue of the "Evening Standard," for example, we find it asked what will be the future of the wireless listener when both the B.B.C. and television are offering different forms of entertainment. "For broadcast television," stated the "Evening Standard," "licensed by the Post Office, is to begin this autumn." And the paper further went on to state that questions that wireless listeners are now asking include:

"Does the B.B.C. intend to allow television to develop on its own account, without co-operation between broadcast sound and broadcast sight? Will the television plant content itself with broadcasting silent visual scenes, with no form of spoken comment or musical accompaniment? Will the Post Office confine the B.B.C. and television to their separate spheres, or will the two be asked to co-operate?"

Public Interest

This journal went on to state that, of course, neither the B.B.C. nor the television authorities can be expected, in justice to themselves, to reveal all their future plans in these matters. If, for instance, the B.B.C. showed a public interest in a new device to broadcast sight, sound, or what not, it might feel it was encouraging listeners to indulge in something for the ultimate success of which the Corporation might not like to take responsibility. Television, of course, is bound to be reticent; lacking the traditions, the status and the several million customers of the State-backed B.B.C., it cannot wisely make promises regarding any other than the immediate future.

That is the position as seen by the "Evening Standard." The first three queries are legitimate ones, but we cannot understand why the B.B.C. nor the television people cannot be expected to reveal their future plans in these matters, i.e. with regard to television. Considering that a large amount of publicity has been given to television in this country which has awakened the very keenest interest in the minds of millions of people, it would seem only natural that the fullest possible light should be thrown upon the whole question of television and its relation to broadcasting.

B.B.C.'s Position

The Baird people have many patents covering their television inventions, and therefore they have absolutely nothing to fear in making public details of the inventions

PHOTOGRAPHS BY RADIO

Capt. O. Fulton (right) with some of his apparatus by means of which still-pictures can be sent and received by wireless. (Note that these are "still" pictures—not moving "television.")

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which, they hint, may in the near future enable one to see the "glories of Ascot," etc., etc.

However, we recently went into the matter as regards the B.B.C.'s attitude to television, and, as a result of an interview with Captain Eckersley, that gentleman pointed out that the first thing he wanted to do was to deny most emphatically the frequent rumours to the effect that the B.B.C. will, in the autumn, set apart a definite period for the transmission of pictures by wireless.

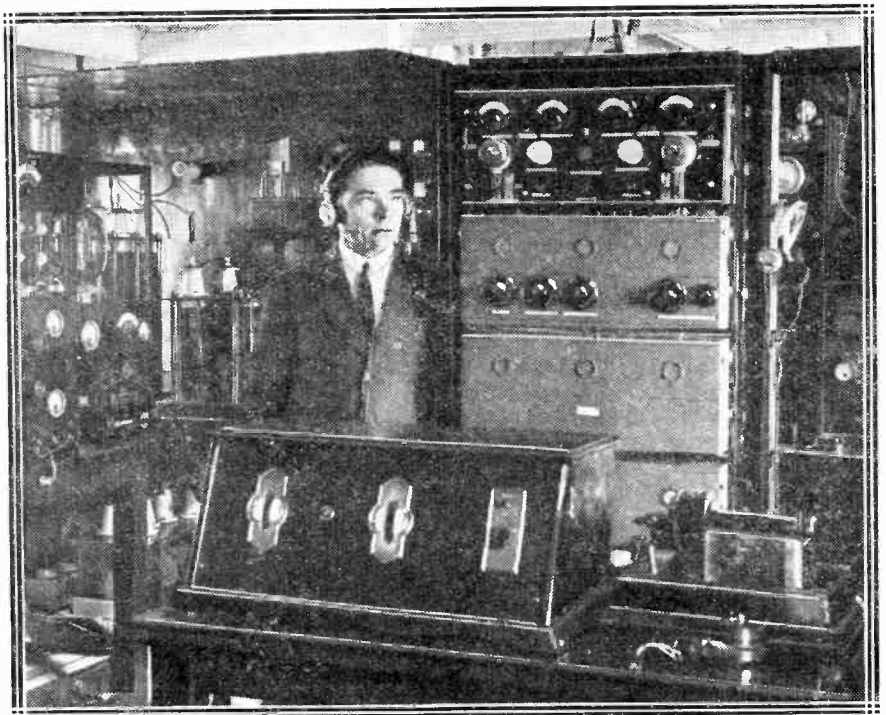
Experimental Stage

"Synchronisation," said Captain Eckersley, "is one of the most important things of wireless transmission, and unless perfect synchronisation is provided for at both receiving and sending ends, the picture will be a hopeless failure."

Captain Eckersley went on to say that many wireless enthusiasts still confuse television with photograph transmissions. He very rightly pointed out that, having seen in the Press glowing accounts of the success of still-picture transmissions, many listeners are expecting to be able to buy attachments for their receivers which will enable them to see the artists before the microphone simultaneously with their entertainment. "Such a system," said Captain Eckersley, "in all its essentials constitutes television. An art which, I believe, is very far from perfection. Television is still very definitely in the experimental stage."

"If television were perfected," commented Captain Eckersley, "that would be a very different proposition. There would be, I believe, a very popular demand for the B.B.C. to take it up. But in its present form it would be useless for us to do anything. We might just as well have inaugurated a broadcasting system twenty years ago with the Poulson Arc as the nucleus of our transmitting equipment. I believe that a radical discovery is necessary before television will be practicable, just as the valve made broadcasting possible."

A FLOATING LABORATORY



This view was taken on board Marconi's magnificently equipped yacht, the "Elettra," and shows the chief officer listening-in on the apparatus of the new revolving beam.

In short, Captain Eckersley is of the opinion that not any of the existing television methods can succeed without the aid of some far-reaching discovery—which is in exact accordance with the opinions of Sir Oliver Lodge, Mr. A. A. Campbell Swinton, F.R.S., Dr. J. H. T. Roberts, Dr. Lee de Forest, and other famous physicists.

Question of Monopoly

That, in short, answers the question the "Evening Standard" wanted answering in regard to what the B.B.C. intended doing re television.

With respect to the second question as to whether the "television plant" will content itself with broadcasting silent visual scenes, with no form of spoken comment or musical accompaniment, the answer seems pretty obvious. If the B.B.C. does not feel itself justified in co-operating with television, it is difficult to see how the Baird Broadcasting Television Service will be able to offer sound transmissions as well as sight transmissions. As is well known, the B.B.C. has the monopoly in this country, and it is not likely that the Post Office will permit television to be accompanied by concerts, etc.—at least, not until the Post Office feel thoroughly assured that television would be an adjunct to broadcasting by the B.B.C.

What Will P.M.G. Do?

So Question 3 is more or less answered. The Post Office are quite likely to confine the Baird television transmissions to the experimental wave-lengths permitted for these television experiments. There is no question of the Post Office asking the B.B.C. to co-operate with television because, as the Postmaster-General has stated several times in the House of Commons during the last month or so, his engineers have informed him that television is not yet in a state which would warrant its adoption as a practical utility service.

That is the present state of television to-day, and it is not likely that any other new or important move will be made, nor will the public be enlightened much further, until September, when, if the Baird people's publicity is correct, televisors will be on sale at Olympia, and in the autumn some sort of an experimental service will be started from the company's station in Long Acre. This service should be extremely interesting for experimenters.

SHORT-WAVE ITEMS OF INTEREST

Radio Malabar, the Dutch East Indies short-wave station, has been broadcasting on Saturdays from 1.40 to 3.40 p.m. on a wave-length of 17 metres.

* * *

The New York station W R N Y will welcome reports upon its short-wave transmissions which are sent out on 30·9 metres. The times of transmissions are Tuesdays, Wednesdays, Fridays and Saturdays from 7 p.m. onwards (E.S.T.), and Sundays from 4 to 6 p.m.

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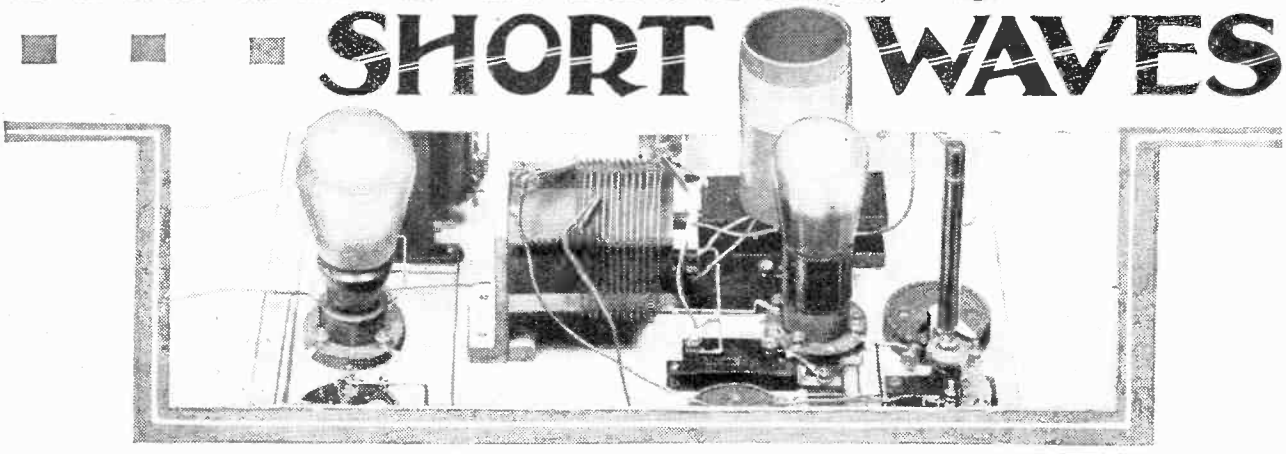
THOSE STARTLING SHORT WAVES



Some recent developments in high-frequency radiation reveal astonishing effects.

By J. C. JEVONS.

THE early long-distance records of amateur wireless transmission, combined with the recent amazing success of the Marconi Beam system, have now fully convinced the radio engineer of the outstanding merits of short-wave radiation. He foresees that future developments must tend more and more to the exploitation of ultra high-frequencies, and is already exploring new and interesting possibilities in this direction.

Power By Radio

The radio transmission of power, or the transfer of electrical energy in bulk through the ether by wireless means, is one problem, for instance, which will in due course be solved simply by generating oscillations of much shorter wave-length than those now used for Beam signalling, and concentrating them into a still narrower path.

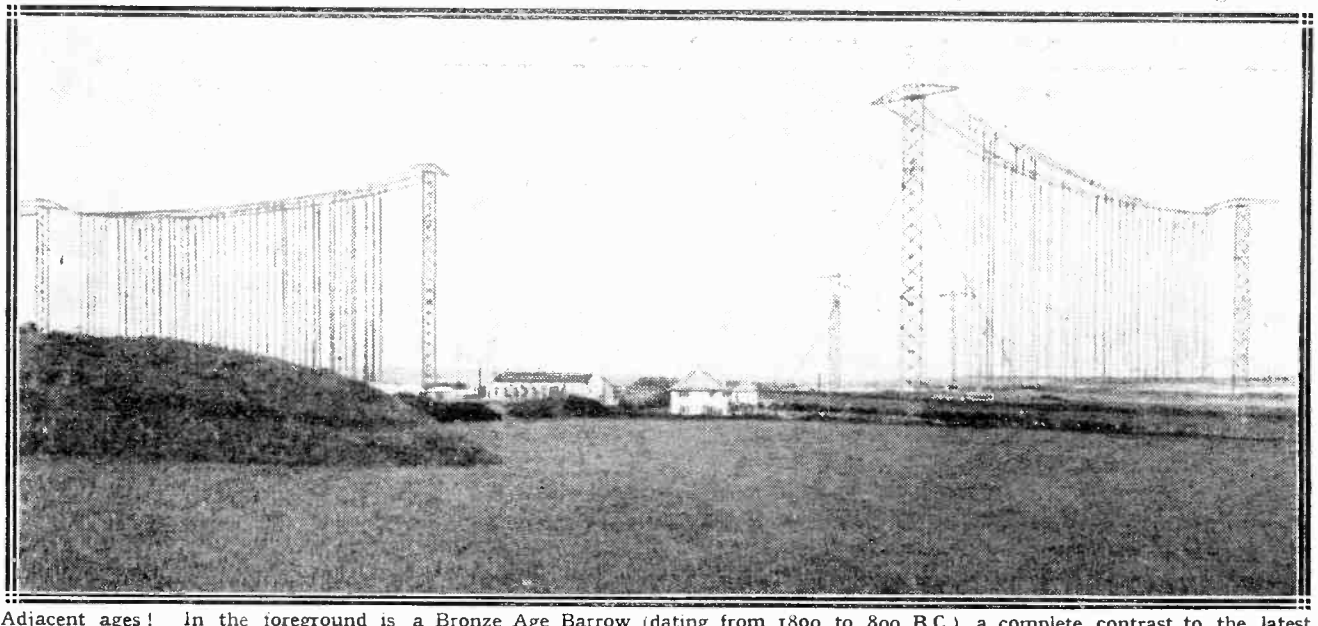
The shorter the working wave-length is made, the easier it becomes to focus the wave-front by means of a reflector into a clear-cut path free from dispersion or "spread."

The problem, therefore, amounts to this: Before radiated energy can be effectively concentrated into a dense or powerful beam, a reflector many times larger than the radiated wave-length must be employed. As there is an obvious limit to the size of such a reflector it becomes necessary to reduce the working wave-length until it can be handled by reflectors of practical and convenient size.

Unfortunately, the matter is not quite so simple as it appears. The thermionic valve is at present generally accepted as the only practical means for generating high-frequency oscillations. As soon as one attempts to employ a valve for generating wave-lengths of the order of 10 metres or less, very serious difficulties arise

Below 10 Metres

For instance, the capacity existing between the internal electrodes of the valve, small though it may be when measured in microfarads, is sufficiently large to offer very little "resistance" to the passage of high-frequency currents of this order. The plate energy accordingly tends to spill over on to the grid and



Adjacent ages! In the foreground is a Bronze Age Barrow (dating from 1800 to 800 B.C.), a complete contrast to the latest achievement of science represented by the "Beam" (the Dorchester station aerials are shown). The "Beam" is one of the most startling short-wave developments. (*Marconi Co.*)

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filament, and the whole valve "boils over" and ceases to function as a generator.

Special methods of design have, however, been developed to meet this particular difficulty. For instance, the General Electric Company have recently produced a valve generator capable of radiating as much as 15 kilowatts, or over 20 horse-power, on a wave-length of only 6 metres. This is about fifty times more powerful than anything previously produced capable of working at such a frequency.

Astonishing Effects

Some astonishing effects have been obtained by the G.E.C. apparatus. Incandescent lamps placed within the field of radiated energy light up automatically, whilst any metallic body within range will blister the hand by the heat caused by the induced currents. Again, large flames or standing arcs, more than a foot in height, spring into being automatically, wherever the aerial into which the valve feeds its energy is touched by a metal-tipped rod.

One seems to be actually approaching the ideal of the "death ray," of which so much was whispered and so little known towards the later stages of the war. Given a suitable form of projector, there seems no reason to doubt that such a wireless ray would effectively put out of action any aeroplane, motor-car, or other machinery depending upon magnetic action for its driving power.

As to its action upon human life there seems to be a considerable difference of opinion. Generally speaking, the effect of ultra high-frequency oscillations is not harmful upon any form of life coming within its range.

Reverting to the question of generating oscillating currents of extra high-frequency, i.e. of very short wave-length, it is interesting to consider an ingenious suggestion advanced some time ago by a French physicist.

A French Brain-Wave

His idea, in short, was to utilise the beat effect between two light-waves of different frequency in order to produce electrical oscillations of an enormously high order. For instance, the frequency of violet light is approximately eight hundred billion per second, whilst that of yellow light is only six hundred billions. The difference between the two is two hundred billions per second, and oscillations of this frequency could be created by causing the two light rays in question to beat together.

The scheme adopted for this purpose is illustrated in Fig. 1. Violet light from source A, after passing through coloured filter screens F, is concentrated by a lens L on to a light-sensitive cell C. At the same time yellow light filtered out from a source B is directed on to the same cell by a lens L_1. The cell responds to both frequencies simultaneously, and the beat effect is separated out in the tuned circuit L_2, K.

Valve Variations

A more practical method of obtaining ultra high-frequency oscillations from a thermionic valve has recently been developed both in America and Germany. The method consists in utilising electronic vibrations set up in the actual electron stream flowing inside the valve.

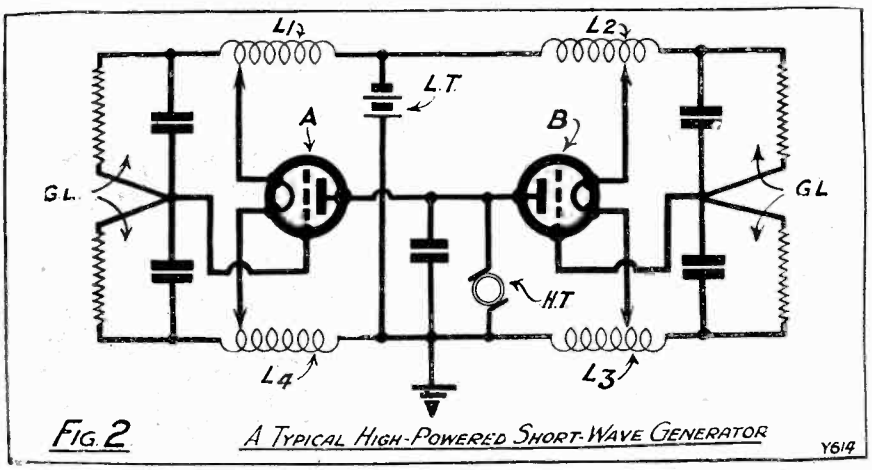
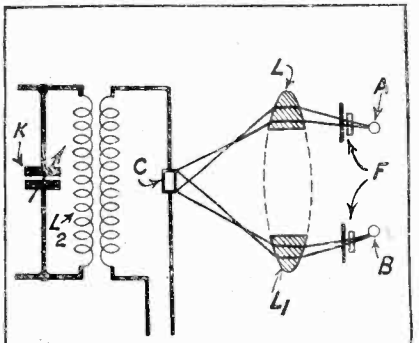


FIG. 2 A TYPICAL HIGH-POWERED SHORT-WAVE GENERATOR Y614

—in fact, they are frequently employed with beneficial effect in medical treatment—but when used at maximum strength such a ray might well have a dangerous, if not a fatal, effect

By using a negatively-charged plate and a positively-charged grid, the electrons coming from the filament are first attracted by the positive grid, and then repelled as the electrons accumulated by the grid add their effect to the negatively-charged plate.

As a result the electron stream is set into a constant and very rapid oscillation, the individual electrons swinging to and fro inside the tube at a frequency which corresponds to a wave-length of the order of centimetres. These surges of current are then communicated to an external Lecher-wire circuit and form a stationary-wave system from which



BEAT FREQUENCIES FROM LIGHT WAVES
FIG. 1. A339

energy is tapped off to a radiating aerial.

Neither of the two last-mentioned systems is, however, suitable for the production of really high-powered short-wave energy. For this purpose it is necessary to employ a push-pull system of valves of the kind shown in Fig. 2.

It will be noticed that the anodes of both the valves A and B are connected together and to earth. When high power is being generated, the valve anodes rapidly become red-hot, so that it is necessary to cool them by means of a running-water supply. It is chiefly in order to avoid insulation difficulties with the cooling apparatus that the anodes are deliberately kept at earth potential.

The Frequency Factor

It follows, of course, that the filaments must be at a very high negative potential, and as the low-tension supply (L.T.) must be removed from this area it is placed as shown, so as to feed the filament current through the oscillating coils L_2, L_3 in parallel. The four coils are arranged symmetrically with regard to the grid through divided grid-leak resistances and condensers G. L., as shown.

The frequency of the output supply is determined in part by the inductances of the coils L_1, L_4, and in part by the self-capacities of these coils and the external leads, supplemented by the internal or inter-electrode capacities of the two generating tubes.

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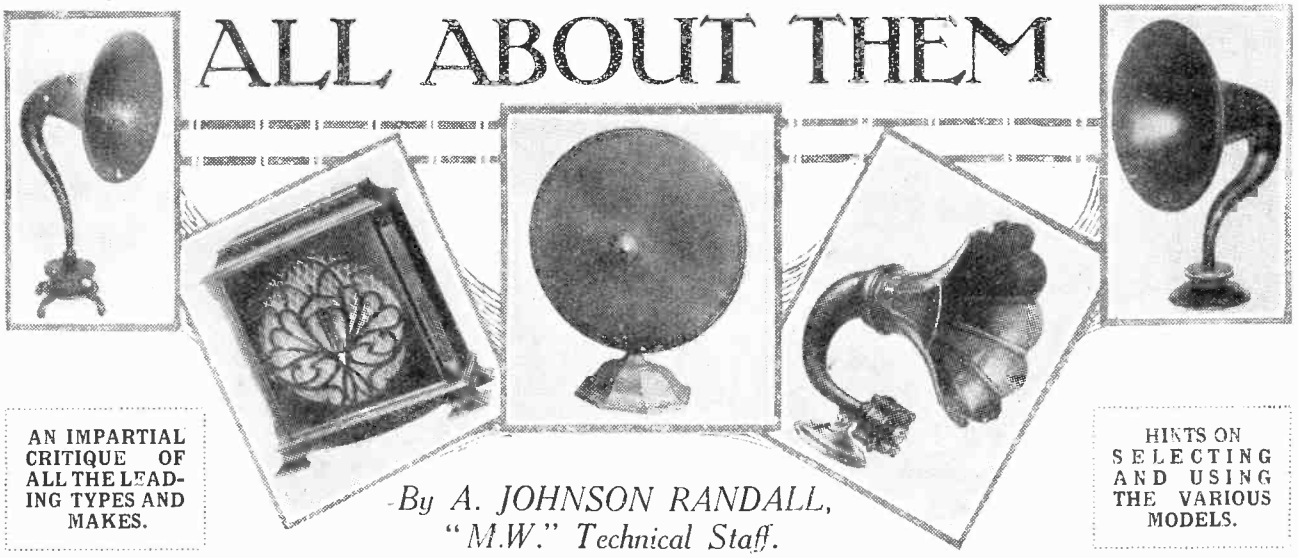
LOUDSPEAKERS - ALL ABOUT THEM



AN IMPARTIAL CRITIQUE OF ALL THE LEADING TYPES AND MAKES.

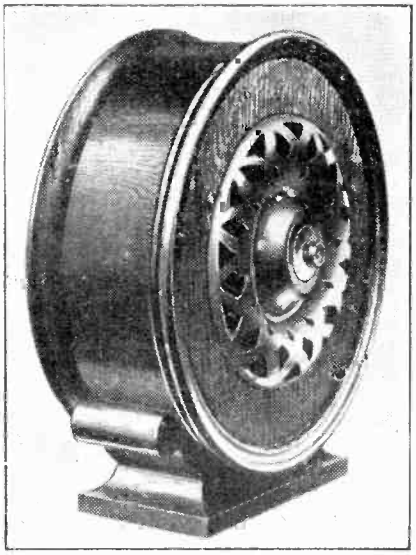
HINTS ON SELECTING AND USING THE VARIOUS MODELS.

By A. JOHNSON RANDALL, "M.W." Technical Staff.

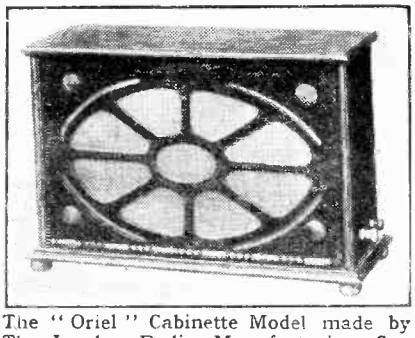
I THINK one may safely say that over sixty per cent of the wireless sets in use at the present time are intended to be employed with loud speakers. Telephone reception, which was once so popular, is rapidly falling into disuse, and it is now a comparatively rare occurrence to see the members of a family grouped round a table with headphones clapped over their ears, enraptured by some item of the broadcast programme.

Why 'Phones Were Popular

The reason for this is threefold. First, the modern radio receiver has made such rapid progress both in purity of reproduction and general sensitiveness that it is now possible to work a loud speaker satisfactorily even with two valves. Secondly, improvements have been made at the transmitting end, and the power of our broadcasting stations has in many cases been increased, with the result that greater volume can be obtained with a given set. Thirdly (a most important point), the modern loud speaker is vastly different to that wretched contraption of a few years back which the "man in the street" was rather apt to say "sounds like a gramophone." Perhaps this was rather unfair to the makers of both the speakers and the gramophones, because there is no doubt that much of the distortion was due to the use of a lot of reaction coupled with a poorly designed low-frequency amplifier.



The Marconiphone Cone Model "105," which sells at £5 5s. The cabinet, which is open at back and front, is made of a special non-resonant material.



The "Oriel" Cabinette Model made by The London Radio Manufacturing Co., Ltd. It sells at 60s.

"In Those Days . . ."

The tendency in the past was to use telephones because the listener was of the opinion that they gave better reproduction. Here, again, it is only fair to the loud speaker to explain that with telephones smaller volume was required in order to give satisfaction, and in consequence the deficiencies of the amplifier were not so noticeable as they were when the volume was increased in order to work a loud speaker at full strength. In those days there were no super-power valves, no L.F. transformers of the "super" types, reaction was used "up to the hilt," and the H.F. side tended to be rather unstable. In fact, the poor loud speaker had not really a chance.

Modern Improvements

With the advent of special loud-speaker valves, and with the progress in component and set design generally, the listener began to learn that loud speakers really could give quite good reproduction, and to realise what

This is an assembled Kabinet Kone Kit which is marketed by Walker Bros., Ltd., at 52s. 6d. complete, in oak. The unit used is of the balanced-armature type.

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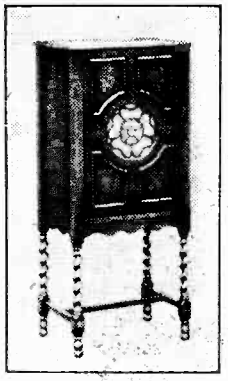
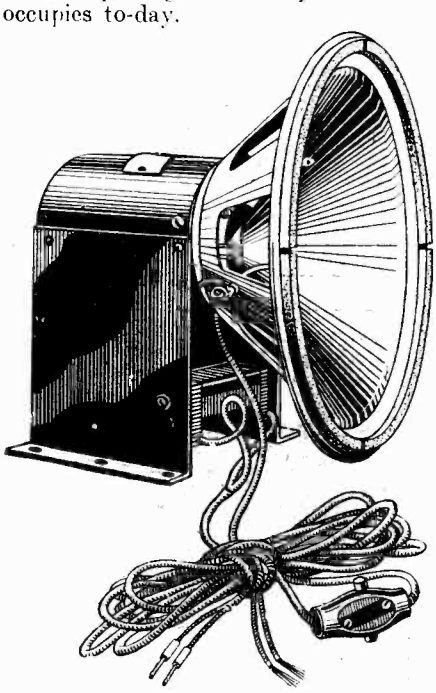
selfish things telephones were. One has visions of the head of the family sitting, pulling away at his pipe, with



The Model M.C.2 Moving-Coil Speaker Cabinet due to W. & T. Lock, Ltd., which in solid oak retails at £8.

the only existing pair of headphones over his ears, and contentedly listening-in to the broadcast programme, with the rest of the family eagerly waiting their turn, which, incidentally, in some cases never came. Nowadays the whole tendency is to use a loud speaker, the headphones being employed only with single-valve and crystal sets, or in special cases for the reception of long-distance transmissions. I believe that in another year or two the loud speaker will completely oust the 'phones for broadcast reception. I feel that one cannot pass on without paying tribute to such pioneers as Messrs. Amplion and S. G. Brown, Ltd., who have worked so hard to popularise the loud speaker and who have done so much towards placing it in the position it occupies to-day.

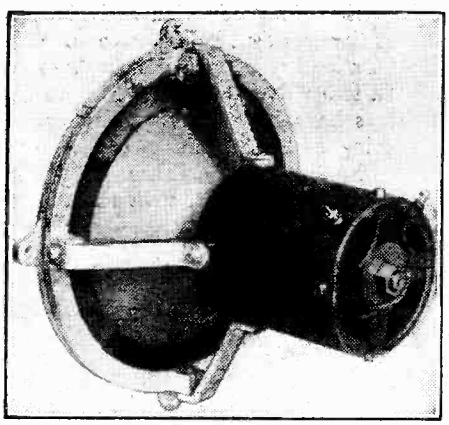


This is the Magnavox Moving-Coil Loud-Speaker Unit, Type R.4, the field winding of which takes .5 amp. at 6 volts The complete unit retails at £9 10s.

At the present time there are three main types of loud speakers in use. These are the horn type, the cone, and the moving-coil or coil-driven cone. The horn type is perhaps the best known, particularly since the beginner is rather apt to think of a loud speaker in terms of a telephone ear piece with a horn attachment. This, of course, is entirely wrong, and a modern horn loud speaker is not simply an earpiece capable of magnifying sounds, but it is a piece of scientific apparatus.

Very Important Point

For instance, the shape and length of the horn are very important. If the lower musical frequencies are to be reproduced the horn must be as long as possible, and then again the rate of opening is also very important. For the best results the increase in diameter for a given length must be calculated from certain known physical laws.



The Moving-Coil Unit which is sold in parts by F. Squire at £4 18s. 6d.

The principle of the average horn-type loud speaker is as follows: The base of the instrument contains the magnet and diaphragm. The electro-magnetic system normally consists of a coil of very fine wire such as No. 46 or No. 48, or perhaps slightly thicker where space permits, wound over the poles of a permanent magnet. The two ends of this coil of fine wire are connected to the two terminals on the loud-speaker case.

A Sensitivity Adjustment

A circular diaphragm of iron or stalloy steel is placed just above the magnet poles. Lines of force pass from the pole pieces through the diaphragm, which is therefore attracted by the permanent magnet. When the loud speaker is connected to the set, the currents due to speech or music pass through the fine wire winding and thus weaken or strengthen the magnetic field through the diaphragm. The diaphragm therefore vibrates in sympathy with the frequencies of the currents in the coils. It is usual to

The "Puravox" Medium Loud Speaker sold by Falk, Stadelmann & Co., Ltd., at £2 8s.

arrange for the distance between the permanent magnet and the diaphragm to be varied at will by means of a knurled knob on the containing case at the base of the instrument. By this means the sensitiveness of the loud speaker can be adjusted to suit individual requirements. If the magnets are adjusted too close to the diaphragm, unpleasant "dithering" will occur. The instrument should therefore be adjusted when in use.

Regarding Resistances

The small end of the horn is attached to a cap on the top of the magnet containing case and the diameter or cross-section of this small end has an important bearing upon the results. It may be as well to mention at this point that horn-type loud speakers are normally made in two types. One has a high-resistance winding, the value usually being about 2,000 ohms, whilst the other has a medium-resistance winding of approximately 750 ohms or so. The

A Baker's "Selhurst Radio" Moving-Coil Speaker. A complete set of parts is available at £4 7s. 6d. A permanent-magnet type is listed at £6.

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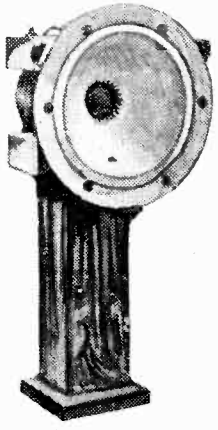
high-resistance type is possibly more sensitive and is very suitable for use with small sets.

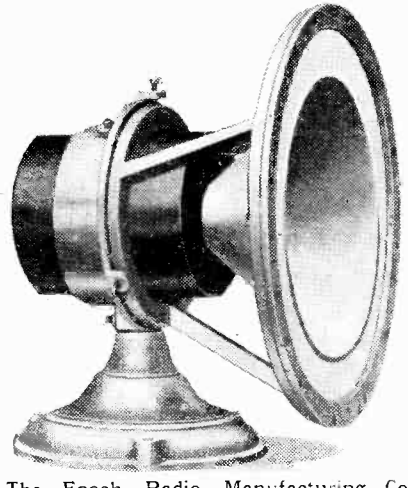
The increasing use of valves of the super-power types, designed to handle large volume, however, made it



The Colvern Moving-Coil Speaker assembly, a set of parts of which costs £3 7s. 6d. You will notice a substantial stand is provided, making it easy to arrange a baffle or fit the unit into a cabinet.

necessary for manufacturers to introduce a more robust winding of lower D.C. resistance. The super-power valve requires a fairly "hefty" anode current, and this would, of course, put an unfair strain on the very fine wire windings of a high-resistance coil.

In addition, this heavy current, in conjunction with the high D.C. resistance, would produce a drop in voltage across the loud speaker, and the actual H.T. voltage applied to the anode of the valve itself would be considerably lower than the voltage of the H.T. battery. This is undesirable, and in cases where sets employing a valve of the super-power type are used, it is better to choose a winding of the low-resistance type if this is to be connected directly in the anode circuit of the last valve.

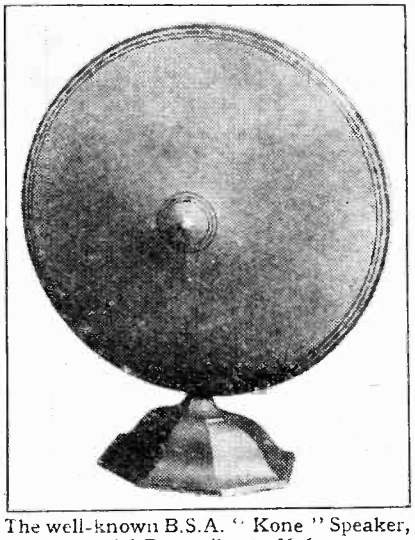


The Epoch Radio Manufacturing Co. supply sets of parts for moving-coil speakers. The type "A" (accumulator drive) at £3 10s., and the mains-drive type "B" at £4 2s.

With receivers incorporating filter devices, the question of D.C. resistance is not important, because the actual plate current does not pass through the loud-speaker winding, but there is still one point and that is on very big volumes there is a danger of the fine wire winding breaking owing to mechanical vibration of individual turns. In short, the choice of types depends upon whether the set is a small one such as a two-valver, or a large one designed to handle big output.

Design of Horns

One of the greatest difficulties which manufacturers have to face is the design of the horn itself. As was stated previously, the longer the horn the better the reproduction of the



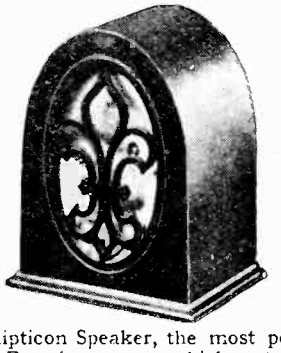
The well-known B.S.A. "Kone" Speaker, model B, retails at £6 6s.

lower musical frequencies. It has been shown that in order to obtain the real bass with a horn of the conical type a length of over twenty feet would be necessary. This is, of course, not a practical proposition for a loud speaker designed for domestic use.

Exponential Varieties

In attempts to cover a wide range of frequencies loud-speaker designers have made full use of all the known laws of sound and many of them have adopted horns of the exponential or logarithmic types. It would be out of place in an article of this nature to go into the theory of the exponential horn, but it may be stated that from the point of view of reproducing the bass notes the exponential horn is much more efficient than the ordinary conical types.

In their efforts to obtain the greatest possible length in a given space some designers have tried folding the horns, but this unfortunately introduces other difficulties if the folding is taken too far. In general, one may say that the average horn loud speaker is a very efficient device when one considers the difficulties with which manufacturers are

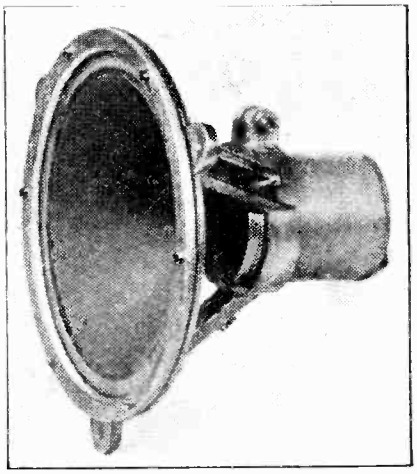


The Ellipticon Speaker, the most popular of the Brandes range, which retails at £4 15s.

faced. There are not many which will reproduce the lower frequencies in the neighbourhood of one hundred cycles. They have the advantage, however, of giving bright reproduction and the higher frequencies are clear and sharp.

A Valuable Feature

On speech the horn loud speaker is usually very good and its sensitiveness is a very valuable feature. I usually recommend horn loud speakers to the owners of small two-valve sets or to those who are situated some distance from a main station, and who therefore require the utmost sensitivity. In addition, many readers are compelled to use small valves owing to their difficulties in obtaining the sufficiently large batteries to supply the current which super-power valves require. A horn-type loud speaker is probably ideal in these cases.



A complete set of parts for the assembly of this Lang and Squire Moving-Coil Unit costs £4 3s. 6d.

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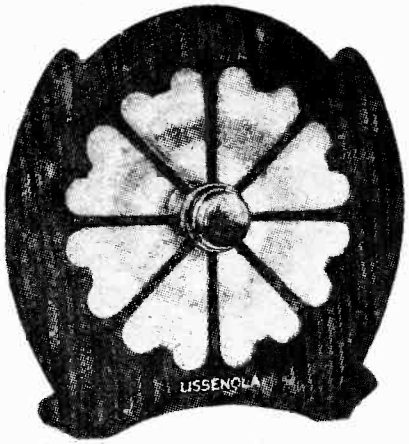
While on this question of sensitivity, I may say that with a Brown H.1 loud speaker, which I have in my possession, I have obtained speech audible across a drawing-room with only a simple crystal set. The Brown loud speaker is rather different in principle to those of normal types, inasmuch as it incorporates a reed which is attached to a cone of thin aluminium which forms the diaphragm. This cone is held at its periphery by a ring of aluminium and the whole making a small compact assembly. The arrangement is very sensitive indeed.

The progress in the design of modern amplifiers, and the difficulty in reproducing the lower frequencies in a loud speaker, made manufacturers turn their attention in another direction in their endeavours to achieve these results.

If instead of attaching a horn to an electro-magnetic system we make use of a very large diaphragm and secure it at its centre point to a vibrating electrical system, it is possible to obtain very good results and to improve the lower register. There are various methods of doing this, and different manufacturers claim special advantages for their particular systems. Generally a cone having a diameter of between one and three feet is used, and loud speakers of this class are spoken of as the cone types.

A Balanced-Armature "Drive"

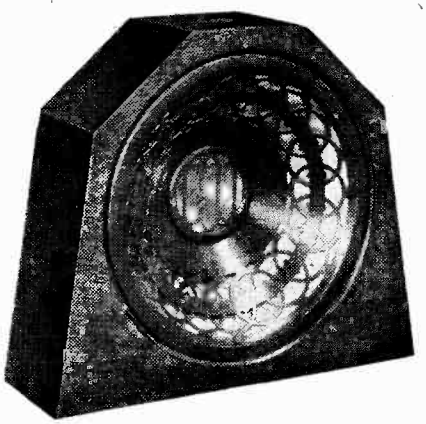
I believe the first cone loud speaker to be marketed in this country was the Kone, made by the Standard Telephone and Cables, Ltd., and now sold by B.S.A. Radio, Ltd., and by Messrs. Burndept Wireless, Ltd. The latter instrument has the trade name Ethocone. The Kone employs an armature which is placed between the pole pieces of a powerful horseshoe permanent magnet and attached to this armature by a short length of stiff rod is a thin reed. This reed has in turn attached to it a driving rod, which passes through a collar in the centre of a cone of specially prepared material, and is locked in position in the collar with a small set-screw. The vibrations of the armature are transmitted, via the rod, to the cone. This particular type of loud speaker is known as the balanced armature type.



The "Lissenola" Cone Speaker has a combination of horn and cone. It sells at 29s. 6d.

Makers of "Cones"

There are several other manufacturers who now make cone loud speakers. Amongst them may be mentioned Messrs. Graham-Amplion, Ltd., who market a whole range suitable for sets of every possible type; the Marconiphone Company, Ltd.; Messrs. S. G. Brown, Ltd.; The Ormond Engineering Co., Ltd.; Messrs.



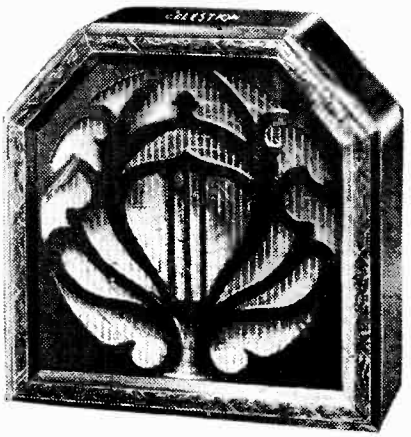
The Brown Universal type Loud Speaker is priced at £6.

Lissen, Ltd.; Messrs. Mullard; the General Electric Company, Ltd., and Celestion, etc., etc.

Those manufacturers who market a complete range of the cone types of instruments have designed senior and junior models. The senior models are intended to handle considerable volume and are suitable for very large sets, whilst the junior models are intended to fulfil the needs of the small set owner. Usually the junior models are particularly sensitive.

Reed-Type Mechanisms

Messrs. Amplion have split up their range into two groups on these lines. They use the same type of cone diaphragm in all their models, employing a strong seamless fabric material. In some of their models the cone diaphragm is of the semi-free-edge type whilst in others the edge is fixed. Celestions employ a reed-type mechanism and a reinforced cone. The diameter of the cone is 12 in. in the smaller model and increases according to the use for which the loud speaker is intended.



This is the Model C.12 Celestion Loud Speaker which sells at £7 5s. in oak and £7 10s. in mahogany.

The Marconiphone cones also incorporate a reed mechanism, and special attention has been paid to the elimination of any resonance effect. The edge of the cone rests on a felt sheeting, the pressure being adjusted to introduce the necessary quantity of damping without reducing the sensitivity. The winding of the smaller model has a resistance of 2,000 ohms, but the larger model is intended to be used in conjunction with super-power valves and only has a resistance of 500 ohms. Apart from the question of reproduction, one of the advantages of the cone type instrument is that it can be given an artistic finish. For instance, there is nothing to prevent the whole instrument from being mounted in a special cabinet to match the furniture in the room, or alternatively in some cases it can even be designed to hang from the picture-rail.

Cabinets for "Cones"

Many readers prefer to build their own loud speakers, and to meet this demand a number of firms, amongst whom are Messrs. Lissen, Ltd., are catering for the home-constructor by supplying cone units at very moderate prices. If he desires, the listener can build the complete loud speaker and set in the one cabinet, and it is interesting to note that Messrs. Carrington and W. T. Lock, Ltd., supply special cabinets for this purpose.

There are so many different types of cones on the market that it is impossible to describe all of them, but from the standpoint of reproduction one may say that they give a much better

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rendering of the lower musical frequencies than the short horn types of loud speaker. On the high frequencies some of them are not too good, and the response curve tends to fall away rather rapidly at this end of the scale. Manufacturers, of course, are well aware of this, and are doing their utmost to overcome the difficulty. At the same time the reproduction obtained is extremely pleasant and the presence of the lower musical frequencies gives that richness which is so pleasing to the ear.

Notes That We Miss

In any loud speaker it is very doubtful whether the absence of the higher frequencies is as noticeable as that of the bass. One can always tell when bass notes are lacking, because of the high-pitched tone which is obtained. With the higher frequencies, however, provided the cut-off is not too low, it takes a very keen and musical ear to notice where the high notes commence to fall away.

With cones there is a marked absence of trumpet effect—that is to say, one does not get the impression that the sound is coming from one point in the room. This is undoubtedly a strong point in the favour of the hornless loud speaker, since it tends to give a more realistic touch to the reproduction.

We now come to another type of cone, and that is the coil-driven cone or moving-coil loud speaker. When the British Thomson-Houston Company first demonstrated their famous R-K loud speaker in this country people listened with amazement. They had not thought that such realistic reproduction was possible. The idea of possessing one of these loud speakers was very attractive, but

There are two types of Mullard Loud Speaker: the one shown above, Model E, sells at £3 5s., and a Model D at £5 5s.

unfortunately the price (which was in the neighbourhood of fifty guineas) was so high as to place the instrument quite out of the reach of the "man in the street." In addition, it was essential to have the electric-light mains in order to supply the H.T. necessary to operate the amplifier, which incidentally was sold as part of the equipment.

Coil-Driven Cones

Since then, however, the British Thomson-Houston Company, Ltd., have placed on the market a complete R-K unit suitable for the home-constructor who wishes to obtain reproduction of the highest quality. In addition, Messrs. Rothermel are marketing the Magnavox Company's coil-driven unit in its various types.

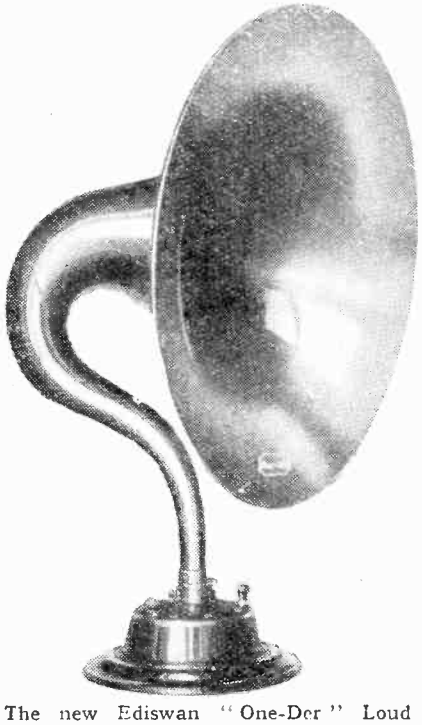
A coil-driven cone is very simple in principle. It consists normally of a small paper cone having a diameter of from five to eight inches, and with a small coil of wire, namely, the moving coil itself, attached to its apex. Around the edge of the cone is a ring of some material such as rubber, thin leather, stockinette, etc., which is also secured to a rigid framework. The cone itself is thus free to move, since it is suspended and held in position only by this ring of "elastic" material.

Attached to the end of the unit nearest the moving coil is a large magnet, either of the externally energised or permanent type, and the moving coil is so placed that it is free to move in and out in a small air gap at the centre of this powerful magnetic field. The moving coil is connected to the loud-speaker terminals on the receiver, and the cone moves backwards and forwards at frequencies corresponding to those in the output circuit of the wireless set at a given moment.

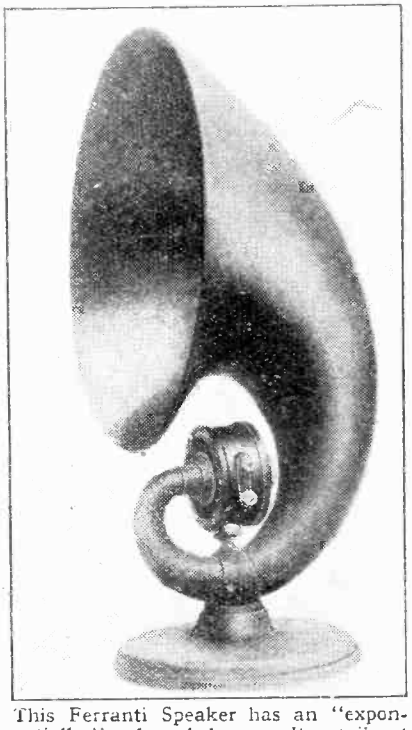
Three Different Types

Moving-coil instruments are made in three different types. First, there is the type similar to the original R-K, namely, that which makes use of a permanent magnet. Secondly, there is the mains-operated type, which has a magnet winding designed to suit the voltage of the electricity supply mains, and is designed to be plugged-in direct to the existing power supply. Thirdly, there is the type which has a field winding suitable for use with a six-volt battery.

The permanent-magnet coil-driven cone is fairly sensitive, but not quite so sensitive as those which have a separately excited field. Obviously, the permanent-magnet moving-coil instrument is most suitable for listeners who have difficulty in getting their accumulators charged or who have no electric lighting in the



The new Ediswan "One-Der" Loud Speaker, a full-size instrument which is available at £2 10s.



This Ferranti Speaker has an "exponentially" shaped horn. It retails at £3 3s.

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house. The current taken by the mains type is quite small, this being, in one case which I have in mind, 90 milliamps at 240 volts. The battery types, which are intended to be worked from six-volt accumulators, take heavier currents than this, and generally the values are in the neighbourhood of half an ampere or a little more.

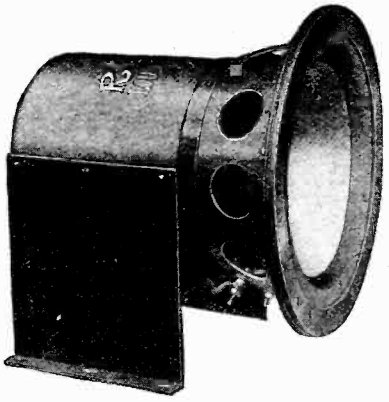
The moving coil itself can be either of the high- or the low-resistance type. Usually the commercial designs employ a low-resistance coil, in many cases the value being as low as eleven ohms or so. These coils are employed in conjunction with 25-1 ratio output transformers, and one of their advantages is that the winding is much more robust than a similar high-resistance winding consisting of a very large number of turns of fine wire.

Moving-Coil Resistance

On the other hand, the moving coil can be wound to have a resistance of about 1,000 ohms and can be connected in a filter output circuit, or even directly in the anode circuit, of a valve. This latter procedure is not desirable if the best results are to be obtained, but there is nothing to prevent one from using a properly designed output filter circuit with a high-resistance moving coil. Generally speaking, however, the low-resistance coil will give much better service, and if one is building a special amplifier it is just as easy to include a 25-1 ratio output transformer as it is to arrange for a filter circuit.

With a coil-driven cone it is necessary to use a wooden baffle having a diameter of two to three feet if the low notes are to be reproduced properly.

This baffle can be a piece of stout plywood with a hole cut in the centre the same diameter as the cone. Alternatively the unit can be mounted in a special cabinet; and there are many on the market which are quite suitable, the front of the cabinet being used as a baffle. Unquestionably a moving-coil loud speaker, provided it is used with an amplifier capable of giving an undistorted output, will give better reproduction than most other types. It will bring out both the upper and lower frequencies and the reproduction is remarkably life-like.



The R.K. Moving-Coil Unit is now supplied separately by the B.T.H. people at £9 10s.

Revealing Distortion

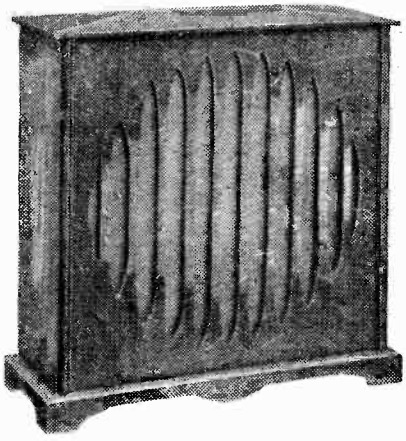
It is particularly susceptible, however, to any slight distortion in the amplifier itself, and in this respect it differs from the horn types and some of the cone loud speakers. For instance, a horn loud speaker will give quite respectable quality from an amplifier employing low anode voltages and small valves. There are many reasons for this, and amongst them may be mentioned selectivity. A short horn loud speaker and a small reed type cone are normally more sensitive than the moving-coil type, and therefore make the most of the amplifier's outfit. For this reason there is a smaller chance of distortion occurring on equivalent volumes, also much of the distortion occurs on the bass notes, which the average short horn loud speaker will not reproduce. Naturally, directly the same amplifier is hitched on to a moving-coil instrument the results sound very disappointing.

Speakers for Small Sets

Hence for a small set, or for a set which is being operated at some considerable distance from a broadcasting station, I would not recommend a moving-coil instrument because full advantage cannot be taken of its chief characteristics. A coil-driven cone is at its best when dealing with big volume, that is to say, an intensity greater than ordinary room strength.

If an attempt is made to cut down the volume to a strength suitable for a small room the lower frequencies are not reproduced to their best advantage, and this very desirable feature of the moving-coil instrument is partly lost. Hence to work a coil-driven loud speaker as it should be worked, one, or even two, super-power valves are necessary in the output stages of the receiver.

In addition the set must be capable of reproducing the lower frequencies and should have at least two low-frequency stages. A four-valve set will operate a moving-coil loud speaker extremely well, and a five-valve set, with two valves in parallel in the last stage, would be better still. The instruments will work on any H.T. voltage from 120 upwards, but naturally they will give better reproduction on 250 or 300 volts than on 120, because they can in this case handle greater volume without distortion. The loud speaker in every case is limited by the set and the results cannot be better than the set will permit.



The cabinet-type Six-Sixty Cone Loud Speaker, in oak or mahogany, costs £4 4s.

The moving-coil units mentioned are, of course, supplied practically ready for use and only require mounting in a suitable cabinet. For home-constructors who prefer to actually build their own instruments from the necessary castings and parts a number of firms supply the essential components for the construction of coil-driven cones. For instance, Messrs. A. Baker lists parts for both the permanent and electro-magnetic types, and these can be purchased either separately or as a complete kit. Other firms who market the necessary parts are Langham Radio, Ltd.; The Bedford Electrical Radio Co., Ltd.; Messrs. Goodman; Messrs. Colvern, Ltd., etc.

Output Transformers

There should be no difficulty in obtaining 25-1 ratio output transformers to be used in conjunction with the low-resistance moving coils, because many firms are adding suitable instruments to their existing range. Messrs. Ferranti and R.I.-Varley are amongst those who have already done so. These components, incidentally, can be obtained with split windings for push-pull amplifiers.

In writing a general article on loud speakers it is a difficult matter to touch on every point owing to limitations of space, but I have covered all those points the average listener or constructor will be likely to meet with.

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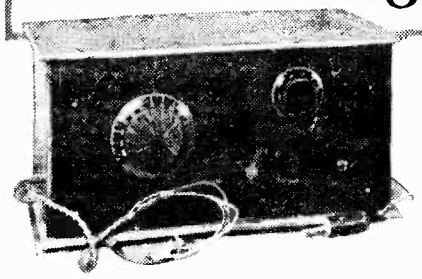
FROM SET TO LOUDSPEAKER
— OUTPUT CIRCUITS



In this easy-to-understand but comprehensive article the whole question of loud-speaker and output connections is dealt with from the point of view of providing practical improvements in operating.

By PERCY W. HARRIS, M.I.R.E.

WHILE a loud speaker can be connected directly to almost any wireless receiver capable of giving sufficiently strong signals and good reproduction obtained, the discriminating experimenter has come to look upon a loud-speaker coupling device as an important link in the chain when really efficient sound reproduction is desired. At the same time there is a good deal of misapprehension on this subject which appears to require a little more elucidating than it generally receives.

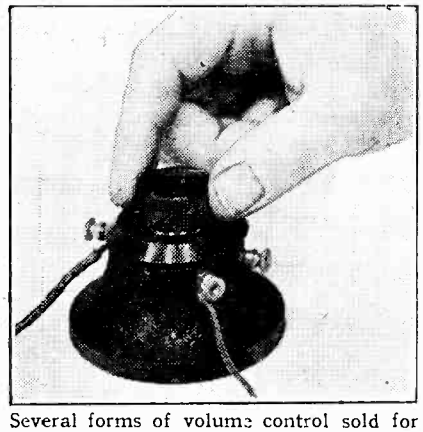
A Minor Point

To understand the why and the wherefore of the loud-speaker coupling device we must briefly run over a few preliminaries, and, by way of clearing the air, let it be said at once that the usual argument in favour of the loud-speaker coupling device that it "prevents burning out the loud speaker windings by removing the steady plate current from them" is one of the least important, for a number of loud speakers will easily stand more current through them than they are likely to receive by direct connection in the plate circuit of the last valve, and cases where a burn-out has actually occurred through the direct current passing through the windings are extremely rare.

What is Happening

Assuming that our set is well designed and is tuned in to the station we wish to reproduce on the loud speaker, we have flowing in the plate circuit of the last valve a current, the strength of which is modulated in accordance with the sounds we wish to reproduce. If we connect our loud speaker in series with the plate of the valve and the source of high-tension supply, then the variations of strength of current will produce correspondingly varying magnetic effects and the diaphragm of the loud speaker will vibrate and so produce sound waves, giving the reproduction we desire to obtain.

To understand just what happens quite clearly, we must consider the current flowing through the loud-speaker windings as consisting of two components—firstly, a steady direct current, and, secondly, an alternating current superimposed on this. The frequency of the alternating current varies, of course, from moment to moment, according to the modulations of the sound waves. Now the direct-current component is of no value whatever in the loud speaker windings. Indeed, it is directly a hindrance for three reasons Firstly, it causes a wasteful dissipation of energy in the windings. Take, for example, the case of a loud speaker with a 2,000-ohm D.C. resistance



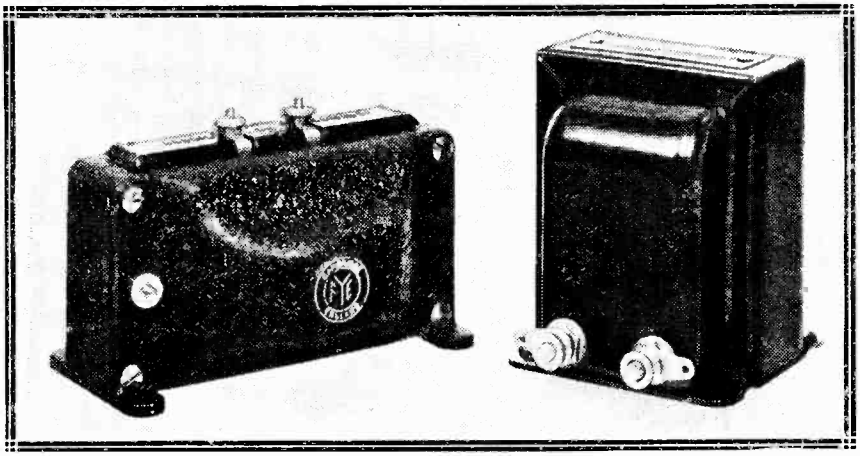
Several forms of volume control sold for gramophone pick-ups can be used for loud-speaker control.

Voltage Drop

With a 5-milliamp steady current flowing through this winding (quite a small current for modern loud-speaker work) we shall get a drop of 10 volts. With 15 milliamperes—quite a usual current when a super-power valve is used in the output—there will be a drop of no less than 30 volts. Fifteen milliamperes at 30 volts means ·45 watt, quite an appreciable loss here with no corresponding gain.

Wrong Bias

Now a drop in voltage of 30 will completely upset our calculations. It is useless assuming in such circumstances that we must grid bias our output valve for 150 volts when using a 150-volt high-tension supply, for our valve will be receiving only 120 volts on its anode, and grid bias for 150 volts will obviously be too much for 120.



Two typically modern L.F. chokes designed for output use.

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The second disadvantage of this current flowing through the loud-speaker windings is that the amount of fluctuating current which the magnet coil can carry before saturation point is reached is less (by the amount of the direct current flowing) than it would be if this current were absent, and therefore the loud speaker will overload more easily. There is in addition to this a permanent-magnetic bias on the speaker, tensioning the diaphragm needlessly, and in many cases making it much less responsive to delicate gradations of sound.

A Third Disadvantage

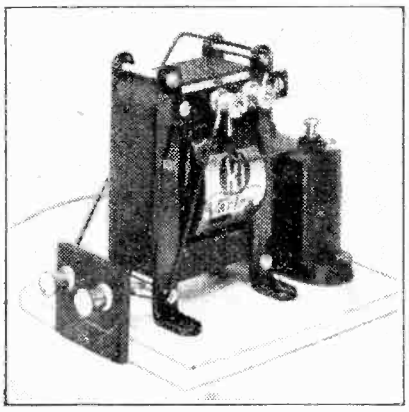
The third direct disadvantage of a steady current flowing is that the loud-speaker is "live" electrically, and touching the terminals may give a severe shock when we are using the high voltages which are becoming more and more a regular practice. Not only this, but loud-speaker leads are frequently run from one room to another, or even from one part of the house to another, and there is considerable risk of leakage when the loud-speaker leads carry such a high voltage.

Five Reasons "Why"

Here I would like to digress for a moment to point out that it is quite a mistaken idea to imagine that when a loud-speaker output device is used one will not get a shock by touching the loud-speaker terminals! Strongly modulated signals, such as are produced by a dance band, produce such rapid and high-voltage fluctuations in loud-speaker windings that one can get quite an unpleasant shock from such a musical passage as the roll of a drum or the final "smash" of a lively dance number.

A properly designed loud-speaker output device, by separating the direct current from the pulsating audio-frequency current, performs a very useful service, or, rather, a number of most useful services. These may be roughly classified as follows:

1. Confines high-voltage direct current to the receiver itself.



The conventional way of making up a loud-speaker coupling unit utilising an output choke where only one condenser is used in series with the loud speaker.

2. Enables the maximum load to be given to the loud speaker by removing the loading due to the steady current.

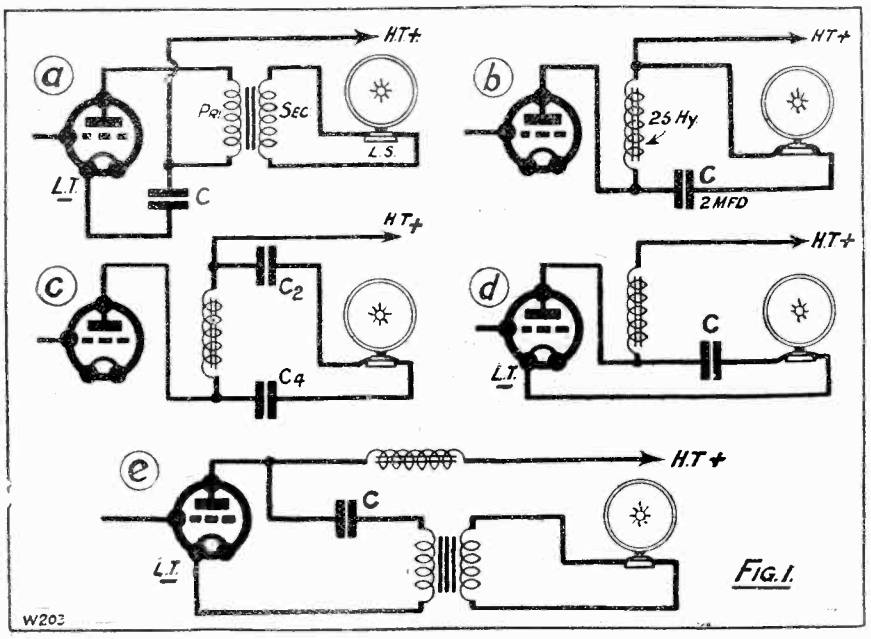


FIG. 1.

3. Removes unwanted mechanical bias on the loud-speaker diaphragm.

4. Prevents wasteful drop in voltage applied to the plate of the last valve.

Impedance Question

5. Prevents wasteful heat dissipation in the loud-speaker windings and a possible burn-out.

But we have not yet mentioned one of the most important functions of a properly designed output device, and that is the adjustment of the impedance of the load to the output valve. The loud speaker is really a power converter changing electrical power into sound waves, if the impedance of this load is unsuitable to the output valve then we may get both loss of strength and distortion. Experimenters with moving-coil speakers have discovered a great deal in this regard during the last few months.

Various Forms

There are a number of forms of loud-speaker output devices, several being shown in Fig. 1; (*a*) in Fig. 1 shows an output transformer which, to be efficient, must be specially designed for the purpose. Requirements here are that the D.C. resistance of the windings must be low (so as to avoid much voltage drop here), while the inductance must be high otherwise we shall not get a proper power transference.

With such a scheme both loud-speaker terminals are completely insulated from the direct voltage and only audio-frequency currents will flow in the windings. The disadvantage of the transformer in such circumstances is that the audio-frequency pulses in the plate circuit of the output valve return to the filament through the high-tension supply, which, being, common to several valves, may be the source of unwanted back-coupling unless there is adequate by-passing such as by the condenser C, which if large enough (two to four mfds.) provides a low-impedance path back to the filaments.

A way of overcoming this difficulty is shown in (*e*), where the direct-current supply to the plate of the valve shows through the choke, while the audio-frequency pulses have paths through the condenser C and the primary of the transformer. For satisfactory operation here, the choke must have a high-inductance valve and a low D.C. resistance.

A Simpler Scheme

As the transformer in the (*e*) arrangement does not carry any direct current, but only audio-frequency pulses, its own inductance can be obtained with less iron; in fact, the design of the transformer in the scheme (*e*) may be quite different from that of the transformer in scheme (*a*). However, if we are using a high-inductance low-resistance choke we shall find the scheme of (*b*) simpler. Here the choke

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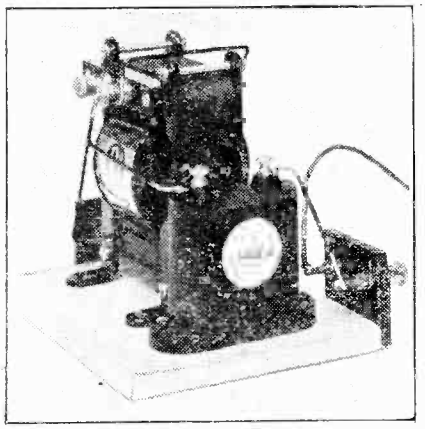
offers very high impedance to the audio-frequency currents, a much lower impedance path being through the condenser C to the loud-speaker windings, the condenser also serving to prevent the flow of direct current through the loud-speaker windings.

Large Condensers Necessary

In all these arrangements where a coupling condenser is used, we must be careful that it is of sufficiently high a value not to offer a high impedance to the frequencies we wish to



This photograph, together with the previous illustration, gives all the wiring details necessary.

pass. A simple calculation will show that if the value of the choke is 25 henries and the condenser 2 mfd., then at 100 cycles the impedance of the choke will be 15,700 ohms and that of the condenser 800 ohms.

If now we have a loud speaker which has an impedance at this frequency of 2,000 ohms (do not confuse this with the D.C. resistance of the speaker, as the two are *not* related) it will be seen that we have two parallel paths to consider between the valve and negative filament. The valve itself, we will assume, has an impedance of 3,500 ohms. In series with this are two parallel paths, one through the choke and the other through the speaker and condenser. It will now be seen that the speaker path takes by far the larger proportion of the load, which is as it should be; the drop through the condenser being still quite high enough.

Cut-Off Bass

If we were to use a small condenser of, say, ·02 mfd., this would effectively stop the D.C. passing through the loud speaker. The impedance offered by the condenser would thus be so high that there would be a considerable cut-off of the low frequencies. In reality the actions in the output circuit are much more complex than the simple theory above, and experimental results do not always quite tally!

As the impedance of the condenser becomes progressively lower as the frequency goes up we should not notice the cut-off at the high frequencies to anything like the same extent, but we should obtain that thin, unpleasant tinny type of reproduction which is so irritating to the sensitive ear. All through this argument I have, of course, assumed that the loud speaker is capable of reproducing frequencies as low as 100—very few are, as a matter of fact!—yet if we have a loud speaker which is in itself weak in its reproduction of the low frequencies, the use of too small a value of the coupling condenser here further accentuates the trouble.

The Best Method

It will be noticed in scheme (*b*) that although no direct current passes through the loud-speaker winding one terminal is at high potential to earth for D.C., and thus it is possible to obtain a shock on the loud speaker from this scheme. To avoid this, we can introduce a condenser as shown in the scheme (*c*), but we must remember that this is a further series impedance, and that if we are not to have an unpleasant cut-off of low frequencies, this must be of adequate size. We want to avoid, if possible, using two condensers, and at the same time we want to prevent our loud speaker being "alive," so it is preferable to use the scheme (*d*), where only one condenser is used and one side of the loud speaker is connected direct to low-tension negative or earth.

With regard to the condensers which are used in these coupling

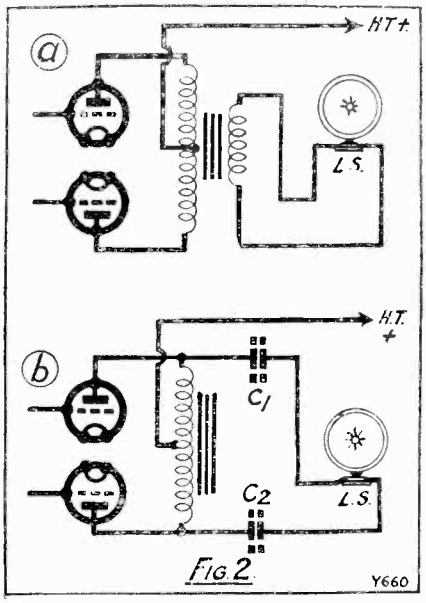
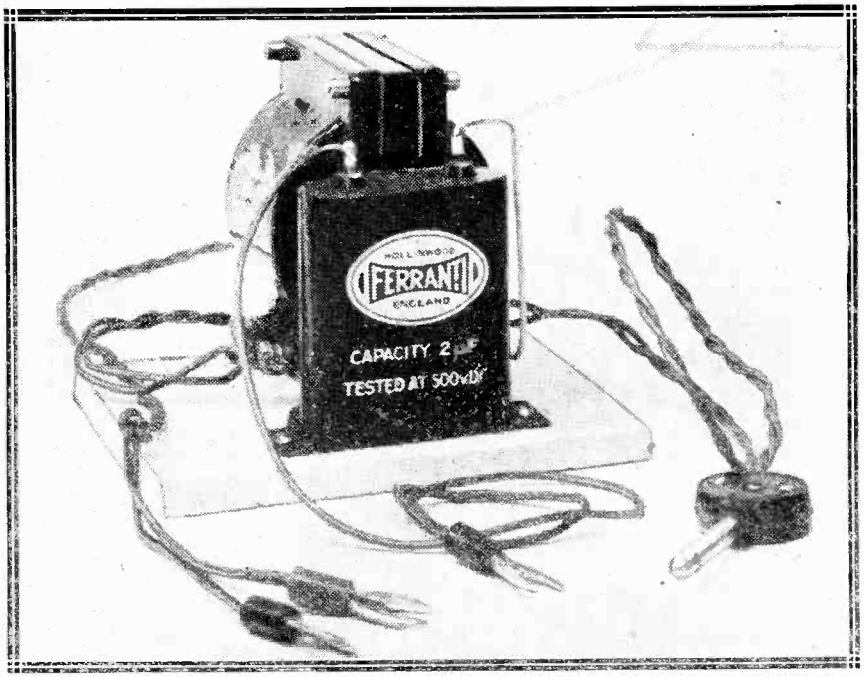


FIG. 2

devices, we must consider not only their capacity, but their break down voltage, for we shall have surges of voltage which will bring the strain to which these condensers are subjected far above that of the D.C. voltage itself. Take the scheme of (*d*). This has the advantage, as has just been pointed out, of giving an insulation to both terminals of the speaker so far as D.C. potentials are concerned



It is always an advantage when using an output transformer to provide an additional large condenser for shunting across to low-tension negative. This is explained in the article.

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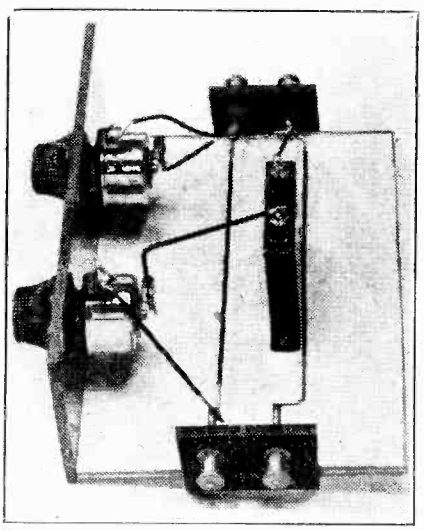
while using only one condenser, but if this condenser should break down then almost the full voltage of the H.T. battery (less a negligible drop in the low-resistance choke) will be impressed on the loud speaker, which can easily be burnt out, as with 150-volt battery and a 1,500-ohm D.C. resistance loud speaker a current of a tenth of an ampere will immediately pass! On the other hand, in the scheme (*b*) the breakdown of the condenser C would merely mean that the plate current would flow through the choke and the windings of the loud-speaker in parallel, and as the resistance of the valve itself will always be in series, and as, furthermore, the resistance of the choke is much less than the speaker, no harm will be done to the speaker winding. In scheme (*c*), with the two condensers in series there will be a very small risk of any breakdown occurring.

Choke Characteristics

A number of illustrations are given in the present article of loud-speaker output devices which have been put together in my laboratory for practical and experimental use. Remember that a choke to be satisfactory in a loud-speaker output device must have, say, 20 or 25 henries inductance *when the plate current of the valve used with it is passing*. Many chokes have very high inductance with one or two milliamperes passing, but owing to poor design and inadequate iron their inductance drops to a very low figure as soon as heavy plate current flows. The D.C. resistance, too, must be low, otherwise we shall get that objectionable drop in voltage to which reference was made earlier in the article. Several "low-frequency chokes" have been submitted to me for test at various times which on measurement showed to have a resistance considerably in excess of that of some of the valves with which they were designed to be used!



The two resistances used in this unit are of the continuously variable type.

Leaky Condensers

A 2-mfd. condenser is the smallest I should recommend for use in any of these schemes, or 4 mfd. when two are connected as in scheme (*c*), although, in point of fact, with the great majority of loud speakers it is doubtful whether any difference whatever would be noticed for the substitution of even 1 mfd. in each case. However, with the increasing tendency to use good-quality moving-coil speakers and the better cones, it is just as well to choose a value high enough to give proper reproduction with the lowest frequencies we are likely to get.

A point that I have rarely seen mentioned, but which is of considerable importance when handling the large-capacity or Mansbridge type of condenser made up with a paper dielectric, is to make sure that the sealing of the container is kept intact. The actual paper used is perfectly satisfactory if the original sealing is unbroken, but if any of the sealing substance breaks away through an attempt to bend or open the case or being dropped, then moisture may get in and the insulation will drop to a very low figure. Several cases have come to my notice where large-capacity paper-dielectric condensers have developed faults within a few hours of being dropped. Investigations have shown that a small piece of the casing has split open or broken away, allowing the entry of moisture.

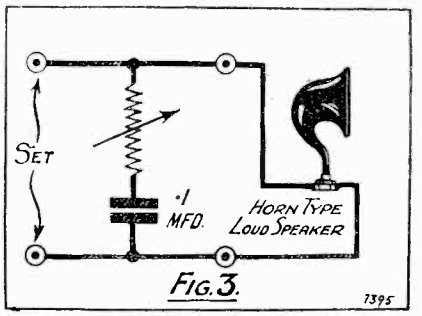
Push-Pull Outputs

So far I have not mentioned output devices for use with push-pull amplifiers, as valves used in "push-pull" cannot be connected directly to the loud speaker.

Fig. 2 (*a*) shows the conventional method of connecting the output of a push-pull amplifier to the loud speaker, a transformer with a centre-tapped primary being used and a secondary of ordinary form. The push-pull output transformer can be designed more economically than an ordinary output transformer as we have not to deal with the large magnetising effect of the d.c. current such as occurs in the arrangement (*a*) in Fig. 1. In (*a*) Fig. 1, the steady current magnetises the core and makes it necessary to have a good deal of iron in order that saturation may not be obtained by the combination of the D.C. and A.C. effects.

Less Iron Required

In the push-pull arrangement in Fig. 2, the direct current flows in opposite directions in each half of the primary, and therefore so far as this direct current is concerned the two magnetic effects are balanced out,



leaving the iron free for the magnetising effect of the modulated current. This means in effect that a push-pull output transformer can be designed efficiently with less iron than is the case with the transformer in arrangement (*a*) in Fig. 1.

Transformer Not Necessary

Contrary to belief in some quarters, it is not necessary to have *output transformer* in push-pull as we can use a single choke without condensers, as shown in (*c*) Fig. 2. It might at first be thought that the absence of condensers (shown dotted in C_1 and C_2) would make the device inoperative, but a moment's consideration will show that there is no difference of D.C. potential between the two ends of the choke, and therefore no current can flow round the circuit connected to them. As, however, the plates of the two valves are at different alternating potentials for the modulations, differences of A.C. potential are set up across the ends of the choke, and the modulated currents therefore flow through the loud speaker.

High Impedance

It is, in general, however, advisable to insert a condenser at C_1 or C_2, or both, having a capacity of 2 to 4 mfd. (4 mfd. if two condensers are used), in order to isolate the loud-speaker terminals from D.C. potential to earth, thus avoiding possible leakage current and strain on insulation. The disadvantage of the (*b*) scheme is, however, that the impedance of this scheme will probably be too high for the average loud speaker, although, of course, it is possible by tappings on the choke to adjust the output impedance suitably. On the

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whole, I prefer the transformer arrangement for " push-pull."

While on the subject of loud-speaker coupling devices I would like to draw attention to one or two interesting arrangements which are helpful in correcting or making more pleasant the effects of some types of loud speaker. Many of the older types of loud speaker have an unpleasantly "sharp" reproduction due to a tendency possessed by these types to over-accentuate the higher frequencies.

Tone Control

By shunting a continuously variable resistance in series with a ·1-mfd. condenser (note this value : a *tenth* of a mfd., not *one* mfd.) the over-accentuation of the higher frequencies can be considerably reduced, the amount of reduction depending upon the value of the resistance. A very

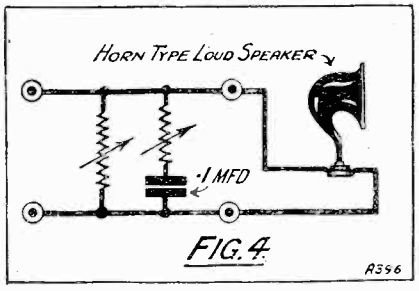


FIG. 4.

suitable device for this is the volume-control Clarostat, the Dubilier volume control, or the Marconiphone volume control, all three being excellent variable resistances of high maximum value. The scheme is shown diagrammatically in Fig. 3, and gives a surprisingly good improvement with some of the older types of horn speaker.

Easily Made

Such a scheme will not, of course, bring up low tones which are not present, but by giving a more uniform reproduction curve they certainly give a much pleasanter effect. In point of fact, shunting a tenth of a microfarad across many of the older horn loud speakers makes them sound just like many cheap modern cones!

A useful little device shown diagrammatically in Fig. 4 and illustrated photographically comprises two variable high-resistances, mounted up on a suitable little panel with terminals, one being used to shunt the speaker, therefore reducing the total volume given by the loud speaker, and the other to adjust the repression of the higher frequencies in the manner just described.

This little device can be placed in some suitable position and will serve to quieten down the speaker when it is too loud and also to adjust the high-note repression to suit the particular item. The ideal loud speaker, of course, has a uniform reproduction curve and suits all items equally, but an imperfect speaker can be adjusted from time to time to give the best possible effect with a particular item

Volume Control

The volume control by shunting the loud speaker with a high resistance is usually better when an output device is used, otherwise if the loud speaker is directly in the plate circuit of the last valve any adjustment of this resistance alters the total plate current and the effect will not be satisfactory.

Furthermore, such a volume control to be really effective requires that there shall be no overloading of the output valve or valves, on the loudest signals the set will give, for you cannot correct overloading on the last valve by this scheme, but only reduce the total output of undistorted volume.

Valve Overloading

It is interesting to note that many people call a loud speaker too loud when the actual volume is really not very great, but when the cause of the irritation is overloading of the last valve. With a properly designed amplifier, free from overloading, the volume given by a loud speaker can be far in excess of normal without any unpleasantness being observed.

Many listeners like to use two loud speakers in combination, one of the horn type known to be good on the upper frequencies, and the other of the cone type, good on the lower tones but which may drop a little in the higher register. There are several methods of combining speakers and often difficulty is experienced in adjusting volume between the two. Fig. 5 shows a scheme which is often helpful and which consists in placing the two loud speakers in series and in shunting both with variable high resistances, such as those mentioned in connection with the volume-control scheme.

By adjusting one or other or both of these resistances one can make one or other speaker predominant. On some theoretical grounds the scheme is not good, but in practice it works very well and should certainly be tried by those who like to experiment with loud-speaker effects.

There is a growing tendency to place the "family" receiver somewhere other than in the living-room and to bring leads from the set to a place where the loud speaker is in use. Indeed, many enthusiasts are now wiring the chief rooms of the house with loud-speaker plugs, and in this connection the Lotus distant control scheme can be recommended.

Remote Control

In this the insertion of a plug in a loud-speaker jack automatically turns the set on and, so long as any speaker is plugged in, so long will the set operate, the withdrawal of the last plug serving to turn it off. There are two models available, one for ordinary

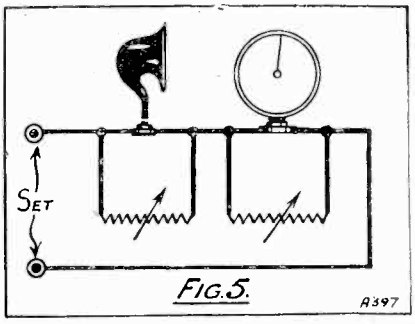
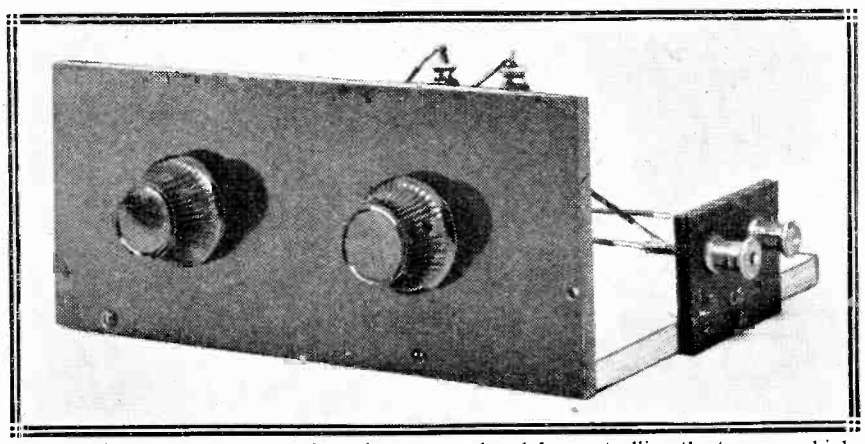


FIG. 5.

working with high-tension batteries, and the other for sets utilising high-tension mains units. This latter has a special form of relay which automatically turns off the mains unit as well as the accumulator.



This combined unit serves both for volume control and for controlling the tone on a high-pitched loud speaker.

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HENDON AGAIN

We were promised a bigger, better, brighter Hendon for 1928, and were told that Radio would play a great part in the pageant—But read what happened at Hendon.

By LAWRENCE W. CORBETT.

PERHAPS it *was* a *bigger* Hendon, made so rather by super-abundance of pilgrims than by magnificence of pageantry. As for it being a *better* Hendon—well, how did it differ from that of last year or the year before?

We've been twice as much thrilled by an aerial jamboree at Mitchell Field, New York, where the crazy flying fairly sent the shivers down one's spinal column, and where we almost dropped to our knees to pray for the safety of the flyers in their racing 'planes tilting at crazy angles but twenty feet from the ground, to negotiate the numerous pylons.

Could Do Better

We applauded twice as much when the American "sniping" 'planes scored "bull's-eyes" one after another with tiny toy balloons as the objective than we did when the 'planes at Hendon, using a hulking "sausage" balloon as target, finally brought it down in flames.

As for it being a *brighter* Hendon—well, we surmise that incorrect prognostication on the part of the weather prophet was the cause of this paradox!

The sad thing about it all is that our British fellows are capable of putting on every bit as brilliant a show as can be seen at Mitchell Field, but just didn't. The glory they earned for themselves in the World War is witness of this.

Of all the things at Hendon this year, we enjoyed most that event entitled "Parade of New and Experimental Types." We were disappointed at not seeing the weird bird-like "Pterodactyl" in flight, especially as we overheard a gentleman standing at its side explaining the technicalities of it and reporting to his audience that he had built it and flown it there.

Radio's Part

We did, however, get a tremendous "kick" out of seeing the lazy "Inflexible" taking off, and wondered, as we noted the tiny "Tiger Moth" nestling up against it, how many times the latter would go into the "Inflexible's" tail!

Most of the other events on the programme merely duplicated those of last year.

Now, what was the great part that wireless played at the pageant? We must have missed it! Wireless certainly did not distinguish itself, and we're not cynical. There was an inadequate public address system of forty-odd loud speakers, odd in the sense that there were *about* forty instruments, not that they were singular.

Bert Hinckler telling a thrilling tale to the 3LO (Melbourne) microphone on the completion of his epoch-making flight from England to Australia.

This figure, we were told, represented a big increase over the number used last year. Personally, we suggest a 200 per cent increase for 1929, perhaps more. The announcements to the audiences were fairly intelligible when they were made from the central control tower, and providing one was fortunate enough to be seated close to one of the forty loud speakers, but the wireless *pièce de résistance* of the day was, candidly, a "flop."

For this event, listed as "Evolutions by Wing of Three Fighter Squadrons," all the 'planes in one of the squadrons had been fitted up with receiving and transmitting sets. In so far as the transmitting was concerned, only the squadron-leader was to perform.

The other two squadrons were not equipped with wireless. All the drill, even that of the outfitted 'planes, had been rehearsed and was, therefore, pre-arranged.

Unintelligible Noises

The order of the drill escapes our memory, but it was something like the following. First of all the squadron with wireless appeared over the aerodrome. The order for each manœuvre was transmitted by wireless by the leader to the other 'planes in his squadron, and repeated—"about turn," "form squadron," etc.—and was acted upon accordingly and instantaneously. In addition to being picked up by his other 'planes the squadron-leader's remarks were also picked up by one of two receiving stations on the ground, transmitted by landline to the amplifier-room, and outputted to the public address system for the benefit (?) of the audience on terra firma.

The commands were mostly unintelligible! The roar of the engines, perhaps combined with certain landline and amplifier noises, tended to drown out what was being said.

As the other squadrons, in turn, performed over the aerodrome (the signals for their evolutions being given by hand by their individual squadron-leaders) the squadron-leader of that group of 'planes fitted up with wireless explained to those on the ground the various movements that were being executed.

THE "FRIENDSHIP'S" FLIGHT. Mr. W. A. Battison, (of Cambridge, Mass.), who arranged to fly the Atlantic as radio operator with Miss Amelia Earhart. He was compelled to remain behind, but fitted up his station to listen for the 'plane as long as possible.

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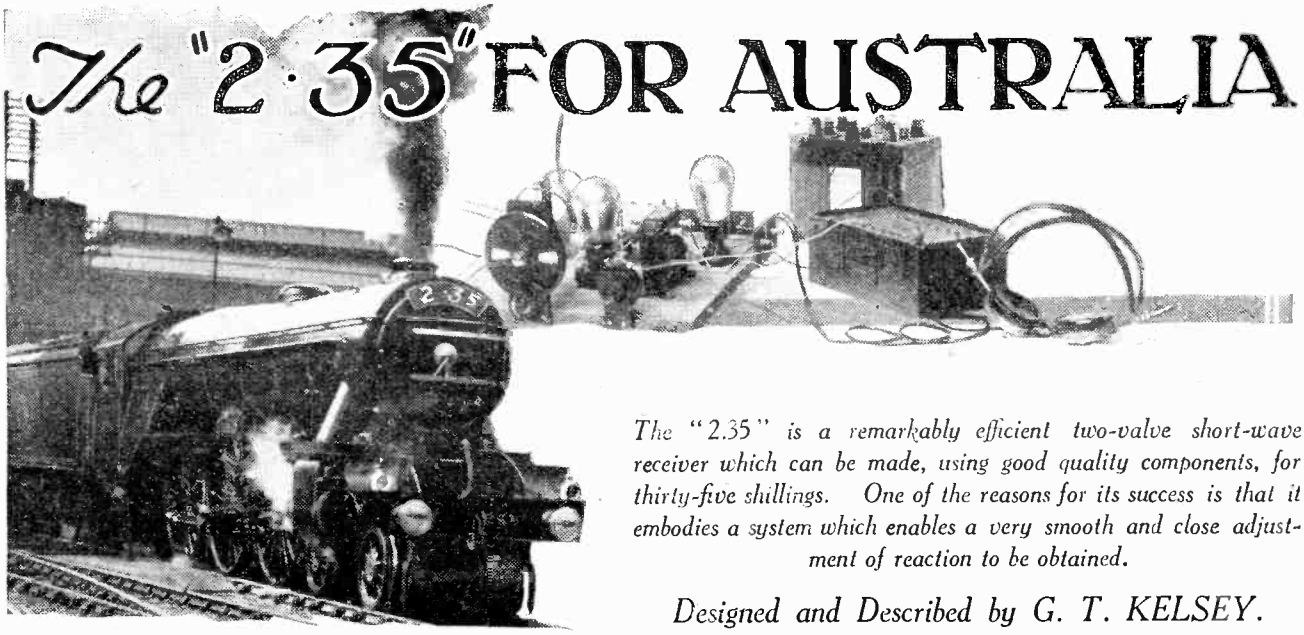
The "2·35" FOR AUSTRALIA



The "2.35" is a remarkably efficient two-valve short-wave receiver which can be made, using good quality components, for thirty-five shillings. One of the reasons for its success is that it embodies a system which enables a very smooth and close adjustment of reaction to be obtained.

Designed and Described by G. T. KELSEY.

As you will probably already have guessed, the "2.35" is one of those modern affairs which gets there without going. In other words, it is nothing to do with travelling in the strict sense of the word, but is merely an efficient short-wave set capable of receiving Australian and American broadcasting direct.

But what exactly is meant by 2.35? To come to the point, the expression is intended to convey that the set, consisting of two valves, can be built for a total cost of 35s.

It is only reasonable to suppose that there are a number of readers interested in short waves who do not feel disposed to go to a lot of expense on a set which, strictly speaking, can only be used experimentally, in fact, correspondence in the past has shown this to be the case.

Reducing Costs

In this connection then, it occurred to the writer that it would be a sound idea to carry out experiments with a view to producing a set as cheaply as was consistent with efficiency.

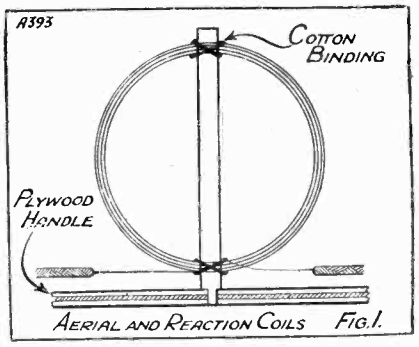
At the outset, the difficulties in choosing a suitable circuit were innumerable. Quite obviously, if expense were to be the prime consideration the use of the popular capacity-controlled-reaction circuit was out of the question, since such an arrangement necessitated the use of two variable condensers.

It was therefore decided to use only one variable condenser, with a swinging coil for reaction. Accordingly the layout was arranged on a baseboard and tests were made, but, alas, it was found as was feared that variation of the reaction coil not only controlled oscillation, but also had a serious effect upon tuning. Experiments were therefore continued with the idea of regulating reaction by means of a variable filament resistance, but here again every movement of the rheostat was found to upset the tuning.

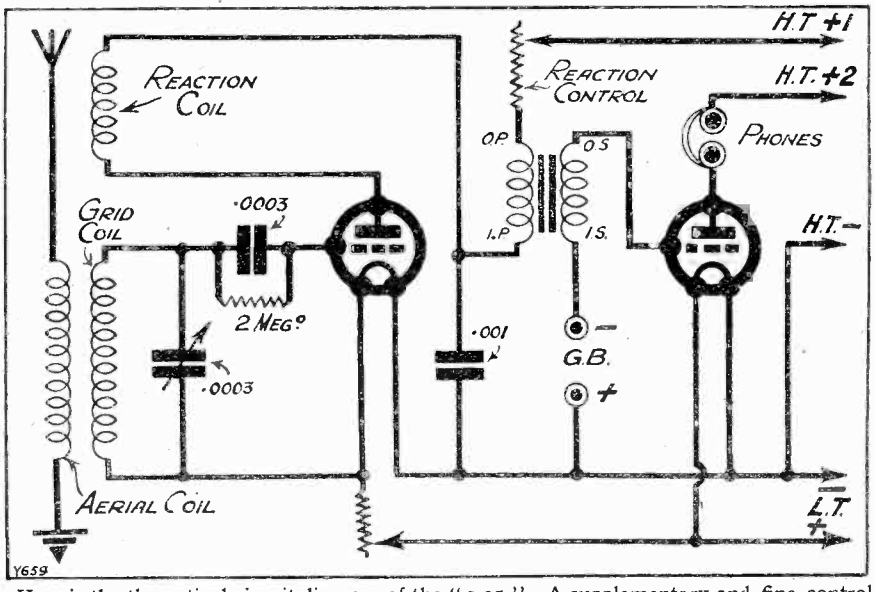
A Resistance Control

As readers are probably aware, the effect of increasing the H.T. voltage on the detector valve is usually to start the valve oscillating, and bearing this in mind the next experiment was made with a variable resistance in series with the detector valve's H.T. lead.

With this particular scheme it was found possible to obtain excellent results by adjusting the reaction



coil to a point just on oscillation—taking the set in and out of oscillation by variation of the resistance, and,



Here is the theoretical circuit diagram of the "2.35." A supplementary and fine control of reaction is obtained by a variable resistance in the anode circuit of the detector valve

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what was of greater importance with this arrangement, variation of the resistance was found to have no noticeable effect upon tuning.

Here then was the ideal arrangement—one condenser, home-made coils, two valves; Australia—and all for thirty-five shillings!

But just one moment—so that there shall be no spilt milk, it should clearly be understood that the reception of Australian broadcasting

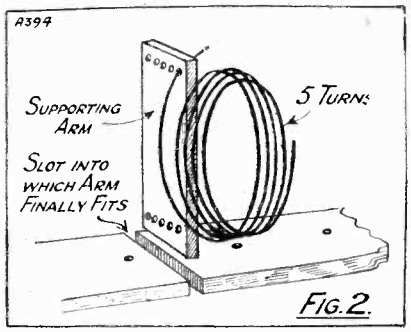


FIG. 2.

at this time of year is by no means a "regular as clockwork" affair. On the contrary, during the summer months it is often impossible to hear anything at all from the Antipodes for a week or so, and then, quite as mysteriously as signals have been inaudible, the next broadcast is received with surprising clarity. However, as the evenings draw in, reception from "down under" will get much more consistent.

Remarkable Results Possible

With regard to American stations, even at this time of year, which from the wireless fan's point of view is probably the worst, remarkably good results can be obtained after about 11.30 p.m., so that really there is always something to be heard.

By now I think quite enough has been said in explanation of what "2.35" really is, and also in regard to what may be expected from it. It only remains therefore to give all the necessary constructional details.

HOW THE 35s. IS SPENT.

	COMPONENTS.	Price allowed. s. d.
1	Variable condenser, ·0003 (Formo in set. Lissen or other first-class make of low cost.)	5 0 to 7 6
1	Potentiometer, panel type (Lissen or similar type)	2 6
1	Anti-microphonic valve holder (Igranic in set. Any standard make, Ashley, Benjamin, Bowyer-Lowe, Burndept, Burne-Jones, Igranic, Lotus, W.B., etc.)	2 0
1	Ordinary valve holder (Igranic, Lissen, etc.)	1 0
1	Baseboard rheostat, 30 ohms (Lissen, Igranic, etc.)	2 6
1	L.F. transformer (Various models are available around this general figure, e.g. Formo, Lissen, etc.)	10 0
1	Fixed condenser, ·001 (Dubilier in set. Any of the standard makes, Clarke, Igranic, Lissen, Mullard, T.C.C., etc.)	1 6 to 2 6
1	Grid condenser, ·0003 (Lissen in set.)	1 0
1	Grid leak, 3 megohms (Lissen.)	1 0
1	Slow-motion dial (Raymond on set.)	2 6
	Baseboard 12 in. × 10 in., terminals, small quantity of No. 22 enamelled wire, length of tinned copper wire, etc.	4 0
	Total cost should not exceed	35 0

Simplest Possible Construction

From the constructor's point of view the present set is probably one of the most simple short-wavers of any that have recently been described. There is no panel, and so when the components have been gathered together the first thing to do is to prepare the two small ebonite supports, one for the variable condenser and the other for the potentiometer.

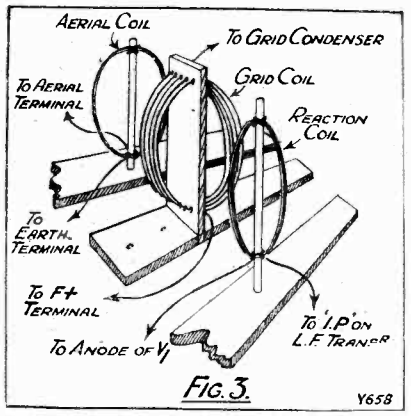
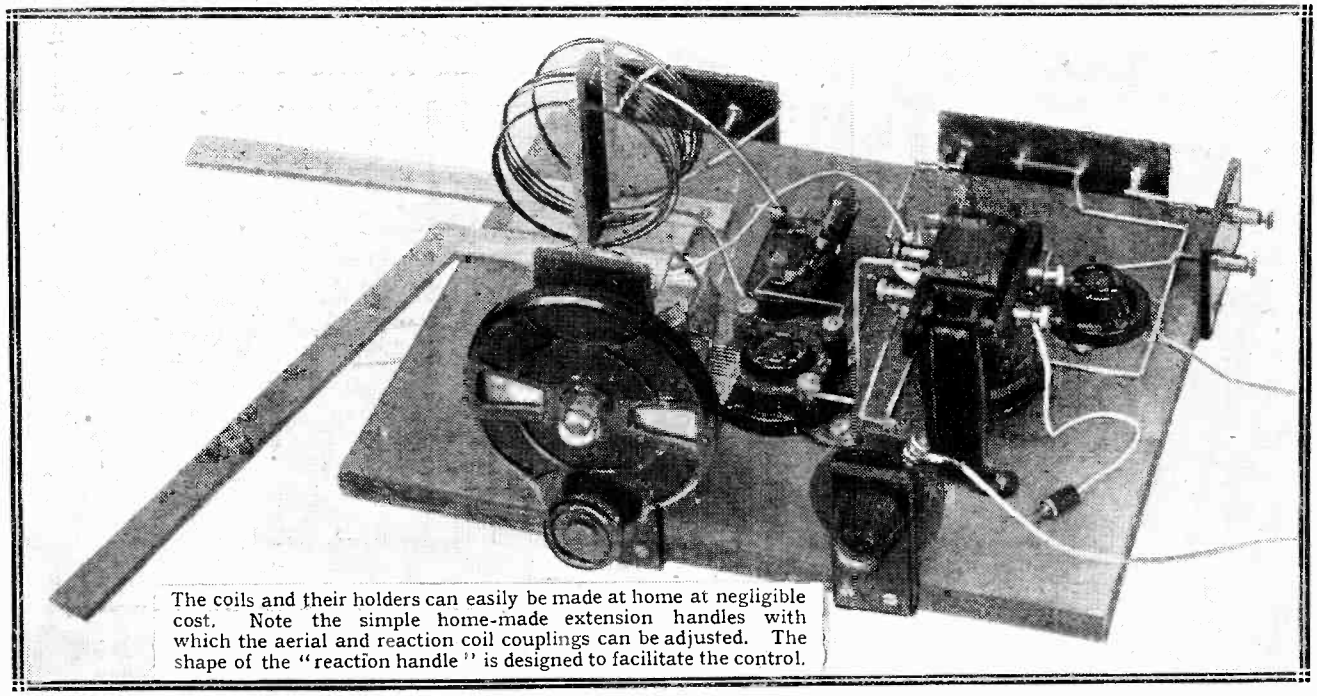


FIG. 3.

In the original, a piece of ebonite 5½ in. by 1½ in. was used for the condenser, and a smaller piece 2½ in. by 1 in. for the potentiometer, but, of course, any scrap pieces of ebonite will do for this purpose providing they are sufficiently large.

As will be seen from the various photographs and the wiring diagram, three terminal strips are also required, two each carrying two terminals, and



The coils and their holders can easily be made at home at negligible cost. Note the simple home-made extension handles with which the aerial and reaction coil couplings can be adjusted. The shape of the "reaction handle" is designed to facilitate the control.

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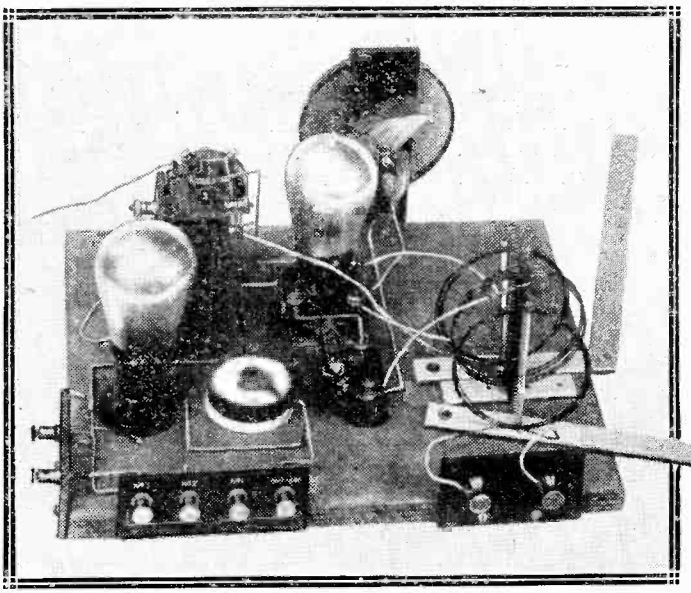
one to accommodate four terminals. Having fixed the ebonite supports and terminal strips to the baseboard (the correct positions can be obtained from the wiring diagram), the coil holders and coils should be made and fixed before securing the rest of the components.



This photo shows the finished "2.35" with coils and valves in position. Quite an attractive appearance is possible providing the wiring is neatly carried out.

The actual arms upon which the two moving coils are carried can be made from three-ply wood, and perhaps before proceeding it would be as well if I explained the reason for the bent handle.

The Home-Made Coils

When operating a set on short-waves, trouble is often experienced from hand-capacity, and to overcome this as far as possible it is desirable to arrange for the reaction coil, which requires fairly frequent adjustment, to be varied from the front of the set.

Such a refinement is unnecessary for the aerial coil, since this latter only requires occasional adjustment, but even in this case a straight extension handle—about 8 or 10 in. long—is to be recommended.

The actual arrangement of the three-coil holder, if such it can be called, is clearly shown in the wiring diagram, and I will therefore proceed by giving details of the special home-constructed coils.

The aerial coil, which is the one nearest the back edge of the baseboard, consists of three turns of No. 22 gauge enamelled wire. The coil should first be wound round a milk jug or similar former with an approximate diameter of 3 in. It should then be removed and secured to a thin wooden rod by cotton or thin string. The wooden rod, with, of course, the coil tied to it, are held upright by wedging the rod into a hole drilled in the pivoted handle.

A good idea as to how the grid coil is constructed may be obtained from the drawing shown in Fig. 2.

A thin piece of ebonite, approximately $3\frac{1}{2}$ in. by $\frac{3}{4}$ in., is drilled with two sets of five holes. The distance between each hole is just over 1/16th inch, and three inches separates the two lines of holes.

As in the case of the previous coil, the five turns which are to comprise the grid winding should first be wound round a former, and this time the diameter should be the same as the distance between the two sets of holes in the ebonite support.

In connection with this particular coil, here is a hint which readers would do well to observe. If the wire is wound round the temporary former a few hours before it is actually required, when the wire is eventually removed it will remain reasonably to shape, and will not spring loose.

Fixing the Coils

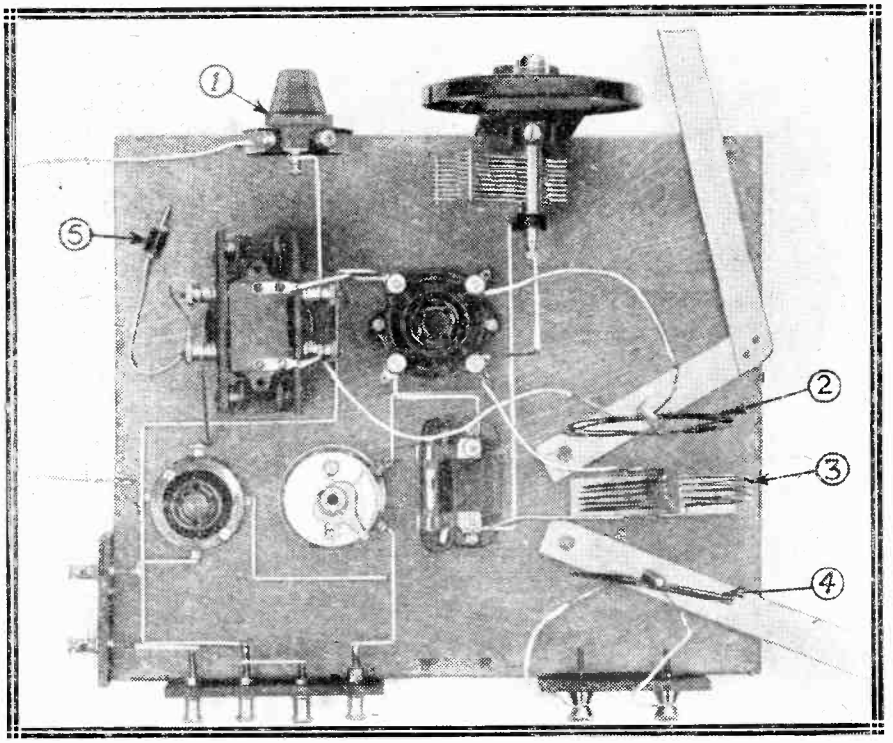
It is then only necessary to thread the winding through the holes in the ebonite support, starting at the first hole and gradually working through until a wire passes through every hole.

Once the coil is complete, pieces of matchsticks wedged into the holes will hold the winding in position. The actual method of fixing this coil's support to the baseboard is shown in Fig. 3, and further explanation is really unnecessary.

There is now only the reaction coil to be made, and this is exactly similar to the aerial coil, except that it consists of four turns. The same gauge wire, namely, No. 22 enamelled, is used for all three coils.

To complete the receiver it now remains to fix the rest of the components to the baseboard and to make the necessary connections.

Next month the turn numbers will be given for coils to cover a higher



Here some of the important parts are indicated by numbers: (1) The variable-resistance reaction control; (2) the reaction coil; (3) the grid coil; (4) aerial coil; (5) grid-bias negative plug.

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band of wave-lengths, and in view of this none of the flex leads from the coils should be soldered. It will be noticed that the components to which the flex leads from the coils are taken are all conveniently fitted with terminals, so that coil changing will be quite a simple procedure.

The set is now ready for testing. In the matter of valves, those of the 2-, 4-, or 6-volt variety can all be used quite successfully in this particular receiver.

In the detector position a valve of the type usually styled H.F. should be used, and since the set is to be used in conjunction with telephones, a valve of the L.F. type will give louder signals than a power valve in the second position.

Preliminary Adjustments

With suitable valves inserted, next determine whether the set will oscillate over the whole of the tuning range. Starting with the tuning condenser at zero (plates all out) move the reaction coil towards the grid coil until the set commences to oscillate.

If any doubts exist as to whether the set is oscillating, touch the fixed vanes' terminal of the variable condenser with a moistened finger, whereupon if such is the case a double click will be heard in the telephones, one upon touching and one when withdrawing the finger. Only one click is an indication that the set is not oscillating.

The oscillation test should be made at every five degrees or so of the tuning condenser, until the plates have been rotated from minimum to maximum. In going from 0 to 180°, fairly frequent adjustments to the reaction coil will probably be necessary in order to maintain the set in a state of oscillation.

Should you be unable to obtain reaction over part of the tuning range, move the aerial coil away from the grid coil, and increase the reaction coupling until oscillation commences.

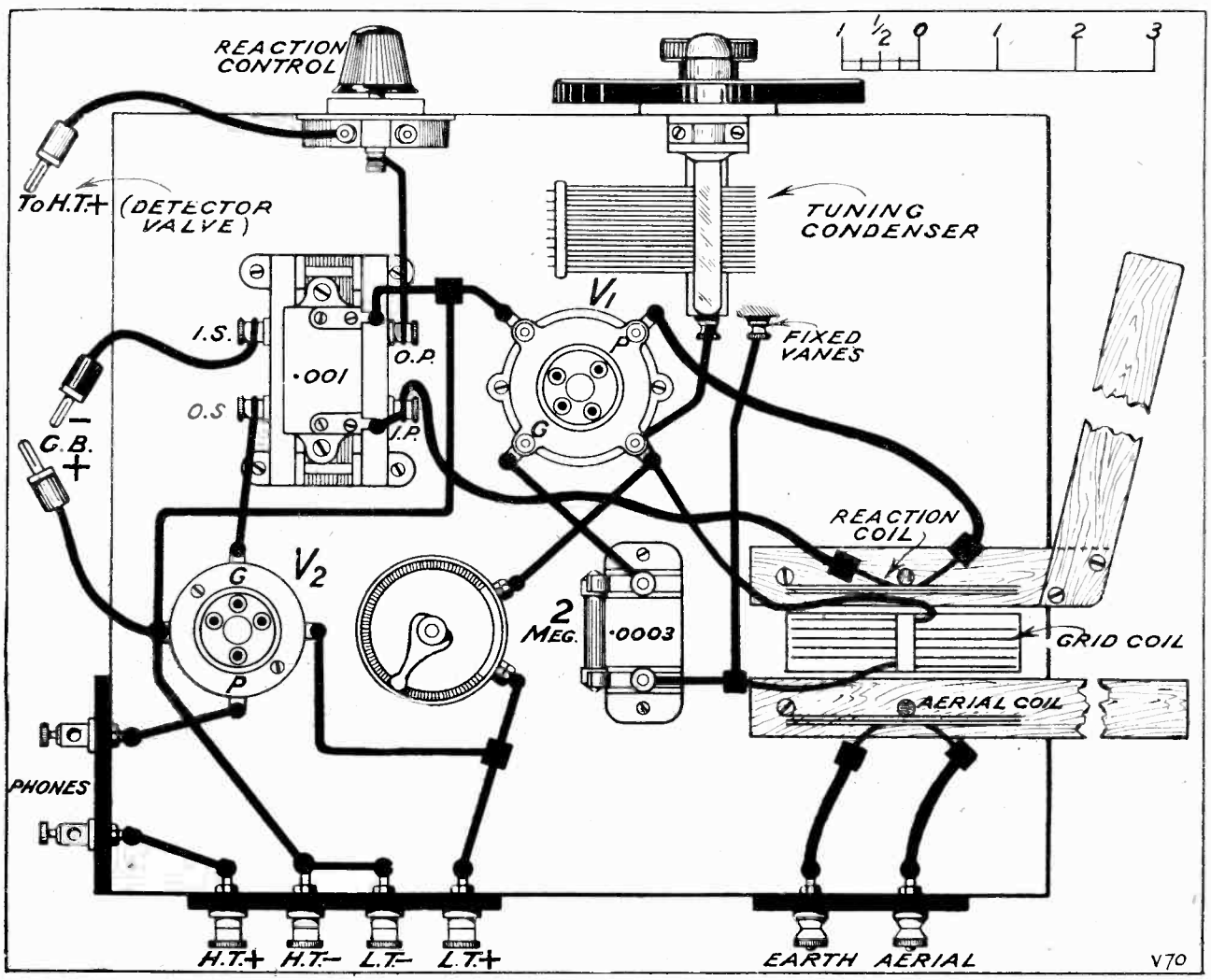
Up to now I have not mentioned anything about the best H.T. voltages to use. These will, of course, depend upon the particular valves in use, but, as a rough indication, the flex lead from the potentiometer should be taken to a tapping on the H.T. battery at about 45 volts, whilst from 60 to 80 volts should be quite sufficient for the second valve.

It is important to note that the change to the oscillating condition must be very smooth, and if it is at all inclined to be ploppy or sudden, the H.T. voltage on the detector valve should be lowered.

Reception of Signals

Now for the reception of signals. Starting once again with the tuning dial at zero, adjust the reaction coil until the set is *just* oscillating and very slowly turn the dial until a carrier-wave is located, then vary the potentiometer slider until the set ceases to oscillate.

The resistance for reaction control will only be found to be effective when the set is just on the verge of oscillation, and if you tune in a station with the reaction adjustment well beyond the oscillation point, the resistance will have little or no effect.



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CIRCUIT PROS & CONS

All the better-known types of circuits are briefly reviewed and their advantages and disadvantages impartially brought foward.

By G. V. DOWDING, Grad.I.E.E.

THERE are three standard detector circuit arrangements, three very well-known forms of L.F. coupling, and about eight more or less completely different H.F. circuit arrangements. You will see from this that an H.F.-Det.-L.F. set lends itself to some sixty different variations. How many different versions of a five-stage arrangement it would be possible to tabulate would need some working out. Anyhow, it would be a very great number. Therefore, I can extend my sympathies to the constructor who, having dug down into the theory of radio more or less superficially, scratches his head in puzzlement and says: "Which will be my ideal arrangement?"

A Puzzling Business

And I can picture him wandering among a maze of split-primaries, split-secondaries, tuned grids, and so on and so forth, with the horizon getting farther and farther away from him. Of course, a very great number of constructors pay little or no attention to the circuit of a set. They note that the designer or designers of the "Standard" Three, or whatever it is, say that the hook-up has these or those qualities and can accomplish certain things under certain conditions, and, if the story as a whole appeals to them, then they make their choice by this means.

But a study of the circuit, however superficial it may be, will be worth while, for it will enable the constructor more easily to make his mind up for himself and not to rely completely upon the directions of others. You see, designers of sets are notoriously optimistic people, at least the majority are. A notable few are remarkably modest in regard to their productions.

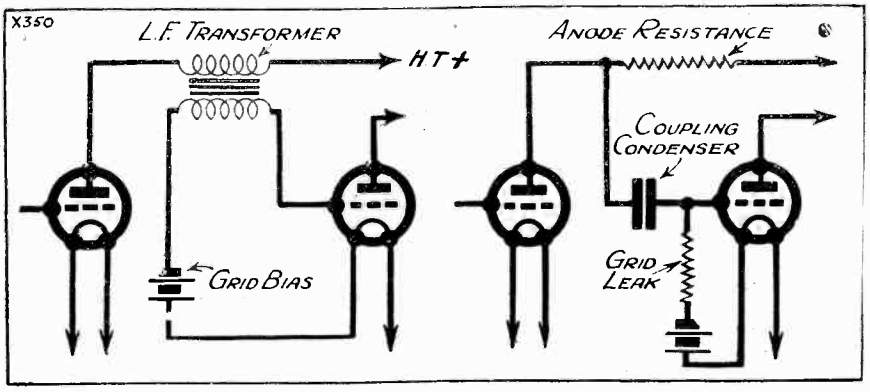
I must add in parenthesis that every receiver described in MODERN WIRELESS is independently tested by the "M.W." Research and Construction Department. We have always recognised the necessity for some such department, but it was only about a year ago that it was constituted, under the able control of Mr. G. P. Kendall, B.Sc. Every set forming the basis of a prospective constructional article for MODERN WIRELESS is very carefully tested and all its claims verified, whoever may be the designer. And it is worth noting that very, very few sets indeed pass through without suggested modifications being made.

However, to get back to this circuit business. Last month I contributed an article entitled "Selecting Your Set," and this month, as the title of this article indicates, I am going to deal with circuits.

First of all, let us take rectification. In these days I am of the opinion that the crystal detector should be confined to the simple crystal set. If any valves at all are to be used, then it is just as well to eliminate crystal detection. Even the best of crystal detectors are liable to pack up in the middle of a concert. Remember that providing the batteries are O.K. nothing short of the house falling down is likely to stop a first-class valve set operating.

Two Rectifying Schemes

There are two well-known methods of valve rectification. The one is known as the leaky-grid method (grid leak and condenser) and the other is anode-bend. Undoubtedly the anode-bend method enables a greater purity of reproduction to be obtained, but, despite anything which you may hear or read to the contrary, you can take it from me that a fairly careful choice of valves and a moderately skilful adjustment of conditions are needed in order to obtain this superior quality.



Here are the two most popular forms of L.F. coupling. The transformer allows greater magnification to be obtained in ordinary circumstances, while for greatest purity properly arranged resistance-capacity coupling is the better scheme.

None of these complications occur in leaky-grid rectification, and I think this is the scheme I would recommend to the average constructor, for unless

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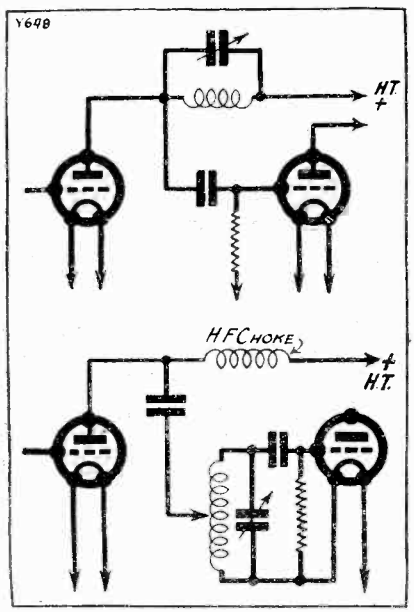
he uses a moving-coil loud speaker and first-class gear throughout, he is not going to benefit very much in point of quality by adopting the anode-bend method, and, on the other hand, it is probable that he would lose considerably in point of sensitivity.

Very few people can afford to ignore the sensitivity obtained through the use of reaction, although the careful operator uses only the minimum degree.

There is a third detector circuit arrangement, and that is my own Filadyne, where, contrary to all normal practice, the input is on to the filament of the valve and not on to the grid.

L.F. Circuit Arrangements

Regarding L.F. amplification the issue is less clear, but nevertheless it is really quite straightforward. Here we have choke capacity, resistance capacity and transformer coupling. These are the three best-known arrangements, but, additionally, there is the push-pull scheme and what is known as dual impedance coupling. This last is comparatively new and undoubtedly has many advantages, but as it has not yet been included in any of our published specifications there is no need for us to concern ourselves with it now.



The top diagram shows a simple tuned-anode H.F. coupling. Below is what is sometimes termed the "shunt feed" method.

The choice of the average constructor will range between the first three mentioned methods and combinations of these. I think it is a mistake to strive for very high amplification per valve on the low-frequency side. In my opinion, it is better to aim for more stages and lower amplification per valve. But, unfortunately, only the fortunate few could afford to carry this idea through thoroughly; the majority find it financially necessary to limit the number of valves.

Arranging the Stages

For one stage of L.F. amplification it is safe to say that the transformer method of coupling has the most points in its favour. Useful amplification and very passable quality can be obtained with but moderate high-tension voltage. But to get really loud-speaker signals, even from the local station, two stages of amplification are needed. An arrangement which has much to commend it and is much used is a stage of resistance-capacity coupling followed by a transformer-coupled valve.

Somewhat superior results might be achieved by the employment of resistance-capacity coupling throughout, but you would need three valves instead of two unless you were to force the magnification up by using throughout high values of coupling resistances and high-magnification valves, but in doing so you would endanger the quality of results.

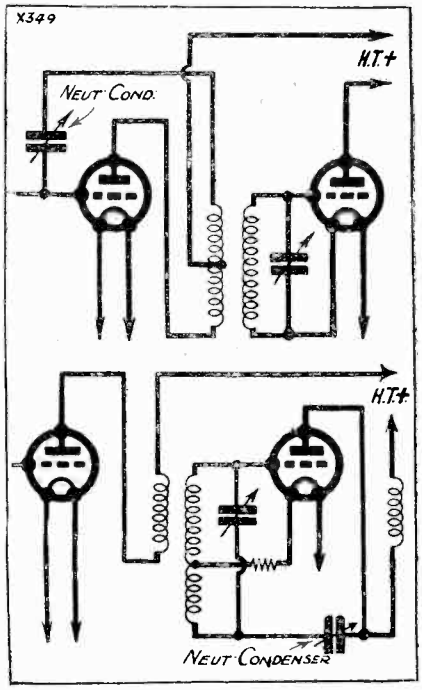
With choke-capacity coupling one is not able to get the magnification possible by the transformer method, although an approach to the quality obtainable with resistance capacity is possible with lower H.T. But there seems to be a "settling down" towards resistance capacity and transformer methods, and it is easy to summarise the most popular arrangements.

A Useful Summary

For one valve, transformer coupling; for two stages of L.F., resistance capacity followed by transformer; for three stages, resistance capacity throughout with two valves in parallel in the output position.

H.F. amplification seems to lend itself more readily to circuit variations. And here I am on rather tricky ground, for opinions are apt to be sharply divided. The screened-grid valve has been very prominent of late, and it is a fact that a screened-grid stage will provide the greatest possible amplification together with a remarkable stability and freedom from extraneous neutralising devices and all their complications. But the screened valve has its disadvantages. It is not selective, and even when two stages are employed one finds in cases that a wave-trap is essential.

Further, the screened-grid valve demands a high anode voltage. Other types of H.F. circuits offer compromises between selectivity and sensitivity. Others, again, are more stable and less sensitive, and so on. In fact, there are so many considerations, or, I should say, varying combinations of considerations, that it is impossible to lay down hard



Split-primary H.F. transformer coupling is illustrated at the top, below being shown a typical split-secondary scheme.

and fast rules. To add to the complexity we are always coming up against special schemes which individually appear to be extraordinarily attractive. These are generally modifications of better known arrangements, and I do not think I could do better than to confine myself to a consideration of the more standard hook-ups.

H.F. Coupling Schemes

Resistance-capacity H.F. coupling can be dismissed in a few words. This appears to be of value only on the longer wave-lengths and, although it enables one to dispense with tuning, it will not meet the average constructor's needs.

The old-fashioned but very simple tuned-anode coupling can likewise be put aside as being more or less obsolescent. The simple tuned-grid circuit, however, has its points. An H.F. choke is placed in series with the plate circuit of the "H.F. valve" and the feed to the detector is via a fixed condenser. The detector has a

(*Continued on page* 200.)

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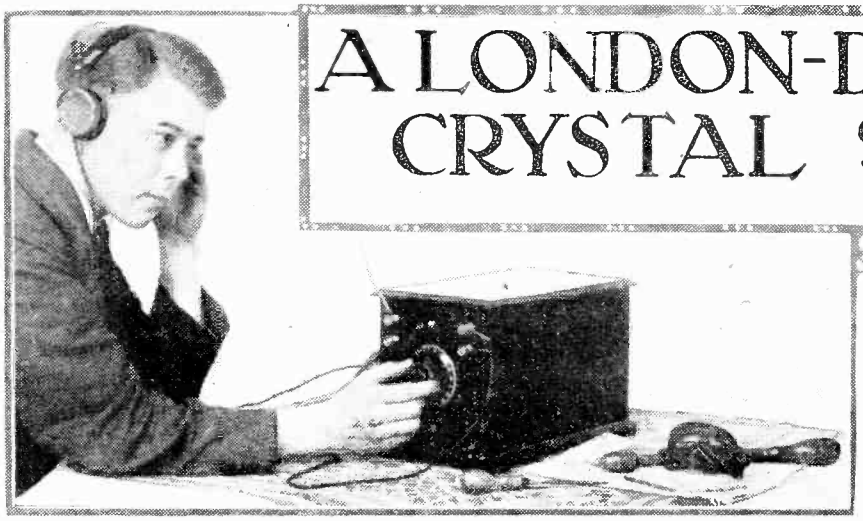
A LONDON-DAVENTRY CRYSTAL SET



Without the bother of changing the plug-in coils this receiver can be switched over from 5 X X to the local station in a second.

Designed and described by

A. JOHNSON RANDALL.

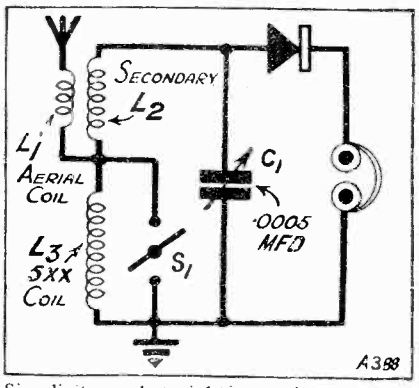
THERE is something about a crystal set which exercises a very powerful appeal. Possibly it is its great simplicity and the fact that the cost of upkeep is exactly nil. In any case, it is a very sound proposition for those who are situated within a reasonable distance from a main station and who are content to listen-in on the headphones. I estimate the effective range of a well-designed crystal set at ten to twelve miles from a main station and one hundred miles from either of the Daventry stations. This distance of ten to twelve miles may in many cases be exceeded, but the range given may be taken as an average.

Selectivity

The possessor of a crystal receiver must be content with the reception of, at the most, three stations, namely, the local, Daventry 5 G B, and Daventry 5 X X. In some cases it may not be possible to receive any other than the local transmission, and a case of this nature would occur when the set is being operated within the "shadow" of the local transmitter.

I have known cases where listeners within three or four miles of the London station have not been able to receive Daventry 5 G B or 5 X X on their crystal set because of the swamping effect of the powerful 2 L O transmitter. This is unavoidable, and such listeners may well take warning in advance, that if they are so situated they will probably have to be content with the reception of their nearby station.

The reason is that the selectivity of a crystal set is strictly limited, and although attempts have been made to provide a high degree of selectivity, in practically every case signal strength has been considerably reduced and the scheme has not been found to be worth while where standard methods were used. I am therefore making no extraordinary claims for this little receiver, and I can only say that it is a good, sound set, equal to the best, but with one special advantage.

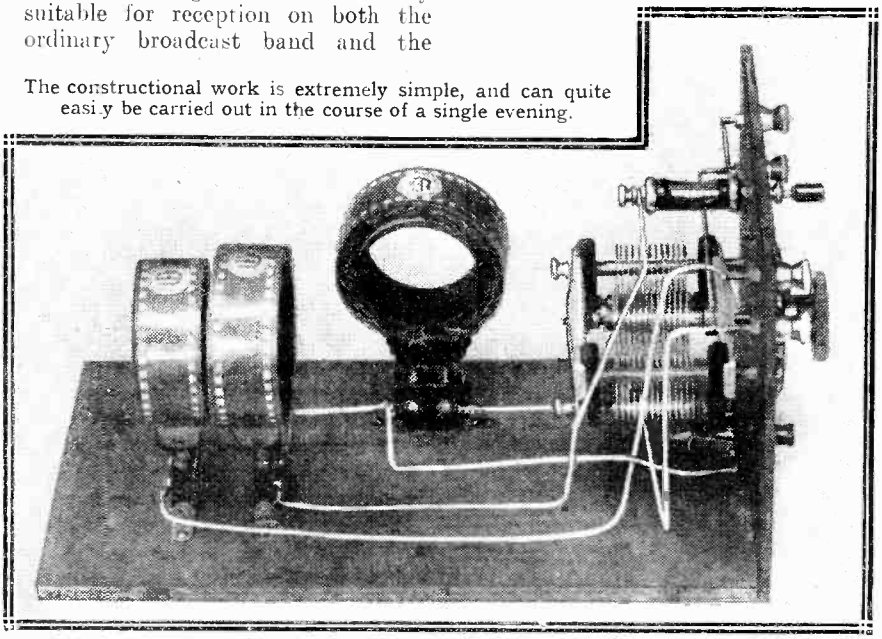


Simplicity and straightforwardness are the features of the circuit connections.

This advantage is that it is entirely suitable for reception on both the ordinary broadcast band and the Daventry 5 X X wave-band without changing coils. The special circuit employed enables the listener to switch straight over from his local station or 5 G B to 5 X X. Moreover, plug-in coils are utilised, thus enabling the constructor to make use of his existing stock.

The Circuit

Although no special claims are made as regards selectivity, it is yet possible to vary the sharpness of tuning by altering the size of the aerial coil. The sizes of the two remaining coils are fixed within limits. There is little need to say much about the theoretical circuit, but it may be stated that the aerial coil is of the semi-aperiodic type, and this is coupled to a tuned secondary coil which is also in series with the large coil employed for the Daventry 5 X X wave-band. This large coil is short-circuited by means of an ordinary



The constructional work is extremely simple, and can quite easily be carried out in the course of a single evening.

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push-pull switch when it is desired to listen in on the ordinary broadcast band.

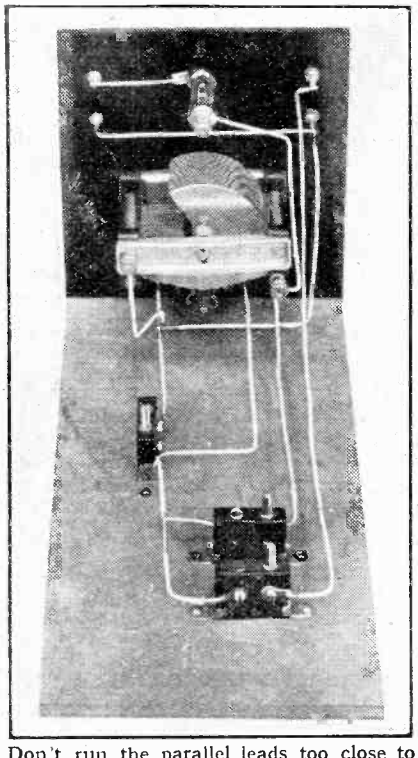
The construction of the receiver is very simple and can easily be carried out in an evening. The panel should first be drilled in accordance with the dimensions given on the drilling diagram, and the variable condenser, crystal detector, wave-change switch, and the four terminals should be mounted in the positions shown. The variable condenser, of course, is in the centre of the panel and below that is the wave-change switch.

COMPONENTS REQUIRED

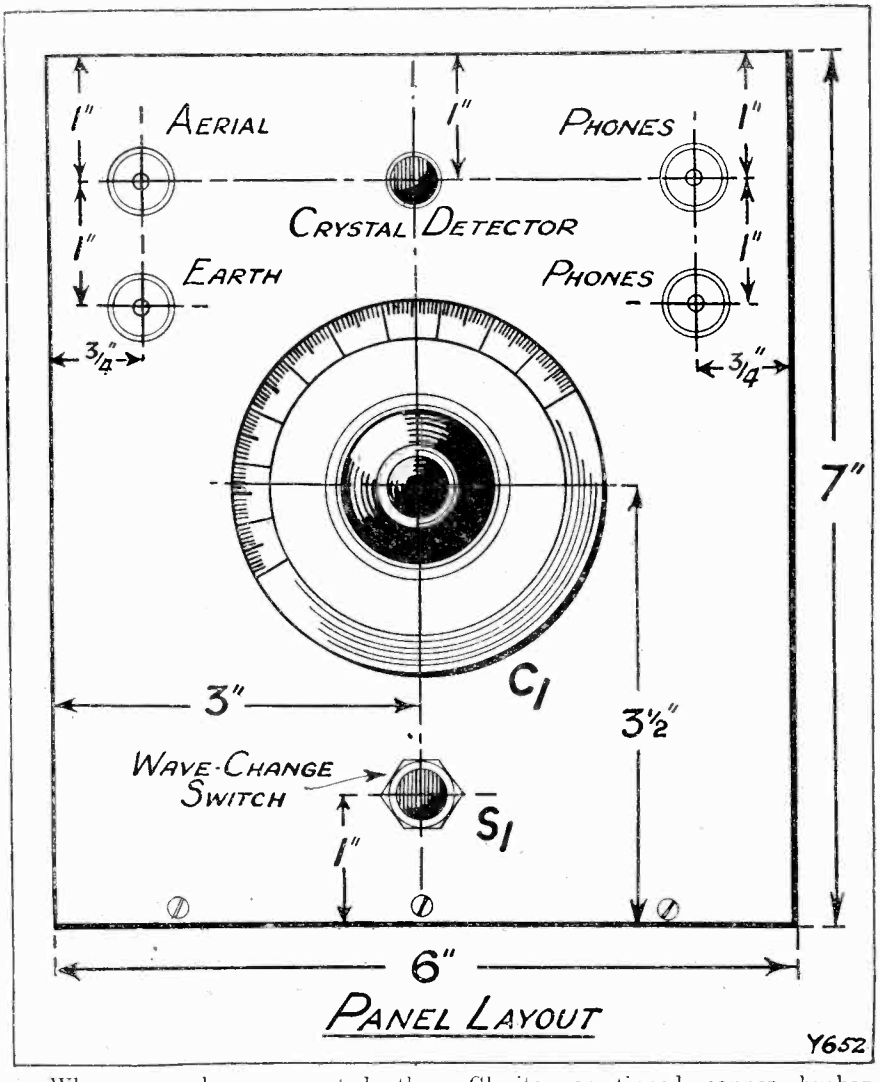
- 1 Ebonite panel, 7 in. × 6 in.
- 1 Cabinet and baseboard 11 in. deep (This is a cabinet commonly used for mains H.T. units, available from the usual firms).
- 3 Baseboard-mounting coil sockets (Burne-Jones, Igranic, Lotus, Peto-Scott, etc.).
- 1 ·0005-mfd. variable condenser. (Bowyer-Lowe in set. Any good make).
- 1 Crystal detector (See text).
- 4 Terminals (Plain or engraved, such as Belling-Lee, Eelex, Igranic, etc.).
- 1 Push-pull on-off switch (Lissen, Lotus, or similar type).
- A length of wire for wiring-up, and plug-in coils, sizes as given in the article.

Constructional Details

The crystal detector actually used is a Prince and retails at 2s. 6d., but actually it does not matter what type is chosen since there are very many of these excellent little components on the market selling at round about this figure. Some constructors may prefer a cat's-whisker detector, whilst others have a preference for the semi-permanent type. This is entirely a matter for personal choice, and it may be said that, in general, the cat's-whisker type is the more sensitive and less reliable of the two, whilst the semi-permanent class scarcely ever requires readjustment.



Don't run the parallel leads too close to one another, or H.F. losses will result.



When you have mounted the various components on the panel and secured it to the baseboard with the aid of three ½-in wood-screws spaced at convenient distances along its bottom edge, you are then ready to mount the three coil sockets in position. The chief point to remember is that the position for these coil sockets on the baseboard depends upon the sizes of the plug-in coils employed. You must take care to leave plenty of space for the big coil which will be inserted in the single socket for 5 X X. The other two coil sockets are spaced fairly close together so that when the aerial and secondary coils are placed in position they will practically be touching.

Wiring-Up

If the coils are large ones, that is, large in diameter, you will have to place the coil sockets nearer the centre line of the baseboard, otherwise you will not be able to place the coils in position when the set is in the cabinet. The wiring can be carried out with Glazite, or tinned copper busbar. Some constructors may prefer to use a Systoflex covering, but it does not much matter so long as each lead is separated from that adjacent to it. The most convenient gauge of wire is probably No. 16, on account of its stiffness. Here, again, if insulation covering is employed the gauge of wire is really immaterial. Constructors may wonder why such a long and seemingly large baseboard was employed. The reason for this is that the baseboard length happens to suit a standard cabinet which can easily be

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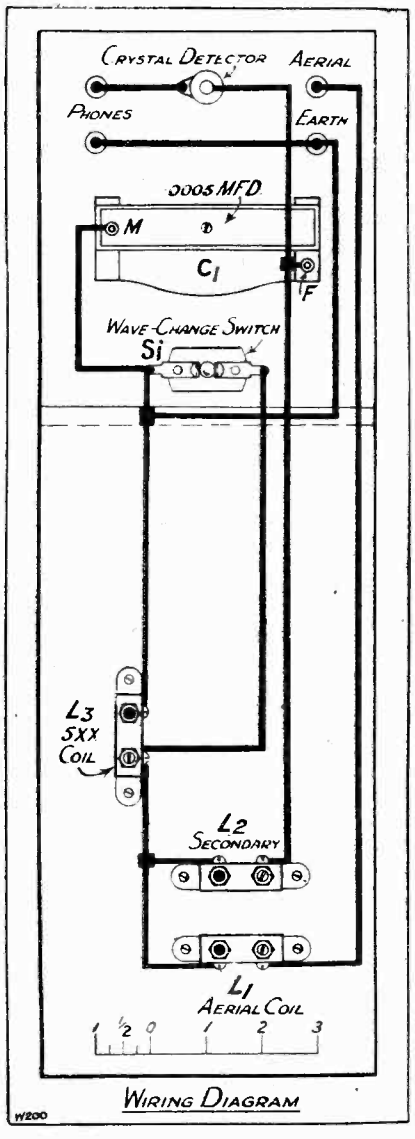
purchased ready-made. It was thought better to make use of an existing standard size rather than to employ a special type to suit the design. Obviously in the latter case the cabinet would have to be specially made and would actually be more expensive than the larger but standard size.



WIRING DIAGRAM

There is little to say regarding the operation of the set. Connect up the aerial lead to the aerial terminal and the earth lead to the terminal immediately below it, that is, the one marked E. Connect a pair of high-resistance telephones to the two telephone terminals.

Coils To Use

Insert a No. 200 coil in the long-wave socket L_3, place a No. 35 or 40 coil in the aerial socket L_1 and a No. 60 in the secondary socket L_2. Push the switch in and listen-in for your local station. If you rotate the tuning condenser dial you will soon find a position at which the signals are at their maximum strength. Then adjust the crystal detector until you are sure that the signals are as loud as you can possibly get them. Then pull out the switch and adjust the tuning condenser until you find 5 X X.

POINT-TO-POINT WIRING.

Join aerial terminal to one side of coil socket L_1. Join other side of L_1 socket to one side of long-wave socket L_3, to one side of wave-change switch and to one side of secondary coil holder L_2. Join the other side of coil socket L_2 to fixed vanes of variable condenser and to one side of crystal detector. Join other side of crystal detector to top telephone terminal. Join bottom telephone terminal to earth terminal and to remaining side of coil socket L_3, also to moving vanes of variable condenser, and to remaining side of wave-change switch.

If you wish to listen-in to 5 G B it is possible that you will get better signals if you insert a No. 50 coil in the aerial socket L_1 and a No. 75 in the L_2 socket. This is largely a matter for experiment, and the original coils given will tune equally well to the 5 G B wave-length, but very frequently a slightly larger aerial coil is an advantage. In general, one might say that for stations having wave-lengths in the neighbourhood of 450 to 500 metres a No. 50 coil in the aerial socket and a No. 75 in the secondary socket is about right, but for stations below these wave-lengths a No. 35 to 40 coil in the aerial and No. 60 in the secondary are correct.

DEVELOPMENTS IN FRENCH WIRELESS

An up-to-date review of the radio situation.

By our Special Correspondent.

WIRELESS amateurs in France, keenly conscious of the inferior quality of concerts transmitted from French stations, are looking forward with interest to forthcoming legislation and regulation of wireless in their country.

Government intervention is coming. Though state-control is not looked upon favourably in France, the projects put forward by persons in authority are being eagerly discussed by all interested in wireless.

First and foremost is the question of taxation. Up to the present, the only semblance of a tax has been the sum of one franc (2d.) registration fee, so small an amount that few wireless users take the trouble to pay it. This has meant that stations in France are subsidised entirely by manufacturers and sellers of wireless instruments and parts, and it also means a great deal of advertising on the air, as listeners-in to Radio-Paris have no doubt noticed. The entr'actes in musical programmes have shown a tendency to grow inordinately long while the virtues of this or that product of household use are being extolled.

The Proposed Scheme

The proposal before the Finance Committee of the French parliament foreshadows a tax of 10 francs (1s. 8d.) on each set, with an additional 5 per cent of the value of each

valve in the set. It is hoped by this means to raise ten million francs per annum. Wireless amateurs are asking that three-quarters of this sum shall be devoted to the improvement and upkeep of stations and the providing of concerts worthy of France.

State Control

An earnest desire of the authorities to do something for wireless in France and place it on a footing comparable with what is being done in other countries is shown by the report of M. Bokanowski, Minister of Commerce and Posts and Telegraphs, outlining a plan for dividing France into wireless sections. Each of these sections will have one state-controlled wireless station.

Some of the proposed divisions already have two or more posts (Lyons, Toulouse, etc.)—not to mention Paris. Surplus stations will be suppressed. The power of these eighteen stations is to be not less than 3 kilowatts, so that crystal-set users within a radius of 30 to 35 miles, with a good aerial, may be served. Each post before being put into commission will undergo the severest tests for purity of emission.

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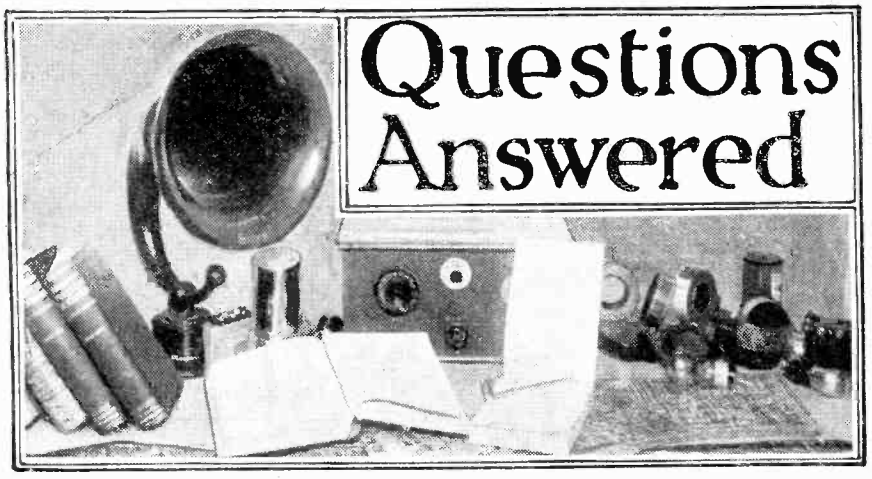

Stabilising An Old Set

T. R. P. (Luton).—"I have a four-valve set employing a tuned-anode, not neutralised. With bright-emitter valves it was perfectly stable, but since changing over to dull-emitter I have been troubled with oscillations.

"Is there any simple method of stabilising the set?"

Sets employing one stage of H.F. amplification which are inclined to be unstable may be stabilised by the addition of a potentiometer as follows:

Examine the grid of the first valve. You will see that it is connected to one side of a coil and one side of a variable condenser. The other side of these two components are joined together and connected either to earth or to the filament circuit. Disconnect the wire making this connection and, instead, still keeping the condenser joined to the coil, take a lead to the centre or moving arm of potentiometer. The remaining two contacts on the latter must now be connected across the filament terminals of the H.F. valve holder.

If the set now tends to howl or oscillate, it may be stabilised by moving the potentiometer arm towards the *positive* end. A point will be found where the set stops oscillating, and the best position for general reception is one such that the set has *just* ceased to oscillate.

H.F. Control

E. M. (Ramsgate).—"I intend to insert a filament rheostat in the positive lead of my 2 H.F. receiver. What value is suitable, bearing in mind that the resistance is to be used as a strength control?"

About 30 ohms is a good value. When purchasing the resistance, see that the wire with which it is wound is stout enough to carry the current for your two H.F. valves.

Selectivity

F. L. (Manchester) wishes to know if the 1928 "Solodyne" is sufficiently selective to cut out his local station, distant less than half a mile, in a few degrees of the control drum.

Although the "Solodyne" employs three tuned circuits and incorporates a wave-trap, it is rather doubtful whether it will cut out this powerful local transmission so easily at such a short distance. Unless the screening is very complete there is always the danger of direct "pick-up," with the result that the nearby transmission tends to spread, thus giving the impression that the set is not selective. A super-heterodyne used in conjunction with a small frame aerial is F.L.'s best solution to his problem if he wishes to listen to distant transmissions without interference from his local station.

THE TECHNICAL QUERIES DEPARTMENT

Are you in trouble with your set?

Have you any knotty little Radio problems requiring solution?
The MODERN WIRELESS Technical Queries Department has been thoroughly reorganised and is now in a position to give an unrivalled service. The aim of the department is to furnish really helpful advice in connection with any radio problem, theoretical or practical.
Full details, including the revised and, in cases, considerably reduced scale of charges, can be obtained direct from the Technical Queries Department, MODERN WIRELESS, Fleetway House, Farringdon Street, London, E.C.4.
A postcard will do: on receipt of this all the necessary literature will be sent to you free and post free, immediately. This application will place you under no obligation whatever. Every reader of MODERN WIRELESS should have these details by him. An application form is included which will enable you to ask your questions, so that we can deal with them expeditiously and with the minimum of delay. Having this form you will know exactly what information we require to have before us in order completely to solve your problems.

Pick Up Strength

L. J. M. (Newquay).—"Can you give me any idea of the strength to be expected from a reasonably sensitive pick-up?"

It is almost impossible to say anything very definite in connection with this question since the answer depends upon so many variable factors. However, as a rough indication, a moderately sensitive pick-up will give an output comparable to that given by a single-valve set worked at a distance of from eight to ten miles from the local station. In other words, if you use det. and two L.F. for loud-speaker work, the two L.F. valves used with a pick-up will give you as much volume from the gramophone as you obtain from the local station.

High-Pitched Reproduction

C. R. (Cardiff).—"I am using a three-valve set consisting of an H.F., anode-bend detector, and a transformer-coupled L.F. stage. The reproduction is rather high-pitched, but in other respects the receiver is quite satisfactory. The transformer, incidentally, is a well-known low-ratio instrument."

The reason for the high-pitched effect is probably due to the use of an anode-bend detector in conjunction with an L.F. transformer. A valve when employed as an anode rectifier has a very high impedance, and however good the transformer may be, the usual effect is for the bass notes to be "cut out," thus producing a high-pitched reproduction. Your best plan is to employ a grid-leak detector instead of the anode rectifier.

Suitable Valves

A. S. C. (Croydon).—"I have just built a straight four-valve set which consists of a neutralised H.F. stage (split-primary), a grid-leak detector, and a resistance-coupled L.F. stage followed by one transformer-coupled valve. The value of the anode resistance is 250,000 ohms. Will you please say what types of valves should be employed?"

In the H.F. socket we suggest a valve having an impedance of 20,000 ohms and an amplification factor of 20. Similar valves will also be suitable for the detector and first L.F. sockets.

In the last socket a super-power valve having an impedance of 3,000–4,000 ohms is desirable if freedom from distortion on loud signals is desired. An H.T. voltage of 120 could be used throughout.

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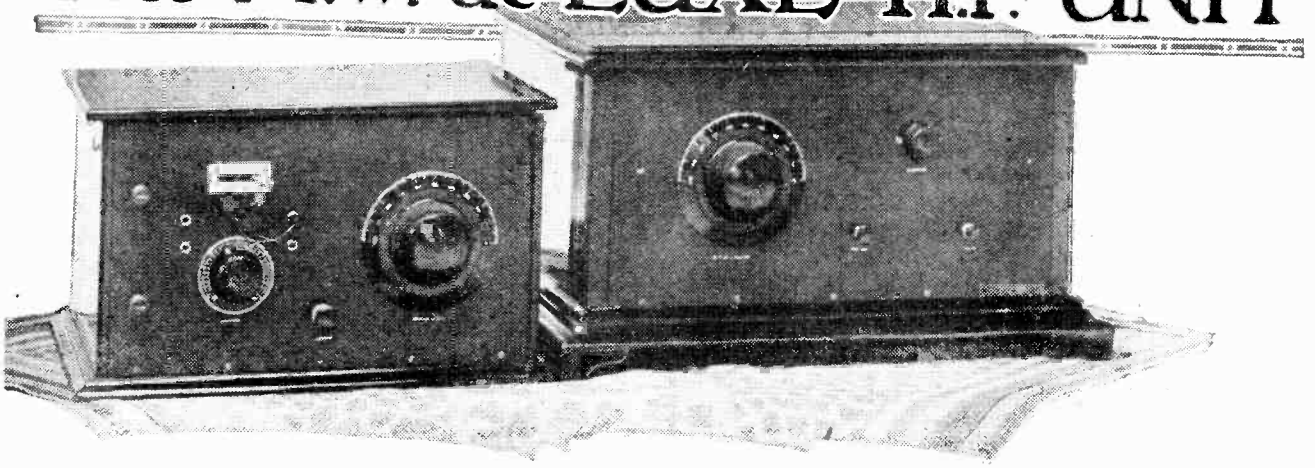
The "M.W." de LUXE H.F. UNIT



Although in operation and results this is a de luxe instrument, it is of quite an inexpensive nature. It can be coupled to practically any set (including the Mullard "Master Three," Cossor "Melody Maker," etc.), and will greatly increase its range of reception. A simple wave-change scheme obviates the necessity of coil changing.

Designed and Described by the "M.W." Research Department.

THIS unit is intended really for the enthusiastic constructor who likes to put a good deal of work into anything he builds, and so produce something a little out of the ordinary, with special gadgets and refinements.

COMPONENTS REQUIRED

- 1 Panel, 12 in. × 7 in. × $\frac{3}{16}$ or $\frac{1}{4}$ in. (Any good branded material).
- 1 Cabinet to fit and baseboard 9 in. deep (Original by Raymond, also available from Artcraft, Bond, Camco, Caxton, Makerimport, Pickett).
- 1 ·0005-mfd. slow-motion condenser (Dubilier in original. Any good make).
- 1 On-off switch (Benjamin, Igranic, Lissen, Lotus, etc.).
- 1 Double-pole change-over switch (Dubilier, Utility, etc.).
- 1 200- or 400-ohm potentiometer, panel mounting, used as series resistance in tuned circuit for volume-control purposes (Lamplugh in set. Any good make, Lissen, etc.).
- 4 Sockets and 1 wander plug (Eelex, Clix, etc.).
- 1 Standard loading coil (Burne-Jones, Paroussi, Wearite, etc.).
- 1 Plain or sprung valve holder (Ashley, Benjamin, Bowyer-Lowe, B.T.H., Burndept, Burne-Jones, Igranic, Lissen, Lotus, Marconiphone, W.B., etc.).
- 1 Baseboard neutralising condenser (Any standard make).
- 1 H.F. choke (R.I.-Varley in unit. Any standard make).
- 1 Fixed condenser, ·001 mfd. (Clarke, Dubilier, Igranic, Lissen, Mullard, T.C.C., etc.).
- Materials for shorter-wave coil (1 piece tubing, such as Paxolin, Pirtoid, Radion, etc., 3 in. diameter, 3½ in. long; and 4 oz. No. 24 D.C.C. wire), 1 tapping clip, wire, flex, etc.
- 6 Terminals and 1 terminal strip, either right across back of set in the new standard fashion, or as shown in photos.

There is nothing out-of-the-way in the basic circuit (there is really only one way to arrange such a unit for use with as many different types of sets as possible, but more of this later), but it carries a number of special devices which will be found a great convenience in working, and should make a strong appeal to the man who likes something a little "different."

Varying the Selectivity

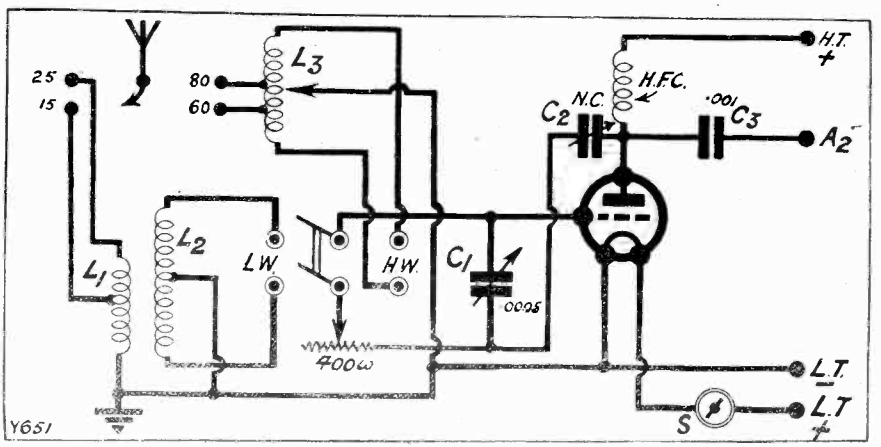
For example, in most sets and units it is necessary to open the lid and fiddle about inside to vary the degree of coupling in the aerial circuit and so adjust the selectivity, usually by shifting a clip on the tappings upon a coil, whereas here there is a neat plug-and-socket arrangement actually on the panel, so that you can make the adjustment in a moment.

This plug enables you to vary the aerial coupling on either long waves or short, by inserting it in one or other of the appropriate sets of sockets.

Quick-Change Switching

Again, there is no coil changing with this unit, a double-pole double-throw switch of the anti-capacity type completing the operation very simply. When this switch is moved, of course, you also require to make the corresponding change in the position of the aerial coupling plug, but the whole proceeding only takes a moment, and is incomparably less trouble than groping in the interior of a set to change a series of coils, some of which are pretty sure to be tight and hard to fit.

Another special feature is a particularly effective form of volume control, which is almost certain to be called for when the local station is being received. Of course, one could



This is the theoretical circuit of the unit. You will see that the wave-change switching is quite straightforward.

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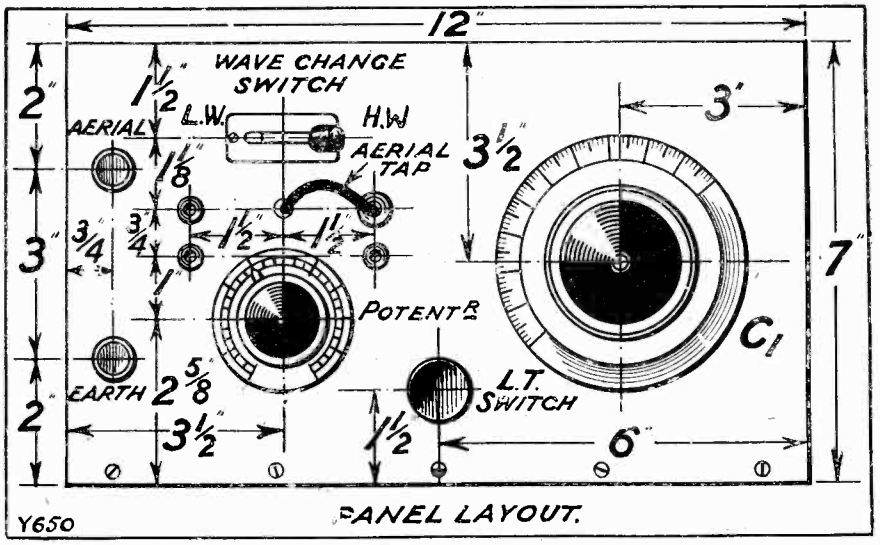
simply disconnect the H.F. unit at such times, but it is rather a nuisance to be obliged to do so, and the user is far more likely to find that not merely is it easier to leave the unit in place, but also preferable in the sense that the volume control enables him to adjust the strength of signals to exactly the desired figure with great nicety.

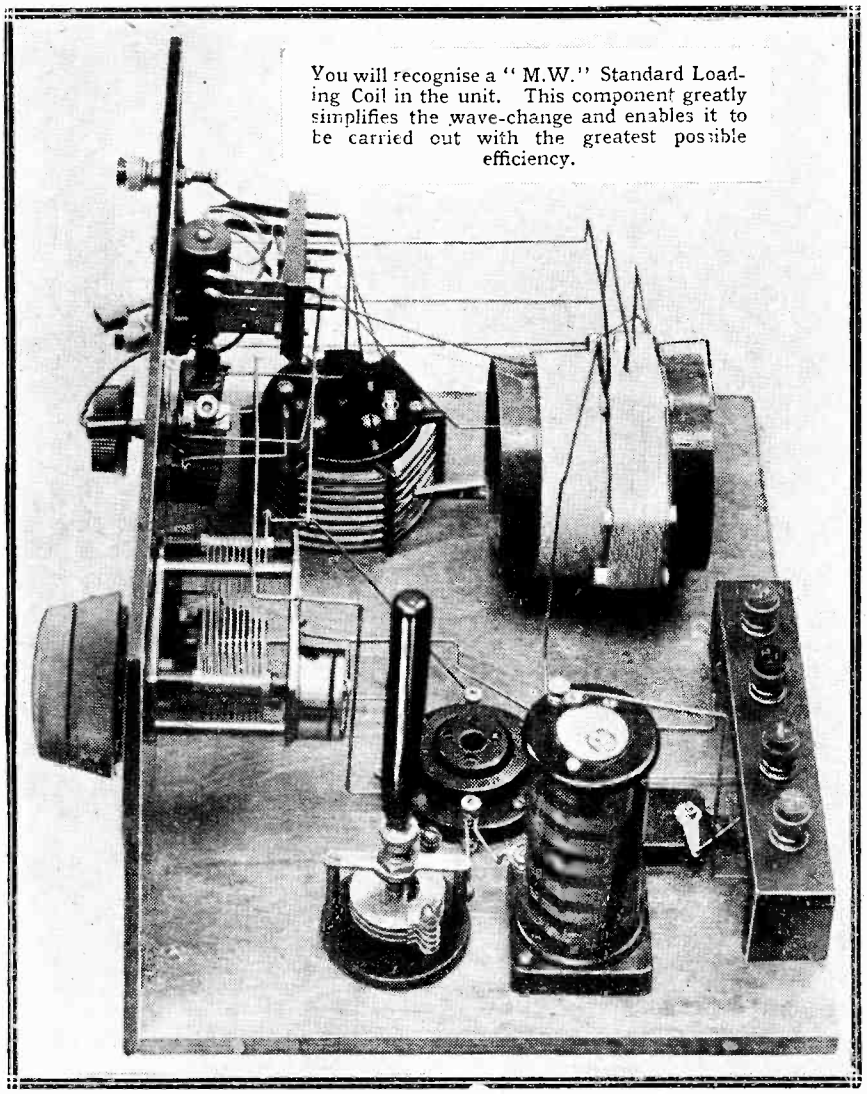
This is a great asset if you are keen on high-quality reproduction from the loud speaker, since it gives you the chance to adjust the volume with care to just the right point, whereat the signals are as loud as is safe without starting to overload the last valve.



Quality on the Local

The volume control chosen for this unit is one which has been found to be extremely valuable from the quality point of view, namely, a series resistance in the tuned-grid circuit of the H.F. valve. The insertion of resistance here has the effect of flattening out the tuning very broadly so that there is no tendency to cut off the side-bands, and so that any slight reactive tendencies resulting from imperfect neutralising are completely smothered. The value of this resistance will vary considerably in different cases, according to the total number of valves and other factors, and may lie between 10 ohms and 50 ohms, or even more.

In order to make certain of rendering the unit as widely useful as possible the resistance chosen is actually a potentiometer, connected up so that it acts merely as a variable resistance, i.e. with one end of the resistance element left blank. This can be of either 200 or 400 ohms, and will give an ample range of control.



You will recognise a "M.W." Standard Loading Coil in the unit. This component greatly simplifies the wave-change and enables it to be carried out with the greatest possible efficiency.

A Potentiometer Hint

It should always, of course, be placed at the "all out" position for distant reception, and it is advised that you should carefully examine the potentiometer you are going to use, and see whether in this position all the turns of the resistance are really cut out. It is quite likely that you will find that a few turns at the end are left in circuit, and this state of affairs must be remedied. The simplest cure is to take your soldering iron and run a little solder over the last few turns at the end and so short them all together.

The circuit, it has already been mentioned, is quite an ordinary one, and is actually the same as that used in the "M.W. Station-Getter" recently. It consists of the usual aerial coupling arrangements (inductive on the shorter waves and auto on the long), a split-secondary circuit for neutralising, and parallel-feed output to the set which is to follow. This latter arrangement is practically the only one which can be more or less guaranteed to suit almost every set with which the unit may be used, and moreover to do so without any alterations inside the set itself.

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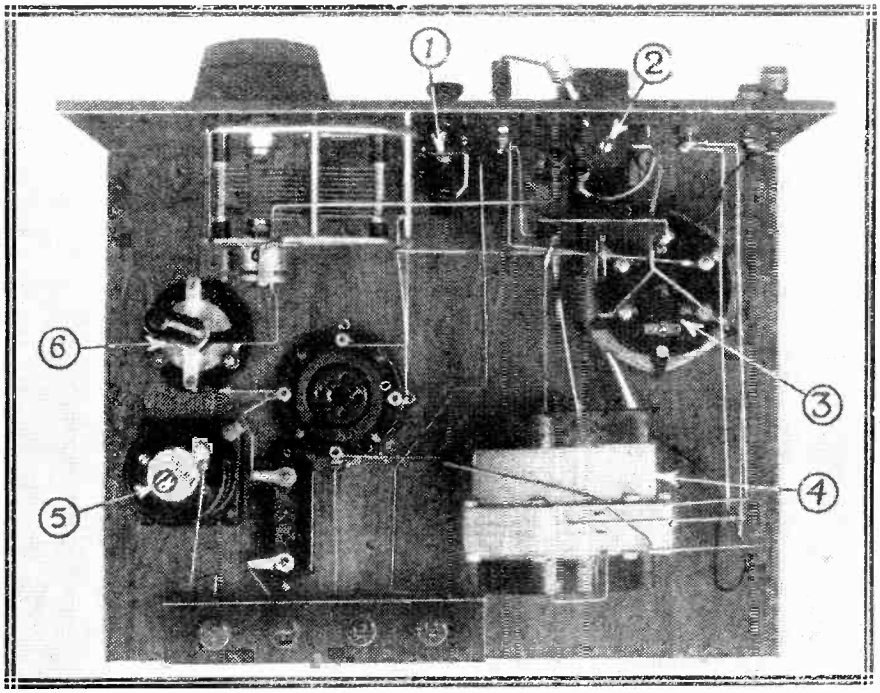


Check your components by this photo. (1) The "on-off" switch. (2) The wave-change switch. (3) The "M.W." standard loading coil. (4) The short-wave coil unit. (5) The H.F. choke. (6) The neutralising condenser.

True, there are one or two types of sets in which alterations must be made if proper results are to be obtained, but this must be done whatever kind of unit is employed. These sets are mainly of the "Det. and L.F." variety, where the coupling to the aerial circuit is very weak, or where no proper provision is made to keep H.F. currents out of the L.F. circuits.

Good Results on Test

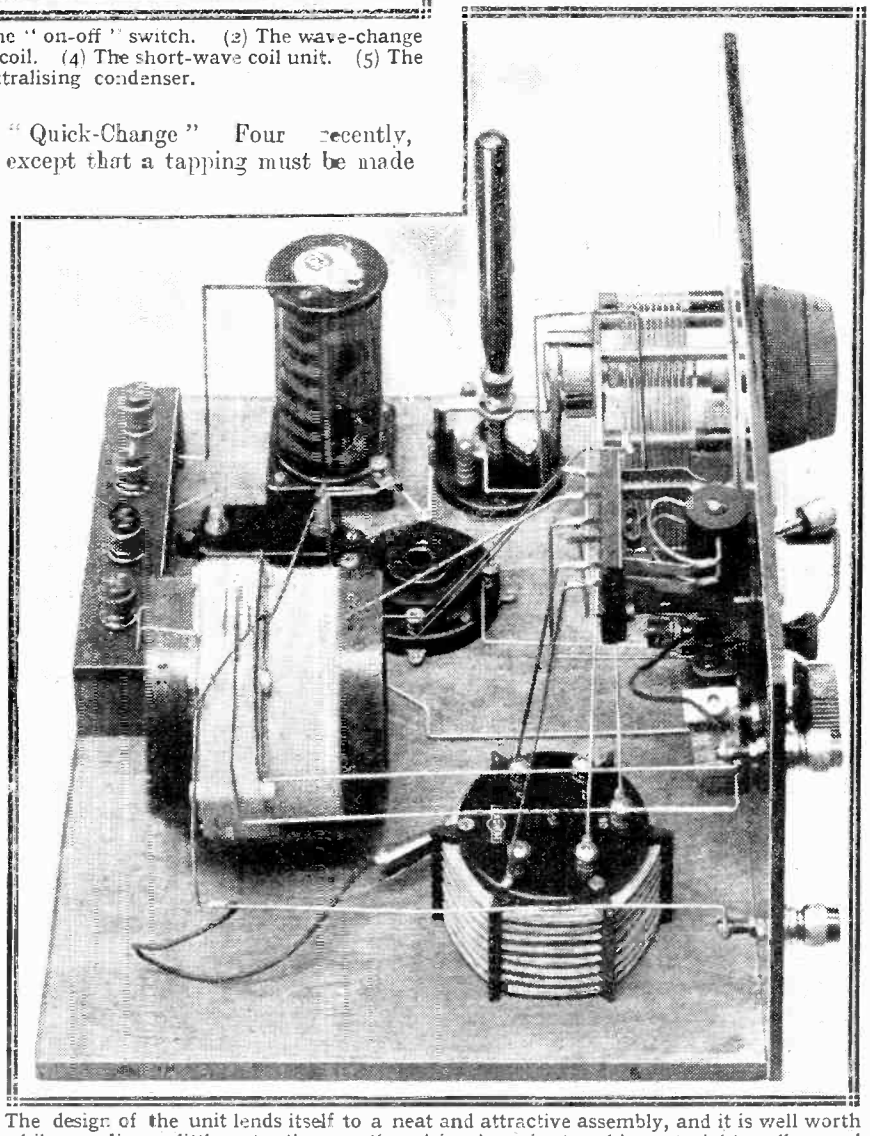
These are rather exceptional cases, however, and we can scarcely go into details here. In the vast majority of cases no such difficulties will be met with. On all the sets with which the present unit was tested, for example, a good step-up in signal strength was obtained, with a decided improvement in selectivity.

Elaborate "how to make" instructions will neither be needed nor desired by the constructor who is likely to build this unit, and, indeed, the wiring diagram, list of parts and photos will probably be all that he will need with the single exception of the coil specifications. Of these, the long-wave one is simply a standard "M.W." loading coil, which it is advised you should obtain ready-made, since it is not expensive but is necessarily rather tedious to wind.

Avoiding Coil Winding

The other coil is also one which you can buy ready-made quite cheaply. It is exactly the same coil as that specified for the aerial circuit of the "Quick-Change" Four recently, except that a tapping must be made roughly at the centre of the secondary winding. This is quite easily done if you count 30 turns along from one end, and then prise up the selected turn carefully with the blade of a penknife, scrape it bare and solder a short length of wire thereto.

The coil is quite an easy one to wind, and the following details will show how it is done. The former is 3 in. in diameter and $3\frac{1}{2}$ in. long, of any good material such as Paxolin, Pirtoid, Radion, etc. The secondary consists of 60 turns of No. 21 D.C.C. wire with a centre tap. The primary is placed over this in the position shown, and separated from it by means of about six pieces of wooden rod, ebonite strip, etc., about $\frac{1}{4}$ in. in diameter. This winding consists of 25 turns of the same wire, in the same direction as the secondary, and a tapping is to be made at the 15th turn. (On the original coil taps



The design of the unit lends itself to a neat and attractive assembly, and it is well worth while spending a little extra time on the wiring in order to achieve straight, well-spaced leads and firm, reliable connections.

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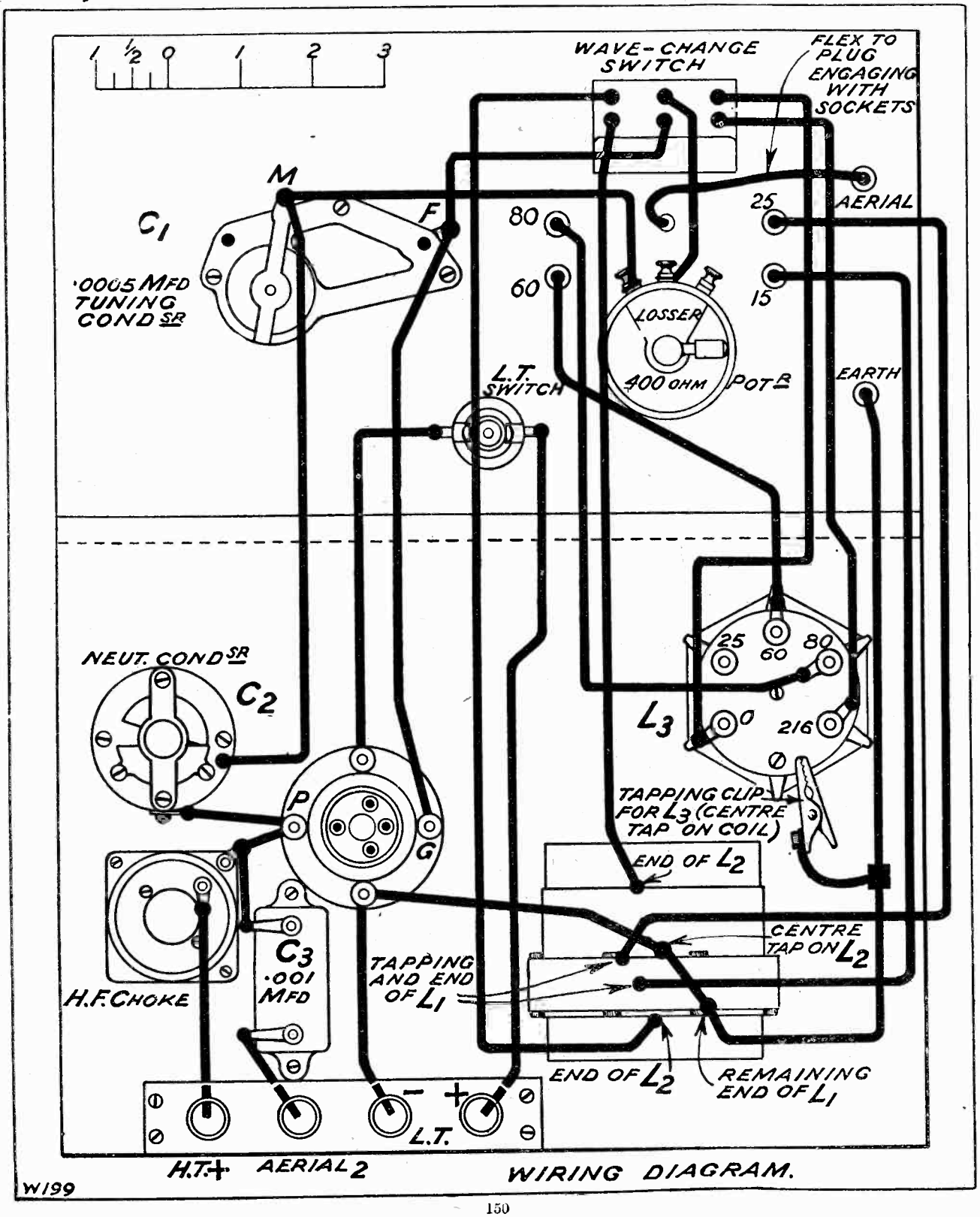
were also made at 10 and 20, but these are not used in the present instance.)

A few practical notes on the use of the unit must be given, and then the constructor can be left to carry on. First, observe that when the unit is employed the earth lead should be connected to the appropriate terminal thereon, and *not* to its old position on the set. Next, note that there is no H.T. negative terminal on the unit; this is not the result of forgetfulness on the designer's part, but simply means that no connection is to be made between the unit and the batteries other than these: H.T. +, L.T. +, and L.T. —.

The output terminal, of course, is that marked "Aerial 2," and this goes to the old aerial terminal on your set. Another point: the centre tap on L_3 is easily located by eye, the turn is then scraped bare and the clip attached.

A few suitable valves are these: D.E.L. 610, Cossor 610 H.F., P.M.5X, 6075 H.F., etc.



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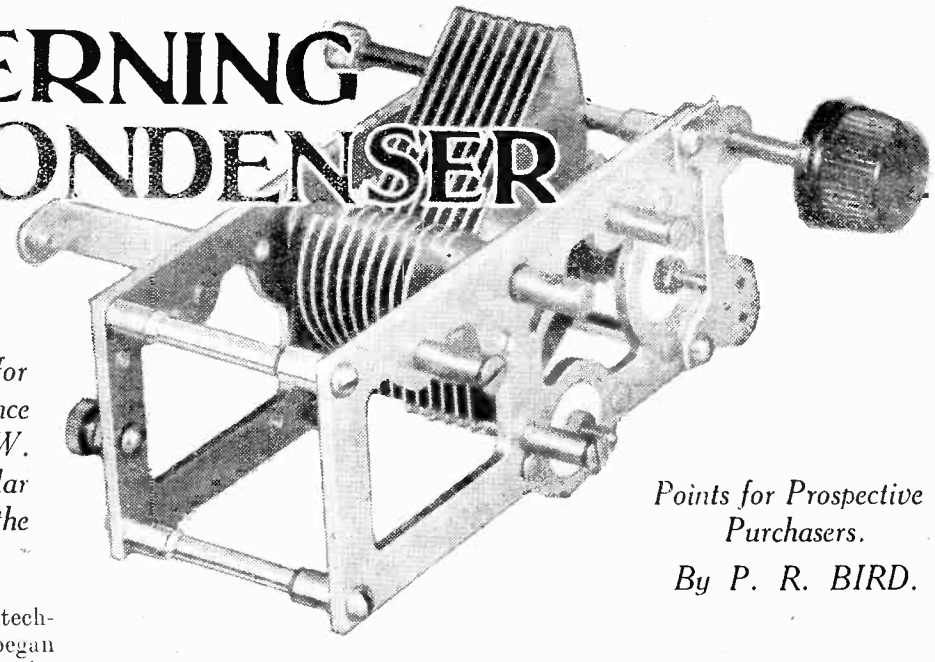
CONCERNING THE CONDENSER



What is the best type for tuning?—What is the difference between S.L.F. and S.L.W. types?—These and similar questions are answered in the article below.

Points for Prospective Purchasers.

By P. R. BIRD.

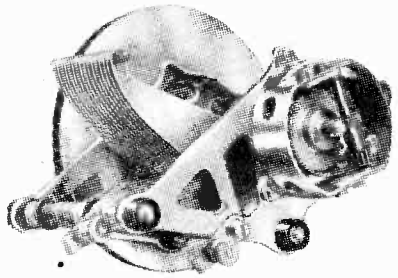
THE rapid advance in radio technique since broadcasting began is well illustrated by the changes which have taken place in the condenser. Twenty years ago a condenser was a crude and clumsy affair, and its only really remarkable feature was the exorbitant price one was asked to pay for it. Since then popular interest in broadcasting has demanded the design of more and better condensers, so that nowadays purchasers are puzzled by the wide choice offered them.

The Various Types

The variety available—especially of variable condensers—is quite amazing, and customers are often dubious concerning the merits of the various "S.L.F.," "S.L.C.," and other types. What is the real difference between all the various kinds of variable condensers?

The best way to approach the condenser question is to consider what the ideal condenser should be like. For instance, it is obvious that the variable condenser gets more twisting and turning, moving and altering, than any other component in the set. So the ideal condenser must be robust in order to stand up to the constant strain.

This movement, too, involves the interesting side-problem of how to make good contact to the moving plates. All sorts of methods have been tried in efforts to obtain perfection, and the most popular form of



In this example of a modern condenser, note the "skeleton" framework, and the elaborate provision for smooth mechanical movement of the plates.

connection is the "pigtail," which ensures an absolutely constant contact in all positions of the vanes with no difference developing due to wear and tear.

Dial Difficulties

That the dial of the condenser should fix firmly to the moving plates and not slip round the spindle on its own will be insisted upon as essential by anyone who has had trouble from this wicked little weakness. And this necessity for the satisfactory setting of the dial calls attention to the two-fold task of the variable condenser.

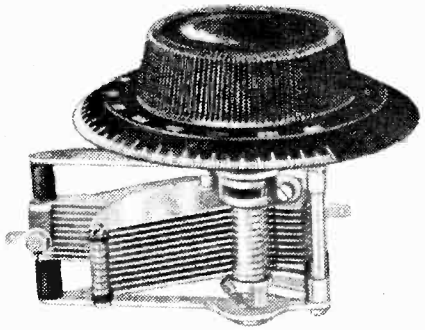
The mechanical virtue of robustness and the electrical virtue of good contact are obvious necessities of all variable condensers; but the relation between the movement of the dial and the interleaving of the vanes of a condenser is not so obvious. It is in this connection that the letters S.L.F., S.L.C., etc., occur, to differentiate between the various types.

Suppose that we have a dial marked from 0 to 180 degrees locked fast to the spindle of a variable condenser. What exactly do we do by turning the dial from one position to another?

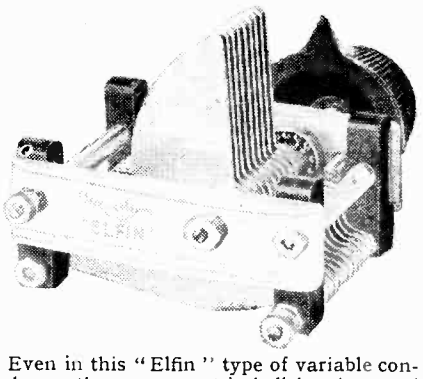
A condenser-dial adjustment involves two distinct operations. At the front of the panel the setting of the dial gives a visual indication by which adjustments can be made repeated. And naturally, for convenience sake, these dial divisions are equal ones.

The Corresponding Capacity

On a dial marked 0 to 180, 0 indicates zero, 180 the maximum, and exactly half-way round is the half-way figure, 90. One-third of the way round we find 60, which is one-third of 180; the figures always corresponding with the dial movement.



A typical example in which the fixed plates are well air-spaced from the frame, and the long, tapering, moving plates are "bound" at their ends.



Even in this "Elfin" type of variable condenser the movement is ball-bearing, and the framework is of a skeleton type.

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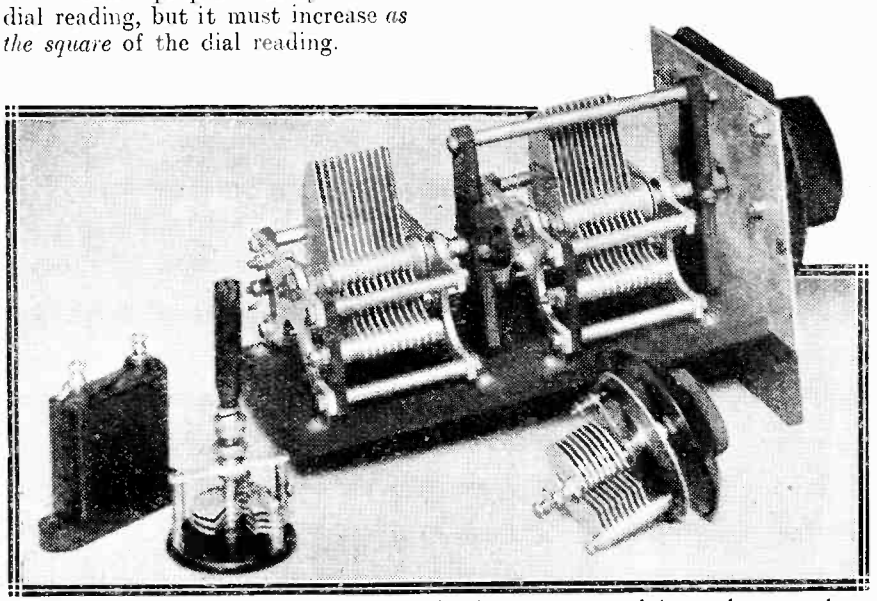
Behind the panel, if the moving plates are of semi-circular shape, at 0 the capacity of the condenser is at its minimum, at 180 at its maximum; 90 on the dial will give a half-way division, 60 a one-third division, and so on.

Such a condenser is called a straight-line-capacity condenser (S.L.C.), its capacity increasing smoothly as the dial reading is increased. The important thing to note is that to cover a wave-band smoothly we do *not* want a proportionate increase in capacity. For wave-length does not alter as capacity alters, but as the product of capacity and inductance.

Coil Complications

The coil across which the condenser is connected supplies inductance, and as the inductance of the coil is fixed, all the wave-length changing in the circuit has to be done by the variable capacity. So to give a smooth increase in wave-length the capacity must *not* increase proportionately to the dial reading, but it must increase *as the square* of the dial reading.



Metal end-plates which screen the operating dial from the vanes of the condenser, and so prevent "hand-capacity" effects, are a feature of modern tuning and reaction condensers. Dual or "ganged" condensers are another modern development illustrated in this group of representative condensers.

Taking the dial readings at four and eight, for instance, the *dial* at the front of the panel takes a straightforward view that four is half of eight, and, therefore, will be found half-way to eight.

For smooth wave-length alteration the capacity takes an entirely different view of affairs. At four the capacity takes the view of four *squared* (i.e. sixteen), at eight the capacity ought to be equivalent to eight squared (i.e. sixty-four). The dial reading on the front of the panel in altering from four to eight has been doubled. The capacity at the back of the panel must, by the same movement, be quadrupled.

Whilst the figures on the dial must be proportionate to the distance it is moved, for smooth wave-length alteration the increase in capacity must be proportionate to the *square* of the movement.

There are several practical ways of increasing the capacity, slowly at first, and then more, and then much more as the square of the distance gets greater and greater.

A Further Factor

When a designer has found the correct shape for the plates so that they give a straight-line wave-length effect (S.L.W.) as the dial reading is increased, one might imagine that the ideal condenser has been found at last. Not so! For if you consult a list of broadcasting stations in Europe you will find that they are not placed as one might expect, at equal distances from each other on the wave-length scale, but that the lower the wave-length the closer the stations are crowded!

There is a technical reason for this, of course, but all that we need notice at the moment is that whatever coil is used, a straight-line wave-length condenser will cover more station wave-lengths between 0 and 90 on the dial than it will between 90 and 180 on the dial, for the simple reason that stations can be crowded together on short waves, but the longer the wave-lengths the more they must be spread out.

Not wave-length, but frequency-separation is the deciding factor, so that the search for the ideal tuning condenser has gone beyond the stage of smooth wave-length change, right into the stage of frequency separation. In discovering plates to fulfil these conditions, the designers have evolved a straight-line-frequency condenser (S.L.F.).

Initial Increases

We have said that in the straight-line wave-length condenser (S.L.W.), the capacity does not increase at the same rate as the dial reading, but starts slowly and increases at a faster and faster rate when the readings are increased. In the straight-line-*frequency* (S.L.F.) condenser this process is, as it were, exaggerated.

The initial increases are not merely slow, but are very slow. The final building-up of capacity near the maximum is not merely fast, but is very fast. And generally to obtain this effect the moving plates of the S.L.F. condenser are very long and tapering, so that such a condenser requires a lot of room behind the panel.

In the opinion of many constructors, the long tapering vanes of the S.L.F. condenser are a disadvantage which outweighs the advantages of this particular design. So that very often a compromise is made between the S.L.W. and the S.L.F. types of condenser to which the terms "Straight Line Tuning" (S.L.T.) condenser is often applied. But in all the various types the aim has been to balance the two functions of the condenser to the best advantage; to bring the front-of-panel dial readings into step with that totally different conditions of the back-of-panel tuning adjustment.

Skeleton Construction

Apart from the rate of interleaving of the plates which settles the capacity of the tuning condenser at various dial readings, there are many important considerations for the designer to watch.

At first, in the search for robustness, condenser end-plates and other metal parts incidental to the construction were solidly and strongly constructed. Later, experience with short-wave reception proved that unnecessary metal in the vicinity of the active area of plates gave rise to very much the same kind of losses as shielding which is placed too close to tuning coils. It is for this reason that the light skeleton method of strength without unnecessary substance has been employed.

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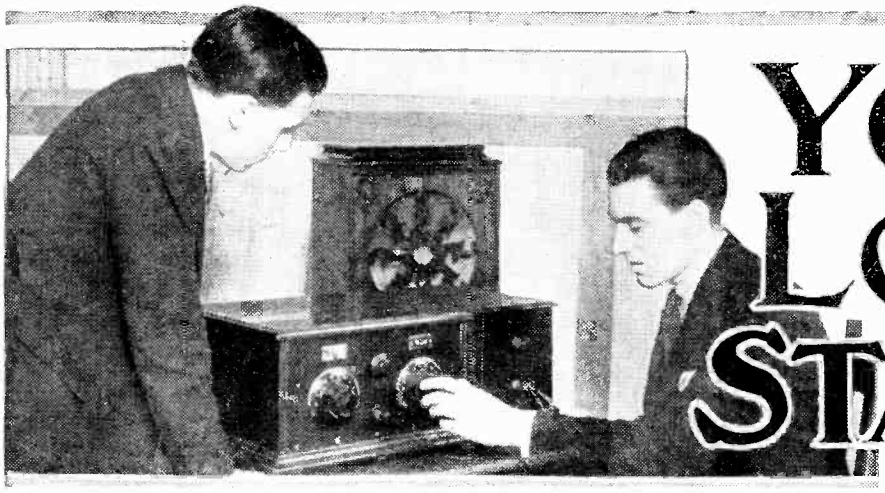


YOUR LOCAL STATION

Those who have listened with interest to Capt. Eckersley's Talks will enjoy this article which deals with that most important subject, the strength of reception.

By Dr. J. H. T. ROBERTS, F.Inst.P.

WHATEVER may be the transmission-strength of the station you are receiving, what really concerns you is the strength of the waves by the time they arrive at your aerial, just as a shareholder in a company is not concerned with the total amount of money distributed by way of dividends, but only with the amount which accrues to him in respect of his shareholding.

"Attenuation" Simply Described

Although you expect the reception to become weaker and weaker as you get farther away from the station, you might at first think that the weakening effect (scientifically known as "attenuation") would be the same in all directions, so that all listeners at a distance of, say, 50 miles from 2 L O, would receive radiation from that station of the same strength as each other, whilst listeners situated anywhere on a circle of 100 miles radius of 2 L O would receive radiation of the same strength as each other, although, of course, weaker than that received at 50 miles.

It is probable that in absolutely uniform country or, better still, in the centre of the ocean, waves would be attenuated uniformly in all directions, unless there were some peculiarity about the transmitting aerial which rendered it "directive." But in the case of a broadcast aerial, such as that at 2 L O, the design is arranged so that the radiation, so far as possible, shall be uniform in all horizontal directions.

Therefore, we can hardly expect variations in the rate of weakening of the waves in different directions to be due to peculiarities of the radiating aerial system, and, if the rate of falling-off in strength of the waves is actually found to be different in different directions of the compass, we must presume that the effect is due to differences in the nature of the country traversed by the waves and to various other causes, which may be mentioned later.

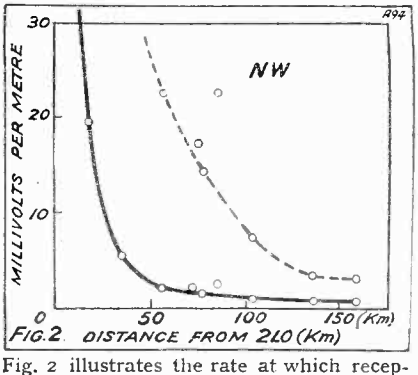
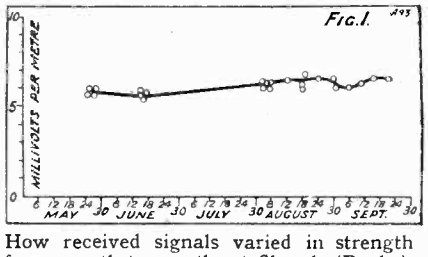


Fig. 2 illustrates the rate at which reception falls off, as measured in a direction N W. of 2 L O.



How received signals varied in strength from month to month at Slough (Bucks).

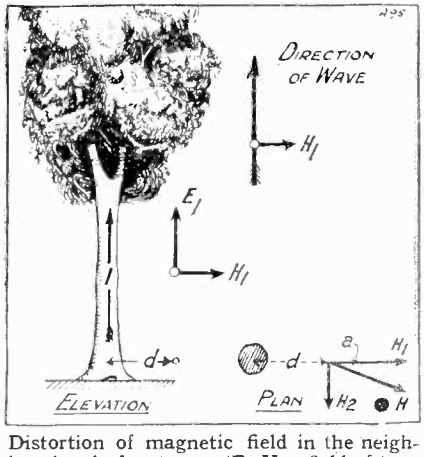
Interesting Experiments

Experiments have been carried out by Mr. R. H. Barfield, the well-known engineer, and have lately been described before the Institution of Electrical Engineers.

Before describing the actual methods used to investigate the falling-off in signal strength in different directions, perhaps I ought to say that the waves travel away from the transmitting or broadcast station in two principal ways, namely (1) in association with the ground, and (2) *via* the upper atmosphere. The energy travelling in association with the ground is sometimes called the "ground ray," and may be expected to be affected by the nature of the ground, such as presence of trees, hills, metallic-ore deposits, rivers, lakes, and so on.

The "Upper" Waves

The waves which travel by the upper atmosphere will be affected by the earth's surface in a different way, and, in general, to a much smaller extent, and the case of such waves is excluded from the present discussion; this is partly for the reasons given and partly because the experiments were carried out in daytime, satisfactory evidence being obtained independently to show that, within the distance ranges employed, there was no appreciable reflection



Distortion of magnetic field in the neighbourhood of a tree. (E_1 H_1—field of tree. H_2—field due to tree. H—resultant field.)

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from the upper atmosphere. In this way it was ascertained that for all practical purposes only the intensity of the ground ray was actually being investigated.

The theory governing the surface attenuation or weakening of wireless waves has been very thoroughly investigated by Sommerfeld, and the weakening has been found to depend upon the earth's conductivity and dielectric constant.

Special portable receiving apparatus was used, designed so that its sensitivity was reasonably constant. The sensitivity could, in any case, be frequently checked and adjusted if necessary. This portable receiver latter being specially adapted to maintain constant transmission strength.

The relative values of signal strength as measured on the portable apparatus were converted to absolute values in millivolts per metre.

A Check Station

Now it is clear that there would be little point in measuring the signal strength at various places (the tests extending over a period of several months) unless some careful check were kept upon the constancy of the transmission strength of 2 L O. The investigators therefore set up apparatus at the Radio Research Station at Slough (which has since been

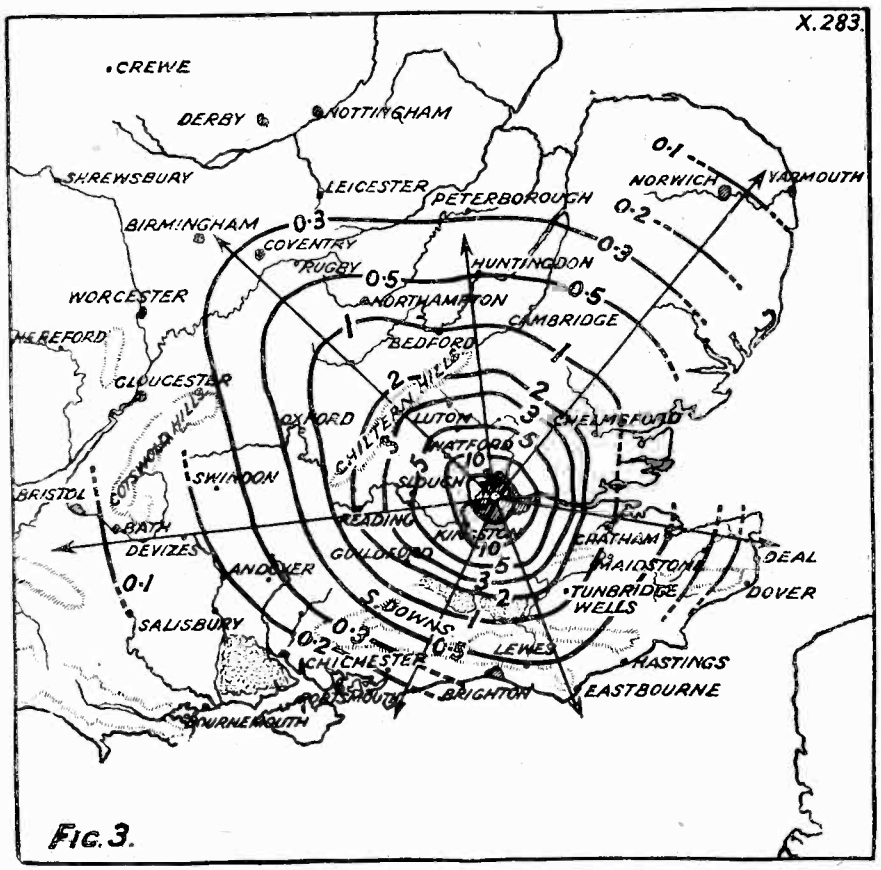

FIG. 3.

The contour lines join places of equal signal strength, showing that 2 L O was best received in a north-westerly direction.

was taken to various places at different distances from 2 L O, and in different directions, and by its aid the actual intensity of the radiation from 2 L O could be measured with considerable accuracy. A light, portable aerial, 20 ft. high and 50 ft. long, was used in conjunction with a counterpoise.

Signal Strength Measurements

As a further check, the received energy from 2 L O was continually compared with the radiation from a local small-power transmitter, the destroyed by fire) whereby they could make check measurements of the signal strength received at that location from 2 L O.

If there had been any appreciable variation in the signal strength at this fixed place, the chart would have enabled them to make the necessary allowance in the strengths observed with the portable apparatus at various locations. But, as it happened, the strength of the waves received from 2 L O at Slough was remarkably constant, and in Fig. 1 is given a chart which shows how small was the variation in strength of the 2 L O transmitter from May to September, one of the periods in question.

It is interesting to notice the actual rate of attenuation as shown in Fig. 2 for a N.W. direction from 2 L O. You will see that at a distance of 100 kilometres from the transmitter the intensity has fallen to a very small fraction of the value which it has at a distance of 5 kilometres.

Probably the most interesting view of the results of all these tests, however, is gained from the contour map shown in Fig. 3. The contour lines surrounding 2 L O are arranged in such a way that all places on any contour lines are places of equal signal strength.

Field-Strength Variations

It is easy to see from these contour lines that in a north-westerly direction the wireless waves from the London station are weakened *less* rapidly than in some other directions, whilst in a southerly direction they are weakened *most* rapidly. The map shows that the field-strength within a radius of 6 or 7 miles from the transmitter is 30 millivolts per metre, whilst in the Greater London suburban area the field-strength is about 10 millivolts per metre.

As the distance from the transmitter increases, the field strength continues to fall until at places such as Bedford, Chatham, Tunbridge Wells, and Oxford only 1 millivolt per metre strength was registered. The measurements were, however, continued to places such as Peterborough, Yarmouth, Deal, Chichester, and Bristol, at which places the field strength from 2 L O had fallen to $\frac{1}{5}$th or $\frac{1}{10}$th of a millivolt per metre.

Absorption By Trees

In his paper, Mr. Barfield suggests that the general nature of his results can be explained as being due largely to the well-wooded nature of the English countryside. In order to investigate the feasibility of this explanation, he worked out an experimental method for measuring the energy-absorbing properties of an individual tree which, of course, acts as a "sink" for the energy in the field, just as an aerial does. From the results for a single tree he could readily calculate the total energy-absorbing effect of a tree-covered area.

The general conclusion arrived at is that the difference in absorption in different directions is due mainly to the distribution of trees, the greatest absorption corresponding to the most wooded regions.

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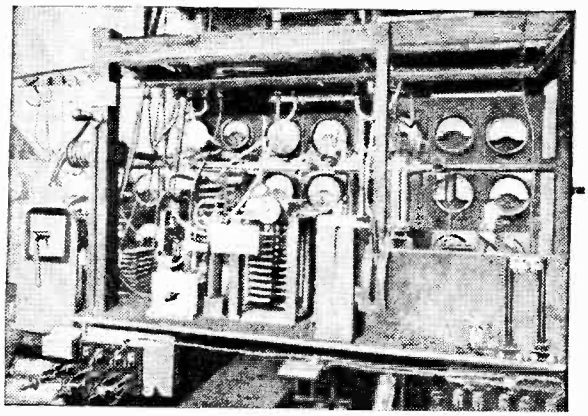

The PCJJ SHORT-WAVER

Full details of the latest transmitting gear at the well-known Eindhoven short-wave station, a pioneer in the higher frequencies which still holds a leading place among "D.X." transmitters.

From a Special Correspondent.

In 1925 it was felt that radio telephony over large ranges and on short waves was possible. The question which could not be solved was whether reliable communication could be obtained. This was doubted by interested parties who based their opinion on the fact that connections which have been established between amateurs in England and U,S.A. were unreliable. The output used for their transmissions, however, was not greater than 1 kw.

Hardly Any Fading

Nevertheless, tests on short waves from 25 to 35 metres have given excellent results for radio telegraphy over large ranges and fading hardly occurred (at least not so often as on long waves). Moreover, a wave-length of 30 metres enables communication over the greater part of the day and night. It was assumed that once regular telegraphic communication had been established with a power of $\frac{1}{4}$ to $\frac{1}{2}$ kw., it would ultimately be possible to transmit telephony on a power of 10 kw.

In principle it is sufficient for telephony transmission to cause variations of the amplitude of the emitted high-frequency oscillations, e.g. by variation of the grid voltage or the anode voltage of the transmitting valves, by means of a microphone and a suitable amplifier. In the course of experiments it was proved that the voltage variations in their turn cause fluctuations in frequency.

Crystal Control

This frequency modulation can be larger than the real modulation by amplitude variation. Distortion caused thus is so great that on short waves especially speech becomes unintelligible. Therefore, experiments were conducted with a view to maintaining a constant frequency, independent of the voltage.

In the U.S.A. a piezo-electrical crystal was used to obtain a constant frequency, especially on short waves. Such a crystal oscillates with a very high and constant frequency, thus acting as a kind of electro-mechanical tuning-fork. In this way a high-frequency energy of some watts, but with a very constant frequency, can be obtained.

This energy is amplified by means of valves, the great difficulty being to avoid reaction between the single stages of the amplifier. This undesired reaction has a very bad influence; it causes unreliable working and can spoil the transmitter. In many cases screening of the amplifying stages by surrounding earthed metal screen is insufficient.

A satisfactory solution of the problem is to transform the frequency of the stages following one another.

The anode circuit of the transmitting valve is tuned to the first or second harmonic of the grid circuit. The oscillations obtained in the anode circuit, under these circumstances, are very powerful, while the difference in tuning of the two circuits is large enough to avoid reaction. This method of producing oscillations can be compared to a pendulum kept in motion by a shock after every second or third swing.

The First Experiments

On June 25th, 1926, the first experiments were made with a transmitter having a small output, and operating on a wave-length of 90·56 metres. This transmitter was the first radio telephonic short-wave transmitter in Europe controlled by a

Her Majesty the Queen and the Princess of the Netherlands broadcasting a message to Dutch Colonies via the Philips short-wave station which was operating on 30 metres on this auspicious and historic occasion.

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piezo-electrical crystal. The transmissions of this station, which had an output of 300 watts, were received very well in Germany and Austria. The purity of the transmission left nothing to be desired.

A Notable Broadcast

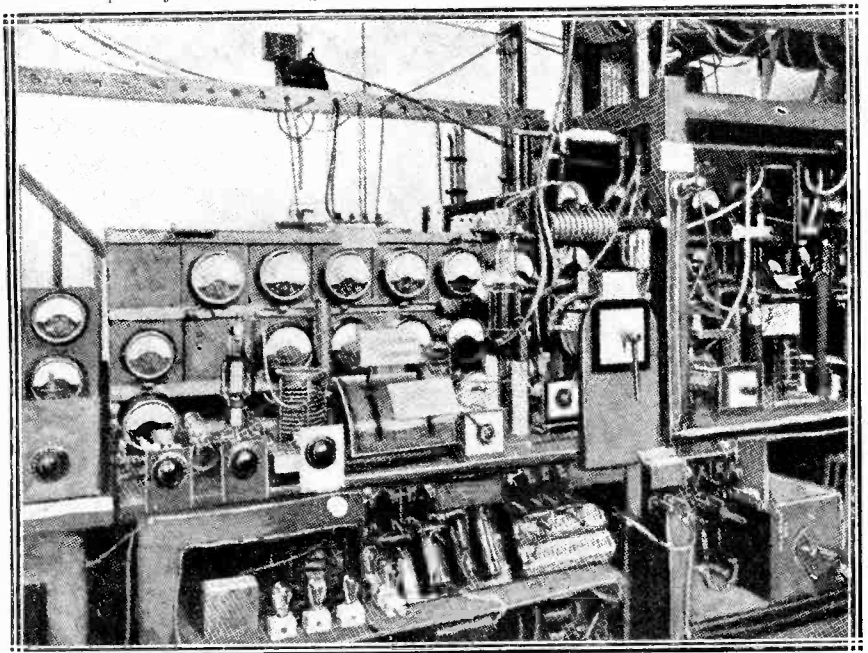
In March, 1927, the transmitter was completed, being opened on April 28th, 1927, by Mr. A. F. Philips. On May 14th, 1927, the Minister of the Colonies addressed the Dutch Colonies through the Philips transmitter. On May 31st and June 1st, 1927, Her Majesty the Queen and Her Royal Highness Princess Juliana visited Philips Short-Wave Station and, via the microphone, they addressed their subjects in the Dutch East and West Indies.

The frequency of the Philips transmitter, which has now been transferred to Hilversum, is kept constant by means of a quartz crystal, which has a resonance frequency of 1,656,000 periods per second, which corresponds to a wave-length of approximately 181·06 metres. The transmitting valve, T.B. 04/10, which is controlled by this crystal, is followed by six amplification stages, one of which is intended to double the frequency and another to triple this new frequency.

Seven-Stage Amplifier

The frequency finally obtained in this way corresponds to a wave-length of about 30·2 metres. In total the amplifier has seven stages, of which the last two are water-cooled transmitting valves of type T.A. 12/20,000 K. Modulation takes place in the anode circuit of the last water-cooled amplifying valve. The modulator valves used, of type M.A. 12/15,000, are also water-cooled and have a total output of 30 kw. Preceding these valves are two modulator valves, type T.B. 2/250, air-cooled, with a total output of 400 watts.

In one of the groups of units there are three stages, of which the centre stage is intended to triple the frequency, with the result that the final wave-length is approximately 30·2 metres. Both first stages contain valves of type T.B. 2/250; and the third stage is fitted with a water-cooled valve, type T.A. 12/10,000 K.



Some idea of the modern and well-arranged gear at the PCJJ station can be gained from this photo which shows only a small section of the apparatus used. You will note that no less than fifteen meters are visible.

The high-frequency output amounts to approximately 3 kw., with a wave-length of 30·2 metres.

Some Power Details

The output of the last water-cooled amplifying valve, T.A. 12/20,000 K., amounts to approximately 20–25 kw. With an efficiency of approximately 70 per cent the power in the aerial is approximately 15 kw. The aerial current has a value of approximately 8 amps. The output of the water-cooled transmitting valve in the anode circuit is derived from a rectifying installation, which contains six water-cooled rectifying valves, type D.A. 120/2000, with a corresponding smoothing system and speech choke.

The aerial consists of a single phosphor-bronze wire connected to the top of a wooden mast in the courtyard of the laboratory.

The resistance of the water-column in the rubber tubes, used for the water-cooling system, is so high that the electrical loss can be completely ignored. As the output for the excitation of the first amplifying stage amounts to less than 1 watt, measures must be taken to avoid any reaction of the following stages, and especially of the last stage on the first.

Parasitic Oscillations

Considerable difficulties can be caused by a reaction of only 1/20,000.

Serious difficulties can also be caused by parasitic oscillations in ultra-high frequencies. These oscillations are mostly due to the fact that certain of the connecting wires form an oscillation circuit with the internal capacity of the valves.

This evil is to be feared, especially when several valves are connected in parallel. The dimensions of all connecting wires are kept as small as possible, which, of course, leads to a compact installation. This is in contradiction to the electrical requirements to which the apparatus must come up. Condensers especially cause difficulties of this kind.

ITEMS OF INTEREST

More than one thousand applications for radio patents were registered in this country during last year.

* * *

When overhauling an accumulator make sure that your hands are neither cut nor grazed, as sulphuric acid and lead are both poisons which should on no account be allowed to come into contact with broken skin.

* * *

It is reported that the French are building three super-power stations this year, one of which will have a power of 50 kw., and will replace the Radio-Paris station.

* * *

A new system of talking pictures is being developed by a well-known film corporation in conjunction with the Radio Corporation of America.

* * *

The Hilversum short-wave station, which at present has a power of 5 kw., has applied for permission to use four times this power in future.

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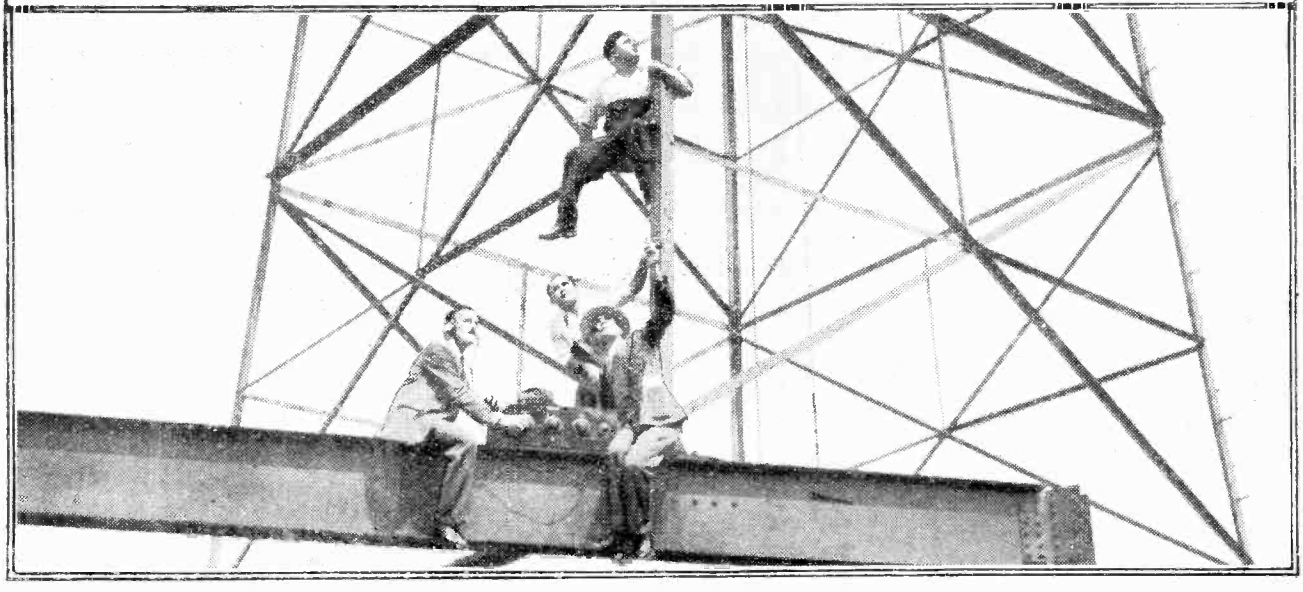
The Truth About Radio in America



This is the second and concluding article on U.S. wireless affairs written by one who is in a pre-eminent position to tackle the subject. Mr. Corbett was for four years closely associated with broadcasting in America and lately has returned to England and became once more a British listener.

By LAWRENCE W. CORBETT.

Of all the problems with which the American broadcast listener has to cope, perhaps the most intolerable in our eyes is that which results from ineffectual and unsystematic control of broadcasting by the higher authorities. It is true that the recently passed Radio Bill is a remarkable example of comprehensive legislature, but its enactment has been the subject of so much dilly-dallying and procrastination, not to mention political enmity and squabbling, that its arrival was many months too late to prevent radio broadcasting sinking to its present low level—to a condition which it will take a long time to right.

Politics!

In passing, it might be mentioned that, of the political enmity I refer to above, the main feature was an effort on the part of the opposition to prevent wireless control getting into the hands of Secretary of Commerce, Herbert Hoover. His enemies feared that such control would considerably strengthen the possibilities of his being nominated for President of the United States in the coming election.

Before studying too closely the present status of broadcasting in America, a general idea of the extent of the territories involved should be obtained. Many people do not realise the vastness of the continent, and will not comprehend the fact that the distance from an Atlantic coast city to one on the Pacific coast—the distance between New York City and San Francisco, for example—is about the same as that between London and New York.

This is the "Nerve Centre" and radio headquarters of Uncle Sam's National System of Civil Airways. From this room weather reports and other information can be transmitted. The key controls a powerful transmitter at the Arlington Naval Radio Station.

48 States!

The British Isles would be lost if they were suddenly dropped into the middle of the United States! Every State in North America—and there are forty-eight of them—is divided into as many counties as is England.

Travelling from New York to the Pacific coast we pass through vast plains, huge lakes

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of thousands of square miles in extent, mammoth forests, snow-capped mountains with rocky crags lost in the clouds, hamlets, villages, towns, and immense cities. Farms and ranches, miles off the beaten track, fringe the desert. And, as might be expected, wireless conditions and limitations differ as frequently as does the panorama. Is it any wonder then—if you fully visualise the expanse of the North American Continent—that there are more than six hundred broadcasting stations in the country?

Some Interesting Comparisons

Yet, if we compare service with population, we find that the number of American stations is altogether out of proportion to the total of English stations. In the whole of the United States there are not even four times as many people as there are in England! But there are thirty or more times as many broadcasting stations! The total area of the United States, on the other hand, is seventy

General Pershing telephoning Paris via the Transatlantic Radio Telephone.

times that of England, thus if we compare number of stations with area we find that the service *should be* the same as it is in this country. Such, however, is far from the case.

Distribution of American Stations

The distribution of stations throughout the States is as unequal as the apportionment of population. Wherever there is a centre of population there will be found a plethora of broadcasting stations. Where the country is dotted with dwellings few and far between it is dotted with broadcasting stations fewer and farther between. We find that in a city like New York, where the population is not very different in size to that of London, there are crowded thirty to forty odd stations, whereas a small middle-western town of a hundred thousand population will not boast a single broadcasting station. Thus, in spite of its many broadcasting stations, the United States, taken as a whole, is very inadequately served with wireless entertainment.

Between 550 and 1,500 kilocycles, which is the frequency band allotted for the purpose of broadcasting in America, there are less than one hundred separate wave-lengths if we allow a separation of ten kilocycles between stations. It is obvious, then, that there must be an average of six or seven broadcasting stations on each wave-length, disregarding those few exclusive wave-lengths in the band which have been handed over to Canada for some of the sixty-odd Canadian stations.

Due to the fact that some of the more powerful stations would seriously interfere if they had to share a frequency with several other stations, there are not an equal number of stations on each available wave-length. Station W E A F of New York, for example, operates on 610 kilocycles, and shares that wave-length with K G W of Portland, Oregon, only. These two stations are considerably more than two thousand miles apart; but even with such separation (geographical) listeners midway between the two stations would experience difficulty in obtaining clear reception from either one or the other should one of them wander ever so slightly from its allotted frequency.

Time Differences Reduce Interference

The power of W E A F is 50,000 watts and that of K G W is 1,000 watts. Due to the difference in time between New York City and cities in Oregon (on the Pacific coast), stations in the latter district will usually be on the air for several hours after those on the Atlantic coast have "signed off" for the night, which tends to limit interference.

It follows then that if some of the frequencies devoted to broadcasting in the States are used by only two stations (the W E A F—K G W example is only one of many), there must be others that are shared by a considerable number of stations.

Suppose we take at random the frequency 1,120 k.c., which happens to be one of the more crowded ones, we find that there are no less than *nineteen* stations operating on this frequency. Interference from heterodyning is naturally bad, for many of these lesser satellites find it inordinately impossible, so it seems, to maintain their frequencies constant, despite the frequent threats of the authorities.

Varying Powers Used

Of the nineteen stations on 1,120 k.c. we note that three are located in Newark, N.J., and only one of these three will be on the air at a time, thus reducing congestion to a certain degree. There are many other cases where the authorities have compelled stations in the same areas to operate on a time-sharing basis, so that all the six to seven hundred U.S. broadcasters are not necessarily working at the same time. The other sixteen of the nineteen referred to above are located all over the States and Canada—in Virginia, Kentucky, California, Wisconsin, Florida, Illinois, etc. Their powers vary from fifteen to one thousand watts!

Less than half of all the broadcasting stations in America use five hundred watts or more power. Some of the smaller stations operating with a broadcasting licence use only five watts, causing very little interference except to

(*Continued on page* 198.)

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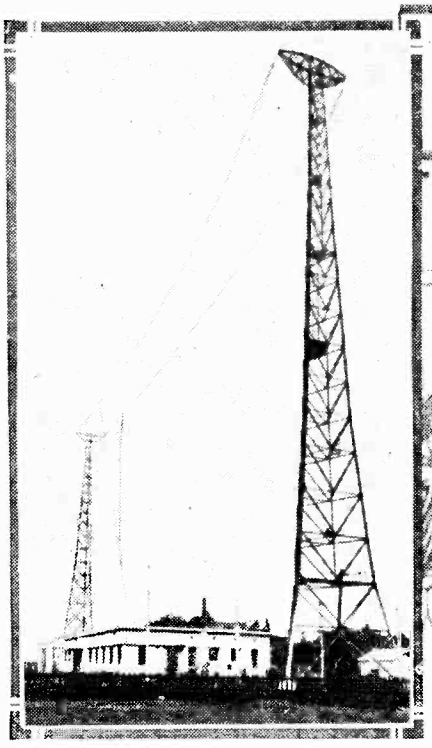
The NEW JOAK



"JOAK strikes one as being a happy call-sign for a broadcasting station. Let it be said, however, that the Japanese engineers take their 'JOAK' very seriously . . . they manage to keep themselves well abreast of the most modern developments in radio."

By Our Special Correspondent.

ALTHOUGH few (if any) individuals in this country appear to have received radio broadcast from the Land of the Rising Sun, the progress of radio in Japan is by no means at a standstill, as many of us are apt to presume. Station J O A K, of Tokyo, is well-known by name to the English amateur, and, admirable as the efforts of this pioneer Eastern station have been in the past, its present-day activities greatly overshadow its past triumphs.

A few very brief notes on what may be termed the "history" of station J O A K may be acceptable to the long-distance-reception enthusiast, for they will serve to indicate the progress of the evolution of this Far Eastern station to its most recent development.

A Japanese Broadcasting Corporation

In Tokyo there exists what is termed a *Chuo Hosokyoku*, or Central Broadcasting Bureau. This institution was organised in November, 1924, a year after the great earthquake in Japan had worked havoc among the cities of that nation. The Broadcasting Bureau operated a small station, and it was supported by the principal newspapers, banks, manufacturers, and business firms.

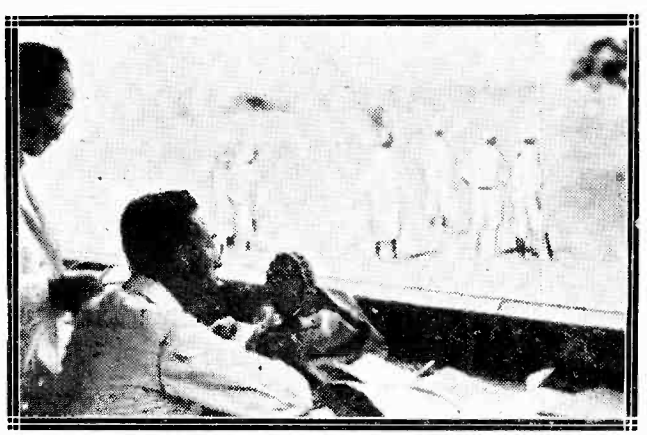
In August, 1926, a Japanese Broadcasting Corporation was formed. This body had its headquarters in Tokyo, and it erected and operated several small stations as well as the main station, J O A K, which until very recently has been situated on top of the hill Atagoyma, outside Tokyo. The Atagoyma station of J O A K has thus been successfully worked for two years.

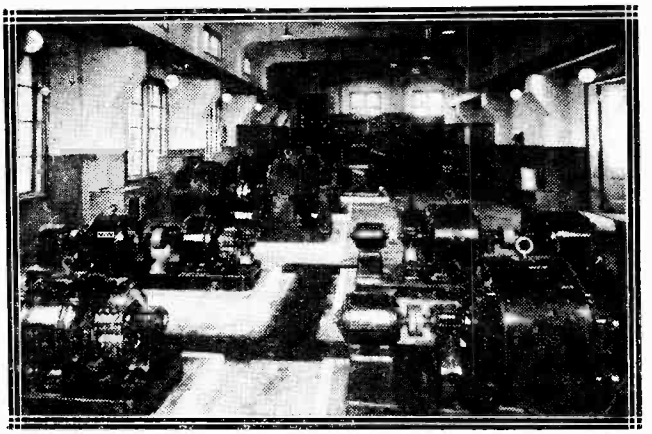
Radio developments in Japan, however, have proceeded apace, and, for obvious reasons, plans were made just one year ago for the erection of a new and more powerful station to take the place of the old one.

Luxurious Transmitting Room

The new J O A K, which was opened in May last, is now located at Shingo-mura, about ten miles north of Tokyo. Here the twin steel masts of the transmitter, each nearly 200 ft. high, tower over the countryside, and can be seen for miles around. The newly-erected and equipped station has a power of 10 kw.—more than double that of the old transmitter on the Atagoyma hill. Its present wave-length is 375 metres, but very probably this will be changed for a longer wave-length after the station has finally settled down to its routine work.

The transmitting room of the new Japanese station is quite a luxurious affair. Built in concrete, it is at once spacious, well-lighted, and probably what is more essential from the staff engineers' point of view, it is





The Japanese stations are quite up-to-date and run outside broadcasts. On the left can be seen an announcer transmitting details of a baseball match. To the right can be seen the imposing "machine" room at the new station described in the accompanying article.

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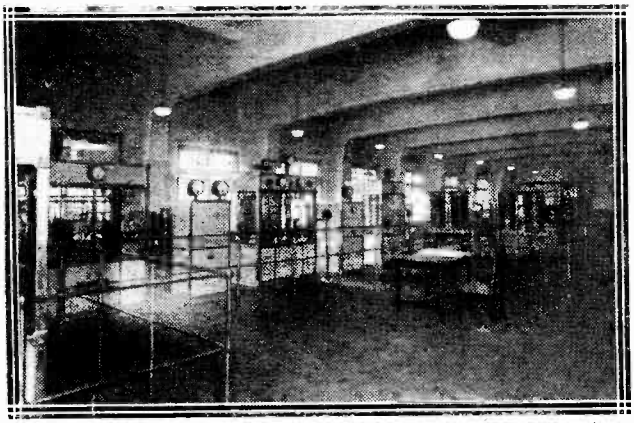
comfortable! Adjoining the main transmitting room there are workshops, experimental laboratories, each containing small-scale transmitting and receiving plant, a well-equipped power house, and a small suite of offices.

The power plant of the new station is interesting. Formally, the J O A K engineers had to take their current



The transmitting room at the Shingo-mura station. Note how well laid out are the various panels.

from the local Tokyo mains. Now, however, the main current is "home-made," if one may be allowed to use that expression.

Several sets of generating plant, each on its own massive concrete bed, have been installed, together with the necessary complement of H.T. step-up transformers, control switch-gear, and so on. A view of a portion of the generating plant, showing the large motor alternators, will be seen among the accompanying photographs. The switch-gear panels will also be seen in the background of the illustration.

The Studio at Tokyo

Whilst erecting their new transmitter 10 miles away from Tokyo, the J O A K authorities have retained their old studio site in Tokyo. The studio has, of course, been redesigned and refurnished, but it retains much of the appearance of the older studio. It is equipped with microphones of the Western Electric type, and is heavily draped. A land-line carried on overhead poles connects the studio to the transmitter and aerial at Shingo-mura.

The total daily broadcasting effected by the new station at present is approximately 6½ hours during weekdays, and 10 hours on Sundays and holidays. The station programme staff divide their broadcasts up into four main classes, viz.: news reports, stock and market prices; educational features, such as special courses on languages, domestic economy, children's hours, and lectures on literary and general cultural subjects; recreational items, such as musical broadcasts, radio plays and dialogues, and various other miscellaneous items.

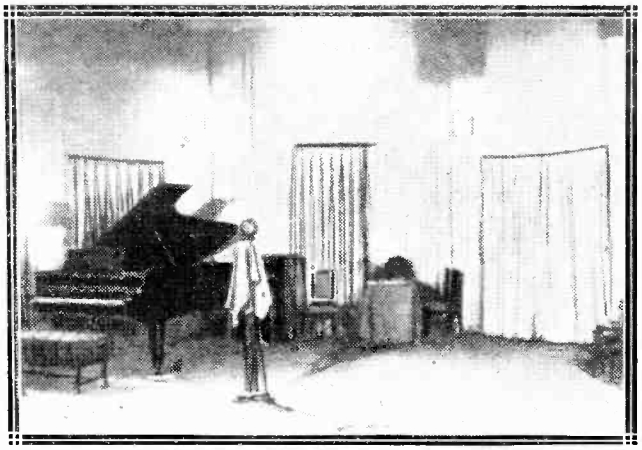
The fourth division of the J O A K broadcasting programmes concerns itself with outside broadcasts, and it is in this respect that the Japanese radio engineers are showing themselves to be fully awake to the almost unlimited possibilities of radio in these directions.

Many Sporting Events Broadcast

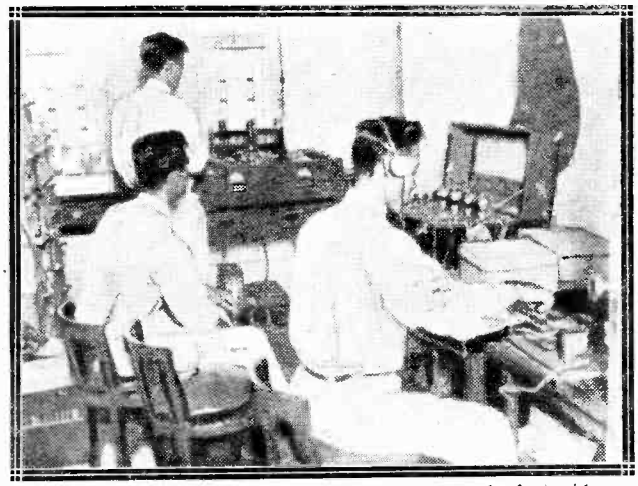
Station J O A K now broadcasts many national sporting events, such as baseball matches, national wrestling games, theatre entertainments, and important speeches.

J O A K has always maintained a purely experimental staff, and now that the new station has come into operation the experimental workers will be kept still more fully occupied in the furtherance of fresh improvements and developments.

Much of the experimental work carried out by the station is concerned with short-wave transmissions, it being proposed ultimately to erect numerous short-wave stations in various parts of Japan.



The studio at Tokyo. The microphone which can be seen is of the Western Electric variety.



The experimental staff at work on the control of outside broadcasts.

The experimental staff also makes a special study of the many problems connected with the relaying of outside broadcasts and the elimination of land-line and other objectionable noises. Naturally, these investigators are always at hand at the main station in order to tackle any technical problem which may crop up during the course of routine broadcasting.

Although there does not appear to be any published record of J O A K having been heard in England, the distance records of the station are worthy of admiration. The old station was heard quite frequently in the United States of America, and during 1927 as many as 250 reports of reception were received from the latter country.

J O A K has been heard in China, Australia, Siberia, New Zealand, Philippine Islands, Canada, the western coast of Alaska, and in the Hawaiian Isles. It is not to be doubted, therefore, that the new J O A K transmitter will be heard still more frequently in these areas of the world. Possibly, during the coming autumn, some keen enthusiast in this country may be fortunate enough to hear these far-flung Eastern broadcasts in this country.

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SHARP-TUNING CIRCUITS

A receiver needs to be selective as well as sensitive or the latter quality becomes valueless. The following article deals with the subject of selectivity in an eminently practical and interesting manner.

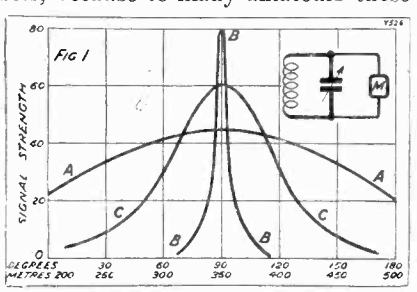
By *J. ENGLISH.*

SELECTIVITY, that ability to tune in one transmission to the exclusion of all others, has played an important part in the evolution of radio receivers. In fact, it is the guiding star of modern design and of equal if not greater importance than high sensitivity. As the number of broadcasting stations has increased, so the demand for sharply tuned sets has become more and more insistent.

Need for Selectivity

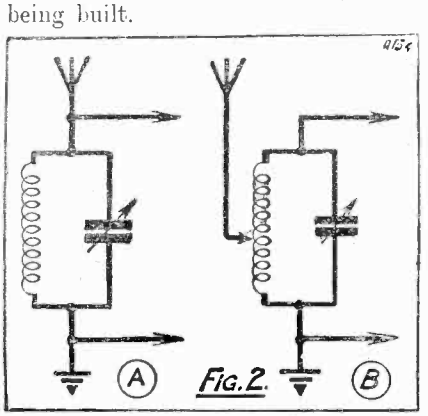
A selective and sensitive receiver has always been a necessity to the many D.X. enthusiasts within the swamping area of the B.B.C. main stations. To them "cutting out the local" was a difficulty unknown to more favourably situated listeners. But new conditions are now arising which will bring home to a vastly wider circle of amateurs the need for real selectivity in their receivers.

The proposed regional broadcasting scheme, when put into operation, will immediately necessitate more selective sets, because to many amateurs these



new stations will be fresh sources of "local" interference.

Therefore, when thinking about that new receiver you are going to build this year, by all means consider the best way of obtaining really selective tuning. No doubt you have already longed for a set with "knife-edge" tuning, so let the ideals of selectivity get a good grip of you, and then your new set will not get out of date as soon as many now being built.



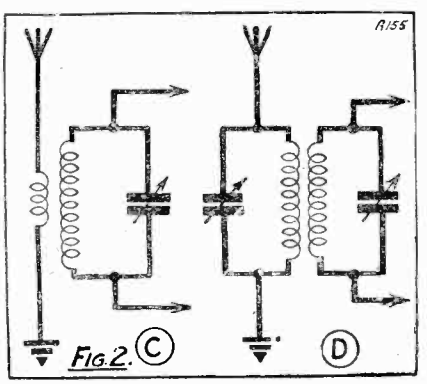
While there are modifying influences, the degree of selectivity of any set depends upon the efficiency of its H.F. circuits—that is, the tuning coils and condensers. An unselective set spells at once badly designed H.F. circuits and valves incorrectly used. I shall deal with the subject of this article mainly under the three headings of design, construction and practical operation. The theory of H.F. circuits should interest us most, as therein lie the secrets of true selectivity.

Let us take the simplest of H.F. circuits, a coil and condenser in parallel, and see what properties are necessary for sharp tuning. Imagine that this circuit is capable of picking up broadcasting signals and that some device M, for measuring signal strength, is connected to it, as in Fig. 1. We tune in a station and note the strength of its signals as measured by M for various settings of the condenser, which we will suppose reads also in metres. Plotting M values against wave-lengths, we get the curve A of Fig. 1. This circuit is not, therefore, very sharply tuned because the signal strength of one station is nearly the same all over the dial!

An Efficient Circuit

Now suppose the properties of the H.F. circuit to be changed suddenly so that fresh readings give the curve B. Signal strength is a maximum at 350 metres, rapidly falling off to zero for higher or lower wave-lengths. Selectivity is now good because the 350-metre signal is tuned in loudest at 90 degrees, M being 80; but at 6 degrees either side M is only 20.

This means that if the 350-metre signal is tuned in accurately (90 degrees on condenser) a station of



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equal power on 340 metres (86 degrees on condenser) would only be one quarter as loud. The degree of selectivity, therefore, consists of the ratio of the signal strength of wanted and unwanted stations when the circuit is tuned to the former. This ratio must be very high.

Effect of Resistance

Curves such as A and B of Fig. 1, which are known as *resonance curves*, may be drawn for any H.F. circuit, a high-peaked one like B denoting sharp tuning, and a relatively flat one, broad tuning.

Now let us insert in our simple H.F. circuit giving the curve B a resistance such as a *non-inductive* winding of five wire. Notice that a small resistance in series with coil and condenser has the same effect as a large resistance in parallel with coil and condenser. This is important. Plotting M values against wave-length for these new conditions provides us with the curve

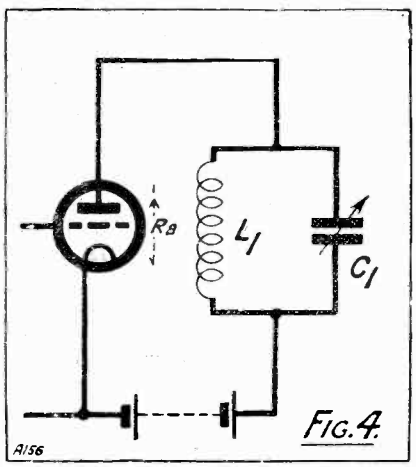

FIG. 4.

C of Fig. 1. This is not nearly so peaked as B, so that the effect of inserting resistance in an H.F. circuit is at once to *decrease* selectivity. If this added resistance is large enough, the resonance curve becomes a straight line, and the circuit ceases to tune at all!

The effect of added resistance is thus very important, demonstrating

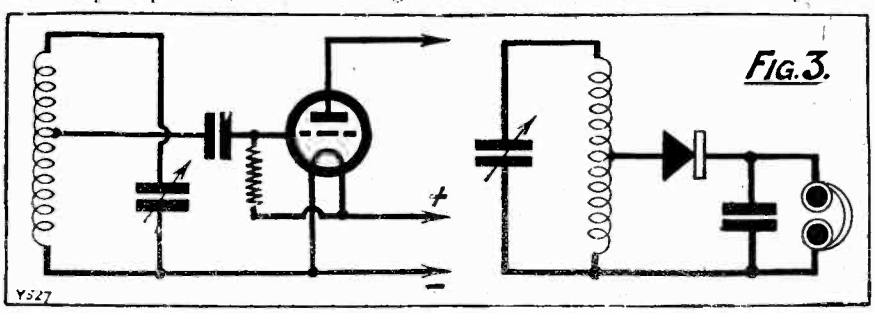

FIG. 3.

the principles governing selective tuning. If our simple H.F. circuit had very little resistance it would give a very sharp resonance curve, while as more resistance was added the curve would get broader and flatter. Selectivity, therefore, depends upon the resistance of the H.F. circuit,

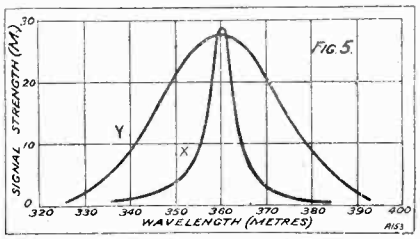

FIG. 5.

which must be made small by proper design and construction. On the other hand, no resistance at all, besides being a practical impossibility, is undesirable, as we shall see later.

"Damping"

The simple H.F. circuit also demonstrates another important feature of tuned circuits—that is, the relation of signal strength and selectivity. It will be seen from the resonance curves given in Fig. 1 that the sharper the tuning the greater the strength of the desired signal at the point of resonance. Added resistance, besides flattening the tuning of the circuit, also lowers the resonance peak of the curve because the H.F. oscillations cannot build up to such a large value. This is known as "damping." Therefore H.F. circuits with little resistance are desirable both from the standpoint of good selectivity and strong signals.

Now let us examine briefly the nature and cause of those added resistances usually met with in practice. If we know all their possible forms we shall be in a better position so to design our receivers that these resistances shall be a minimum. In fact, the whole question of selectivity and good signal strength amounts to a consideration of the resistance losses of H.F. circuits.

Due to Bad Design

Now the resistance of a circuit may be due to several causes. Firstly, we have the resistance of the coils and tuning condensers themselves. This resistance is due to "skin effect," dielectric and other losses. In good quality tuning condensers this resistance is so small as to be negligible, but in tuning coils it can amount to quite an appreciable value unless they are well designed.

External Influences

Modern types of tuning inductances designed to have small H.F. resistance are often wound with wire composed of a cable of finely stranded wires (Litzendraht) upon formers having small dielectric losses. The length and diameter of the coils are also proportioned to give the maximum inductance for their size.

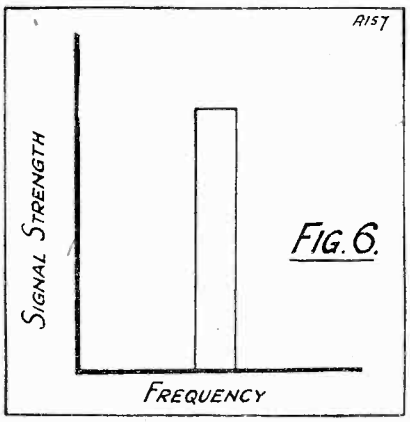

FIG. 6.

An important cause of resistance in H.F. circuits arises from external influences which are many and various. In most receivers they contribute by far the greater proportion of added resistance, which, as we have seen above, is responsible for poor selectivity.

Given well-designed coils and condensers, now readily obtainable, the only form of resistance which we need worry about is that arising from causes external to the tuned circuits themselves. As these external influences are rather varied and complex, in effect we shall get a better idea of their nature and means of overcoming them if we take a receiver, say a straight circuit, and by examining the H.F. circuits in turn deal with each cause as it arises.

Aerial-Earth System

First of all we have the aerial-earth circuit, which may be tuned or untuned and coupled in various ways to the proper tuned input H.F. circuit. Four methods are shown in Fig. 2—direct coupling (A), auto coupling (B), so-called "aperiodic" coupling (C), and fully-tuned loose coupling (D). The resistance of the aerial-earth system is usually quite large, and some or all of this is introduced into the tuned system according to

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the coupling. This added resistance flattens the tuning of the input circuit L_1 C_1. In the four methods of coupling shown, the first (A) introduces most added resistance.

The effect of added aerial resistance on the resonance curve of the H.F. circuit L_1 C_1 has to be borne in mind when designing a selective receiver. Methods of reducing such damping while obtaining good signal strength with ease of tuning are of first importance.

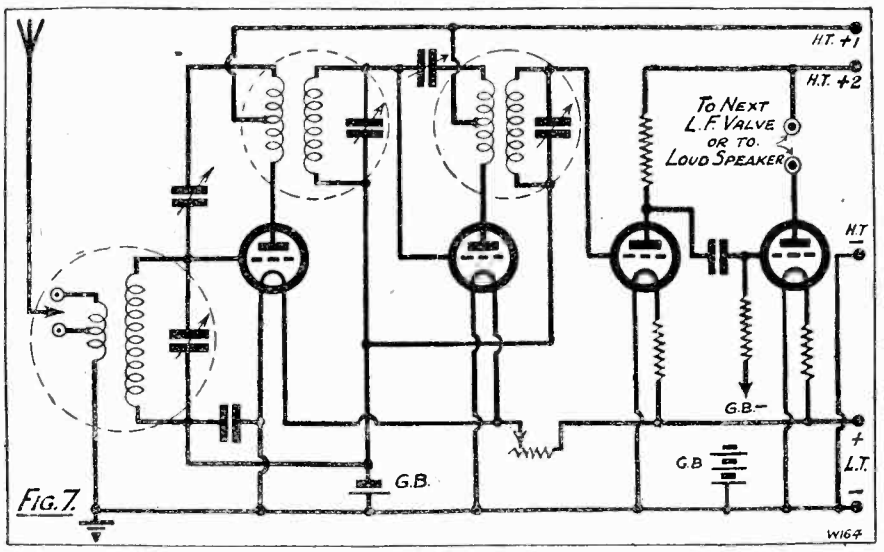


Fig. 7.

In one-valve receivers reaction has been largely used in the past to counteract the effect of aerial resistance on the input H.F. circuit, and thus improve selectivity. Reaction, of course, does reduce considerably the effect of added resistances, but as direct reaction is becoming less popular it is not proposed to deal here with regeneration and its uses (or abuses).

Input Damping

We have now to consider the first input circuit and its relation to the valve used with it. This valve may be responsible for quite a lot of added resistance. If it is a grid condenser rectifier, the flow of grid current essential to this method of detection is equivalent to a large resistance in parallel with the tuned circuit, which, as we have seen above, will flatten the resonance curve.

Similarly a crystal detector acts as a resistance in parallel with the tuned circuit. With these detectors methods similar to Fig. 2 (B) are used to reduce added resistance, as shown in Fig. 3. If the valve is an H.F. amplifier or anode-bend rectifier, the negative grid bias then used considerably reduces added resistance due to the valve. If the valve is in a neutrodyned H.F. stage the input damping is very low. The input circuit, without aerial coupling, is then very sharply tuned and selective.

Flat Anode Tuning

The effect of valve resistance is more important when the H.F. circuit is on the output side, as in a tuned-anode H.F. amplifier such as Fig. 4. It will be seen that the valve internal resistance R_a is in parallel with the tuned circuit, the consequent added resistance flattening the resonance curve of L_1 C_1. Unless R_a is extremely high this added resistance will be sufficient to make the tuning of L_1 C_1 unselective. Although amplification with a "tuned anode" properly neutrodyned or stabilised can be very high, the lack of adequate selectivity arising from this and other causes has made this form of H.F. amplifier unpopular.

It is now general practice to use an H.F. transformer to couple H.F. valves with suitable "neutrodyning" arrangements. The primary of this transformer is still shunted by the valve resistance R_a, but the resistance added to the tuned circuit, i.e. the secondary, is much reduced. Signal strength is good, while selectivity is quite high, due to the undamped resonance curve of the secondary tuned circuit.

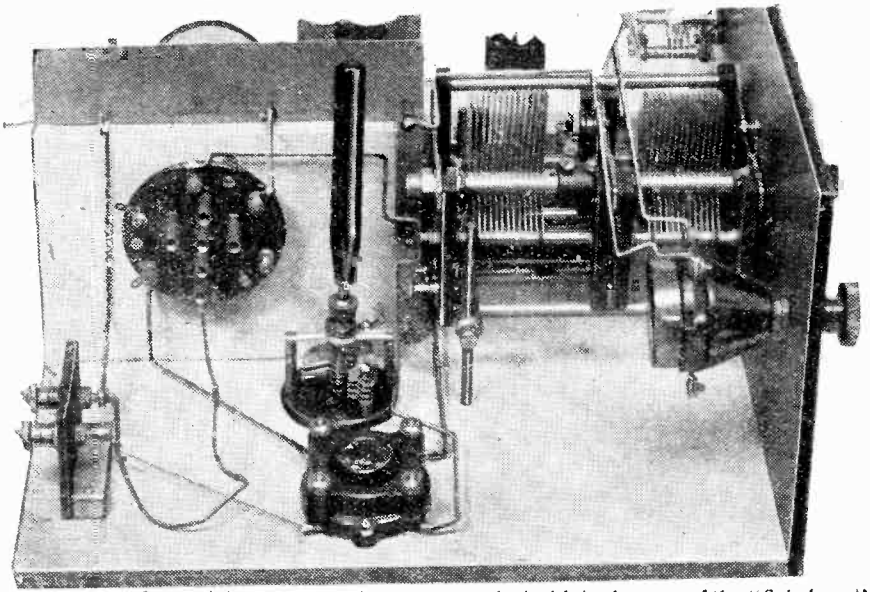
Of course, when this secondary forms the input to a detector valve, we have to consider the effects mentioned above, in order that the tuning of this circuit shall not be ruined by valve damping.

External Losses

Besides the added resistances due to aerial and valves, which are of most importance in the design of a receiver, there are other external influences which must not be lost sight of. It is becoming very important in the design of H.F. stages to use metal screening in order to prevent stray capacity and magnetic coupling between input and output circuits. If a metal plate is fixed against the end of a low-loss solenoid coil, so much resistance is added that the resonance curve of a H.F. circuit using that coil would be rather flat.

This is because eddy currents which are induced in the metal by the fluctuating field of the coil result in a loss of energy from the H.F. circuit. This loss of energy is equivalent to the addition of a resistance to the circuit, which added resistance can make tuning quite broad. Therefore, metal screens must not be placed too close to tuning coils, especially

(*Continued on page 203.*)



The problem of selectivity was a very knotty one to deal with in the case of the "Solodyne" Three. The "M.W." Research Dept. designed a special layout which enables the set to give wonderful amplification, together with a very excellent degree of "sharpness of tuning."

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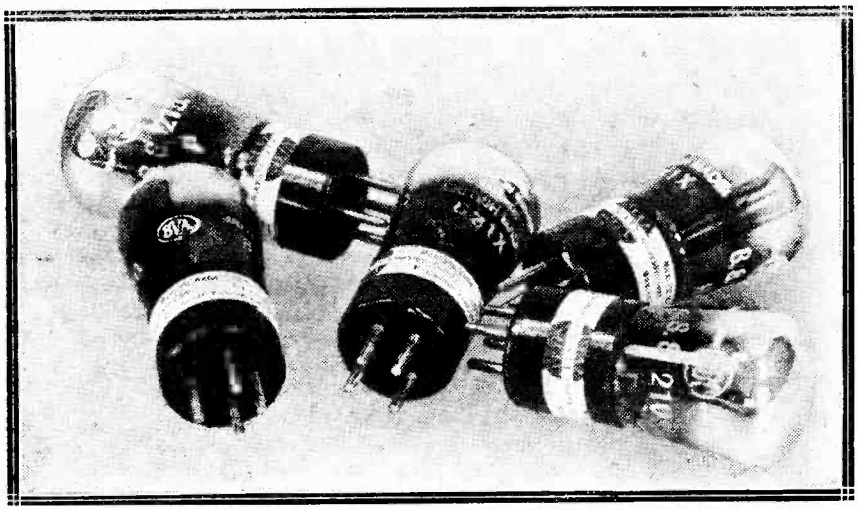


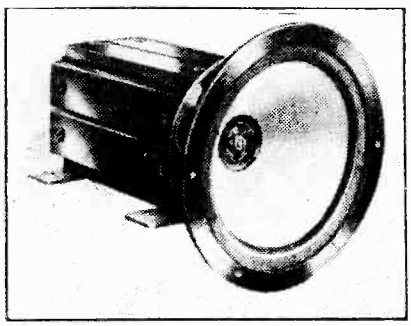
Loud-Speaker Valves.

A great deal depends upon the successful choice of your output valve.

By KEITH D. ROGERS.

I AM often asked by readers, "What valve should we use in the last stage?" and I am expected to give a reply straight away. No further details of the set are given as a rule, except that the valves are to work from a certain filament voltage and possibly at a certain amount of H.T. and that a certain number of valves are employed.

Very rarely does anybody give the slightest clue as to what type of output circuit or what type of loud speaker is to be used with the set. Many



The B.T.H. permanent-magnet moving-coil loud speaker (£9 10s.) A step-down transformer is necessary with most moving-coil loud speakers.

seem to think that any old valve will do practically anywhere in the set, and provided one has a reasonably good one, he can be sure of good reproduction from the loud speaker.

Question of Impedance

That is all very well, but you must not forget that the loud speaker has an impedance and that impedance may be quite a high figure. If it is, then you are liable to lose many of the bass notes and, moreover, saturation of the core of the windings or weakening of the core magnetism is liable to occur if the anode current passes through the speaker.

That is why output choke systems have become so popular. These do away with the trouble caused by the direct current passing through the speaker and incidentally make it very much easier for the designer of a set to make it suitable for any type of loud speaker.

For instance, if you were using one of the famous cone types of loud speakers which has an ohmic resistance of only 750 ohms with an impedance of quite a low figure, then it would be hopeless to use, say, an output valve having an impedance of 8,000 ohms, as the valve would give very little magnification and quality of reproduction would not be of the highest order possible with that type of loud speaker.

Need For "Matching"

A low-impedance loud speaker needs a low-impedance valve in its circuit.

A speaker such as we have just mentioned would do very well with a set with a 2,200-ohm valve, as this valve's impedance would probably nearly match that of the loud speaker —the ideal state of affairs.

In the case of moving-coil loud speakers, here we must have a step-down transformer unless a high-resistance coil is used. It would be impossible to get a valve of suitable impedance to match a low-resistance moving-coil loud speaker and therefore the step-down transformer is essential in this respect.

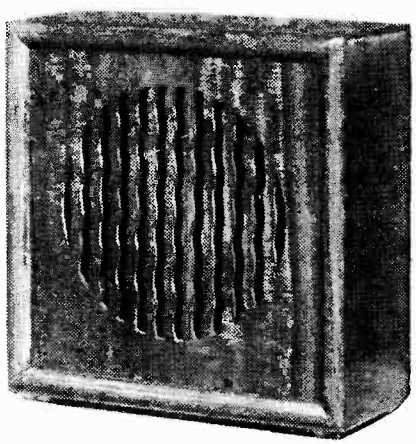
As this happens to be of a fairly high ratio the impedance of the valve must be carefully matched with the primary, and the secondary matched to suit the loud speaker. It should be used either in a choke output circuit or else made a very substantial size in order to carry the plate current of the last valve.

When considering loud-speaker valves one should always think in terms of grid swing as well as of impedance. If the last valve of a set cannot handle the grid swing passed to it from the previous valve, distortion is bound to occur. The more H.T. you can use on a valve, with suitable grid bias, the larger the grid swing, but it must not be forgotten that increase of H.T. means increase of plate current, and if, as I said before, either the output circuit or the output choke is not of high enough current-carrying capacity, or if the loud speaker is directly in the plate circuit of the valve, distortion due to saturation is likely to occur.

In Conclusion

Where the loud speaker is directly in the plate circuit of the valve, it is advisable always to get in touch with the makers of the speaker in order to obtain advice as to the best type of valve for that certain loud speaker.

If you wish to be absolutely sure of getting the best results you must get your output circuit impedance matched with the impedance of your valve as nearly as possible. In other words, either the valve and loud speaker must match each other on average frequencies, or else an output filter or transformer circuit suitable for the valve must be employed.



This Ormond cone-type speaker (£4 4s.) is capable of providing very full bass reproduction, but should be carefully matched with its output valve for best results.

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MORE CARPENTRY for the RADIO AMATEUR

In this article the author of the pedestal cabinet described in the April "M.W." gives full details for the construction of what he terms the "ideal" self-contained wireless cabinet.

By H. BRAMFORD.

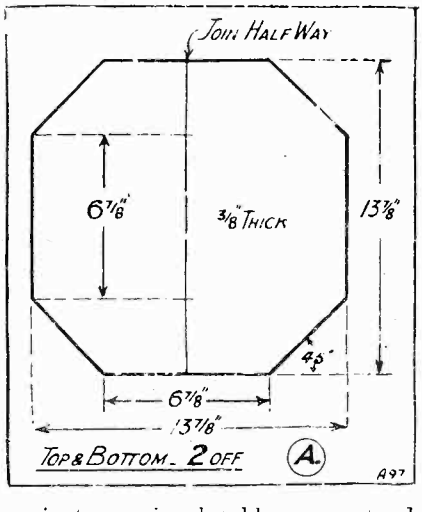
MANY enthusiastic wireless constructors must have sought for a long time for a wireless cabinet which may rightly be termed "ideal." In this article, however, it is claimed that something approaching the ideal has been designed.

The cabinet is really like nothing yet attempted, and has several unique features to recommend it. In endeavouring to create an interest in cabinets, and thus bring sets in general into a more glorified place, the reader could not do better than attempt the construction of the one to be described.

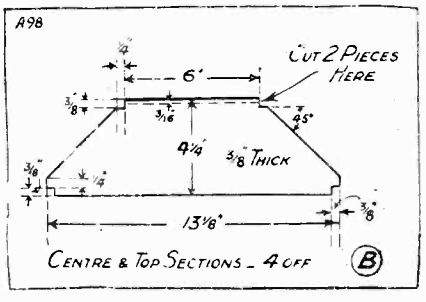
Careful Design

The design is not simple, but the details have been carefully worked out, and the method of construction considered in such a way as to render the work comparatively easy, even to a beginner.

The first thing to notice about the cabinet is its original shape. It is intended for use as a table cabinet, and may be placed upon any convenient occasional table, or a stand could, of course, be built to match the style. Whatever angle the cabinet is looked at it presents a pleasing appearance, there being no front or back—that is to say, every view is a front view.



The whole cabinet revolves upon a circular base, so that any part may be presented. There are several reasons for this. Firstly, the interior of the cabinet is equipped with a frame aerial, so that it may be turned round to the best position with absolute ease for directional reception.



The frame upon which the set is built is also unusual. There are two small panels instead of the usual one, and a baseboard. Both panels are secured to the baseboard and face each other.

Internal Layout

Thus the tuning dial may be mounted on one panel, and the reaction control and switch upon the other, thus separating the two operations. The cabinet can, of course, be just turned round for this purpose, and finally set for the frame.

In the lower portion of the cabinet are two small doors, each below one of the panels. This feature allows for accessibility to the batteries, which are placed in the lower section.

The low-tension battery is placed adjacent to one door, and the high-tension battery near to the other door, thus whichever battery requires attention the cabinet is just swung round, the door opened, and the battery is at hand.

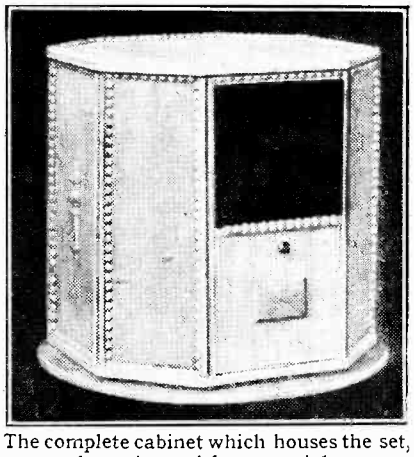
A good point about this feature is that the batteries are thus kept apart, and the possibility of accident minimised. A grid battery can, of course, be included, or the high-tension battery—if of the Lissen type—made to answer the dual purpose.

The connections from the set to the batteries are made direct by dropping the insulated leads through to the lower portion of the cabinet. The same applies to the frame aerial, while the loud-speaker leads are taken to two panel terminals, or alternatively direct from the set, through one of the sides of the cabinet.

Frame Aerial Included

With the loud speaker placed on top of the cabinet, for which there is ample room, these leads, of course, would be quite short, as would be all the others. The set is easy to remove from the cabinet, and in addition to this the frame aerial may be lifted out, together with the top, which is removable.

This cabinet is intended for frame aerial use, as thus it is possible to have an entirely self-contained installation with absolutely no external connections. It can be adapted for ordinary aerial and earth connections,



The complete cabinet which houses the set, batteries and frame aerial.

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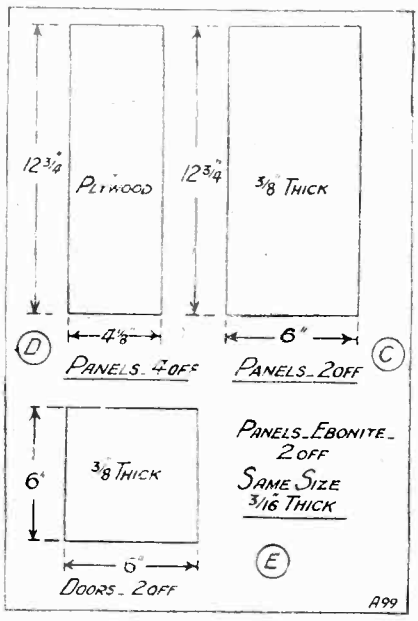
in which case the frame would be dispensed with; though the main feature of design would be lost.

The first thing to consider in setting out to make anything in the



nature of woodwork is a cutting list. It is necessary to have such a list before you, so that the various items may be cut and checked off.

A Necessary Precaution

In the cutting list given the sizes are dead, but a slight allowance should be made on all cutting edges, to allow for squaring up and finishing. Use a square for all marking out to ensure accurate cutting, and if the dead sizes are marked, saw on the outside of the line. Use a tenon saw, as this will give a more accurate and a finer and truer cut than an ordinary wood saw.

Check Carefully

Be careful to check over all measurements after they have been marked out, to make sure that they are accurate. By carefully considering the method of layout in drafting the work on to the wood, much waste can be eliminated, and all pieces should be cut from planks which are as near as possible of similar width to the piece required.

Where waste is kept down to a minimum, labour is also saved in cutting. The wood chosen to work on may be left to the taste of the constructor, but figured oak is recommended, or mahogany, or maple. The best finish is usually easiest to obtain on oak, figured or otherwise, but the figured oak, of course, is very beautiful in grain.

Cutting List

A—Ends—4—13⅞ in. by 6 1/16 in. by ⅜ in.

B—Sections—4—13⅛ in. by 14¼ in. by ⅜ in.

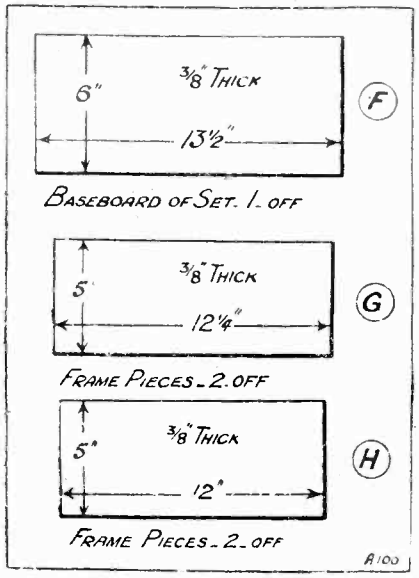
C—Panel—2—12¾ in. by 6 in. by ⅜ in.

D—Panel—4—12¾ in. by 4⅛ in. by ⅛ in. Plywood.

E—Door—2—6 in. by 6 in. by ⅜ in.

F—Baseboard—1—13½ in. by 6 in. by ⅜ in.

G—Frame—2—12¼ in. by 5 in. by ⅜ in.



H—Frame—2—12 in. by 5 in. by ⅜ in.

J—Base—1—16 in. by 8 in. by ⅜ in.

K—Moulding—16—12¾ in. long by ⅜ in. by ¼ in. Quarter section.

L—Moulding—4—3¾ in. long by ⅜ in. by ¼ in. Quarter section.

M—Dowel—1—1 in. long by ⅜ in. diameter.

Further Sections

N—Ornament—2.

O—Ornament—2.

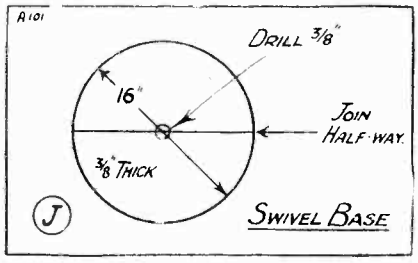
P—Bead—6—6 in. long by ¼ in. Quarter section.

Q—Bead—8—4⅛ in. long by ¼ in. Quarter section.

R—Bead—12—12¾ in. by ¼ in. Quarter section.

S—Knobs—2.

T—Bead—4—1⅞ in. long by ½ in. Half section.

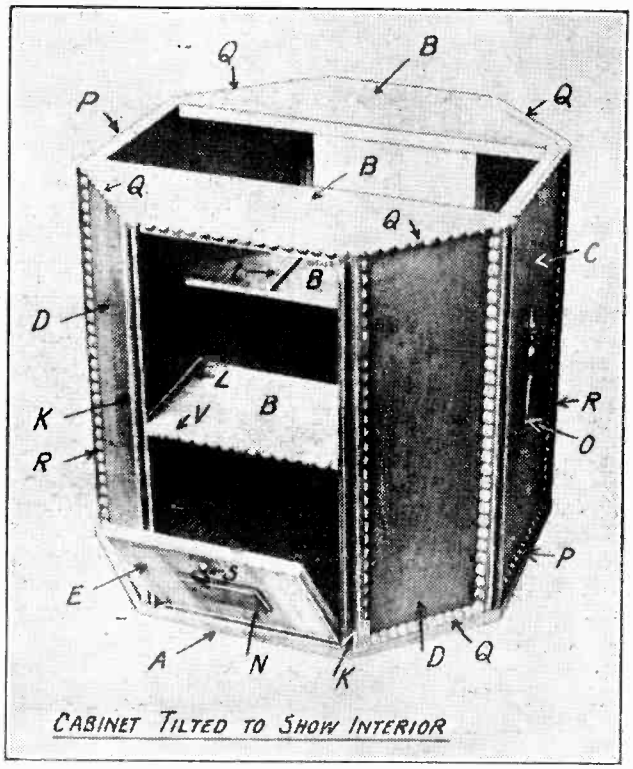


U—Bead—1—6⅞ in. long by ½ in. Half section.

V—Bead—2—6 in. long by ½ in. Half section.

W—Ebonite—1—2 in. by 1 in. by 3/16 in.

X—Panels—2—6 in. by 6 in. by 3/16 in.



This photograph clearly shows the construction of the cabinet. The set itself occupies the section above the door E, while the batteries can be housed below the set, behind E. The frame aerial is wound round inside the cabinet, and the whole is mounted on a platform so that it can be easily rotated to obtain the best directional setting for the frame aerial.

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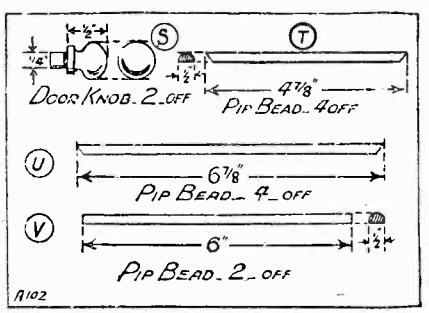
First prepare the top and bottom pieces A and the swivel base J in half sections. The reason for making these in two pieces is that it is easier to procure wood in 9-in. planks than one piece 16 in. wide, and, in any case, such a single width of $\frac{3}{8}$ in. thickness is liable to warp badly, however dry or seasoned it may be.

Sawing and Shaping

The half sections should be carefully shaped, finished and papered all over. The semi-circular pieces are quite easy to cut with the saw, or a key saw could be used to advantage for this purpose.

Alternatively, the shaping may be finished with a sharp knife or chisel, so long as no attempt is made to cut against the grain, which will result in chipping. The edges, which have to be joined together, should be absolutely smooth and dead straight, and a small plane will best produce this result.



In the detailed diagram the method of joining the pieces is shown. Set the marking gauge to $\frac{3}{16}$ in., being half the thickness of the wood, and scribe a line down the edge.

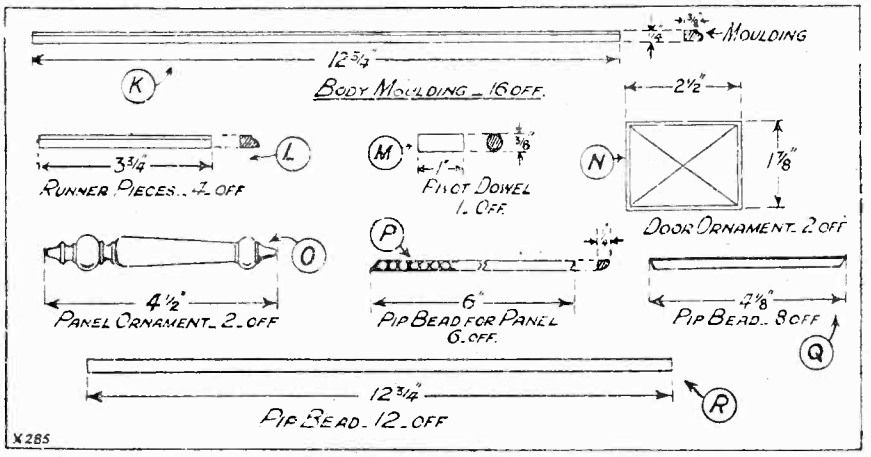
Then place the two pieces to be joined accurately together in a clamp and mark off distances across the two edges where drillings are to be made for the dowel pins. Set the drill to a depth of $\frac{3}{8}$ in. and drill both pieces.

Make a mark with a centre-punch first to ensure true drilling. Squeeze a little Seccotine into each hole in one piece, and tap in the dowel pieces as far as they will go. The dowels used should be $\frac{1}{8}$ in. diameter and $\frac{3}{4}$ in. long, and a $\frac{1}{8}$-in. drill should be used for drilling.

Assembling the Frame

Finally, squeeze some glue into the holes in the other piece, glue the edge also and fit the two halves together and tap in. If the process described is carefully followed, a perfect fit should easily result. Give a final finish and papering to the joined pieces, smoothing any furniture projections at the edges or seams.

Next cut the sixteen moulded pieces K and the four centre pieces B. The frame may be assembled by gluing and pinning the moulded pieces round the centre and top pieces, as shown in the sectional method of building.



The centre pieces should be positioned 6 in. clear from the top pieces. The base piece is next secured by pinning and gluing to the sixteen ends of the mouldings, preparatory to inserting the panels. If accurate measurements have been made, the whole arrangement will fit perfectly.

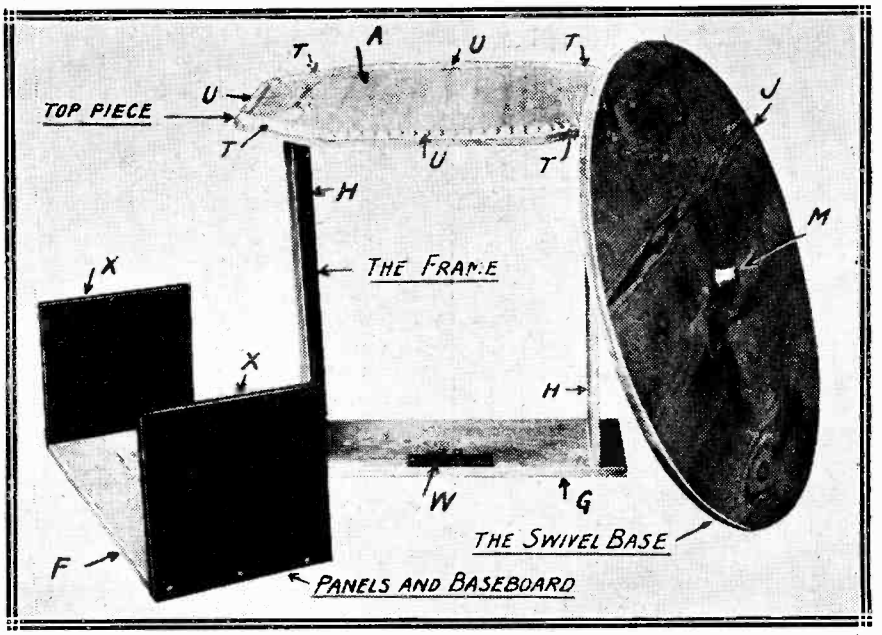
No Bevelling

It will be noticed at this stage that the design is so arranged as to obviate any difficult bevelling of edges. The panels C and D are cut and placed in position, panels C being pinned from the top and bottom pieces, in addition to gluing.

This completes the building of the frame, and the finishing touches are added by pinning and gluing the beads around each panel. For the swivel base a $\frac{3}{8}$-in. dowel 1 in. long (piece M) is tapped and glued into a hole ready drilled in the centre of the circular base J.

The projecting portion of the dowel is slightly papered down to make a smooth running fit in a $\frac{3}{8}$-in. hole, ready drilled in the centre of the bottom piece A of the cabinet. On the underside of this piece four ball castors, or "domes of silence," are secured to allow the cabinet to revolve evenly and smoothly on the circular base.

The pieces G and H form the frame, which is built up as shown in the method of frame building in the drawing. When the frame is completed the winding is made by slotting the projecting edges of the top and bottom pieces G, and the



Essential sections of the cabinet. Note that the panels X,X, are of ebonite cut to the same size as the doors, E.

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wire wound around in the form of a square.

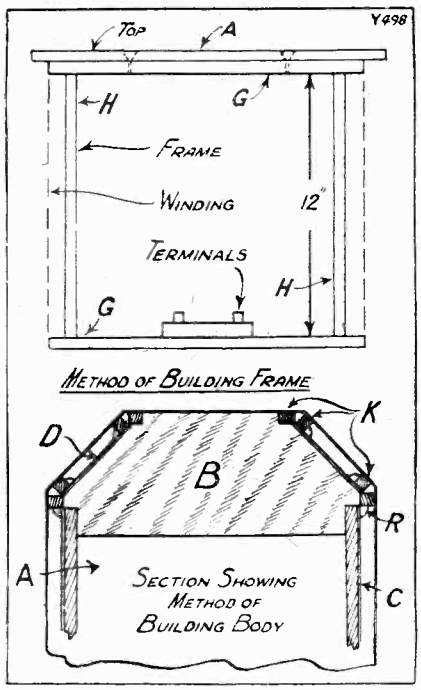
The ebonite fitting W is secured in the position shown in the drawing to the frame, and the beginning and end of the winding connected to each of the terminals on the fitting respectively. These terminals also provide means of connecting direct to the receiver. When completed, the frame is finally secured to the top piece A in the manner shown. The whole device drops centrally down into the cabinet before the set is inserted.

The general construction is completed by securing two ebonite panels measuring 6 in. by 6 in. by $\frac{3}{16}$ in., one at each end of the baseboard F. Panels and baseboard slide into the cabinet from either side, and are held in position by the simple expedient of attaching a bead V to the front edge of the cabinet piece B as shown.

Finishing Touches

With the bead edge slightly raised, the set drops into position and is prevented from moving. Small runner pieces L, however, should be secured to pieces B to allow the baseboard to slide in with ease.

The finishing touches are obtained by fixing half-section bead around the top edge of the top piece A. The ornaments O are glued centrally

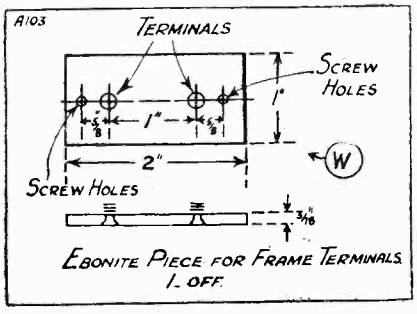


on panels C. The drop doors E are hinged to the base piece A, and an ornament M is glued centrally on each, in addition to a small wood knob S.

It is advisable to paper and finish each piece as it is cut, in addition to giving a general finish when completed. Glue or Seccotine is used whenever a joint is made. Very fine wire nails are used for the bead and moulding, and flat, headless nails for the rest of the work. Screws are only used to secure the panels to the baseboard, and the top piece to the frame.

Staining and Polishing

If properly carried out, the assembly is so arranged as to leave not a nail or screw visible anywhere. Correct marking out and cutting is the whole secret of success in the construction of this cabinet. Reference to the cutting lists, the details and drawings, in addition to the lettered photographs, is the surest way to render



the building of this cabinet a simple and easy matter.

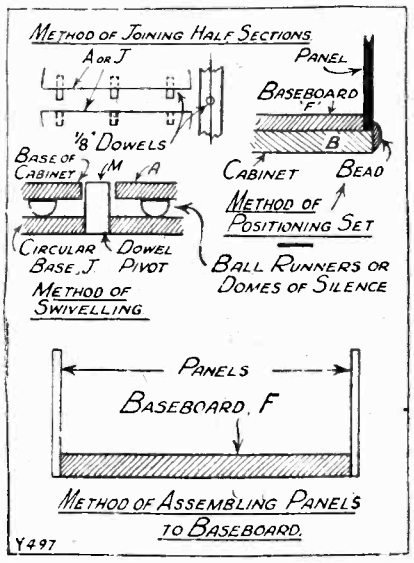
A good finish may be obtained by lightly staining, in the case of oak, with permanganate of potash, or logwood chips boiled down. One ounce of the former dissolved in one pint of cold water makes a very good and cheap stain.

When perfectly dry a dull finish may be obtained by polishing with beeswax dissolved in turpentine, or with linseed oil, the former being recommended.

Improving Appearance

A high polish may be obtained with the use of pure spirit varnish, or button polish, but this must be applied thinly, quickly, and evenly to obtain good results. It is a good idea to varnish over a waxed surface, but never use varnish on any material that is not absolutely dry.

Finishing polish, easy to use and which gives good results, may also be obtained from "Hobbies." The panels should be of wavy finish "Trolite," or mahoganite, or ebonite. The first two, of course, will greatly enhance the general effect of the cabinet from an artistic point of view.



OVERSEAS ITEMS

There are over 61,000 licence-holders in Norway, but the broadcasting company estimates that there are another 40,000 wireless pirates there.

* * *

By means of the transatlantic picture service, the latest Paris models are being reproduced by New York fashion houses within twenty-four hours of their being worn in Paris.

* * *

The Langenberg programmes have been picked up in the Malay peninsula, nearly 6,000 miles distant from the popular German station.

* * *

The area called "The Forties" so often referred to in the Daventry shipping forecast, lies between the coast of Scotland and that of Scandinavia, and takes its name from a famous shoal called the "Long Forties."

* * *

S.O.S. Watch

A constant watch upon the wavelengths used by shipping is kept by the American broadcasting stations, and in the event of an S.O.S. being heard all programmes are instantly stopped.

* * *

The number of broadcasting licences issued in Germany is fast increasing, and now approaches the British total, which is nearly two and a half millions.

* * *

Harvard, America's most famous university, has a broadcasting station of its own to enable students to gain practical experience of the engineering problems involved in broadcasting.

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MY BROADCASTING DIARY

Under this heading month by month our Broadcasting Correspondent will record the news of the progress of the British Broadcasting Corporation, and will comment on the policies in force at B.B.C. headquarters.

A Broadcasting Mystery

IT is five months since the representatives of the three political parties were in earnest conclave with the B.B.C. about the new scheme of party political broadcasting. There was a great gathering of the mighty in a Committee Room of the House of Commons. The lobby ascertained that Lord Clarendon presided, and was supported by Sir John Reith, Admiral Carpendale, and Mr. Roger Eckersley for the Corporation. Sir Herbert Samuel upheld the Liberal cause, Mr. J. C. C. Davidson the Conservative, and Mr. Arthur Henderson the Labour.

There were numerous satellites, attendants, trumpeters, mace-bearers and armed guards! Savoy Hill declared afterwards that all those present at this meeting agreed solemnly to avoid all publicity. This being the case, it was only in accord with custom that the newspapers were immediately filled with contradictory accounts of what happened. The Liberals began by blaming the Conservatives for insisting on double the time of each Opposition party, thereby crashing the conference.

The Conservatives replied innocently that they were only complying with a suggestion that originated at Savoy Hill. Labour marked time, in some anxiety that the scheme should not be smashed, because they obviously stood to gain more from it than either of the other parties. And then it got out somehow or other that the real originator of the double measure for the Government was none other than the Chancellor of the Exchequer himself. It is gathered that the B.B.C. made several other proposals, all of which were turned down by one or other of the parties. Therefore it looks as if there is to be no party broadcasting at least until the General Election. But the B.B.C. has acted quite wrongly in not telling the public about the part it played in all this mysterious business.

One section of the newspaper-reading public believes that the B.B.C. was involved in a Government intrigue for a misuse of the medium; another is of opinion that the B.B.C. showed no "guts" in the negotiations. Such impressions are unpleasant and should be removed if possible.

What of 1937?

The year 1937 may seem a long way off, and it is perhaps surprising that people should be thinking seriously about what will happen to the broadcasting service then. January 1st, 1937, will see the B.B.C., or its successor (or successors), under a fresh constitution. Many people were of opinion that the Report of the Crawford Committee, adopted by the Government as the basis for the constitution of the present B.B.C., put an end for all time to any idea of competitive or plural broadcasting in this country. But this is not the case. Broadcasting is still in a very tentative and experimental state of organisation.

Four years under the Company are not taken into account at all by their

THE VOICE FROM VLADIVOSTOK

When the "Italia," with General Umberto Nobile on board, sent out her distress call it was first picked up by a Vladivostok amateur. Re-broadcasting it from Siberia, he got through to the San Francisco amateur station N U 6 G G, shown above.

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official mind. Ten years under the Corporation are regarded as a gentle preliminary canter. There would appear to be some reason for the belief that the official view is that at the end of the present licence the service will be fully incorporated as a state department, staffed only by those who have complied with all the tests of the permanent Civil Service. It is known that plans to this end have already been framed at the Treasury.

In the advertisements for the Civil Service examinations beginning in 1932, there is to be a special clause inviting candidates with "natural aptitude for the work of public entertainment and education." This will refer to the prospective taking over of the broadcasting service. It may be logical and right for the Treasury to take this view, but the fulfilment of the policy is another matter.

There are likely to be sweeping changes at the end of the present licence, but in the opposite direction. All intelligent and unbiased students of broadcasting are agreed that the change from the Company to the Corporation was a change for the worse. To continue the process in a retrograde direction will not be tolerated.

It is much more likely that after 1936 broadcasting in Britain will be thrown open to some measure of healthy competition. The technical objections which have stood in the way of this course hitherto will no longer be present. Incidentally it is significant that already there is in existence the nucleus of a powerful group that will be ready to operate one of the new broadcasting authorities when the licences are granted after the Report of the Government Committee in 1936.

Is the B.B.C. Slowing Down?

Savoy Hill is too self-satisfied just now for my liking. Whenever it is suggested that something is wrong with the programmes, I am told by my friends there that licence revenue continues in a healthy state and that the box-office is the surest test of public approval.

This is all very well. People have to get licences even if they want to listen only to foreign stations. Indeed this is the cause of some jealousy abroad. Herr Bredow, the "Reith of German Broadcasting," is quoted as complaining recently that a very large proportion of the B.B.C. revenue is due to the effort and excellence of the German programmes. This is probably an exaggeration, but there is some truth in it.

Amateurs or Professionals?

Commentators on the first annual report of the new B.B.C. remarked that the entertainment work at Savoy Hill was still too much in the hands of amateurs; that is, people without stage or concert experience outside. It is probably right that the control of the broadcasting service is better left in the hands of amateurs, provided they are well advised by professionals of experience and competence.

But the B.B.C. does not take the trouble to seek and get the right advice of this kind.

Those High-Power Stations

Three months ago it was hinted that the Post Office might create a new record by agreeing within a year to an inevitable proposal. I am not so optimistic now as I was then about this threatened revolutionary change in attitude. As soon as they got permission to start building the new London high-power twin-wave station at Brookman Park the B.B.C. sought authority to start the other four high-power stations simultaneously.

But there is no final news yet as to what is to be allowed or disallowed. Of course, all four stations should be put in hand by the end of the autumn. It is only by simultaneous construction and completion that the Regional scheme can be put to work within two years. By separate building, one after the other, the licence will have expired before the first satisfactory alternative programme service will be on the air in Britain!

The Menace to 5 G B

Insidiously, but surely, the menace of talks is creeping on 5 G B. The fact that this station has not been encumbered with talks since its start has been the chief factor in its undoubted popularity with millions of listeners. The increase in licence revenue last year was solely and entirely due to the programmes of 5 G B.

And now the B.B.C. proposes to spoil one of its chief assets by allowing talk to appear in 5 G B's programmes. The first formula was talks of "exceptional programme value," such as "An Hour with Captain Eckersley." These were not an unqualified success, but were tolerable. But then came some "experimental" follow-up in adult education, and so the movement grows. The highbrows and uplift merchants will not stop short of ruining 5 G B as they have ruined London and 5 X X.

I give the B.B.C. a serious warning. If they do not protect 5 G B this coming season, and it falls a victim to uplift, then the slump will set in. On the other hand, if they maintain 5 G B on the altogether excellent lines of last year, it will prove a friend indeed in a time of need.

ACROSS THE WORLD TO AN EXPRESS!

Members of the Australian Scottish Delegation listening to the Melbourne station (3 L O) whilst flying north on a London to Edinburgh express.

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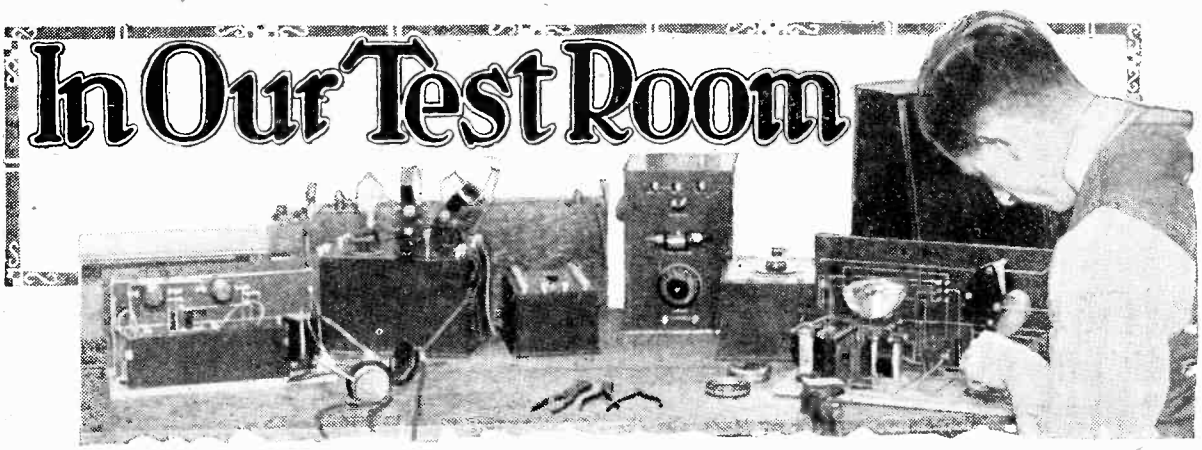
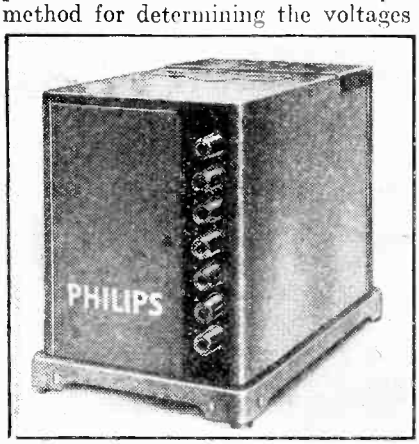


Philips H.T. Supply Units—Ripaults' Variable Condenser—Ferranti High-Resistance Voltmeter—Raymond Variable Condenser—R.I.-Varley L.F. Choke, etc., etc.

Philips H.T. Supply Units

MESSRS. PHILIPS LAMPS, LTD., appear steadily to forge ahead in regard to the development of mains units. One of their latest productions of this nature is the unit type 3003, from which six different anode voltages can be derived simultaneously, and with which, moreover, three negative grid voltages are available, each of which can be adjusted independently of any other at twelve different values, ranging from 0 to 40 volts. A very important feature is that these adjustable grid voltages are also quite independent of the anode-current supply.

Adequate smoothing is incorporated and there is an entire freedom from "hum." With an anode voltage of 150 the instrument will supply a current of 30 milliamps, and with 120 volts the supply is 50 milliamps. The very clear directions for use supplied with this unit include a simple method for determining the voltages



This is the Philips H.T. unit, type No. 3002, which supplies six different voltages.

of the various tappings. In the words of the makers, the anode voltages are not variable, and the apparatus is, therefore, very simple in operation. In many cases two or three or, at the most, four different anode voltages will be sufficient, in this case the most suitable anode voltage can always be obtained as a choice can be made from six voltages. If necessary, all six tappings can be used at the same time.

> Manufacturers and traders are invited to submit for test purposes radio sets, components and accessories to the "Modern Wireless" Test Room at Tallis House, Tallis Street, London, E.C.4. Under the personal supervision of the Technical Editor all tests and examinations are carried out with the strictest of impartiality.
>
> Readers can accept the Test Room reports published monthly under the above heading as reliable guides as to the merits and demerits of the various modern productions of the radio industry.

The unit is compactly contained in a metal casing and the valves are accessibly placed behind a removable cover. The necessary sockets are all placed at one side of the unit. Seven are for the H.T. plugs. Beneath these are the four for the grid-bias tappings. Then come the three rows, each of twelve small sockets, into which small switch plugs can be inserted in order to vary the grid tapping voltages. Everything appears to be scientifically arranged for the safe and easy manipulation of the unit.

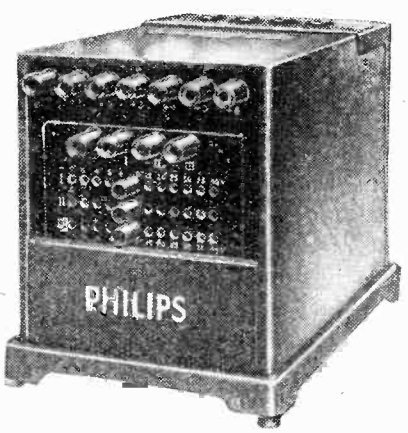
Another model, the Philips H.T. Unit 3002, also supplies six different anode voltages, but does not incorporate a grid-voltage supply. This unit makes use of one full-wave rectifying valve.

We have carefully tested both units and have found them perfectly satisfactory in every respect. They fully maintain the Philips' reputation as manufacturers of high-class radio instruments, and we have no hesitation whatever in bringing them to the notice of our readers. The price of the type 3003 unit is £10 10s., complete with valves, and of the type 3002, £8 10s. complete.

Ripaults' Variable Condenser

A sample of the new improved Ripaults' lateral-action variable condenser recently came to hand. The component incorporates two sets of rectangular plates which can easily be reduced in number by the removal of two accessible nuts if the capacity range of the component is desired to be decreased. The one set is laterally moved into or out of mesh with the other by means of a simple cam control.

The action is pleasingly smooth and it is completely free from slip or backlash. The control, in fact, approximates to "slow motion," as one complete revolution of the substantial dial is required to cover the range.



The type No. 3003 also includes an independent grid-bias supply. Both units are for use with A.C. mains.

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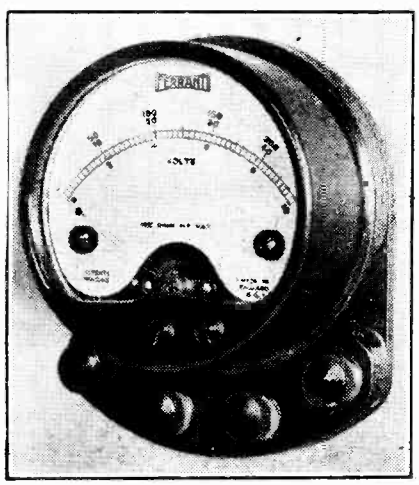
This Ripaults' lateral-action variable offers a definite alternative to the more common design of rotary vane movement. Its various advantages have briefly been indicated and we have no doubt that its popularity will be enhanced by the introduction of the new and improved model.

Ferranti High-Resistance Voltmeter

An ordinary voltmeter will not give even an approximation of voltages existing in mains units circuits. For this an instrument having a very high resistance is necessary, such a one as that now added to the already very comprehensive and useful range of Ferranti meters. It has a resistance of 1,000 ohms per volt and is of the familiar portable type, and has three ranges, viz., 0 to 10, 0 to 50, and 0 to 250 volts. Like all the other Ferranti meters, it is full of good points and is, in fact, a high-class instrument.

The scale is wide and the needle light and responsive. A good point is that the zero adjustment screw can easily be manipulated by the thumb-nail and an accurate setting obtained, but this is not an adjustment that frequently has to be made. In fact, we have found the Ferranti meter sent us for test extremely stable. It has been left in circuit for hours at a time without becoming "tired," as apparently do some meters.

A careful comparison on all ranges with calibrated meters of a special

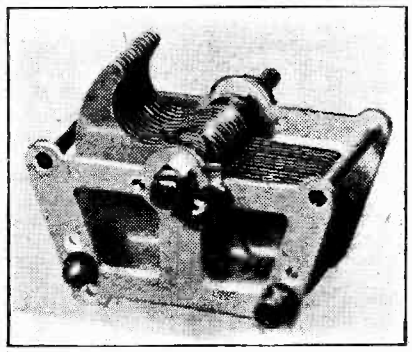


This Ferranti portable type, triple range voltmeter has the high resistance of 1,000 ohms per volt.

and, we must add, very expensive type, having restricted ranges, shows that the Ferranti has commendable accuracy throughout. We also checked up its resistance, and found it to be exactly as stated. It has many points usually associated only with large laboratory instruments, and that these are embodied in a compact and reasonably inexpensive design is something of a triumph for the manufacturers.

Raymond Variable Condensers

Messrs. K. Raymond have produced a variable condenser, and one which will appeal to constructors both for



The variable condenser due to Messrs. K. Raymond.

its price and its sound construction. The ·0005 mfd. type costs 6s. 11d., complete with a large, well-moulded dial, and is in our opinion as good value in radio gear as can be found to-day.

The movement is exceedingly smooth and positive.

Corrected vanes and a pigtail connection to the moving set are other points which figure in this Raymond production. It is robustly assembled, and, as we have already indicated, mechanically it is a good piece of work. An insulation test proved that its electrical qualities are high, so that taking everything into consideration, and not forgetting the price, many constructors will find it worth while to include one in their sets.

Magnum Fixed Condensers

There never can be too many good makes of components on the market, so we have no hesitation in extending a hearty welcome to Messrs. Burne-Jones as manufacturers of fixed condensers, and there are several points of particular interest in connection with these new Magnum productions. In the first place, they are edgewise mounting types, a scheme which appeals to us for it enables one to tuck away the condensers in otherwise useless spaces. Simultaneously, it makes for a neat and compact layout.

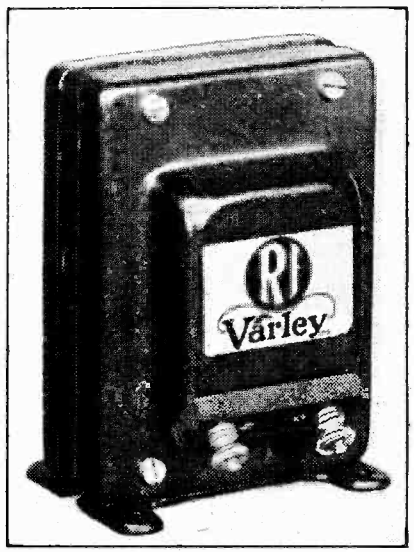
The values are engraved on the sides of the condensers and cannot be scraped off or lost to view after being mounted on the baseboard. Also, the neat little terminal nuts are slotted so that they can be tightened up with a screw driver. This is a point which will be much appreciated by the constructor who has had experience of trying to get pliers into awkward corners in order to tighten nuts. Mica and copper figure in the construction of these Magnum condensers, and their capacities are guaranteed to within 10 per cent. Their prices are remarkably reasonable, ranging from 1s. 6d. for values from ·0001 to ·001 mfd., up to 2s. 6d. for the ·01 mfd.

A Transmitting Valve

The Marconi D.E.T.1. S.W. 40-watt double-ended transmitting valve, which is suitable for wave-lengths down to ten metres, and which was developed originally in connection with the Beam system, is now available for amateur use at the price of £7 5s. This transmitting valve has the filament requirements of 6 volts and 2 amperes.

R.I.-Varley L.F. Choke

Ordinary L.F. chokes are not generally of much use in mains units. Here there are comparatively large currents to be dealt with and efficient smoothing necessitates heavy chokes having plenty of iron. The induct-



The R.I.-Varley smoothing choke.

ance of a choke falls as with increases of current flowing through it, and as ample inductance is a primary requirement in a smoothing circuit, you will see that the choke used must be of a special nature.

A new R.I.-Varley choke recently produced has the useful inductance of 20 henries, while even when the full load of 100 milliamperes is passed

(*Continued on page* 201)

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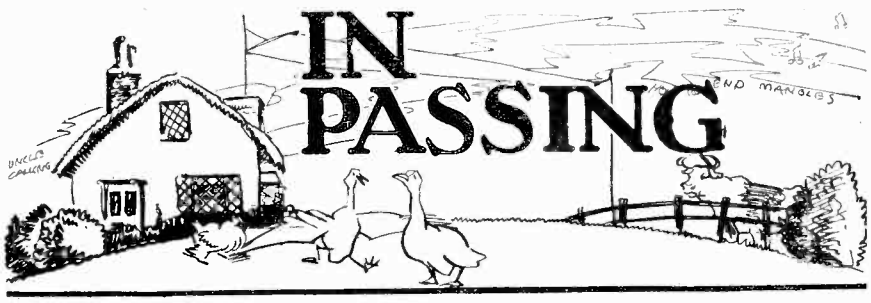
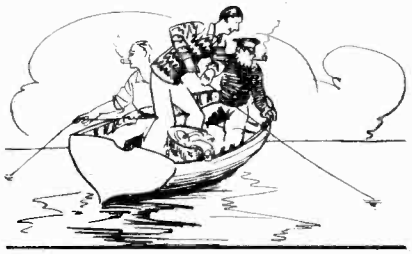


HERE it is again! The august month of August, the (so-called) crown of the year. Farmers all ready to be ruined; crops all ready to be gathered when the weather permits. Funny thing! Have you ever met a farmer who wasn't ruined several times annually? Yet see how the fellows live! Lashings of dairy produce; bacon and eggs to repletion. Cream, butter and vegs. innumerable; poultry past counting, and fruit beyond the wildest dreams of an anti-meat enthusiast. Fine young sons and daughters all "a-blowing and a-growing." Gosh! I'd like to be ruined on those terms.

Yes, my radio boys, I know that this is frightfully agricultural. You want to know where radio comes into all this. Well, I've just spent two mortal weeks as ever were, "down on the varm." I intend to reflect to you my reaction to that environment, so that you may be attuned to the same note when you wriggle out of harness and make for the truly rural.

No Escape

I do this because I know that wherever you may go on your annual escape you will find the demon radio. You may escape from business, the Civil Service, the L.C.C., or the ministry, or even from relations, but unless you plunge into the deeps of



. . . Whiting! Biting like tigers . . .

tropical Africa or a coal mine you cannot evade the tentacles of broadcasting.

Broadcasting reception is ubiquitous—nearly. Its insidious temptations have ramified all over the world, with a valve-power proportionate to the distance from the centre of the evil. Evil, I say, who liken the pest to malaria or cancer. Rather should I liken it to a ray of light, a revolving ray, with slight blurs of chamber music and symphonies evolved by congenital perverts.

But let me, your faithful passer-by, compose a Pastoral for your delectation as you lie by babbling stream or soothing sea; allow me to voice the views of the "voiceless" kin who bleat, moo, bark, coo, neigh, or squawk their rights and wrongs from the trees, posts, mats and hillsides in this stilly, sunshiny weather, between the showers of that gentle English rain which makes our England so fertile and ruins our farmers to such prosperity and high-living.

Down in Zummerset

Come with me to Zummerset! Yea, I went to that fair land of red fields, fat sheep, and contented kine—to say nothing of the saucy rabbits—and even there I found radio in full blast, morning, noon, and night.

Seated before a mighty teapot and a home-made cake as big as a ten-gallon oil drum, in the garden of a farmhouse at the edge of Exmoor, I heard the Derby result by radio. The fact—not the result—made me grind my teeth. I mean the two which engage; the rest are "staggered."

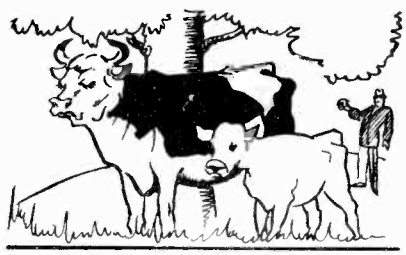
One epic day I and another man left the land and from a wet-nosed hooker (skippered by Mr. Preston Ley, a fisher-body who I now immortalise in prose out of gratitude) we angled four hours and pulled up the blighters at the rate of thirty per hour. Whiting! Biting like tigers. This massacre brought to us a holy calm, a benignity, a sort of Twilight of the Gods, a satisfaction with lesser men and things too deep for words. All I remember of human speech was the epithet evolved by my companion.

"Fish," he murmured. "A hundred and twenty in three hours and fifty-seven minutes. Think of it, *you deckle-edged bell-wether.*"

And then—this is the point—as we poised forks a little later over a Brobdingnagian pile of freshly-fried whiting, a black, horrid, apparently obsolete and underfed loud speaker snarled, "Mister Alfred Tompkins will now give his talk on 'How to mend mangles.'" We regarded each other in silence, and then began to talk rapidly about the amazing slump in Ecuadorian Rails and Patagonian Industrials. The dream had bust!

In order to escape from my London memories of the human crowd I threw myself into an intense contemplation of the personalities of the Somerset animals. But I'll say here and now, and have done with it, that the Somerset folk are folk to like and live amongst. Each one worth a couple of Continentals with a dozen Esquimaux thrown in.

Now about radio and the animiles—I quickly discovered that the field fellows had very marked personalities.



. . . "Cleopatra received me with hauteur . . ."

One wordless conversation I held with an elderly ram, who chewed meanwhile like an American senator convinced me that although we probably approached the subject from widely divergent angles, nevertheless he and not I had the right idea. Had he not resembled one of my great-uncles, on the paternal side, and thus caused me to retreat breathless with mirth, I should have gone further into the matter with him. However, as I left he took a few thoughtful bites of grass and remarked that in his view wireless was responsible for the deterioration of the herbage thereabouts.

Cleo the Cow

After that display of human intelligence on the part of what I perceived to be merely a provincial ram I made it my business to interview some of the higher officials, all living within a mile of the Ship Inn. I except the Exmoor pony, whose seat was more distant, and who sent a foal to tell me dad was nottatome.

First, I secured an introduction to Cleopatra the Cow. I found this lady taking a light meal, as is her custom, at about 7.45 p.m., *al fresco*, under a tree in the estate of Farmer Mugsworthy, a friend and assistant of hers. Cleo—if I may presume to use the diminutive on so slight an

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acquaintance—received me with hauteur almost amounting to indifference. The flies were *most* troublesome and, as she said, seemed to have more teeth than ever. She affected the "Charleston Twitch" with her tail. "*So* modern, do you not think?"

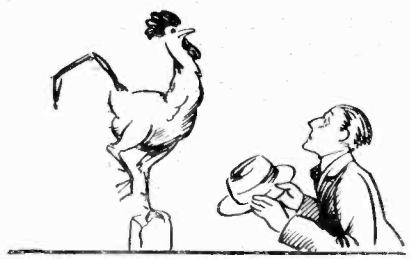
I introduced myself with a clod of earth which exploded on her rear verandah, and with a slightly disdainful air she turned and acknowledged my existence.

"I regret," I said, "that the exigencies of modern journalism and the iron routine of Agricolus, *alias* Varmer Mugsworthy, renders it compulsory for me to approach you within a few minutes of milking time. You understand? Yes. And your views on radio? Pardon me. I see a bluebottle approaching from the nor'-west. Allow me. Got him! He was a winner, with fangs like a crocodile. I am all attention."

B.B.C. Pronunciation

Cleo turned to me, bored beyond belief. She spoke with four buttercups in her leathery lips.

"Young man, radio is of no advantage to a cow and a mother like me. It's turned the head of thicey melk-med. (Tut! this vernacular). Why, I have to walk up to that gate and *moo* before she'll drag herself from the contraption. Life is hard enough, what with this calf. He's for ever trying to pronounce 'moo' like B.B.C. cows. And then there's this field. I'm s'posed to keep it cropped and all that, but what I say is, if a hardworking lady like me is expected to do that, why should that milkmaid with her bobbed hair and silk stockings be allowed to



. . . This nightingale business is badly overdone . . .

keep me moo-ing ten minutes past my lawful milking time, all because some young London spark wants to do the la-di-da with his pro-nouncei-a-shun, ch? Moo? No! On the whole, I am anti-radio, though I'd swap my horns and tail for a couple of pairs of silk stockings. You're a nice-looking young fellow, now. Don't you think——" Cleo was becoming sentimental and so I left her.

I interviewed Andrew next. Andy is the dog that runs the Tower Inn, and directs the motor traffic through the village.

"Yes," he said, "this is my hostelry right enough, and that's my bone—you can keep away from it because I'm hasty in my conclusions." All the time he was speaking he trotted to and fro.

No Use For It

"Radio," he continued. "No, I can't say I think much of it. You can't *smell* it, can you? Or bite it, can you? And it can't hear you *bark*, can it? Then its no earthly use to a dog, for you can't eat it. Ah, but perhaps I overstate the case." He sat down and fixed his bloodshot eyes one on me and one on the garden gate.

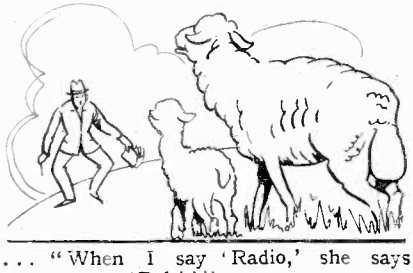
"I knew a dog. Common chap, name of Spot, who got a job—through influence—to bark for the B.B.C. Couldn't hold it down, though. They said his—er—diction was provincial and his pronunciation archaic. He bit the Uncle who started that and was disrated from an artist to a mere stunt hand. Had to bark and howl in playlets about Irish people living in lonely cabins and such. His family tried to live it down by giving out that he had turned specialist. Haw, haw! Did I—did you—hark! Was that anything like the sound of a bantam? No? My fancy, I suppose.

"Well, Spot played to crowded houses for six months, and then one night he buzzed across the Embankment to look for rats in the Thames, and was flattened by a bishop's car. At least, his family *said* so. Name of Spot. From Devon. If you doubt it, ask about if there wasn't a dog called Spot who had a butcher living with him. In Devon! Excuse me, now! They say that bantam of ours is boasting he's still one feather left to his tail. I must adjust that. I won't have it."

The Battered Bantam

I noticed that Andy was diverted from his cruel errand by a block in the traffic; a "Watson Five" was trying to carry a loaded hay-wain on its back. So I slipped round to the back of the inn to meet Gladwyn the Bantam. With one yellow eye immovably focussed on Andy's usual line of attack and the other fast asleep, Gladwyn occupied the summit of a clothes-post. When I had explained the object of my visit he spread his last pathetic little tail-feathers as though his ancestors had been peacocks, flapping his wings ferociously.

"I expect Andrew is a bit peevish to-day," he began. "I had to correct him this morning. Queer thing he can't keep to his own job and let me run this garden in peace. Lorna Doone knows its hard enough, what with summer-time, electric light and all. But there, you do not want to be bored with our petty village gossip."



. . . "When I say 'Radio,' she says 'Bah!'" . . .

"I will, however, mention that I consider that nightingale affair to be ludicrously overdone. As a pro. my pride is wounded by it. Dammee, sir! For *verve*, for *timbre*, for the true music, for that quality of tone which wakes the blood—and the sleeper—they ought to apply to yours very truly.

Radio? Bah!

Shocked by these scandals I fled to the uplands and hobnobbed with an ancient sheep with a face like a well-known cleric of heterodox tendencies and with the soul of a journalist. She looked me through and through for the space of some eight minutes, and apparently came to no conclusion. Reversing her cud and shaking herself free from a thirsty lamb whose tail waggled at a frequency corresponding to a wavelength of about two metres, she remarked, "Ma-a-a!"

Then, shifting her quid and ringing her buccal engines to half-speed, counter-clockwise, said, "Ba-a-a-!

"Yes, bah," I thought, as I turned away; "that is fair comment by an impartial witness. Is it a gesture of contempt? Is it a call back to nature? This sheep has known man and his ways for thousands of years, and when I say 'radio' *she* says 'Bah.'"

Thoroughly humbled, I went back to London, and altered the set from transformer to res-cap. coupling as a penance. It works fine.

After all, radio rules the roost, the camp, the farm, the Court and the home; or *will* do.

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RADIO and the GRAMOPHONE

A SECTION FOR THE MUSIC LOVER

CONDUCTED BY KEITH D. ROGERS.

In this section of MODERN WIRELESS each month will be discussed both technical and other data of interest to the set owner who is also interested in gramophones, whether from a technical or purely utilitarian point of view.

Besides articles on the operating sides of amplifier and pick-up combinations, and various hints and tips of value to the constructor and set owner, a brief survey and critique of the latest gramophone records is included, making the section of vital interest to all music-lovers.

CONTENTS

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ROUND THE TURNTABLE

A page of odds and ends of interest and value to all radio or gramophone enthusiasts.

IT is essential that records be kept clean and free from dust when in use. Dust, and powdered record due to natural wear, will soon cause noisy reproduction if allowed to remain in the track of the needle.

* * *

Special cleaning pads can be obtained, or a fine camel-hair brush will do admirably, for keeping records free from dirt.

"Chatter"

A sound-box with a mica diaphragm can sometimes be cured of "chatter" by a spot of sealing-wax or candle grease on the centre screw which holds the fulcrum to the centre of the diaphragm. A little looseness here can cause a great deal of unwanted noise and distortion.

* * *

Completely shutting the doors of a gramophone to "soften" the music is bad for the sound-box. It causes a back transference of the sound waves and consequent chatter of the diaphragm.

* * *

Where high H.T. voltages cannot be obtained a push-pull L.F. amplifier will sometimes provide better results than one which is transformer- or resistance-coupled.

Bass Notes

An all-transformer-coupled amplifier is not advocated for pick-up work. Cut-off of the bass notes is too marked with the majority of such amplifiers.

* * *

In order to do it justice a moving-coil loud speaker needs a fair strength of output, otherwise the reproduction is wont to sound distant or blanketed.

* * *

If your pick-up chatters badly take steps to find the cause of the trouble and remedy it or you will rapidly ruin your records.

One of the adjustable pick-up arms now available for about 13s. may do a great deal to lessen wear on your records—especially if the pick-up you prefer weighs more than 4 ozs.

* * *

See that the needle bears evenly in the record groove and does not "lean" on one wall more than the other. If it does bad wear and poor reproduction will result before long.

* * *

Evenness in running is a vital feature in any turntable and motor assembly. Any sway or "out of centre" effect on the part of the turn table will have a marked effect on the reproduction of the music, besides shortening the life of the records.

Earthing

It is often essential to have a pick-up amplifier earthed, a metal connection being employed between the L.T. leads and a water-pipe or other earthed system.

* * *

Don't forget that any record with deep bass notes, such as "The Storm" or other organ pieces, needs careful amplification or the valves in the amplifier will overload on the loud, deep pedal notes.

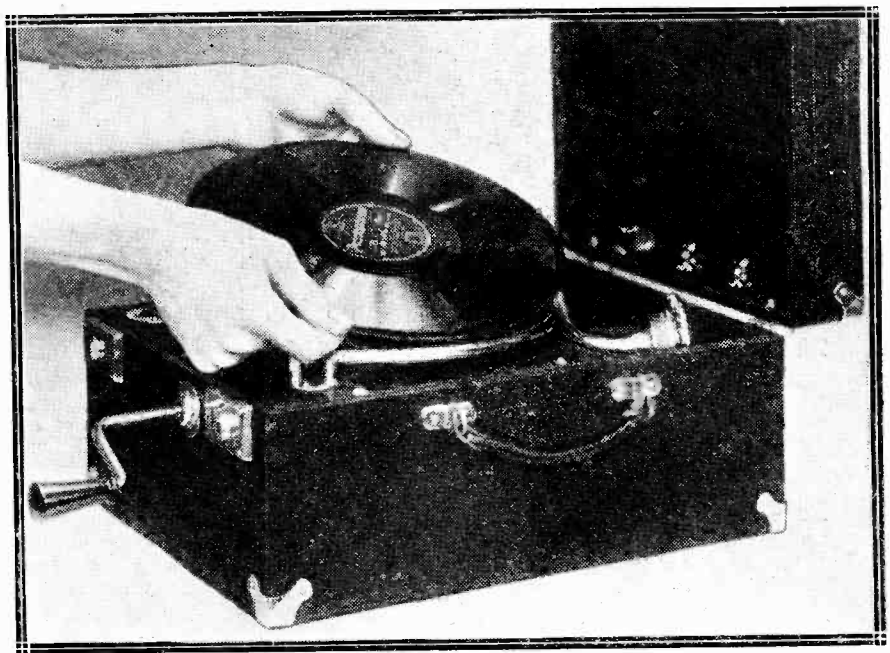
Two Types

The Pathé sapphire-point records are not suitable for pick-up reproduction. The grooves are modulated "up and down" instead of "side to side," and need a different type of sound-box from the ordinary "needle-cut" records.

* * *

The Pathé people make needle cut records as well as the others, so be careful what you get when ordering.

The "Actuelle" and the "Pathé Perfect" are those suited to pick-up reproduction.



Messrs. Lissen, of battery and wireless component fame, have entered the gramophone trade. Their first venture—the "Lissenola" Portable, is shown above, and is reviewed on page 10.

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IN THE TWILIGHT

Music has great charm in that most fascinating period of the day—'twixt sunset and dusk. To enjoy it wherever you may be—in the house or garden, on the tennis court or river, or by the countryside—in fact, anywhere, at any time; for dancing, or just for the entertainment provided by good music perfectly produced, take the line of least resistance and invest in one of the new Lissen products, the

LISSENOLA
REG. TRADE MARK
GRAMOPHONE
THE PERFECT PLAYING PORTABLE

Here is a portable gramophone, with a fine sound box, a robust, silent-running motor, fitted with speed regulator and cam brake, and which has a horn longer than in any other instrument up to double the price. Its reproduction of bass notes is a revelation. The case is covered in artistic black figured leatherette. The cover carries eight 10 in., and the machine will play up to 12 in. records.

Every gramophone tested before despatch, is compact, handsomely finished, light and easy to carry—the ideal companion for the picnic and the holiday. Provides a full volume of dance music at any time, anywhere. Buy a "LISSENOLA" to-day, and add to the enjoyment of your holiday or week-end.

If unable to obtain prompt delivery from your dealer, order at once direct from Lissen's, but give your dealer's name and address, and state Model required. Cash with order, or will be delivered by return, C.O.D.

MODEL No. 1
(As illustrated)
£2:2:0

MODEL No. 4
With special horn, sound box and long-running motor
£3:7:6

7 DAYS' APPROVAL

If you are not entirely satisfied with the "LISSENOLA" after trial, return to Factory within seven days and money will be gladly refunded in full.

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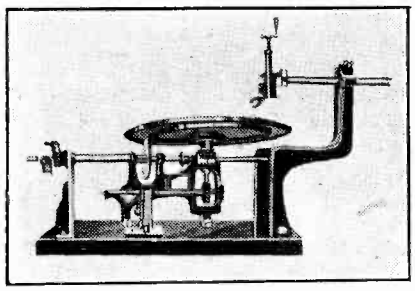
The SEARCH FOR SILENCE

In this interesting article our Scientific Adviser, who is a recognised authority on gramophone matters, discusses the causes and cure of "surface scratch."

By Dr. J. H. T. ROBERTS, F.Inst.P.

I STATED in a previous article that the fine groove or track in the surface of the record, if it could be examined under a microscope, would be seen to have a wavy or sinuous character, and that it was the wavy character of the track (imparting a vibratory motion to the needle of the sound-box) that caused the sound to be reproduced.

If the sinuosities of the sound groove or track were entirely smooth, that is to say, if there were no extra irregularities (smaller than the musical waves of the track) superimposed upon them, and if the material of the record and the material of the needle were



One of the earlier types of recording machine. The device seen above the turntable carries the cutting stylus.

absolutely smooth, and, furthermore, if no breakdown of the record material and the needle material took place—in short, if there were no friction (other than that necessary to sway the needle point in accordance with the musical waves) between the record and the needle—then the surface noise would not arise.

Recording

I think I also explained in the article that the first process in making a record is for the artist to sing before a trumpet (or before a microphone, or number of microphones) and for the sound-waves to actuate ultimately a device which is, in effect, an electrical gramophone pick-up working "backwards."

The Stylus

The needle rests lightly upon the surface of a rotating, circular, horizontal slab of specially prepared wax and the needle is progressively moved in a radial direction (by means of a worm-drive geared to the machine), so that it traces the spiral groove which is eventually reproduced in the commercial record as you buy it in the shop. Whilst the needle is cutting the groove it is at the same time vibrating in accordance with the sound waves from the singer's voice, and therefore the groove is not merely a plain groove, but is, as I have already indicated, of a wavy or sinuous character.

"Cutting Noise"

Now, when the recording needle, or "recording stylus," as it is generally called, is cutting the original track in the "wax master" record, it is performing an operation precisely similar to that of a tool cutting a metal job on a lathe. It is true that the wax of the wax master is very soft compared to the metal, but, nevertheless, the two jobs are precisely similar.

When a record is being made, a slight continuous hiss is audible, and this hiss corresponds directly with the squeak of the metal-cutting tool.

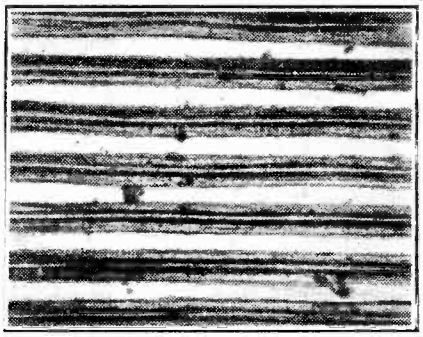
By giving careful attention to the cutting and clearing angles of the recording stylus (which is a tiny chip of sapphire carefully sharpened by a lapidary), and by taking special precautions with the composition of the wax blank for the making of the master record, and running the wax

A highly magnified photograph of a part of the record where the walls of the track have been completely broken down. This is the kind of thing that happens in a record which has been much used.

blank at a carefully chosen temperature, as well as by a number of other precautions, it is possible greatly to reduce the cutting noise or hiss.

Chatter

In the early days of gramophone recording, the chatter of the recording stylus and the irregularities thereby produced were quite considerable, and when carried through the various duplicating processes they contributed an appreciable quota to the large



A highly magnified view of the sound grooves in a record showing particles of disintegrated record material which gives rise to clicks and surface noise.

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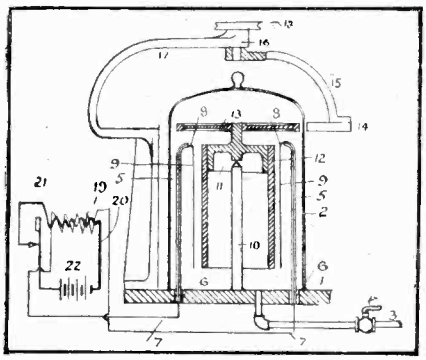
amount of surface noise which, in those days, was such an unwelcome characteristic of the record.



A diagram from one of Edison's early patent specifications showing the vacuum method of sputtering a thin gold film upon the original cylindrical wax master.

Now let us assume that a perfect, or nearly perfect, wax master record has been obtained; the next step is to prepare this wax master for electrotyping. A copy or "positive" (using an analogy to photography) of the wax master has next to be made and this is done by copper-plating the wax master in a copper sulphate solution in the usual way.

But you will notice at once that the wax master is a very good *non*-conductor, and before it can be electroplated it has to be rendered sufficiently electrically conducting.

"Plating"

This is done by producing a conducting film of extremely small thickness over its recorded surface. There are various ways in which the surface of the record may be "metallised." One method, due to Edison, was known as the "gold moulding" process, and consisted in placing the wax master in an evacuated vessel in which a high-tension electrical discharge took place between electrodes, one of which was of gold.

The gold electrode was "sputtered" and deposited an exceedingly fine gold film over the whole of the surface of the record, thereby rendering it sufficiently conducting. Another method is to rub the surface of the record with extremely fine graphite applied with a fine, soft brush, and rubbed and rubbed until the wax has a "black-leaded" appearance.

Easily Spoilt

Without going into further details of this, you will see that unless the metallising of the surface is carried out with the utmost care and skill, and the finest grade materials used, there is a glorious opportunity for all kinds of irregularities to be introduced into the recorded track, even if it were nearly perfect to start with.

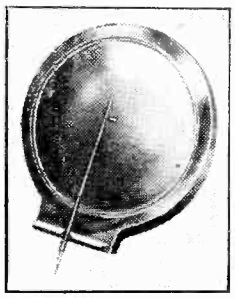
The next stage is the immersion of the wax master in the copper sulphate bath, and the depositing of a layer of electrolytic copper upon it. Unless the electrotyping is carried out by an expert skilled in this particular application of electro-plating, all sorts of troubles will arise due to irregular deposition of the copper, bad places, minute air-bubbles lodging in the track, and so on. In fact, having regard to the delicacy of this particular part of the duplicating process, and to the fact that it has to be carried out under commercial or "factory" conditions, it is really remarkable how well the difficulties have been overcome.

Further Steps

When the copper coating has been produced upon the wax master to a sufficient thickness (about 1/32nd or 1/64th of an inch) it is stripped off and it constitutes the first really permanent record.

This first copper impression is called the "copper master," and is, as I said before, a positive of the original negative wax master.

The copper master has then to serve the purpose of making a number of copper negatives (or "copper mothers" as they are called in the trade). And this duplication is again carried out by electrotyping, when most of the possible troubles to which I have just referred crop up afresh.



One of the earlier forms of recording sound-box for use with the non-electric method. The diaphragm is of extremely thin glass.

After a series of "copper mothers" have been made, each of these copper mothers produces a set of "working stampers," these being, of course, duplicates of the "copper master" and all being produced by electrotyping.

You will see, therefore, that in the production of a working stamper for pressing a commercial record there have been three successive electrotyping processes of duplication, and in the duplication from the copper master and again from the copper mother it may be that several previous copper mothers or stampers (as the case may be) have been made previously.

"Stock" Records

Now, finally, the working stamper is again electro-plated with a special metal, which is much harder than the copper itself, and this plated stamper is used in the record presses for impressing the soft black material, which is known in the trade as "record stock," to produce the actual black records as you buy them.

The material of the record varies greatly with different manufacturers, but I am not giving away any secrets

A recorded wax blank as it comes from the recording room and before it has commenced its journey through the record factory.

when I say that it contains, amongst other things, shellac and a very fine mineral powder. It has sometimes been urged that this powder is responsible for most of the surface noise, but this is not true. One of the purposes of the powder is to bind the record together and to give it strength as well as hardness. You must not imagine that the grains of the powder (in a properly made record) are all protruding through the surface.

Keep Clean

When the record "stock" is being made, it is heated to a temperature which makes it very soft indeed, and the shellac and other substances automatically flow around the particles of powder and enclose them completely so that the powder is entirely enveloped within the record and is not sticking out of the surface.

It will be clear that it is very desirable indeed to keep records always *clean*. Any dust, if allowed to remain in the sound grooves, acts as an abrasive powder and rapidly promotes further disintegration of the record, as well, of course, as interfering with the rendition from the record.

This dust is not always due to that deposited from the air. The worst enemy of the record is the dust due to the actual wear and tear of the record caused by the passage of the needle round the grooves, and this dust rapidly wears away the record.

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The "RADIO-GRAM" AMPLIFIER

Here is a specially designed L.F. amplifier capable of giving really good volume and pure reproduction from both radio broadcasts and gramophone records.

Designed and described by C. T. KING.

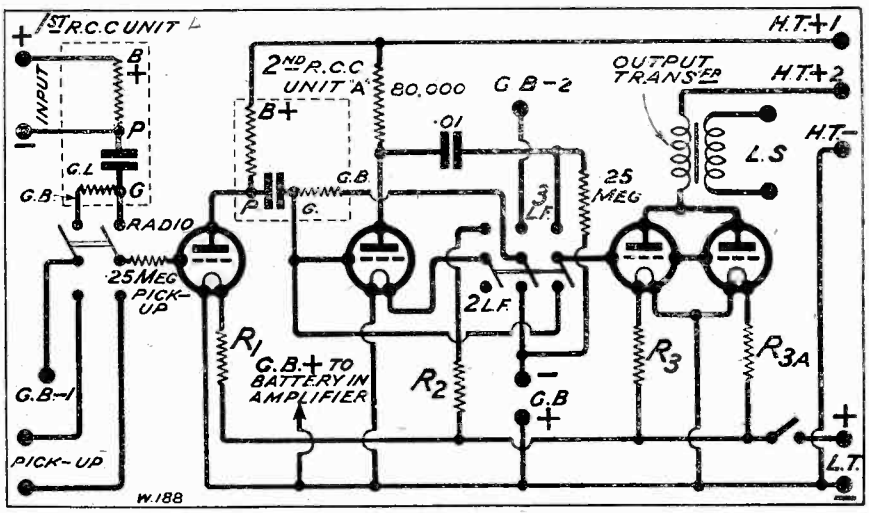
THE amplifier described hereunder consists of three L.F. stages, all resistance coupled, with provision for two power valves in parallel in the last stage, and was designed to meet the following requirements: (1) to operate a moving-coil or cone-type loud speaker; (2) to allow for a good volume from a gramophone pick-up, and yet enable the operator to reduce the volume on radio by cutting out one L.F. valve; (3) radio or gramophone by a turn of switch; (4) grid bias automatically maintained correct regardless of circuit changes; (5) prevents the H.T. current from flowing through the loud-speaker windings, and (6) to couple to any radio set consisting of a detector or detector and H.F. stages.

Resistance Values

A switch is provided to cut out the 2nd L.F. stage, with provision for compensating the grid bias for the last L.F. valves and breaking the filament circuit of the 2nd L.F. This allows one the choice of two or three L.F. stages for radio reception and the whole amplifier for the gramophone.

The grid leaks in the 1st and 2nd R.C.C. units can have values of 2 megohms or less, and the anode resistances maximum values of 250,000 ohms. If the anode resistance is replaceable in the 2nd R.C.C unit, the writer suggests 150,000 ohms, otherwise 200,000 to 250,000 ohms is quite suitable. A valve suitable for the 1st L.F. stage is one of 15,000 to 30,000 ohms, with as high a "mu" as can be obtained.

The last valves should, of course, be of the super-power type, and can be of the lowest impedance procurable. Makes such as the Marconi or Osram D.E.5A, Cossor Stentor Six, or Mullard P.M.256, are recommended. Larger power valves than these can be used if one is prepared to supply the necessary



The theoretical circuit of the "Radio-Gram" Amplifier.

LIST OF COMPONENTS REQUIRED

1 Cabinet, 14 in. × 7 in. × 9 in. deep, complete with baseboard (Camco). (Artcraft, Bond, Caxton, Maker-import, Pickett, Raymond, etc.)

1 Ebonite panel, 14 in. × 7 in. × ¼ in. (Any good branded material).

1 2-pole change-over switch (lever type) (Utility).

1 3-pole change-over switch (lever type) (Utility).

1 2-stud L.T. on-off switch.

2 R.C.C. units, type A, for valves 15,000 to 30,000 ohms impedance (R.I.-Varley in original. See text for general requirements).

1 Output transformer (Ferranti). (For ratio see text.)

4 Sprung valve holders (Ashley, Benjamin, Bowyer-Lowe, Burndept, Burne-Jones, Igranic, Lotus, Pye, Redfern, W.B., etc.).

4 Fixed filament resistors (Cyldon, Peto-Scott, etc.).

2 Grid-leak holders (Dubilier, Lissen, etc.).

2 ·25-meg. grid leaks (Dubilier, Igranic, Lissen, Mullard, etc.).

1 80,000-ohm wire-wound anode resistance and holder (Dubilier, Igranic, Mullard, R.I.-Varley, etc.).

1 ·01 mica condenser (Dubilier, Lissen, Mullard, etc.).

2 9-volt grid-bias batteries (Ever-Ready or other make of similar size).

2 Sets of G.B. battery clips.

13 Terminals, markings according to diagram (Belling and Lee, Eelex, Igranic, etc.).

2 Aluminium panel brackets.

1 Strip of ebonite for terminal board, 14 in. long and any suitable width × ¼ in. thick.

5 Wander plugs (2 red and 3 black).

Quantity of No. 20 S.W.G. tinned copper wire and Systoflex of small bore or, alternatively, quantity of Glazite.

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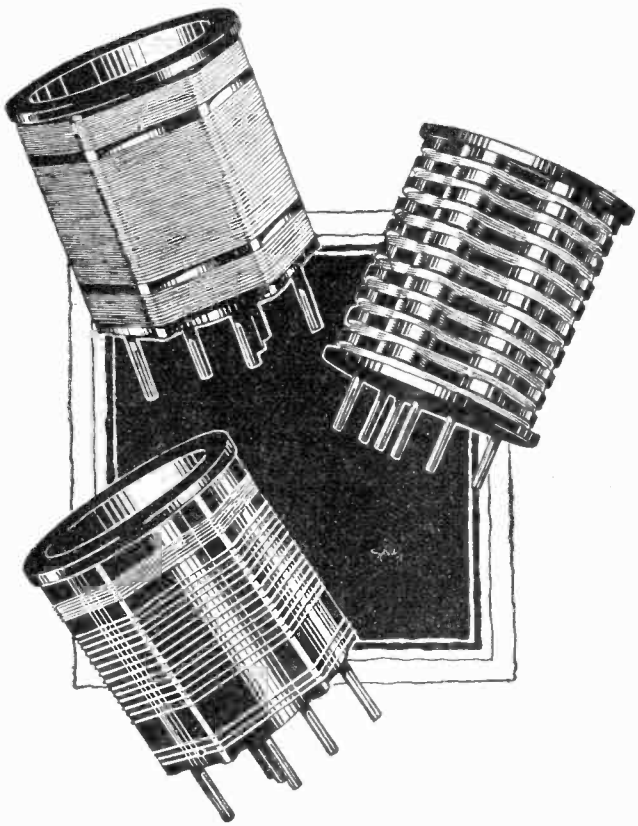
Range...Volume Selectivity...Control



SELECTIVITY to the highest degree is easily obtained with Colvern Coils.

RANGE depends to an extremely high degree upon efficient coils, and it is very important that these should have a very low high-frequency resistance. To obtain this Colvern Coils are accurate space-wound. Experience proves that the use of Colvern Coils increases the range of a radio receiver. In the case of the Master Three Colvern Coils give maximum range on each of the three wavebands.

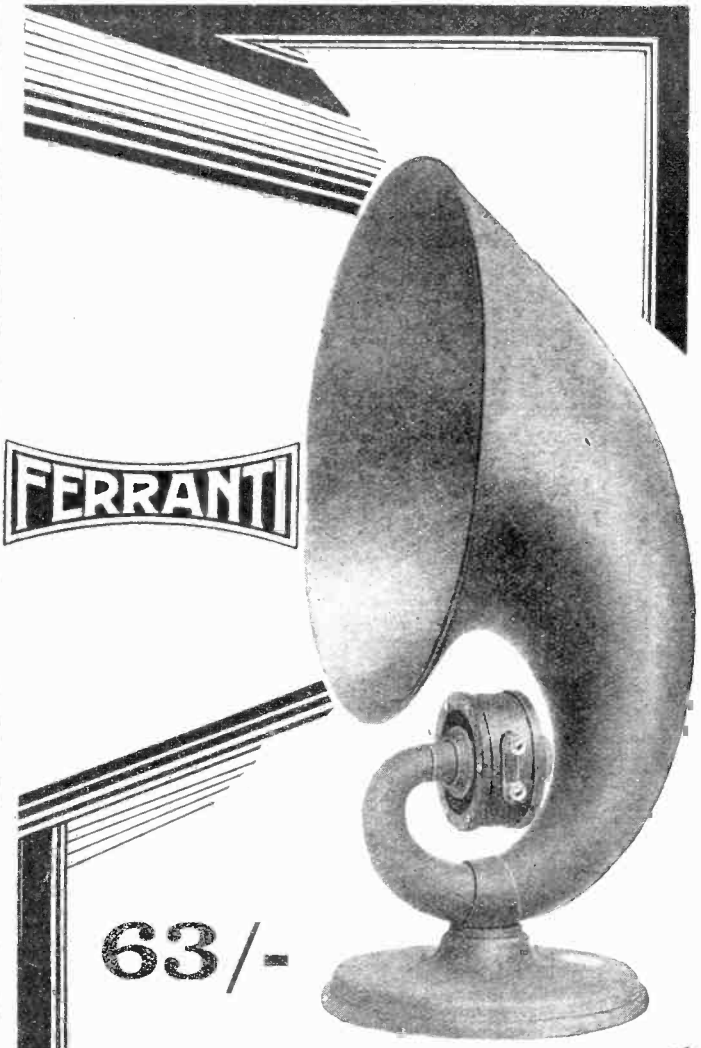
VOLUME is similarly dependent upon the efficiency of coils. Logically, the signal strength of distant stations is greatly increased by Colvern Accurate Space-Wound Coils.

Also manufacturers of the COLVERN (Haynes type) Moving Coil Loudspeaker. Full details upon request.

COLVERN
ACCURATE SPACE WOUND COILS

From all Dealers

Advt. of Colvern Ltd., Mawney's Road, Romford.



THE SPEAKER WITH THE EXPONENTIAL HORN

□□□

THE BEST SPEAKER for THE ORDINARY SET

FERRANTI LTD.
HOLLINWOOD, LANCASHIRE

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filament current and H.T. voltage, but it must be remembered the output transformer is only rated to carry 40 milliamperes, so that the possibility of "saturating" the core of this transformer must not be overlooked.

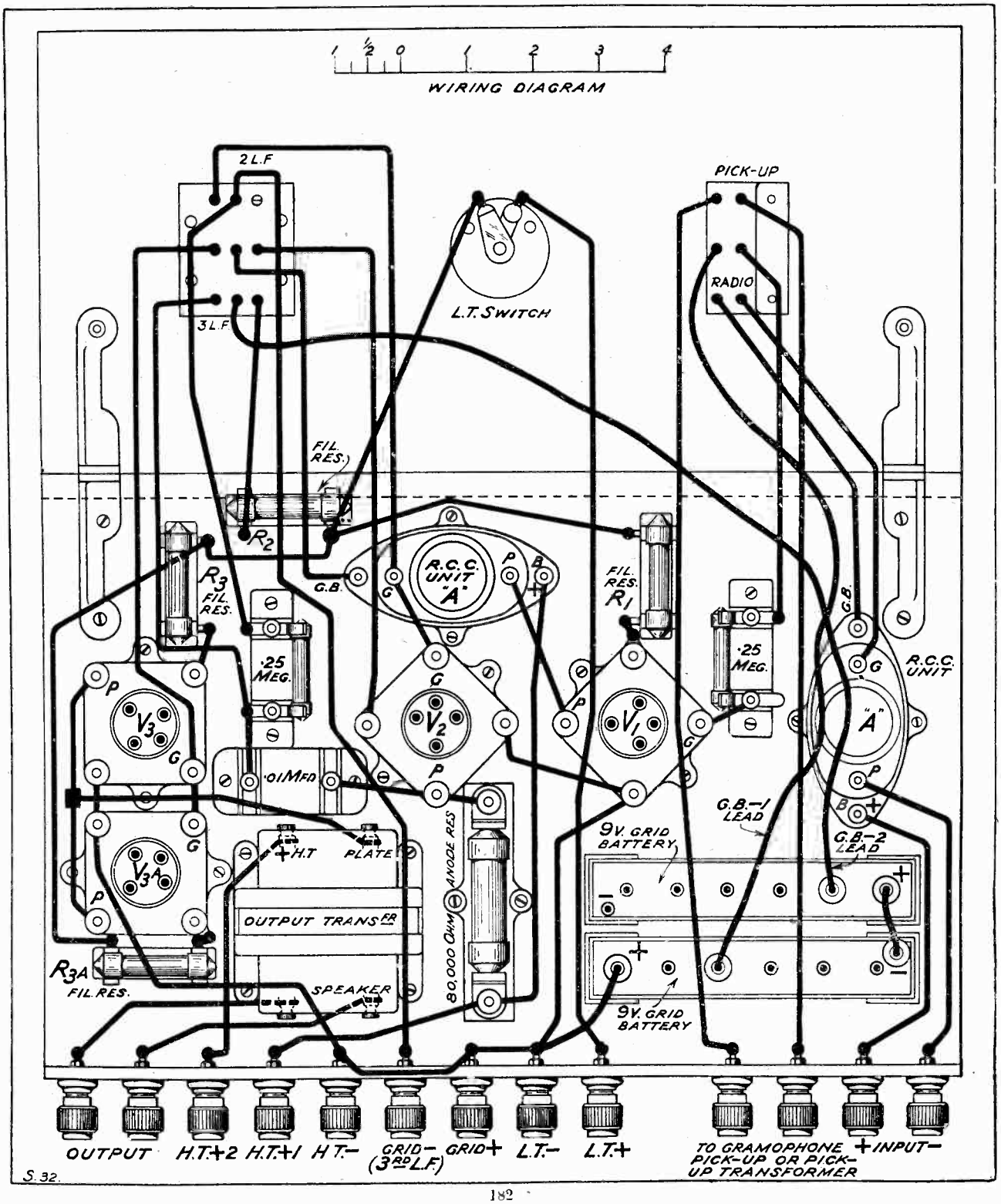
Regarding the latter component, some few hints regarding the ratio and its function would not be out of place.

Its primary function is, as explained before, to prevent the steady anode current of the last valves from passing through the loud-speaker windings.

Output Transformers

In the case of a high-resistance loud-speaker winding, the ratio will be 1 : 1 (equal), so as to pass on the fluctuating A.C. impulses only. With low-resistance loud-speaker windings, as with a moving coil, the ratio should be 25 : 1, and Messrs. Ferranti have designed this particular model to suit most of the moving-coil loud speakers now available. The model which will eventually be purchased will therefore depend entirely on the type of loud speaker to be operated.

A point which needs explanation is that of grid bias, and why G.B.



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terminals have been arranged on the terminal strip and 18 volts G.B. inside the amplifier. Although most constructors will probably derive sufficient voltage for grid bias from the batteries accommodated inside, yet it is certain some constructors will use power valves in the last stage which necessitate the use of between 20 and 40 volts, and these cannot, of course, be arranged inside the amplifier. The grid-bias batteries inside the amplifier can be utilised for the 1st and 2nd L.F., the exact voltage tappings depending on the valves employed.

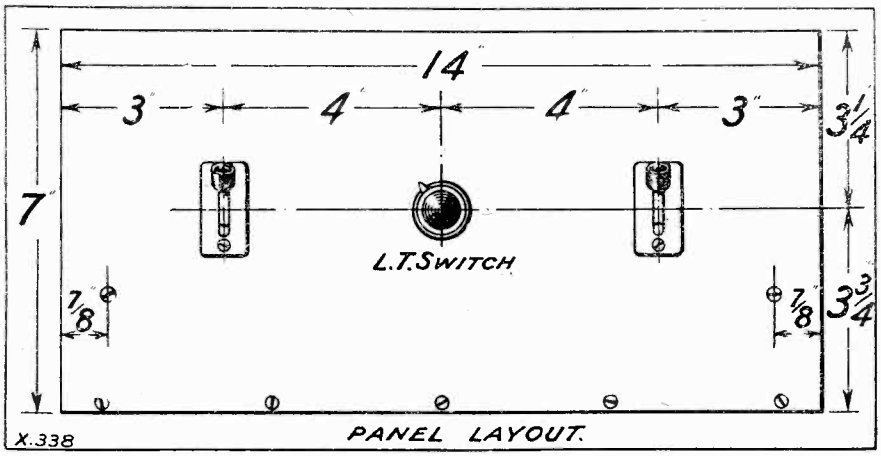
If the grid bias needed on the last valves does not exceed 18 volts, the "grid—" terminal on the terminal strip can be arranged with a plug and flexible wire, and the plug inserted in the maximum negative socket on the battery. "Grid +" terminal will in these circumstances be left unconnected. In the same connection, it may be mentioned, the H.T.+1 and H.T.+2 terminals can in most cases be joined together, and one common H.T. lead taken to the battery or H.T. eliminator. The only occasion on which this scheme will not hold good is when an abnormally high H.T. voltage is applied to the last valves, or whenever the amplifier tends to "motor-boat," and then a separate tap should be used.

Constructional Details

Now, having covered some of the general phases of this amplifier, we must turn to constructional details. As far as this amplifier is concerned, the work will be found very easy, since the panel drilling is the acme of simplicity. Two slots, the templates for which are the front plates of the switches, and a plain hole for the L.T. on-off switch, constitute the drilling other than holes at the bottom edge of the panel for fixing to the baseboard, and two small holes for aluminium brackets.

Components mounted on the baseboard, are screwed in approximate positions only, as shown on the wiring diagram. When fitted, the amplifier can be wired with any suitable wire; covered wire being preferable, owing to the compactness of the whole unit. The writer used No. 20 S.W.G tinned copper, with a special thin Systoflex for neatness. Alternatively, "Glazite" is also very suitable.

After wiring, the leads should be checked carefully from the wiring diagram before connecting the batteries.



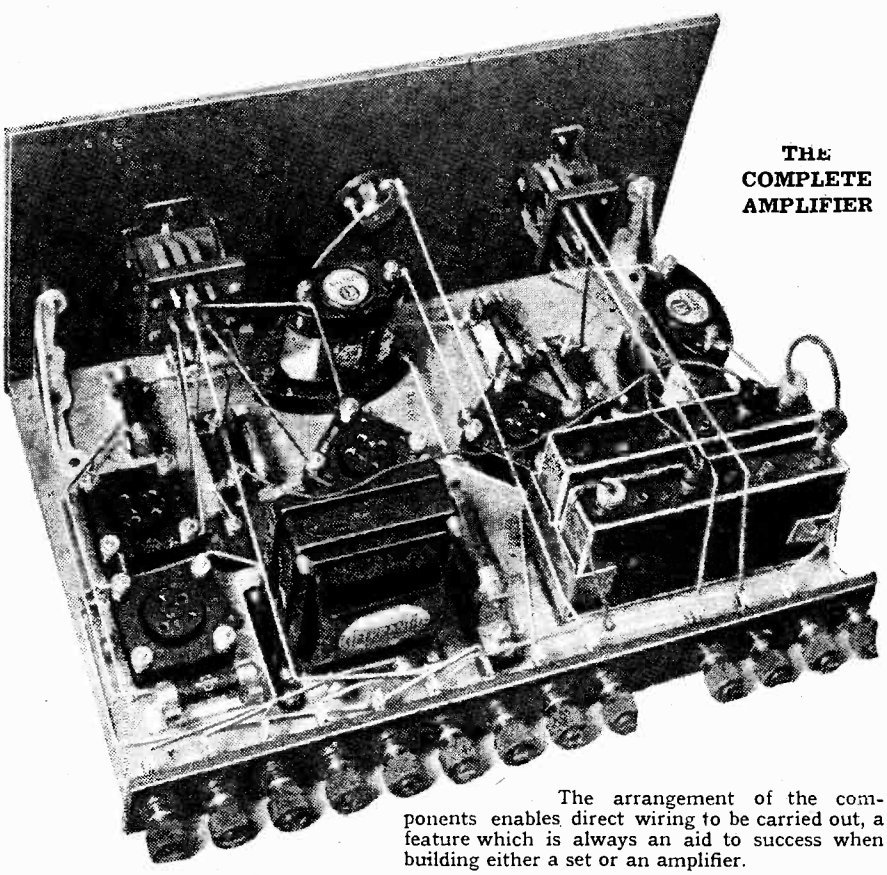
It must be remembered the switches on the panel point in opposite directions to the points marked. Thus when, say, the arms of the first switch are down for "radio," the actual lever on the front of the panel is up.

Connecting Up

Constructors should, with these switches mark "radio" at the top, "pick-up" at the bottom of the same switch, and "3 L.F." at the top on the second switch.

Lastly, when connecting the amplifier to an existing detector (with or without H.F. valves) circuit, make certain the "Input —" terminal joins to the 'phone terminal on the set which is connected to the plate of the detector valve, possibly through an H.F. choke in the set itself. The "Input +" terminal then goes to the remaining 'phone terminal, which on the *set* will join to H.T. +.

Since an anode resistance will replace the 'phones when coupling the amplifier to a detector unit, it is possible reaction will be inoperative, owing to the value of H.T. normally applied to the detector valve being insufficient. In these circumstances constructors are advised to adjust the H.T. wander plug for the detector valve to something like 100 to 120 volts.



THE COMPLETE AMPLIFIER

The arrangement of the components enables direct wiring to be carried out, a feature which is always an aid to success when building either a set or an amplifier.

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RECENT RECORD RELEASES

Orchestral and Band

Pathé Actuelle. ***Dance Macabre*** (Parts 1, 2, and 3) and ***Le Cygne.*** Pathé Symphony Orchestra. (Two 12-in. records.)

Quite a good rendering, but rather on the "under-modulated" side.

Zonophone. ***"Aida" Selection*** and ***"The Bohemian Girl" Selection.*** The National Symphony Orchestra. (A340. 12 in. 4s.)

A skilful arrangement of the wonderful airs from "Aida," and an equally pleasing performance of the ever-popular opera by Balfe.

Vocal

British Brunswick. ***The Man I Love*** and ***Bluebird, Sing Me a Song.*** By Vaughn de Leath. (3757. 10 in. 3s.)

Light vocal items that are well rendered.

Who's That Knocking At My Door? and ***I'm Going to Settle Up.*** By Kel Keech and Ord Hamilton. (170. 10 in. 3s.)

Two little gems which do justice to the artistic methods of this notable pair.

Broadcast. ***Can You Imagine Me?*** and ***I'm Going Home to See If I've Gone Home.*** Harry Weldon. (260. 1s. 3d.)

Taken too fast. It is difficult at times to follow the words.

Gems from "Show Boat." (261 1s. 3d.)

Another delightful musical comedy "selection" record.

Parlophone. ***Limehouse Rose*** and ***What Do We Care?*** By Noble Sissle (R128. 10 in. 3s.)

Sunny Skies and ***Guiding Me Back Home.*** By Noble Sissle. (R129. 10 in. 3s.)

Two ultra-sentimental records that should be popular among the followers of Americanised dance music.

Pathé Perfect. ***Highways Are Happy Ways*** and ***Wide Open Spaces.*** By Gilbert Austin. (P382. 10 in. 1s. 6d.)

A couple of light items that should be very popular. We like the latter-named better than the former.

Zonophone. ***Worthy Is The Lamb*** ("The Messiah") and ***He Watching Over Israel*** ("Elijah"). The Mormon Tabernacle Choir. (A341. 12 in. 4s. 6d.)

Two brilliant recordings. The singing is superb though a little interfered with by echo at times. An impressive record.

Dream Kisses and ***You'd Rather Forget Than Forgive.*** The Silver-Masked Tenor (with Orchestra). (5128. 10 in. 2s. 6d.)

A well-rendered record by the mysterious tenor who specialises in the ultra-sentimental type of song.

The Star of Bethlehem and ***The Holy City.*** Barrington Hooper (Tenor, with Organ). (5121. 10 in. 2s. 6d.)

A notable addition to the record library of religious music.

Ave Maria (Gounod) and ***Ora Pro Nobis.*** Esther Coleman (Contralto), with Organ and Violin Obligato and with Chorus and Orchestra. (5125. 10 in. 2s. 6d.)

Miss Coleman is at her best in these two popular items.

Oh, Susanna! and ***When the Sun Goes Down Again.*** Dalhart, Robison and Wood. (5126. 10 in. 2s. 6d.)

Some of the real old "darkie stuff."

Instrumental

Brunswick. ***Rain*** and ***C'est Vous.*** Organ solos by Archie Parkhouse. (167. 10 in. 3s.)

Both excellently recorded. The bass is very good.

Parlophone. ***That's a Good Girl.*** Selection, Piano Solo. By Raie da Costa. (R130. 10 in. 3s.)

A remarkably good record. The playing is brilliant, both in execution and in recording.

Dance Records

Brunswick. ***Can't Yo' Heah Me Callin', Caroline?*** and ***Poor Butterfly.*** (Symphonic Syncopation). Red Nicholls and his Five Pennies. (20066. 12 in. 4s. 6d.)

An excellent piece of work. The former is exceptionally good.

Back in Your Own Back Yard (F.T.) and ***I Just Roll Along Having My Ups and Downs*** (F.T.). Ben Bernie and Hotel Roosevelt Orchestra. (3754. 10 in. 3s.).

"Bright" and "American" about describes this very good record.

The Dark Town Strutters' Ball (F.T.) and ***Somebody Stole My Girl*** (F.T.). Fred Elizalde and his "Hot" Music. (177. 10 in. 3s.)

Real "dirty" items in which Adrian Rollini, Bobby Davis and Chelsea Quesley have a chance to shine, not forgetting the inimitable "Fred."

Broadcast. ***Where the Cot-Cot-Cotton Grows*** (F.T.) and ***Away Down South in Heaven*** (Slow F.T.). (264. 1s. 3d.)

After My Laughter Came Tears (F.T.) and ***My Man*** (W.) from "Lumber Love." (265. 1s. 3d.)

Both records by Harry Bidgood and his Broadcasters.

Ramona (W.) and ***My Ohio Home*** (F.T.). Ciro's Club Dance Band. (262. 1s. 3d.)

Well-played items.

Parlophone. ***Can't Help Lovin' Dat Man*** (F T.) and ***Why Do I Love You?*** (F.T.). Sam Lanin's Famous Players. (R120. 10 in. 3s.)

Fine "Show Boat" recordings.

Pathé Actuelle. ***Why Do I Love You?*** (F.T.) ("Show Boat") and ***Calling Me Home*** ("Lady Mary") (F.T.). Casino Dance Orchestra. (11553. 10 in.)

Mary Ann (F.T.) and ***Dixie Dawn*** (F.T.). The Virginia Creepers. (11556. 10 in.)

Ol' Man River (F.T.) and ***Can't Help Lovin' Dat Man*** (F.T.) ("Show Boat"). Willard Robison and his Orchestra. (11552. 10 in.)

All well played.

Pathé Perfect. ***How Long Has This Been Going On?*** and ***Bluebird, Sing Me a Song*** (F.T.). Meyer's Dance Orchestra.

Very good recordings.

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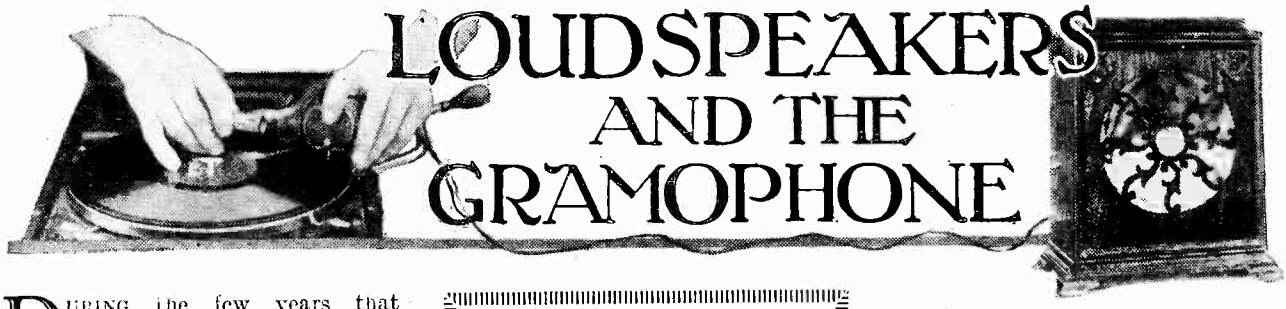


LOUDSPEAKERS AND THE GRAMOPHONE

If really good pick-up reproduction is to be enjoyed it is essential that the loud speaker be of good design.

By KEITH D. ROGERS

DURING the few years that broadcasting has been in progress in this country we have progressed very rapidly with the design of apparatus and especially with the design of loud speakers.

Certainly for a time improvements in this instrument did not appear to come very rapidly, but once a move was made then improvement after improvement was achieved though it is said that even now we have not reached near perfection, and that a definite advance upon the present moving-coil loud speaker is likely to be made in the near future.

Bad Design

Now as this number of MODERN WIRELESS deals largely with loud speakers, I want to discuss these from the point of view of gramophone reproduction, and especially do I want to do so as one or two readers have written saying that they have used pick-ups and find that the reproduction with these pick-ups, *as supplied by their loud speakers*, is not so good as that obtainable from their gramophones. Naturally, they want to know why.

Well, inquiries elucidated the fact that the gramophones were of good modern design—in two cases they were of the latest type available—while other inquiries also brought to light the fact that the loud speakers were not of the best, nor were the sets particularly well-designed.

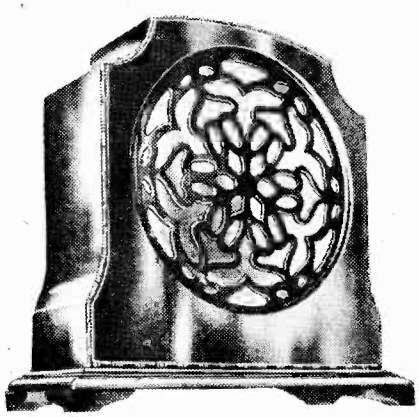
It is, of course, useless to expect good results from a badly designed set. Purity of reproduction and bad design do not go hand in hand, so the best thing to do if really good reproduction from the gramophone pick-up is required, is to look to the set and see that it is beyond reproach.

Good Speaker Essential

There is, however, another point which must be considered. Although the set may be beyond reproach, the loud speaker must be of moderately good type and moderately efficient in its reproduction of the various musical frequencies if anything like a pleasing performance is to be obtained.

It is no good having a good gramophone record, a good pick-up, a really up-to-date amplifier, and then to push the results through a loud speaker that is out-of-date. The actual reproduction obtainable from a *gramophone* nowadays is very good, and if you are to beat that you must be careful what loud speaker you employ.

A tinny speaker, made perhaps from an old earpiece or an adapted earpiece and a small trumpet, is useless



A handsome loud speaker of the cabinet cone type is the Amplion A.C.9 model shown above. The price is £7 and the whole speaker is a really first-class job.

to cope with the bass notes provided by the modern gramophone record, and really remarkably handled by an up-to-date pick-up. Such a record and pick-up demand a good speaker, preferably of the hornless type.

You will have gathered from the preceding pages where loud speakers have been discussed what the various points regarding these speakers are, what points to avoid and what points to look out for, but I must impress upon you that much of the dissatisfaction I have heard expressed by various people who have, half-heartedly I must say, attempted gramophone reproduction is due to the loud speakers they employ.

Now, it is obvious that we cannot all go in for expensive amplifiers and really up-to-date moving-coil loud speakers. Money is easy to spend, but difficult to get, and such equipment is beyond the pockets of a great many of us.

But we can do reasonably well on small sets. For instance, it does not cost much either to buy or to make a loud speaker of the hornless type which will give reasonably good reproduction; nor does it cost very much to make quite a satisfactory three-valve resistance-coupled amplifier. A good pick-up can be obtained for under a pound, and a reliable motor, turntable and tone arm can be obtained for quite a small sum of money.

Not Expensive

As I have said before in these pages, there is no need to have an elaborate gramophone. A reliable motor and turntable and tone arm is all that is required. With a good pick-up and a reasonably good amplifier and loud speaker we may expect to obtain really satisfactory reproduction.

There are a large number of loud-speaker units now on the market specially designed for cone speakers, and one of these should be quite suitable for our purpose. These units may be either of the reed or the balanced-armature type, but either kind is suitable for giving quite good results when used with a well-designed cone.

This may be either of the free-edge or the fixed-edge type, and instructions for making these may be obtained from the manufacturers of the units. So it will be seen that a home-made loud speaker to give quite good results is not an expensive item.

Commercial Types

Now for the bought types. Among these is a variety of small cone speakers capable of giving the results we require. Such speakers can be obtained for quite reasonable sums of money, or if you feel inclined to go to five or six pounds you can

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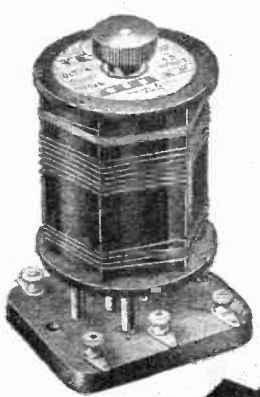

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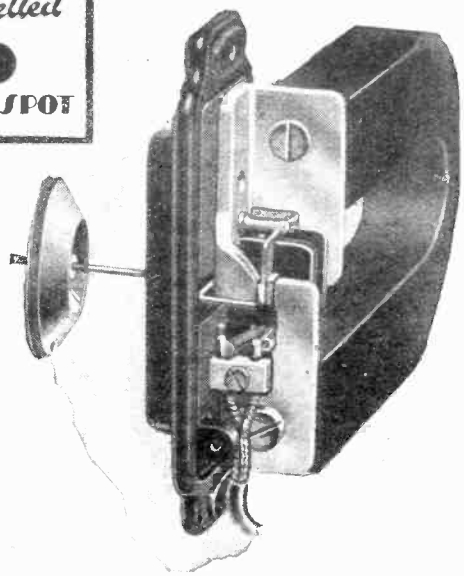

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The well-known cone speakers embodying this unit are notable for purity of reproduction—particularly at the extremes of the tonal scale. This well-distributed reproduction results from an evenly balanced flow of current regulated by the special four-pole construction.

The use of the four-pole unit as a basis enables you to build at home a speaker with a tonal effectiveness actually superior to that of many highly priced models.

The magnet steel used in the Ideal unit is of a special kind, enabling a powerful flux and making the unit very sensitive. The armature is damped to obviate resonances produced by conflicting frequencies.

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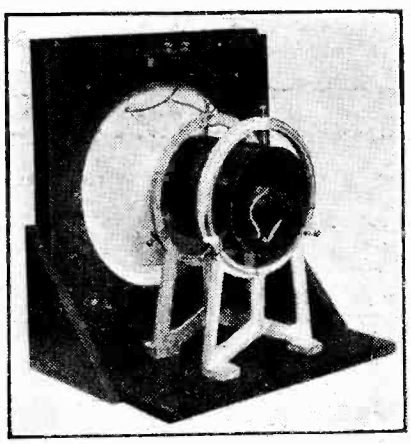
buy one of the later and more elaborate cones. For this sum also sets of parts for mains or accumulator-driven moving-coil speakers can be obtained, and as it is not a very difficult matter to assemble these sets of parts it is rapidly becoming within the range of the pocket of the average man to obtain and work a moving-coil type of loud speaker.

"Gramophoney"

Of horn loud speakers for gramophone reproduction I would rather not say very much, because unless these are very well designed and carefully chosen to suit the set with which they are to be used the horn is liable to give just that gramophoney timbre which it is the purpose of the pick-up to avoid. After all, if you have a reasonably good gramophone, and it sounds to a certain degree what might be called "gramophoney," there is no sense in employing a pick-up and set and loud speaker if the same gramophoney sound is to be the result. One might just as well save one's trouble and expense and play the gramophone itself.



The Goodman moving-coil speaker assembled on the special centring board, but without the baffle. The complete sets of parts vary round about £6.

There is, however, a definite advantage in employing an ordinary gramophone together with a pick-up and amplifier, together with a good loud speaker, to obtain really improved results, and to get away from that tone which is so disliked by a great number of people.

Moving Coil Best

So if I am talking to any of you who may be thinking of taking up gramophone reproduction by means of a pick-up for the first time, and feeling doubtful as to what type of loud speaker you should use, I would advise you right away to get one of the hornless types. If a moving-coil type is possible so much the better, but if not, get a good cone speaker.

Those of you who already have loud speakers and are not quite satisfied with the reproduction you are getting would do well to make sure that your set is giving the best quality obtainable, and that the fault is not absolutely in the loud speaker before deciding to give up the idea to change the loud speaker, or to make any alterations at all.

There is one point which may be of interest to some of you. Where horn loud speakers are being employed and the bass notes seem rather lacking, if a preponderance of bass notes is obtainable from the set this will help to balance out the preponderance of high notes in the loud speaker. A ·05-mfd. condenser across the speaker may help in this respect.

False Bass

Similarly in the case of some cone types of loud speakers rather a false kind of bass is produced, and here again if the higher register is amplified more than the bass in the receiver and the bass is cut down, then a balancing adjustment can be made whereby a really good result is obtained.

Such wangles as these sometimes enable the keen amateur to beat the ordinary listener, and to make all the difference between mediocre and really good results when using a gramophone pick-up.

After all, if the thing is worth doing at all it is worth doing properly, and in order to do anything properly where radio is concerned one must have patience. Do not be unduly perturbed if the first time you use your gramophone with a pick-up and a set it does not come up to all you wish. The trouble may be the pick-up, the set or the speaker, or even the whole three, so look to them all, and especially look to the set and the speaker.

Balancing

As I have said before, if there is too much treble, cut it down in the set and increase the bass. This will help to balance things out for the speaker. If there is too much bass in the speaker, cut the low notes down and use a higher impedance output valve, and so increase the upper register output from the set, thereby balancing the whole reproduction.

Finally, in a word, do not forget that a loud speaker cannot reproduce that which is not put into it, and conversely a good set does not always make up for the faults of a bad loud speaker.

A NEW GRAMOPHONE

READERS will have noticed from advertisements that Messrs. Lissen, Ltd., have entered the gramophone world, and announced their entry by the production of the "Lissenola" portable.

This little gramophone may be obtained in two sizes at £2 2s. and £3 7s. 6d., Models No. 1 and No. 4 respectively, and as Messrs. Lissen themselves put it, they have entered the gramophone trade "with a determination to make good in it." They are certainly doing the latter.

Good Reproduction

The difference between the models is mainly in the motors and the horn. In the more expensive model a special horn and sound-box and a Garrard motor are provided. Both models work excellently, and the tone is exceptionally good, while the protected metal sound-box provided in the £3 7s. 6d. model is a very sound scheme where a portable gramophone is concerned.

The motors are of robust construction and are perfectly silent and regular in running.

Both models are reasonably light, and are easy to carry, though nothing has been skimped to cut down either the weight or the price. A "seven days' approval—money back if not satisfied" system is in operation, but we think we can safely say that Messrs. Lissen need not worry about having any returned.

The "Lissenola" gramophone with a Lissen pick-up fitted instead of the sound-box.

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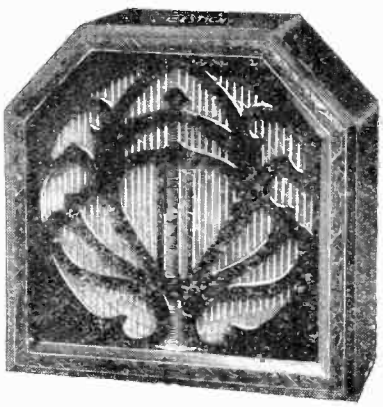

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DISTINCTIVE APPEARANCE.
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"Celestion" is British-made throughout.

Write also for particulars of our "Woodroffe" Type Gramophone Pick-Up. When ordering please state whether adaptor is for H.M.V. or ¾-inch size.

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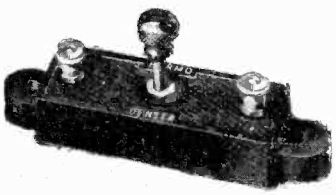

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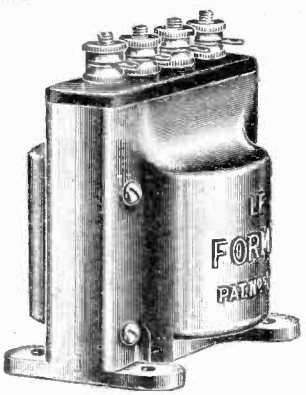

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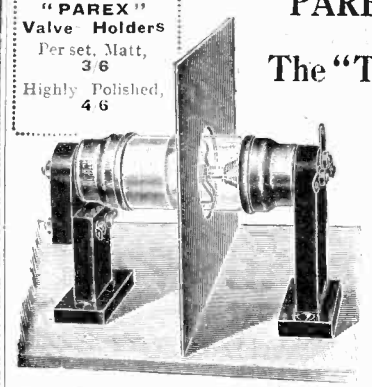

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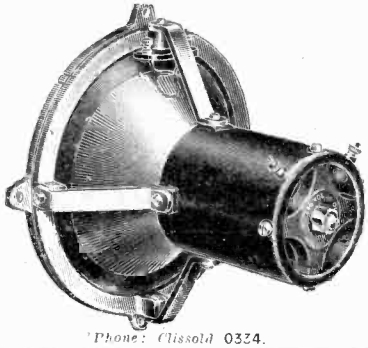

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RADIO ABROAD

Congested Ether

THE technique of radio broadcasting has now become more or less standardised, and in the past three or four years there has been little really new in the way of transmitting arrangements. Now, however, rapid strides are being made by two large research laboratories in the United States in the development of an improved method of broadcasting which will give much better quality and will permit narrower wave-bands to be used for broadcasting. This means that interference will be minimised, there will be room for more broadcasting stations on the air, and a smaller number of valves will be required at the transmitter.

Limiting the Wave-Band

Owing to the rapid increase in the number of broadcasting stations in various parts of the world—especially in the United States—the ether is rapidly becoming so congested that the situation is becoming serious, and it is therefore essential, if broadcasting is to maintain a proper standard—let alone make headway—that the ether congestion shall be relieved. The most obvious way to do this is to limit the wave-band necessary for any particular set of stations.

Sun and Radio Waves

It has been discovered that the position and altitude of the sun influence the route by which radio waves prefer to travel. For instance, during the morning period in England the waves generally prefer to go from England to Australia in a westerly direction across the Atlantic, following the great circle along the longest route, which is approximately 14,000 miles.

During the afternoon and part of the night period, however, the waves travel best in an easterly direction, over Europe and Asia, following the shortest great circle route, about 10,000 miles. It is the practical application of this discovery which has resulted in the setting up of the Australian transmitters and receivers so that transmission and reception can take place in either direction as required.

Wood Horns

The wooden horn for loud speakers is coming into its own again, if we are to accept the dictum of the president of the National Lumber Manufacturers' Association, in Washington. He points out that wood is free from any "metallic" quality and has proved to be by far the best material for making sound-amplifiers. In this connection, he cites the fact that wood has never been superseded for the making of violins.

"Photograms"

The Marconi Company established in May, 1926, what was known as the "wireless photogram service" between London and New York. By this system, all kinds of photographs, drawings, signatures and facsimiles have been transmitted and received between London and New York for over two years. Now the system is to be extended to include other important commercial centres in the United States.

According to the extended arrangements, a photogram which is sent from London by radio, addressed to certain other cities, is transferred in New York to the telephone-wire picture service of the American Telephone and Telegraph Company. The cities included in the "wireless-and-wire photogram service" are Boston, Cleveland, Atlanta, Chicago, St. Louis, Los Angeles, and San Francisco.

In this way, illustrations of the day's happenings, or European fashions, as well as all kinds of business and engineering documents, may be received in any of the cities mentioned within a few hours of their being handed in at London. Photographs of the fashions at Ascot on Gold Cup Day may be seen in California almost before the wearers have left the racecourse.

To send a picture about 5 in. by 3 in. to New York costs £10, whilst if this has to be transmitted beyond New York, over the telephone lines of the American Telephone and Telegraph Company, an additional £9 7s. 6d. is charged.

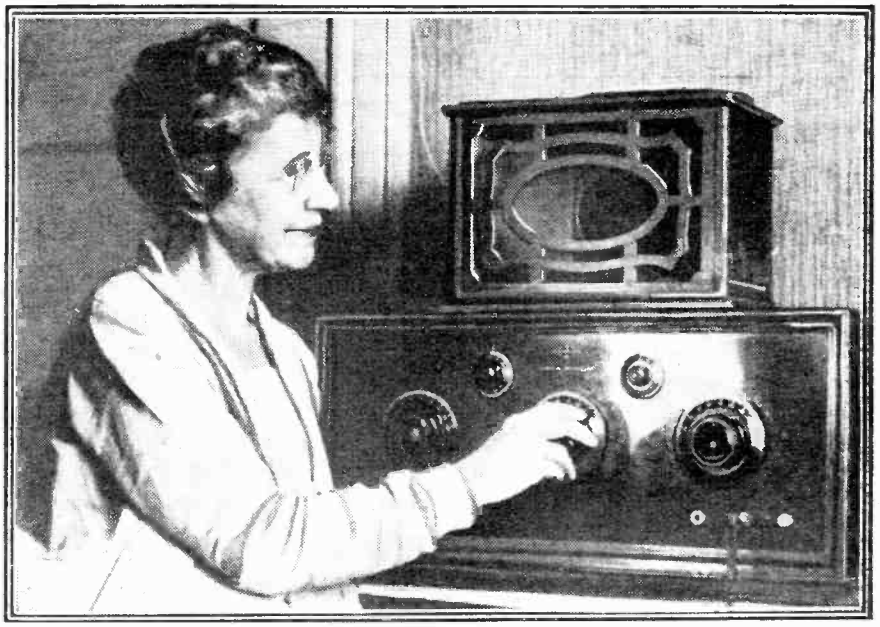
Picture Transmission

By the time these notes are in print you will possibly have seen accounts of Captain Fulton's system for the sending of pictures by radio broadcast.

Demonstrations have lately been given of this system (although the system itself has been in use for over two years) and pictures were transmitted from Rosenhugel (the Vienna station) on 517 metres and were received in London. Pictures have

(*Continued on page* 204.)

LISTENING FOR "LADY LINDY"



Mrs. Earhart, the mother of Miss Amelia Earhart, who was the first woman to fly the Atlantic, in the 'plane "Friendship," listening-in with her wireless set at her home in New York.

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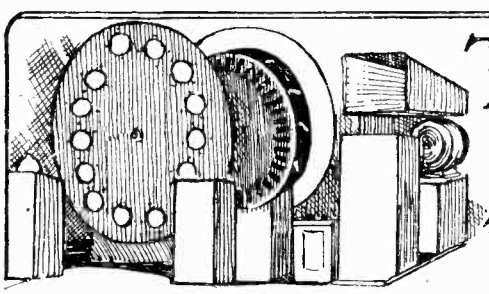
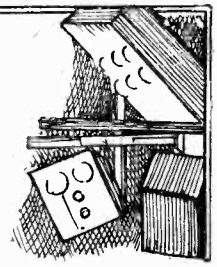


TELEVISION NOTES OF THE MONTH



The latest developments chronicled by ***WILLIAM J. BRITTAIN,*** *our Special Television Commissioner.*

I AM beginning these notes in Berlin. My visit here to investigate television progress has coincided with a brief stay of Dénes von Mihály, who is just back from demonstrating his new television apparatus in Budapest, and in two days goes to show it to business people in Stockholm. "Ah!" said von Mihály enthusiastically, when he

Dénes von Mihály (left), with his assistant, Nikolaus Langer.

saw me. "Now I can show you television!" I was a little disappointed after this greeting to find two spiral-holed discs on a long axle.

"Years Ago"

"Yes, they are just the Nipkow discs used years and years ago," the Hungarian admitted. "But this apparatus I have set up merely to demonstrate the efficiency of my photo-electric cell and my receiving lamp." Just as in the Selfridge simple televisors—with which, by the way, Mr. Baird told me recently he denies any connection—letters painted on glass are brought between a bright light and a spinning disc. The holes scan the letter and let through flashes of light to a photo-electric cell. About von Mihály's photo-electric cell I cannot tell you much except that the electrons fly from a deposit of sodium: the cell looks very much like any other, though delicate sensitivity is claimed for it. The currents, corresponding to the light flashes, given by the cell are passed through one stage of amplification, and then on to the lamp behind the receiving disc.

New Arc Lamp

This is where von Mihály shines. Years ago he used a carbon arc. The light given was too erratic, and the young Hungarian turned a year or two ago to the Wolfram arc lamp. In this, two electrodes of Wolfram, in a vacuum, are drawn apart by fine metal springs, which contract with the heat generated by the current. This movement of electrodes made the lamp unsuitable for television, so von Mihály had made for him a lamp with rigid electrodes.

"Better Than Neon"

Is a vacuum best for the lamp? This was the next question von Mihály asked, and with his assistant, Nikolaus Langer, he began to make experiments with lamps filled with gases. Dr. Nernst, scientific head of Berlin University, became interested and set aside two rooms at the university for the investigations. The latest lamp is filled with a mixture of two gases. It is far more suitable for television than the Neon lamp, von Mihály tells me, for while Neon operates at a frequency of 10,000, the new lamp responds to frequencies very many times as high.

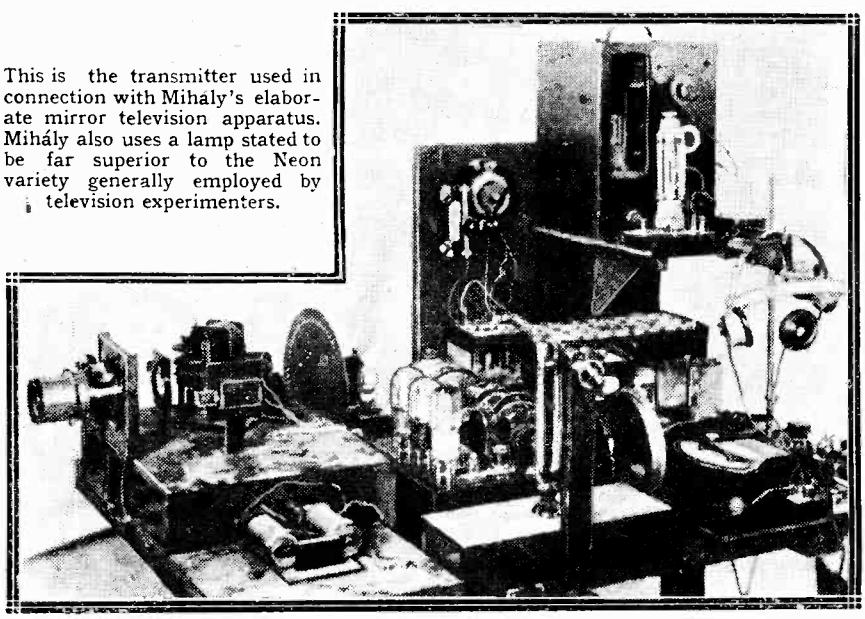
Colours

Langer described happenings during the lamp experiments which have interesting possibilities. "We have found that with different frequencies the glow changed colour," he said. "This suggests an easy way to colour television. Three lamps, filled with different gases at varying pressures, could be used. Each would respond to a certain band of frequencies and give different colours, which would be built up into the received image."

Mirror Apparatus

Von Mihály explained to me a year ago his oscillating mirror apparatus. An image of the object to be transmitted is focussed by lenses on a tiny mirror mounted on fine wires between electro-magnets. The mirror oscillates rapidly from side to side, and the whole apparatus oscillates vertically, and much more slowly, so that the image it reflects is passed rapidly and repeatedly over a small aperture before a light-sensitive cell. In the old apparatus

(*Continued on page* 199.)



This is the transmitter used in connection with Mihály's elaborate mirror television apparatus. Mihály also uses a lamp stated to be far superior to the Neon variety generally employed by television experimenters.

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RADIO NOTES AND NEWS OF THE MONTH

A feature in which our Contributor brings to your notice some of the more interesting and important Radio news items.

Conducted by "G. B."

Australia's Super Station

It is proposed that a super-power broadcasting station shall be built at the new capital of Australia—Canberra. The new station is likely to have a range of 5,000 miles, thus enabling the Government to have available a first-class means of communication with the rest of the Empire and ships at sea.

Allocating Long Waves

The Union International de Radiophonie will shortly have to tackle the problem of the allocation of the few long wave-lengths at the Washington Conference left available for broadcasting. In all, there are only seven channels available in this long-wave region, but thirty stations are asking for them. It may be taken for granted that this country will not relinquish the one long wave-length in use here, that of Daventry 5 X X.

Fitting in the Stations

As regards the medium wave-band, the situation is even more difficult than the one which the Union dealt with in its original scheme. According to the Washington Conference, broadcasting now has to be fitted in to a wave-length band between 200 and 545 metres, and on paper the number of channels available for broadcasting in Europe is 103, while there are well over 200 stations.

A National Chorus

The B.B.C. has the idea of evolving a National Chorus, the members of which are all to be amateurs drawn from the leading London choral societies. It is hoped that about 250 performers will be brought together, the idea being to use this chorus for special outside broadcasts. It is likely that this National Chorus will be heard at three or four symphony concerts next season.

5 S W Abroad

According to Mr. H. A. Hankey, an official of the Wireless League, who has just returned from a tour of the Empire to determine the success of the Imperial broadcasting station 5 S W, the authorities in Australia are quite willing to co-operate with the home authorities with regard to short-wave broadcasting. Mr. Hankey says that 5 S W was received at quite good strength in Cape Town between 7 and 8 p.m., South African time. Good signals were received nearly all the way from Cape St. Vincent down to the Equator. When crossing the Indian Ocean, 5 S W became less reliable, but when nearing Western Australia, when 5 S W was not working, Mr. Hankey could pick up signals from 2 N M, Mr. Marcuse's well-known Caterham station.

Broadcasting Plays

One of the B.B.C.'s new features is the broadcasting of a series of twelve of the world's most celebrated plays. These will include Moliere's "La

(*Continued on page* 194.)

Construct the

"TWIN-WAVE" FOUR

as described in this issue.

		£	s.	d.
1	Oak Cabinet 21 ins. x 7 ins. x 12 ins. deep, with baseboard	2	2	0
1	Ebonite Panel 21 ins. x 7 ins. x ¼ in., ready drilled	0	9	6
1	Ebonite Terminal Strip, ready drilled,	0	1	6
2	Cyldon Variable Condensers, ·0005	1	11	0
1	Cyldon Bebe Condenser ·0001	0	7	6
1	G.E.C. Potentiometer, 1 meg.	0	7	6
4	Magnum Vibro Valve Holders	0	8	0
1	Magnum Standard Wave-Trap	0	15	0
5	Magnum Fixed Resistors and Bases	0	12	6
2	Magnum Fixed Condensers, ·001	0	3	0
1	Magnum Fixed Condenser, ·0003	0	1	6
4	Magnum Coils, ready wound, as described	1	10	0
2	Indigraph Dials	0	15	0
2	Utility D.P.C.O. Lever Switches	0	8	0
2	Lissen Leaks, 2 meg.	0	2	0
2	Lissen Leaks, ·25 meg.	0	2	0
2	Lissen Leak Holders	0	1	0
2	T.C.C. Mica Condensers, ·1 mfd.	0	16	0
1	T.C.C. Mansbridge Condenser, 4 mfd.	0	7	6
2	T.C.C. Mansbridge Condensers, 2 mfd.	0	7	8
1	R.I. H.F. Choke	0	9	6
1	R.I. Anode Resistance with upright holder	0	9	6
1	R.I. 150,000-ohm Resistance with upright holder	0	9	6
1	R.I. L.F. Choke, 20 henry	1	1	0
1	On-and-Off Switch	0	1	6
15	Belling-Lee Insulated Terminals	0	7	6
1	Wearite Valve Holder for S.G. Valve	0	2	6
1	Siemens "T" Cell	0	1	5
	Connecting Wire and Sundries	0	3	5
		£14	14	0

The above set, ready wired and tested.. £16 16 0
Plus Royalty £2 10 0
Any parts supplied separately as required.
Cabinet can be supplied in Mahogany at extra cost of 3/-

MAGNUM PUSH-PULL POWER AMPLIFIER

A carefully designed Power Amplifier employing the Push-Pull system for the perfect operation of Moving Coil Speakers.

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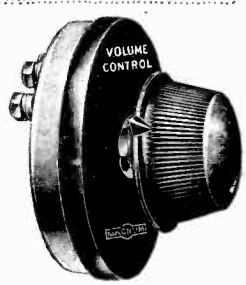
MAGNUM VOLUME CONTROL



Supplied in two Resistance values—500,000 ohms and 2 megohms.

Price **7/6**

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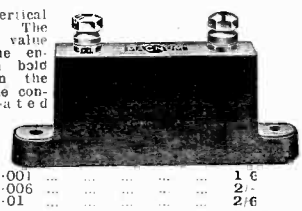
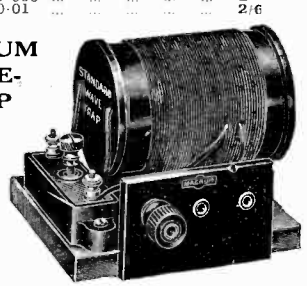


For Vertical mounting. The capacity value is machine engraved in bold figures on the side of the condenser. Rated capacities are guaranteed to within 10 per cent limits.

0·0001-0·001	1/6
0·002 -0·006	2/-
0·007 -0·01	2/6

MAGNUM WAVE-TRAP



As used in "Twin-Wave" Four, "1928 Solodyne," and other modern receiving sets.

Price **15/-**

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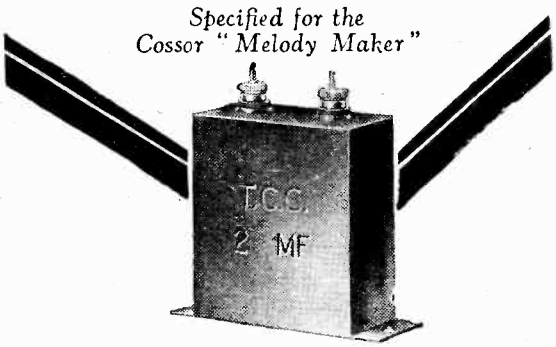

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12. OUT OF PRINT.
13. 2-VALVE REFLEX (Employing Valve Detector).
14. OUT OF PRINT.
15. OUT OF PRINT.
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20. OUT OF PRINT.
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22. "THE GUARANTEED REFLEX."
23. THE 1-VALVE "CHITOS."
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26. A "STRAIGHT" 4-VALVER (H.F., Det. and 2 L.F.
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33. A "KNIFE EDGE" CRYSTAL SET.
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RADIO NOTES AND NEWS OF THE MONTH

—*continued from page* 192

Bourgeoise Gentil Homme," Ibsen's "Brand," Calderon's "Life's a Dream," Maeterlinck's "Monna Vanna," and Tchekov's "Cherry Orchard." German and Japanese dramatic art will also be included. A preliminary to the series will be the first broadcasting performance of "Hamlet," which, by the time this issue is on sale, will have been heard by our readers on July 18th from 2LO.

Coming Events

A lot of the spade-work for the National Radio Exhibition at the new hall, Olympia, which opens in September, has been done, and most of the big manufacturing firms have all secured good stands of large areas. There is every indication that this will be the biggest wireless show ever held. A good deal of the apparatus to be exhibited will not have been seen before, while it will be noticed that in sets considerable advances in simplicity and control and in artistic outward appearance have been made. We hope to publish very shortly further details of the forthcoming exhibition.

Promise Rather Than Performance

"The Electrical Review," commenting upon the Baird International Television Company, Ltd., a prospectus for which recently appeared in the newspapers, and which was heavily over-subscribed, says that: "With all respect to the talented inventor and to the distinguished men whose names appear as members of the company, we must repeat that television up to the present has taken the shape of promise rather than performance, and that its prospects of success appear to us to partake of the nature of vision in the sense of unreality rather than that of actual accomplishment."

Television Detail

Only a few days ago the "Morning Post" blazoned forth what it considered to be a revolutionary step forward in television, this revolutionary step forward being an announcement to the effect that Mr. Baird can now televise without the aid of artificial light. This was described in the usual non-technical way by the press as an historic achievement, etc., etc. An interesting advance, certainly—but America has done the same. If Mr. Baird could get really more detail, then that certainly would be an historic and revolutionary achievement. But, as it was stated by one of his officials recently, detail in television is in itself a detail which will come in the near future.

Paying for the Regionals

According to facts and figures published in the B.B.C.'s first report, the five-minute appeals for charitable causes broadcast on Sunday nights have brought in a total of £40,000 last year. Of 802 S.O.S. messages broadcast 340 were successful, 396 unsuccessful, and in 66 cases the result was unknown. Of over 68,000 hours' transmission the percentage of breakdowns was only ·03. Income totalled £901,926, of which licence revenue was £800,959, and net revenue from B.B.C. publications £93,686. Expenditure on programmes was £487,728, and maintenance of plant £131,036. These two items account for over 80 per cent of the total. For the five stations of the new Regional Scheme £100,000 have been reserved.

(*Continued on page* 196.)

For The Best Gramophone Reproduction Fit The New

ALDEN LIGHTWEIGHT PICK-UP 17/6

MAGNAVOX MOVING COIL SPEAKERS

6-volt Field Pattern - - £9 10 0

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The "Wireless World" says: "We hope that other dry battery makers will follow Messrs. Ripaults' lead and come out into the open with details of the average life which may be expected from their cells."—See page 478, May 2nd issue.

FACTS AND FIGURES

The figures shown on the table below in respect of a "High-class Ordinary Battery" are as a matter of fact identical with those which recently appeared in a Trade Organ, and from the figures quoted it will be seen that

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STANDARD, 60-volt, 10/6; 99-volt, 16/6. DOUBLE, 60-volt, 15/6; 90-volt, 22/6. TREBLE, 60-volt, 19/6; 90-volt, 29/6.

RIPAULTS LEAD IN LIFE, EFFICIENCY AND VALUE.

How do we obtain more than 1½ volts per cell? Many Technical Experts will tell you this is impossible and yet, for example, our 60-volt models contain only 40 cells and the total E.M.F. is approximately 64 volts. The common practice of including additional cells to bring up the voltage is misleading unless the purchaser is warned that a Battery containing, for example, 44 cells should give a reading of not less than 66 volts, otherwise deterioration has already commenced. Write for "Life Chart" and "Right Choice" table M.W.99 with full range of voltages and prices, also complete copies of technical Press "test" reports.

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The Condenser you choose should have ample rigid bearings, accurately spaced vanes, and not be unnecessarily bulky. A large condenser will probably force you to crowd other components, thus leading to inter-reaction and oscillation. The mass of metal in such a condenser will, if it is anywhere near the coil, absorb energy and lead to damping and flat tuning.

A study of all J.B. Condensers reveals a wonderful compactness in design, such as is found in no other condensers.

The high standard of excellence of J.B. Condensers must be your guide.

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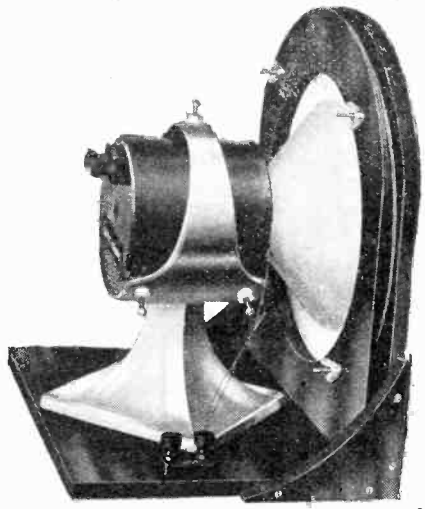
A REMARKABLE ADVANCE in MOVING-COIL SPEAKER DESIGN



Reed. Design

GOODMANS have already established a reputation second to none in Moving Coil Loudspeaker Parts. The "Centrex" Stand and Frame (Prov. Pat.) marks a new era in Coil-Drive Speaker Stands. Correct tensioning and centring are assured with the minimum of trouble by the use of a separate member, supported on special springs, adjustable by the wing nuts. This enables the tension on the cone suspension to be varied at will. The POT STAND is of unique and exceptionally sturdy design and incorporates the well-known GOODMAN centring feature.

Write for illustrated descriptive lists for full particulars. In a recent constructional article "Popular Wireless" used Goodmans Moving Coil Speaker Parts exclusively.

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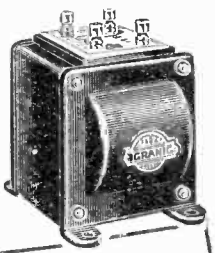
A New L.F. Coupling



Particulars of the principle of this new coupling will gladly be sent on a request for List No. J.611

Just look at this curve. It is the amplification-frequency curve of a three-stage amplifier embodying the Igranic Dual Impedance Coupling Unit—the latest and most perfect low-frequency coupling produced. The curve shows absolutely distortionless amplification between 30 and 10,000 cycles—practically the whole audible range. Nothing could be nearer perfection than this.

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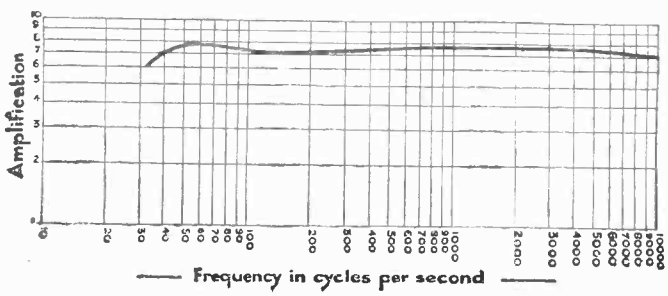

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NO PINS—NO WRONG CONTACTS.
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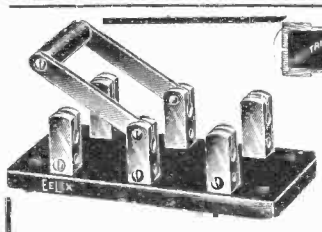

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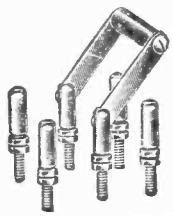

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RADIO NOTES AND NEWS OF THE MONTH

—*continued from page* 194

Radio in France

The Government of France has tabled a Bill regulating wireless transmission in that country. The Bill asserts that the principle of State control of transmitting stations which may either be worked by the State itself or be leased out for a period not exceeding ten years. One provision of the Bill is to impose a tax to meet the expenditure of the new broadcasting department.

B.B.C. Expansion

We understand that the 2,500,000 listener mark has been passed, and that the B.B.C.'s organisation continues to expand. There are rumours that a great new building is to be erected at no far-distant date to house broadcasting The B.B.C. is at present situated next door to the Institute of Electrical Engineers. At one time the whole block of buildings near them belonged to the Institute, but the B.B.C. went on buying them out until they now occupy only a very small portion. A new wing has, of course, been built since those early days, but even the B.B.C. find there is not enough room.

The Brookman's Park Site

Negotiations have been completed for the acquisition of a large tract of land between Potter's Bar and Hatfield for the site of the new high-power Regional Scheme broadcasting station. The actual site is on the Brookman's Park estate, which adjoins the Great North Road. This estate takes its name from the family which held it in the reign of Henry IV. John Lord Somers, the famous Lord Chancellor, lived in the old house on the estate, but it was burnt down thirty-five years ago.

Captain Eckersley at Manchester

Readers will remember that not so long ago Captain Eckersley visited Manchester, where he was badly heckled at a meeting of a Manchester amateur radio society. This meeting was discussed by the Association of British Radio Societies recently, and a letter was read in which the chief engineer invited a deputation from Manchester radio societies to visit him for the purpose of discussing some of the problems involved in the working of the Daventry experimental station, 5 G B.

Contrasted Programmes

During the course of the discussion by members of the committee, exception was taken to Captain Eckersley's statement that 5 G B was not intended to provide an alternative programme for Manchester listeners. It was pointed out that at the opening of 5 G B it was stated by the B.B.C. that the station would probably be of a contrasting character to that of 2 L O, and would provide an alternative crystal-set programme within a hundred miles radius of Daventry.

Strength of 5 G B

It was also urged at the meeting that a point to be cleared up was the weak strength of 5 G B as compared to other stations on the Continent. It was eventually decided to leave the matter to the Manchester societies and ask those who desired further information on the point at issue with Captain Eckersley to appoint representatives to meet him.

British Radio Societies

The General Committee of the Association of British Radio Societies

(*Continued on page* 198).

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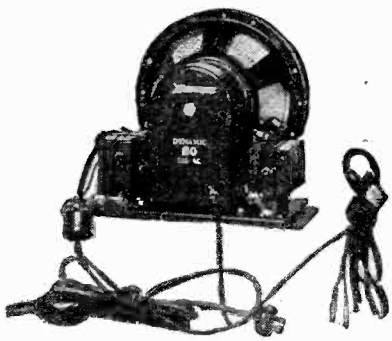

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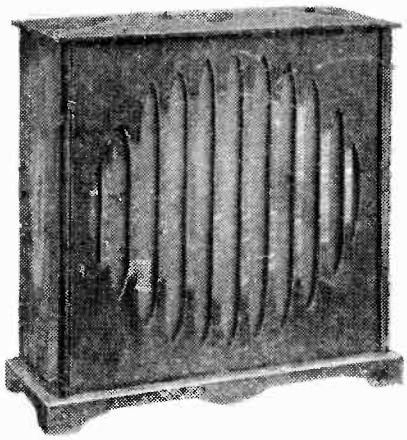

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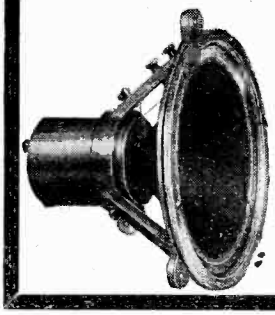

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A perfect unit designed to bolt to the baffle direct, eliminating vibratory distortion. Perfect coil centering device. Reception unequalled, making listening luxurious.
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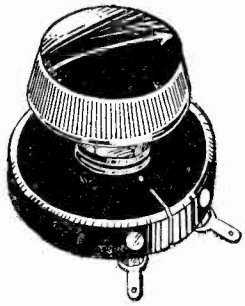

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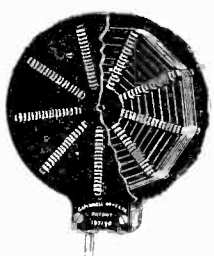

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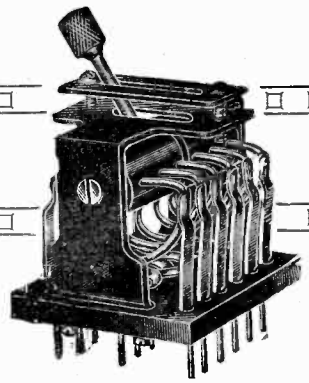

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RADIO NOTES AND NEWS OF THE MONTH

—continued from page 196

also decided to appoint an organisation committee to get into touch with radio societies all over the country with the object in view of building up an effective organisation to protect the interests of radio associations. It was suggested that the basis of society membership might be widened in order to include a section for non-technical listeners, in order that adequate representation could be made to the B.B.C. and the Postmaster-General on questions affecting the interests of all those possessing wireless sets.

Licence Figures

Some statistics concerning licence figures have just come to hand. In March, Bournemouth had 154·5 licences per thousand; Aberdeen, 116·5 per thousand; and Plymouth, 83.

All the leading authorities on radio construction write for
POPULAR WIRELESS
BRITAIN'S LEADING RADIO WEEKLY.
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These three stations are now acting as relay stations. London comes next with 78·8 per thousand, closely followed by Nottingham and Cardiff. Other figures per thousand, according to the "Daily Telegraph," are Liverpool 68·8, Newcastle 68·5, Leeds 67·5, Birmingham 64·9, Manchester 59·1, Glasgow 51·1.

The total number of licences in force for the whole country at the end of April was 2,494,911, representing an increase of about 12,000 over the previous month.

Oysters' Noise Annoys

A curious story appeared in the Press the other day from Hatteras, North Carolina, where it appears oysters were humming so merrily during the month of May that certain wireless under-water experiments had to be abandoned. Apparently, the delicate mechanism used by the experimenters was put out of gear by the noise caused by the oysters.

The experimenters applied to the Bureau of Fisheries for relief, but it appeared that the Government office announced that it could give no remedy to make oysters stop singing!

THE TRUTH ABOUT RADIO IN AMERICA

—continued from page 158

listeners in their immediate vicinity. On 201·2 metres, for example, there are two fifty-watt stations, eight of one hundred watts, and one of two hundred and fifty watts.

When stations have to share wavelengths it is essential that each should not wander more than a very small percentage from the frequency it is given. If it does do so, heterodyning results. It is evident from any evening spent listening to American broadcasting that the veriest amateurs must be in charge of some of the stations, for the air is rent with ear-piercing howls of varying intensities and notes!

Useless Threats!

One might ask is there no law to prevent this. Yes, indeed. Well, what is done to enforce the law? Threats! Nothing more. These broadcasters are used to threats.

The interference range of a broadcasting station is, unfortunately, considerably greater than its useful programme range, thus it is that a broadcaster on the Atlantic coast, slightly off its allotted frequency, is often responsible for a nasty beat-note on the Pacific coast, although its programmes have never been heard more than five hundred miles away.

Open Defiance!

As an example of open defiance of the laws, we have the American broadcaster who publicly declares that he employs a system to vary his wave-length if necessary to prevent a heterodyne. That by varying it he is deviating from his assigned frequency, and is, therefore, breaking the law, does not occur to him. Admittedly he improves matters as far as his listeners are concerned, but by so doing he may interfere with a more distant station which is operating legally.

The output of this set is carried by landline back to the broadcaster, and in this way the operators are able to tell exactly how their programme is getting over. If they hear a heterodyne (which may be caused by a station sharing the same wave-length wandering a little) they forthwith adjust the tuning of their own transmitter in accordance with that of the distant station and thereby eliminate the heterodyne note—a good but an illegal idea!

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TELEVISION NOTES OF THE MONTH

—continued from page 191

were many elaborations which made it necessary for the would-be looker-in to wait patiently perhaps three hours to see a moving image which lasted a few seconds.

London Demonstration

I asked von Mihály to repeat to me his claim that with his old apparatus he obtained an image of a face in light and shade, and he did so emphatically. Now, he says, he has been able to cut out many of the elaborations, and he is having made in Budapest a new mirror apparatus in which he will use his new photo-electric cell and receiving lamp. Von Mihály asked me whether he should take his present apparatus to London. I suggested he should wait until his mirror apparatus is ready.

No Mirror, No Discs

Mechanism has by no means yet given proof that it will go on to televise the Derby and the Boat Race—despite talk which has accompanied the announcement of Mr. Baird's television by daylight. New work which it is hoped will produce a television receiver without mechanism has been shown to me at a government department of scientific research here in Berlin. Dr. Carl Müller has been experimenting for a long time to produce exceedingly thin foils of metal, and he has produced some of gold a hundred times as thin as the thinnest gold leaf. I read printing easily through six layers of it. A current of electricity, it is found, alters the intensity of light passing through the foil. In making use of this property with his extremely thin and sensitive foils is the promise, Dr. Müller suggests to me, of just the cheap and efficient receiver needed to make television popular.

What's In A Name?

My conversation with Herr Walther H. Fitze, technical editor of "Der Deutsche Rundfunk," Germany's leading radio journal, was prefaced by a long explanation of why the word "fernsehen" must not be used. "Fernsehen" means far-seeing, and is the German counterpart to our "television." "Only with a telescope can you see a long way," said

(Continued on page 200.)

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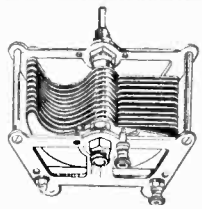

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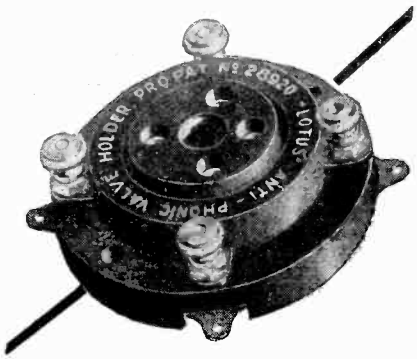

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TELEVISION NOTES OF THE MONTH

—continued from page 199

Herr Fitze. "We use 'bildfunk'." He agreed with me that since this word is used for photo-telegraphy its double use might be confusing. "But the word is logical," he said. The German newspapers, nevertheless, use "fernsehen." Mr. D. McFarlan Moore, the Neon lamp experimenter, is among those who object to our English word because it is a mixture of Greek and Latin ; he suggests "telorama." In America, too, they complain that a blind man can have vision. I am afraid, nevertheless, that "television" has come to stay. If you forget logic and philology it doesn't sound so bad.

WILLIAM J. BRITTAIN.

and magnification. Nevertheless, special split-secondaries have been invented, notably by Mr. C. P. Allinson, which have very great advantages, but I am of the opinion that the future of H.F. amplification lies in the screened-grid valve. One day it will be as cheap as an ordinary valve, at least I hope so, but at present, as I have already indicated, the subject of H.F. amplification is a very difficult one.

Many Considerations

On the L.F. side the only compromise that needs to be made is that between amplification per valve and quality of reproduction. Here one is not up against such problems as selectivity, operation and, in any way to the same degree, stability. Additionally to these we still have on the H.F. side amplification per valve and quality. You must not forget that quality of reproduction

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CIRCUIT PROS AND CONS

—continued from page 142

straightforward tuned-grid circuit. I would only advise the use of this scheme for one stage of H.F. amplification. The input to the detector can be tapped down the grid coil in order to achieve quite a useful degree of selectivity. Not a remarkable degree of amplification can be effected, but, at the same time, in this respect it does not fall very far short of the best of some of the best of other methods. Neutralisation can be introduced, when the arrangement becomes even more attractive and it certainly lends itself remarkably well to the design of wave-change sets.

H.F. Transformer Couplings

Of the two forms of H.F. transformer coupling, i.e. split-primary and split-secondary, I think that practically everybody these days is of the opinion that the split-primary is the better, both in point of stability

can be ruined before the detector just as easy as after it.

And with this rather unsatisfactory conclusion I am afraid I must leave you to use a great deal of your own judgment. I find also that I cannot make a brief summary of such of the foregoing remarks as refer to H.F. amplification.

But, bearing in mind the few general facts I have brought forward, look again at the constructional articles describing the sets which take your fancy and which you have an idea might suit your own particular needs. Read the text, for in it you will find the case for the circuit of that particular set fairly put forward.

The almost perfect circuit would provide the highest possible amplification per valve plus great selectivity, complete stability, remarkable ease of operation, perfect quality of reproduction, and very low maintenance costs, but there is, of course, no almost perfect circuit and one has to choose the arrangement which appeals to one as being the nearset approach to it, all things considered

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CONTROL

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The Picture Paper with the MOST News

:: **SUNDAY GRAPHIC** ::

IN OUR TEST ROOM

—continued from page 172

through it the value is still in the region of 14 henries. One seldom has to handle currents of the order of 100 milliamperes even in a most powerful mains unit, but it shows that the component has a very wide margin of safety.

We also particularly like the manner in which the terminals on this R.I.-Varley choke are disposed. As you will see in the photo, they are widely spaced at the bottom of the component and are accessible although enabling the wiring to be kept down low. The choke is a very excellent production, and we have no hesitation in recommending it to constructors of any type of H.T. mains unit.

Orphean Loud Speaker

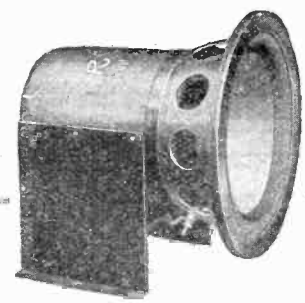
We recently received from the Radio Mfg. Co., Ltd., an Orphean Gem loud speaker for test. This is a medium-size instrument of the horn type. It stands 19 in. in height, and a 10-in. flare is carried on a graceful swan-neck conduit. It is of chocolate and has a moulded and polished bakelite base unit to match. Altogether, it is quite a pleasing little speaker in appearance, and is less of the "trumpet" than many of these types of accessories which have appeared in the past.

Its four claw-type legs are tipped with rubber to prevent them scratching anything upon which the speaker might be stood. A circular knurled knob beneath the base enables an adjustment to be carried out, and two terminals are provided for connecting purposes, one of which is coloured a bright red to facilitate this operation. The speaker has a resistance of 2,000 ohms, and is priced at 30s. The base unit is available separately at 12s. 6d. for those who desire to employ other types of horns. On test it gave good results. It proved to be sensitive and reproduction was quite good for this type of instrument. Amateurs should find it very satisfactory on the smaller type of receivers.

Etherplus Components

The "Etherplus" "Concerto" L.F. transformer sells at 12s. 6d., and while in our opinion it does not compare with most of the expensive makes, it is fairly good value for money. It is contained in a frosted metal case, and is guaranteed for one

(*Continued on page 202.*)



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Send for List No. 24, which contains full details of Amplifiers and Cabinets for Coil Driven Loud Speakers.

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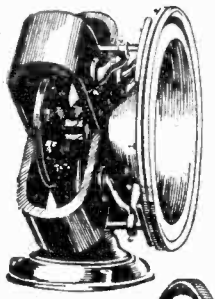

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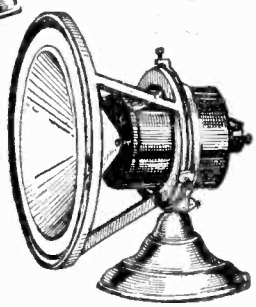

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John H. Lile, Ltd.
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(*'Phone: City* 7261.)
and NOT to the Editorial or Publishing Offices.

IN OUR TEST ROOM

—continued from page 201

year. On test we found, as indicated above, that it is capable of good performances, and it is doubtful whether many amateurs would detect the difference between it and a transformer costing more. But it hasn't enough iron in its core to prevent a saturation at a pretty low current, and this is the failing of most of the cheaper transformers, although it is hard to know why, considering iron is fairly inexpensive.

The "Etherplus" resistance coupling unit consists of a mica condenser and two grid-leak type resistances contained within a small moulding upon which are mounted four terminals carrying soldering tags. It is a neatly assembled unit, and occupies but two or so square inches of baseboard area. It operates well, and its price of 5s. 6d. should appeal to constructors who favour the high-resistance type of R.C. coupling.

"Melody Maker" H.F. Unit

The Peto-Scott Co., Ltd., have produced a simple constructional chart describing an efficient H.F. unit especially suitable for the Cossor "Melody Maker." This unit makes use of a screened-grid valve and has been approved by Messrs. Cossors. The chart is very clear and the construction of the unit simple and well within the scope of the home-constructor. Alternatively, the unit can be purchased complete and ready for use from the Peto-Scott people.

Some Interesting Publications

H. Clarke & Co. (M/cr.), Ltd., of Atlas Works, Eastern Street, Old Trafford, Manchester, have recently produced two publications of interest to radio enthusiasts. The one is a brochure dealing with their entirely new range of "Atlas" Battery Eliminators, in which are incorporated alternating-current models which use the new Westinghouse Patent Metal Rectifiers, and in which there are no valves to burn out, no liquids, and no moving parts.

The other publication comprises a chart giving full particulars, including wiring diagram, together with prices of the components required for Clarke's "Atlas" A.B.C. 3-valve receiving set.

Either of these publications can be obtained by any reader who cares to apply by post to the above address.

* * *

The "Toreador III" receiver, a design due to the Dubilier Condenser Co. (1925), Ltd., of North Acton, London, W.3, is a straightforward Det.-2 L.F. (resistance-capacity coupled) set, simple and inexpensive to build, which is both selective and powerful. A fine chart containing full constructional details can be obtained free upon postal application.

Another Dubilier publication now available is a leaflet dealing with anti-interference units.

"POPULAR WIRELESS"

Keeps you in touch every week with what is going on in radio invention and development.

Costs Threepence, but Saves Pounds!

Full of hints, tips, and practical how-to-make ideas.

Every Thursday **"P.W."** *Price Threepence*

Interesting Swedish Components

We recently received for test some interesting components from Einar Letzen, a radio firm operating from Nordana, Sweden. The Letzostat is a tapped filament resistance, variable in fourteen stages from ·87 to 8·5 ohms. The variations are obtained by connecting the set of terminals either in series or in parallel. It is a neat, well-made little device and occupies very little baseboard space. The Letzen Combinator is a combination of four fixed resistors and an on-off switch. The component can be mounted by means of a single hole on a panel. The Letzen cylinder is an on-off filament switch neatly arranged to accommodate a fuse for protecting the valves against excessive current.

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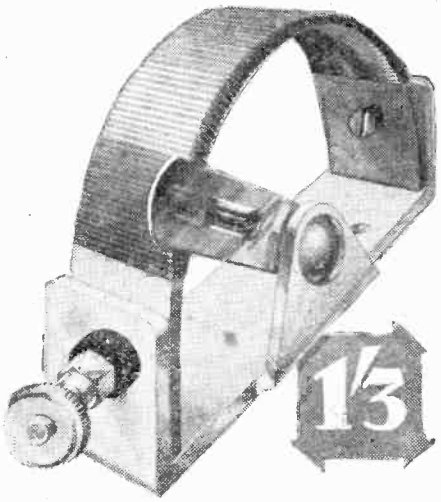
FOR CONVENIENCE SAKE



The "Peerless" Varistor occupies minimum space and stands clear of wiring, making adjustment more convenient in every way.

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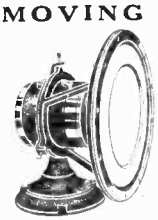

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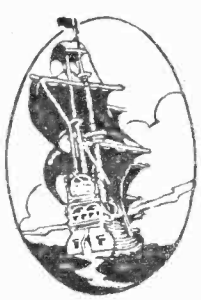

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SHARP TUNING CIRCUITS

—continued from page 163

opposite the ends. The axiom to be remembered is to keep metal parts out of the coil-field as much as possible.

Having considered the chief theoretical sources of added resistance we can now turn to considerations of a more practical nature. Returning to the aerial circuit we have first to reduce the effect of its resistance and provide for good signal strength without complicated tuning. Without examining all the various forms of aerial coupling we can take as the best that shown in Fig. 2 (C), with (B) as an alternative where simplicity is desired, which are now the ones most widely used for short and normal wavelengths.

H.F. and Selectivity

In Fig. 5 I have drawn the resonance curve X for the circuit L_1 C_1 of (C), the primary being 15 turns closely coupled to a secondary of 70 turns, low-loss construction. 2 L O, six miles away, was the source of signals using an aerial of average dimensions. The curve X of Fig. 5, while quite good, is obviously not sufficiently sharply peaked to give enough selectivity. As a comparison, the curve Y, using a single coil as in Fig. 2 (A), shows the very poor degree of selectivity of a direct-coupled aerial circuit.

Curve X is about the best that we should try to obtain for a simple form of coupling, easy to tune, and we must rely for true selectivity on further H.F. circuits, such as those of H.F. amplifier stages. This is one of the great advantages of H.F. amplification in that the extra tuned circuits make possible a high degree of selectivity.

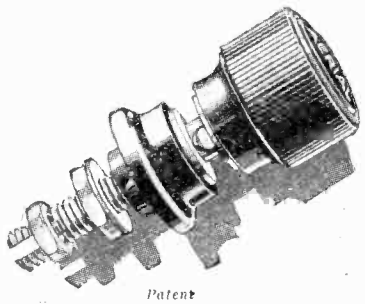
Ideal Curve

The ideal resonance curve for maximum selectivity without loss of quality is something like that shown in Fig. 6. Here the flat top gives even amplification over the band of frequencies covered by the modulated wave, with a sudden drop on each side.

After, say, two H.F. stages, the effect of the grid condenser rectifier is not so pronounced. However, a very sensitive detector is not necessary here, and an anode-bend rectifier is a very desirable arrangement. Unless the H.F. input voltage is large, a high-magnification valve

(*Continued on page* 204).

THE FINISHING TOUCH



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PRICES.
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The "RADIOLA"

Modernises your Set →

A STATELY HOME!

Moving Coil L.S. and → Batteries

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Mechanically and Electrically Perfect.

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SHARP TUNING CIRCUITS

—*continued from page* 203

with R.C. coupling to the first L.F. stage is eminently satisfactory. There now remains the consideration of the degree of selectivity required and the number of tuned H.F. circuits necessary to give it.

A representative circuit is shown in Fig. 7. Here the three H.F. circuit combinations in dotted circles are the parts of the receiver mainly responsible for selectivity, which with this type of receiver can be very high. These three H.F. transformers and their associated components are suitably screened by shields so placed that eddy current losses are small.

RADIO ABROAD

—*continued from page* 190

also been sent on wave-lengths as low as 33 metres.

Exploring the Picture

The Fulton system—known as the Fultograph—which has been fully demonstrated on numerous occasions, is similar in its basic principles to those which have been used by various other experimenters, including Belin, in France, and Jenkins, in the States. The picture to be transmitted is fastened around a revolving cylinder, at the transmitting end, and is "explored" by a needle device.

At the receiving end a sensitised paper is secured around a rotating cylinder, this rotating cylinder being kept in step synchronously with that at the transmitting end, and another needle "explores" the sensitised paper. Fluctuating electric current passes between the needle and this cylinder and causes light or dark stains, according to the strength of the current. The current fluctuates in strength in accordance with the light and dark portions of the picture on the rotating foil cylinder at the transmitting end.

One of the principal secrets of success with the Fultograph appears to be the method of keeping the cylinders at the transmitting and receiving ends in synchronism. Details of this system are not divulged.

IS YOUR SET O.K.?

If it is giving trouble, or you are experiencing any kind of radio difficulty, the MODERN WIRELESS Queries Dept. can help you. For details of the "M.W." Queries Service

SEE PAGE 146

Directing Planes by Radio

Recent tests carried out at Mitchell-field, Long Island, have shown the possibility of directing aircraft in warfare by means of radio. Recent manœuvres embraced several flights of a 5-mile span, and at all times the ground officials were in direct communication with the pilots.

Secret Transmission

There have been many devices for rendering radio communications secret, one of the best-known being a system of "chopping-up" the transmission in such a way that it can only be intelligibly received by a receiver specially fitted.

Another way to ensure secrecy is to have a continual series of changes in the transmitting wave-lengths, these being coded between the transmitter and receiver.

Yet another method is now put forward and was recently demonstrated before the American Engineers' Society. In the latest device, the sounds are converted into gibberish at the transmitter and are then sent out by the ordinary transmitting method, and are "translated" at the receiver. It is only necessary to code the receiver and transmitter appropriately for the gibberish to be turned back into its original form, in which it is immediately intelligible.

Radio in Europe

We in England are sometimes apt to get quite wrong ideas of the radio conditions throughout the rest of Europe. For example, it is commonly supposed that many European countries, and especially Germany, are countries of technicians, where radio is not only thoroughly understood but where conditions such as those in England are closely approached. Many people, in fact, imagine that Germany is far ahead of England, or indeed of any other country in the world, in the matter of radio broadcast.

It is true that Germany, in many technical matters, is ahead of other countries, but curiously enough this is not at all the case in radio.

Leading Radio Countries

The countries with the largest number of wireless receiving sets per hundred of the population are England, Holland, Denmark, Sweden and France; and the countries where radio still lags behind are Germany, Switzerland, Italy and Austria. In Spain radio is rapidly coming along.

All communications concerning advertising in "Modern Wireless" must be made to John H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4. Telephone: City 7261.

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Operation from the electric light supply

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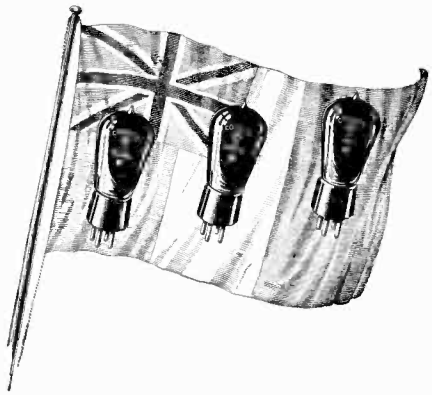

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Constantly seeking perfection, owners of Wireless Receiving Sets are asking to-day for valves that will meet their requirements in the following respects. It will be seen that "Met-Vick-Cosmos" A.C. Valves meet all the conditions:—

Requirement 1. *Valves that give a high degree of amplification with moderate impedance.*	**The "Cosmos" AC/G Valve has an Amplification of 35, the AC/R 10. The corresponding impedance being 14,000 and 2,500 ohms.**
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Requirement 6. *Valves that are not too expensive.*	**"Cosmos" AC/G and AC/R Valves cost only 22s. 6d. each and by the use of Disc Adaptors can be used in a set wired for battery valves without altering the wiring.**

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Difficulties of long standing have been solved, improvements have been added, and in every case our new products live up to the degree of QUALITY for which R.I. & Varley products are famous in nearly every corner of the globe.

The number of new lines for 1928–1929 will be even greater than last year, and a remarkable degree of success has been achieved in gramophone reproduction apparatus (watch for our advertisements giving particulars of gramophone pick-up and gramophone amplifier).

A few of these new lines are already available to the public and the remainder will be marketed before the National Radio Exhibition, Olympia, September 22nd–29th, where they will be on view at our Stands Nos. 56 and 73.

H.F. Intervalve Transformer, Long Wave, 1,000-2,000 metres 24/-
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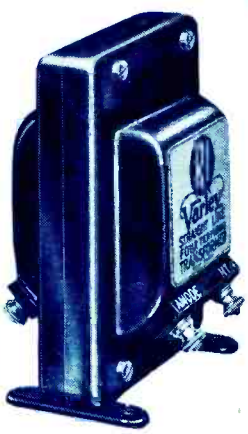
Special 7-pin Base 3/9



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