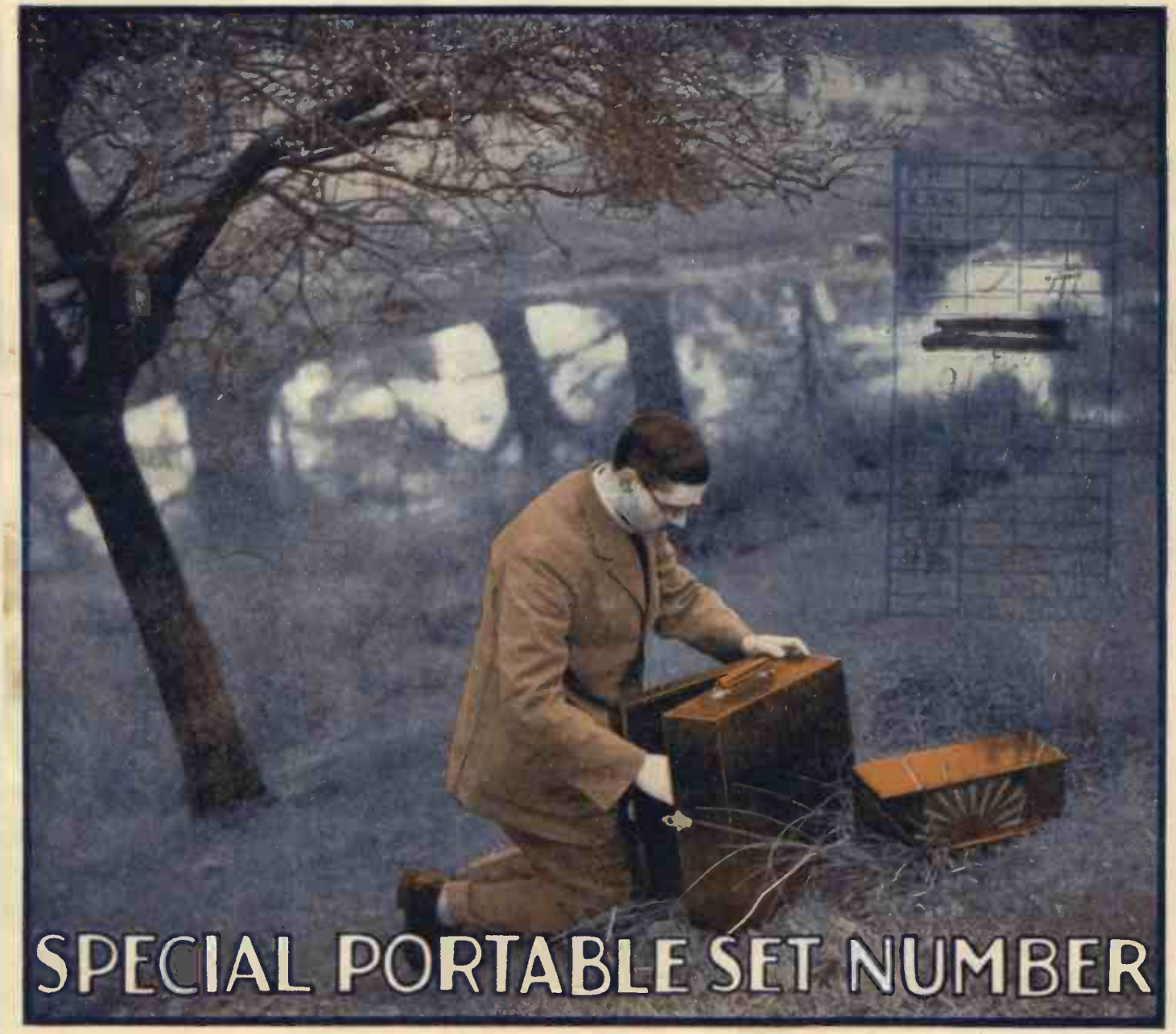
SIR OLIVER LODGE WRITES IN THIS ISSUE

MODERN WIRELESS

1/- MONTHLY

Edited by
NORMAN EDWARDS
M.I.R.E., M.R.S.L., F.R.G.S.

Vol. VII. No. 5. MAY, 1927.



SPECIAL PORTABLE SET NUMBER

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Vol. V11. No. 5. MODERN WIRELESS. MAY, 1927.

Edited by NORMAN EDWARDS, M.I.R.E., M.R.S.L., F.R.G.S.

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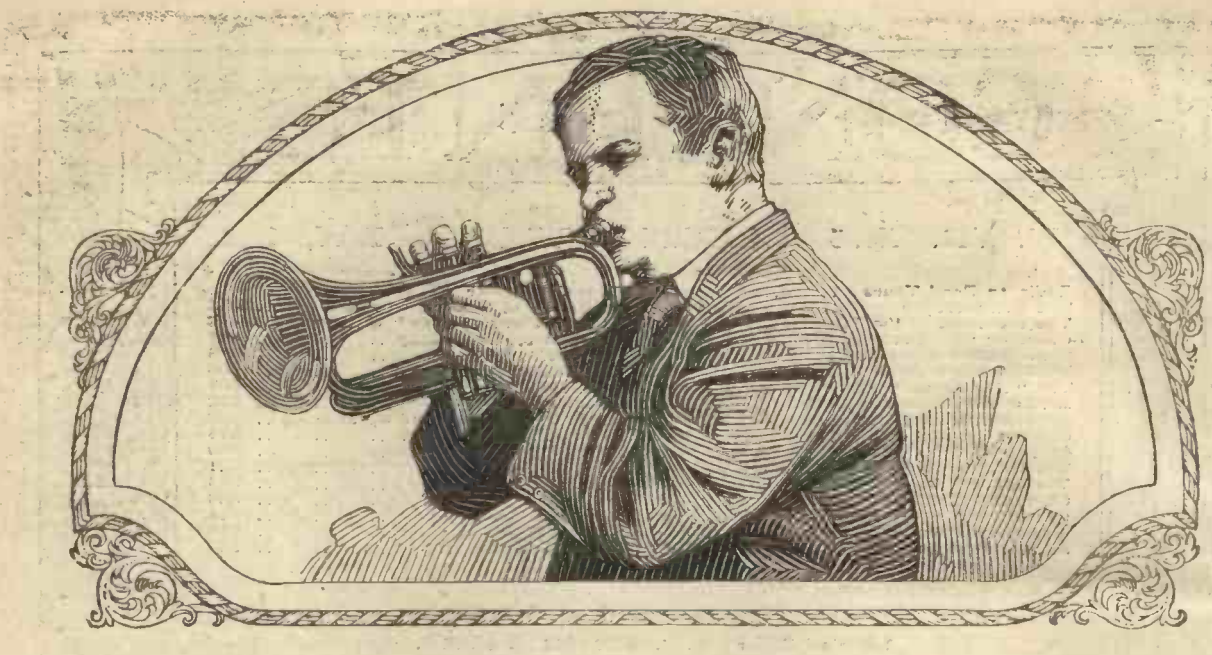
Scientific Adviser: Dr. J. H. T. ROBERTS, F.Inst.P.



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RADIO ON ROAD TOURS

An interesting out-of-doors article by STENSON COOKE, Secretary of the Automobile Association.

I AM firmly convinced that one of the great blessings which has followed the invention of wireless telephony has been conferred upon the inhabitants of lonely villages situated far away from cities and towns beyond the reach of up-to-date news, remote from any of the amusements and recreations which

Mr. Stenson Cooke, well known to listeners for his motoring talks.

are common privileges to those who live in or near cities and towns.

When I think of this aspect of wireless I feel that there is something to be said for the idea of taking a portable wireless set on the car during some holiday vacation runs, or for use during tours, where the car will occasionally be halted for the night in villages, or other places, where the only evening recreations may be a country walk, the reading of a novel, or a hand of bridge.

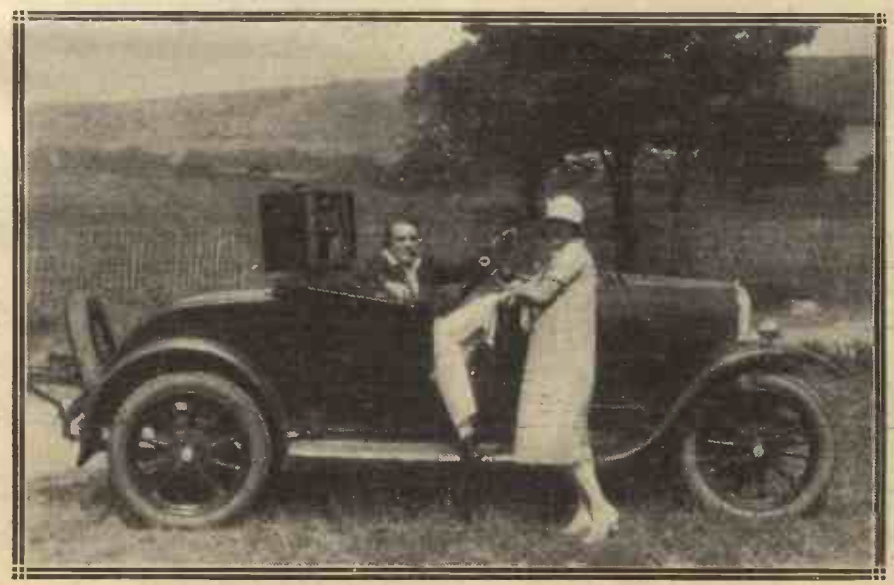
In such circumstances what would be the value of a portable wireless receiver, no longer than an ordinary suitcase, "self-contained" with batteries and all necessary accessories, calling for only a few minutes' preparation and connecting up before setting it going?

I do not profess to be an expert in wireless matters, but I do know that, thanks to the ingenuity of our clever wireless engineers, there are available many efficient portable receivers which are entirely suitable for transport by car, and which are so well contructed that they are unlikely to be affected by road vibration.

Portable sets suitable for touring motorists are, of course, somewhat more expensive than the domestic receiver, but there is nothing to prevent the wireless enthusiast, who is also a motorist, using his well-designed and satisfactory portable receiver all the year round—at home and elsewhere. As we all know, or should know, the portable wireless receiver working on, say, four valves, is called upon to perform a much harder task than is allotted to the ordinary four valve receiver. It has to provide reception under the most adverse circumstances in regard to location, aerial conditions, and other essentials for good and easy reception.

Solution of "what to do"

A good portable four-valver, made by an eminent firm, or even a set which is home-constructed, based upon an efficient circuit, and assembled with the best possible components, will generally eclipse, aerial and other conditions being equal, the reception usually obtainable from the domestic three-valver.



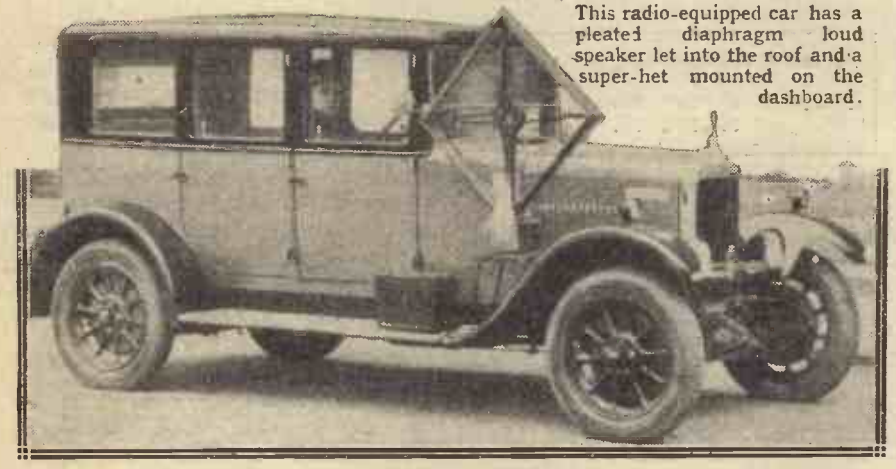
A wayside halt, with a portable wireless set providing radio music.

RADIO ON ROAD TOURS—*concluded*

Of course, on tour the set will be worked under difficulties, but a good portable set will bring in music and news on a wire flung almost anyhow over the branch of a tree. It can, however, be worked on a collapsible frame aerial, which need take little more space on a car than an umbrella.

Let us imagine a touring family—keen on music—halted for the night at a place where there is neither theatre nor cinema, and perhaps not even a village concert or dance to go to. The solution of "what to do" is easily found if a portable set is brought in from the car.

Cars may break down in the most unexpected places, and at most inopportune times. Assuming that a serious breakdown takes place in a quiet country village, and that one is far from repairing facilities—or hotels—the question of where to stay for the night becomes all-important. This problem may be solved by an A.A. road patrol, fortunately able to arrange for a night's lodging in a cottage or a farm-house.



This radio-equipped car has a pleated diaphragm loud speaker let into the roof and a super-het mounted on the dashboard.

The New Question

During the next day, of course, things will happen in connection with the necessary repairs. The car will either be repaired where it is, by mechanics from the distant garage, or it may be towed away. If it becomes necessary to "carry-on" with the makeshift accommodation available until the car is ready to resume the tour, would not such a period of inaction be considerably brightened by news and music from the air?

There are touring grounds in Great Britain where one may be almost cut off from civilisation, so far as the arrival of the daily newspaper is concerned. It may sound very nice to say, "I am going for a holiday, and *I don't* want to be bothered with everyday news, or to hear about revolutions occurring in other countries." That frame of mind may hold during the early portion of a tour, but after that, one is very apt to miss what one has become accustomed to, and, sooner or later, there will be a longing to know what the rest of the world is doing, and a thirst for news which the local newspaper may be unable to satisfy. And please don't forget that weather reports are not entirely useless during tours. Therefore, if holiday tours are decided upon in sparsely-populated areas, why not consider the inclusion of one of these wonderful little machines, which will keep you informed as to what the working world is doing while you are on holiday, and incidentally, if you desire it, provide entertainment when other recreations are hard to come by?

In the Future

One occasionally hears of wireless receivers being permanently installed on cars. That idea, however, has never appealed very strongly to me. I cannot see any more reason for making a wireless receiver a permanent fixture on a car than a gramophone. On ordinary tours, during which recreations of all sorts are abundant, a wireless set might not be worth the luggage space it would need on the car—at least, that is my opinion.

I think, however, that the time may come when wireless will be the accepted method of broadcasting for roadside assistance or road information.

MAKING 'PHONES MORE COMFORTABLE.

From a Correspondent.

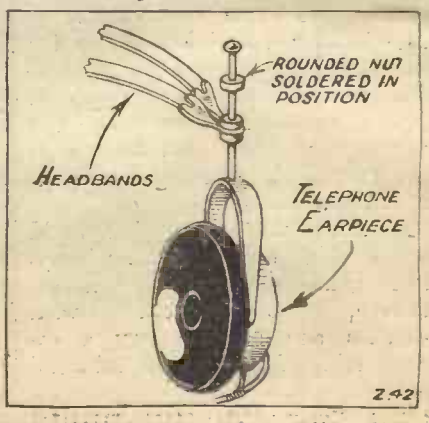
MANY readers will be only too well aware of the annoyance which is caused by the earpieces of a pair of headphones slipping below the ears after they have been worn for some time. Particularly is this the case with children's 'phones.

However, by making use of the little device illustrated here, this discomfort can entirely be overcome.

Obtain a small brass nut, place it in a vice and file away all its rough edges and corners so that it is made as round and as smooth as possible. Next, slip the nut over the adjuster rod of the 'phone earpiece, and solder it to the latter in the manner indicated in the diagram. Treat the opposite adjuster rod of the headphones in the same way.

The headphones will now be ready for use by a person, such as a child, for instance, possessing only a small head, and it will obviously be impossible for the earpiece of the 'phones to slip down the face and give rise to discomfort on the part of the wearer.

Finally, if for any reason it is required to convert the 'phones back again into their normally adjustable condition, the application of a hot soldering iron to the nut on the 'phone adjuster rod will quickly result in the nut becoming detached, after which it can be entirely removed, or re-soldered to the adjuster rod in a different position.



THE SUMMERDYNE

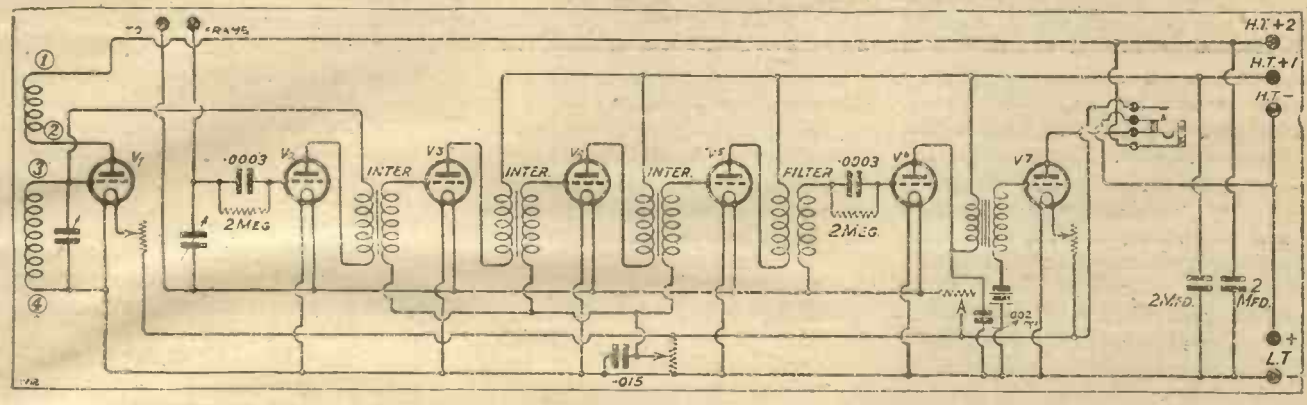
A portable seven-valve super-heterodyne receiver.

Designed and described by

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

THE design of a portable super-heterodyne receiver is a complex and, to some extent, an irritating affair. On the one hand the great sensitiveness of the circuit makes it almost ideal for portable set use, and on the other considerations of portability and compactness prevent our laying out all the components in the ideal manner. Again, if, as was the case in designing the present instrument, it is desired to include the frame aerial in the case itself, we are "up against" several minor problems, one being that unless the case is unduly large the frame itself must be small, and secondly we are bound to build the frame in such a manner as to surround it by wood. Some experience with frame aerials has shown me that the most satisfactory are those which are as free as possible in space, the turns being air-spaced, and in contact with a minimum amount of solid insulating material. We must therefore remember that a built-in small frame is bound to be less efficient than the larger air spaced variety.

The next point is the problem of L.T. and H.T. supply. Accumulators are generally messy, heavy and unsuitable for portable sets, yet dry cells of adequate size to light the filaments of a seven valve super-heterodyne for more than an hour or two are heavier than the accumulator they are supposed to supplant. On the H.T. side of the problem, space



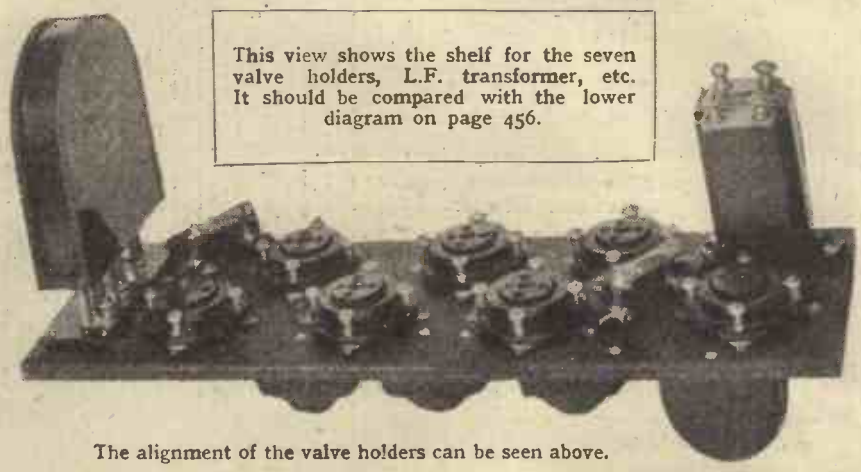
COMPONENTS REQUIRED

1 cabinet as described, with frame for frame aerial.
1 panel, 16 in. x 8 in. x $\frac{3}{16}$ in. (Radion).
1 Bowyer-Lowe oscillator-coupler with base.
7 valve sockets. (Lotus, or any standard make of the same size).
Two ·0003 mfd. fixed condensers, with clips for leaks of two megohms. (Lissen or other standard makes).
1 L.F. transformer (Brandes).
1 potentiometer (C.E. Precision).
Two ·0005 mfd. variable condensers. (G.E.C. s.l.w. pattern, with 30—1 ratio verniers).
1 open filament jack (Bowyer-Lowe).
1 plug for same (Bowyer-Lowe).
3 intermediate frequency supersonic transformers and one filter, G.R. Co. pattern. (Claude Lyons.)
1 fixed condenser, ·002 mfd.
3 calibrated rheostats for baseboard mounting (Magnum); 1 of 6 ohms, the others 30 ohms.
1 fixed condenser, ·015 mfd. (Dubilier).
7 sockets with plugs, five red and two black (Lisenin).
5 wander plugs (Lisenin).
Two 2-mfd. Mansbridge condensers (T.C.C.).
1 Oldham 2-volt unspillable accumulator (miner's lamp type).
1 66-volt Ever-Ready H.T. battery (type W. 23).
1 grid bias battery.
1 clip for same.
Rubber-covered flexible wire for wiring up.

THE SUMMERDYNE—*continued*

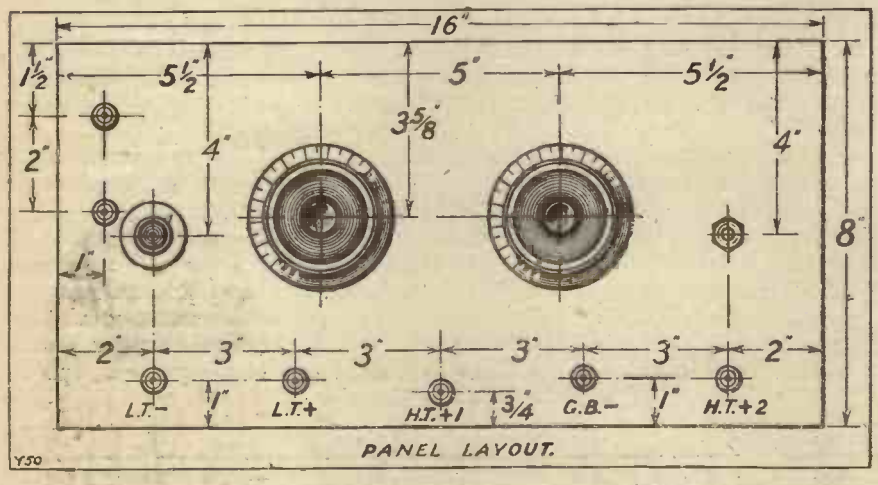
and weight have again to be considered. There is always a temptation to use the smallest H.T. battery we can get on the grounds that such a battery is light, and that a portable set is not to be used a great deal.

These are but a few of the considerations I had in mind when the Editor of MODERN WIRELESS invited me to design a portable super-heterodyne for this issue. I do not pretend that the Summerdyne is as efficient as it is possible to make a seven valve "super" in ideal conditions, but the results given will, I think, fill the needs of many readers.



This view shows the shelf for the seven valve holders, L.F. transformer, etc. It should be compared with the lower diagram on page 456.

The alignment of the valve holders can be seen above.



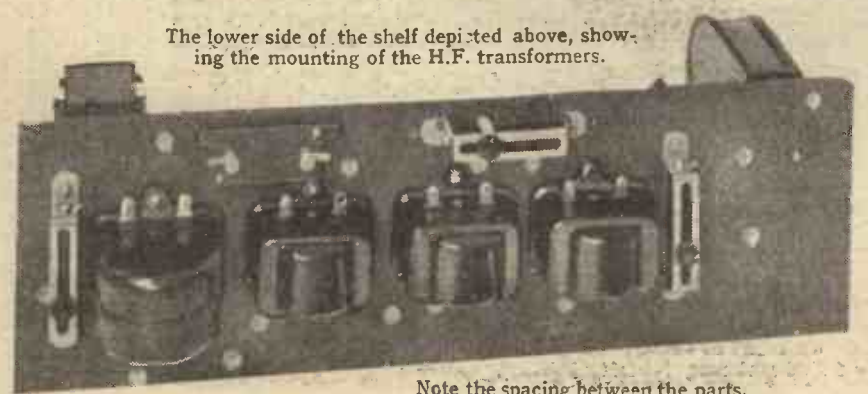
Let us now see how the various problems relating to a portable set have been tackled.

General Portability

The whole instrument is built into a standard cabinet with an interior measurement of 16 × 16 × 5 ins. deep (excluding lid), the frame aerial of the single layer variety being built into the lid which is 2 in. deep.

Batteries

The L.T. supply to the two-volt valves is provided by a standard unspillable two-volt accumulator of a type manufactured in large quantities for miners' lamps. It can be turned upside down if necessary without losing a drop of acid, while its capacity is such that it will run the present set for twenty hours continuous running. It is rapidly removable for recharging by slipping off a pair of clips. The H.T. supply is from a standard large size of dry cell H.T. battery of considerably larger capacity than the usual small sizes fitted to portable sets.



The lower side of the shelf depicted above, showing the mounting of the H.F. transformers.

Note the spacing between the parts.

Circuit Employed

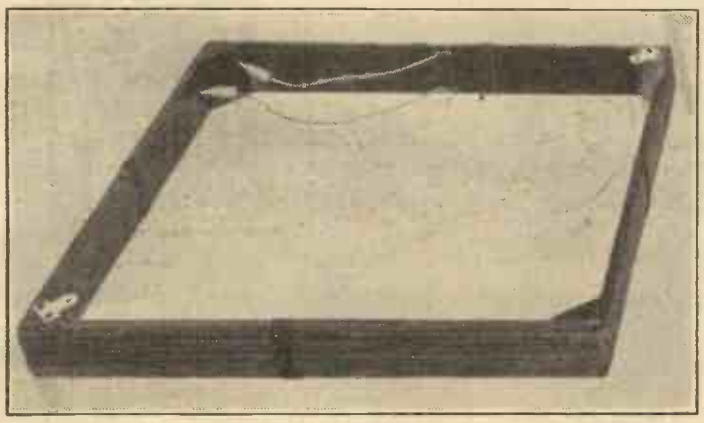
The circuit used is that given on page 453. A separate oscillator valve is used and the method of combining the local generated oscillations with the incoming signals is that originated by Mr. Robert E. Lacault and is known as the Ultradyne circuit. It is less used than, in my opinion, it deserves to be and has certain distinct merits of simplicity. For the H.T. supply to the first detector valve is simply the generated oscillatory current of the frequency we desire. There is thus no oscillator coupler in the ordinary sense, the beat note in the first detector circuit being picked up by the intermediates and passed on in the usual way. Everything else in this circuit is quite conventional and will need no further explanation to those who have previously studied super-heterodynes. And, by the way, I do not recommend the construction of any superhetodyne to the beginner. If you are not fairly experienced in building and handling sets, do not be tempted to build a "super." Beginners may wonder at this advice, but I am sure that all who have handled "super-hets" will agree with me.

The choice of the components for this set has had to be dictated largely by considerations of space. The Bowyer-Lowe Company make an excellent oscillator for the Ultradyne principle, this circuit being that used in their own super-heterodyne kit. The Bowyer-Lowe intermediate

THE SUMMERDYNE—*continued*

former would not fit into the arrangement adopted and the choice has therefore fallen upon the General Radio Co's.,(of America) intermediates which are both shielded and extremely compact. I mention this point as I do not wish any readers to think that the adoption of the Bowyer-Lowe oscillator, apart from their intermediates, has been dictated by any lack of efficiency in these components. They simply do not suit this set.

Again, the variable condensers have had to be very carefully chosen and the selection of the General Electric Co.'s straight line wave-length condensers in place of the same company's straight line frequency is again a matter of space consideration, as in the super-heterodyne the straight line frequency condensers are generally more convenient to handle. So far as the L.F. transformer was concerned, the Brandes fortunately is both small and efficient and fits into the space available without difficulty.

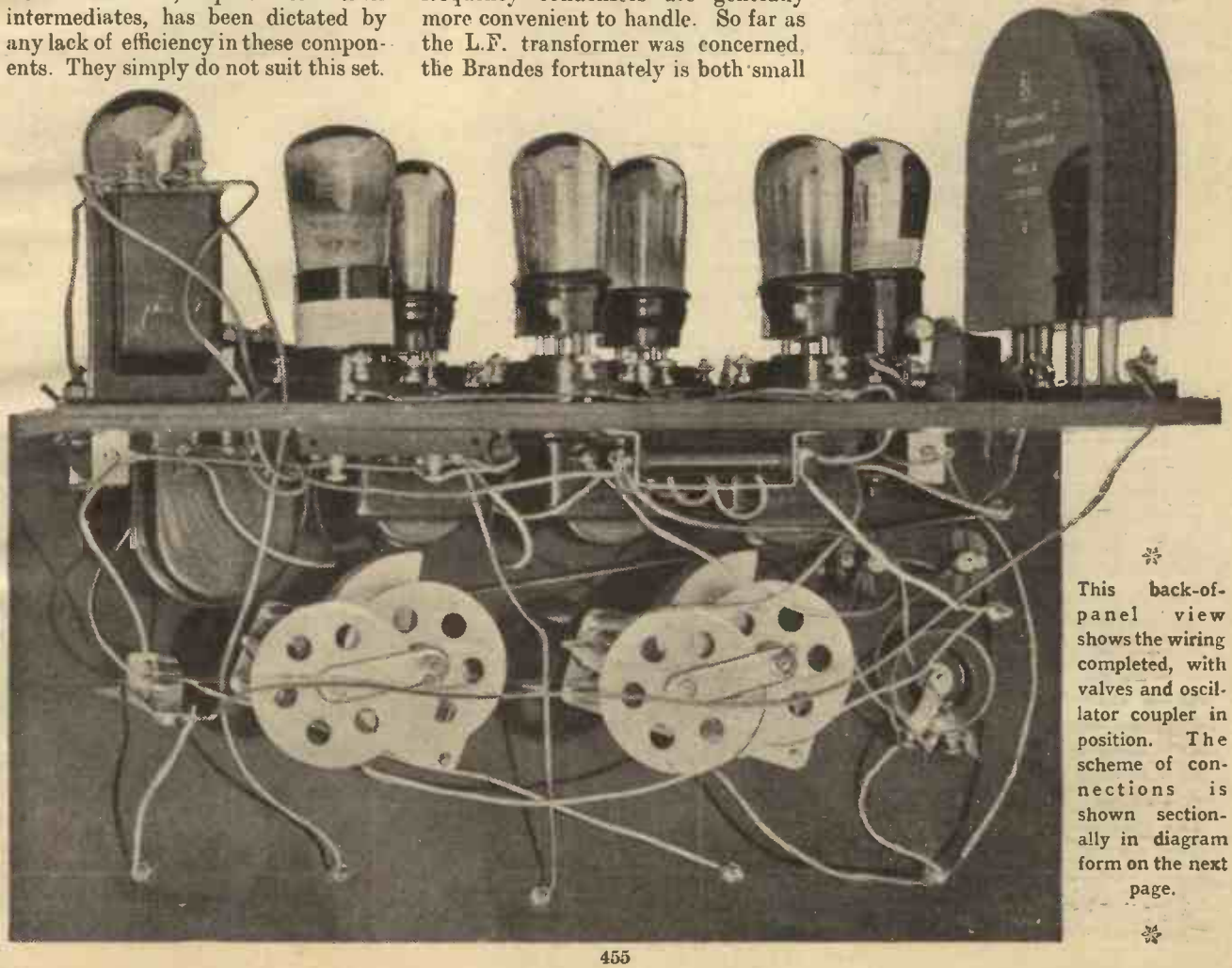


The construction of the frame aerial will be clear from this illustration.

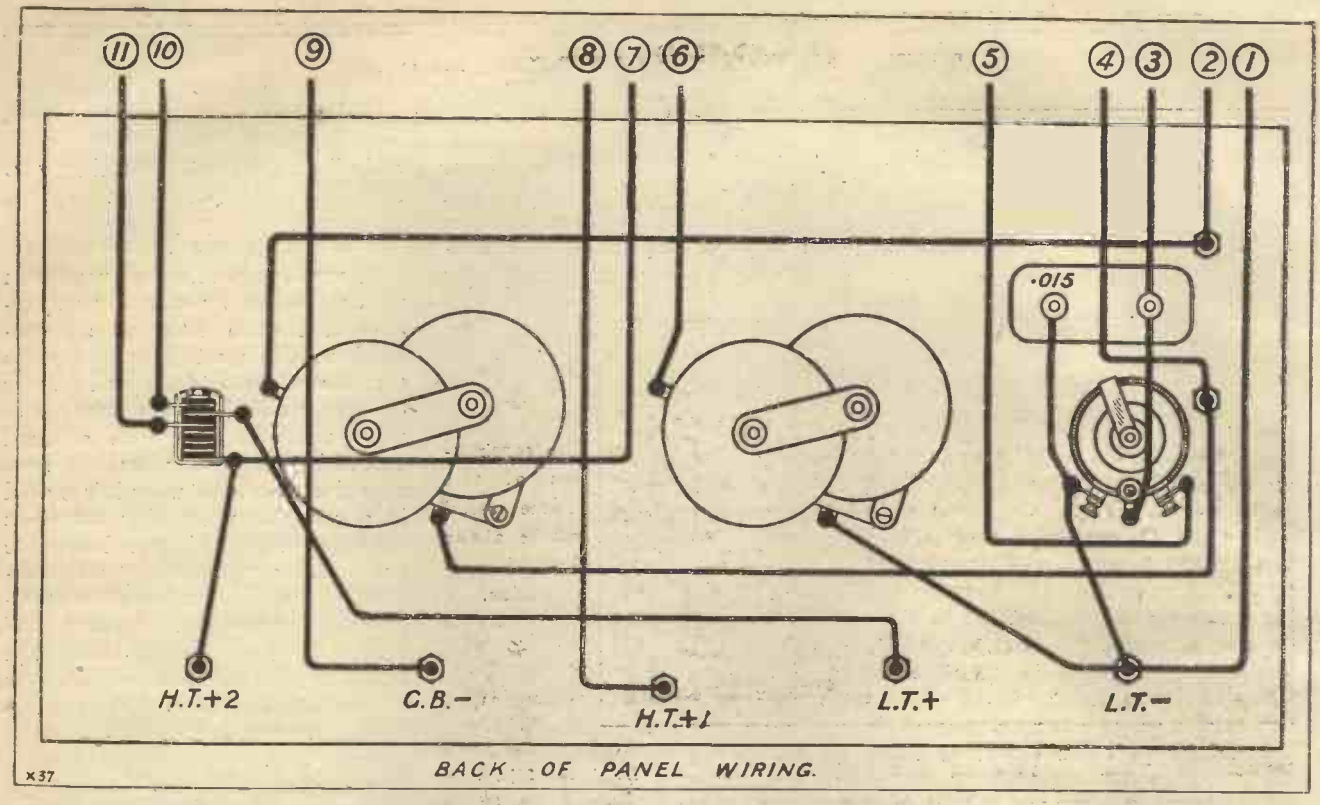
Flexible Wire

I have departed from convention in wiring this set by adopting rubber-covered flexible wire for all connections, the most important wires (*i.e.* the grid and plate leads) being extremely short. The advantage of using the soft wire with soldered connections is that vibration, such as is given to the set when it is carried in a car, will not spring the wires apart and break the joints. I am quite aware that a much more "workmanlike" job could be made for "window-dressing" purposes by using stiff wire with nice straight runs and sharp right-angles, but pleasant as such wiring may be to the eye, it is a fruitful source of broken joints in portable sets.

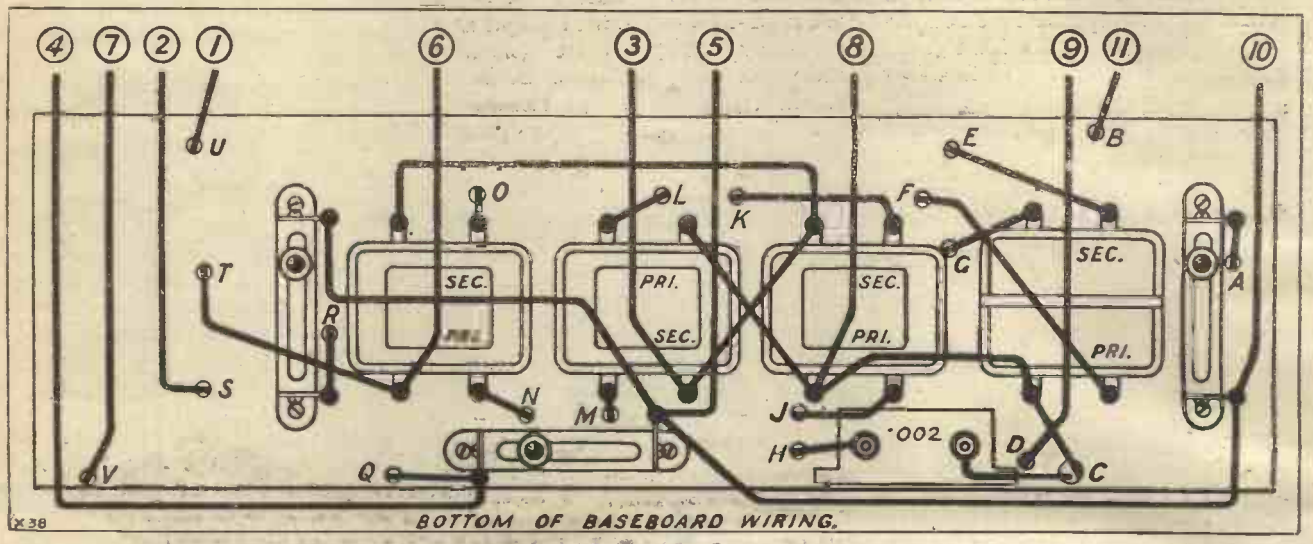
In commercially built portable sets adequate precautions are often taken to avoid trouble of this kind, and the



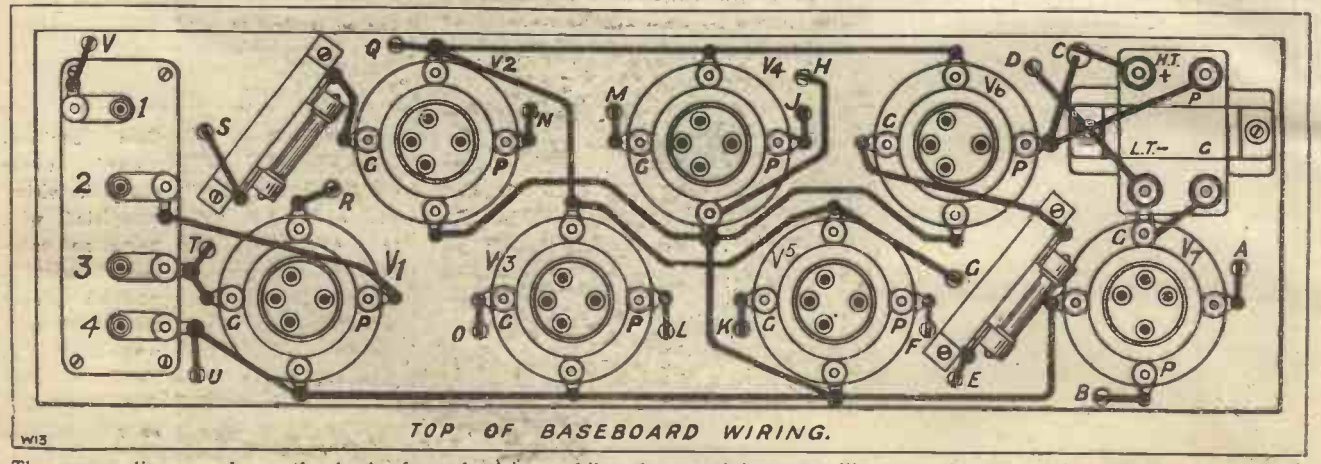
This back-of-panel view shows the wiring completed, with valves and oscillator coupler in position. The scheme of connections is shown sectionally in diagram form on the next page.



X37 BACK OF PANEL WIRING.



X38 BOTTOM OF BASEBOARD WIRING.

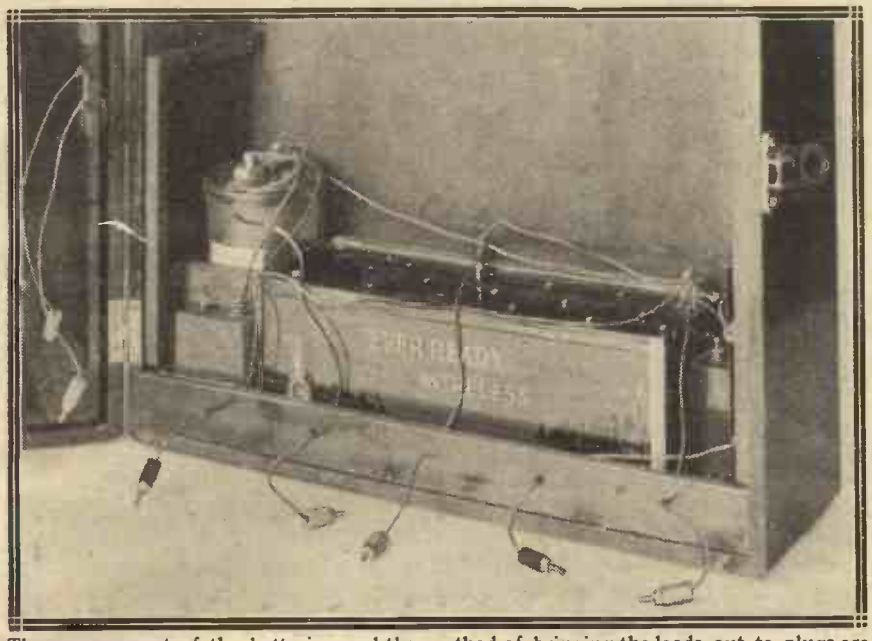


W13 TOP OF BASEBOARD WIRING.

The upper diagram shows the back-of-panel wiring, whilst the remaining ones illustrate the connection of the components above and below the baseboard shelf.

THE SUMMERDYNE—*continued*

best sets are very carefully thought out in this regard, but for the home constructor carefully laid out wiring of the flexible kind is much more likely to remain in order. To test this method of wiring I have submitted the Summerdyne to really rough treatment and long runs in my car over very rough roads, the joints at the end of the test being perfect, whereas, had stiff wire been used I am convinced trouble would have occurred.



The arrangement of the batteries, and the method of bringing the leads out to plugs are shown above.

In order to yield the maximum simplicity in building and in changing batteries, the set has been designed to take out of the cabinet when desired, simply by moving two clips, a few plugs, and sliding the set outwards.

The Battery Positions

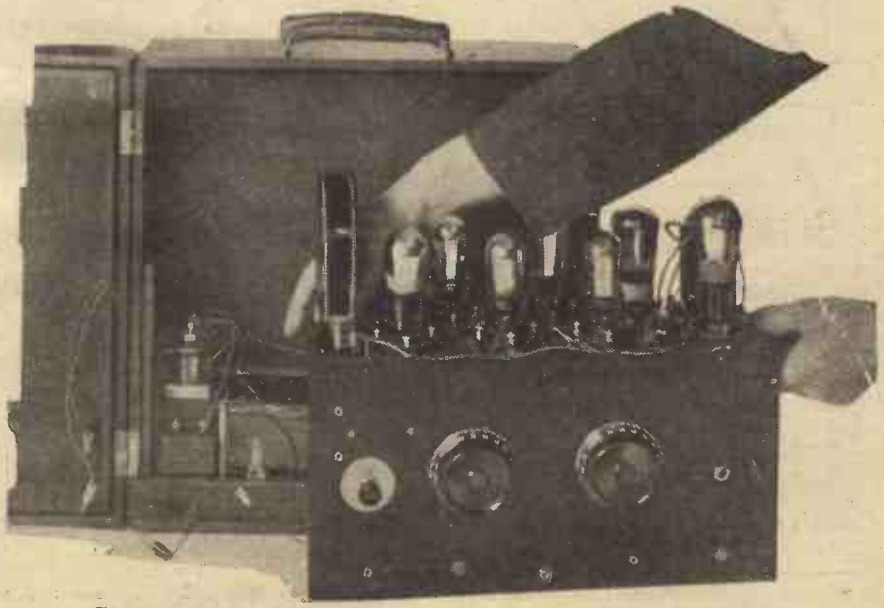
When the set is removed the accumulator, H.T. battery and grid bias battery are revealed, the accumulator dropping into a little compartment on the left and the H.T. into the middle in such a way that it holds one side of the accumulator in place. The grid bias battery is placed vertically on the right in a single clip next to a 2-mfd. Mansbridge condenser, which is shunted across the H.T. tapping for the two detectors and three intermediate stages. A second 2-mfd. condenser is placed in front of the accumulator. This is shunted across the other H.T. tapping.

It will be observed that there are five plugs along the bottom of the ebonite panel (which is a standard 16 in. x 8 in. size). Reading from the left, these are as follow: L.T. negative, L.T. positive, H.T. positive tapping 1, grid bias negative and H.T. positive tapping 2. It will be noticed that there is no connection on the front of the panel for H.T. negative or grid bias positive, as these are made between the batteries themselves.

The object of having plugs on the front is twofold. Firstly, it enables the batteries to be disconnected entirely from the set in a moment when the latter is removed from the cabinet, and secondly, when the set is used at home the batteries in the set can be economised by using others belonging to the ordinary home set, plug connections from these going into the front of the instrument. The frame aerial is also plug-connected not only for the removal of the leads when necessary, but also so that larger exterior frames can be used when desired.

The Case

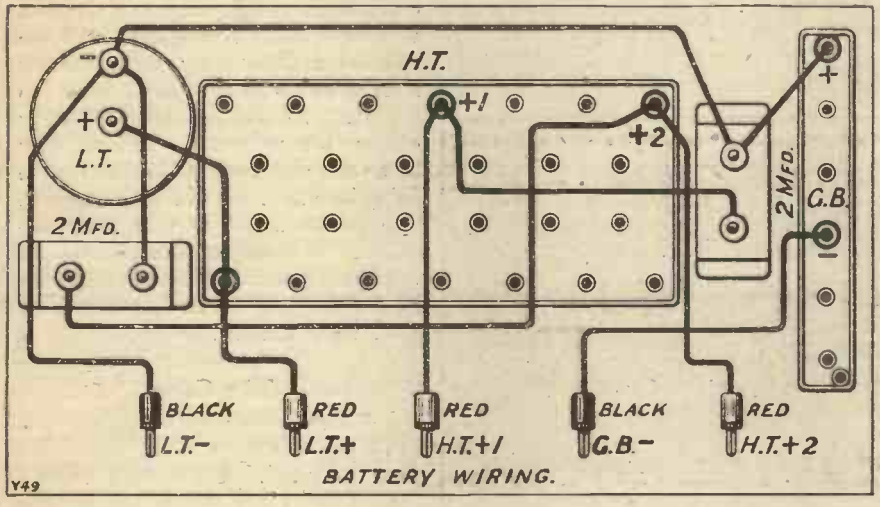
No on-and-off switch is used, but in its place an open filament jack has been adopted. Connection to the loud speaker is made by means of a standard plug. When the plug is pushed into the jack the filaments of all seven valves are automatically lit, and as the lid of the cabinet cannot be closed while the jack is in place there is no possibility of your packing up the set after an outing with the filaments left on. The cabinet is the standard "Camco" portable set case, and can be obtained from the makers fitted with the necessary fillets and battery compartments for this receiver; or, if the reader so desires, he can build one himself, the essential measure-



The set being inserted into its case. Note the plugs for the frame aerial.

THE SUMMERDYNE—*continued*

ments being 16 in. x 16 in. x 2 in. deep in the cabinet itself, with a lip 2 in. deep for the frame aerial. This latter is wound on a frame measuring 15¾ in. square and 2 in. wide.



BATTERY WIRING.

Two holes are drilled 1½ in. apart transversely in the middle of one side of this frame and thirteen turns of flexible rubber-covered wire (I used Lewcos 14-36 VIR wire) wound on, the ends being passed through the two holes mentioned. It is not a bad plan to tie a knot at the beginning of the wire, leaving about 6 in. or 8 in. between the actual end of the wire and the knot, before you start winding, as the knot will hold the wire tight in the first hole while you wind the thirteen turns on the frame. The other end of the wire can be secured by passing it twice through the hole, while it is not a bad plan to wind a strip of electrician's rubber tape round the middle of each side to hold the wires securely in position, as shown in the photograph.

Constructional Work

Actually the constructional work is far simpler than would appear from examination of the photographs, for the valve-strip wiring is done almost entirely before the front panel is attached. If you buy the cabinet ready made, you should begin work by taking the shelf and laying out upon it and securing into position the oscillator coil base, valve sockets, grid leaks and condensers, and L.F. transformer, as shown in one of the photographs.

Before proceeding further drill the holes indicated through the shelf and, having done this, turn the shelf over and attach the components below (*i.e.* the supersonic intermediates and filter, the fixed condensers, and the baseboard mounting resistors). Now take the 16 in. x 8 in. panel and mount on it the variable condensers, jack, potentiometer, sockets for frame aerial and battery connections, and the fixed condenser connected across the potentiometer. Be careful to place the variable condensers at the angle shown, otherwise they will foul the H.T. battery.

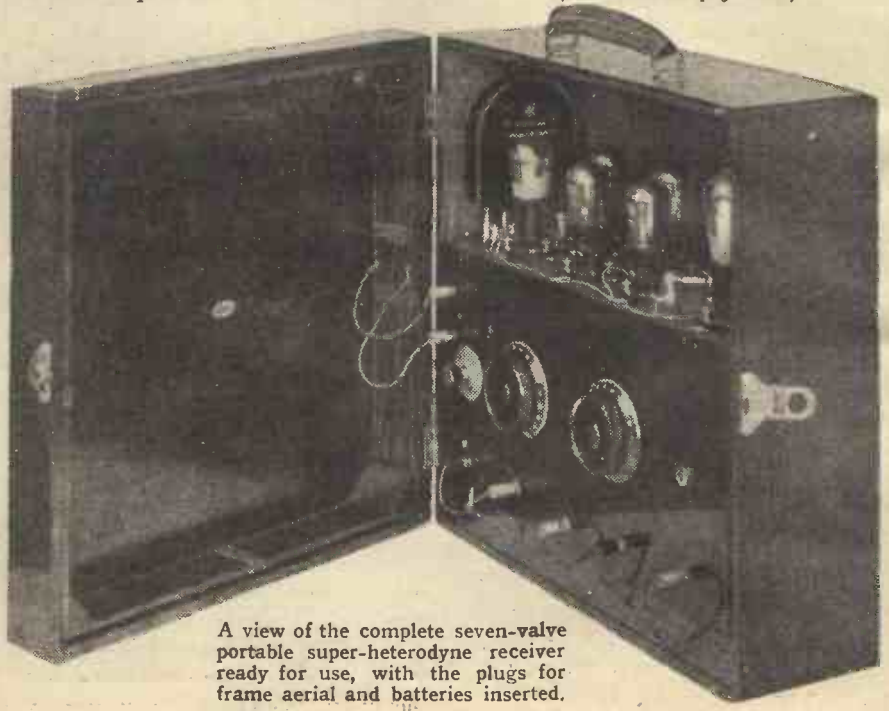
The wiring should now begin on the shelf portion. You will find it a convenience when a lead goes to several points to use short wires between the various points, baring the ends and twisting them together where they have a common contact. This will be found much simpler than attempting to bare portions of a lead in various places. All these wires should be carefully tinned, as well as the points to which they are to be soldered.

Battery Connections

To avoid confusion the holes in the shelf are numbered on both sides, and this should enable the constructional work to be carried out quite simply.

The connections to the accumulator are made by means of clips, consisting of pieces of springy brass or, as I have used, a couple of grid-leak clips soldered to flexible leads. Rubber insulating tape should be wrapped round these clips, except at the points where they make connection to the battery, to avoid the two leads getting together and short-circuiting the battery. The more ingenious reader can devise other means of securing leads to this battery, for the terminals are really spring plungers designed to make a pressure contact against the lid of a box. The clip method, however, is quite simple and suitable for the present occasion.

(*Continued on page* 550.)



A view of the complete seven-valve portable super-heterodyne receiver ready for use, with the plugs for frame aerial and batteries inserted.

The EXISTENCE OF THE ETHER

An arresting article in which the greatest thinker of the day expounds his vast subject with characteristic clearness and charm.

by Sir Oliver Lodge F.R.S.

IN the minds of educated people at the present day there seems to be a general impression that modern developments in physics have enveloped in cloud, or even gone far to put

The late Dr. Steinmetz, a famous American scientist, who endeavoured to disprove the existence of the ether.

out of existence, or at any rate useful conception, the idea of the Ether of Space as a universal connecting medium and physical agent. This is partly due to the brilliant successes of the theory of relativity, which took its rise during the present century, and by mathematical methods accounted for a great number of phenomena, and predicted more that were subsequently verified—and doing all this without mentioning the ether.

What is Matter ?

The ingredients in the theory of relativity were space and time, and even these tended to be unified ; and the idea of matter seemed to be little more than a certain configuration or distortion of space. Space was given certain properties, not indeed precisely specified, and then a calculus was invented that would enable results to be obtained in a blindfold manner without attending to what had been previously considered physical realities at all.

During the whole of the nineteenth century the ether was dominant, being conceived as a rarefied kind of matter. The wave theory of light, which was initiated by that great physicist, Thomas Young, at the beginning of the nineteenth century, reached its zenith about the middle of the century as a mechanical theory, and was then replaced and glorified by Clerk Maxwell into an electromagnetic theory. All electric properties and all magnetic phenomena were attributed to the ether of space ; and light or radiation, which was a combination of the two, seemed to be a pure function of the ether. But still the attempt was made, by Lord Kelvin and many others, to expound the properties of the ether mechanically ; that is to say, to treat it as rarefied matter. All these attempts conspicuously failed.

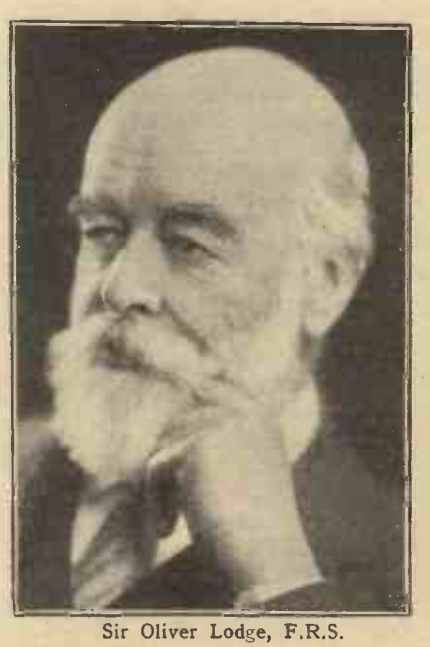
A Modified View

Then, at the beginning of the present century, the quantum of radiation was discovered. It seemed to be ascertained that radiation was emitted and travelled in packets of extremely minute size, rather like the old Newtonian corpuscles which had preceded the wave theory ; so that there was a tendency to revive the corpuscular theory of light, to treat a ray of light as a projectile, and to dispense with the ether. Such a theory was attempted, though again without success. There may be truth in it, and there must be truth in the wave theory ; the modern tendency is to try to combine the two. But if waves are to be admitted at all, there must be some substance to carry them, and moreover the very electrons and protons of which matter is composed must be made of something. Hence the modern tendency is to revive an ether, but in another form, not as a rarefied condition of matter, but as something of which matter itself is composed, a much more fundamental substance, not rarefied at all, but very dense and substantial and full of energy.

Einstein himself, and Eddington, his greatest exponent, both admit the need for an ether of this kind ; but it is not the same ether as that of the nineteenth century ; that truly has been discarded, a rarefied form of matter does not work. Our new ideas of the ether are based on the phenomena of electricity and magnetism and radiation conjointly ; and what form it is ultimately going to take no one at present knows.

The Test of Experiment

Meanwhile, it is true that mathematicians can write down their equations and carry on their calculations without reference to it. It is only when they cease to be mere mathematicians and become physicists and physical philosophers that they recognise the need for something beyond mere empty geometrical space something that has physical properties, which can be specified when we know more, and



Sir Oliver Lodge, F.R.S.

meanwhile can be speculated upon and put to the test of experiment.

The peculiarity of the ether is that it is exceedingly difficult to experi-

THE EXISTENCE OF THE ETHER —*concluded*

ment upon. It never has and probably never will appeal to our senses directly; they only tell us about matter. But since we now know that matter is electrically constituted, it must in all probability be composed of ether; that is, its ultimate elements are so composed, and therefore by studying them, and the results of their interaction, especially the way in which they produce and absorb radiation, we may gradually learn something about the nature of ether itself.

The Vehicle of Energy

In due time we shall find, so I believe, that it is truly the universal connecting medium, through which all our stresses and strains are transmitted, but which differs from matter in not being subject to locomotion. If matter is a modification of it, it is a modification characterised by conspicuous and easy locomotion. It is therefore the vehicle of obvious kinetic energy, whereas the ether is the vehicle or receptacle of all potential energy.

The ether is also the region of electric and magnetic fields, the instrument of gravitation and cohesion, and indeed of all the forces that unite and at the same time separate atoms and particles of matter. In free space we have unmodified ether; in space occupied by matter the ether is modified. If we ask, How modified? we do not at present know; but it seems likely that some kind of circulatory motion or spin or vortices would be able to differentiate one portion of ether from another, and thus confer upon these modified portions a sort of persistent identity and peculiar properties, to which we have grown accustomed as the properties of matter.

A Blaze of Radiation

Those who have studied the blazing phenomena of stars, especially Dr. Jeans', have surmised, and indeed almost proved, that to account for their tremendous energy it must be assumed that the positive and negative ingredients of ether can sometimes meet and neutralise each other in a blaze of radiation energy, the opposite modifications that we call positive and negative being dissolved, as it were, back into undifferentiated ether.

If we could follow out the details of this process, which so far has never been done in the laboratory, we should learn a good deal more about their constitution. And if at some future time we ever find it possible to generate electrons and protons by aid of radiation, we should learn still more; in fact, we should have a clue to the constitution of the material universe.

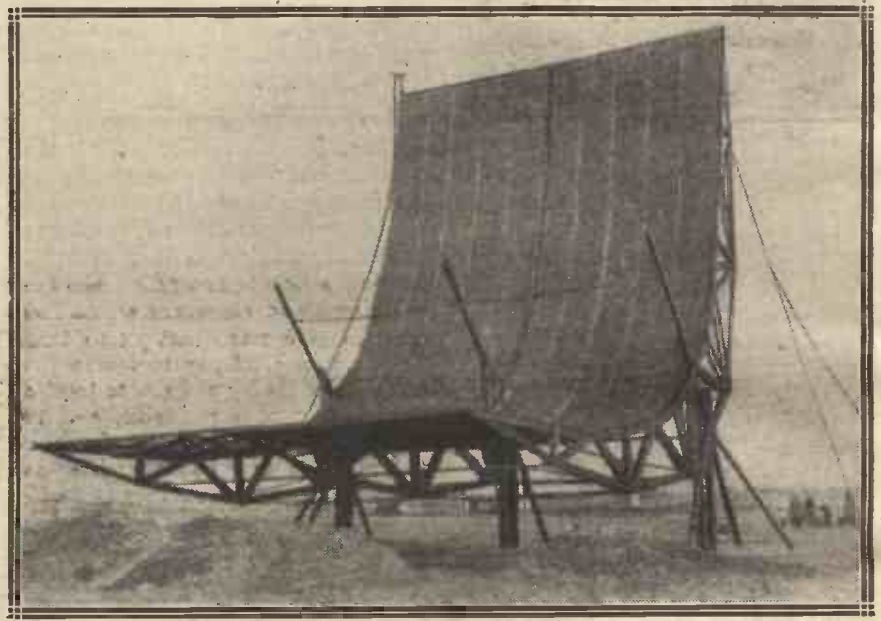
Ether an Entity

But this last idea about the conceivable (I will not say possible) generation of the elements of matter by radiation is nothing more than a guess; it is not justified by any facts known to us. Its only justification, perhaps, is that if nothing of that kind were true then the radiation of all the stars in the universe would be travelling outwards continually through space as a waste product, having no useful result whatever—an idea that to some minds is repulsive.

If, however, it be true, then the universe is slowly running down; the energy now exhibited by matter, and even the matter itself to a great extent, is passing away into the ether as radiation, and gradually wasting itself in the confines of space. On the other hand, if it be not true, and if ether waves can under any circumstances generate matter, then we have a sort of perpetual charter for the material universe, which can renew itself and go on for ever. We are here obviously getting far beyond our present knowledge. These are questions that we hardly know how to ask, still less to answer.

Meanwhile, I counsel all those who deal with the ether in a practical way by the emission and reception of wireless waves to adhere to their faith that some kind of ether exists, that there is some substantial entity that fills all space, and that it has a great variety of functions, some known, many unknown.

When people speak of abolishing it they really only mean that they have abolished and superseded some of the ideas about it that were tentatively and provisionally held in the nineteenth century.



A reflecting "mirror" for short-wave wireless experiments in use at Nauen, Germany.

A DRILL HARDENING HINT

It is not very generally known among amateurs that an ordinary drill may be greatly improved in hardness by the very simple procedure of heating it up to a dull redness and then by dropping it suddenly into a quantity of mercury contained in some convenient vessel.

If, however, mercury is unobtainable on account of its expense, a quantity of heavy lubricating oil may be used in its place, the red-hot drill being dropped into the oil.

Choosing Your Portable Set

Some Practical Hints for Outdoor Radio

An article of a practical nature which will help you to select your portable wireless receiver.

By G. V. DOWDING, Grad.I.E.E. [Technical Editor]

AFTER many years of wireless work I still find portable sets most fascinating, and I do not think that anyone who has not possessed and operated one can possibly imagine how really useful and intriguing such an instrument can be. During holiday times a portable wireless set scores over a portable gramophone because it is able to bring in "live" stuff such as weather reports, which are of vital interest to holiday-

A "Solodyne" 5-valver made up as a portable by Messrs. Peto-Scott.

makers, and news bulletins, not forgetting the new "running commentaries." And at other times a portable set can be most useful. It can be taken out into the garden or even used as an indoor set, in which capacity it has the advantage that it can be shifted about from one room to another.

Home-Made Portables

However, I fancy Mr. Featherstone made out as good a case for the portable in his article "Are Portable Sets Worth While?" which was published last month, as is necessary to convince those who waver that the answer to that question is an emphatic "Yes."

Therefore, I will deal with an even knottier problem, that is the *choice* of a portable set. First of all, the amateur must decide for himself whether he is going to build the receiver or whether he is going to purchase it.

The home constructor's initial task is an easy one. All he has to choose between is loud speaker or telephone reception and frame or temporary aerials, not forgetting to bear in mind the maximum range of reception he desires. But the man who decides to purchase a portable is faced with a much more difficult problem. There are a large number of very excellent portable radio receivers on the market of different makes and at different prices. No two are alike in every respect, while no one is better than all the others.

Question of Cash

In my opinion the most important question that should be asked is, "How much can I afford to pay?" Except in the case of millionaires this at once provides a limitation, and even wealthy folk are brought half way towards the solution by considering the question of cash, for obviously it is among the higher-priced instruments that one would expect to obtain higher qualities.

By this I do not mean to say that the cheaper sets are necessarily inferior in every respect. An additional five pounds—I am not quoting an actual example, might mean but an additional station or two receivable.

The Next Point

If I were purchasing a portable my next point would be appearance. Possibly many others would place this consideration very low down the scale, but I really do think that this factor has a great importance. If you do not like the appearance of a thing and consider it awkward in shape, grotesque in design or otherwise offending to the eye you will not readily forgive any other of its shortcomings. Mind you, I am not placing appearance before performance as a desideratum for *any* radio receiver, but other things being more or less equal, then give the former very careful consideration. That is my advice, and I counsel you to turn to the pages of photos which succeed this article and pick out

These river holiday-makers are adding to their enjoyment with a portable radio set which is used with a collapsible frame aerial and telephone receiver.

CHOOSING YOUR PORTABLE SET—*concluded*

those sets which appeal to your own *individual* taste.

Then comes performance, and intending purchasers will have to give this point very close attention. A guaranteed minimum range of reception is very hard to give, and readers must not blame the manufacturers if they tend towards approximations of a rather conservative character. A portable is liable to be used in all sorts of queer places, some of which may be real "blind

A self-contained receiver due to L. McMichael, Ltd.

spots." On the other hand, and more frequently, I think, they are operated under ideal conditions and bring in their distant stations with ease. In the "wide open spaces" where we go a-holidaying, DX out of all proportion with our town experiences is sometimes possible.

Regarding Wave-lengths

Next, do not forget that awkward wave-lengthed station, Daventry. In some respects it is an excellent station from a portable set owner's point of view, as it has a wide range and transmits morning concerts. On the other hand statics are more pronounced on the higher waveband and, again, Daventry might not be a station you want. But anyway it is worth noting that some portables do not tune up to Daventry, while others tune in nothing else.

Now we come to the question of portability! Weight and size are certainly vital factors, but do not exaggerate their importance. If a pound or two extra weight or a few extra inches of cubic capacity mean much in other respects, then ignore them even if it means slight discomfort in transporting the instrument. Those two items must not be made fetishes at the expense of, say, reliability.

My next point might have been higher up the scale, perhaps, for I consider it of extreme importance. It concerns quality of reproduction, which all too frequently is ignored in the case of portables. I appeal to readers of this article to hear the portables they intend to buy and satisfy themselves that their reproductions are good before purchasing the instruments for the sake of the good name of radio if not for their own sakes. There is no more excuse for distortion in a portable than in any other receiver.

Ease of Control

I think I can leave it at that, and proceed on to "ease of control." Some portables are inclined to be rather critical in adjustment. This is something of a fault, for we want to be able to turn on the news or music with the minimum of "fiddling about." This, accompanied by squeaks and groans from the speaker or 'phones, is liable to prove distressing to one's holiday nerves and to one's companions and, even though it is a portable, can cause interference in the ether of space.

We must not forget the battery requirements of our portable. The H.T. we need not worry about, although in the case of a portable using four or more valves, one should ascertain that this will have a reasonably long life as to have to carry spare H.T. batteries would be a nuisance. The L.T. is a graver problem, and this must be very closely considered. Some portables use dry battery L.T. supplies and some use non-spillable accumulators.

Hours of running per replacement or hours per charge must be ascertained, that is obvious, but if an accumulator is used, it should be seen that this is truly "non-spillable" and safely housed, as sulphuric acid is nasty stuff to have running about one's luggage! In conclusion, I do hope that this short article will prove helpful and will not lead any one reader to imagine that portable sets bristle with snags. They don't. Nevertheless, the choice of one from so many is and must be difficult, as nearly all of them are really good.

The Eight Important Points

Therefore, let me summarise the points I have brought forward.

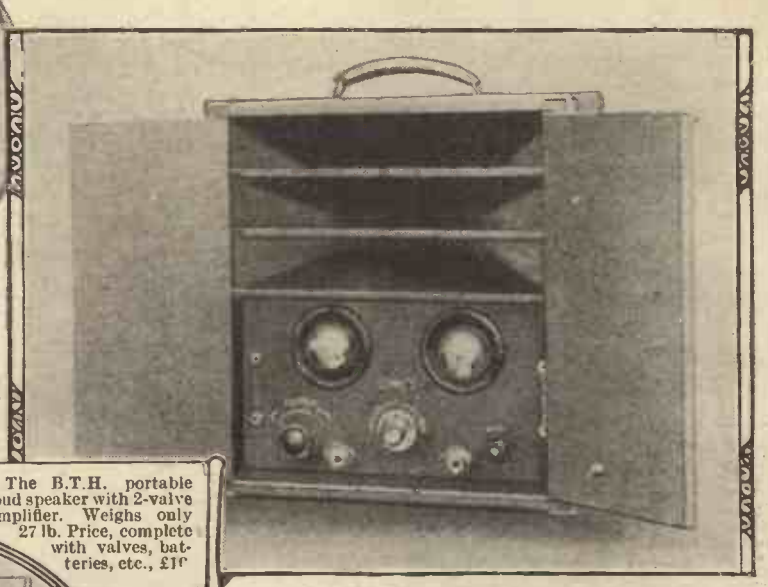
1. First of all you must decide how much you can pay.
2. Then run through our pictorial supplement, the advertisement columns, and all the catalogues you have available, and mark off those sets whose appearances strongly appeal to you.
3. You must then decide what you want your portable to do in the way of reception.
4. Next query the all-important question of wave-length range.
5. Then comes portability.
6. Try and hear the set working so that you can judge the quality of reproduction and—
7. Ease of control.
8. Finally, the "lives" and other essential details of the batteries should be ascertained.

A completely self-contained loud-speaker portable set provides the music during a cosy little picnic in the New Forest.

Some 1927 Portable Sets

The Rayol IV., shown above, is for use without aerial or earth. Designed to give main stations at 50 miles, and up to 250 miles on loud speaker. Price complete £30, plus £2 10s. royalties.

Right: The self-contained Pye 5-valver gives L.S. results anywhere in Britain. Price, complete and royalties paid, £30 12s. 6d.



The B.T.H. portable loud speaker with 2-valve amplifier. Weighs only 27 lb. Price, complete with valves, batteries, etc., £1[illegible]

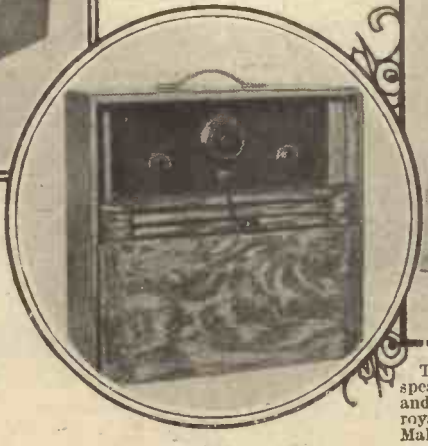
The "Alphian" Four (above) is designed for receiving Daventry in practically any part of the British Isles, and local stations up to 75 miles, according to locality.

With built-in loud speaker, and complete with accessories, price £45.

The Hart-Collins 4-valver (right) is for loud-speaker reception at 20–30 miles (main station), or 100-150 miles from 5 X X. As illustrated, with aerial and loud speaker embodied, £20, plus £2 10s. royalties.

Made by the B. T.-H. Co., this 3-valver weighs only 23 lb. Designed for headphone reception within 30 to 40 miles (main station), and 100 miles (5 X X). Price complete, £20.

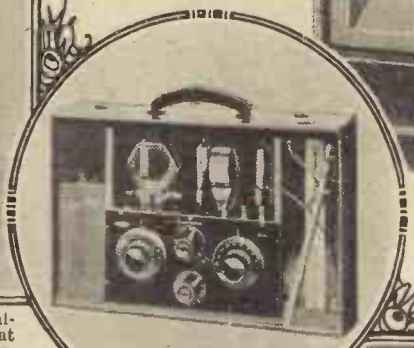
(Below) The Hart-Collins 4-valver, which embodies loud speaker and aerial. Price £20, or complete, royalties pd., £27 4s. 6d.



The "Nulli Secundus" 5-valver, designed for loud-speaker results from 5 X X in any part of the country, and London up to 80 miles. Price, including royalty, £33 2s. 6d.; or, with L.S. enclosed, £38 2s. 6d. Maker, C. Creswick Atkinson, Bedford.

The Levis 4-valve portable shown above is contained in a normal-sized leather attache case and incorporates the same circuit as that employed in the 4A cabinet receiver. The whole set can be taken out of the case and used as an indoor receiver if desired. Including royalties, but excluding 'phones or loud speaker, the Levis portable costs £25.

Below is shown a photograph of the Magnum All-Season 3-Valve Portable Receiver (Burne Jones & Co., Ltd.), which has the distinctive feature of being detachable from its case, enabling it to be used as an ordinary 3-valve set in the home when portability is not called for. The circuit consists of 1 H.F. (tuned anode), detector, and 1 L.F. stages, and the whole outfit, including royalties, costs £17 12s. 6d. Coils for Daventry can be supplied at extra cost if desired.

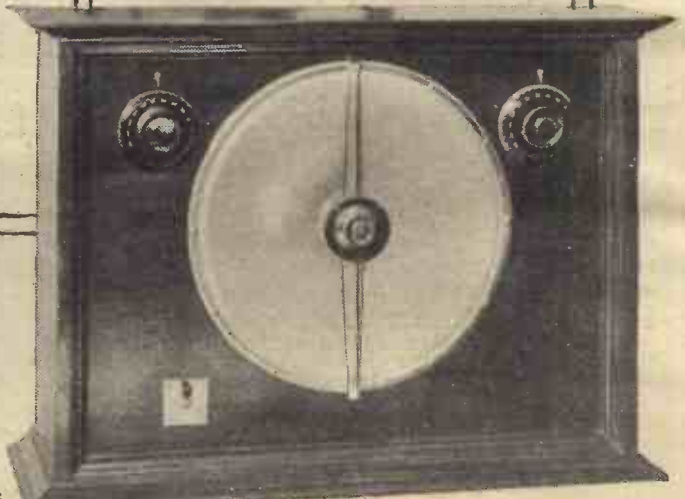


Weighing only 21 lb. costing £25, and containing loud speaker, aerial, and all accessories, this portable receiver (see above) employs four valves. With the set absolutely self-contained a range of 30 miles on the "B.B.C. waveband" and 80 for Daventry should be obtained.

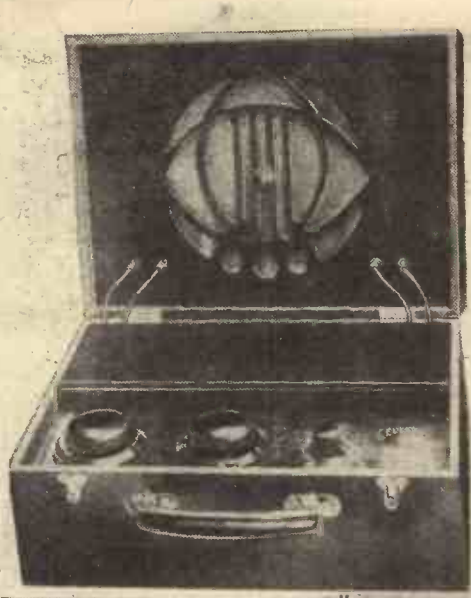
The "Portadyne" 5-valver seen below is extremely simple to operate, and is designed to give a loud-speaker range of over 300 miles on the high-power station and 60 miles or so from a main B.B.C. transmitter. The aerial is of frame type, included in the set, together with a loud speaker; the outfit costing £35, including royalties.

Contained in a leather attache case of ordinary dimensions, the "Cantophone" 3-valve set shown above weighs 20 lb., and, using the frame aerial contained in the lid, "has a Daventry range of 75 miles for loud-speaker reception, with a 'local' range of 20–25 miles." The price of the complete receiver is £18 18s. less royalties.

Complete with cone type loud speaker, enclosed frame aerial, batteries, valves, etc., the "Liberty" 8-valve super-heterodyne, made by Radi-Arc Electrical Co., Ltd., forms a luxurious portable set. The price is moderate (£35, excluding valves and royalties), and, as the photograph above shows, the set is neat in appearance and reasonable in size.



Right: The self-contained "Greater London" 5-valve receiver made by Messrs. Princes Electrical Clocks, Ltd. This set costs £21 and although capable of greater ranges when used with an outdoor aerial or with 'phones instead of loud speaker, it is designed to provide full volume on the latter at distances up to 25 miles from the local station. Use is made of the new "Trigger" circuit, and the set is extremely easy to handle. As will be seen, the loud speaker is mounted in the face of the set and is of the hornless type.



On the left is shown the Celestion Radio Four, which is sold in two models—for broadcast wave-lengths or for Daventry *and* local—at £35 or £39. The receiver is completely self-contained, the frame aerial and loud speaker being fixed in the lid. The dimensions are those of an ordinary suit case. The photograph on the right illustrates the Ediswan Portable "Toovee Radiophone," which will appeal to many readers.

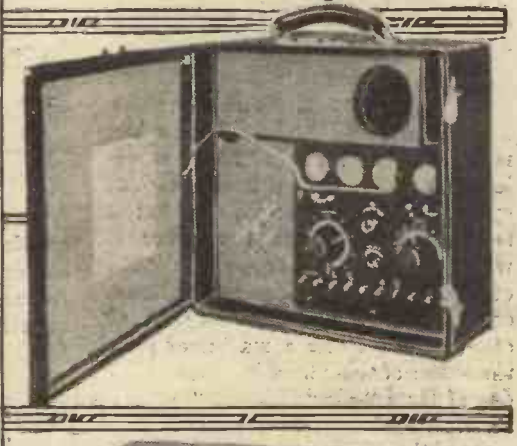
The operating panel is mounted inside a light framework which fits into a hardwood case covered with black leatherette. Special compartments are provided for accommodating the plate battery, grid battery, and filament accumulator. The latter is of the non-spillable type, 4 volts, 5 amp. hours, enabling the set to be placed in any position without fear of acid leaking. This accumulator will furnish supply for approximately 30 hours. A.R. 06 valves are employed.

Two pairs of headphones are supplied with each set, and the lid of the cabinet is made deep enough to accommodate 50 feet of rubber-insulated aerial cable.

An earth contact is made by means of a brass spike and connecting lead; the spike may be pushed into the ground or dropped into a river, pond, etc.

The price is £10 complete excluding valves and royalties.

The P.lican 5-valver shown in the centre of the page is designed to receive both high and low wave-lengths, the change-over being controlled by a switch. Special attention is paid to the batteries enclosed in the set, which contains a 2-volt, 50-100 amp. accumulator of unspillable type, and a large capacity H.T. battery. The receiver is designed to have a range of about 400 miles from Daventry, using, of course, no external aerial or earth, while the range claimed for other stations is 35 miles, in both cases full loud-speaker reproduction being taken as standard. Complete with all accessories and including royalties, the set costs £40, and is contained in a polished mahogany case with loud speaker included in the receiver. An external aerial and earth can be used if desired, when the set is employed at home.



An interesting receiver is illustrated in the right centre of this page. This set (the "Mayfair" 4-valve portable) has a wave-length range of about 200-500 metres, and a loud-speaker range of reception of about 100 miles or more.

It is entirely self-contained, and is priced at £27, excluding valves.

Two stages of L.F. are used, and the set is controlled by two tuning dials.

The "Rolls" 5-valve loud speaker portable shown at the bottom left gives a choice of either three or five valves, and either long or short wave-lengths. Its range is claimed to be 200-300 miles for 5 X X and 40-60 for the main B.B.C. stations, using the enclosed frame aerial and the loud speaker. Provision is made for the employment of an external aerial if desired. Weighing only 23lb. complete, the receiver costs £30 including all accessories and royalties.

The remaining receiver shown on this page is the Peter Curtis "Super-Het. 8." This is a de luxe set costing 50 guineas (excluding royalties), and has a loud-speaker range of about 750-1,000 miles. It is completely self-contained, and, as the photograph shows, makes a very neat and handsome portable receiver.

WHAT READERS THINK

NOTE.—All communications, MSS., photos, etc., should be addressed to the Editor, "Modern Wireless," The Fleetway House, Farringdon Street, E.C.4. In cases where a reply is required, a stamped and addressed envelope must be enclosed.

"Double or Single Wire Aerials"

SIR,—Mr. G. R. Stanley's article "Double or Single Wire Aerials," in the March issue of MODERN WIRELESS, while exceedingly interesting in scope, nevertheless seems to be *misleading* in some of the conclusions arrived at. The "best aerial" advocated by him may be best for the 2 L O wave-length and for the particular crystal set used in his investigations, but it is more than doubtful whether it would be such in connection with other circuits (with different maximum capacity, etc.), and for reception of other stations. As a matter of fact, the writer of these lines has found that one of Mr. Stanley's "non-selective" aerials does much better work than some of those he passes as "selective." This, of course, for another wave-length (480 m.), and possibly for an altogether different crystal set (large variometer value, 0 00001 mfd. maximum variable capacity). It is surprising to read an article of this kind *without mention of the variable capacity employed!* For the capacity employed in the circuit must substantially modify the optimum requirements as to relation between height and length of the aerial. It is because of this oversight that Mr. Stanley rejects the double aerial 60 ft. high—40 *ft. long* in favour of a much poorer instrument, namely, 60 ft. high—20 *ft. long*. A careful examination of his summary of results would reveal other discrepancies in his statements. For instance, on a purely theoretical basis, I would claim that even for the 2 L O wave-length a single aerial 70 ft. high, 30 ft. long, is *less* selective than a single aerial of the same height with substantially increased length. Although Mr. Stanley's claims in this are altogether different, his own summary of results, (however haphazard and unsystematic the course of his investigations), provides a mathematician with sufficient data to disclaim these claims—*i.e.* unless we question the data submitted in the "summary." But we will leave this to Mr. Stanley himself.

Yours faithfully,

IAN A. OZOLIN.

L. Kaleju jela 33, dz. 4, Riga, Latvia.

SIR,—I greatly appreciate the article, in the March issue, by G. R. Stanley on "Double or Single Wire Aerials," a matter which hitherto has been sadly neglected. Would it be possible to extend the experiments on four wire and six wire aerials? Hoping to see another article in the near future.

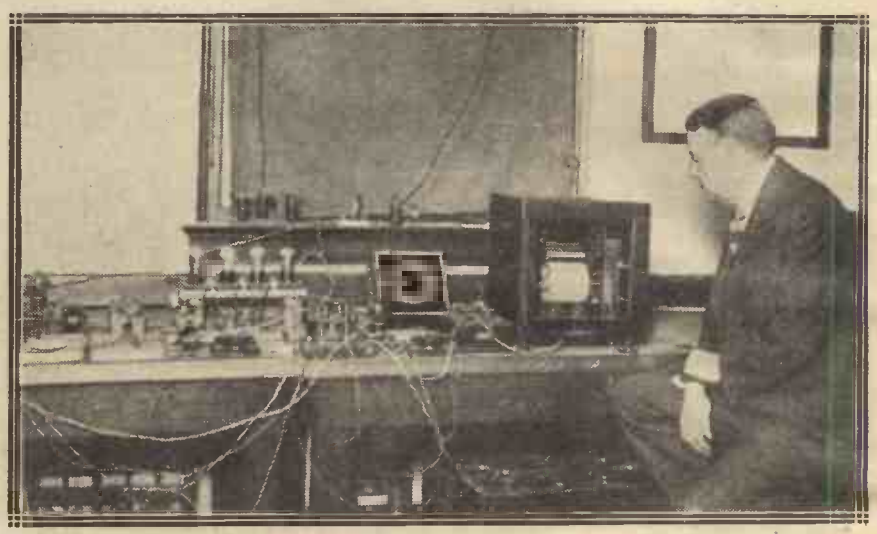
Yours faithfully,

H. BUCHAN.

103, West Ferry Road,
Millwall, E.14.

Directory of Sources of Special Information

SIR,—Just as the practical utility of a book is impaired by the want of an index, so the vast aggregation of knowledge that has been built up and is in many cases being added to day by day is largely lost to mankind owing to the lack of a master-key to its whereabouts. Throughout this country there are numerous centres of specialised knowledge and experience of the most varied description, the existence of which has only to be known for them to prove of great service to the world.



An American radio receiver which is able to tune in any one of twelve stations and record signals all quite automatically.

It is with the object of bringing these to light and recording their salient features in concise form that the Association of Special Libraries and Information Bureaux, in collaboration with the Carnegie United Kingdom Trust, has asked me to compile a Directory.

(*Continued on page* 555.)

THE "HEY PRESTO!" FOUR

by Stanley G Rattee M.I.R.E.

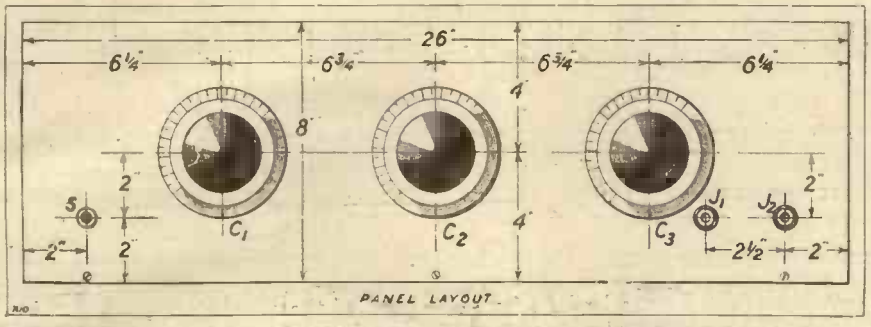
An easily constructed four-valve receiver capable of extremely satisfactory results.

WITH the Continental stations increasing in number week by week the problem of long-distance reception is becoming more fascinating, more and more tantalising and calls for greater selectivity than ever. Small talk concerning the Continental stations has even found its way into the daily Press, where almost every morning and evening at least one paragraph may be seen relating either to a new station to be opened or to the reception conditions of those stations already well known to listeners in this country.

That the European stations across the Channel *are* easily received in these islands is almost common knowledge among valve users, and though in some cases fading rather spoils continuous listening the game loses nothing of its charm, and is not a wit the worse for sometimes trying our patience.

Designed for D X Work

The receiver about to be described, and shown in the photographs, was designed especially for reception of the foreign stations, and in consequence is highly selective. It is intended primarily for loud-speaker work, and though in many cases three valves only would serve the purpose quite well, experience goes to show that where local conditions are not good, or where the only aerial possible is screened more or less seriously, at least four valves are necessary to give satisfactory loud-speaker reception of many of the lower-powered stations situated east of a line drawn north and south through Berlin.

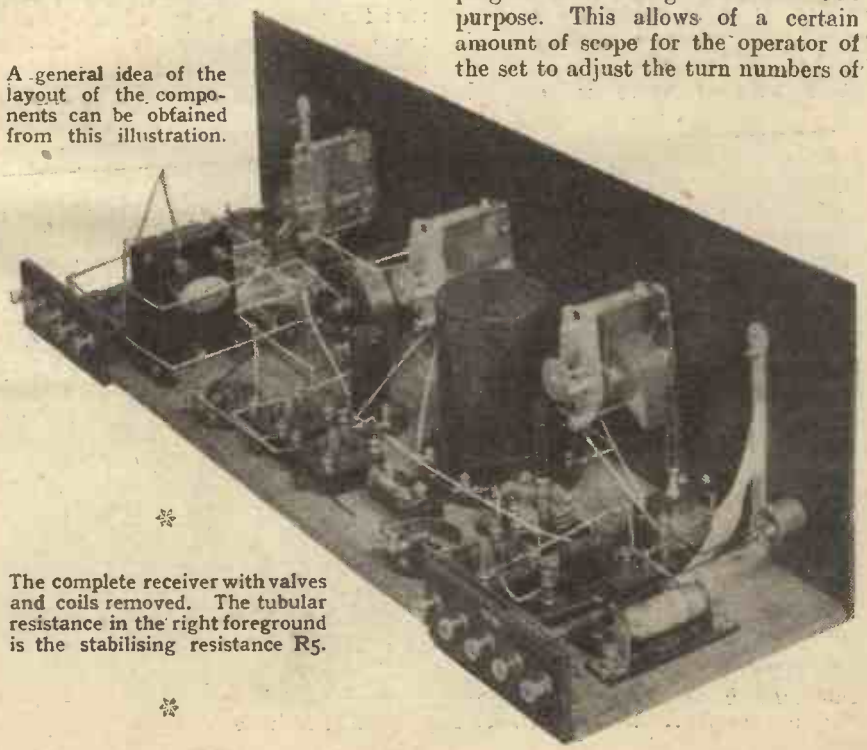


In view of this fact the receiver illustrated incorporates four valves with a jack switching arrangement suitably wired so as to allow of the cutting out of the last valve should more than three valves prove unnecessary for the successful reception of any particular station. The first of these four valves is an H.F. amplifier, followed by a detector, and two L.F. amplifiers, the first of these, latter being choke-coupled, the second transformer-coupled.

The Circuit Arrangement

Inductive coupling is used between the aerial and first grid circuits, plug-in coils being used for this purpose. This allows of a certain amount of scope for the operator of the set to adjust the turn numbers of

A general idea of the layout of the components can be obtained from this illustration.



The complete receiver with valves and coils removed. The tubular resistance in the right foreground is the stabilising resistance R5.

THE "HEY PRESTO!" FOUR—*continued*

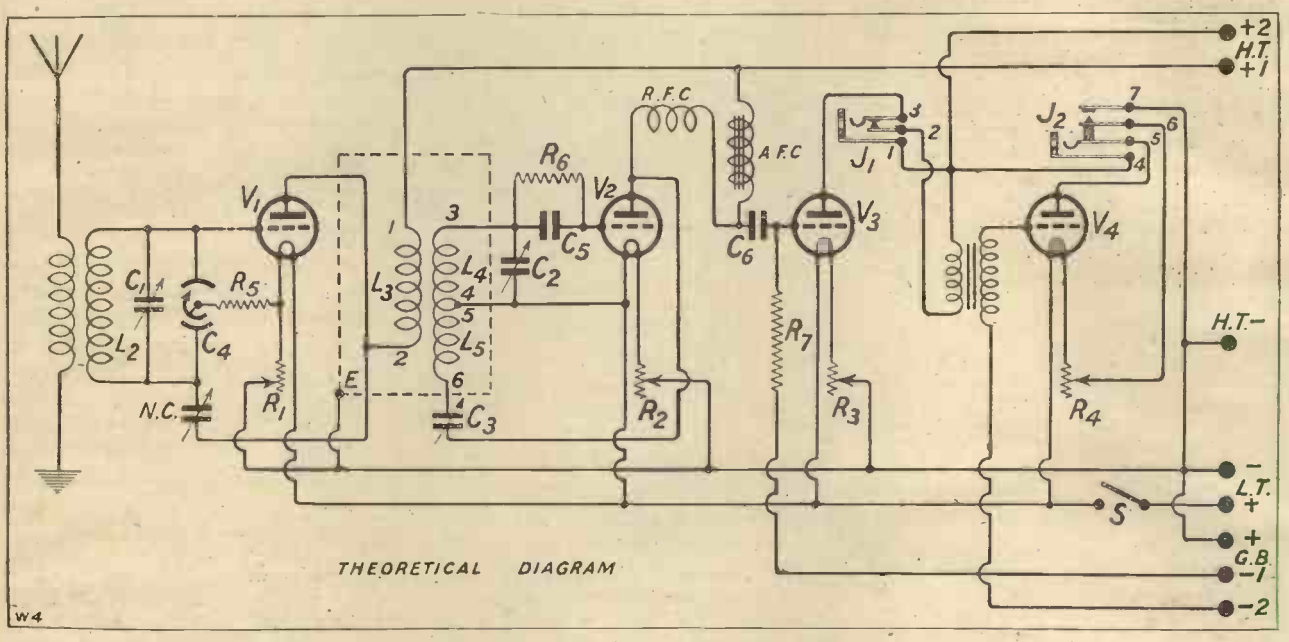
his aerial circuit to suit individual requirements as to aerial and selectivity required. The first valve is coupled to the detector by means of a standard screened split secondary transformer, half the secondary being used for tuning purposes and the other half made to act as a reaction winding as shown in the circuit diagram.

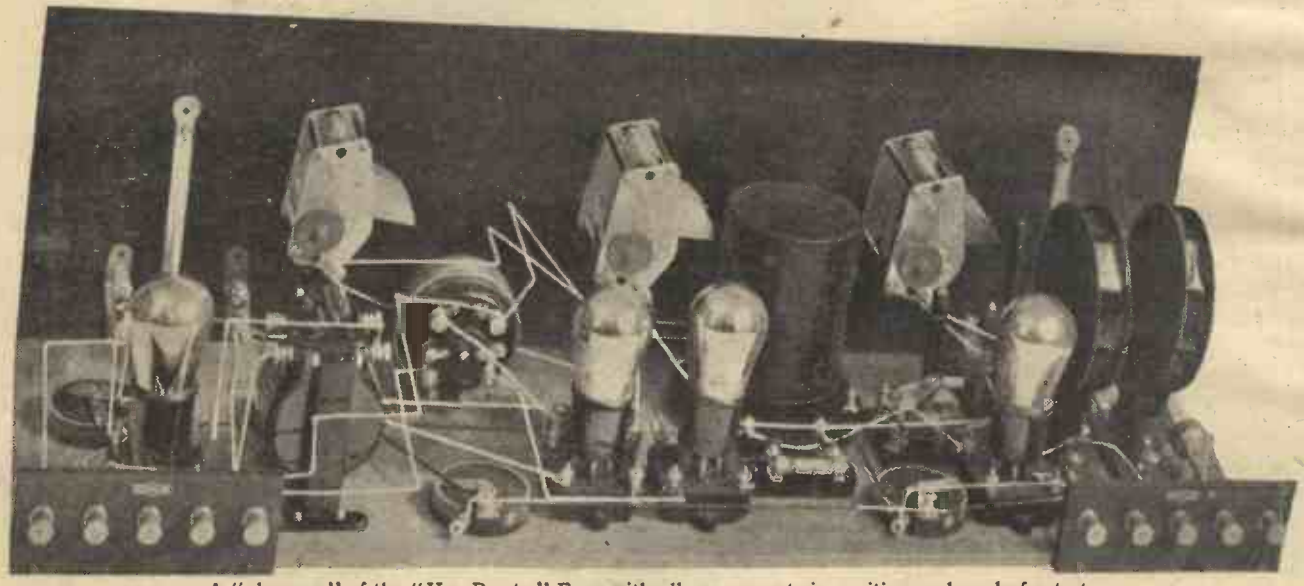
In the present case only half the secondary is used for tuning purposes and in order to cover the correct wave-length range a condenser of ·0005 should be used.

The detector valve is coupled to the first L.F. amplifier by means of a complete audio choke unit, simplifying to some extent the necessary connections. A reaction effect is obtained by the popular Hartley-Reinartz method, and with H.T. voltage to the detector valve suitably adjusted control will be found delightfully smooth and easy.

As to constructional design it will be understood from the photographs that the popular method of using an upright panel and horizontal baseboard has been adopted, the panel merely serving to carry the various controls; the baseboard is used for mounting the remainder of the components and permits of everything in the nature of coils and valves being enclosed within the cabinet.

Apart from the three dials on the front of the panel, there will also be seen immediately below and to the right of the last dial (on the right-hand side of the panel), the two jacks which permit of three or four valves being used as desired. On the extreme left of the panel will be seen an "on-off" switch for controlling





A "close up" of the "Hey Presto" Four with all components in position and ready for test.

THE "HEY PRESTO!" FOUR—*continued*

the L.T. supply for the filament. In order that the last valve may be switched on or off with all due speed and simplicity the jack employed for switching the remainder of the circuit also makes or breaks the filament circuit for the last valve.

COMPONENTS YOU WILL NEED.

- Ebonite panel measuring 26 in. x 8 in. x $\frac{3}{16}$ in. ("Radion.").
- 2 angle brackets ("Camco").
- Cabinet and baseboard, 26 in. x 8 in. x $\frac{3}{8}$ in. ("Cameo").
- 3 variable condensers, 2 of ·0005 and 1 of ·0003 (Brandes).
- 1 "on—off" switch (Igranic Electric, Ltd.).
- 1 double circuit jack (Rothermel Radio Corp., Ltd.).
- 1 single filament jack (Rothermel Radio Corp., Ltd.).
- 1 100,000 ohms anode resistance (Varley Magnet Co.).
- 4 valve holders "(Etherplus").
- 1 balancing condenser (Peto-Scott Co., Ltd.).
- 1 neutralising condenser (Peto-Scott Co., Ltd.).
- 2 baseboard mounting coil holders (Beard & Fitch, Ltd.).
- 4 baseboard mounting rheostats (Lissen, Ltd.).
- Condenser ·0003 and leak 2 megohms (Dubilier Condenser Co., Ltd.).
- Split secondary coil, screen, and base (Burne Jones & Co., Ltd.).
- 1 radio frequency choke ("Radiax").
- 1 audio choke unit—1st stage (Watmel Wireless, Ltd.).
- 1 L.F. transformer, type A.F.3 (Ferranti, Ltd.).
- 2 6 in. terminal strips, with 5 terminals each (Burne Jones & Co., Ltd.).
- 1 plug for operating jacks.
- Quantity of connecting wire, wood screws, etc.

As regards the three dials, the first two are used for purposes of tuning the first and second grid circuits, the third acting merely as a control of the reaction effect. In practice most of the operating is performed with the first two dials, the reaction adjustment not often requiring to be altered and then only a few degrees at a time.

Components Required

Before attempting to build the receiver, as illustrated, the materials and components given above should be collected together and though of course, makes other than those suggested may be found equally suitable, where the values are actually specified, these should be strictly adhered to. Care must be taken, however, to ensure that the present lay-out will permit of other makes of components being used without cramping them together or fouling the valves or coils when these are inserted in their respective holders.

In view of the fact that the aerial and first grid circuit coils are of the plug-in type, without screens, it is essential that the lay-out illustrated be copied with care, otherwise there may be some difficulty in obtaining either selectivity or stability over the whole range of the tuning condensers.

Wiring Up

The wiring up of the components will not be found a difficult problem, neither will it occupy many hours. There are one or two points which will be found useful in speeding up the work. For instance, soldering all those leads in position which lie near to the panel will be found a rather tedious occupation unless fixed in place during the early stages of wiring up.

The various connections to the two jacks, and those to the balancing condenser C_4, should also receive early attention, for, if left to the latter end of the work, other leads will possibly make the path of the soldering iron a very restricted one.

The terminal arrangement along the back edge of the baseboard is perhaps a little unusual in its manner of placing the terminals, but this was done to simplify the wiring and so keep the set as free from lengthy leads as possible. In the actual work of wiring up, this arrangement will be very readily appreciated, the various points which have to be connected to other points being sufficiently near to each other as to eliminate much wire bending.

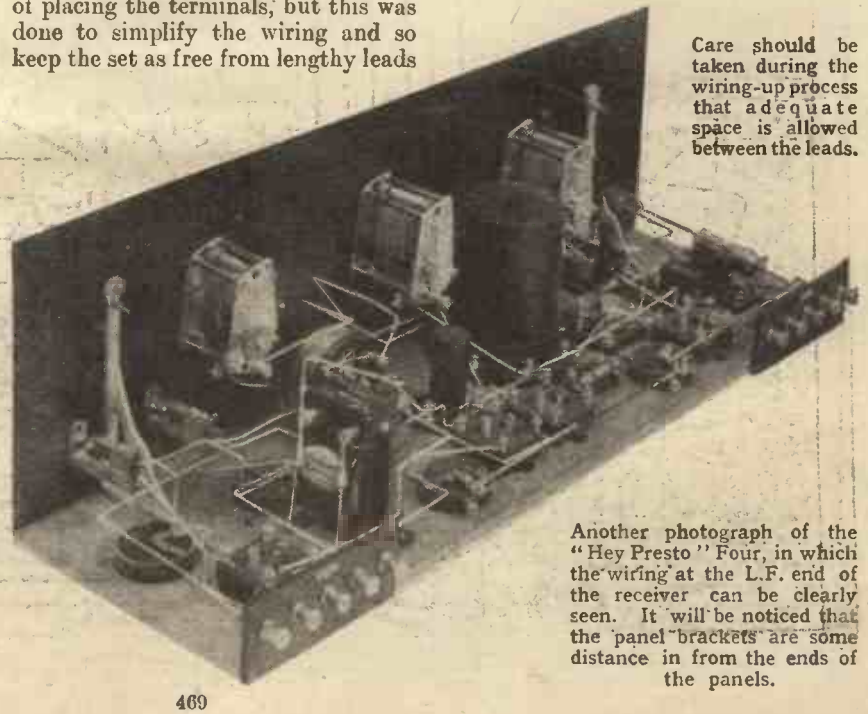
The set has been used with 2-, 4- and 6-volt valves of most well-known makes, and results in all cases have been about the same. It is recommended, however, that valves of the high *mu* type be used for the H.F. and detector stages, with power valves for L.F. work. General purpose valves may, of course, be used if desired, but special valves are to be preferred.

RESULTS.

Madrid*	Breslau
Berlin*	Copenhagen*
Manchester	Petit Parisien*
Strassborg*	Cardiff
Elberfeld	Leipsig
Bremen	Oslo*
Milan*	Rome
Gothenberg	Bilbao
Stuttgart	Brussels*
Hamburg*	Newcastle
Glasgow	Bournemouth
Berne*	Münster*
Ecole Superieure*	Dortmund
Birmingham*	Toulouse
Daventry*	Radio Paris*
Barcelona*	Prague*

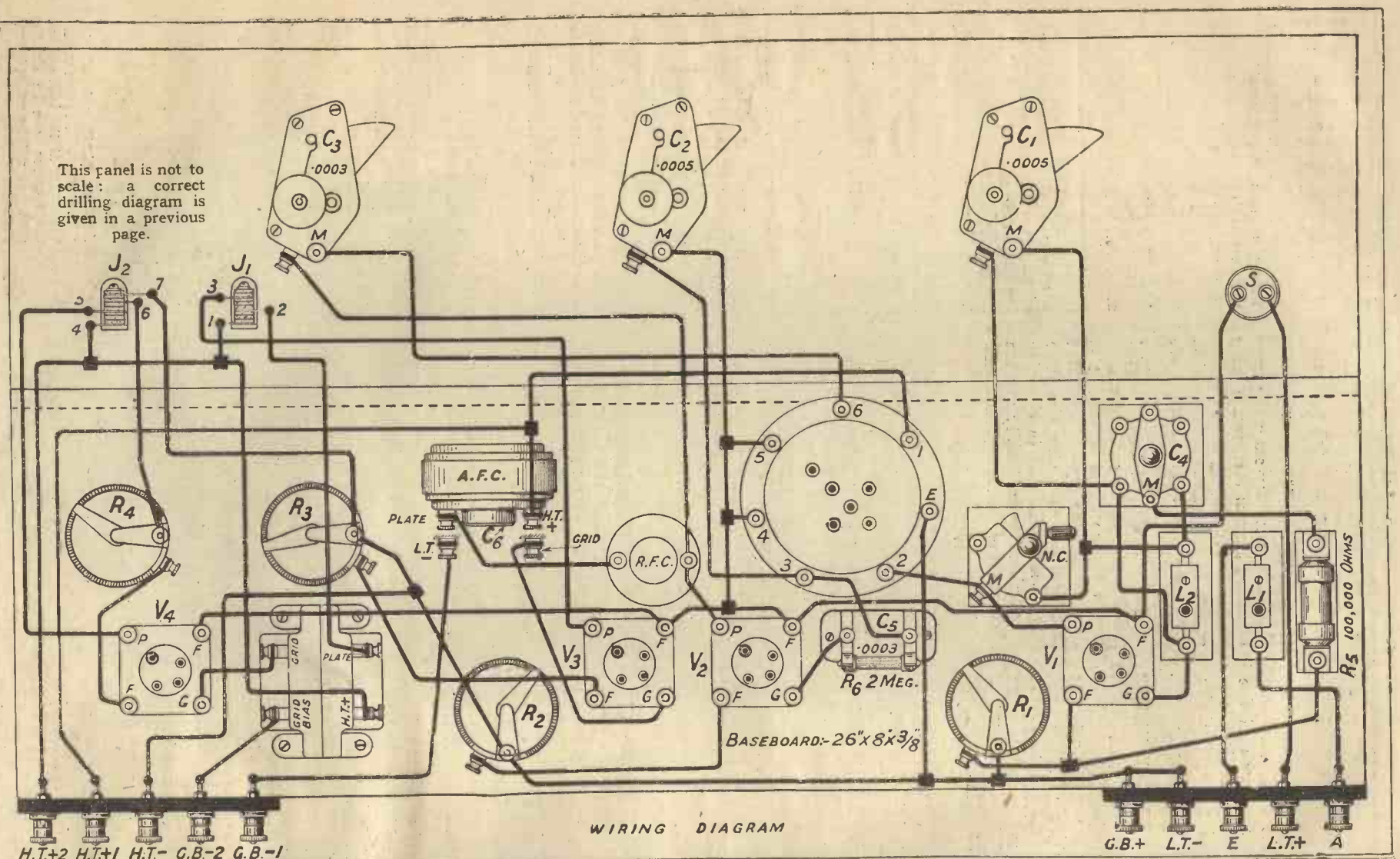
* *Denotes L.S.*

Since variable filament rheostats are used in the set, different valves of varying filament voltages may be



Care should be taken during the wiring-up process that adequate space is allowed between the leads.

Another photograph of the "Hey Presto" Four, in which the wiring at the L.F. end of the receiver can be clearly seen. It will be noticed that the panel brackets are some distance in from the ends of the panels.



WIRING DIAGRAM

Join A to socket side of L_1 holder; join pin of same holder to E.

Join socket side of L_2 holder to one set of fixed vanes C_4 and fixed vanes C_1; same side of L_2 holder to G of V_1.

Join pin of L_2 holder to other set of fixed vanes of C_4 and to moving vanes of C_1; same side of L_2 holder to fixed vanes of N.C.

Join moving vanes of C_4 to one side of R_5.

Join remaining side of R_5 to F negative of V_1, and side of R_1.

Join L.T. negative to G.B. positive and then to the remaining side of R_1.

Join the same side of R_1 to one side of R_2 and one side of R_3, and to E on screened coil base and contact 7 of J_2. Same side R_3 to H.T.−.

Join P of V_1 to the moving vanes of N.C., and to 2 on screened coil base.

Fixed vanes of C_2 to 3 on screened coil base and thence to one side of C_5 R_6. Remaining side of C_5 R_6 to G of V_2.

Join the remaining side of R_2 to F negative of V_2.

Join L.T. positive to one side of S, connecting the other side of S to F positive of V_1, F positive of V_2, F positive of V_3, moving vanes of C_2 and F positive of V_4.

Connect M of C_2 to 5 on screened coil base, and join 4 on the same base to 5.

Join P of V_2 to one side of R.F.C. and to fixed vanes of C_3.

Remaining side of R.F.C. to "Plate" of A.F.C.

Join "H.T. +" of A.F.C. to 1 of screened coil base and to H.T. + 1.

Join "Grid" of A.F.C. to G of V_3 and "L.T. −" of A.F.C. to G.B. − 1.

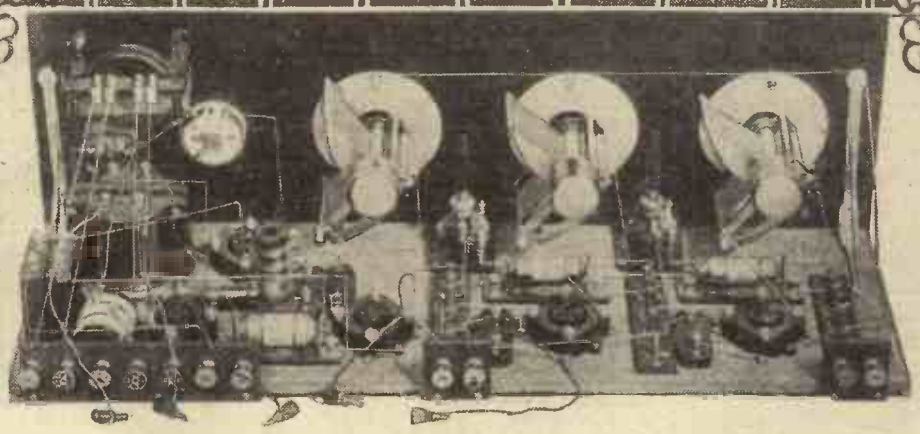
Join P of V_3 to contact 3 of J_1. Join contact 2 of J_1 to "Plate" of L.F. transformer. Join contact 1 of J_1 to "H.F. +" of L.F. transformer, contact 4 of J_2, and thence to H.T. + 2.

Join G of V_4 to "Grid" of L.F. transformer and "Grid Bias" of L.F. transformer to G.B. − 2.

Join P of V_4 to contact 5 of J_2. Join F negative of V_4 to one side of R_4, the remaining side of R_4 being connected to contact 6 of J_2.

Join moving vanes of C_3 to 6 on screened coil base. (*Contd. on page* 554.)

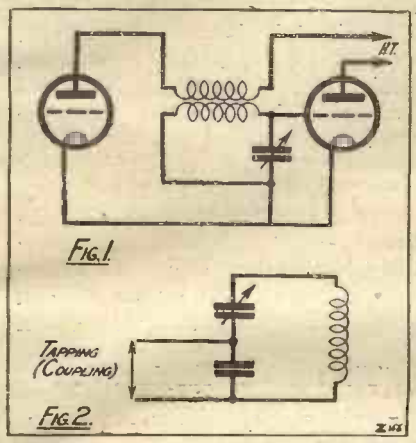
A New H.F. Coupling Method



An Article Of Practical Interest to Every Valve-set Owner

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

WHAT appears to be a new and very important principle in connection with the control and stabilisation of H.F. amplification has recently been announced by Messrs. White & Loftin, two well-known United States radio engineers. This new system depends briefly upon the employment of two condensers in series across the coil, one being a variable condenser and the other a fixed condenser, so that as the circuit is tuned for shorter



and shorter wave-lengths, which would give an increase in the regeneration for the fixed position of the reaction coils, the capacity coupling is at the same time decreased to the same extent, so that the total magnetic and capacity coupling remains constant even when the circuit is tuned throughout the whole of the broadcast wave-lengths, say from 200 to 560 metres.

Before going into details of this invention, it will be clear that since it provides a means of varying the tuning of the circuit for a considerable range without upsetting the reaction adjustment, it is a very valuable discovery, for the reaction can be set as near as may be desired to the point of oscillation without any fear of the set breaking into oscillation when wave-length adjustments are made.

Loftin-White Principle

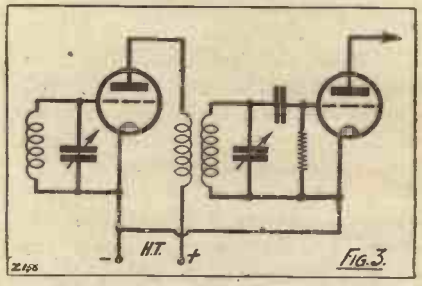
The principle of the discovery, in short, is the balancing of a magnetic coupling and a capacity coupling, one of which increases as the wave-length is decreased, whilst the other decreases as the wave-length is decreased, the two being chosen in such a way that the coupling is constant and independent of the frequency throughout the wave-length range desired.

It is only comparatively recently that radio frequency amplification has been made really practical in the sense that any considerable step-up per stage has been obtainable. This development dates principally from the discovery of the neutralising principle by which the inter-electrode capacity of the valve is overcome; hitherto this inter-electrode capacity had placed a very definite limit upon the radio frequency amplification practically obtainable.

Dependent on Frequency

When reaction is used in the ordinary way, the amount of reaction which is obtained for a given adjustment depends upon the wave-length which is being received.

It will be easy to understand the reason for this if we consider an ordinary single-valve circuit employing magnetic reaction. It might be thought that, provided the position of the reaction coil in relation to the aerial coil remained fixed, the coupling between the two coils would be constant. The voltages in the grid coil (that is, the amplified voltages) are produced by induction from those



in the anode coil, and by adjustment of the relative positions of the two coils the circuit may be brought near to the point of self-oscillation. In saying this, however, we are tacitly assuming that the tuning adjustment of the circuit remains fixed. If so, then the coupling between the reaction coil and the aerial coil depends solely upon the relative positions of the two.

Now let us assume that the reaction and aerial coils remain in a fixed adjustment, and turn our attention to the tuning of the circuit. If the circuit is tuned to a shorter wave-length than before, the coupling

. . . . Consider an ordinary single-valve circuit, employing magnetic reaction . . . .

A NEW H.F. COUPLING METHOD—*continued*

between the coils will be *increased*, since the voltage induced in the grid coil from the reaction coil is (for practical purposes) proportional to the frequency.

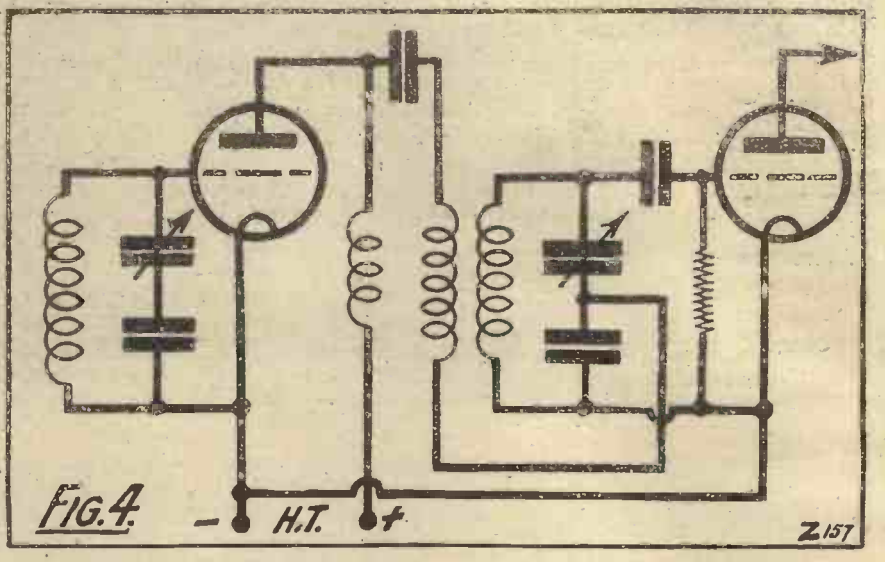
Quite apart from these two main considerations which govern the transfer of energy from the plate circuit to the grid circuit, there is also the question of the tendency of the grid circuit itself to oscillate, and that is a matter which depends, amongst other things, upon the ratio of the inductance and capacity in that circuit; for this reason alone the tendency to oscillation is again dependent upon the tuning.

Fixed Reaction

We thus see that for fixed relative positions of the reaction and aerial coils:—(1) the voltage induced in the grid coil will depend upon the *frequency*; and (2) the *tendency to oscillation* in the grid circuit will depend, amongst other things, upon the tuning of that circuit. If, therefore, we could arrange matters in such a way that the *tendency to oscillation* increased whilst the *frequency* (and therefore the value of the voltage generated) *decreased*, there might be a possibility of these two effects balancing one another, so that, notwithstanding the decreased voltage developed in the grid circuit with decreasing frequency, the regenerative effect would remain at a constant value.

If we could achieve this object we would, in fact, have a circuit in which the reaction arrangements would not need to be adjusted for different tuning adjustments, and in which we had what might be described as "constant coupling."

Before giving actual details of the method by which Loftin & White have accomplished the object mentioned above, let us consider for a moment the characteristic features, first of magnetic coupling, and secondly of capacity coupling, in order that we may understand how it becomes practically possible to balance the characteristics of the one against those of the other to achieve our object.

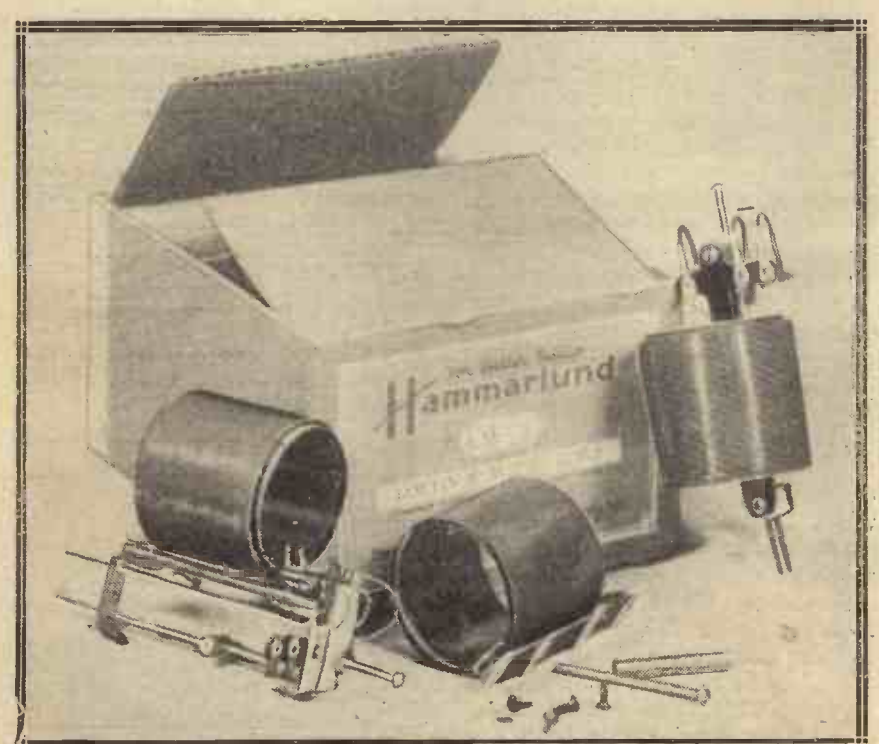


In Fig. 1 is shown a conventional arrangement for magnetic coupling. Here it will be easy to see, what has been pointed out above, that the coupling will depend upon the relative positions of the two coils. It is not, of course, evident from the diagram that the coupling increases with the frequency, but this is an elementary fact in connection with transformers generally, which is no doubt well known and appreciated by the reader.

Theoretical Explanation

In Fig. 2 is shown a circuit including an inductance and a capacity, the capacity, however, being divided into two parts in series with one another, one part being variable and the other part fixed. If we tap off across the fixed condenser we shall obtain a certain voltage in the circuit across the tapping, which voltage will evidently depend upon the capacity of the condenser across which the tapping is taken. For the sake of simplicity, if we assume that the fixed and variable condensers shown in Fig. 2 are of equal capacity we see that the total voltage will be equally divided between the two, and the

(*Continued on page* 552.)



The Loftin-White circuits are becoming very popular in America and are being extensively commercialised.

Experimental Aerials

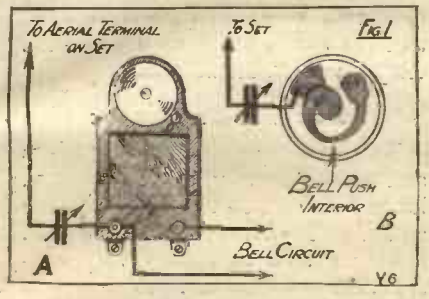
By J. F. CORRIGAN, M.Sc., A.I.C.

Some Interesting Novelties that anyone can try.

THERE is, perhaps, no other radio device which is so accommodating and versatile in nature as that ether energy collecting system which we designate by the term "aerial." No better confirmation of this statement can be obtained than that derived from a critical inspection of all the aerials which one meets with during a short walk in a suburban district. Crowded together in such localities, one comes across an almost infinite variety of these structures, good ones, bad ones, and, if I may be allowed the use of the expression, "badder" ones.

Some Simple Experiments

Nevertheless, all these aerial systems must give some sort of satisfaction to their owners, and thus we can presume that even an obviously inefficient aerial is carrying out to some extent the functions which are allotted to it.



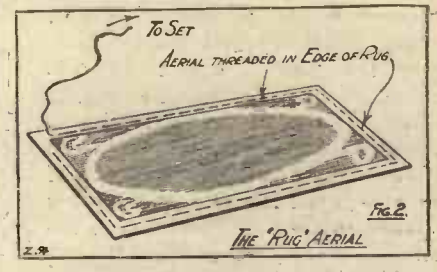
All of which goes to prove, as I said above, that the aerial of a receiving set is really a most obliging piece of radio apparatus, and that it endeavours to give some satisfaction to its owner even under the most heart-breaking conditions.

It is owing to the fact that the conventional types of aerial are three in number (*i.e.*, the outdoor, the indoor, and the frame aerial), that many amateurs are apt to forget that quite a number of other devices can be used for the purpose of picking up transmitted signals and of conveying them to the receiver. In this article I want to describe just a few of these curious types of aerials, in the hope of interesting the amateur who wishes to carry out a number of radio experiments, and with the absolute minimum of apparatus. Naturally, we shall not concern ourselves in these pages with those types of experimental radio aerials which can be constructed by employing light rays, columns of ionised air, radio-active substances, and so forth, for, after all, although descriptions of such devices are interesting enough, there are very few amateurs indeed who possess the equipment necessary for the prosecution of such technical experiments.

The Bell System

We shall deal, then, merely with types of aerials which, although they are uncommon, and, in many cases, quite inefficient, will actually give results with any multi-valve set at short distances from a broadcasting station. These aerial types are practical ones, and a very considerable number of fascinating experiments can be conducted with them.

Every amateur is aware of the method of employing the electric lighting mains of the house as an aerial. A few layers of lead foil are cemented round the bulb of an incandescent filament lamp, and the aerial lead of the receiving set is attached to the foil. Signals can be heard quite well by this system, using a three-valve set. The lead foil on the outside of the lamp bulb converts the latter into a condenser device, and, although the lighting current cannot pass from the filament to the external lead foil, the radio-frequency current collected by the lighting mains system finds very little difficulty in so doing. Thus, the incandescent bulb with the lead foil attached acts very similarly to a large series condenser in the aerial circuit of the set.



A bell-wire system can often be brought into service as an aerial. Generally, however, the leads connecting an electric house bell with the front door bell-push run through the cellars of the house, and thus, being very near to the ground, their radio energy collecting properties are not very great. Nevertheless, at short distances from the transmitting station they give interesting results when connected to a sensitive three or four valve set.

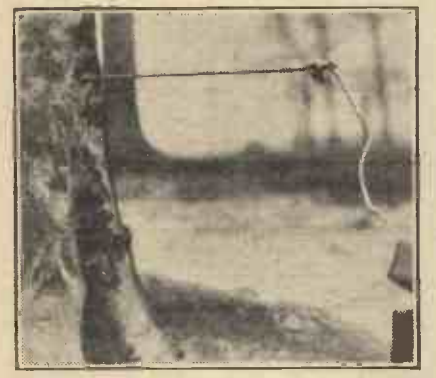
Successful "Aerials"

The illustration, Fig. 1, indicates two modes of taking the aerial lead from the receiving set to the bell wire system of the house. In the first illustration, A, the aerial lead of the

EXPERIMENTAL AERIALS —*continued*

set is connected to the bell terminal, whilst the illustration, B, depicts the method of connecting the aerial lead to the bell push. In either of these instances, it will usually be found that rather better results are obtained when the aerial lead of the set is attached to one particular side of the bell push or to one particular terminal of the bell. A little experiment, however, will soon put the amateur right so far as that detail goes.

Bedstead aerials in which the aerial lead of the set is connected to a metal bedstead or wire mattress are well known. Quite an interesting little



The method of fixing the lead to test a tree aerial.

variation of this principle, however, is that which we may conveniently term the "rug" aerial. In this device, which is illustrated at Fig. 2, a length of well-insulated wire is threaded through the edges of a large bedroom rug or carpet. One end of the wire is left free, whilst the other is taken to the aerial terminal of the set. If the bedroom in which the rug aerial is laid is high enough, and is not situated at a very great distance from the broadcasting station, interesting results can be obtained by the use of this improvised aerial. It is not fair to expect loud-speaker results from it, however, no matter how efficient the receiver may be.

New Use for Piano

Another type of domestic aerial which, so far as I am aware, is quite a novel affair is the piano aerial. This is illustrated in the photograph.

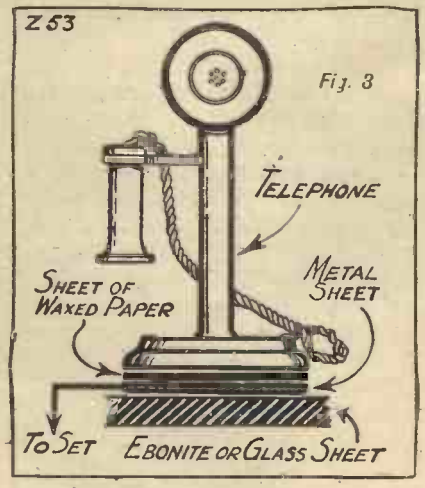
Many domestic pianos are long-suffering instruments, and in these days of wireless many of them seem merely to fulfil the function of providing a convenient stand for flower-pots, photo-frames, and the other infinitely varied and multitudinous knick-knacks of our national domesticity.

Now, if you have such a Victorian relic whose days of "Harmonious Blacksmith" variations and "Maiden's Prayer" have long passed, why not put it to a really up-to-date use? Connected to a good four-valve receiving set, the strings of a piano will very often provide quite an interesting receiving aerial. The mode of connecting the aerial lead of the set to the piano wires is shown clearly in the photograph, the lead wire to the set being merely wound tightly round each tuning peg of the piano.

Directional Properties

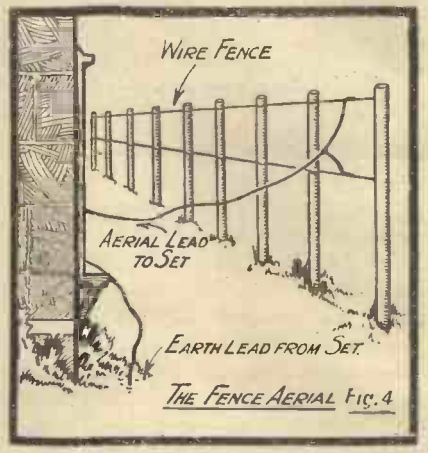
In carrying out experiments with the piano aerial, it must be borne in mind that such an aerial has very directive properties. It is, in fact, a sort of large frame aerial. Thus the position of the piano in the room will have a very great influence on the results obtained from the use of the aerial. It should also be remembered that aerials of this type contain large amounts of capacity, and thus the capacity included in the receiver should be kept down to an absolute minimum.

Naturally, I do not advocate the converting of any good piano into an experimental aerial of this type. It is only in those instances in which a piano of the "old crock" type is available that this modern rôle for it is suggested. A good piano would certainly be put out of tune by such



a procedure. However, apart from this, I do not see any other harm which would accrue to a piano so used. Nevertheless, only old and disused instruments should be utilised in this fashion, if only to be on the safe side.

As a final example of indoor devices which may on occasion be brought into service as radio aerials, we may deal with the "telephone aerial." This, as the diagram (Fig. 3) indicates, is very readily fixed up. A sheet of



metal is laid flat upon a sheet of glass or ebonite, and a lead is taken from the metal sheet to the aerial terminal of the receiving set. On top of the metal sheet is placed a sheet of thin waxed paper, and the telephone instrument is allowed to rest upon this. Signals are naturally far from being strong by this mode of reception, but anybody possessing a telephone on the premises will find the experiment of interest, for it illustrates the fact that an ordinary house telephone line can pick up ether energy and transmit it to a rectifying circuit by the capacity leakage arrangement comprising the metal sheet and the waxed paper upon which the telephone instrument rests.

Some Curious Types

Turning now to a number of curious and out-of-the-way outdoor aerials, let us consider, first of all, the "tree aerial." That the majority of tall trees are able to absorb very considerable amounts of radio energy is a fact which has been known for at least twenty years. Working on this fact, Major George O. Squier, of the American Army Signal Corps, successfully utilised trees for the purpose of picking up electro-magnetic waves. These experiments were carried out a considerable number of years before broadcasting began. However, owing

EXPERIMENTAL AERIALS—*concluded*

to the inefficiency of the tree aerial, little has been heard of it since. Nevertheless, no keen amateur should miss taking an opportunity of conducting a few experiments with natural aerials of this type.

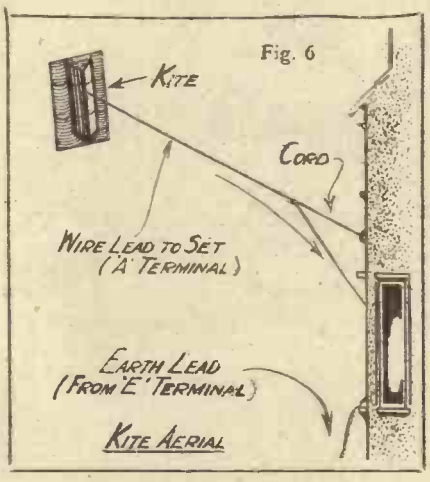
The apparatus required is simple. It consists of a stout rod of brass, steel, or copper, and—a tree (the taller the tree the better), together with, of course, a sensitive three- or four-valve receiver.

The Tree Aerial

The tree aerial is fitted up simply by driving the metal rod into the trunk of the tree at a distance of about a foot or two from the ground. This mode of procedure is illustrated in the photograph. A lead from the end of the rod is then taken to the aerial terminal of the receiver. For the earth connection an ordinary metal stake driven into the ground will suffice; or, on the other hand, the earth connection can be made by driving a metal rod into a neighbouring tree; whilst, in some cases, the set may be made to function without any direct earth connection at all.

Despite the fact that the trunk of the tree provides a direct earth path for the electric waves picked up, some of the collected energy will flow into the receiving set, and if the latter instrument is suitably sensitive, reception will be obtained. Preferably, the tree selected for these experiments should not be situated in a wood or near any tall building. It should stand by itself more or less in the middle of a field. The driving of the metal rod into the trunk will do little harm to the tree, provided that it is a fully grown one, and that after the rod has been withdrawn the hole in the tree trunk is stopped up with a little clay.

Portable set enthusiasts would do well to conduct a few experiments in the utilisation of wire fences and railings as aerials. In many cases, a fence running along the side of a field will be found to consist of a series of parallel wires secured to wooden posts. Hence the insulation of these wires in dry weather is fairly good, and they may be brought into service as an improvised receiving aerial in the manner depicted at Fig. 4.



The illustration, Fig. 5, also shows another type of improvised outdoor aerial for portable set working. This is the balloon aerial. It consists of a balloon filled with hydrogen or coal gas, to the end of which is attached a length of No. 24 or 28 D.C.C. wire. When released the balloon rises in the air and is held captive at any distance above the ground by the aerial wire. This type of aerial is capable of affording really strong signals.

Still another type of aerial (illustrated in Fig. 6) is the kite aerial, which, as its name suggests, consists of a kite flown in the usual manner. The kite, however, is held captive by wire instead of by the more usual string or twine.

A Curious Form

Lastly, a curious form of aerial from which good results are said to have been obtained in portable set working is the umbrella aerial depicted in Fig. 7. It consists of an old umbrella

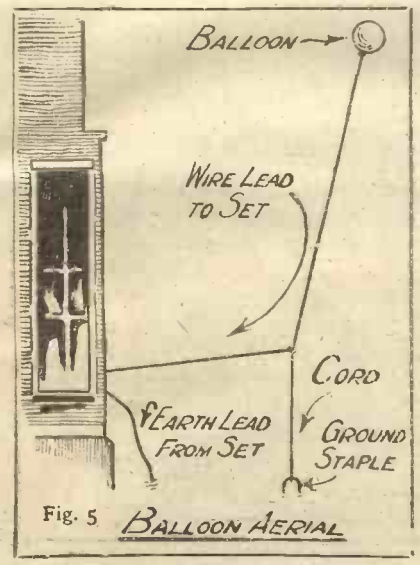
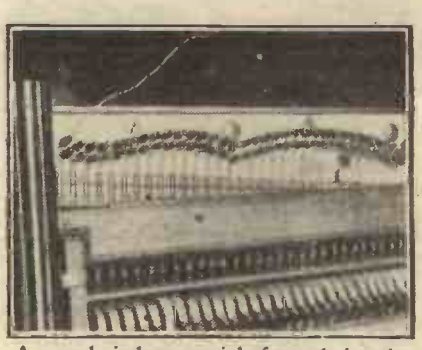


Fig. 5 BALLOON AERIAL


A novel indoor aerial formed by the wires of a piano.

to each of the metal stays of which is attached a piece of wire. Near the handle of the umbrella is placed a block of wood, and the wire leads from the umbrella stays are threaded through holes in this wooden block, afterwards being all joined together to form a down lead. The umbrella is then mounted on the top of a pole, or upon the branch of a tree, and the down lead is taken to the receiving set underneath. In conclusion, however, I must add that I have had no experience with this suggested type of aerial; but, nevertheless, its construction and utilisation will form the subject of an interesting experiment for the keen radio amateur.

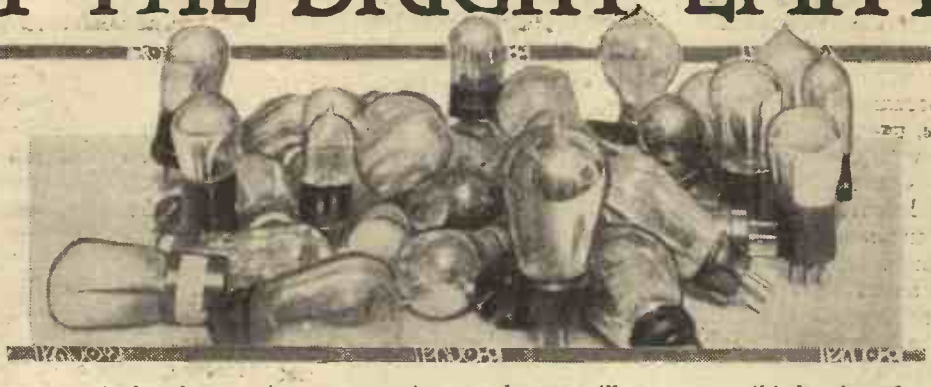
Doubtless many other ingenious ideas with regard to objects that can be used as aerials will occur to the reader and many an amusing and instructive hour can be spent with a small but efficient portable receiver, some wire, and, more important still, some fine weather.

Fig. 7 UMBRELLA AERIAL

WAVELENGTHS

EXIT THE BRIGHT EMITTER

Why does the dull emitter command such popularity and success? Our contributor discusses the subject in this interesting and informative article.



By H. J. BARTON-CHAPPLE, Wh. Sch., B.Sc. (Hons.) A.C.G.I., D.I.C., A.M.I.E.E.

IT is only a comparatively short bridge across the space of time to when a large proportion of amateurs changed their existing B.E.'s for D.E.'s. The dull emitter valve has become so commonplace now, however, that the reasons for its popularity and the benefits conferred by its use are apt to be lost in the background. That being so, a little time will be well spent in analysing the

A popular type of bright emitter—the Ediswan R valve.

situation in order to prove that this type of valve has little to learn from its elder brother, and can, indeed, give it many points when the two are weighed in the balance.

Some people go so far as to say that the advantages of a dull emitter valve are so obvious that the only reason for the continued existence of the bright valve is lower initial cost. This is rather a drastic statement and our earlier remarks, however, should not be interpreted as implying that the bright emitter valve is a nonentity; it still has its adherents, and under certain conditions is admirably adapted for particular work, but in these days of multi-valve sets the governing factor frequently is not first cost but running costs, and that is, perhaps, where the dull emitter scores best.

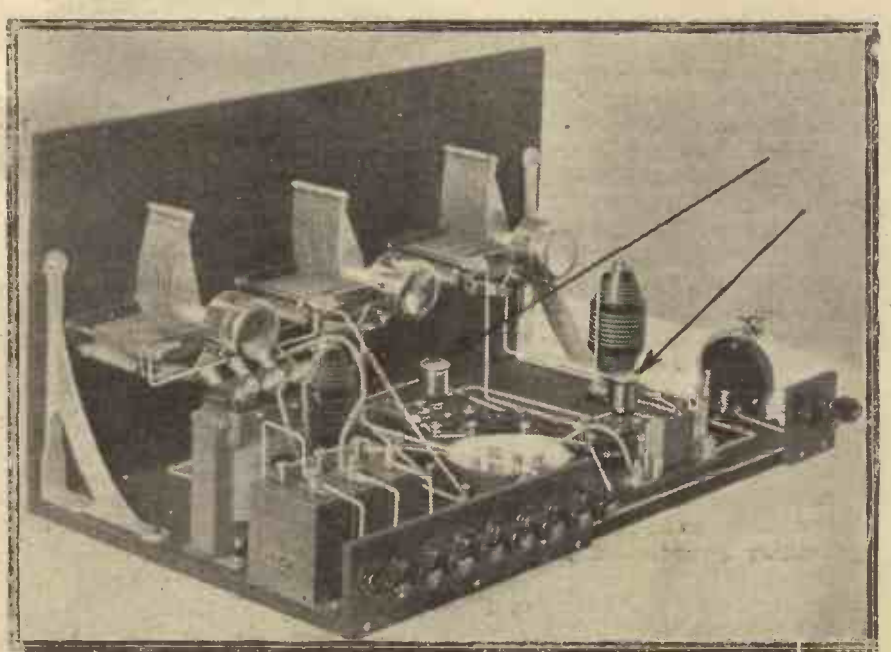
Instruments of Precision

Now what are the main features which we must attribute to a valve? An easy question to ask, you will say, but not quite so easy to answer. A little thought, however, shows that they can be summed up as precision and efficiency, allied to robustness, durability and adaptability. That being the case, it will be logical to follow our line of thought to cover the points just enunciated. No one can gainsay the fact that the present age demands instruments and apparatus which can be relied upon for accuracy, and the years of research which have been devoted to the improvement of the dull emitter valve have resulted in the production of an article which can boast of a good measure of precision in working. Samples from any batch of D.E. valves can be taken and they will be found to agree in the majority of their characteristics, it being borne in mind, of course, that one is thinking only of those turned out by makers of repute.

This feature has only been made possible by the refinements introduced into the process of manufacture, and a rigid observance of the importance of details and was far from being so conspicuous with the earlier bright emitters. After a visit to a valve factory one cannot fail to be impressed with the fact that it is the *little* things that count, and that is where the processes of electrode making, mounting, exhaustion of the bulb, removal of occluded gases in the electrodes, etc., have been reduced to a fine art, resulting in an instrument of precision.

Efficiency

Coming now to our next point, viz., efficiency, this can be broadened somewhat to embrace such cardinal points as low filament consumption, with the resulting economy in use, and a fulfilment of the expectations of range, volume and purity. The average value of the filament current with bright emitters is 0·7 amp., so that with



Will the rheostat follow the bright emitter, and be replaced—by fixed resistors?

EXIT THE BRIGHT EMITTER—*concluded*

3-valve set, using the valves in parallel, the total current consumption is 2·1 amps., hence, with say, a 40-ampere hour accumulator the set can, at the outside, never be used for more than a week without recharging the accumulator. Conversion to the 0·1 amp. valves, however, immediately gives one seven times the service and at 1/- a charge, results in an annual saving of about 45/-, which more than compensates for the increased cost of the valves. If preferred, a lower capacity accumulator could be installed which, although it entails more frequent visits to the charging station than with the 40-ampere hour model, brings about a saving in first cost and weight, the last named being an important detail when the journey to the charging station is a long one. If the ·06 class of valve is installed the running costs are reduced still more, hence on this count alone there is a very forcible argument in favour of using D.E.'s.

Portable Sets

The approach of summer brings in its train the temptation to acquire a portable set, so that the usual seasonable programme can be enjoyed to the full while out of doors. Now in the design of those receivers which can be justly termed "portable," several factors have to be given earnest consideration, and generally the most important is filament consumption. The contemplation of bright emitter valves would entail the carrying of unwieldy and heavy accumulators of a large ampere hour capacity, and this would make the transportation of the set a burden, and detract from the pleasure that could otherwise be obtained. We thus see that dull emitters have undoubtedly contributed in the largest measure towards the popularity of this type of apparatus and enabled an efficient receiver to be designed.

The characteristics of the valves have been so carefully thought out that the cardinal features of range, volume and purity, are not only theoretically expected, but are practical realisations. A little time spent in studying the published curves of the valves enables the requisite voltage adjustments on the set to be made, so that the resulting reproduction has the desired volume to fulfil the demands from questions of environment with the "purity factor" well to the fore.

Robustness

At first it seems a little out of place to talk of robustness in connection wtih a valve, but we have had ample evidence recently of the relatively rough treatment that can be meted out without complete damage to the article. In the demonstrations of filament strength, some manufacturers have gone to great extremes, as witness the "aeroplane tests" of Cossor's and the "weight-lifting" tests of Mullard's, but while appreciating these finer points, the user is not advised to adopt such drastic treatment with a view to securing personal enlightenment on this point. Take the thought for the deed and treat your valves with care, allowing the attribute of robustness to serve as a worthy feature only to be called upon as the outcome of unfortunate accidents. If the makers' instructions as to voltage

A wireless receiver modelled on the lines of a grand piano which was exhibited in London recently.

and current for the filament and plate are followed the D.E. valves will prove quite durable and wear a long time.

Restoring the Filaments

When signals are somewhat weaker than desired with a particular receiver, there is a great tendency to get another "ounce of effort" out of the valves by adopting one of two methods—i.e. increasing either the H.T. voltage or the filament current. With dull emitter valves, however, this is a wrong policy, for their life will be reduced considerably in consequence, and before long the set appears to be quite lifeless. Fortunately, this trouble, whether the result of deliberate, but ignorant, practice or through accident, frequently can be remedied, and it will not be out of place at this juncture to pass on the information to the uninitiated or jog the memory of those readers who have forgotten the details.

The most common practice with dull emitter valves is to treat the filaments, during the course of manufacture, with a special material, by mixing with the tungsten oxide of thorium, as this gives to the property an increased electronic emission at a lower filament temperature after a special heat treatment. Under normal running conditions, this thorium diffuses to the outside of the filament, but if excessive voltages are applied to the filament or plate the substance is used faster than it can be replenished and the valve will lose its dull-emitting property. If this happens, disconnect the H.T. supply and run the valve or valves for a considerable period, say, three or four hours, at the maker's specified filament voltage. This will, in most cases, renew the thorium coating and thus give the valves a new lease of life.

An Insurance Policy

The modern tendency of resorting to fixed resistors thus may be looked upon as somewhat of an insurance policy against such possibilities of over-running taking place, while wedded to this we have the distinct advantage of a reduction in the number of controls for operating the set. Having calculated the resistance to be put in series with the valve filament and battery, according to the particular valve chosen, further adjustment is unnecessary, while any falling-off in signals may be regarded as an indication that the L.T. battery needs recharging, provided, of course, the H.T. battery is in good condition, and excess voltages have not been applied in that direction.

A third virtue calling for careful consideration is the general absence of crackling or explosive noises which were so often found with the bright emitter valves. It appears, therefore, that from the points just enunciated, the dull emitter valve has proved a worthy successor to its "bright brother," and is rightly being very firmly established.

The B.B.C. and the Music Halls

An interesting survey of Broadcasting in relation to Music Hall Variety entertainment with some comments on the recent controversy between the B.B.C., Sir Oswald Stoll and Mr. Charles Gulliver.

ST. JOHN ERVINE.

(The well-known Playwright and Dramatic Critic.)

THE B.B.C. seem always to be in trouble. That, perhaps, is not surprising, for they are trying to perform an impossible feat: please everybody. Their programmes seem to me to be remarkably good and various, considering that they have to provide entertainment for a very diverse crowd for eleven hours in every day in the year, and I doubt if any other body could do the job so well. But they are bound to get into trouble and they do.

Masses of half-educated and nearly illiterate people listen in, and for them music means "Yes, sir, she's my baby!", or "A Girl's Best Friend is Her Mother!" When they hear Beethoven or Bach, or Chopin or Mozart, they yell with rage and immediately write to the authorities to complain that they are not getting value for the three-ha'pence a week which the wireless programme costs them.

The educated people in this country, a small and therefore negligible body of persons, find themselves listening to "comic" songs that give any intelligent person a pain in the stomach, and they write to the B.B.C. and complain that they are not getting any Wagner or Lizst.

A Reasonable Point of View

Some are aggrieved because they could not hear one word of the talk delivered by Professor Mumbling Mumbles on "The Sex Life of the Newt," and others are aggrieved because they did hear it. Finally, there is that fraud, sham and humbug, the Tired Business Man, who creeps home at night, utterly exhausted after the long day's labours and is fit only to listen to the very lightest music!

And now, on top of all their usual, almost daily, troubles, comes a row with the Music Hall Combine! Sir Oswald Stoll and Mr. Charles Gulliver are reported to disapprove of music hall performers doing a "turn" on the wireless, because, they say, such "turns" kill their business. They do not mean, as might be imagined, that listeners once hearing these "turns" would never wish to hear them again. They *do* mean that a listener having heard a music hall artist in ease and at a trivial cost, will not fuss himself very much to go to a music hall to hear him, especially when the visit involves him in expense. That is a very reasonable point of view, and one which is not to be altered except by reasonable replies.

Mr. St. John Ervine, dramatic critic and author.

The first thing to be borne in mind is that the music hall proprietors are not refusing to allow their expensively-paid employees—which is what the music hall artists are—to broadcast their songs out of pure petulance or naughtiness. To them the situation is seen as one in which a rival entertainer is attempting to injure their business with their consent and the assistance of their workmen.

An Artist's "Drawing" Capacity

Let us suppose that Sir Oswald Stoll engages an artist at a salary of £80 per week to perform in his circuit of halls. The engagement may be for a year or several years and fulfilled in various towns and cities. The contract is made in the belief that the artist will draw into the theatre at least £80 per week in money. If he does not draw at least that sum, then he has involved Sir Oswald Stoll in a loss, and since Sir Oswald is not a philanthropist, but a man engaged in a difficult and costly business, he naturally does not encourage the artist to diminish his drawing capacity.

But what do the B.B.C. do? They go to this expensive (to Sir Oswald Stoll) artist and invite him to perform for them at a fee which, whatever it is, is considerably less than that paid to him by Sir Oswald. And this performance is given, not to an audience of a thousand or two at a time, but to an audience of several millions. In a single evening, a performer on the wireless gives his entertainment to the whole of the British Islands, to an audience which would keep the music halls filled for months!

The artist himself has used up, through wireless, in a single evening, an audience which would, in music halls, have kept him occupied for a year! The B.B.C., in short, are getting for a few pounds an entertain-

THE B.B.C. AND THE MUSIC HALLS—*concluded*

ment which costs Sir Oswald Stoll thousands of pounds! He is actually subsidising a rival form of entertainment.

The point will be made plainer if I illustrate it from my own point of view as a lecturer. Suppose that I prepare a lecture on Drama, to be delivered during the autumn and winter seasons, and that my fee for delivering it is twenty-five guineas, and that thirty Societies in various parts of Great Britain invite me to deliver it to their members. I earn seven hundred and fifty guineas by that lecture. But suppose that the B.B.C. come to me and say, "We will give you twenty-five guineas to broadcast your lecture on the Drama!" What happens to me if I consent to do so? The members of the Societies very properly say, when I am due to appear in their town, "Oh, we've heard that man's lecture on the wireless. We won't go to hear it again!"

Question of Salaries

The societies, indeed, may cancel the lecture engagement altogether on the very proper plea that it is not now the attraction to their members that it might have been before it was broadcast. If I hold them to their contract they may lose money through the delivery of a lecture staled by previous broadcasting; if I let the Societies off their contract, I get twenty-five guineas from the B.B.C., and lose seven hundred and fifty guineas from the Societies.

Sir Oswald Stoll, who is to-day one of the controlling figures in the entertainment world.

The situation from the point of view of Sir Oswald Stoll and Mr. Charles Gulliver is very like that. The substantial fact for them is that a person sitting at home listening to one of their stars broadcasting his entertainment, is *not* sitting in the local Empire or Hippodrome listening to the entertainment given in it. Another substantial fact, from their point of view, is that the B.B.C. could not get these star performers at all if they were not employed by the music hall syndicates.

An occasional "turn" at a radio station would not keep the artists for very long, and if Sir Oswald Stoll and Mr. Gulliver were to say, "Very well, we will not employ any artist who broadcasts!" either the B.B.C. would have to pay large salaries to the stars, if they wished for their services, or dispense with their services altogether. That, then, is the argument of the music hall owners. They complain that they are practically asked to subsidise a rival entertainment.

The "Publicity" Inducement

The B.B.C.'s reply to that is that the advertisement given to the artists by the publicity they receive through broadcasting is of incalculable value. The reply sounds reasonable, but is it as reasonable as it sounds? The B.B.C. offer that bait to every person who is asked to accept a smaller fee than he deserves for broadcasting, and I have doubts about the value of an advertisement which *everybody* shares. I do not believe that listeners, after hearing someone sing over the wireless, instantly resolve to attend the first concert he gives, nor do I believe that they rush to the nearest booksellers' shop to buy one or more of the books written by the novelist whose discourse they heard on the previous evening.

I remember hearing that the first concert given at the Albert Hall by Tetrazzini after she had broadcast was sparsely-attended, and the testimony seems to be general that concerts have been ruined by wireless, just as the sale of music has been enormously reduced by the sale of gramophone records. The advertisement, in my opinion, is largely mythical, and it is about time that the B.B.C. stopped offering it as an inducement to people to broadcast for low fees.

But the situation ought not to be left like that. The B.B.C. are here for good, and they do an immense amount of valuable work. They have brought the artistic and intellectual and social amenities of large cities to the inhabitants of small towns and villages, and they have enabled poor men and women to enjoy the entertainments of the rich. No one can measure or estimate the cultural value of the B.B.C. I firmly believe that their programmes are having an educational and civilising effect on the community which is beyond all calculation.

On the evening on which this article was written, I listened to Beethoven's Mass in D being broadcast from the Albert Hall, and as the rich and lovely music filled my room,

A famous music hall favourite—known to all listeners — Mr. George Robey.

I realised that hundreds of thousands of people of all classes were hearing it too, who, but for the wireless, might never have heard it at all. We deride the "talks," many of which, I am bound to say, though good in content are poor in delivery, but, despite our derision of the lecturer's defects, this indisputable fact remains, that a multitude of people are learning about things of which they formerly were ignorant and that they are, therefore, extending the range of their minds and their capacity for imaginative experience.

Listeners Are Pampered

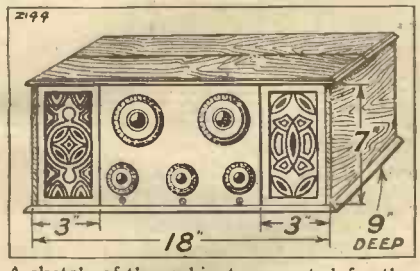
What I think should be arranged, if it be possible, is that concerts or theatrical entertainments, instead of subsidising the B.B.C., should be subsidised by them. I do not mean by this that the B.B.C. should supply huge sums of money to the theatre-managers and concert promoters, but that when they wish to use a vaudeville or theatrical or concert programme for broadcasting they should pay a proper fee for it, even if the cost of broadcasting has to be raised to the listener. The listener, indeed, is a pampered person, receiving an extraordinarily good entertainment at a negligible price, and he would suffer no wrong if he were asked to pay twice as much for it as he does.

The recent debacle at Queen's Hall need not have happened if a little English common sense had been used by the parties involved in it.

The K.L.1. TWO

This novel receiver utilises the new K.L.1 valves and operates direct from the A.C. mains, deriving both H.T. and L.T. energy from that source. Specially designed and constructed by J.R.WHEATLEY.

ONE of the greatest drawbacks to wireless, in the opinion of many people, is the need for installing and renewing batteries. Especially does this seem to be the case when the house where the set is to be used has an electric-light



A sketch of the cabinet suggested for the K.L.1, two.

supply laid on, and consequently many attempts have been made to eliminate both L.T. and H.T. batteries, and to run the set direct from the electric mains. With direct current the problem is admittedly rather difficult, except, perhaps, for the professional electrician; but these difficulties have always been increased greatly when the house-supply is alternating current (A.C.).

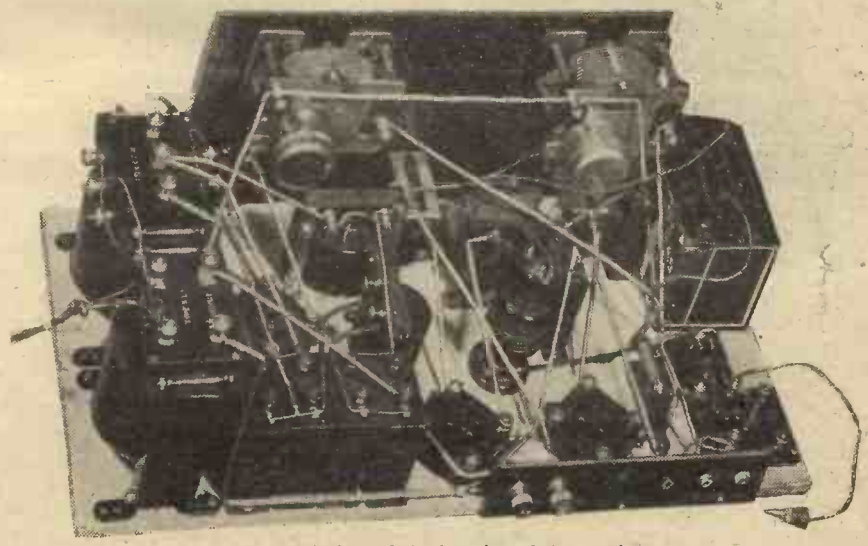
A.C. differs from D.C. in that it does not continuously flow in one direction, but is constantly changing, first flowing one way and then the other. The number of changes or cycles per second is usually in the neighbourhood of 50 for the ordinary house supply. A.C. must, therefore, first be rectified by some means which will change it from a pulsating current into a flow in one direction. Such means are not only extremely expensive to arrange, but also to maintain and for the ordinary listener have been out of the question.

The New Valve Used

Quite recently, however, an entirely new valve has come into being, which does not require D.C. to operate, but will work direct from A.C. The principle that this employs is as follows: An ordinary filament is used which is surrounded by a small metal sheath, which acts as the cathode. (In an ordinary valve it will be remembered that the filament acts as the cathode.) As the temperature of the filament rises, the heat radiated gradually increases the temperature of the cathode, and electrons are emitted. By using this indirect method of heating it will be found that any change in the relative potential of the ends of filament, *i.e.*, as the A.C. changes its direction, cannot be transfered to the cathode and thus affect the electron stream.

List of Components.

- 1 panel 12 x 7 in.
- 1 ·0005 mfd. variable condenser with vernier attachment.
- 1 ·0003 mfd. variable condenser with vernier attachment.
- 1 ·0001 mfd. fixed condenser.
- 1 ·0002 mfd. fixed condenser and grid leak (2 megs.).
- 2 ·5 mfd. fixed condensers.
- 4 ·2 mfd. fixed condensers.
- 1 K.L.1 transformer
- 1 full wave transformer with filament winding.
- 2 L.F. chokes.
- 1 L.F. transformer.
- 1 H.F. choke.
- 3 rheostats (to carry 2 amps).
- 3 valve holders.



A general view of the interior of the receiver.

THE K.L.1, TWO—*continued*

The cathode really remains at a more or less fixed temperature. The set to be described employs two of these new valves as a means of overcoming the L.T. battery charging problem, and constant renewal of expensive H.T. batteries. It has many interesting features which very few other sets can claim.

(*a*) No constant renewals of L.T. or H.T. batteries are required.

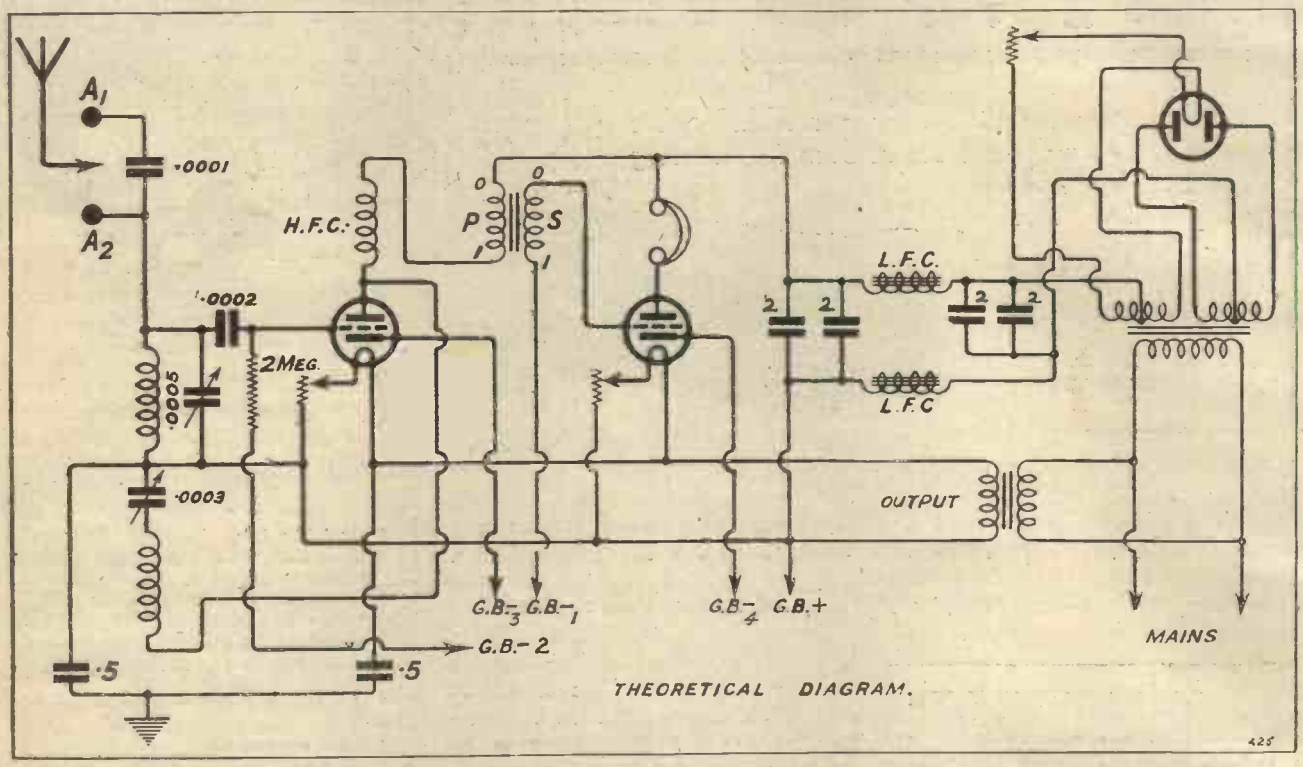
(*b*) It will work well on a short indoor aerial.

(*c*) Both 5XX and the local station are received at good loud-speaker strength.

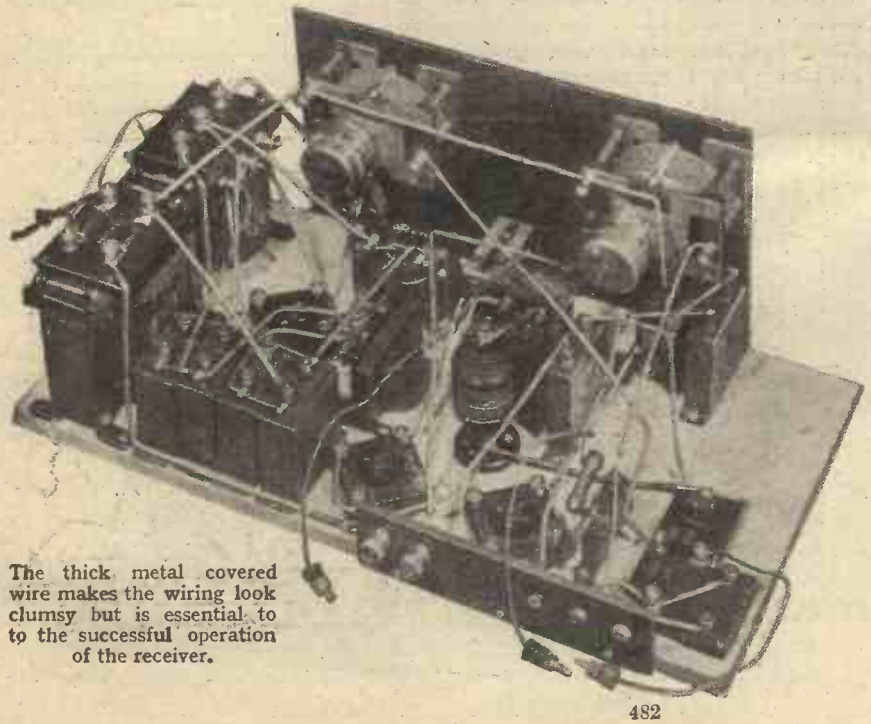
(*d*) The whole set is operated by one small switch or plug.

(*e*) Cost of running approx. 50 hours per unit.

From the circuit it will be seen that an ordinary det. and L.F. circuit is used with slight modifications to allow for the use of the special valves. The aerial circuit is tuned by means of an ordinary aerial coil, and Reinartz reaction is employed. For the sake of simplicity a Dimic coil was used, although ordinary plug-in coils of any of the well-known makes give good results. The tuning ranges of the Dimic coils are as follows: 1a, 210–483 metres; 2, 300–668 metres; 2a, 450–1,037; 3, 550–1,490; 3a, 1,000–2,310 metres. By arranging the two variable condensers as shown, the moving vanes are always connected to earth, and thus at earth potential. This eliminates hand-capacity effects and really makes the set a pleasure to tune.



THEORETICAL DIAGRAM.



The thick metal covered wire makes the wiring look clumsy but is essential to the successful operation of the receiver.

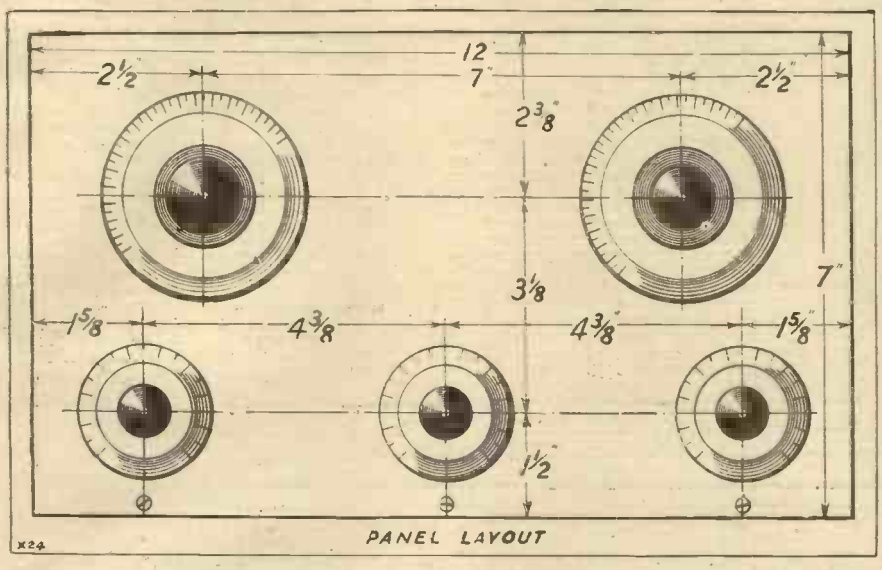
The Panel and Cabinet

The cabinet may appear to be abnormally large for a two-valve receiver, but it must not be forgotten that the set is entirely self-contained, and unsightly battery leads are not prominently displayed. A panel of rather unusual design is employed as this does not fill the whole area usually occupied by the latter. It is only 12 ins. long, whereas the cabinet is

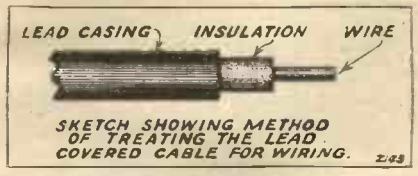
THE K.L.1, TWO—*continued*

18 ins. Owing to the heat generated from the K.L.1 valves it is not advisable to totally enclose the whole of the components, and this accounts for the space not occupied by the panel. (Details of how these gaps are filled will be given later.)

The baseboard should be prepared from a piece of five-ply wood, 18 in. × 9 in. On the extreme left of the baseboard are mounted the power transformers, one to supply the power for the K.L.1 filaments and the other for the rectifying valve and H.T. It is possible to obtain transformers incorporating both these arrangements in one, but the separate transformers were found to give excellent results. The chokes, which may be obtained from different sources, are mounted in the positions shown.



PANEL LAYOUT



SKETCH SHOWING METHOD OF TREATING THE LEAD COVERED CABLE FOR WIRING. Z43

Arranging the Components

When mounting the reservoir condensers, which may either be two ·4 mfd or four ·2 mfd care should be taken that they are placed not only on the extreme edge of the baseboard, but also as close as possible to the K.L.1 transformer. A great deal of space may be saved by arranging the components carefully on the left hand side of the baseboard, and thus leaving the maximum space at the receiving end.

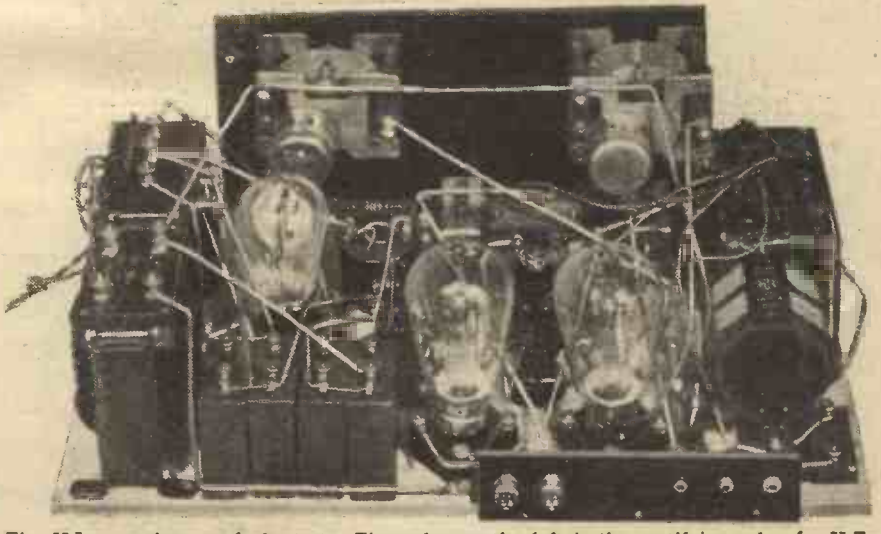
The L.F. transformer, which is mounted next, should preferably be of the 2nd stage type, although several 1st stagers gave excellent results. Although not absolutely essential, a screened transformer is favoured. Valve holders need not be of an extra special type, providing that their insulation is good and a fairly large surface contact to the pins is arranged for. Three holders are required and should be mounted in the way indicated by the baseboard layout.

Several types of H.F. chokes were tried, but in nearly all cases it was found that the natural wave-length was too low to give really satisfactory results when receiving 5 XX. In fact, with most chokes the set oscillated hard with the reaction condenser entirely disconnected. If plug-in coils are to be used, two small baseboard mounting plugs should be arranged in juxtaposition near to the right-hand side of the baseboard.

The mounting of the two ·5 mfd. fixed condensers, and grid leak and condenser unit, etc. completes the baseboard layout. Care must be taken that room is left at the top right-hand corner for the 21-volt biassing battery. The panel should now be prepared. This need not be given any special treatment, the various holes being drilled for the rheostats and variable condensers from the panel layout. When this set was in the experimental stage, ordinary direct drive variable condensers were employed, but the set resolved into such an ultra selective arrangement that geared or vernier condensers were found to be essential.

Special Rheostats Necessary

If S.L.F. condensers are used in which the vanes have a far greater sweep than those specified, the panel will probably have to be correspondingly increased in size to allow for this. Ordinary rheostats capable of handling ½ to 1 ampere are of little use to control the filaments of the K.L.1's. As the current taken by these is approximately 2 amps, special rheostats are essential, but these are as easily obtained as ordinary filament rheostats, and are of the type used to control the filament current of small transmitting valves.


The K.L.1 receiver ready for test. The valve on the left is the rectifying valve for H.T. supply; the other two being the K.L.1 receiving valves.

THE K.L.1. TWO—*continued*

The rheostat controlling the rectifying valve need only be an ordinary bright emitter rheostat of 10–15 ohms. (10 to 15 ohms also should be found quite sufficient to efficiently control the K.L.1's.) After the panel and terminal strip have been securely fixed to the baseboard, and the variable condensers and rheostats mounted, the set is ready for wiring. The wiring of such a set opens up an entirely new field for the constructor, in so far as the actual wire used.

The Lead Covered Cable

After extensive tests it was found that thin lead-covered cable gave excellent results, and prevented, or

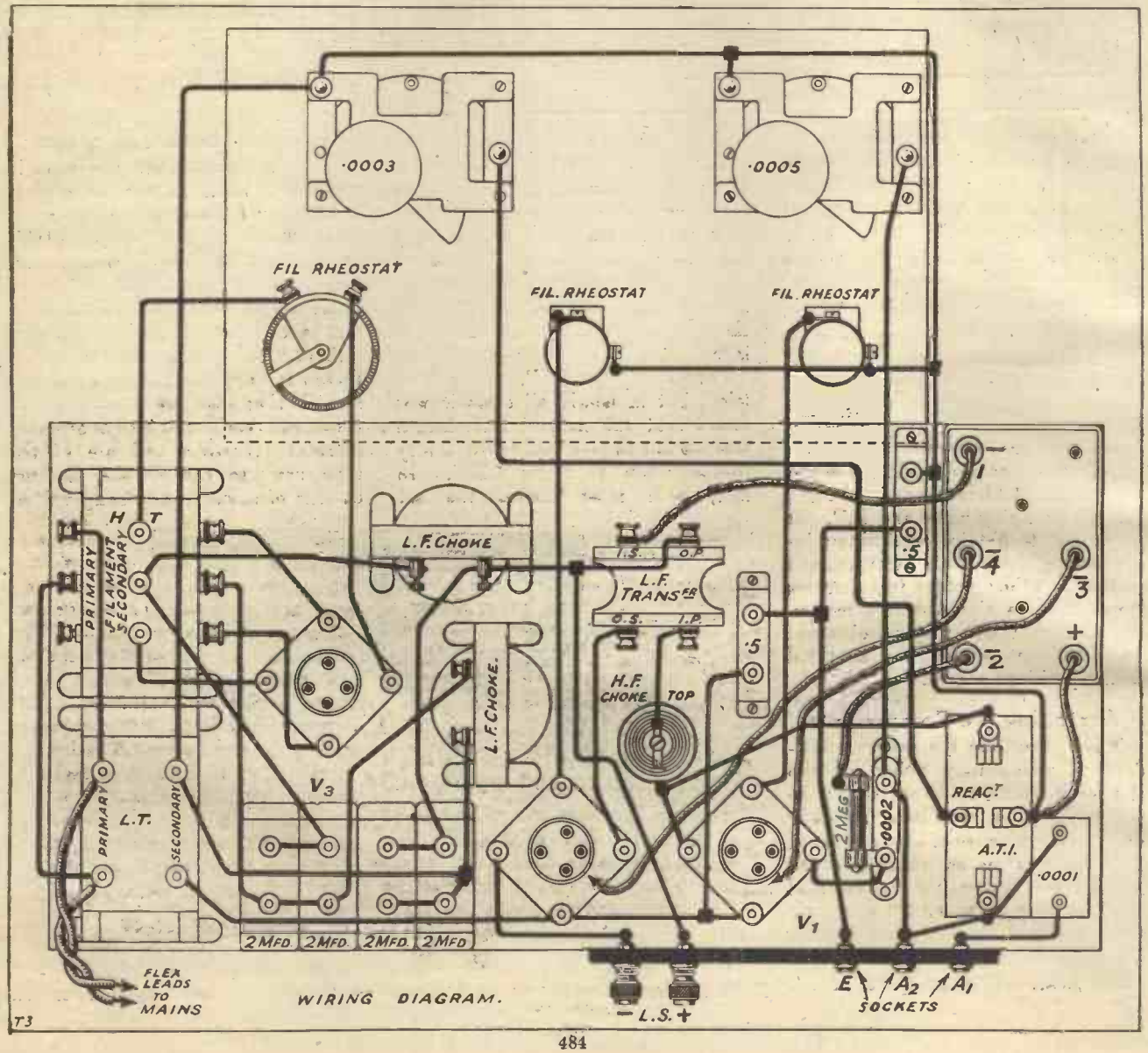
Point-to-Point Connections.

A_1 to one side of ·0001 fixed condenser. A_2 to one side of grid condenser (·0002) and remaining side of ·0001, one side of A.T.I and fixed plates of ·0005 variable condenser. Remaining side of A.T.I to one side of 1st two rheostats, moving vanes of ·0003 and ·0005 variable condensers, one side of 1st ·5 mfd. fixed condenser, G.B +, one secondary terminal of L.T. transformer, one side of each of the 1st pair of 2 mfd. fixed condensers, and one side of 1st L.F. choke. Other side of this choke to one side of 2nd pair of 2 mfd. condensers, and centre tap on H.T. winding of H.T. transformer.

Remaining side of ·0002 grid condenser to grid of 1st valve and one side of grid leak. Plate of 1st valve to one side of H.F.C. and one side of reaction coil. Fixed plates ·0003 variable condenser to remaining side of reaction coil. One filament pin of each KLI valve holder to remaining secondary terminal of L.T. transformer, and one side of 2nd ·5 mfd. fixed condenser. Remaining sides of 1st and 2nd ·5 fixed condensers joined together and taken to the earth terminal. Remaining sides of 1st and 2nd rheostats joined together and taken to their respective filament pins. I.P. of L.F. transformer to remaining side of H.F.C. O.P. to one L.S. terminal (+) to remaining side of 1st pair of 2 mfd. fixed condensers and one side of 2nd L.F. choke. Remaining side of 2nd L.F. choke to remaining side of 2nd pair of 2 mfd. fixed condensers and centre tap on filament winding of the H.T. transformer. O.S. of L.F. transformer to grid of 2nd valve. I.S. to G.B. neg. 1 via flexible lead. Remaining side of grid leak to G.B. neg. 2 via flexible lead. Cathode of V_1 to G.B. neg. 3 via flexible lead. Cathode of V_2 to G.B. neg. 4 via flexible lead. One end of the H.T. winding of the H.T. transformer to grid socket of 3rd valve holder, plate to remaining H.T. terminal of this transformer. Plate of 2nd K.L.I valve to remaining L.S. terminal.

One filament terminal of H.T. transformer to one filament pin of V_3, remaining filament pin via the 3rd rheostat to the remaining filament terminal of the H.T. transformer.

The two primaries of the L.T. and H.T. transformers should be connected in parallel and taken via flexible leads to the mains adaptor.



THE K.L.1, TWO—*concluded*

at least reduced, interference from the mains to a minimum. Ordinary commercial lead cable used for lighting systems is really far too heavy for such a purpose, and special cable known as "Ledex" wire was used. When a connection is to be made carefully strip off slightly under an inch of the lead covering, leaving the cotton and rubber covering in place.

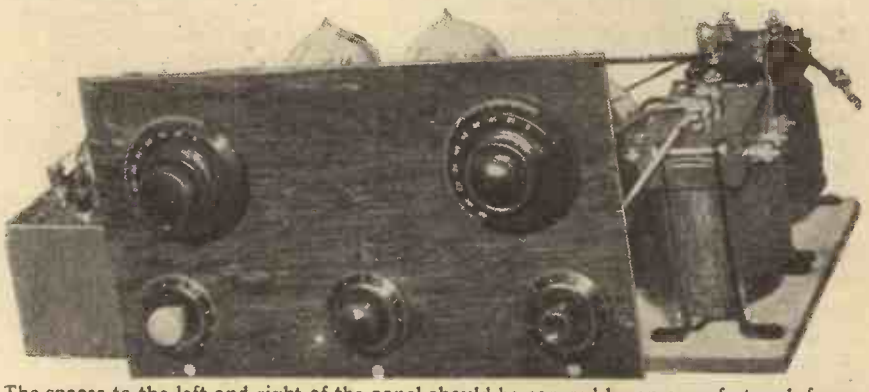
Testing the Wiring

Then bare just enough of the wire, by scraping off the undercoverings, until a sufficient soldering surface is available. Do not try to execute any really neat wiring, but spend the time on making good joints, taking each lead direct between the two points. Square wiring carried out in a nice parallel formation with nice right angle bends and joints is quite satisfactory in some sets, but it certainly does not pay in a set of this class.

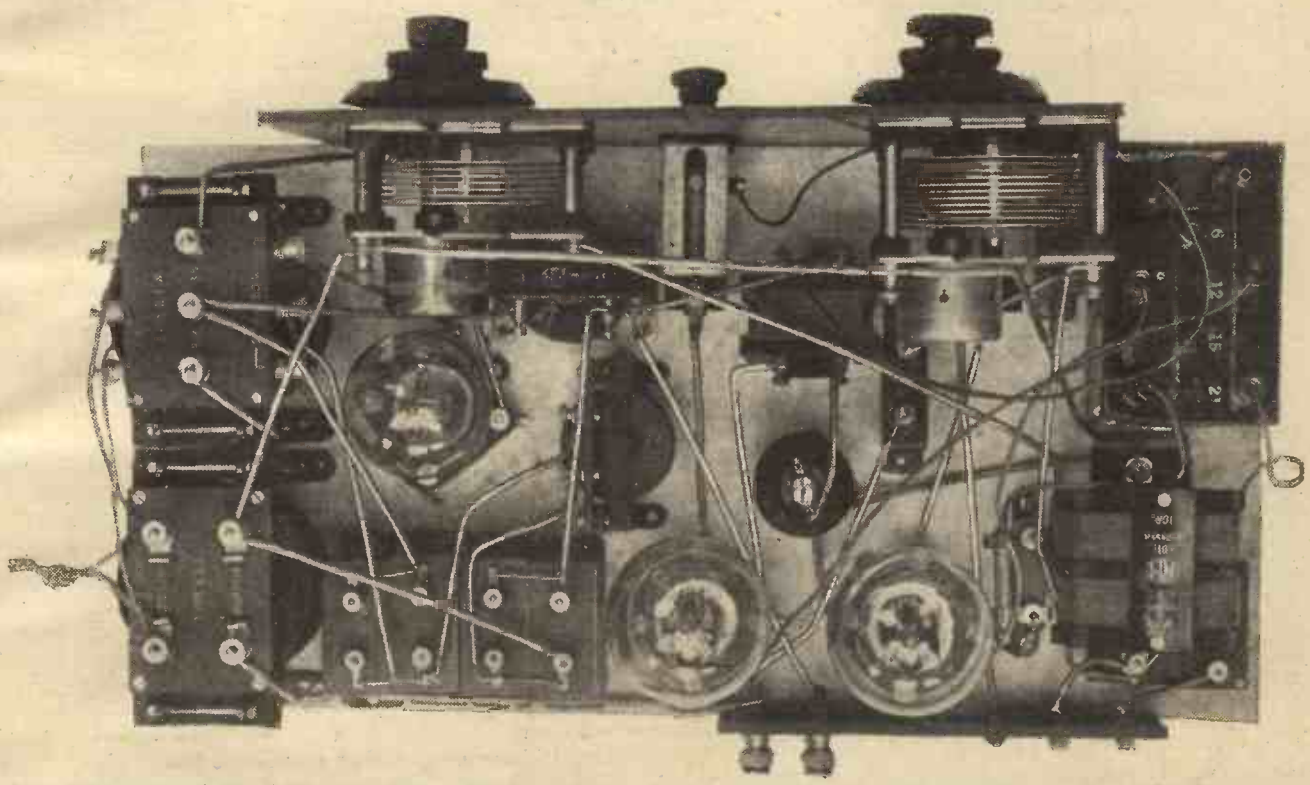
The filament wiring should first be carried out, following this with the connections to the H.T. side, chokes, reservoir condensers, etc. For the sake of easy wiring the variable condensers may be removed from the panel and the connections made to these last of all. The wiring must now be tested in a rather peculiar way. One side of a flash lamp bulb should be connected to one side of a suitable battery. The remaining side of the battery is now connected to the lead casing of the section of wiring under test.

The other side of the lamp is joined to any point to which the wire inside this particular piece of cable is soldered. If the lamp lights, this is a sure sign that the cable is touching the wire, and the section affected must be re-wired. Not only does this cable act as a screen against stray fields setting up all manner of peculiar effects in the set, but it also forms a protection against accidental shocks from the wiring if this should be touched.

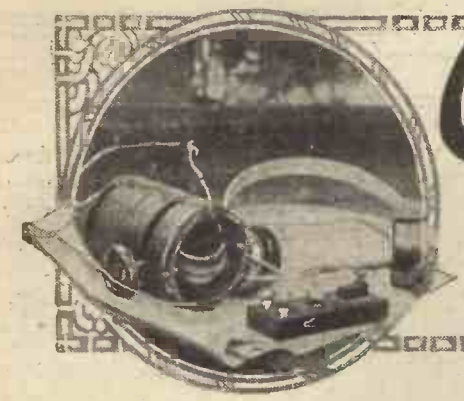
Do not forget that a very nasty shock indeed can be obtained by carelessly handling such a set. It may even be serious, so remember that to work inside the set with the mains connected is "to look for trouble." After carefully checking the wiring over from the point-to-



The spaces to the left and right of the panel should be covered by an open fretwork frame to allow a current of air through the set. This is essential if overheating is to be avoided.



This photograph, together with the wiring diagram, will make all the connections and the position of the various components quite clear.



Questions Answered

A.C. Charges

B. M. (Herts).—I have an A.C. mains unit which, while very satisfactory when in use on a 2-valve receiver employing general purpose valves, seems unable to supply a 3-valve set or even the 2-valver when a super-power valve is used. Although signal strength is not too bad, low notes become very boomy and whuffy, while it is difficult to distinguish the words of a speaker if he has a low voice. The set I know is quite all right with the valve mentioned, as it gives excellent results when dry batteries are used for the H.T. supply. What is likely to be the trouble ?

It is difficult to say without having full details of the eliminator which you are using, but it sounds very much as if either the chokes in the eliminator output circuit are becoming saturated when a heavier H.T. current than that needed by the 2-valve set is required, or else the valve or valves employed in the eliminator are incapable of giving a sufficient electron emission. A third cause might be in the transformer windings of the eliminator, which, if unsuitable, would not allow the rectifying valves sufficient power in order to supply the required number of milliamps. By using a super-power valve in your set, or by increasing the number of valves from two to three, you are of course withdrawing or attempting to withdraw a far heavier H.T. current from the eliminator, and unless this piece of apparatus is capable of supplying the required H.T. current you will notice the effect mentioned in your query. For the purpose for which you require it you will need an elimator capable of supplying at least 15 milliamps, and we would advise you to use one which will give a greater output.

Frame Aerial Dimensions

P.B. (Ilford).—I am contemplating the construction of a portable set, the frame aerial of which will have to be somewhere about 2 ft. square. How many turns will be required in order that this aerial may cover the lower broadcast wave-lengths ? I am using a ·0005 variable condenser.

The exact number of turns will depend on the gauge of wire and the spacing, but if you use 28 D.C.C. spaced $\frac{1}{8}$ in. you should find 12 turns will be about what you require.

Distortion Results

M.D. (Bournemouth).—I have constructed the receiver employing one stage (the last) of choke coupled L.F. amplification, using one of the many chokes which are now on the market. While the set seems to be perfectly satisfactory in most respects, I find it will not reproduce piano music with the clarity which one might expect, as I understand that choke amplification is very efficient.

Assuming that you are using valves capable of dealing with the grid voltages supplied to them (this will probably mean that a super-power valve will be required in the last stage), and that your coupling condenser and grid leak in the choke stage are of approximately the right values, we should think that your trouble is due to saturation of the core of the choke owing to its being overloaded. Many of the small chokes sold for L.F. purposes have neither sufficient inductance to enable them to give satisfactory amplification over all frequencies, nor a sufficient amount of core or suitably arranged windings to enable them to deal with the H.T. current they are asked to pass without becoming saturated. You say in your query that you have been advised to use a choke of a certain make having an inductance of somewhere about 100 henries. This should be quite O.K., as it is especially designed for choke amplification and will carry a current of 30 milliamps or more without reaching saturation point.

The Reinartz Three

D.L. (Watford).—I am building the Reinartz 3-valver described in the March issue of MODERN WIRELESS, but am not clear as to the wave-lengths it will cover with the coils specified, and should be obliged if you would let me know the windings necessary to enable me to pick up Daventry ?

On the lower band with the short wave coils mentioned in the article the set will cover from about 40 to 90 metres, while if you wind coils having about 75 per cent additional turns to the short wave coil this will take the set up to about 150 metres. With the broadcast coil you can cover about 200 to 450 metres, while another coil having half as many turns again as the broadcast coil will take you up to 700 metres. For Daventry you will of course need a larger choke, say a No. 400 ; while the coil should be wound as follows, using 32 gauge wire ; Between points 5 and 6, 50 turns ; between 4 and 5, 150 turns ; between 3 and 4, 75 turns ; and between 1 and 2, 100 turns.

WHEN I discovered Ambo, Julian Pilldrum Ambo, the innocent and childlike in radio matters, and lightly imposed upon myself the task of training him into the perfect radio amateur, I thought I had tuned in what the second-hand motor-car advertisements term a "snip." That was an error of judgment greater even than that other brick I dropped when I tried to demonstrate a freak circuit to the Hon. Mrs. Jankle, Commodore of the Land Girls, at a *soiree*, and gave her all the available watts in at the

. . . I gave her all the available watts, in at the finger and out at the funny-bone. . . .

finger and out at the funnybone. I can't think where these land girls pick up their fluency. Such *verve* and variety!

Some idea of the real magnitude of the job will have been gleaned by the indulgent readers of the preceding narratives I have set down. In four weeks from the word "go," I had divorced Ambo from the caresses of one of the worst specimens of crystal receivers imaginable. I had succeeded in clearing his house of whiskers—said whiskers belonging to one, Twipe, his pa-in-law—by a stratagem worthy of Machiavelli. You see, hanging chinweed is a handicap to fine soldering work or coil-winding. I had even paved the way to persuading Ambo that his adherence to the potato trade was against his best radio interests, and was maturing my plans to give him a wireless *debut* that would make a full-blown D X knob-spinner feel like two turns of No. 100 cable with the wire stolen out of it. And then——

There was a bad hitch. Partly due to those worms and partly due to Leonidas Buller Bones. But I see that this needs filtering out.

A Resurrection

I will go back to the evening when I went round to Ambo's shack, bulging with beneficence and blue prints. Madame was in the mysterious regions beyond the bead curtains at the end of the hall (or passage), polishing the panels of the latest thing in Ambo Juniors, judging by the howls. Pa Twipe, who ushered me in, looked like something that had been caught dying at the age of a hundred and four and then thoroughly monkey-glanded. This unnerved me, because it was all my fault for having made him shave.

Ambo was seated at the table, playing with plasticine. By his side was a near-mahogany cabinet which struck a familiar note. It was the case of the crystal receiver which I had flung out of the window and which the dog had buried. This evidence of body-snatching gave me a bad voltage drop along my spinal marrow.

"You ghoul," I said. "What in the name of Mho made you resurrect that frightful junk? And what's the game with this putty? Are you preparing to glaze a hothouse for taters?"

Ambo rolled a blob of the stuff between his palms.

"I am making models of wire worms for use during my lecture on "Edible Tubers and Their Enemies" at the Institute of Applied Pestology. Have a look at the real things: old boy. Aren't they fierce?"

"Ambo's Folly"

He lifted the lid of the box and permitted me to take one horrified glimpse at its writhing contents.

"'Did He Who made the lamb make thee?'" I quoted, turning hastily away. "I came round to talk about wireless, Julian, but, of course——"

"Ah! Wireless! That reminds me," he replied, in the tone of one who recovers consciousness. "You know that mast in the garden?"

I knew it. I used to call it "Ambo's Folly." It was two hundred feet high, best ship steel, anchored like a Dreadnought, stayed like the sticks of a windjammer, and insulated in fourteen holes.

A Licence Enquiry

"What," I said, "have the wire-worms pulled it down at last? I always warned you——"

"No; but it's under suspicion. Several days last week a fellow has come and looked at it thoroughly through a pair of binoculars. He's had quite a crowd helping him each time, and the rumours the crowd sent round were very interesting—specially to me. The best was to the effect that I was boring for oil with it. I offered to let the binocular chap climb up and satisfy himself that there were no nests up there, but he had no humour. Then, yesterday evening, he called here and asked whether I listened. I said that depended on what there was to hear; he seemed awfully bucked and asked to see my licence."

"Ha! Ho!" That was my interruption.

. . . A fellow came and looked at the mast through binoculars . . .

"Well, of course, I said I didn't need one because I was born with my ears, and had not infringed anybody's patent except perhaps that of an elephant. Then he said he meant did I "listen in," and I told him 'Yes, and out as well,' at which he grew hot, blushed, and asked whether I used wireless. I said I should have to take

IN PASSING—*continued*

counsel's opinion as to that, and asked him to call to-night. I thought you and he might thrash it out."

"You're a cool hand, Ambo," I said; "but you have the makings of a genius. I will bandy words with this bloke right blithely. Meantime ——" And here I whispered to Daddy Twipe, who flickered off, neighing like Tattersall's.

"Me Name Is Bones"

Presently there was a knocking at the front door—something midway between the postman and the young man who cleans the windows. It was the Inquisitor. Ambo and I exchanged winks and then settled our faces.

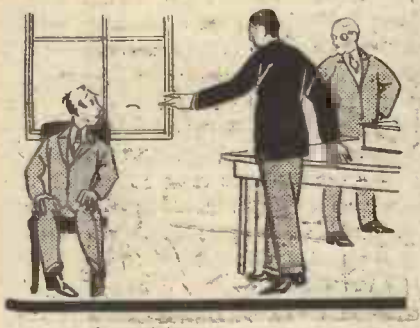
"Come in, Mr.—er—" I said briskly, as he stepped through the doorway, and, in an undertone, "Ambo, have you chained up that snake? You remember the last time someone—— Oh, you have? Good!"

Our visitor was an under-nourished male, clad in a shiny-blue serge suit rather shrunken at the coat-tail. He side-stepped at the reference to a snake, looked under a chair, put his hat under it—he had refused to part with it in the hall—and sat down.

"Well, Mr.—er—I don't know your name, by the way," I said.

"That don't matter! See?"

"Oh, but I must know," I said. "I must know with whom I am dealing."



. . . Our visitor, an under-nourished male, sat down. . . .

"Yore dealing with the Post Office! See?"

"Ah! Good evening, postman, I——"

"Neow! I never said——"

"Ambo," I said sharply, "this gent contradicts himself. I'll put him down as Buggins." That roused him.

"As a matter of fact, me name is Bones, but it hasn't——"

"There you are! I wasn't far out. Initials?"

"L. B."

"Not Lulu surely," I murmured. "Ah, well—Lulu Bones be it."

"'Scuse me! That's wrong. It's B fer Buller."

"Great Scott, Ambo!" I said, "did you or did you not hear him say Bones? Now he says it's Buller. Most unreliable witness. I shall write to Sir Jonas about him. Get his stripes cut off or his beer-money scrounged. What?"

"'Ow, neow," cried our visitor. "B fer Buller and B for Bones."

"You are wrong," I replied gravely. "It is freely acknowledged by all the best authorities that B was a Butcher who kept a Bulldog. But what about the L. Did you say Lulu?"

"Neow! It's fer Leonidas. Sorter Greek fer Leonard, I expect. But what I called here ternight fer is——"

Bones Asks Questions

"Pardon! One moment," I said. "You are Leonidas Buller Bones. Age?"

"Wa—what fer?"

"Twenty-odd. Right! Occupation?"

"But, I say, mister, I'm not——"

"Never mind what you are not! You are not Lulu, or Labouchere or another. Occupation?"

"I'm—but that don't matter, mister."

"You cannot come here, Mr. Buller—er—Bulbones, and ask questions without presenting your credentials, you know. Who are you? What are you? (*Is that your uncle having another fit, Ambo?*)"

Mr. Bones felt for his moustache, missed it, and scratched his head nervously.

"I'm from the Post Office," he said. "Sent round, like."

"By gum!" put in Ambo. "I've got him now. Of course. And his little brother delivers the newspapers. Why, how you *have* got on, Boner—er—Bulls—I mean Butcher."

"Yes," I replied. "Real nasty exam, I believe. Jografry, Cross Tots, Double Decimals and Long-Distance Logarithms. He's got a head on him." And I smiled sweetly upon the limb of the G.P.O.

"What I called about was to see yer licence, that's all. Lessee it and the matter's over," he said.

I solemnly produced Ambo's dog licence.

"That's fer a dog," said Leonidas with intelligence.

"Quite!" I answered. "It is a dog my friend possesses. The snake goes untaxed—so far."

"Yes, but I don't *want* to see yer dog licence; it's yer wireless licence I'm after. See?"

". . . Ambo," I said, "he's escaped. . . ."

I handed him mine, and his jaw dropped, until he noticed the address.

"Ar! Hall in order, sir, but what about *this* house?"

"What about it?"

"Where's the licence, hey?"

"What for?" Here Ambo snorted with joy.

"Wireless."

"What wireless?"

"This here gentleman's."

"Has he admitted that he has installed a receiver?"

"Well, no! Can't say he did, properly speaking."

"Then why do you ask for his licence? Have you asked next door? Does Mr. Ambo look like a free and enlightened B.B.C. patron?"

Worms Which Turn!

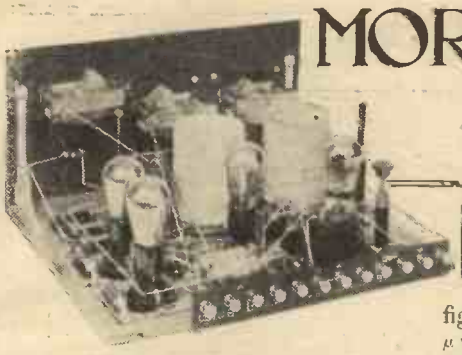
Just then our victim's eye lighted on the mahogany case, which bore the legend, "True Blue Crystal Set" (Pat. applied for.)"

"Why, look there, mister! What's that?" he chuckled.

"Ambo, you ass," I groaned, "the game's up. All right, Lulu, you had better make sure," and I gave the wormery a shove in his direction. He snapped up the lid and with a sneering:

"I know the feel of a cat's-whisker any day," plunged in his hand.

(*Continued on page 546.*)



MORE ABOUT THE "BLACK PRINCE"

Some operating notes concerning this efficient "M. W." four-valve receiver

SHORTLY after I wrote my description of the "Black Prince" in last month's MODERN WIRELESS, the opportunity presented itself of having the original set tried at the house of a friend in South London. While the report of its achievements was most flattering, the point that interested me most of all was that, when tried by a listener who had not previously touched the set (on a temporary aerial to boot), foreign stations were picked up with accuracy by the calibrations given on a card attached to the instrument. On visiting the house a few days later, I easily picked up Rosenhugel in daylight on the loud speaker.

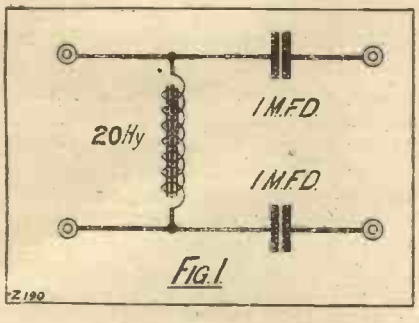


FIG. 1

Suitable Valves

With the multiplicity of valves available to the British constructor, it is becoming more and more the problem to find just which is the best combination for a given set, particularly as almost daily I am receiving specimens of new types or new modifications of older types. At present, of course, the new high-magnification valves designed for resistance-capacity-coupling are "booming," but with all of them we must face the fact that they cannot handle large volume as satisfactorily as the valves of more moderate magnification and impedance.

In the case of the "Black Prince", if you want the best volume on distant stations, then the high μ valves will give it; yet prolonged tests with the receiver have shown that with an overall sensitivity of such a high figure, it is possible to use medium μ valves, if you have them on hand, and still get splendid distance reception.

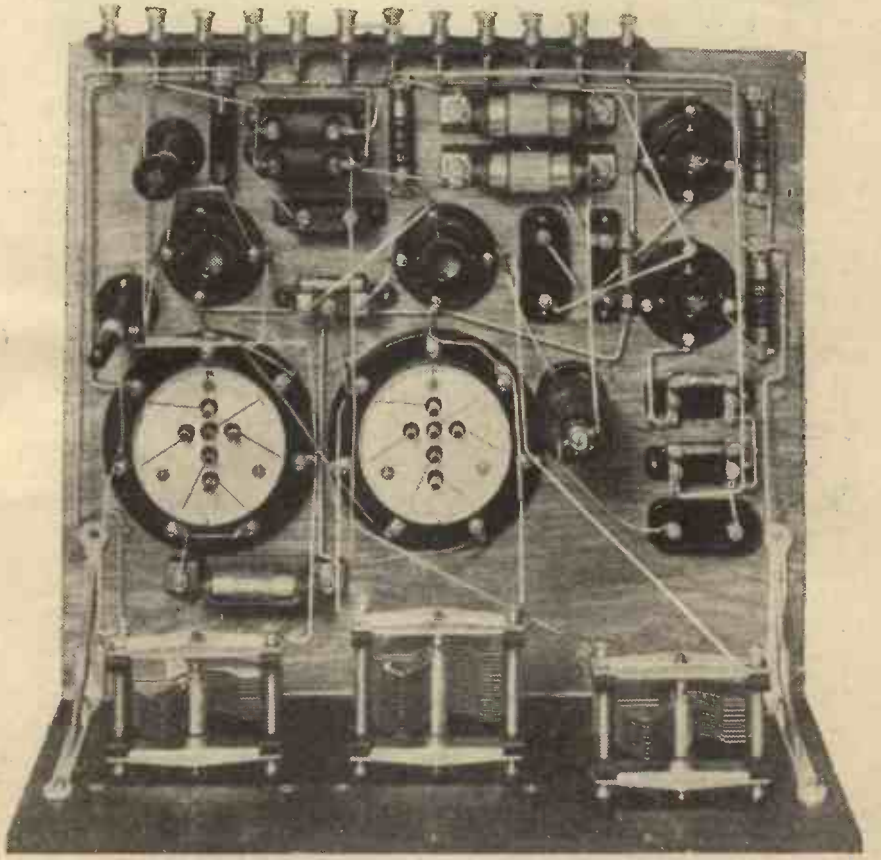
So far as the nearby station is concerned, the best combination seems to be a high μ valve as the detector with 250,000 ohm resistance in the anode circuit, and for the first note-magnifier a valve of a magnification of, say, 20 to 25, with a 100,000 ohm resistance in the plate, using, of course, a super-power valve in the last stage. With such an arrangement a one-megohm grid leak for the first L.F. valve, with half a megohm as the special stabilising resistance in series with the grid, and a quarter megohm leak for the second note-magnifying valve, make an excellent combination, giving a wonderful volume from the local station without any trace of distortion, yet also giving thoroughly adequate magnification of weak signals.

I should like to take this opportunity of saying that I am in full agreement with Mr. K. D. Rogers' notes on the valves for the "Black Prince" on page 380 of the last issue, all the valves he names having been tested in the set.

The Super-Power Valve

As indicated in my previous article, I am a great believer in the modern super-power valve for the last stage, when adequate means exist for supplying the H.T. current, but, at the same time, it is not advisable to pass the plate current of a super-power valve directly through the windings of a loud speaker, for which reason I recommend the use of a filter. The filter was not built into the "Black Prince" as the same filter can be used for a number of sets and should really be considered as a separate accessory, like the H.T. battery.

A filter is so simple a device that there is really no need to describe the construction of any instrument speci-

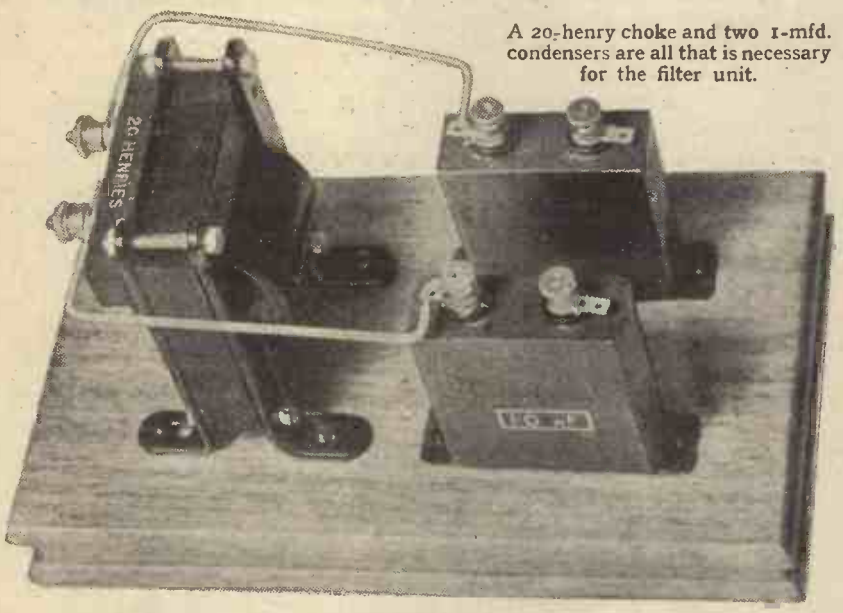


Looking down at the baseboard of the "Black Prince."

MORE ABOUT THE "BLACK PRINCE"—*concluded*

ally built up. My own experience shows that with the modern low-impedance loud-speaker such as a cone of one of the various types now deservedly popular, a 20-henry choke and a couple of one-mfd. condensers are all that is required. A theoretical diagram is shown in Fig. 1 and an actual 20-henry choke and two condensers wired up on a board are shown in the accompanying photograph. I strongly advise all readers who are likely to use a super-power valve to make up a little unit of this kind.

It possesses several advantages.



A 20-henry choke and two 1-mfd. condensers are all that is necessary for the filter unit.

Firstly, the windings of expensive loud speakers are adequately protected; secondly, the loud speaker can handle more energy without overloading, as the direct current component is removed from its windings, and, thirdly, if you are using the loud speaker at a distance from the set the long leads will not need to carry any H.T. current. A further point is that there is no need to worry about the polarity of the windings of the loud speaker, for as this only carries the audio-frequency pulses, there is no chance of demagnetising the instrument by wrong connection.

A Different Grid Leak

Quite likely you will have a small box that can be adapted to take the filter unit, in which case an ebonite lid can be fitted with four terminals, two for the input and two for the output.

By the way, I now use a three-megohm grid leak for the detector valve of the "Black Prince," in place of a two-megohm originally specified. I find that this gives a slightly improved reaction control with most of the high μ valves. The change is not an important one, but it is worth trying, particularly by those readers who like to work a set on the limit of sensitivity in picking up very distant stations. This is quite permissible on the "Black Prince" as, when neutralised, it is a non-radiating set, and you will not disturb your neighbours if accidentally you use too much reaction. P.W.H.

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 of the Month.

Conducted by P. R. Bird

Broadcasting from a Buried Aerial

THE famous New York station W R N Y—which works on 375 metres and is often picked up in this country—is going "on the air" from underground! In co-operation with Professor Rogers, who has developed the underground aerial system, the station authorities are laying a terra cotta pipe 6 feet deep in terra firma! The aerial is to be drawn through this pipe, and then a short-wave broadcast transmission will "go out" from W R N Y at the same time as the ordinary programme on 375 metres.

Good Going on Long Waves

Have you noticed how well the long-wave stations are coming over of late? Daventry, Radio-Paris and Hilversum used to be the only ones worth tuning-in, but now the Eiffel Tower transmission has improved, and right up on the 4,000-metre mark there is Konigswusterhausen in fine voice. Kovno, too, on 2,000 metres is pretty good, if one can unravel him from the C.W. interference. (It's a thousand pities that these continuous wave stations are so conscientious, isn't it? If only they wouldn't wave *quite* so continuously!)

Croydon Calling

A powerful new wireless station is to be erected at the Croydon air-port, for the Air Ministry. The aerials will not be at the aerodrome, but will be situated several miles away, and operated by the "remote control" system.

The power, wave-length, and other details are not all made public yet, but provision is to be made for improved radio direction-finders, to assist aircraft during misty weather.

Not so "Petit"

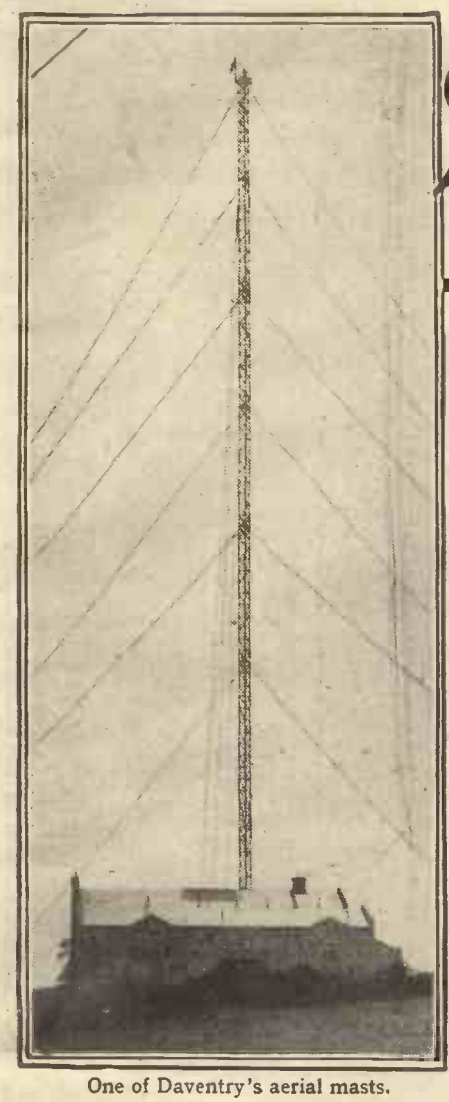
South-of-England listeners are being rather puzzled by the behaviour of their old pal Petit Parisien. This popular station has been oiling its aerial or spring cleaning its output in some way, for signals seem to be unusually vigorous lately.

In addition to this increased punch behind the signals, the French station is getting quite a reputation as a duettist, several listeners having reported picking up its transmission on about 175 metres. Is this a short-wave young brother, or can it be a cross-Channel harmonic?

Britain's National Radio Exhibition

It is announced by the organisers that the National Radio Exhibition will this year begin on September 24th, and close down on October 1st. It will be held in the New Hall, Olympia, London.

(*Continued on page* 559.)



One of Daventry's aerial masts.

Daventry Junior

A short article describing how the B.B.C. are paving the way for the regional scheme of broadcasting. By THE EDITOR.

THE new 20-kilowatt "Junior" Daventry station is very nearly ready: tests have already been made outside broadcasting hours. The B.B.C. have not, however, as yet made any public announcement with regard to the general efficiency of this station, although many amateurs report that they have heard Daventry Junior testing.

Daventry Junior is to work on high power and on a wave-length between 300 and 400 metres, and it is anticipated that the transmissions from this station will cover a much larger area than the present high-power station, 5XX. Daventry Junior, in fact, is comparable to the high-power station, Langenberg, in Germany, which is now working on about 468 metres with results which have been somewhat conflicting, although on the whole evidence seems to indicate that the results have not been as satisfactory as had been anticipated.

We have had many correspondents writing and informing us that they have been disappointed with the results from Langenberg, and in many cases the signal strength does not seem to have been greater than that of the Stuttgart or Hamburg stations, which are four-kilowatt transmitters.

The main object of the new Daventry station is to provide crystal-set reception over a very wide area so that all listeners will have an opportunity of an alternative source of programme; and an exclusive wave-length will have to be found for the station, and one that is not too near that of the wave-lengths of the other B.B.C. stations.

High Power Essential

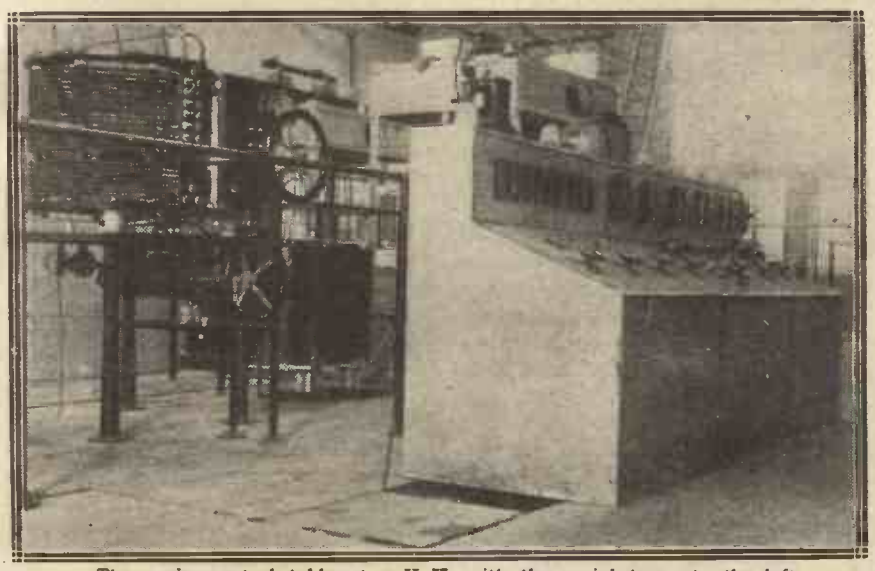
Here again Langenberg is an interesting object lesson, for several European broadcasting stations have found their vicinity to Langenberg (from the wave-length point of view) unsatisfactory, and they have had to alter their wave-lengths in order to avoid interference from Langenberg.

Captain Eckersley has stated that the B.B.C.'s plan is to place the new high-power transmitter well away from the large centres of population at present served by broadcasting, and to give in general the same signal strength over large towns as is done to-day by the main B.B.C. stations. High power is essential, in Captain Eckersley's view, to any new scheme of broadcasting distribution, in order to give an uninterrupted service for every listener in the country.

The Regional Scheme

In his opinion a large number of low-power stations cannot fulfil this condition. Whether Daventry Junior will prove the success anticipated remains to be seen, and whether it will mean the wiping out of reception of several Continental stations in this country also remains to be seen.

In broadcasting practice there is undoubtedly a trend in the direction of high-power stations to take the place of the present 1½-kilowatt main B.B.C. stations, and one of the chief duties of Daventry Junior will be to supply data in connection with the scheme for the new regional transmitters which, if erected, will work on high power; that is to say, on a power of about 20 kilowatts; and

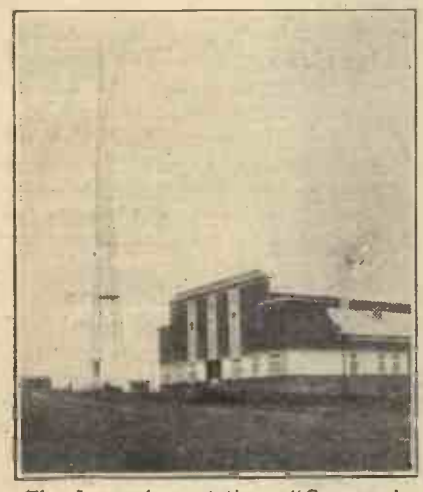


The main control table at 5 X X, with the aerial tuner to the left.

DAVENTRY JUNIOR—*concluded*

will replace the 1½ kilowatt stations at present in operation.

Thus the trend in broadcasting is exactly opposite to that in commercial wireless, where many critics believe that the day of the high-power station is over and that short-wave, low-power stations are not only cheaper but even more efficient than the long-wave, high-power stations. There



The Langenberg station. "Germany's 5 X X."

has been, of course, a good deal of criticism about Rugby, which cost about £480,000 to build, and the recent success of the Beam stations in communicating with Australia and America have again drawn attention to this controversy.

Some critics believe that there is no clashing between the long-wave, high-power system, and the short-wave, low-power system, and that each system has its own special purpose. The powerful long-wave station should be able to communicate with distant parts of the world, and so keep in touch with ships at sea, and all quarters of the globe, while the short-wave directional station, which concentrates its transmissions in a beam like a searchlight, can use much less power because of its beam concentration and, because of the use of short waves, in certain circumstances can cover greater distances than the long waves and maintain constant communication with very distant points, although with no others except those which are in a direct line with the beam, and in view of this it has been suggested that, however much the beam system is developed, the long-wave station will always be a necessity for general wide-world communication, while the beam station is likely to retain first place as the cheapest method of direct communication on low power and short waves with very distant places.

The importance of the short-wave, low-power station in commercial wireless has now been undoubtedly proved, especially when a few weeks ago the Marconi Company succeeded in passing the very stringent tests imposed by the Post Office on the beam system operating between this country and Australia.

The Beam System

But it must not be forgotten that the beam system owes a great deal to the activities of amateurs who, when restricted to the use of short waves, found, much to their amazement, that the lower the wave-length they used for transmission, the greater were the distances over which they could communicate. On exceedingly low-power and on short waves, amateurs have achieved communication between this country and the United States, Australia, New Zealand, India, and other parts of the world, and it was these amateur experiments which led to a further investigation by commercial concerns of the short-wave system.

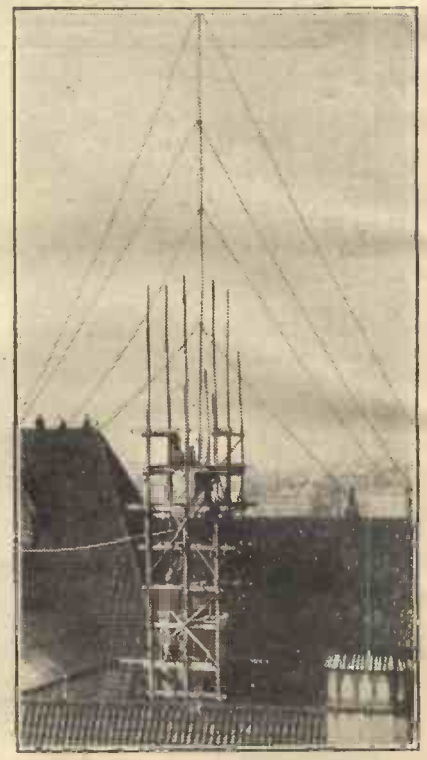
It was found that the short-wave, when radiated in all directions from the usual aerial, was not comparable to the long-wave, high-power station, but when these short waves were focused or concentrated in a beam, then their importance and utility were found to be superior.

Broadcasting on very short wave-lengths has not proved successful, and it would seem that the future of broadcasting in this country undoubtedly lies in the direction of maintaining a system of high-power regional transmitters instead of the local medium-power transmitters at present in use.

Daventry Junior will be the first in the direction of devising this regional scheme and putting it into practical use. Whether Daventry Junior will prove a success in practice, and whether its performance will justify the adoption of the high-power regional transmitters in practice, remains to be seen. Theoretically the possibility seems logical—but we must wait until Daventry Junior makes its public début.

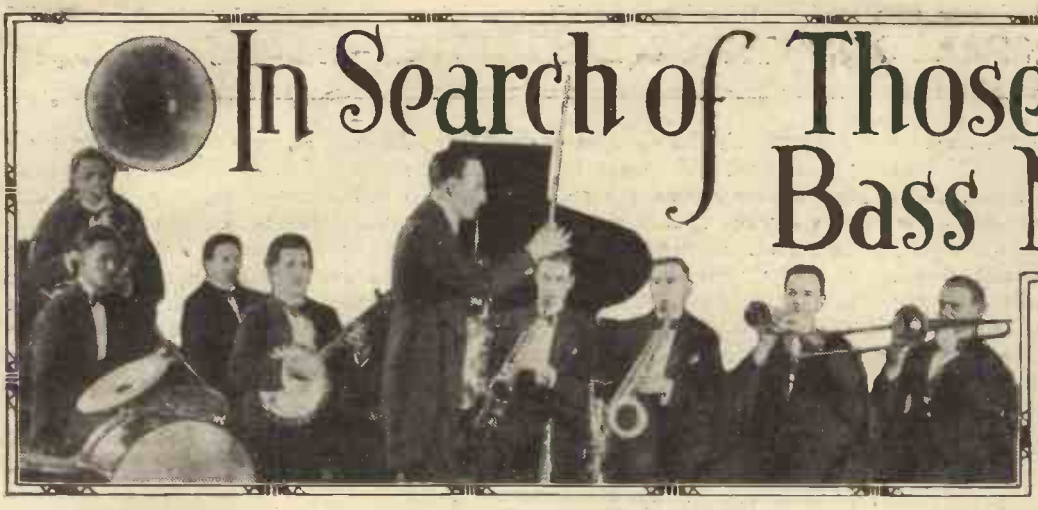
Some Long-Wavelength Broadcasting Stations

Wave-length.	Name of Station.
577	Frieburg.
720	Osterstind.
760	Geneva (H B 1).
850	Lausanne (H B 2).
940	Leningrad.
980	Warsaw.
1010	Moscow (Popoff).
1050	Hilversum (H D O).
1100	Debilt.
1100	Bâsle
1110	Kbely.
1150	Soro.
1150	Ryvang
1165	Leningrad (10kw.).
1200	Luxembourg (to be 2174)
1200	Boden (S A S E).
1300	Berlin (Koenigswusterhausen A F T).
1365	Karlsborg.
1400	Nijni Novgorod.
1450	Moscow (R D W).
5000	Riga.
1600	DAVENTRY (5 X X).
1750	Radio Paris (S F R).
1800	Norddeich.
1950	Scheveningen Haven.
2000	Kovno.
2525	Berlin.
2650	Paris Eiffel Tower (F L).
2900 / 4000	Berlin Koenigswusterhausen (A F P).



The mast of the Hamburg station on the roof of the G.P.O.

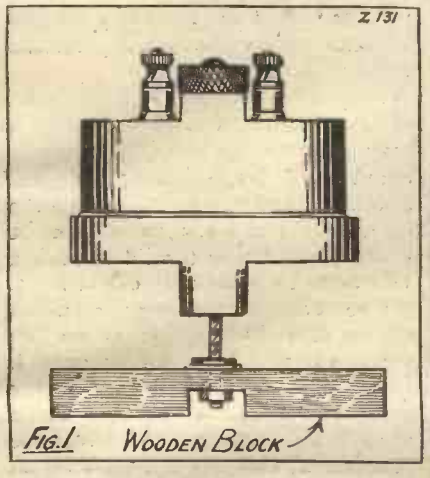
In Search of Those Bass Notes



Some interesting details of experiments carried out with a novel loud speaker.

By
A. V. D. HORT, B.A.

THE impression that really good quality of reproduction, combined with adequate volume, is inseparable from a high first cost of the necessary apparatus has, for many people, been strengthened by the introduction of instruments such as the now well-known Rice-Kellogg loud speaker. Fortunately for those among us whose pockets are not so well-lined, the human ear is extraordinarily adaptable.



When you are listening to an orchestral selection, as reproduced by your small loud speaker of the ordinary diaphragm type, or even by headphones, there are a great many notes being played by the orchestra which your ear does not actually "hear" at all, in the ordinary sense of the term. But because you have at one time or another heard an orchestra direct, without the medium of wireless, your brain supplies some of the missing qualities of the music.

Interesting Experiments

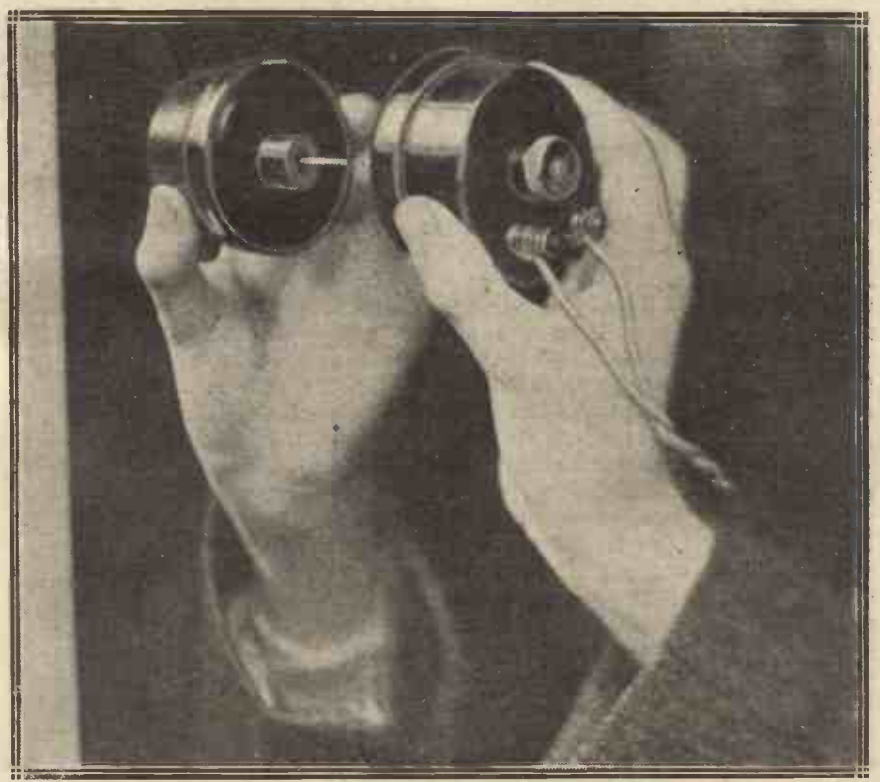
The first few times that you listen with that particular loud speaker, you will probably be very critical of its performance; but with use you will unconsciously adapt yourself to it and be prepared to say that "for a loud speaker it's not so bad," which for many enthusiasts is high praise.

This was very much my attitude towards my own loud speaker, until I undertook a few experiments to see how much I was being deceived by familiarity with the instrument. These experiments soon showed me that I had been content with something poor indeed, compared with the reproduction which I could obtain by very simple means.

In reading the account of these experiments, and in trying them for yourself, do not look for absolute perfection of performance, or you are likely to be disappointed. Unless, however, you are the fortunate possessor of a really superlative loud speaker, you will be agreeably surprised to find what a great deal you have been missing in all the programmes which you have hitherto received with your set.

Paper Diaphragm Speaker

My original starting-point was a loud speaker of the reed and metal diaphragm type, with a small metal horn. With this I was never really satisfied, and the next step was to make up a loud speaker with a pleated paper diaphragm.



The L.S. Unit was held up to a large mirror when testing the reed movement.

IN SEARCH OF THOSE BASS NOTES—*continued*

The actuating mechanism for this consisted of a "Lissenola" loud speaker unit with the reed attachment. The diaphragm was nearly 12 inches in diameter, and was rigidly mounted in a frame of three-ply wood. For some time this remained the standard instrument for home use, and in many respects its performance was quite good. For speech especially it gave admirably clear reproduction, free from any of the "nasal" tones which are frequently so prominent.

Further Tests

Piano solos seemed to reproduce particularly well with this instrument, but care had to be taken not to overload it, or else an unpleasant "chattering" noise was produced, due to the reed jarring against the pole pieces. For this reason large volume was unobtainable, and music from a full orchestra was usually rather poor in effect. So well accustomed did my ear become, however, to this loud speaker, that I did not realise that a considerable range of the musical scale was really outside its compass, and it was not till I tried other "diaphragms" that I discovered that the whole of the lower bass register was missing altogether.

The first step was to fit a loud speaker "ear-piece" with its reed attachment, connect it to the set with a long pair of flex leads, and then to try pressing the tip of the rod in the centre of the reed on various surfaces. The ebonite panel of the receiver itself, 14 by 7 inches, gave results very similar to those obtained from the paper diaphragm; quite good volume for a small room, but rather thin tone. The glass of moderate sized pictures gave some improvement, while a large, heavy wall-mirror made audible some of the lower bass notes for the first time, and indicated the possibilities of further development in this direction.

For preliminary tests it was found sufficient merely to rest the tip of the rod on the surface to be tried. Prolonged trials require a more permanent and steadier method than this. If you wish to try a surface thoroughly, or to mount the loud speaker permanently in any one position found satisfactory by trial, it is best to mount on the end of the rod a piece of wood about 2 inches square and $\frac{3}{8}$-inch thick, securing it on the rod by means of nuts and washers. The unit should then be wedged in position with the piece of wood flat against the surface chosen. The face of the wood should be sand-papered as smooth as possible, and firm but not heavy pressure applied, so as to allow of adjustment of the setting of the pole pieces relative to the reed in the ordinary way. The tip of the rod must not project beyond the wood, so that the nut at the end must be sunk a short distance into the face of the wood. (See Fig. 1).

A general view of the unit fixed in the piano.

This method of fitting up the unit also allows of its use in application to the top of a table. In this case, for temporary use the unit may be merely stood on the table "upside-down," the face of the wood resting on the top of the table and the weight of the unit sufficing to prevent it moving unduly. This cannot, however, be recommended as a permanent arrangement, owing to the tendency of the unit to "walk" on the table with the vibration which it produces, and the consequent jarring effects.

A Novel Idea

The final experiment tried proved undoubtedly to be the best. This consisted in attaching the unit to a piano. There are various surfaces in the piano which may be utilised, the sounding board proper, the loose front board above the pedals, and the front boards above the keyboard. As soon as tests were made on these surfaces, it was realised how thin the reproduction from the paper diaphragm had been. The Savoy Bands were playing at the time when the first test was made, and notes were at once audible which had not been apparent at all before.

The music had come through clearly and crisply enough then, but the deeper bass notes had been completely lacking. The real result of this for dance music, to take but one example, had been that the undercurrent of plucked strings which supplies so much of the rhythm had merely been unconsciously added, without being "heard" at all.

Attaching the Unit

It is now a delight to listen to any kind of music, if only for the knowledge that practically nothing is omitted in the reproduction, while it seems incredible that it could have been possible to enjoy the half-hearted efforts of the previous loud speaker. The effect of the addition of the bass register by this means gives an impression of quite startling realism to any musical broadcast.

Coming now to the actual method of attaching the unit to the piano, it may be as well to point out that this does not involve disfiguring the piano at all. The unit is secured inside the case, and the leads to it can be brought out under the lid in such a way as to be practically out of sight.

One of the photographs which accompanies this article shows the position in which the unit is mounted. Inside a "cottage" piano of the ordinary type there will be found a wooden rail running right across the instrument, carrying felt pads on its lower side. In front of this rail there are usually three panels, two small ones at the sides and a larger one in the middle. This centre panel is to be used as the "diaphragm."

The unit is placed on the rail with the tip of the reed resting against the centre of the panel. A small block of wood is secured to the rail about one inch behind the unit with a single screw: this is all the "damage" that is done to the piano. Small wooden wedges are then inserted between the fixed block and the unit, so that the tip of the reed is pressed firmly against the panel and the unit cannot move backwards away from the panel. The unit should be

IN SEARCH OF THOSE BASS NOTES

—concluded

mounted with the reed resting against the pole pieces, the adjustment to separate them being made afterwards.

The other wood surfaces of the piano which were mentioned above may be used in a similar way, but the method described is the simplest. It is not always easy to get good reproduction from the larger panels, owing to their considerable vibratory movement under the action of the reed.

It may be that even with the upper panel the reed tends to chatter on the pole pieces when heavy bass notes or loud chords are coming through. If this happens, the unit should be taken apart and a piece of very thin rubber or oiled silk inserted between the reed and the poles. This remedy will enable much greater volume to be obtained without chatter.

Preventing "Chatter"

Owing to this limitation of the possible movement of the reed, the application of the unit to the centre of a large sounding board is not recommended. If a large surface is used, it will be found best to attach the unit within a few inches from its edge. Sufficient movement will then be communicated to the "diaphragm" without any disturbing chatter whenever a loud passage of music comes through.

The volume actually obtainable is, of course, controlled by the inherent limitations of the reed type of unit. The reed is not capable of free enough movement to deal with very large volume. It should, however, be found possible to dance to the music from the "piano loud speaker" in a room of moderate size, without the annoyance of having to listen carefully all the time to hear the music.

It may be that the bass notes will be found to predominate when the unit has been fitted to the piano. This is especially likely to happen if one of the larger wooden surfaces is employed as the diaphragm. There will then be noticeable a rather hollow tone in speech, and the brilliance of the higher musical tones will be lacking.

The remedy in this case is to connect one telephone earpiece or a pair of them either in parallel or in series with the unit. The most suitable method of connection should be found by experiment. If an ordinary horn type of loud speaker is available, the horn should be removed. A pair of headphones will, however, serve quite well. Connect them as required and then put them inside the piano. This will help the various tones to blend together.

If the 'phones and the unit in the piano are at opposite sides of the room, the notes of the violin will appear to come from one side of the room and the 'cello from the other, though on cutting out either reproducer, most of the notes will still be audible from the other, one giving predominance to the treble and the other to the bass.

Life-Long Reproduction.

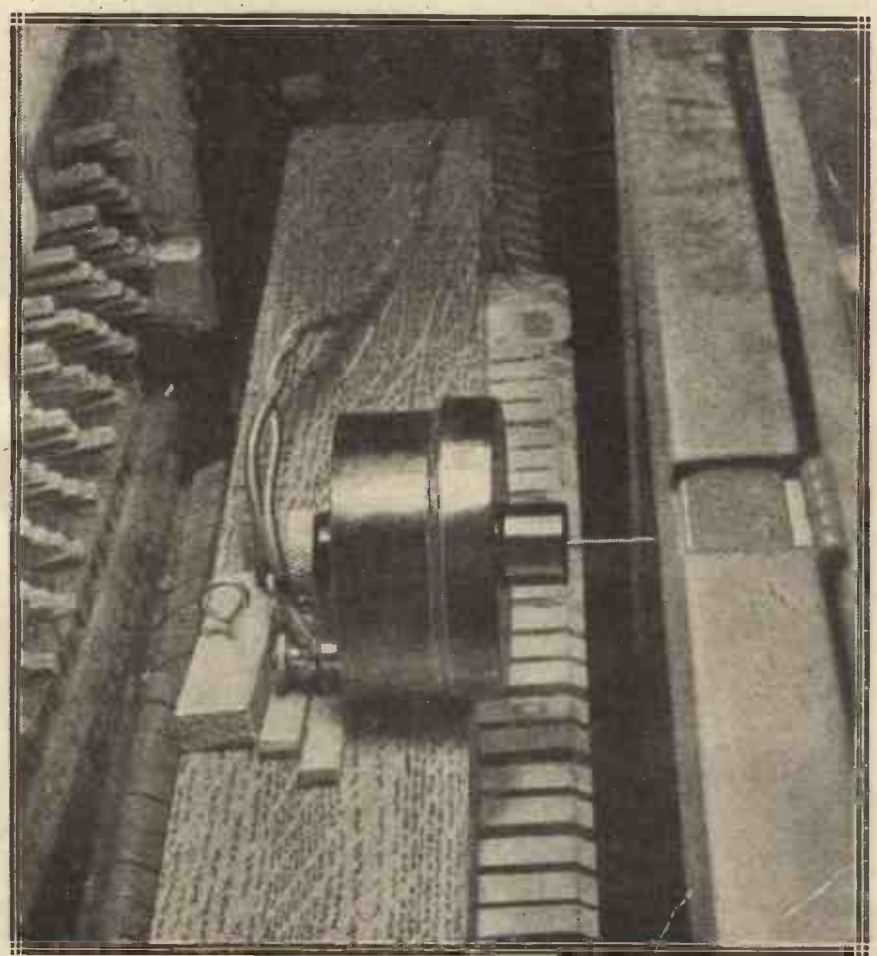
When a piano solo is coming through the illusion is remarkable, and the listener can quite easily imagine that the actual instrument in the room is being played.

It should not be necessary to use any shunting condenser across the loud-speaker terminals. Certainly nothing larger than ·0003 should be used, when the circuit requires the provision of an H.F. by-pass. A large shunting condenser often gives with an ordinary loud speaker a spurious impression that the bass is being properly reproduced. Too large a capacity results in the suppression of the higher register.

The experiences and opinions of any readers who carry out experiments along the lines indicated will be welcomed.

SUPER POWER VALVES

A great deal of misapprehension still exists with regard to the meaning of "super power" in relation to valves. It should be realised that this does not mean that the valve will give *louder* results than the ordinary power valve but merely that it will handle more input without introducing distortion due to overloading. By this means a greater volume *can* be obtained but this is not *necessarily* the sequel to the replacing of a power by a *super* power valve.



A "close-up" of the unit in position behind the front panel of the piano.

SOME COMBINE 5" QUERIES

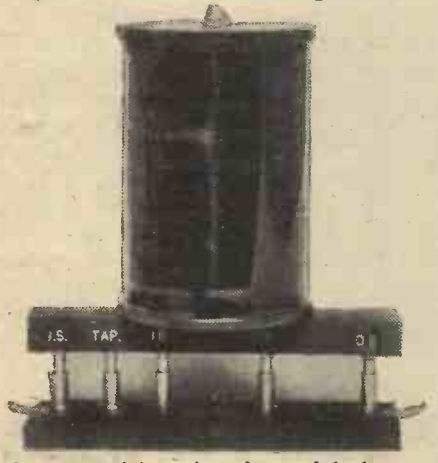
Typical questions about this famous "Modern Wireless" receiver answered by

G. P. Kendall, B.Sc.

(Chief of M.W.'s Queries Dept.)

"WHAT is the ratio of the telephone transformer?"

No ratio can be fixed for this component, since it must be suited to the resistance (more correctly, the impedance) of the loud speaker which is to be used with the receiver. In the case of the average high resistance loud speaker, with a resistance of 2,000 to 4,000 ohms, a "one to one" transformer will be required. When the loud speaker is



A commercial version of one of the long-wave coils.

of the low resistance type (say, 120 ohms) a step-down transfomer is required (usual ratio, ten to one). If a loud speaker of unusual resistance is to be used (there is an example on the market of 750 ohms resistance) this should be specified in obtaining the transformer.

The Centre Taps

"Why is a centre tap provided on the third of the coil units when this is apparently not used? Is there an error in the diagrams in this respect?

There is no error; all the coils are provided with centre taps, although in the case of the coil forming the grid circuit of the detector valve the tap is not used. This was done in order that there might be no difference between the second and third units, thus eliminating the possibility of error in inserting them.

Earthing the Filament Circuit

"I notice a dotted connection in the circuit diagram connecting the filament circuit to earth. Is this an optional arrangement?"

This connection is sometimes helpful in obtaining a stable neutralising adjustment, and is always worth trying, especially in view of the fact that it also helps to stabilise the L.F. amplifying circuits.

Selectivity on Long Waves

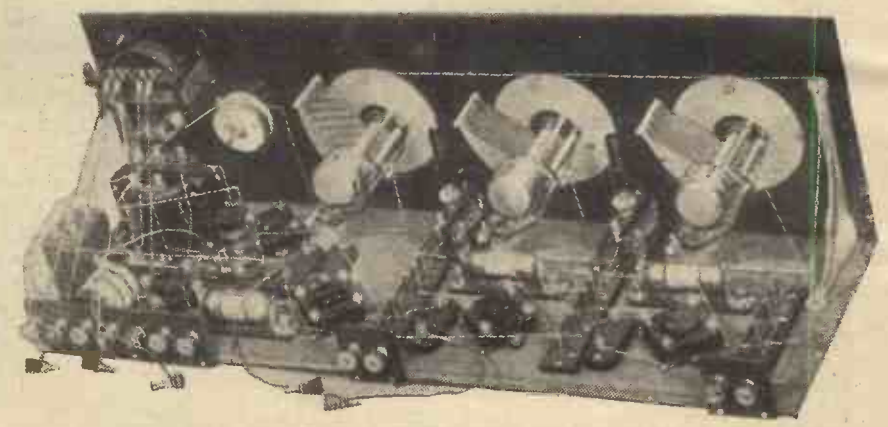
"For the shorter waves the aerial coil consisted of 30 turns of wire, with tappings at 15, 20 and 25 turns. For the Daventry range a fixed-size aerial winding of 90 turns is specified, without tappings. Does this mean that no adjustment of selectivity is needed on these long waves?

No very high degree of selectivity is needed on the longer waves, and it is possible to fix a size for the aerial coil which will suit the majority of conditions without adjustment. Some gain in simplicity of construction can therefore be obtained by omitting the tappings on the aerial coil and connecting its ends direct to the appropriate pins (I.P. and O.P.) on the base. In the unlikely event of a little more selectivity being needed in some special circumstances, it can be achieved by the adoption of the usual expedient of the inclusion of a fixed condenser of about .0002 mfd. in series in the aerial lead.

A Jack for 'Phones

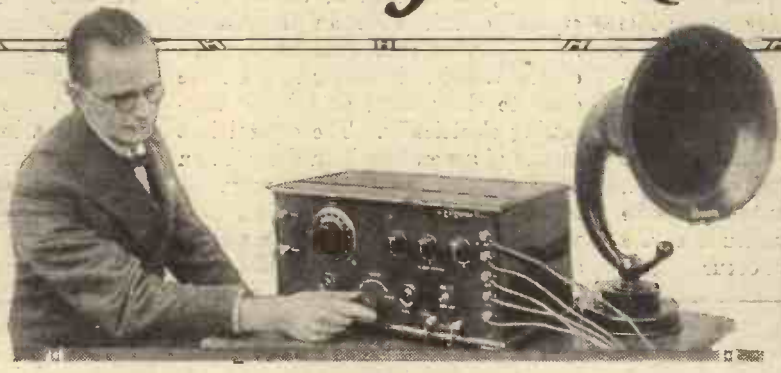
"Would it lead to any ill-effects if I inserted a jack so that four valves only were used for 'phone work?"

Quite harmless. Use a "double circuit" jack, arranging the connections so that when the 'phone plug is inserted the L.F. transformer primary is cut out and replaced by the 'phones.



A back-of-panel view of the famous "Combine 5" receiver.

The Search *for* Quality



The second article in this important and exclusive series deals with efficient rectification.

By Capt. P. P. ECKERSLEY (Chief Engineer of the B.B.C.)

Part II.—Rectification

HAVING dwelt on the point which I feel is so often left out of consideration in broadcast receiver design—the efficiency of the H.F. system, aerial, coil and earth—it is logical to diagnose a little the diseases endemic to rectification. *In general* the principle of the rectifier is that of the lobster pot which lets the lobsters in one way, but won't let them get back the other—the rectifier lets the current flow in one direction but not in the other, it presents a sensible resistance to an E.M.F. in one direction, but an infinite resistance to a reversed E.M.F.

Although there is probably little amplification in a detector valve, as we know it, in the normal valve there is such a thing as "efficiency of detection." This is perhaps clearer when one realises that while the ordinary crystal does not amplify, it still has something one may call "efficiency," because it can, according to its size, shape, make, point chosen, etc., vastly vary the amount of signal.

Let me make it perfectly clear, in the hope that I am not beating a dead horse, as to what is meant by efficiency of detection. Refer to Fig. 1. Here I have drawn a line to represent the voltage excursions of the H.F. plotted against time. Above is the envelope of the tops of the undirectional impulses, that is, the

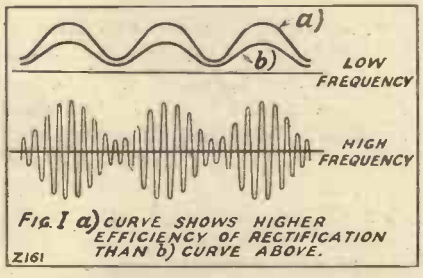


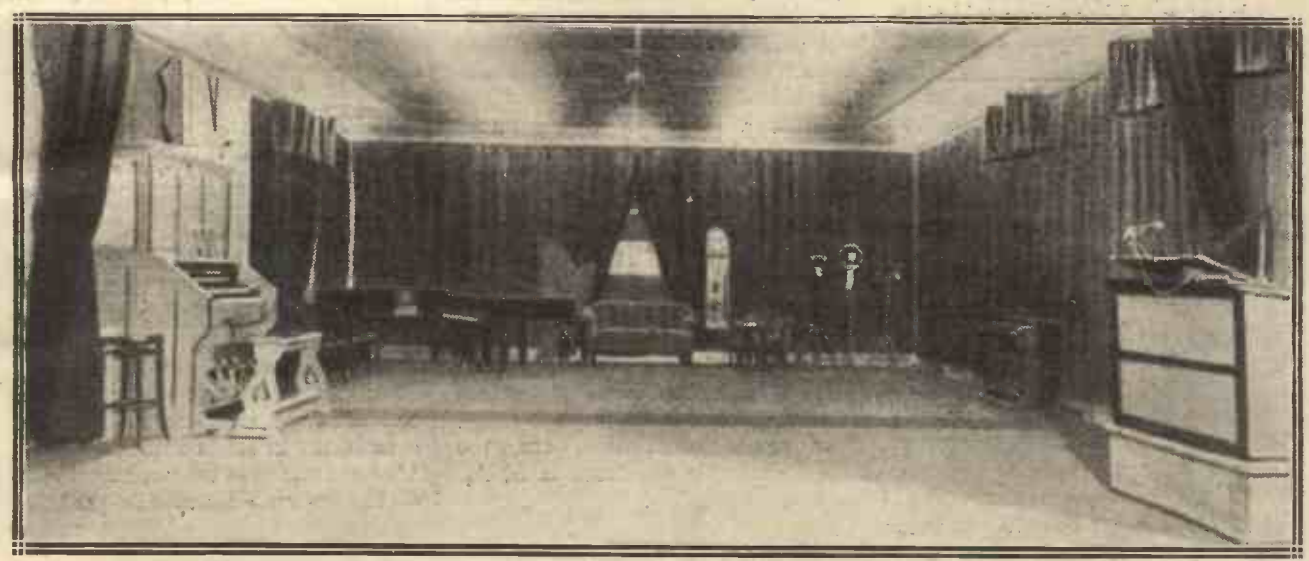
FIG. 1 a) CURVE SHOWS HIGHER EFFICIENCY OF RECTIFICATION THAN b) CURVE ABOVE.

excursions of currents, plotted against time, after the process of rectification. Obviously the *shape* of the curve may be as in *a* or *b*, but *a* gives a greater rectified current, and hence the detector has a greater efficiency.

We can obviously see that quality will be impaired if the shape of the rectified current is not exactly the same as the shape of the envelope containing the tips of the H.F. impulses.

The Crystal as Rectifier

The shape of the rectified current curve may be different from the shape of the envelope of the tips of the half-wave H.F. impulse, if either the curve of the detector is not straight and/or if the load of the detector to the impulses varies with amplitude. Thus, take a crystal curve as in Fig. 2. This shows (*a*) a perfect, and (*b*) an imperfect curve. If the curve (*a*) is taken, then 2 volts along the X axis produces a current of say 0·2 milliamps, and 4 volts 0·4 milliamps, and 10 volts 1 milliamp, the resistance is constant, being $\frac{2}{0002}$ $\frac{4}{0·0004}$ which is always



The large studio, used for orchestral work, at the Voxhaus Broadcasting Station, Berlin.

THE SEARCH FOR QUALITY—*continued*

equal to 10,000 ohms. But in curve (*b*) we have non-linearity and while 2 volts produces ·2 milliamps, 4 volts produces ·3 milliamps, and the resistance is 10,000 or 5,000 ohms, in fact all over the place. Even supposing the load of 10,000 or 5,000 ohms made no difference to the *amplitude of the H.F.*, the resulting L.F. currents will not be proportional to the amplitude of the H.F., and distortion will occur.

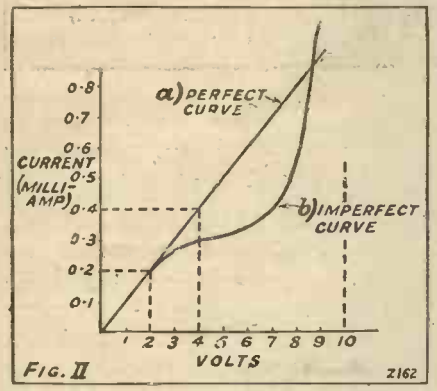


FIG. II

It is possible and probable that the halving of the load from 10,000 to 5,000 ohms will, however, limit the excursion of the H.F. voltages, and more distortion will result.

This is fairly obvious for a crystal detector; with a valve the problems are more complex, since grid current may take place for values above certain voltages and not at other times. This would be all right provided the "regulation" of the circuit applying the H.F. impulses is perfect, *i.e.*, that its volts will not drop with load.

Many hold that the crystal must give better quality than the valve. This is not so. I have been told that the devotees of the crystal as rectifier

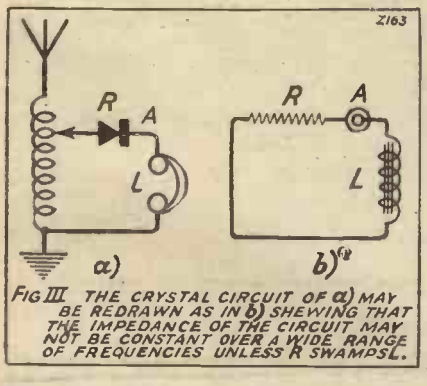


FIG III. THE CRYSTAL CIRCUIT OF a) MAY BE REDRAWN AS IN b) SHEWING THAT THE IMPEDANCE OF THE CIRCUIT MAY NOT BE CONSTANT OVER A WIDE RANGE OF FREQUENCIES UNLESS R SWAMPS L.

find that different types of crystals give different quality of reproduction. At the risk of being boring, it is well to explain why this should be.

Draw, as in Fig. 3, an ordinary crystal circuit with an impedance, be it 'phones or transformer, in the crystal circuit. Re-draw it as I have done to show what actually is happening electrically. The crystal is a means of generating from the H.F. an L.F. current which may vary, in broadcasting, between 50 and 10,000 vibrations a second. Thus an alternator A. The crystal has resistance, this is shown in R. Looked at from the crystal point of view, the circuit contains shall we say, an inductance, this is in the simple case, the inductance of the 'phones. The impedance of the resistance inductance circuit varies over the wide range of frequencies dealt with in broadcasting. Varies, too, in the amount of variation over this range, depending upon R and hence the type of crystal.

The Ideal Detector Valve

Good crystals do have quite reasonable curves and give in consequence good quality. The valve scores, however, if properly treated, in robustness and the ability to stand overload. (I have often wondered if a crystal could not be found reasonably sensitive and robust to replace a valve which after all absorbs some filament energy.)

The best way to approach the question is first to consider the valve as a crystal, i.e. as a device with a non-linear characteristic. A set of characteristic curves is plotted in Fig. V.; these curves are simply grid volts against anode current for different anode volts. The valve has not got a constant resistance, and two factors enter to vary resistance—grid volts and anode volts. Suppose we set ourselves by suitable anode and grid volts at the point A. Suppose there is a *resistance* in the anode of the detector valve. Now we "tune in" to the carrier wave. Immediately the grid has superimposed on it an H.F. voltage which sweeps us along to grid volts (*d*). But the anode volts fall because we ask the valve to pass more current, and there is a "drop" in the resistance resulting in less anode volts. Instead of being on curve I, we find ourselves, perhaps, on curve 2 at A_1. Now comes modulation, and the actual characteristic curve is A, A_1, A_2, etc.

Actually, in the case drawn, we see that the grid under modulation becomes positive, and grid current must flow at certain times. Unless the circuit preceding the detector valve has perfect regulation, i.e. unless it gives the same voltage whether there is a load from grid current or not, this will cause distortion, and it is therefore better to work wholly

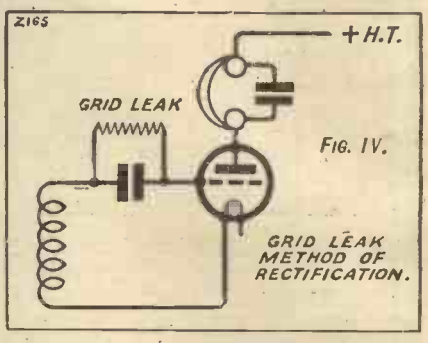


FIG. IV.

negative. If we choose, in order to accomplish negative working, a valve with very open mesh, the characteristic at the point of bottom bend is very curved. There is not a sharp change between some current and no current, due to the fact that with a very open mesh valve the grid, however (within limits) negative, exercises no influence upon those electrons which pass willy-nilly between the large gaps in the grid.

Under Working Conditions

It appears from all this that for proper bottom bend detection a fine-mesh valve is required; but to enable it to be worked with one or

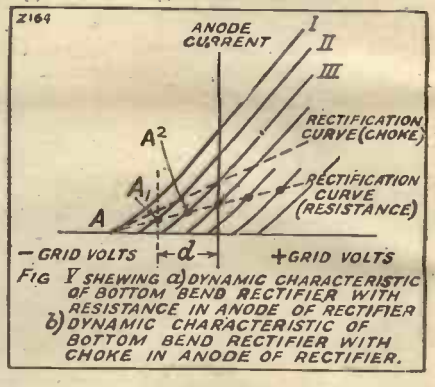


FIG V SHEWING a) DYNAMIC CHARACTERISTIC OF BOTTOM BEND RECTIFIER WITH RESISTANCE IN ANODE OF RECTIFIER b) DYNAMIC CHARACTERISTIC OF BOTTOM BEND RECTIFIER WITH CHOKE IN ANODE OF RECTIFIER.

two volts grid negative, a high value of anode volts (high, high-tension) is also necessary.

So far we have considered a resistance capacity magnification, i.e. a *resistance* in series with the anode. We have seen that the "carrier wave" of the transmitting station produces an immediate drop of volts, and a

(*Continued on page* 555.)

THE "WEE" THREE

This efficient three-valver specially built for "Modern Wireless" can be used as a portable receiver for outdoor use, owing to the compactness of the design employed.

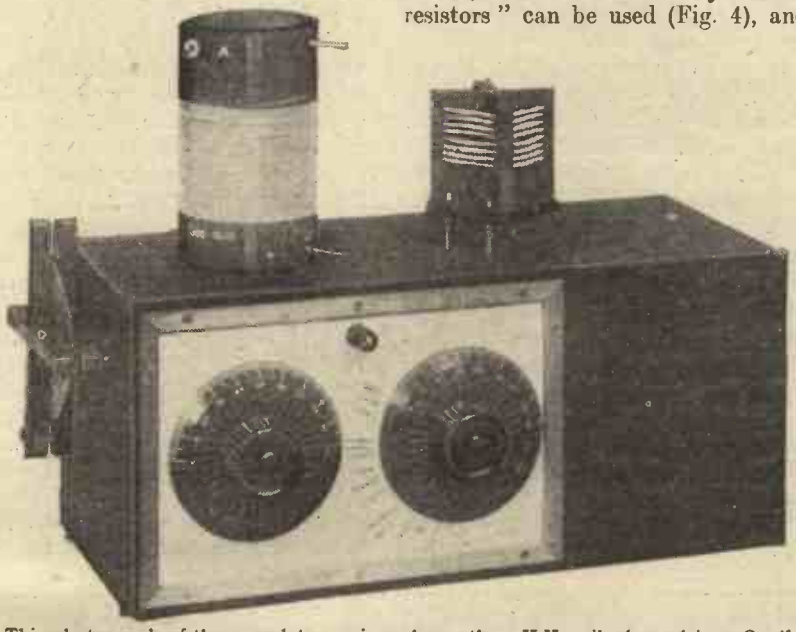
By Donald Straker

THE "Wee" Three is designed to give adequate loud-speaker reception of 5 X X at long range, or a main station at 50 miles or so with the sort of aerial that can be extemporised almost anywhere in the open. Although the overall dimensions of the receiver have been reduced to a minimum, the set will be found to do practically anything that is possible with three small valves. It should, however, be realised that the making of these very compact receivers takes three or four times as long as the assembly of one of more normal design, as a certain amount of special construction is necessary.

The Cabinet

The case is made of ordinary three-ply, only the ends being of hardwood to simplify construction. These should be cut from good, dry wood $\frac{3}{8}$ in. thick, and a few extra minutes spent in making sure that the edges and corners are true and square will save time later. The base, front, and back are fixed to the ends with small brass screws, and a few $\frac{1}{2}$ in. No. 2 screws are put through the front and back into the edge of the base to add strength. The case should be completely finished and rubbed down first. The inside should be given a coat of shellac varnish, and the outside left white for the present.

As the "panel" is of three-ply and neither side of the anode condenser is at earth potential, it would seem advisable to keep to the type of condenser specified, which has ebonite end plates and is fixed with three screws, but it may be mentioned that the writer has a similar receiver in which condensers with metal end plates and one-hole fixing are employed, and it seems to make no appreciable difference in performance.



This photograph of the complete receiver shows the 5 X X coil plugged in. On the top of the case are the aerial and anode coils, for 300–600 metres.

Neutralised H.F.

A simple home-made neutrodyne condenser (Fig. 3) is used, as no compact condenser was available. The "Polar" N type is suitable, and the long handle of this can be shortened if desired. With ·06 amp. valves the capacity required is very small.

In place of the filament resistance shown, one of the ordinary "fixed resistors" can be used (Fig. 4), and space has been left on the base for this, if desired. Having allowed the shellac to dry, the case is ready for mounting the components.

Ordinary single valve sockets are used for the aerial coil and loud-speaker connections. These are

COMPONENTS REQUIRED

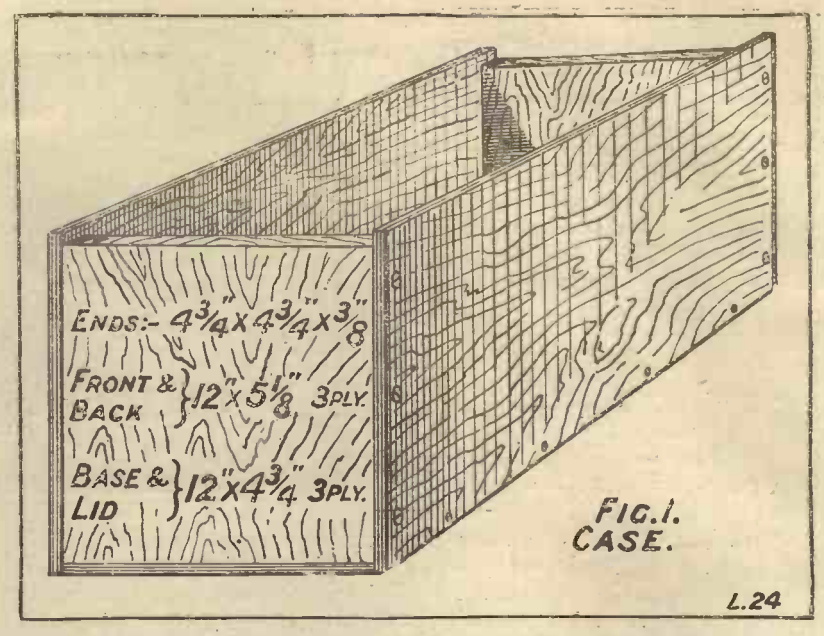
1 cabinet (see Fig. 1)
3 valve holders.
1 L.F. transformer (Eureka).
1 variable condenser (·00025).
1 five-plate variable condenser.
One ·0001 fixed condenser.
Two ·0003 fixed condensers.
Ebonite strips, sockets, etc. for coils (see Figs. 6, 7, 8, and 9).
Rod, etc. for home-made neutrodyne condenser and filament resistor (see Figs. 3 and 4).
1 grid leak (2 meg.).
Fixed Resistor or Resistance wire.
$\frac{1}{2}$ Coil of Glazite wire.
Terminals, flex, screws, etc.

THE "WEE" THREE

—continued

mounted on slips of ebonite and screwed on from the inside, the sockets passing through ½ in. clearance holes in the hardwood ends (Fig. 6). Note that the grid leak clips supplied with the Dubilier condensers are fitted to the detector valve holder for the grid leak (Fig. 5). The by-pass condenser across plate and negative of this holder is supported by the thick wire connections only.

The L.F. transformer is secured to the front with 6 B.A. screws and nuts, but if an R.I. type of transformer is to be used, it had better be laid on its side and screwed to the right-hand end of the case.



Coil Dimensions

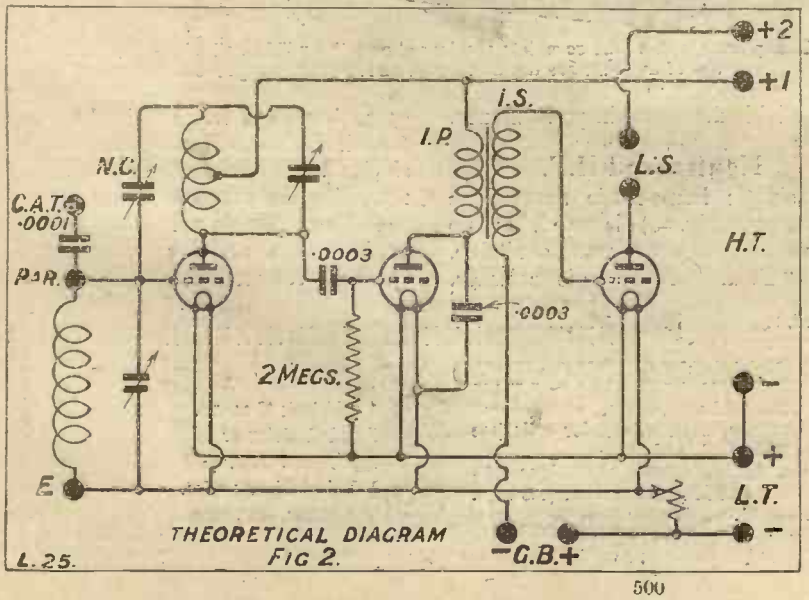
The aerial coils are of the Harris X type. The formers are made of ebonite, as shown in Fig. 8. For the low wave the slots are 1-32 in. wide. The winding consists of 70 turns of No. 30 D.S.C. wire. Using C.A.T. this will tune from 300 to 600 metres with a 60 ft. aerial. A very slight increase in efficiency can be obtained with plain solenoids, but they are too big to pack inside the case, and the increase in volume is almost imperceptible.

For 5 X X the slots are 1-16 in. wide (two hack-saw blades), with a winding of 250 turns of No. 32 enamel. A tapping is taken out to a terminal on one of the arms from about the 175th turn for auto-coupling. With the 60 ft. aerial this will tune in 5 X X near the beginning of the condenser scale, or about half-way round when using auto-coupling.

If "special selectivity" is required on occasion a semi-aperiodic coupling can be used without structural alteration. A small coil in a holder is placed on the table facing the aerial coil. One terminal is connected to the earth terminal on the receiver by a short piece of flex and the aerial connected to the other terminal. The holder is then moved away from the receiver until the desired degree of selectivity is obtained.

To retain good volume the size of this coil is fairly critical and varies with different aerials and wave-lengths. The low waves may require from 20 to 40 turns while from 150 to 200 will be required for 5 X X. With this arrangement, using a Gambrell E coil, Radio Paris can be received without a trace of 5 X X and with very little loss in volume. With the small aerial mentioned, however, these stations are quite separated without the extra coil.

The tapped anode coils are wound on the type of former developed by the writer and described in "Wireless Weekly" (Nov. 24th, 1925). The eight slots are all of the same depth and are cut with a fine tenon saw. The mouth of each slot should be splayed out with a triangular file to admit the wire easily. (See Fig. 9 and photo.) An equal number of turns is wound in each slot continuously, and the tapping is brought out from between the fourth and fifth slots to the single pin.



Tuned Anode Coils

Besides being efficient, this type of coil has a small magnetic field, a great advantage in a compact receiver. For the low wave the winding is 16 turns per slot, or 128 total of No. 30 D.S.C. wire. With a very small capacity in parallel (actually a condenser with three fixed plates is ample), this coil will tune from Kiel to Vienna.

For 5 X X, wind with No. 36 D.S.C. allowing 75 turns per slot (600 total) and taking out the tapping as before between the fourth and fifth slots. If very long pins and sockets are used it is advisable to cut off ¼ in. from both sockets and pins so that the anode coil does not stand up above the lid of the case.

After mounting the components screw the two ends to the base and complete as much of the wiring as possible, as shown in Fig. 5. Then

THE "WEE" THREE—*continued*

screw on the front and wire up the tuning condensers, anode coil holder and L.F. transformer. The anode coil holder sits over the grid condenser (Figs. 5 and 7), and is fixed by screws passing up through the base. Permanent leads of flex are fitted to the terminal strip, those for the accumulator ending in spade tags and those for H.T. in Clix wander plugs. They may be passed

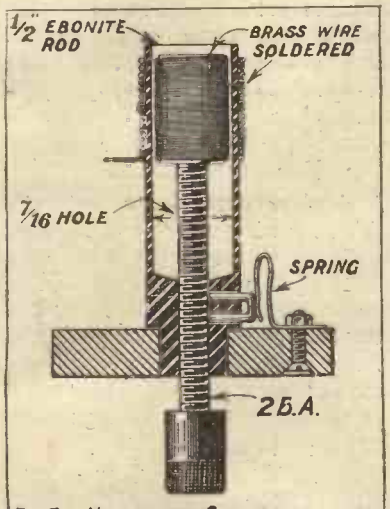


FIG. 3. NEUTRODYNE CONDENSER. L.26.

through a slot at the right-hand end of the case, and they stow away inside when not in use.

A white card with an edging of mahogany is fitted under the dials for recording the station settings. The outside of the case is painted with "Berlin Black," which can be obtained from any ironmonger. It gives a good matt black finish and lasts well. Pads of thick felt are stuck to the underside of the lid so that they press on the valves and prevent violent movement.

Valves with a moderately high impedance should be chosen for H.F. and detector and one of the small power class for the last. Although greater volume can be obtained from valves of the six-volt class such as the D.E.8, their use will involve nearly doubling the weight of gear necessary. However, the small ·06 valves work exceedingly well in this receiver and the writer has a preference for B.T.-H.B.5 in the first two holders and a B.T.-H.B.6 in the last.

The Necessary Batteries

A pair of Exide DTG cells in a crate (weighing 8lbs.) will run these for 80 hours safely. For H.T. supply 90 Lissen cells were made up in a three-ply box and arranged in two sections so that 30 cells supply the first two valves, while the other 60 are used for the last valve only. This equalises the load and gives a good useful life. Under these conditions the total current taken by the three valves is about 4 milliamps.

The grid battery is a torch refill (Every Ready, No. 730) held against the back of the panel by a metal strip. Its contacts are bent so that they press strongly against the 6 B.A. screws in the terminal strip before the strap is screwed down.

To ensure long life it is essential that ·06 valves should not be overrun. With a good voltmeter across the terminals of the valve holder the filament resistance is adjusted to pass the requisite 2·8 volts. It is then left untouched, the receiver being switched on and off by actual connection with the accumulator.

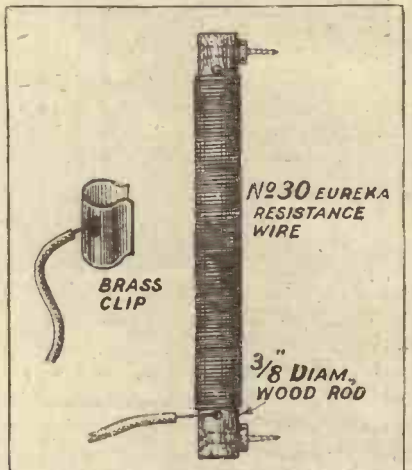
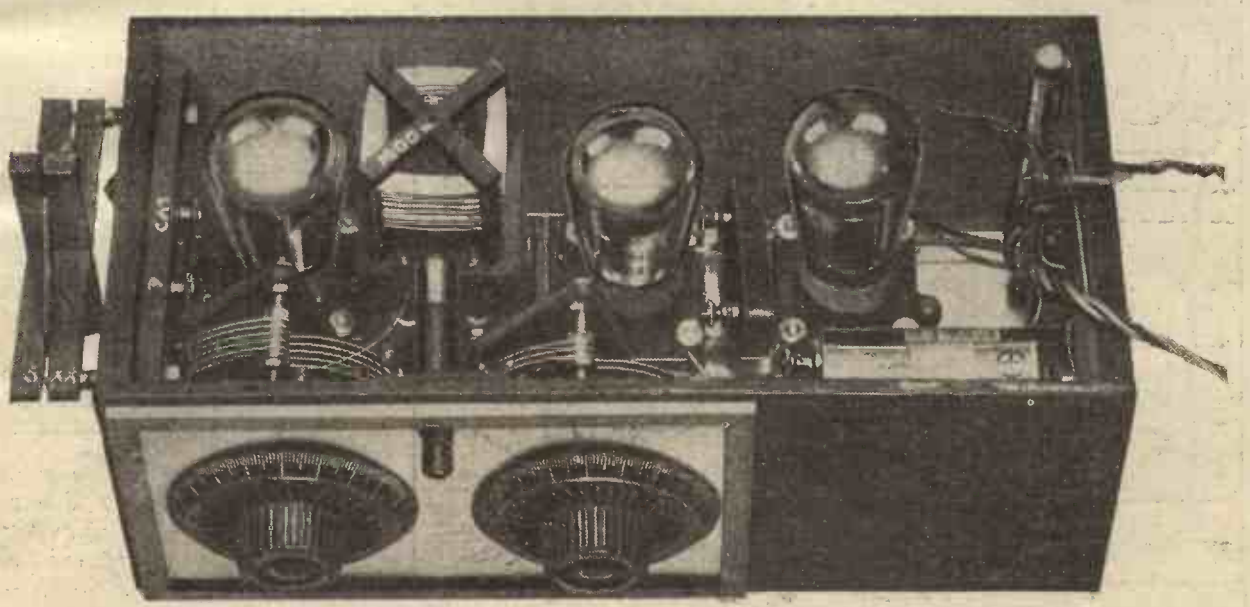
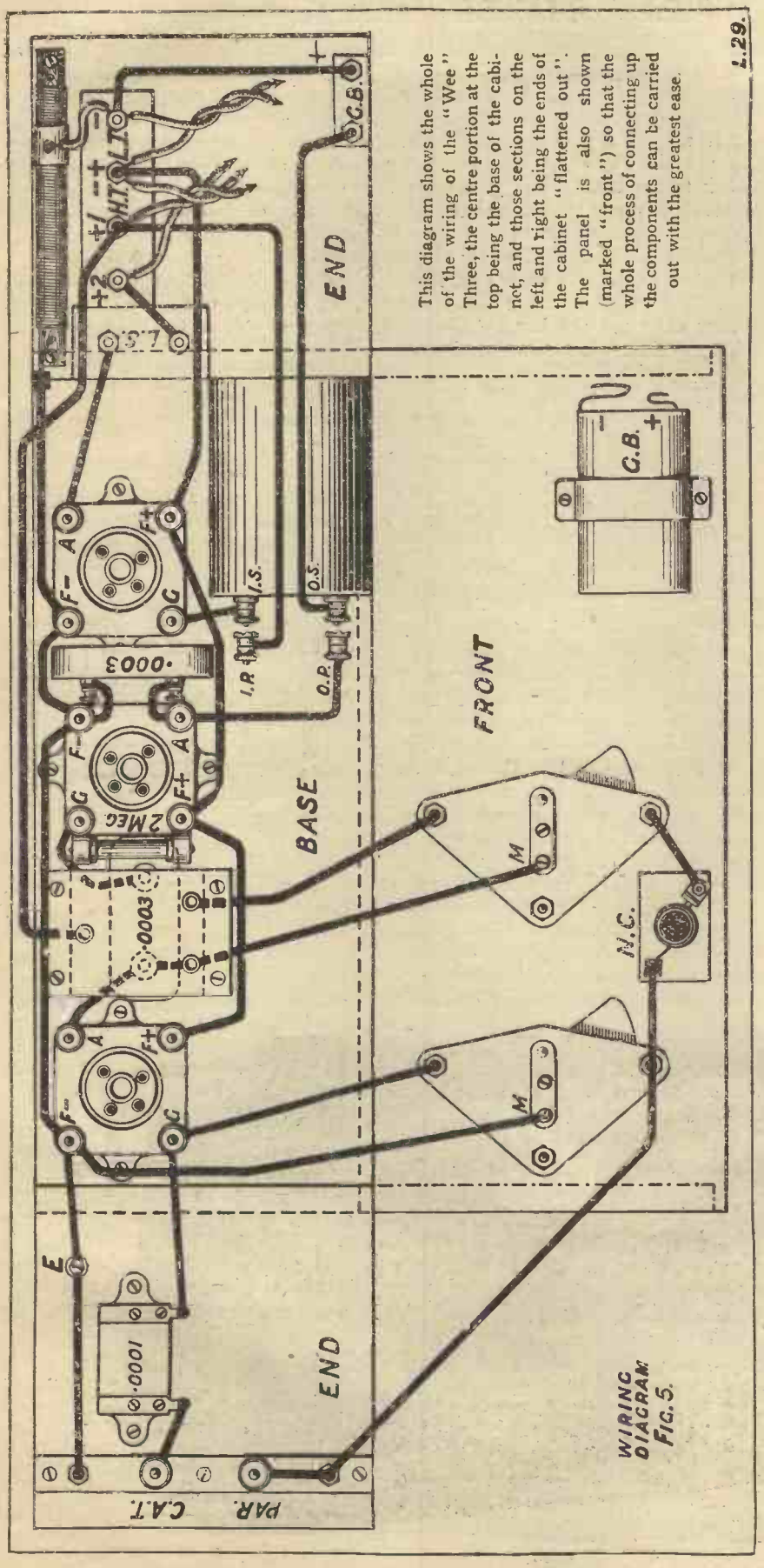


FIG. 4. FILAMENT RESISTANCE. L.27.

After having tuned in a signal a few trials with the neutrodyne condenser will soon locate the neutral point, on either side of which self-oscillation will begin. Reaction may be obtained by either increasing or reducing the capacity, care being taken to stop well short of the danger point at which


The valves and long-wave coils are shown in position in this view of the interior of the cabinet.



THE "WEE" THREE

—continued

distortion and an audible carrier whistle commence.

With this type of circuit the detestable practice of searching by use of an audible carrier wail is totally unnecessary. On the whole the writer prefers to use that side of the neutral point at which reaction increases as the capacity is increased. The same point will hold good with either of the anode coils, but it will require slight alteration when semi-aperiodic or auto-coupling is used.

Results Obtained

A short account of the first tests with this receiver may be of interest. B.T.-H. valves as above were used with 45 volts on the first two and 90 volts on the last. The large Amplion in use was placed on a shelf 6 ft. from the floor, and connected by a lead about 12 ft. long. Four transmissions were used for test, these being :

6 B M : 40 miles.
2 L O : 80 miles.
5 X X : 105 miles.
Radio-Paris : 210 miles.

Volumes were measured as follows: The Amplion being directed towards a window it was noted at what distance away speech could be easily understood.

A 60 ft. length of insulated wire was hung up to a tree and brought in through the window. No insulators were used and the aerial was rather screened by large trees. The earth was a pipe driven into the flower-bed under the window, and connected by 12 ft. of No. 14 copper wire. The volumes registered during the morning transmissions were :

6 B M : 150 ft.
2 L O : 50 ft.
5 X X : 150 ft.
Radio-Paris : 50 ft.

With Indoor Aerial

A change was then made to an indoor aerial consisting of two 12 ft. lengths of 7-22 strung across the ceiling 6 ft. apart.

6 B M : 20 ft.
2 L O : 15 ft.
5 X X : 100 ft.
Radio-Paris : 15 ft.

Aerial and earth were then disconnected and a length of flex laid

THE "WEE" THREE—*continued*

across the floor and connected to the parallel terminal.

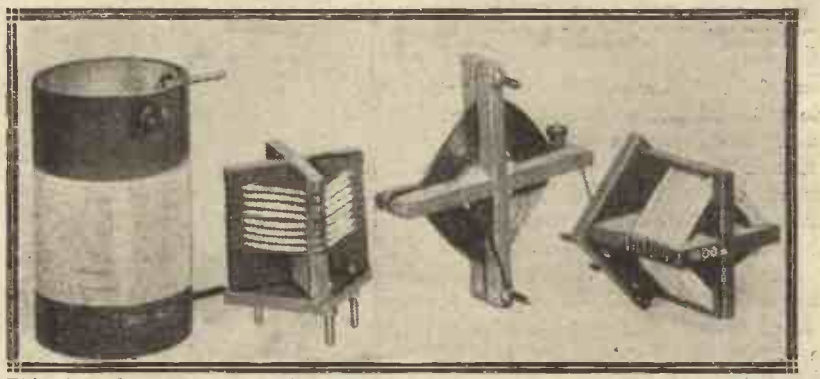
6 B M : 50 ft.
2 L O : 15 ft.
5 X X : 50 ft.
Radio-Paris : 10 ft.

A Peculiar Effect

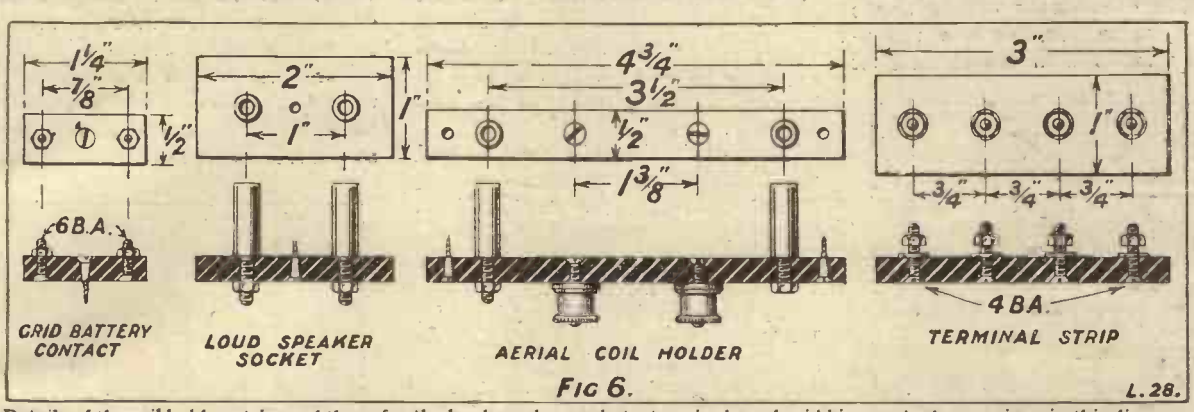
With this collector, hand-capacity was troublesome and tuning had to be done with a wooden stick. The earth wire was then connected in place of the flex and volumes were practically the same as in the last test, but hand capacity was not noticeable. As these last two tests seemed suspiciously good, search was made and it was found that the long Amplion lead and the battery leads which led to a shelf two feet above the receiver were picking up much of the energy.

With the battery and loud speaker close to the receiver volumes were reduced to about half what they had been. As these tests were made in full daylight conditions, the increase by night was quite noticeable except in the case of 2 L O.

The outfit was then taken up on to the Downs and tried under outdoor conditions. As no trees were available the 60 ft. wire was laid out over the gorse, the average height being

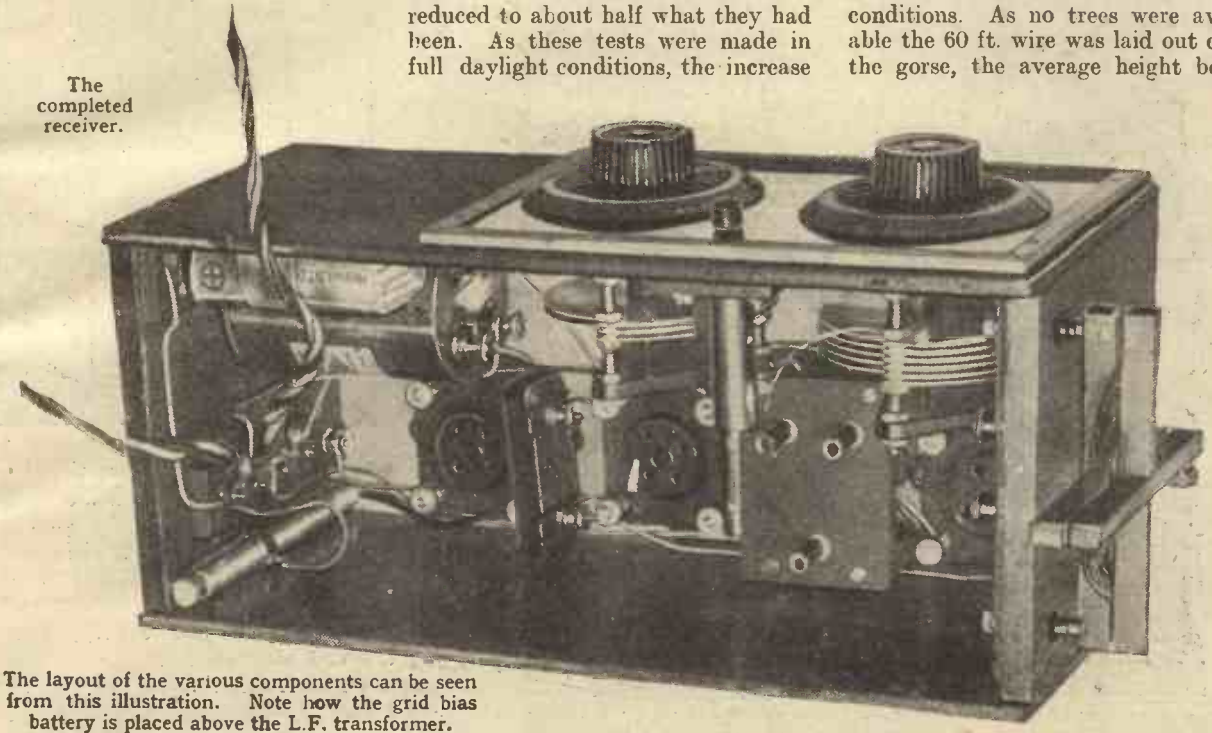


This view of the completed coils will assist the constructor. It should be compared with Figs. 7, 8, and 9.



Details of the coil holder-strip, and those for the loud speaker sockets, terminals and grid bias contacts, are given in this diagram.

The completed receiver.



The layout of the various components can be seen from this illustration. Note how the grid bias battery is placed above the L.F. transformer.

THE "WEE" THREE

—concluded

about 6 ft. A brass stair-rod thrust into the turf formed the earth, but equally good results were obtained with a 12 ft. length of flex laid on the ground under the aerial. The volumes registered here were rather better than with the same aerial wire at home, but unfortunately Radio-Paris was not transmitting. 5 X X was, of course, the star performer, the afternoon transmission of the 2 L O dance band being loud enough to dance to.

Operation

The use of reaction by means of the neutrodyne condenser will necessarily vary the calibrations of the anode tuner, but in practice one unconsciously works with the receiver at about the same safe distance away from oscillation, and provided the same valves are always used the calibration is sufficiently accurate to make the finding of a station practically certain. Further small adjustments are then all that is required to bring it up to the best strength.

For transit the coils are wrapped up in plenty of soft paper and stowed away inside and the flexible leads should also be wrapped up to prevent the Clix plugs coming into contact with the valves.

A final word of caution is advisable. With this type of circuit the shorting of the neutrodyne condenser plates, while the aerial coil is in place, will mean the sudden decease of all three valves. Care should, therefore, be taken to choose a neutrodyne condenser in which accidental contact between the plates is impossible.

Final Details

The twin flex is for L.T. supply, and as no switch is fitted one of these leads is uncoupled or coupled for switching on or off. Of the triple flex, the single red binding supplies the first two valves with 60 v., and the double red binding supplies the last valve. As the G.B. battery is only of 3 volts, not more than 90 v. should be used for this valve.

For large aerials, the tapping on the aerial coils should be used for the aerial connection, but for very small aerials it is better to connect the aerial to the C.A.T. terminal on the short waves, and to the parallel terminal for 5 X X, etc.

The sliding resistance in right-hand corner limits the current to all valves and should be about half-way down when used with the ·06 valves, and a 4-volt accumulator.

To neutralise, screw the N.C. in about three and a half turns, and screw in slightly further for reaction.

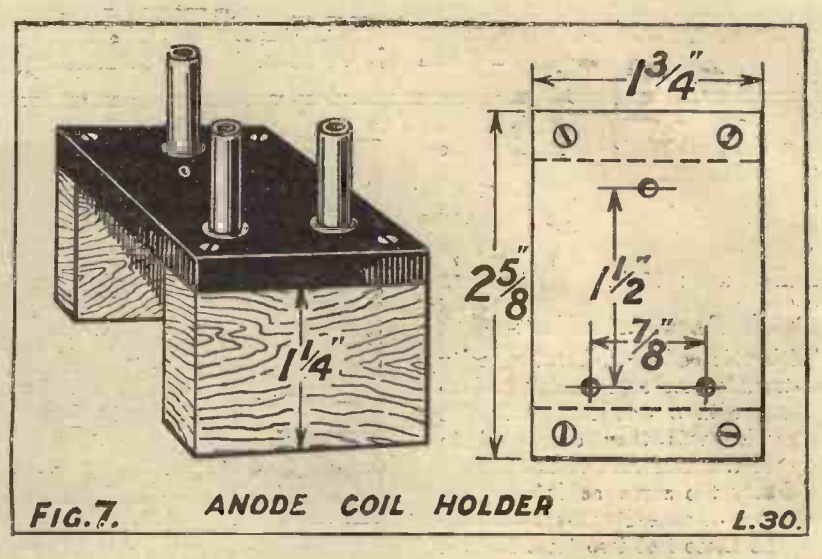


FIG. 7. ANODE COIL HOLDER L.30.

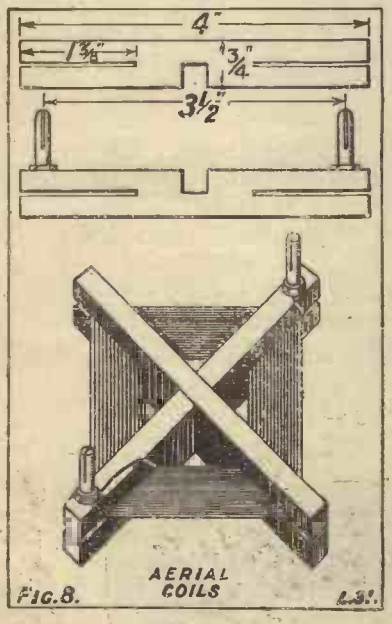


FIG. 8. AERIAL COILS L.31.

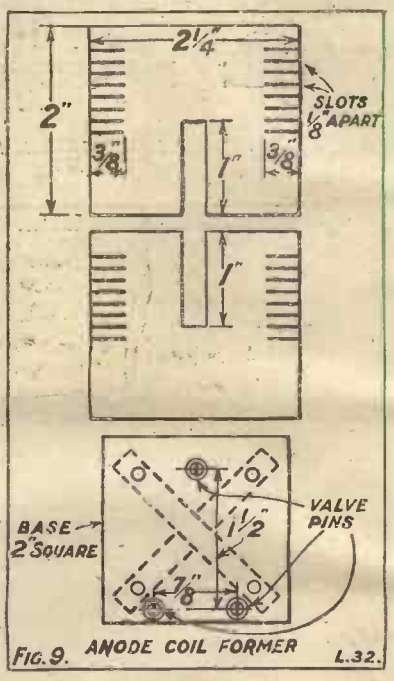
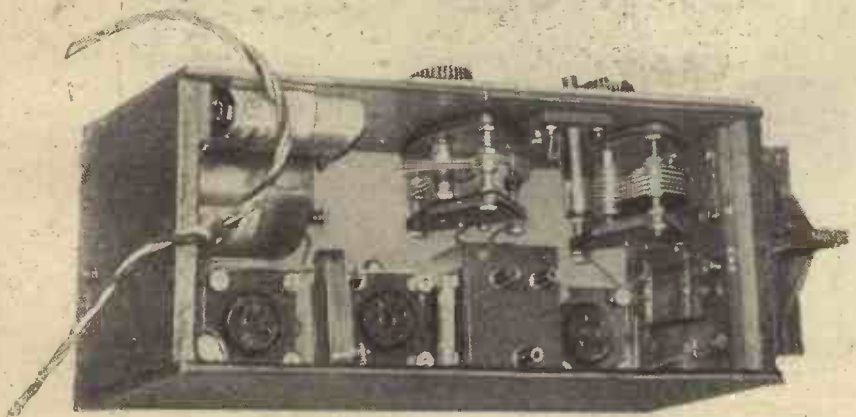


FIG. 9. ANODE COIL FORMER L.32.



The arrangement of the C.A.T. fixed condenser and the aerial coil terminals can be seen in this view taken from the L.F. end of the cabinet.

Wireless in Ceylon

Some interesting details of a new Colonial broadcasting enterprise, From our Correspondent.

A FERTILE island, climatically well favoured, possessing an area of some 25,481 square miles, an estimated population closely approaching the five million mark, and boasting also many prosperous industries—surely such a haven of modern civilisation could not do without a broadcasting station!

Fig. 1. The amplifying unit at the Colombo broadcasting station.

Such was the island of Ceylon a few years ago. Ceylon, as the reader will well know, is one of the largest of all the British Crown Colonies, and it is being commercially worked and exploited in consequence of its tea, rice, rubber, spice, and other industries which its climate and its geographical situations so well favour.

The island has also for many years been undergoing a gradual process of electrical opening-up, if one may use that term. For instance, although electrical stations are present in the island, the latest Government suggestion has taken the form of a scheme for the erection of a super hydro-electric generating station capable of supplying sufficient electrical power to light and heat the greater portion of the civilised areas of the island, and to electrify the Ceylon railway into the bargain.

The Colombo Station

This is not radio, however. Still, my little description of the condition of modern affairs in Ceylon is, I hope, justifiable as indicating to the reader the trend of modern civilised ideas in that country.

When the white inhabitants of Ceylon began to clamour for a broadcasting station of their own, the island was not completely without a wireless service. There was in existence the Colombo transmitting station, a two-way station which was erected primarily for commercial ship-to-shore work. The commercial station was erected at Colombo, the civilised capital of the island (see the map photograph), chiefly because that town is the centre and hub of the island's activities, possessing, as it does, a population of 160,000 inhabitants, very many of which belong to the white races.

Thus the Colombo transmitting station took upon itself an additional activity, to wit, that of catering for the broadcasting interests of the country. It was, perhaps, a daring piece of work for the station to undertake, but every possible success has been attained by it in these praiseworthy pioneer endeavours.

Efficient Studio

The accompanying pictures of the present station will, no doubt, be of interest to the English reader on account of the fact that they illustrate, in some manner, the technical and studio equipment with which the Colombo station has so successfully worked.

Ceylon's population is largely made up of natives who work on the tea and rubber plantations, as illustrated above.

WIRELESS IN CEYLON—*concluded*

Fig. 2, for instance, depicts the studio of the Colombo station. Rather small and cramped, you may imagine, remembering photographs and illustrations of 2 LO's magnificent studio, but, nevertheless, some very happy programmes have gone out from this Colonial studio, and there is no doubt of its efficiency in the entertainment line. Which is, of course, the chief reason for the existence of any broadcasting studio—or should be so, at any rate.

The Transmitter

Turning now to the transmitting gear of the station at Colombo, Ceylon. Fig. 1 shows the generating plant supplying this transimtter. Mullard silica valves are employed, each of them being rated at 2·5 k.w. At the time of writing, the power put into the oscillating circuit supplying the aerial is 1·75 k.w., but there is every hope that this power will very soon be increased to 2 k.w., or probably a little more, thus increasing the effective range of the station.

The amplifying panel, shown at Fig. 6, together with the studio microphone, are products of the Standard Telephones and Cables, Ltd., the amplifier utilising the services of three valves.

Besides providing a broadcasting service for the convenience and entertainment of the inhabitants—white men and natives—of the country, the Colombo transmitting station also works an interrupted continuous wave service on a 600-metre wave-length, and a continuous wave service on a wave-length of 2,300 metres, the wave-length of the purely broadcasting service being of the order of 800 metres.

Thus the officials at the Colombo station really have a busy time of it with their triple radio service. Nevertheless, they manage to provide the island with a daily broadcasting service of approximately 2½ hours' duration. Many excellent reports of this service have been received by the station officials not only from the island of Ceylon, but also from practically all parts of India. The radio station is under the supervision of Mr. Harper, M.I.R.E., the chief engineer, and also of the Ceylon Telegraphs and Telephone Services.

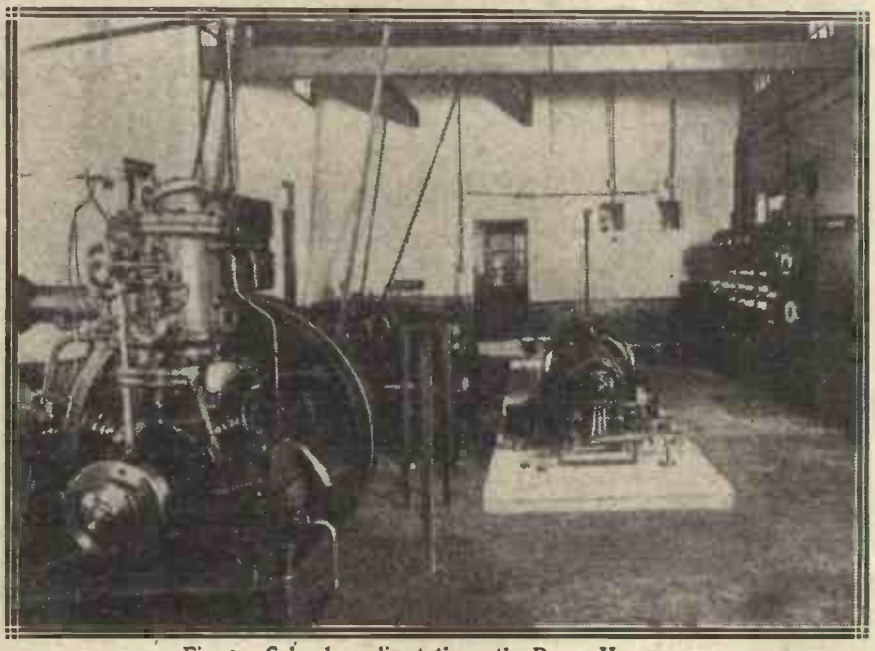


Fig. 3. Colombo radio station—the Power House.

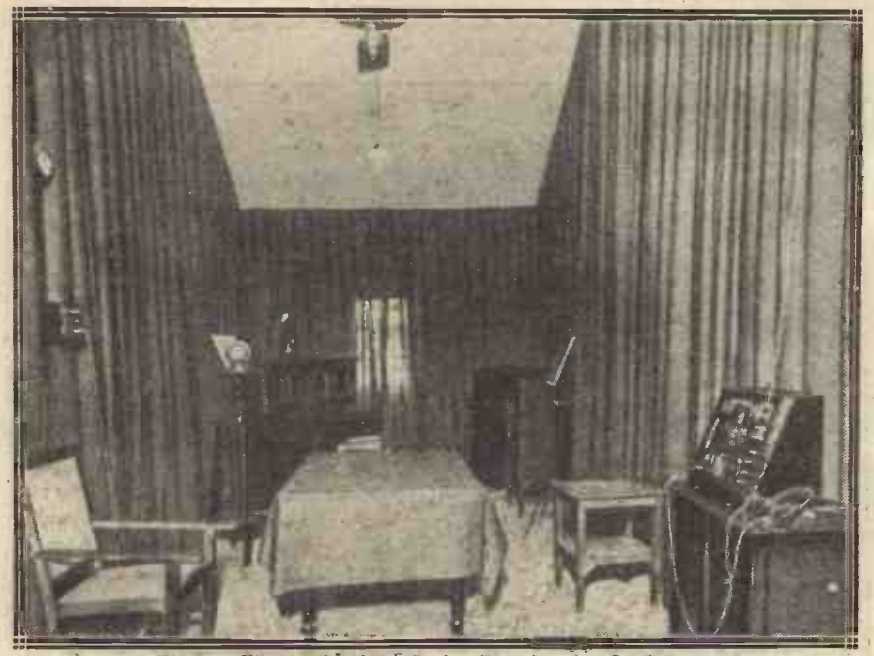


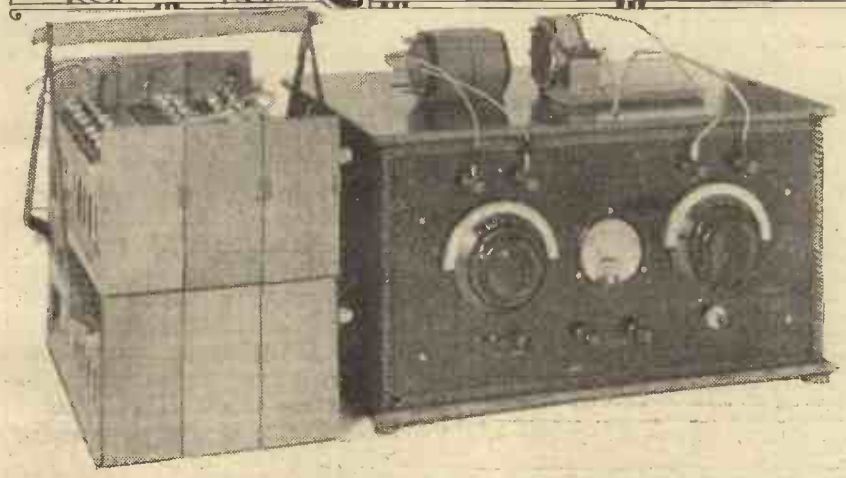
Fig. 2. The studio of the Ceylon Broadcasting Station.

Successful Results

Colombo radio station has not only provided entertainment for the inhabitants of Ceylon. Its influence has extended further than that, and the station's broadcast programmes have, without a doubt, been the means of keeping alive radio interest in India before the inception of the Indian Broadcasting Company and the completion of its stations. In a word, therefore, the triple service radio station at Colombo may be said to have performed a truly great work, and I feel sure that the reader of these lines will readily appreciate the many and varied difficulties with which this pioneer station has had to contend.

The nature of the country which the Colombo station serves is, of course, against the successful reception of broadcasting over long distances, and it speaks very well for the skill of the station designers that such success has been achieved, in spite of a number of very serious drawbacks.

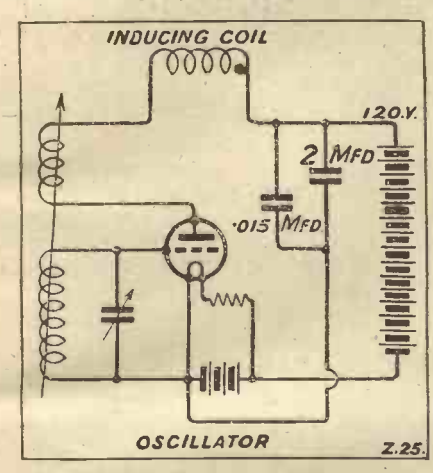
The RESISTOMETER



Full constructional details of an easily made instrument for carrying out High-Frequency Resistance Tests.

By PERCY W. HARRIS, M.I.R.E., Editor of the "Wireless Constructor"

SPENDING the greater part of my working day in the laboratory, I find it convenient to have immediately available apparatus by which practical tests of components, circuits and sets can be made as rapidly as possible. In the past and as the result of lack of proper measurements, we have had a great deal too much unconfirmed theory served up to us, for which reason fallacies current for several years are only just in process o exposure.



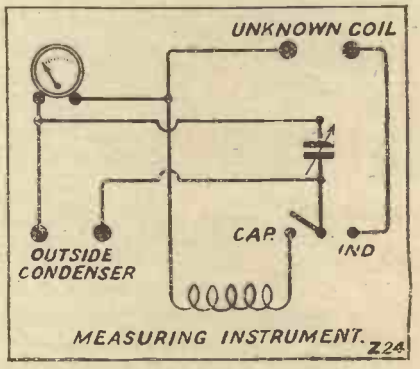
How it Operates

One piece of apparatus of my own design, I have christened the "Resistometer." Built a few months ago, as a result of careful study of the problem of H.F. resistance, it is now described at the request of many wireless enthusiasts who have tried it for themselves when visiting me. It is not a device for the beginner, but to the man who thinks out his own problems it should prove very helpful.

While H.F. resistance of coils can be measured in many ways, one of the most satisfactory is that known as "the resistance-variation method," in which an oscillatory current of the frequency at which it is desired to make the measurement, is induced in a circuit consisting of the coil to be measured, a low-loss variable condenser, and a current-measuring instrument, the radio frequency resistance of which is definitely known. The currents flowing in this circuit will vary with any variation of the resistance of the circuit.

From this it follows that if a current of a certain value is flowing in this circuit, and we increase the resistance of the circuit in any way, the current will automatically diminish.

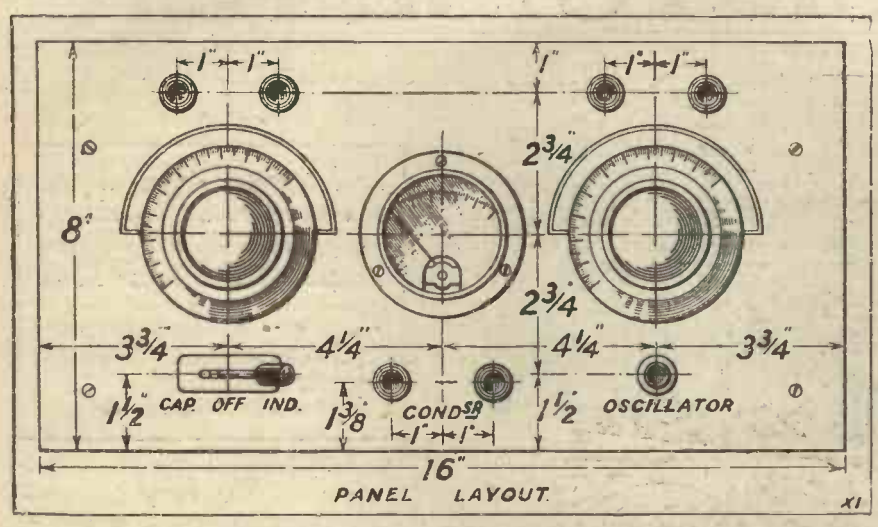
The actual method adopted in the present instrument is to instal in one part of it an oscillator, consisting of a



Note the relative positions of the coils and resistances on the top of the cabinet.

The Resistometer in use, measuring the resistance of an ordinary tuning coil.

THE RESISTOMETER—*continued*



tuned grid circuit connected to a small power valve, in the plate circuit of which is a reaction coil in series with a second coil, this latter inducing current in the circuit to be measured. The grid coil and the reaction coil are standard windings on a six-pin split primary transformer. This transformer is shielded in the conventional way by using a standard screened coil-base. Only the inducing coil is outside the screen.

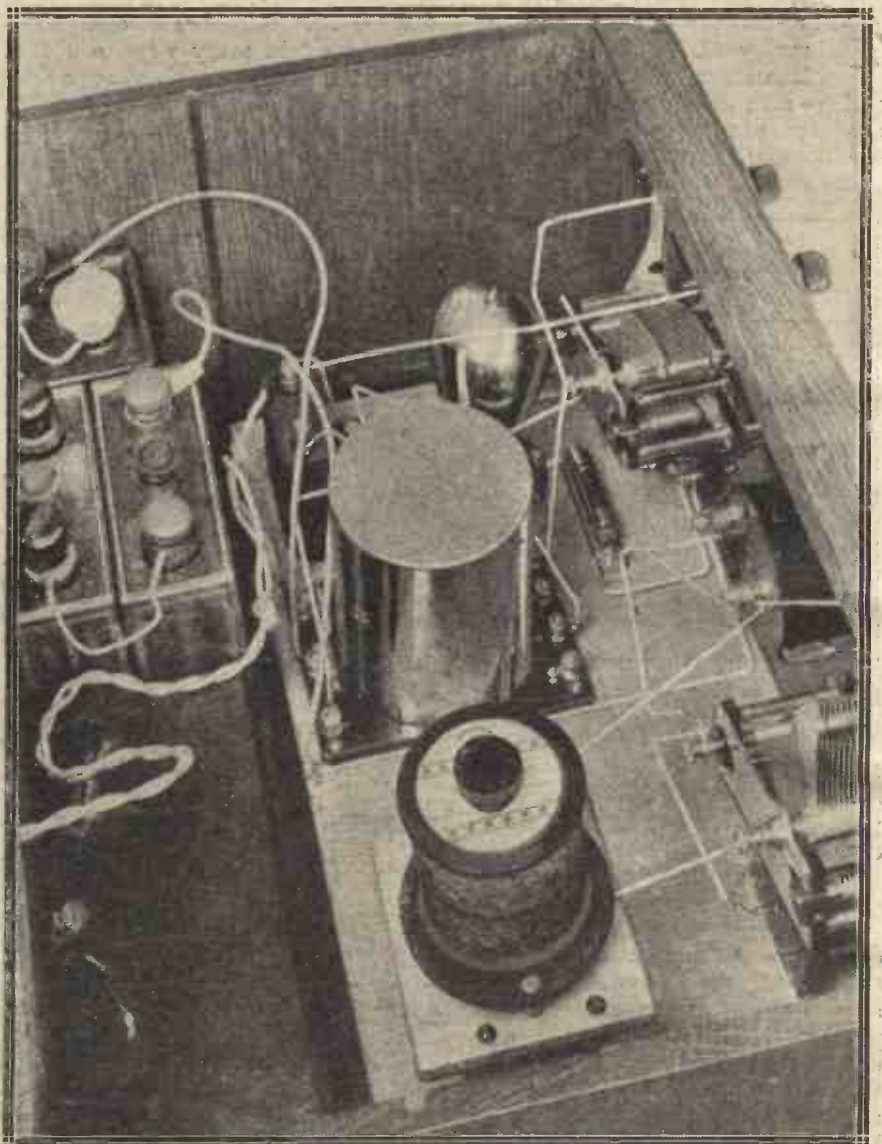
The variable condenser used for tuning the oscillator grid circuit is provided with a Burndept vernier dial and a cardboard scale, upon which convenient markings can be made.

Further Apparatus Used

The other half of the apparatus consists of a similar condenser, a change-over switch, the current-measuring instrument (of which more later), a standard six-pin split secondary transformer in base, and unscreened, and suitable terminals. In one position of the change-over switch the standard H.F. transformer secondary winding (the primary winding is not used) is connected in series with the variable condenser and the current-measuring instrument. This circuit has no valve, and consisting as it does of a fixed coil, a variable condenser and the current measuring instrument only, can be calibrated with some accuracy. At first thought it might appear that it would be simpler to calibrate the oscillator, and this can actually be done, but any change of valve, H.T. voltage, filament current, etc., will upset this calibration, whereas in the case of the other circuit the calibration remains approximately constant. At any time required it takes but a moment to bring the oscillator into resonance with the calibrated circuit.

Standard Circuit

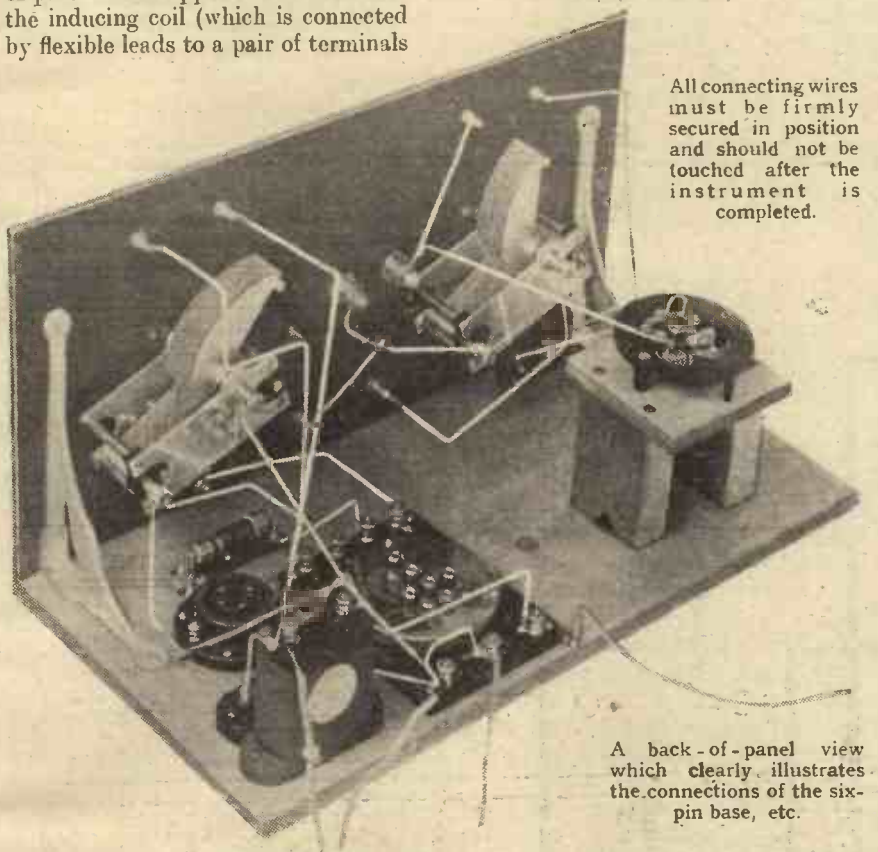
In the other position the transformer winding is cut out and connection made to two terminals, to which any outside coil can be joined. The main use of the coil inside the instrument is to provide a standard circuit which is calibrated, and whenever a test is to be made, the oscillator is brought into resonance with this circuit at the frequency desired. We thus get the benefit of a calibrated oscillator without need of worrying about valve variations.



Spacing is important in the Resistometer, and this photograph shows lay-out and connections.

THE RESISTOMETER—*continued*

In order to make this calibration easy, the mechanical arrangement of parts in the apparatus is such that the inducing coil (which is connected by flexible leads to a pair of terminals on the right-hand side of the cabinet), can be laid on the top of the cabinet lid in a marked position, and will then be coupled to the coil within the instrument sufficiently tightly to give a reading on the current measuring dial.



All connecting wires must be firmly secured in position and should not be touched after the instrument is completed.

A back-of-panel view which clearly illustrates the connections of the six-pin base, etc.

Outside the instrument is a small frame consisting of a baseboard of wood, at the back of and at an angle to which is placed a piece of ebonite carrying four terminals. Flexible leads are taken from the two lower terminals (see illustration), the two top terminals being joined behind the panel.

The Known Resistances

Between the two pairs of terminals can be joined known resistances consisting of straight wires protected by glass tubes. When the H.F. resistance of a particular coil is to be measured, the change-over switch is placed in the position which joins the exterior coil terminals to the condenser and the current measuring instrument. To one of these terminals is connected a flexible lead to the left-hand side of the frame, the flexible lead from the right-hand side of the frame goes to one terminal of the coil to be measured, while the other terminal of this coil is joined to the second terminal on the panel of the Resistometer. Current is induced in the circuit so formed by the inducing coil, and we thus have a current flowing in a circuit consisting of a variable condenser, a known resistance, the coil and the current-measuring instrument.

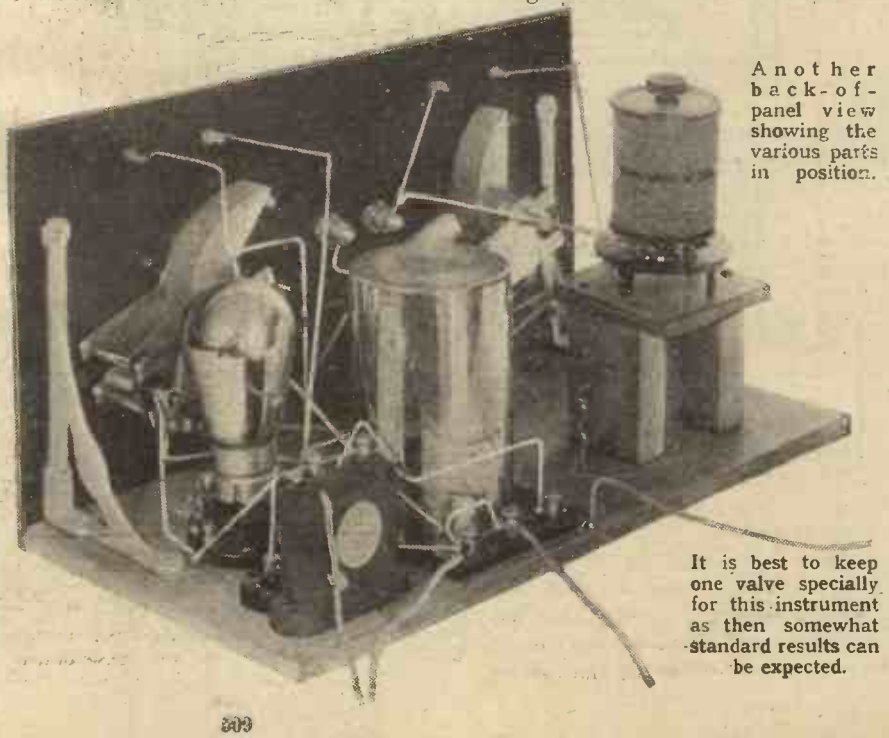
We now come to a very important point in H.F. resistance measurements. The method adopted here is, firstly, to measure the current induced in the circuit with the terminals of the frame joined with thick wires of negligible resistance, and then to substitute for these thick wires known resistances and note the reduction in current. The frame is made up in the manner shown, so that the actual dimensions of the circuit are not changed when the resistance is changed, for if the dimensions were altered, the total inductance would be changed and the readings falsified.

The Working Formula

The formula for ascertaining the H.F. resistance by this method, and when using the particular current measuring instrument specified, is as follows:

$$R_X = \frac{R_1}{\sqrt{\frac{d}{d_1} - 1}}$$

Where R_X represents the unknown resistance, R_1 the inserted known resistance, (d) the deflection of the meter in degrees when the frame terminals



Another back-of-panel view showing the various parts in position.

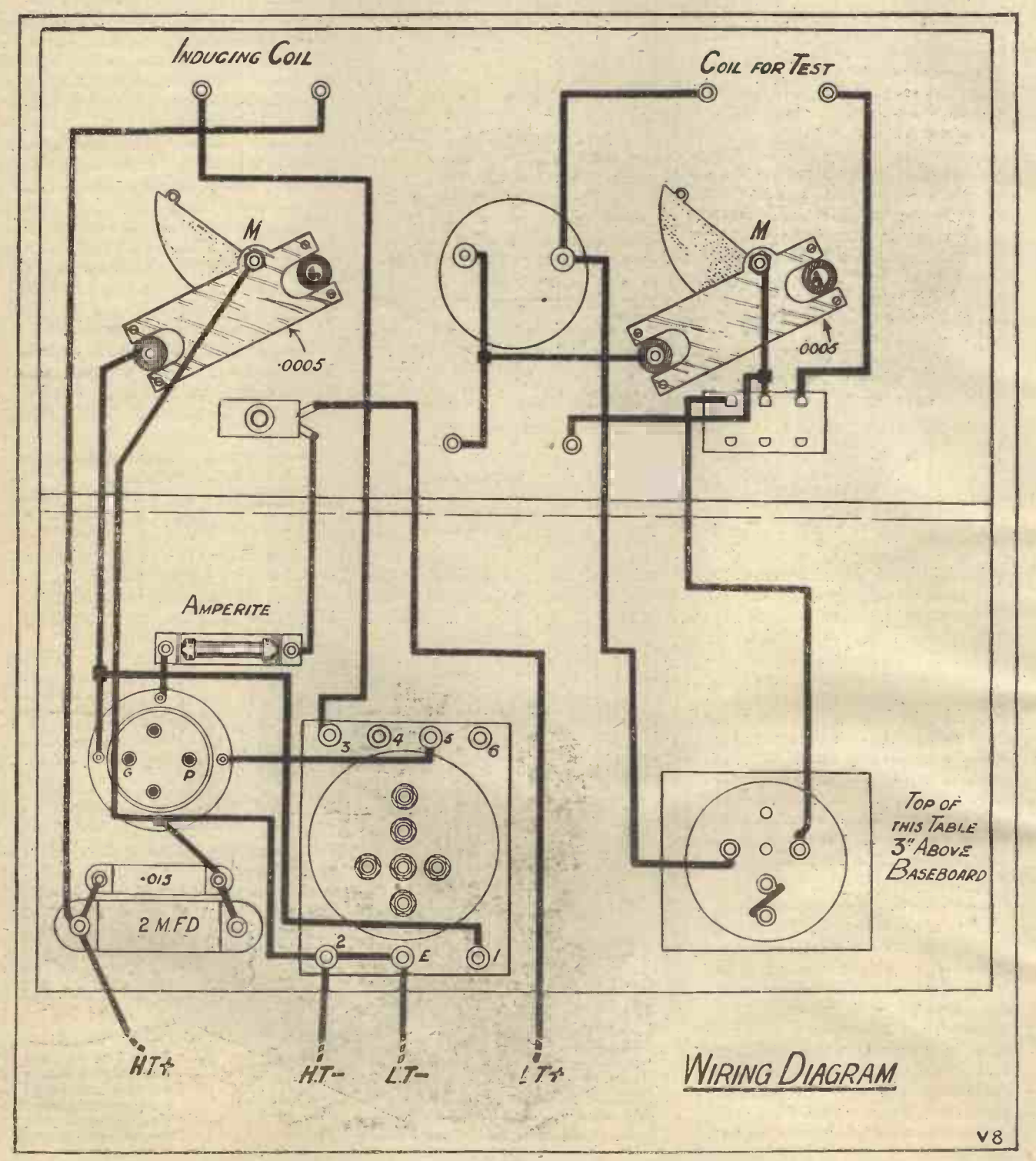
It is best to keep one valve specially for this instrument as then somewhat standard results can be expected.

THE RESISTOMETER—*continued*

are short-circuited, and (d_1) the deflection when the inserted resistance is in place.

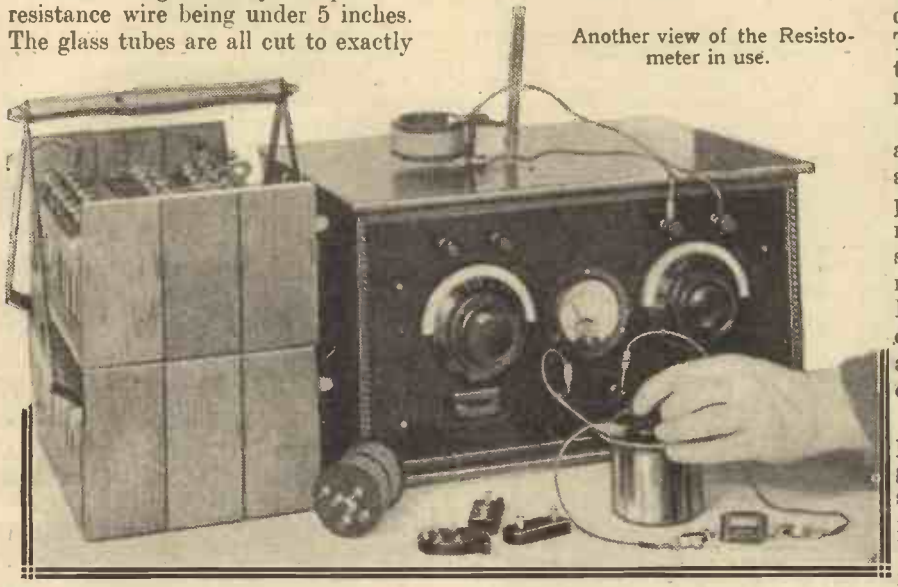
In actual practice, only one side of the frame is generally used, the other pair of terminals being left shorted by the straight wire. The object of having two pairs of terminals in series is that combinations of two known resistances may be used to give a value different from that of any one of them. The resistances themselves are made of Eureka wire of such a thickness that the H.F. resistance is within 1 per cent of the direct current resistance. For example, the resistance per inch of No. 42 S.W.G. Eureka is 1·49 ohms and that of No. 47, 5·95 ohms. I use several known resistances made up in this way, the method of construction being as follows:

First of all, several glass tubes are taken, of such a bore that they will allow No. 16 round tinned copper



THE RESISTOMETER —*concluded*

wire to be inserted, leaving a small space between the wire and the tube. Suitable lengths of resistance wire to give resistances of about 5, 10, 20 and 30 ohms are carefully soldered with non-corrosive flux to lengths of bare No. 16 tinned copper wire, the maximum length of any one piece of resistance wire being under 5 inches. The glass tubes are all cut to exactly



Another view of the Resistometer in use.

6½ inches in length and a known resistance with its two thick wires soldered to the ends is slipped into the glass tube, which is held vertically so that the actual resistance wire comes within the tube, the amount of thick wire in each end of the tube being equal. The tube is now laid on the table, and a warm, but not too hot, soldering iron held against one of the thick wires so that it warms up sufficient to melt some coloured wax, which runs into the tube between glass and thick wire by capillary attraction. When the iron is removed the wax will quickly set. The tube is then held vertically so that the weight of the thick wire at the other end will pull the resistance wire straight. The same process is then adopted at the other end and when the wax is set we have a glass tube with two strong wires at the end and the resistance wire protected.

Method of Calculation

By using different-coloured wax (I use "Glitterwax," obtainable at any toy-shop) the various resistances can be readily identified.

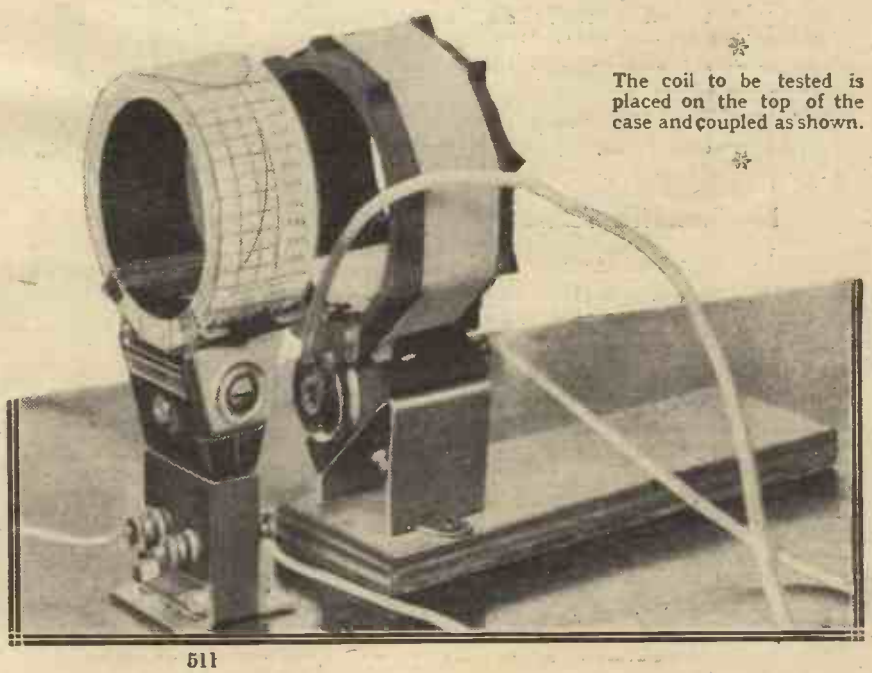
As soldering the very fine Eureka wire is a tricky matter it is better to make your resistance measurement afterwards, for it is by no means easy to solder an exact length of wire to the thicker wires. The resistance of the thick wires at the end can be neglected and once the fine wire has been soldered to two pieces, the simplest method is to measure the fine wire between the points joined and calculate the resistance from the figures given above. The advantage of having several resistances is that tests can be made and an average taken of the H.F. resistances found.

It is very important to obtain the correct meter for this instrument. That used is the Weston Thermo-Galvanometer Model 425. Its total deflection is 115 milliamperes and the readings are from 0 to 100 degrees. The radio-frequency resistance of the instrument is 4·5 ohms.

When a resistance value has been obtained from the formula, this will represent the total resistance of the condenser, the meter, coil and wiring. The coil resistance alone is required, so that we must deduct the 4·5 ohms of the meter and about half an ohm for the rest.

I do not pretend that the highest accuracy is given with such simple apparatus, but values within 10 or 15 per cent of N.P.L. figures are normally obtainable. The chief value of such tests is to place coils in order of merit, and this is very easily done. Keep the coupling between inducing coil and test coil as weak as possible and tune very carefully, as tuning is exceedingly sharp.

As mentioned previously, this apparatus is not intended for the beginner in wireless, and any reader sufficiently advanced to be able to make good use of the apparatus will be able to understand all that is necessary in constructional work from the photographs and drawings provided. In a further article, details of tests on dialectric materials, variable condenser losses, valve holders and bases and many other measurements possible with this apparatus, will be given. For the oscillator a 6-volt small power valve and 120 volts H.T. are used from an H.T. accumulator.



The coil to be tested is placed on the top of the case and coupled as shown.

RADIO ABROAD

A Monthly Feature Reviewing Wireless Progress in Foreign Lands

By a Special Correspondent

Prophecies

HUGO GERNSBACK, the well-known American radio engineer and publisher, has been giving some of his views on the probable progress of radio science, and these make very interesting reading. He thinks that in the near future condensers will be abolished from wireless sets and that tuning will be obtained either by a coil, which is extended or compressed like a spiral spring or concertina, or by means of some development of the variometer.

Another of his prophecies is the cold-valve—this to work by means of a stream of electrons given out from a radio-active substance. Apparently this idea, which has been frequently suggested, first emanated from D. Lee de Forest, the famous inventor of the 3-electrode valve, who patented the method some years ago. There are a lot of difficulties in this scheme, however, of which the chief is the fact that the electrified particles from radio-active substances are as a rule ejected with a very high velocity, so that they become uncontrollable. If anybody can find a really simple and effective way of controlling the electrons or other electrical emission from radio-active substances, this might provide a very ready means of making a cold valve.

Mr. Sarnoff's Views

Another important American who has been writing on the subject of probable developments of the future is Mr. David Sarnoff, the well-known Vice-President and General Manager of the Radio Corporation of America. Mr. Sarnoff regards the solution of the problem of "static" as one of the most important matters facing radio engineers, at any rate in America, where, of course, this interference with wireless transmission is very much more serious than in England.

Change Over from Sets

Owing to the very great popularity of battery eliminators in the States, where it is estimated that about 30 per cent. of set users have now availed themselves of apparatus of this kind for working their sets directly from the electric lighting mains, many manufacturers of sets have turned their attention to the manufacture of eliminators instead. A great impetus has been given to the making of a certain type of eliminator by the production a year or so ago of the now famous Raytheon power tube. This is a rectifying valve made specially for eliminators, and gives excellent results.

Adapting for Short Waves

The well-known Crossley Radio Corporation has lately put on the market a new unit, to be fitted to wireless receiving sets, which will permit the reception of waves from 40 to 200 metres with any type of valve-receiver. By attaching this unit to the average set it is claimed that the 5,000,000 wireless receivers now in use in the United States may be converted for the reception of short waves.

Another company, the J. M. P. Manufacturing Company, of Milwaukee, Wisconsin, is producing a somewhat similiar unit under the curious name of the "Submariner."

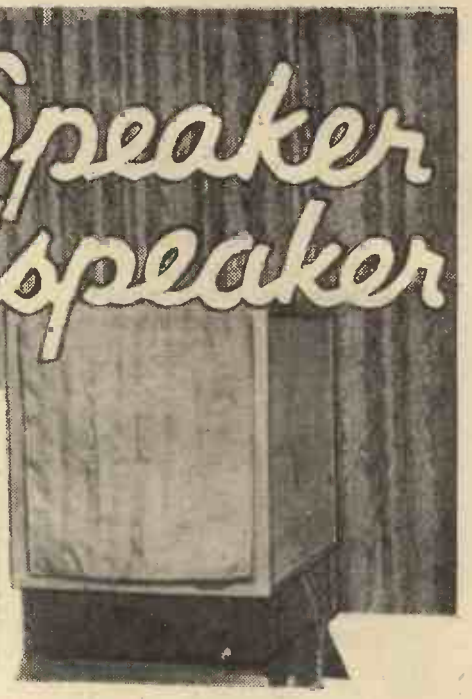
W.G.Y.'s Experiments

At station W.G.Y., which has so often been heard in England, a special staff of statisticians has been working for some time on the tabulation of thousands of reports received with regard to transmissions from stations on various wave-lengths. The tests extended over a period of eighteen months, during which time trained observers in various parts of the world sent in their reports.

(*Continued on page 556.*)

The designer of the "Summerdyne" carrying out preliminary tests with the set, which is described in this issue.

From Speaker to Loudspeaker



"The real secret of good broadcasting, and good broadcasting reception, lies in exact measurement." In this article the whole subject is dealt with clearly and convincingly by

Capt. H. J. ROUND, M.I.E.E.

THE days of trial and error and judgment by guesswork, as to whether this or that is good or bad, have gone. Quality of reproduction is one of the most difficult things in the world to judge by ear, because one has so infrequently the chance of listening first to the original and then almost at once to its replica in the loud speaker, and apparently our memories are not capable of remembering quality for even more than a few seconds.

Of course, this does not mean to say that we cannot be satisfied with something a good distance removed from the original, but I always find that I never know how bad any loud speaker is until I get a better one, unless I make some definite measurements.

Broadcasting Measurements

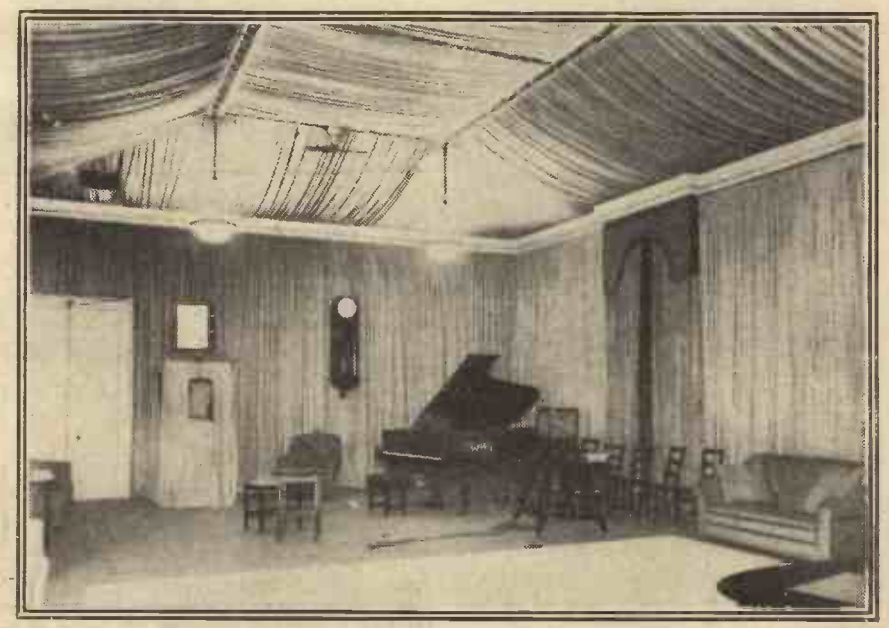
I propose in this article to indicate how some of the broadcasting measurements are made. There is no great mystery about them now. The trouble has been that some of the measurements have been extremely difficult to do with any sort of accuracy, and even now one has to be content with something within 50 per cent. very often. There is no actual need, at least in the beginning, for us to consider the wireless part of the arrangements. We can take a very simple combination such as a microphone, an amplifier and a loud speaker (Fig. 1). and with this combination we can see how the broadcasting engineer would proceed to find out whether what comes out of the loud speaker is identical with what is transmitted, and if it is not identical how he proceeds to make it as near as possible.

Let us consider the operations which will take place in the room in which the microphone is placed. The vibrations from say, a man's mouth set the air vibrating, and waves travel outward until a little tiny portion of them meet the microphone. These waves consist of air particles moving backwards and forwards with a certain speed, and the air pressure is rising and falling at a certain rate at every point where the sound is reaching. The strength of the sound is measured either by the speed of the air particles or by the rise and fall of pressure in the free air, and it has been found that in any normal sound wave in free air these two effects are always proportional to one another.

We can define the strength of the original sound in terms of rise and fall of air pressure quite conveniently, and it is quite obvious that our loud speaker at the other end of the chair must be able to reproduce this rise and fall of air pressure.

Microphone Snapshots

A speaker or singer in a studio sends out a certain amount of sound energy. This goes as a wave all over the room, some reaches the microphone directly and some by reflection, and we have no right to say that at the place in the room where the microphone is placed, the sound waves represent in pressure the total energy



One of the new studios at 2LO, showing the control box.

FROM SPEAKER TO LOUDSPEAKER —*continued*

the man is sending out. But, of course, the same thing applies when we hear anybody. At no two places in the room will we hear quite the same thing from the same source of sound.

A microphone takes a snapshot view of the sound from one particular direction, and we must be satisfied with that or some other view. That view is expanded into a new source of sound in the loud speaker, so that it will never be quite possible to really imitate the original sound.

How the different individual steps in the apparatus perform the operation does not really matter as long as the overall result is correct, but it is generally recognised that each step of the operation should preferably be a correct one.

Proportional Pressures

Thus the voltage produced by the microphone is usually made proportional to the rise and fall of air pressure; then again the amplifier is made to amplify proportionally at all frequencies and strengths, and finally the loud speaker should reproduce pressure in the air proportional to the voltage applied to the last valve. When I speak of proportionality, my meaning is that if we apply to the system an input at any one frequency then any alteration of strength must be followed by a proportional alteration of the output, and also that whatever we do to the frequency the ratio of output to input must remain the same.

We first of all want to determine how our microphone is behaving, and the most recent way of doing this is an interesting one, in that it dodges the great difficulty of measuring the strength of the sound wave when applied to a microphone. Instead of acting on the microphone with a force produced by a sound wave, a method of producing a force electrically has been devised, namely, an electrostatic method. A small plate is placed in front of the microphone diaphragm and electrostatic forces are produced at different musical frequencies on the microphone diaphragm, and then the voltage produced by the microphone is measured by means of an alternating current voltmeter of a particularly sensitive type (Fig. 2). If the action of the microphone during this experiment is beyond reproach, that is at all frequencies it behaves the same, we can assume that any other kind of force like a sound wave will be measured correctly by the microphone. Thus one link in our chain has been determined as correct, or at least we know how it behaves.

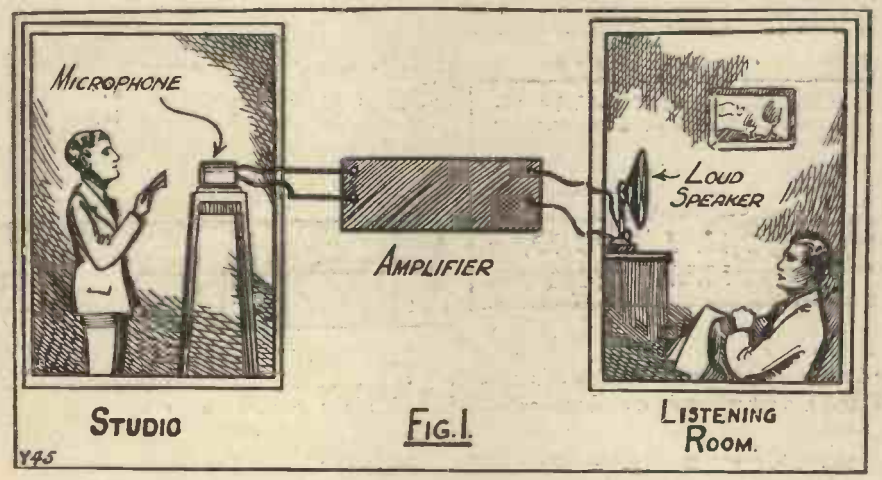


FIG. 1.

Then the measurement of the performance of the amplifier is comparatively simple. L.F. currents of various musical frequencies are put into the beginning of the amplifier and the output is again measured with a voltmeter, the result giving us the performance of the amplifier, and the only remaining thing to determine is just what is the behaviour of our loud speaker. A loud speaker produces a sound wave, and if we connect this loud speaker to its power valve and on to the grid, and in front of the loud speaker hang a microphone which has previously been tested by the method described, we can now measure the strength of the air pressure produced by the loud speaker. This will, undoubtedly, be a curve which is considerably away from the ideal, and unfortunately we shall meet with a snag in that the position in which we put the microphone to the loud speaker will, to a great extent, determine the curve we get.

The Amplifier and Loud Speaker

The best type of loud speaker will undoubtedly be one that, wherever we put our microphone, will give somewhat the same curve, and the open diaphragm type of loud speaker is considerably better than the horn type, in this particular. Even the best loud speakers at the moment on the market will give a curve nothing like as good as our microphone and amplifier. At some point in the musical scale, particularly at the low notes, reproduction will fall off, and it is interesting to speculate on whether it is advisable to

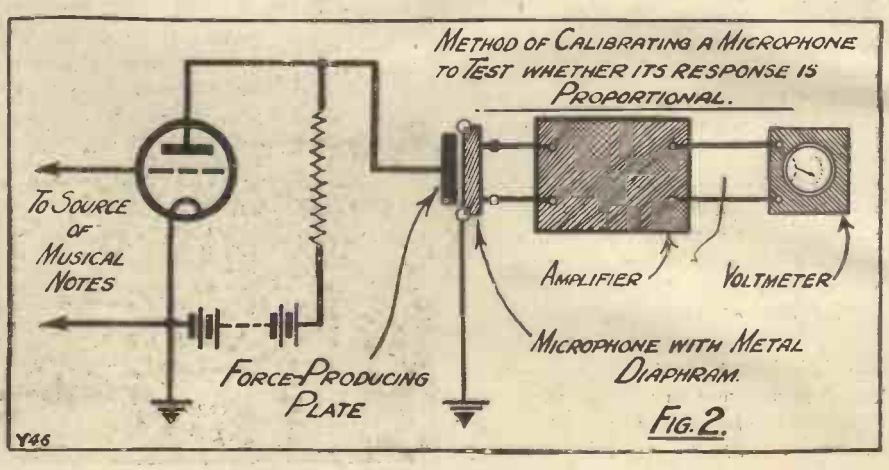


FIG. 2.

FROM SPEAKER TO LOUDSPEAKER

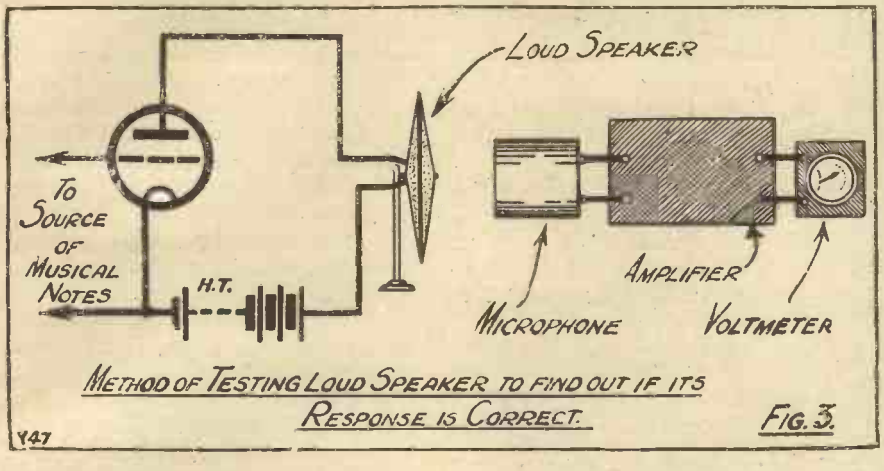
—concluded

apply a correction to the amplifier in the inverse way to the error in the loud speaker. This naturally cannot be done by the broadcasting engineer at the transmitter, because corrections for every loud speaker in England will be different, so that any correction that would have to be applied would be done at that part of the apparatus which might be considered as an extension of the microphone amplifier, *i.e.*, the receiver.

Speaker Corrections

Except in a few local cases, it is not very advisable to apply much correction to the loud speaker. If the loud speaker has a habit of exaggerating very high tones in the musical scale, condenser shunting in the amplifier is not a bad thing to do, but that is about all one could usually recommend; or it might be improved by the use of a choke coil, in parallel with the loud speaker, to improve the tone when it is boomy, but the straight path of getting each part of the circuit right is the ideal to be aimed at.

Why I have not considered the radio part of the apparatus can easily be seen. The broadcasting station consists of a microphone, an amplifier, and a modulated-wave producer. The engineers endeavour to send out a modulation which is correct. The radio part of your receiver should give little distortion, so that your L.F. may be considered merely as an extension of the broadcasting amplifier.

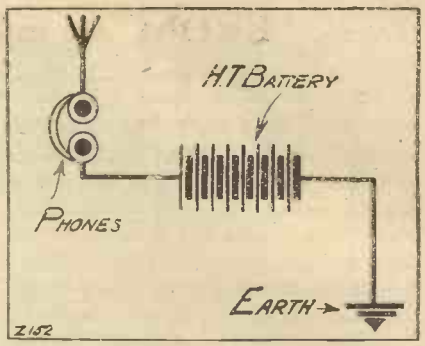


METHOD OF TESTING LOUD SPEAKER TO FIND OUT IF ITS RESPONSE IS CORRECT. FIG. 3.

A SIMPLE TEST OF AERIAL INSULATION

A good deal of the efficiency of radio reception depends upon the thorough insulation of the aerial system. But the amateur is often puzzled when he endeavours to determine whether the insulation of his aerial is as effective as it should be. However, here is a very simple and useful test for determining the degree of insulation of an ordinary aerial.

Connect the H.T. battery of a valve set in series with a pair of headphones. The free end of the battery is then connected to the earth lead of the set, whilst the other end of the 'phone lead should be touched with the aerial lead.



Under these conditions, if the insulation of the aerial system is at fault, a decided click will be heard in the 'phones at every contact of the free end of the 'phone lead and the aerial lead.

Sign of Leakage

If, however, no clicks are heard in the 'phones when the aerial lead and the free 'phone lead are brought into contact, you may be certain that your aerial system is very thoroughly insulated. In most cases a certain number of faint clicks will be noticed, but if the clicks are excessive in number, faulty aerial insulation should be suspected.

It is best to perform this test in wet weather, as under those climatic conditions the aerial insulation will be at its weakest.

Such a test with a battery and phones can be used for many things and forms a most useful rough-and-ready guide.

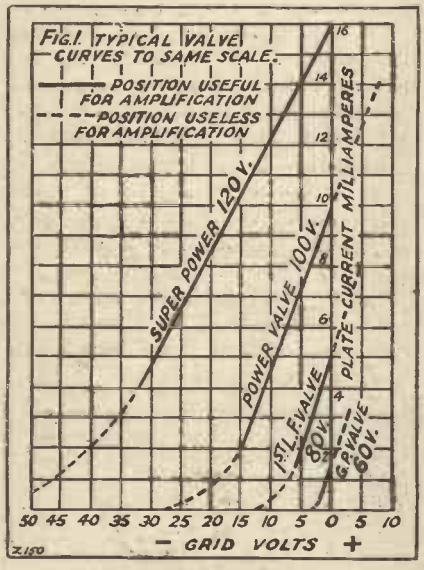
A general view of the control room at 2 L O.

ARE YOU OVERLOADING?

A great deal of the distorted reception present in loud speaker sets is due to the overloading of the valves in the receiver—a fault that can easily be avoided, as will be shown in this article.

By
R. W. HALLOWS, M.A.

ONE of the commonest causes of distortion in loud-speaker reproduction is to be found in what is known as overloading. Either the valves or the loud speaker itself may be overloaded; we shall see in a moment just what happens in either case. The symptoms of valve-overloading are fairly easily recognised; music may be good when coming in at no great strength, but directly a loud passage occurs there is a harsh blaring sound which is most unpleasant.



Distorted Speech

Overloading in the case of speech produces a curious whistling or hissing noise whenever sibilant sounds such as "S," "Sh," or "Z" are uttered. The speaker appears to have impediment in his speech which makes him say: "Let us-ssss now ssss-see ssss-something of ssss-certain as-ssss-pects of the ssss-second ques-ssss-tion." Certain high-pitched sounds, too, in either speech or music will produce effects most unpleasant to the ear.

The symptoms so far described point to overloading of the valves. If the loud speaker is also being overloaded, as very often happens, we may have further a horrid "zizzing" noise on certain notes and a hateful blurring of loud or high-pitched speech sounds and of *fortissimo* orchestral passages.

Poor Demonstrations

One is sometimes surprised to notice how many people seem neither to recognise overloading nor to mind it very much. Not once but many times I have been present when professional demonstrators, attempting to show off the good points of the wireless sets that they had for sale, were doing so (?) by getting the biggest possible volume of sound from the loud speaker without the slightest regard to quality. None of them appeared to think that there was anything at all wrong with the reproduction, though actually it was nothing short of ghastly. One meets also with just the same kind of thing in friends' houses when one is invited round to admire the performance of a new set.

It should be recognised that unless a specially designed set is made, using expensive valves with very high anode voltages and a loud speaker of a particular type, wireless reproduction cannot be quite as loud as that given by the gramophone, if quality is not to suffer. Very great signal strength combined with purity can be obtained, as you will find if you care to pay a visit to the Science Museum at South Kensington, where a special demonstration set, designed by the Development Department of the B.B.C., was installed some months ago.

It is useless to expect a small loud speaker to give the same volume as is obtainable from a large model.

ARE YOU OVERLOADING?—*continued*

Such a set can only be dreamed of by the majority of wireless enthusiasts. Actually it employs no fewer than eight valves for the reception of 2 L O only a mile or two away. Enormous chokes with values up to 400 henries are incorporated, and

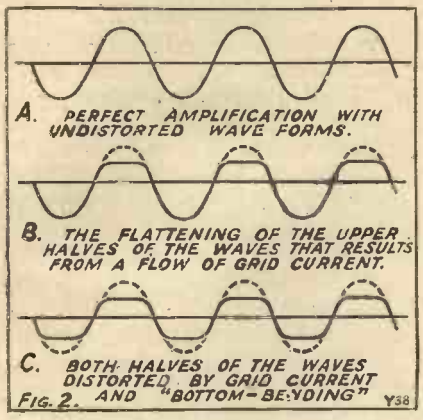


FIG. 2.

in the last stage there are two L.S.5A valves (costing £2 apiece) in parallel. The H.T. voltage is 300, and the drain on the H.T. accumulator is such that cells of quite large size must be employed.

The loud speaker is the Rice-Kellogg, which itself costs more than most complete wireless sets. It requires a heavy magnetising current from the mains. At the present time such a receiving set is for millionaires only, the average man must be content with the smaller volume of sound, but if he exercises care he can obtain reproduction that is little short of perfect.

Valve Overloading

We will consider first of all the question of valve overloading. You are probably familiar with the characteristic curves of valves of many types, you know that each consists of a straight portion of varying length with a concave bend at its lower end. If continued upwards the curve remains for some distance a straight line, but there comes a point at which it assumes a convex bend.

After that bend it becomes a horizontal straight line, the saturation point has been reached and no increase of the positive grid potential will result in a bigger plate current. Actually the ordinary grid volts-plate current curves do not tell us very much about the way in which the valve performs under working conditions. They are taken by means of grid and plate batteries which necessarily supply the D.C. potentials only; there is no large resistance in the plate circuit, and there cannot, of course, be an impedance, since direct currents are used.

Still, such curves will serve well enough to illustrate how overloading occurs; the reader must, however, remember that those referred to in the present article are static and not dynamic curves, and that I shall make no attempt to go into abstruse technicalities. The explanations given will be broadly correct, though with an impedance in the plate circuit the curves would be somewhat different in their shape at any given frequency.

Characteristic Curves

In Fig. 1 I have drawn to the same scale a set of static curves for typical valves with such plate voltages as would usually be supplied to them in the receiving set. The first of these is that of a medium-impedance valve, such as would be used as an H.F. amplifier or rectifier with about 60 volts on the plate. The second is the curve of a "first stage" L.F. valve, with 80 volts on the plate. Next comes the curve of a power valve with 100 anode volts, and lastly that of the super-power valve with an H.T. voltage of 120.

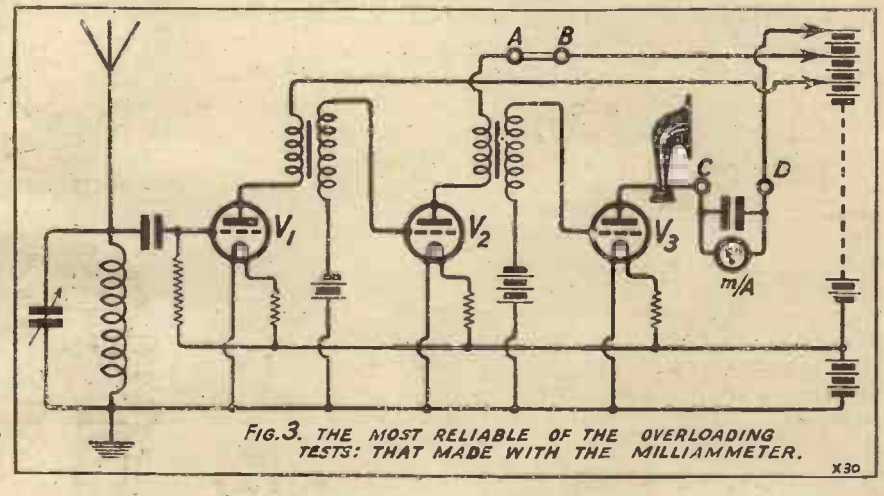


FIG. 3. THE MOST RELIABLE OF THE OVERLOADING TESTS: THAT MADE WITH THE MILLIAMMETER.

We may take it that to obtain undistorted amplification, we must always work upon the straight portion of the valve curve to the left of the zero line. There is, of course, a further straight portion to the right of the zero line, but this is useless for amplification purposes. The reason why is not far to seek. If the grid is made positive it exercises a strong attractive force upon the electrons that are expelled from the filament. So powerful is its pull that a proportion of these electrons do not reach the plate at all.

Effect of Grid Current

Instead, they are caught, so to speak, by the grid, and we thus get two currents flowing through the valve—that from filament to plate, and that from filament to grid. Now the effect of grid current in an amplifying valve is very serious. Look at Fig. 2. At A are seen the wave-forms as they should occur in the plate circuit; they are perfectly regular in shape, the crests being as much above the zero line as the troughs are below it.

When grid current is present the wave-forms are mutilated as shown at B. The lower halves are properly shaped, but the upper halves are flattened out; what, in fact, happens is that partial rectification takes pace in the amplifier, affecting the upper halves of the waves.

It is clear then that we must never allow the working point to go up to what we may call the grid current area. It is equally important that it should not go down to the bottom end of the characteristic curve. If it does so, there will be a further mutilation of the wave-forms; this time the flattening will affect their lower halves, anode-bend rectification will in fact take place. This condition of affairs is illustrated diagrammatically at C in Fig. 2.

On examining the first curve in Fig. 1, that of the general purpose

ARE YOU OVERLOADING?—*continued*

valve with 60 volts H.T., we find that the mid-point of the straight portion of the curve, to the left of the zero line, corresponds to a negative grid bias of about 1¼ volts. The greatest voltage swing that can be applied to the grid of the valve, if used as an amplifier, is just double this amount—that is to say, 2½ volts. Anything bigger will take the working point up into the grid current area or down on to the lower bend.

Adjusting Bias

In the case of the "First L.F." valve, the middle-point of the straight portion is reached with a grid bias of about 3 volts, so that the permissible grid swing is 6 volts. With the power valve we can use a bias of 7½ volts, which means that the maximum grid swing is 15 volts. The super-power valve can be given a negative grid bias of 16 volts, so that it will deal faithfully with a grid swing of 32 volts.

Overloading is very likely to occur unless care is taken when transformer couplings are used, for in addition to the amplification given by the valve we have the step-up voltage produced by the turns-ratio of the transformers. It may be taken that with two efficient L.F. transformers overloading is bound to occur with any signal of reasonable strength, unless a power valve is used in the last holder.

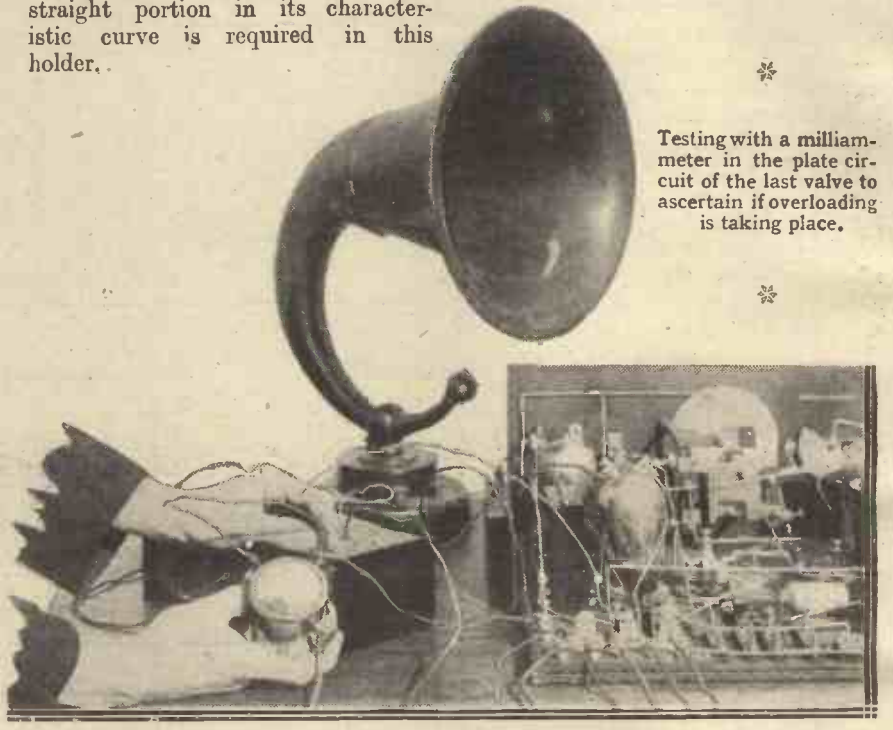
Tracing Distortion

With the resistance-capacity coupling again, where valves with a high amplification factor, such as those of several makes now on the market, are in use, one must always be on one's guard against valve overloading. Valves of the types referred to are capable of giving a voltage amplification of from 37 to 50, with a suitable resistance in the plate circuit, and this clearly means that any fairly strong signal will produce a very big swing on the grid of the valve following the resistance-capacity unit.

A good general rule is that ordinary power valves are capable, without being overloaded, of giving a volume of sound sufficient to fill a medium-sized room; to fill a larger room without a trace of distortion a super-power valve is required, and for big halls and the like, two of these are needed, working in parallel and with a high anode voltage. A general purpose valve in the last stage is insufficient for working a loud speaker, save possibly in a very small room.

Overloading occurs generally in the last valve, but it is quite possible where there are two note-magnifiers for the first to be overloaded. When this happens the results are nothing short of appalling, since the distortion introduced by the first L.F. stage is amplified and made worse by the second.

A good rough-and-ready way of testing stage by stage for overloading is first of all to tune in a signal at your usual loud-speaker strength, and then to cut out the last valve, placing the telephones in the output circuit. Try now whether any improvement in quality results from detuning a little. If it does, and if you are quite sure that your grid bias is correct, then the first note-magnifier is being overloaded and something with a longer straight portion in its characteristic curve is required in this holder.



Testing with a milliammeter in the plate circuit of the last valve to ascertain if overloading is taking place.

Should the first stage be found blameless switch on the loud speaker again with the second note-magnifier in use and try the detuning test again. Should it be found that overloading is present in the last stage, then the remedy is as before.

I made in the preceding paragraph a reference to the condition of the grid battery. There is an unfortunate tendency amongst amateurs to regard the grid battery as something that lasts for ever. Though there is no direct current drain upon it minute leakages are continually occurring, since the insulation can never be quite perfect. Further, the electrolyte within the cells dries up in course of time.

Faulty Bias Batteries

An old or faulty grid battery may therefore be at the root of the trouble if distortion through overloading is present. The voltage of whatever portion of the grid battery is in use should be taken every month or so, and it is good practice to become suspicious of grid batteries when they have been in use for more than six or eight months.

The other day I came across one in a friend's set which had been in place for three years. The grid biasing voltage was zero, and he was surprised at both the poor quality of his reception and the short life of his H.T. batteries.

The simple test for valve overloading already mentioned is a useful one; but it is not quite infallible, since an improvement in the quality will occur when signal strength is reduced if the loud speaker, and not the one, or possibly both L.F. valves, is suffering from overloading. The best test is that made with a milliammeter.

(*Concluded on page* 552.)

Choosing Your Valves

A review of the new valves of the month

By KEITH D. ROGERS

(*Asst. Tech. Editor of "Popular Wireless."*)

DURING the last fortnight I have had 14 valves sent to me—all different valves as far as nomenclature goes—for test, and I intend to devote a portion of this chat to them.

First let us deal with the three valves Messrs. Osram and Marconi sent me belonging to the 4-volt class,

The new Marconi and Osram 410 valves are similar in appearance to the valve illustrated here, having a flat plate and long filament.

and having a filament consumption of 0·1 amp. and designed for H.F., L.F. and power amplification. The H.F. (D.E.H410) has an impedance of 70,000 with a magnification factor of 40 and acts beautifully as an H.F. amplifier, and also as a resistance-capacity valve in the first stage of a resistance-coupled amplifier. It makes a good detector where a high amplification valve is required, though where transformer coupling is employed (say a 4 to 1 ratio) I should advise the use of the D.E.L410, unless the transformer has a very high impedance primary.

Successful Series

The D.E. L410 has an impedance of 14,000, and a magnification factor of 13, and should be used as first stage L.F. where transformer coupling is employed, or as a detector, as mentioned above. Owing to its curve it should not be expected to operate successfully as a last stager if powerful signals are to be handled. In this event the D.E.P410, the third of this little series, should be employed, as this is capable of dealing with greater grid voltages and acts exceedingly well as a last-stage amplifier.

Altogether these valves, both the Marconi and the Osram, are well worth consideration, and can be heartily recommended to the attention of readers.

* * *

A notable little 2-volt power valve which has just made its appearance is the Cosmos S.P.18/R.R, which embodies all the advantages of the special short-path construction with the low impedance of the super-power valve.

More R.C. Valves

The impedance is only 4,500 ohms, and the valve is capable of dealing with a large input without distortion. Priced at 18/6 it forms a valuable addition to the S.P. range, which is deservedly popular. For best results an H.T. voltage of about 100 is required, with a negative grid bias of about 6 volts. The filament current consumption is 0·3 (a little high, perhaps, when compared with some other valves) at 1·6 volts, and the anode current at 100 volts is about 7 milliamps. when biased to the best advantage—not a high value for the results obtainable. The valve has an amplification factor of 6·5.

* * *

I wonder how many more valves the Mullard people will bring out. I should think they have finished their ranges in all voltages now that the high amplification valves for the two- and four-volt classes have appeared. But with such a go-ahead firm it is never safe to conjecture. These two valves are, of course, the P.M.1A and the P.M.3A, having similar characteristics, filament currents, etc., but different filament-voltage requirements.

The 1A takes 1·8 volts, and the 3A 3·8 volts, when best results are being obtained, but I must say here that I have found with *all* high-amplification valves having mags. of 35 and over (the P.M.1A and P.M.3A have magnification factors of nearly 40) care has to be taken to avoid overloading of either the second or subsequent valves. In other words, you can use one of these valves very satisfactorily, but after that distortion is liable to occur unless a valve of lower magnification is employed.

Theory or Practice?

The makers state "for reception of the local station two P.M.1A or two P.M.3A valves may be used, followed by a P.M.2—or P.M.4——"

Well they *may*, but I personally do not like the result obtained. Use a P.M.1A or P.M.3A for the first stage by all means, but then I think you will do better to try a P.M.1 or P.M.3

The famous S.P.55R. has now a rival in both appearance and performance in the S.P.18/R.R—a remarkable two-volt power valve.

(mag. of 17) for the next valve, and then the power or super-power valve.

I should like to hear from readers on this point as to what results (from a purity-with-moderately-good-volume point of view) they obtain when

CHOOSING YOUR VALVES—*continued*

running two high-magnification valves together. I may be peculiar in my tastes, but I don't like the result, and prefer a lower value in the second stage. Incidentally I don't like the trend of development towards the 2- and 3-megohm anode resistances—they may be all right in theory, but it's *practical results* we want, and in many cases such values lead one seriously "up the garden" as to the quality if not quantity of sound.

Mullard's have turned out some very good valves indeed, and the P.M.1A and P.M.3A are not exceptions to this statement, but I hope they will not become too optimistic concerning these valves.

Go Carefully

True (as their letterpress says), resistance capacity coupling *can* "for equal amplification of all frequencies and *true rendering of tone*" (the italics are mine) be unequalled, but this is not always the case. Resistance coupling is good, but perfection is *not easily* obtained, and constructors should not *rush* in where experts have to tread gently; while such statements, though *possibly* true, are not necessarily *generally* true. I have heard some *awful* resistance coupled amplifiers even where high-mag. valves were employed, and especially where 3-megohm anode resistances were in use. Let's forget theory a bit and deal with practice—*average* practice.

Another addition to the Ediswan 5-volt family, characterised by the P.V.5, is the E.S.5, a valve which has an entirely new internal design.

Resistance amplification is *not* foolproof, so it's no good pretending it is, and that you have only to wire up certain valves and certain resistances to get certain results. You'll get results, but they won't be by any means *certain*.

And now, in case it may be thought I am sceptical about the results obtainable with the two valves under discussion, may I offer this advice: By all means use these valves, they are good ones, but give them a fair chance by using a reasonable circuit and not expecting them to do miracles.

* * *

Of the other valves I have received, I may say the S.T. 21A and 41A are excellent, but as they have somewhat similar characteristics to the Mullard valves just mentioned, nothing further need be added.

A New Design

A valve that deserves special mention is the Ediswan E.S.5, which is really new. It has *two* grids and *two* filaments, each in series with the other, and a more efficient control of emission is claimed. Whatever the claims are, the E.S.5 H.F. is an excellent valve and it has ousted an H.F. valve I was using—my pet H.F. it was, too—in a set, as well as taking the place of a good 2nd stage resistance coupling valve I had used for some time. For both H.F. and resistance coupling (2nd stage) the E.S.5 H.F. can be thoroughly recommended. Together with the E.S.5 L.F. (both taking 5 volts. 0·1 amp.) it makes a good detector, and though I prefer the H.F. valve on the whole, especially if a high impedance transformer is placed in its anode circuit, the E.S.5 L.F. must not be forgotten.

This latter valve makes a better detector than amplifier, in my mind, and as an amplifier it seems to lack "punch." The impedance is 10,000 ohms and the magnification factor 7, so it ought to be all right; but there *is* a little something or other missing which would make all the difference between a good valve and one that could be described, like its brother the E.S.5 H.F., as "excellent." The E.S.5 H.F. has, of course, a mag. of 20 and an impedance of 30,000 ohms—two useful figures.

A Peculiar Valve

The latest addition to the valve world is a new form of the S.S.9 (20,000 ohms and magnification factor of 20), a well-known H.F. and detector valve. It consists in placing this valve totally inside another vacuum so as to eliminate microphonic troubles. Why this is done I don't know, because I've never found the S.S.9 to be microphonic, but the idea is novel and very interesting.

The construction, briefly, is as follows: The valve proper is placed inside an outer glass envelope and supported therein by shock-absorbing material. The space between the outer bulb and the valve proper is evacuated; thus preventing any transfer of sound vibrations from the outer bulb to the valve itself, so that the valve proper is entirely insulated by a vacuum.

The new S.S.9T does not look anything like the other S.S. valves being nearly twice the width and of very unusual appearance. It is discussed in these columns.

"Sound-Proof"

This new type, known as the S.S.9T, is claimed to be the only *entirely* non-microphonic valve which has ever been produced, and it is said to be impossible to make these valves howl even after five or six stages of L.F. amplification, which is solving one of the most difficult problems of the present-day receivers.

Why this should be brought up as a triumph of valve design I do not know, as it is not often that one requires five or six stages of L.F., and even if one did, "howling" would not be likely to be caused through microphonic troubles. Or rather the absence of microphonic tendencies would not ensure against L.F. howling.

The makers add that external shocks and the impinging of the sound waves from a loud speaker going "all out" do not affect the S.S.9T, which is certainly quite true.

In operation and characteristic the S.S.9T is, of course, exactly the same as the S.S.9—it is only an S.S.9 with a special "lid on," so to speak.

I have received a letter from "a dozen 2-volt users" saying that nowadays the 2-volt valve is being largely neglected in favour of its

(*Continued on page 558.*)

DO YOU GET LOST?

A helpful article for the distance-getter, showing how he can calibrate his receiver to enable distant stations to be tuned in with speed and accuracy.

From a Correspondent.

QUITE a number of the wireless enthusiasts that I know are completely at sea when one suggests the picking up of a station the actual condenser settings for which are not known. Others again find it very difficult when handling two or more tuned circuits to search upwards or downwards, starting from a given wave-length. The chief reason is that it is often not easy to keep the tuned circuits in resonance with one another unless you have something to help you in the process. With a wave-meter matters are fairly simple, but it is still better to make the set itself into a wave-meter by calibrating one of its tuned circuits. This, as we shall see, is usually a very easy matter.

Many Advantages

The advantages of calibrating a tuned circuit in the receiving set are very great indeed. In the first place, you can tune that circuit instantly to any desired wave-length by reference to the chart. This means that when you desire to find a given station all that you have to do is to set the variable condenser of the calibrated circuit at the reading indicated and then to adjust the other circuit or circuits until the signal is heard. You know, anyhow, that *one* of your condensers is properly set; as soon as you bring the other one or two tuned H.F. circuits into resonance with it the desired station will be heard, provided that it is within the range of your apparatus—and, of course, that it is transmitting at the time. Again, when you have tuned in a station with a calibrated receiving set there is no need to spend a long time in waiting for the call-sign. By noting the reading of the calibrated circuit and referring to the chart you can discover what the wave-length is, and this will enable you to identify the station without delay.

In many receiving sets employing square-law or straight-line wave-length condensers it is not difficult to make them read very nearly alike over a large portion of the scale, though tuning the grid of the first valve, to which the aerial is coupled, may give different readings from the others. Tune in a station about the middle of the broadcast wave-band—2 L O is very useful for the purpose—leave the dial of the circuit that you have calibrated or intend to calibrate, and loosen the screws of the others. Adjust these until all give the same reading for 2 L O, then tighten up again. As a rule, you will find that there is no great difference between them now when other

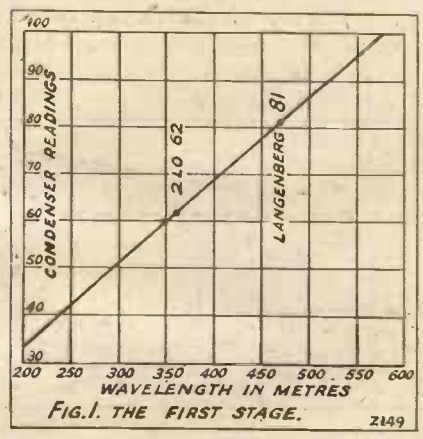


FIG. 1. THE FIRST STAGE.

stations are tuned in. If, however, you cannot make them work together you can make simple calibration charts for each condenser or can draw more than one curve on the same chart.

A Suitable Circuit

The circuit selected in the first place for calibration should preferably not be one in which loose coupling is employed. In a grid circuit to which the aerial is loosely coupled or to which reaction is applied magnetically by means of a swinging coil considerable variations in the wave-length may be caused simply by varying the coupling and without touching the condenser at all. If from necessity a loose-coupled circuit may be used for the purpose, then the coupling must be fixed during calibration and you must be able to return precisely to the adjustment then used when you wish to employ the set as a wave-meter. With swinging coils this can be done by cutting out a cardboard wedge which fits exactly between the coils when they are in the right position.

A Rough Chart

Most receiving sets to-day have either straight-line wave-length or straight-line frequency variable condensers. With either of these calibration is a simple business; with the former, it must be done in metres; with the latter, in kilocycles. Let us see, first of all, how to deal with the square-law type, which gives a regular increase or decrease in the wave-length as its dial is turned. Procure from any stationer who deals in educational supplies a school exercise-book whose pages are ruled off into squares for graph-making purposes. On the left-hand side of one page mark off a vertical scale corresponding to condenser readings—either 100 divisions or 180 degrees, according to the nature of your dials. Along the lower edge mark off wave-lengths in metres from, say, 300 to 500. It is not as a rule, of much use to calibrate a condenser below about 30 degrees, for after this point is reached few variable condensers are particularly efficient, and many are no longer "straight-line."

Fig. 1 shows how the chart is marked off. Now tune in your local station, whatever it may be. We will suppose

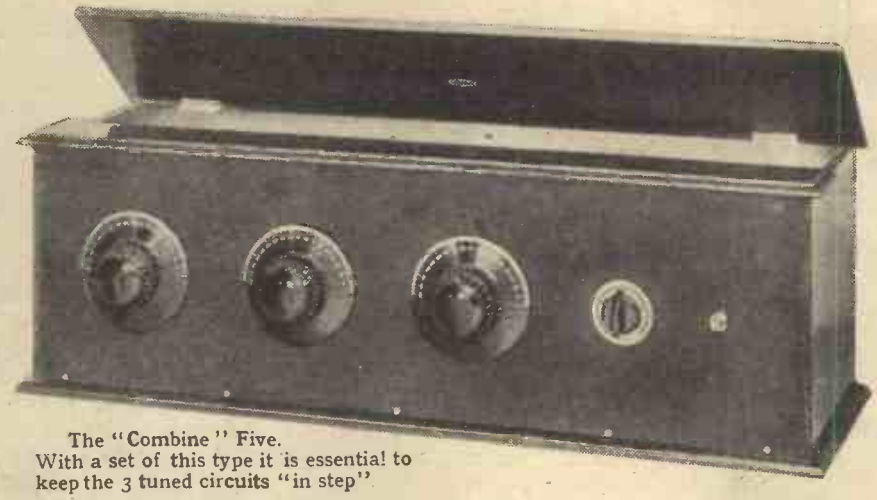
DO YOU GET LOST?—*concluded*

for a moment that this is 2 L O, and that the condenser setting is 62. Place your pencil on the vertical line which corresponds to 360 metres and run it up until you arrive at the crossing between it and the horizontal line corresponding to 62 on the condenser. Move a little to the right, since 2 L O's wave-length is not 360 but 361·4 metres, and make a dot. Next tune in Langenberg, the easiest of all foreign stations to find, and make another dot on the horizontal line corresponding to the condenser reading (which I have taken as 81) and a little to the left of the vertical line corresponding to 470 metres, since Langenberg's wave-length is 468·8 metres. Lay your ruler with its edge upon the two dots, join them, and produce the line in both directions. You now have a rough-and-ready calibration which will enable you to determine the approximate settings required for all wave-lengths within the limits of the coil and condenser in the tuned circuit.

The Final Calibrations

Armed with this, proceed to tune in as many other stations as you can. Do not be in a hurry to get the whole thing finished in one evening. The more stations you tune in and the more carefully you record your settings the more accurate will be the finished chart which you eventually make. Whenever you pick up a station, home or foreign, make a corresponding dot on the chart, and write in the name of the station and the setting required.

The first chart made is only a rough-and-ready affair whose purpose is to help to determine the limits to which the circuit under calibration will tune, and to give one a guide of some kind for picking up more stations. The finished chart, which is seen in Fig. 2, is much more elaborate. On it the vertical edge of each small square corresponds to the condenser scale degree or division, and the horizontal edge of each small square corresponds to only one metre. Now to draw in one straight line a graph on this scale covering 360 metres would require a piece of squared paper a yard in width. Made in this way the chart would be most unwieldy. We get over the difficulty in the way shown in Fig. 2 by making the graph in a series of sweeps instead of in one long sweep. The actual size of the chart illustrated in the drawing is only 7 inches by 9. The first portion of the line takes us from 200 to 290 metres, we then go back to the left-hand edge and move upwards to 380 metres. The next portion goes from 380 to 470 and the last from 470 to 560. If a piece of graph paper with ten large squares can be obtained this is very convenient, since each "step" of the calibration line corresponds to exactly 100 metres.



The "Combine" Five.
With a set of this type it is essential to keep the 3 tuned circuits "in step"

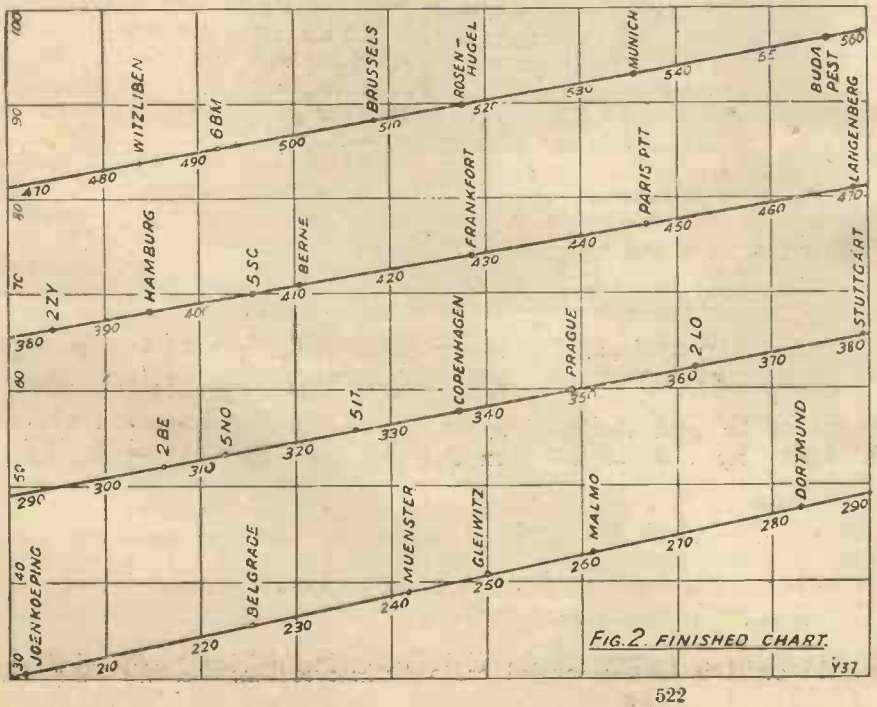


FIG. 2. FINISHED CHART.

Accurate Wavemeter

You will find as you fill in stations on your first rough-and-ready chart that not all the dots lie exactly on the original ruled line. It may, in fact, happen that owing to slight inaccuracies in taking the first two readings the position of the line must be slightly altered. Again, it is quite possible that the line will not be a dead straight sweep between, say, 30 and 90 degrees. As more and more stations are tuned in and recorded the exact path followed by the line will be discovered and the business of making the finished chart can then be undertaken. When the work is done accurately and the tuning of the set is sharp, the final calibration is wonderfully precise. With one of my calibrated sets I have no difficulty in reading wave-lengths to half a metre.

PUTS POWER INTO YOUR SET

YOUR valves and loud speaker have real power and clean smooth-flowing energy behind them if you are using a LISSEN New Process H.T. Battery in your set. This strengthens the electronic emission of each valve and makes volume bigger, loud-speaker tone fresher, and reproduction smoother and more life-like than you have ever known it before. The power of the LISSEN New Process Battery never lessens, even under the drain of the longest programme.

Before marketing the LISSEN New Process Battery we introduced our new policy of direct-to-dealer distribution. This cut out all wholesalers' profits and we were able to put the battery on the market at 10/6. Not satisfied with this, the next step we took was a very bold one. We cut down our own profits on this battery and asked our retail friends to take less profit also. We then drastically cut the price of the battery to 7/11. This battery then became the best value-for-money battery available, and the response from the buying public was so overwhelming that we had to discontinue advertising. Trade orders were cut down in every direction. Strenuous efforts for the past few months have enabled us to overtake arrears. Trade orders are now being executed in full and you should be able to get the LISSEN New Process Battery from any good dealer. If you have any difficulty, send direct to the factory; no postage charged, but please mention dealer's name and address.

7/11

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66 volt. Size 9½ by 3½ in.

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Managing Director - THOMAS N. COLE

L 324

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.

Attacks on the B.B.C. Monopoly

ATTACKS on the B.B.C. monopoly have beome fashionable. The other day Sir Oswald Stoll declared his intention to start a broadcasting service on behalf of the music halls. The argument that, in order to eliminate the baleful effects of broadcasting on the music halls,

Sir Landon Ronald, the famous conductor, is a firm upholder of broadcasting.

it was necessary to increase it, was perhaps difficult to swallow. But there it was. Then came the challenge of Secret Wireless, Ltd. first disclosed in "Popular Wireless." This was to relay programmes from music halls over electric light wires. Both schemes have been accompanied by the customary intensive propaganda against all monopolies in general, and that of the B.B.C. in particular. The effort is, of course, entirely wasted. The Post Office will take good care to safeguard the B.B.C. monopoly for the ten years of the licence. The protagonists of competitive broadcasting are about two years late. The time for their big effort was before the Crawford Committee had reported. Had they acted then with anything like the ability displayed by the old B.B.C., then they might well have been allowed at least a limited measure of competition. By the way, there is one aspect of the Secret Wireless campaign which has failed to attract the attention it deserves. That is the suggestion of an arrangement with a newspaper group prepared to contract-out of the agreement made with the B.B.C. for the news bulletins this year. This agreement prevents the B.B.C. giving news earlier than 6.30, limits both the supply and the occasions when news may be given after 6.30, and specifically prohibits betting news. Secret Wireless, Ltd. apparently contemplate developing just the kind of news which the B.B.C. is prevented from radiating. Thus red-hot news, at all times of the day and night, together with frequent bulletins of betting odds, would certainly make the new service attractive. It would be interesting to see whether, in the event of this stunt "coming-off," the B.B.C. would regard it as automatically invalidating the agreement which restricts their news activities.

The Elgar Festival Fiasco

The general public will share the disappointment of Savoy Hill and of Sir Landon Ronald at the unfortunate collapse of the negotiations for a three days' festival at the Royal Albert Hall, in June, in honour of the seventieth birthday of Sir Edward Elgar. Apparently Sir Landon Ronald and Mr. Percy Pitt, acting together, had hoped to give this festival the character of a surprise tribute to the great British composer. Sir Landon had begun negotiations for the hall, and it looked as if all was well. Then suddenly Mr. C. B. Cochran gave an interview to the Press in which he criticised the B.B.C. for their meanness, and suggested that the hall would not be available for the festival had it not been for the intervention of Sir Landon Ronald. The general unpleasantness that ensued no doubt reached the ears of Sir Edward Elgar, who immediately wrote to Sir Landon Ronald and Mr. Percy Pitt, stating that he would not participate in the festival nor recognise it in any way, and asking them to cancel it. In the face of such a strong remonstrance the only course open was cancellation. Thus came to an end what should have been a well deserved public tribute to a great British composer. What will happen now is a special studio performance of Elgar music on June 2nd, his birthday. The B.B.C. have maintained silence apart from a brief statement of the fact of cancellation;

(*Continued on page* 526.)

Mr. C. B. Cochran, the well-known producer.

MY BROADCASTING DIARY—*concluded*

but they are naturally not overjoyed. It would appear probable that there is some misunderstanding between Mr. Cochran and the B.B.C. This should be timed to follow on the various other little rows that are now fading out.

The "Daily Mail" Week

The B.B.C. programmes for April 24th–31st were an attempt to interpret concretely the results of the Broadcast Ballot conducted by the "Daily Mail." There was about 150 minutes less talk than in a normal week. There were nearly six hours of variety and concert party items, a good deal too much in relation to the limited talent available. The general impression of the week was that the reduction of talk time was a great improvement. There was, also, a certain lack of dullness about most of the programmes.

"Dick" Sheppard for the B.B.C?

Now that the Rev. H. R. L. Sheppard, C.H., has definitely relinquished St. Martin-in-the-Fields, there is a revival of discussion of the idea that he should be given an appointment of some kind at Savoy Hill. The proposal now is that the religious part of broadcasting should be devolved from the general arrangements for talks, and a new department set up to consist of "Dick" Sheppard, in charge, assisted by the Rev. H. W. Fox, D.S.O., who is the present official sermon critic to the B.B.C. That the ever-popular "Dick" Sheppard should be permanently linked with the B.B.C. is a highly attractive proposal, and one which would be universally popular.

The B.B.C. and Exhibitions

The success of the B.B.C. exhibit at the Ideal Home Exhibition has induced the Savoy Hill people to keep the models together, and to organise a regular Exhibitions Section of the Information Department. This is in charge of Mr. Clarke, formerly Station Director at Stoke-on-Trent, who will tour the country with his show. People are keenly interested in the demonstration of the three grades of reception; but many feel a grievance at not being told more about how the sets may be made. The B.B.C. are naturally careful to avoid specific recommendations that would give certain competing trade interests an unfair advantage over their rivals. Nevertheless the demand of the listening public for a more definite lead from the B.B.C. in this matter of reception is becoming so clamant, that something will have to be done soon to satisfy it. There is nothing in the Charter or licence to prevent it.

B.B.C. Revenue

The trickiness of statistics, particularly those of the Government variety, has rarely been more clearly emphasised than in the case of the deduction from Post Office figures which made the B.B.C. revenue for 1927–28 £50,000 less than for 1926–27. The facts are opposite. There is available, this year, more than £70,000 more than was available last year. The totals are misleading, because in last year's accounts there was the considerable sum required for the liquidation of the company. The B.B.C. revenue from licences for 1927–28 will be in the neighbourhood of £805,000, with about £80,000 from publications. It is little enough for the task to be carried through; but it is unfair to the Post Office to suggest that they are sitting on more this year than last.

A recent photograph of "Dick" Sheppard

The latest studio (No. 7) at Savoy Hill, like its predecessors, employs draped walls and ceilings, echo effects being obtained by means of a special "echo" room.

The Trade Committee on Broadcasting

Mr. McKinstry, the energetic chairman of the new Trade Committee on Broadcasting, has already made the views and influence of his Committee felt at Savoy Hill and at the Post Office. They are anxious to speed up alternative programmes, and simultaneously to secure a general diminution of talks. With still another formidable antagonist of talks in the field the B.B.C. will be hard put to it to avoid the revision of talks policy demanded so widely. There will probably be relaxation, but no radical reduction. Indeed, the publication of the report of the National Union of Teachers on broadcasting as an aid to school-teaching seems to have given the talks merchants at Savoy Hill a new lease of life.

Ormond's latest triumph

—*surpassing all previous records of Condenser design!*

When Ormond produced their Standard S.L.F. Condenser they attained a triumph that alone was enough to ensure the endurance of their reputation. But with the eagerness of enterprise they aimed at even greater achievement. The result transcends anything previously accomplished, as you will readily admit if you examine the new Ormond "No. 3" S.L.F. Condenser at your dealer's.

THE NEW ORMOND "No. 3" S.L.F. CONDENSER

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An Adjustable "Earth"

The importance of an efficient earth contact cannot be over-estimated. This article describes an ingenious method of ensuring a good earth connection.

By O. J. RANKIN

EVEN in these enlightened times there is no available earthing device which might be considered a marked improvement on the orthodox plate, tube, or spike. What is wanted is a simple plate, or a series of plates, which can be *pressed against* the earth by mechanical means. In this way we could expect to get a much better contact than is usually obtained when the plate is simply buried, or otherwise when we have to rely upon a mere gravity contact.

Fig. 1. The complete adjustable earth.

I have conducted a few experiments with devices embodying the above idea, and the results have been most gratifying.

Positive Contact Made

In the present example the device is arranged so that the plates (there are four) may be expanded if necessary in order to take up any shrinkage of the surrounding earth, the adjustment being conveniently made by means of a simple screw movement. In effect the amateur is able to feel the contact being made between the plates and the earth, in very much the same way as he would feel a terminal nut "going home" over the end of a connecting wire.

It may be well to mention that I do not wish any reader to imagine that the device, as presented, has been developed to perfection. As a matter of fact, it is *not* perfect: that is just the reason why I am "putting it through" to any experimenter who may happen to regard it as a proposition worthy of further thought and development. Experimenters may therefore appreciate the fact that the idea offers much scope for their inventive faculties.

Constructional Details

The general arrangement of the device will be easily understood by referring to the photographs, Figs. 1, 2 and 3, and the sketch, Fig. 4. An inverted square metal cup, which we will call the cap, is joined to the top ends of four zinc plates by means of brass hinges and copper rivets, each plate being about 9 in. long, 4 in. wide at the lower end, and 1½ in. wide at the top end. Thus the hinges should be 1½ in. long. The cap is made from a square piece of stout sheet zinc which is cut as shown on the left of Fig. 5, bent to right angles at the dotted lines, and well soldered at the corners, one side of each hinge then being riveted to the inside walls in the manner shown on the right. The hole in the exact centre of the cap is fitted with a large brass bush which is soldered over one end of a 20 in. length of brass tubing. Inside this tube slides a 30 in. length of round brass rod which is threaded at one end to a depth of 7½ in., and fitted at the other end with the expander, the arrangement of which is shown in Fig. 6, and also in Figs. 2 and 3. Over the tube is placed a length of thick rubber tubing, the top of the tube being externally threaded and fitted with a brass collar which is provided with some suitable means of making the connection to the earth lead of the set.

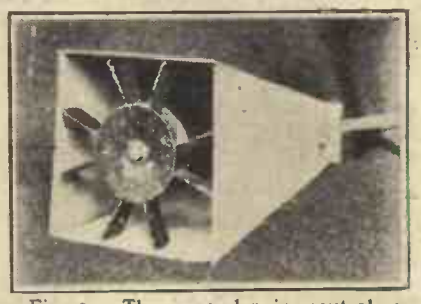


Fig. 2. The expander in neutral or "closed" position.

The four plates are connected to the lower end of the brass tube via stout flexible leads, the upper ends of which are soldered to the four arms of a multiple tag clamped under the nut of the bush (*see* Fig. 7), and the lower ends soldered into small holes drilled in the plates. At the same time small brass caps (taken from old battery carbons) are filled with solder and soldered over the holes in order to protect and strengthen the joints.

A glance at Fig. 4 should now make the idea quite clear. The rod is passed up through the tube, and the expander is set as shown in Fig. 2, so that the plates are closed. A suitable terminal is fitted to the collar on the top end of the tube, the projecting end of the rod then being fitted with a threaded

(*Continued on page* 530.)

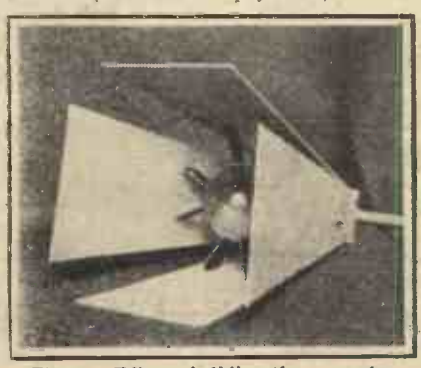


Fig. 3. Effect of sliding the expander upwards.

AN ADJUSTABLE "EARTH"—*continued*

handle which, in the present example, is made from part of an old water tap. (*See* Fig. 8.) The complete device is then buried as shown on the left of Fig. 4, the base of the prepared hole being made quite flat, and the earth well pressed down all round the four plates. A few clockwise turns on the handle will then lift the rod and the expander, so that after burying the device one may make such an adjustment, taking, say, six or eight turns, in order to expand the plates to the approximate extent indicated in the centre sketch in Fig. 4. The right-hand sketch is intended to give an idea of the approximate positions of the plates when the handle has covered rather more than one half of the threads on the rod. Adjustments, after setting the device as in the centre sketch, should of course only be made when absolutely necessary.

Three Points Considered

The design of the expander (Fig. 6) presented a few difficulties, and its construction also called for a little patience. The blades were first soldered into slots cut round the periphery of a thick brass disc, which afterwards proved to be too small in diameter to take a sufficient portion of each blade; and, to avoid making another hub, the blades were reinforced with stout metal discs as shown. In designing the expander the following points were considered: (1) the possibility of loose earth falling between the expanded plates and forming a solid mass between the

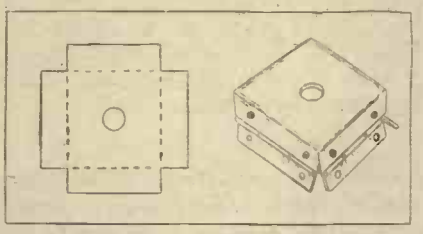


Fig. 5. The dimensions and method of cutting the cap is shown above.

expander and the cap; (2) the necessary self-alignment of the expander (the device, already sufficiently complicated, must work without special guides or runners for the blades); and (3) the method of arranging the ends of the blades so that they would be parallel with the plates at any point within the travel range of the expander.

Feature No. 1 was considered first and foremost, and it was thought that by arranging the expander in skeleton form, with blade-arms, not only would any possible loose earth fall between the blades, but in the event of binding caused by masses of earth too large to pass between the blades, the blades would cut through same, thus avoiding any trouble in this direction. Difficulty No. 2 was overcome by arranging the blades in pairs, and by "spreading" their outer ends so that if the device was properly packed round with earth, the spindle and the expander could not possibly turn when adjusting the handle. In view of the progress already made, and of the general simplicity of the arrangement, consideration No. 3 was abandoned, otherwise it would have been necessary to introduce complications; for if the ends of the blades are set parallel with the plates when the expander occupies the neutral position, as in Fig. 2, it is obvious that the angle will vary considerably when

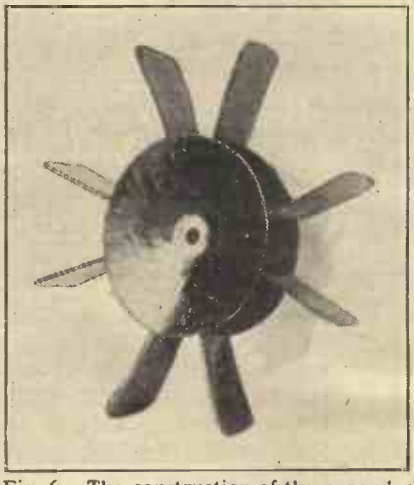


Fig. 6. The construction of the expander can be seen from this illustration.

the expander is adjusted towards the position shown in Fig. 3.

Another Obstacle

I have mentioned these points merely to indicate the fact that the expander presents the real difficulty. Even if the angle problem is solved *simply*, there is another obstacle to be overcome, viz., the difference in the effective pressure exerted on the plates from the Fig. 2 to the Fig. 3 position. With the expander in the latter position we might well imagine the lower ends of the plates bending *inwards*, instead of outwards, through buckling. But, remember, you cannot have a solid expander, or even one which is deeper than our present example. It will be seen, therefore, that the expanding feature alone forms an interesting problem.

But we are not yet through. We have, in Fig. 7, what I would term an obvious or very ordinary method

(*Continued on page 532.*)

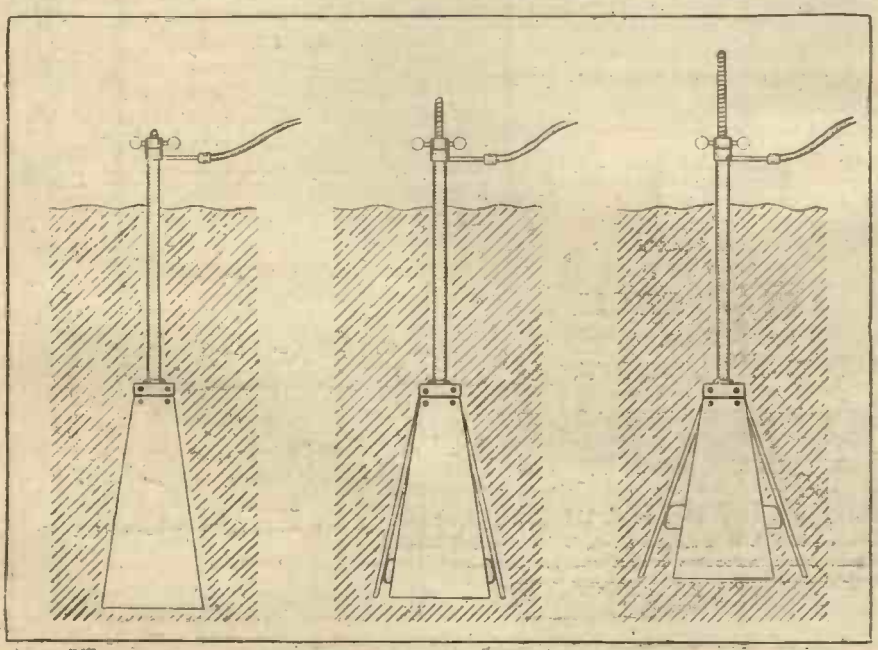
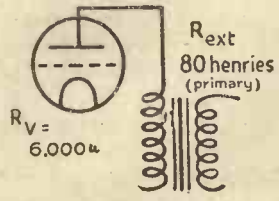


Fig. 4. The earth in position, showing how it can be expanded to allow for shrinkage of the soil round the plates.

To True Radio Reproduction

The Wrong Way

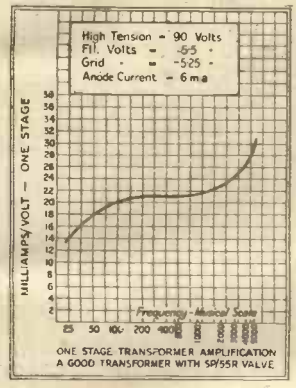
Transformer Coupled



Primary ...	80 henries
Ratio	3 : 1
Voltage Factor ...	10
Valve Impedance ...	6000 ω

Resulting Magnification

25 cycles	20·2
50 „	24·2
100 „	26·8
400 „	29·2
1600 „	29·8



SOME THEORETICAL AND PRACTICAL CONSIDERATIONS

Poor reproduction is nearly always attributable to the irregular or faulty amplification due to L.F. Transformers. The considerations outlined below make theoretical and practical comparisons between L.F. Transformer (or choke) and Resistance coupled circuits.

THEORETICAL

The impedance of a resistance is constant at all frequencies, while that of a transformer primary (or choke) varies directly with the frequency. Consider the circuits represented by the adjoining diagrams, bearing in mind the formula:—

$$\text{MAGNIFICATION OF A VALVE AND COUPLING} = \frac{\text{Imp. of Circuit} \times \text{V.F.} \times \text{Ratio}}{\text{Imp. of Circuit} + \text{Imp. of Valve}}$$

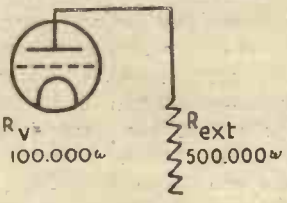
The results as tabulated show that whereas with L.F. transformer coupling the magnification will vary with the frequency, it will be constant with resistance coupling.

PRACTICAL

The curves reproduced make the practical comparison of actual results for one stage of L.F. amplification. The curves for two stages are even more striking. With Transformer Coupling distortion at high frequencies is due to resonance in the windings and at lower frequencies to insufficient primary inductance. With Resistance Coupling the slight distortion at higher frequency is reduced to the small value shown, by the avoidance of a too high value of anode resistance. The form of coupling used is the "Cosmos" Resistance Coupling Unit, which comprises a correctly proportioned condenser with an anode resistance and a grid leak, and the unit is guaranteed.

The Right Way

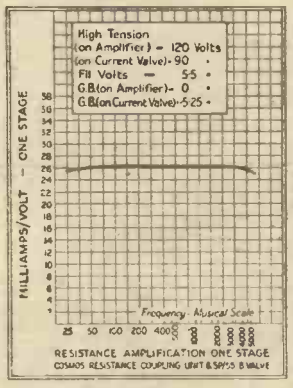
Resistance Coupled



Resistance ...	500,000 ω
Ratio	1 : 1
Voltage Factor ...	35
Valve Impedance	100,000 ω

Resulting Magnification

25 cycles	29
50 „	29
100 „	29
400 „	29
1600 „	29



You'll get good reproduction when you use

Cosmos

RESISTANCE CAPACITY COUPLING UNIT

Advert. of Metro-Vick Supplies Ltd. 155 Charing Cross Road, London, W.C.

AN ADJUSTABLE "EARTH"

—concluded from page 530.

of connecting the plates to the metal tube; this must also be improved upon. In effect, we have plate to flex, flex to tag, tag to bush, and bush to tube. Why not split the end of the tube so as to form four *integral* tags, and solder copper tape spirals direct to these tags and the plates?

Perfect Rigidity Essential

It should not be necessary to add that the device throughout should be perfectly rigid. Use thicker plates than those shown in the photographs, and see that the brass tube is of fairly heavy gauge. If any interested reader can make patterns, I would suggest that the cap and the expander should be cast in brass, their designs being modified as desired, and the blades of the expander being made with a small hub with oval-section blades tapering down sectionally towards their extremities. It is difficult to get away from the idea of using blades; here is another point in their favour, this concerning the method of connecting the plates to the tube. If, for example, we used a solid expander, the flexible leads would be fouled and probably sheared off, and if we soldered the leads to points nearer the upper ends of the plates in order to avoid

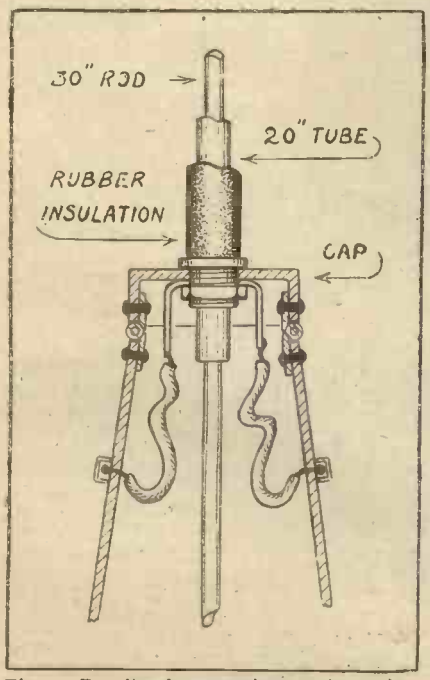


Fig. 7. Details of connections to the various parts of the device.

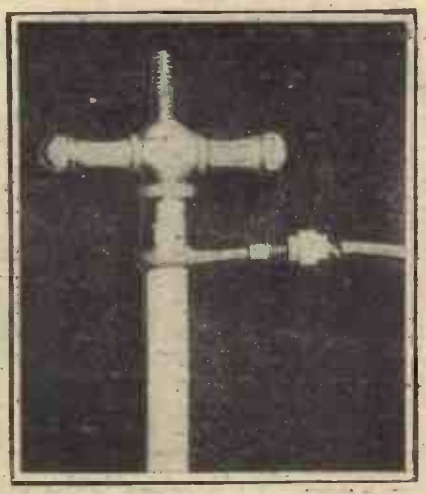


Fig. 8. Showing the adjusting handle, collar and terminal.

this, the result would be insufficient flexibility and a cramped job. The leads must be arranged in loop form, and it will be seen that by using the well-spaced blades the loops are in no way disturbed, since the space between each pair of blades offers sufficient clearance, even if the expander is adjusted to a point higher than the joints of the leads.

ACCUMULATOR TERMINALS

It is very inadvisable to allow accumulator terminals to remain in a greenish condition for any length of time. For one thing, the greenish scale which forms on the terminals is a form of metallic corrosion. It eats slowly into the metal, and will, in time, completely destroy it.

Then, again, corroded terminals of this nature set up very considerable resistance losses, and, what is more, in some types of accumulators, it is very possible that some of the green scale may become detached from the terminals and drop into the accumulator acid, thus contaminating the latter.

Most amateurs endeavour to remove the green scale from the accumulator terminals by the prosaic method of scraping it away with a knife or with a piece of sand-paper. There is a simpler method of effecting this end, however; and, incidentally, it is a much less laborious method into the bargain.

Make up a very strong solution of ordinary washing soda in water. Then saturate a rag with this liquid, and rub the affected terminals with it. A few applications of the rag will result in all the green scale dissolving away.

Always, after employing this method, take the precaution of thoroughly washing the terminals with a little clean hot water. Then dry and smear them with a thin layer of vaseline in order to prevent any further repetition of the trouble.

A DRILL PRESERVER

It pays to keep drills and similar cutting tools in good condition, not only on account of the expense of procuring replacements, but also on account of the valuable time which is saved by having such tools at hand in first-class working condition.

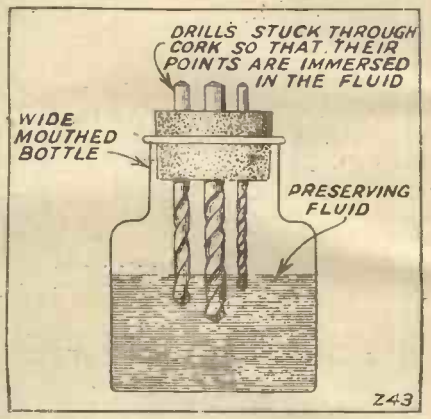
The following preparation will be found to be an excellent one for keeping the keen edge of a chisel or the business end of a drill in good order when it is not in use.

Mix well together in some convenient bottle which can be easily shaken the following ingredients:

Castor oil, ¼ oz.; pure soft soap, 1 oz.; methylated spirits, ¼ pint. Shake the bottle well until the ingredients have dissolved in the methylated spirits.

Drills which are not in use should be immersed in the above liquid.

A convenient way of effecting this is to pour the liquid into a wide-necked bottle, and to slip the drills through the cork so that their tips are con-



tinually immersed in the fluid in the manner shown in the diagram.

Similarly, the cutting edges of chisels should also be immersed in the liquid when such tools are not in use. The liquid, on account of its nature, preserves the cutting edges of these tools from atmospheric deterioration, and it thus prolongs their working life.

The Crystal Gazer sees the condenser of the future

The Condenser of the future is evolved on the logarithmic principle—thus avoiding in the only possible manner the defects inherent in both Square Law and Straight Line Frequency types. Only by designing a condenser on the "log" principle is it possible to spread stations really satisfactorily over the whole dial, without any falling out of step at the beginning and the end. By using individual "log" condensers in multi-tuned circuits remember that all dial readings are the same. Thus tuning is an extremely simple matter.

In time all condensers sold will be designed on the "log" principle, *but so far* CYLDON *Log Mid-line Condensers—just placed on the market—are the first log principle condensers to be made in this country.*

And just as CYLDON Condensers, of whatever type, are reckoned in very highest class of all, so CYLDON "Log Mid-line Condensers" are not only the first out, but will remain the best. Prices:

·001	21/-	·00025	16/-
·0005	17/6	·0002	15/6
·0003	16/6		

Prices include 4" Knob dial. If dial is not required, deduct 2/-.

This new condenser is such a great improvement that in future all our gang condensers will be built up with Log Mid-Line Units. If you are building a receiver using gang control, bear in mind that the CYLDON Log Mid-Line is the only correct condenser. Prices:

2-GANG £2-10-0. 3-GANG £3-10-0. 4-GANG £4-10-0.

LOG CYLDON MID-LINE

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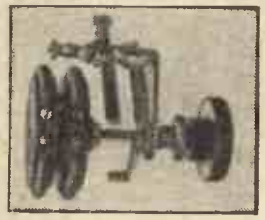
A useful method of position-finding for the correct filament adjustment

By W. R. THOMSON, B.Sc.

THE accompanying chart provides a rapid means of determining what filament resistance is required for any valve.

To make the chart of easier application it will be found advantageous to calibrate approximately each rheostat on the set. For the most popular form of rheostat in which a spring



An unusual form of filament resistance with double winding.

contact, pressed against resistance wire wound on a circular strip, rotates through an angle of about 270° in varying the resistance from the maximum value down to zero, the calibration presents no difficulty. The accompanying figure shows a type of dial which is easily made on paper or linen tracing cloth, and stuck on the face of the panel behind the rheostat knob. The two limits of movement of the contact arm are marked on the paper disc under the knob pointer, and the angle of from 250° to 300° subtended by these points at the centre is divided up into the number of divisions equal to the ohm value of the resistance. Thus the figure shows a paper disc made for a 30-ohm rheostat.

What The Chart Does

The calculation carried out by the chart is as follows :

If——

V = voltage of supply available

v = valve voltage.

V — v = voltage drop required in resistance.

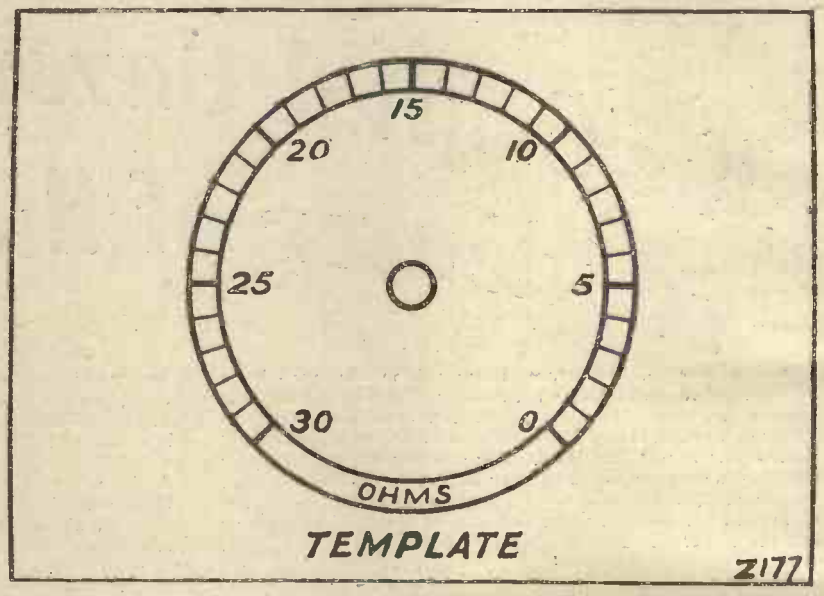
a = current consumption of valve in amps.

r = resistance required in ohms.

Then, by Ohm's Law :

$$r = \frac{V - v}{a}$$

The values of V are given in the right-hand top corner under the various cell combinations normally employed.



The valve voltages are given in each of the columns under the supply-voltage so that the particular values for different valves normally used may be marked out plainly in coloured ink. The voltage drop is given on the left of the chart and may, of course, be used in place of the two foregoing voltages if required. The valve consumption is given in the sloping family of lines on the chart.

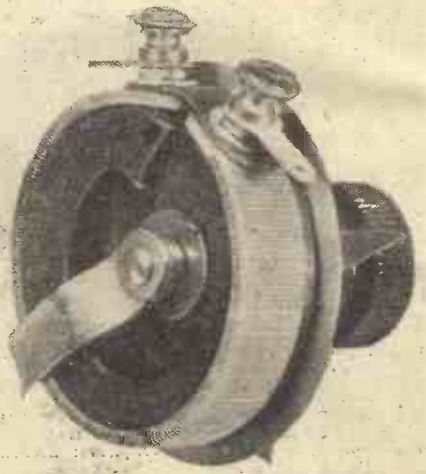
Finally, the resistance value required is read on the bottom scale.

In the example illustrated by arrows on the chart, a B6 valve is cited, with a voltage supply of 4.

The valve voltage is 2·8, and consumption is 0·12 amps. Then the voltage drop is 4 − 2·8 = 1·2 volts (there is, of course, no need to consider this point, as the chart carries out the subtraction automatically) and the resistance required is

$$\frac{1{\cdot}2}{{\cdot}12} = 10 \text{ ohms.}$$

It should be noted in conclusion that it is advisable to allow a larger value for the resistance in the case of secondary cells as the voltage supply is somewhat higher than 2 volts per cell immediately after charging.



An ordinary wire-wound rheostat.

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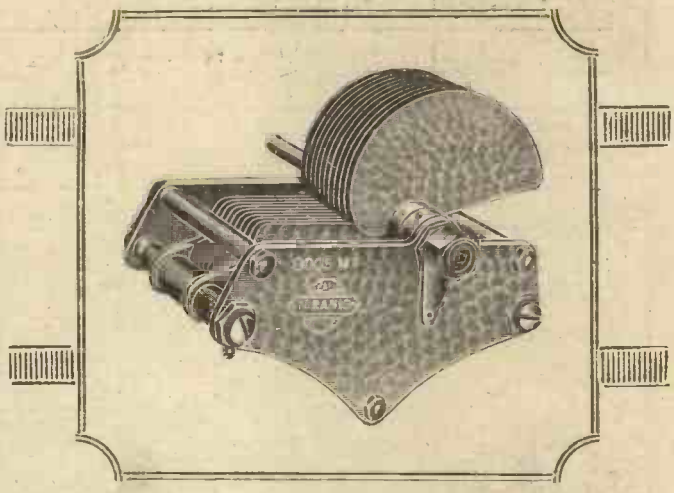

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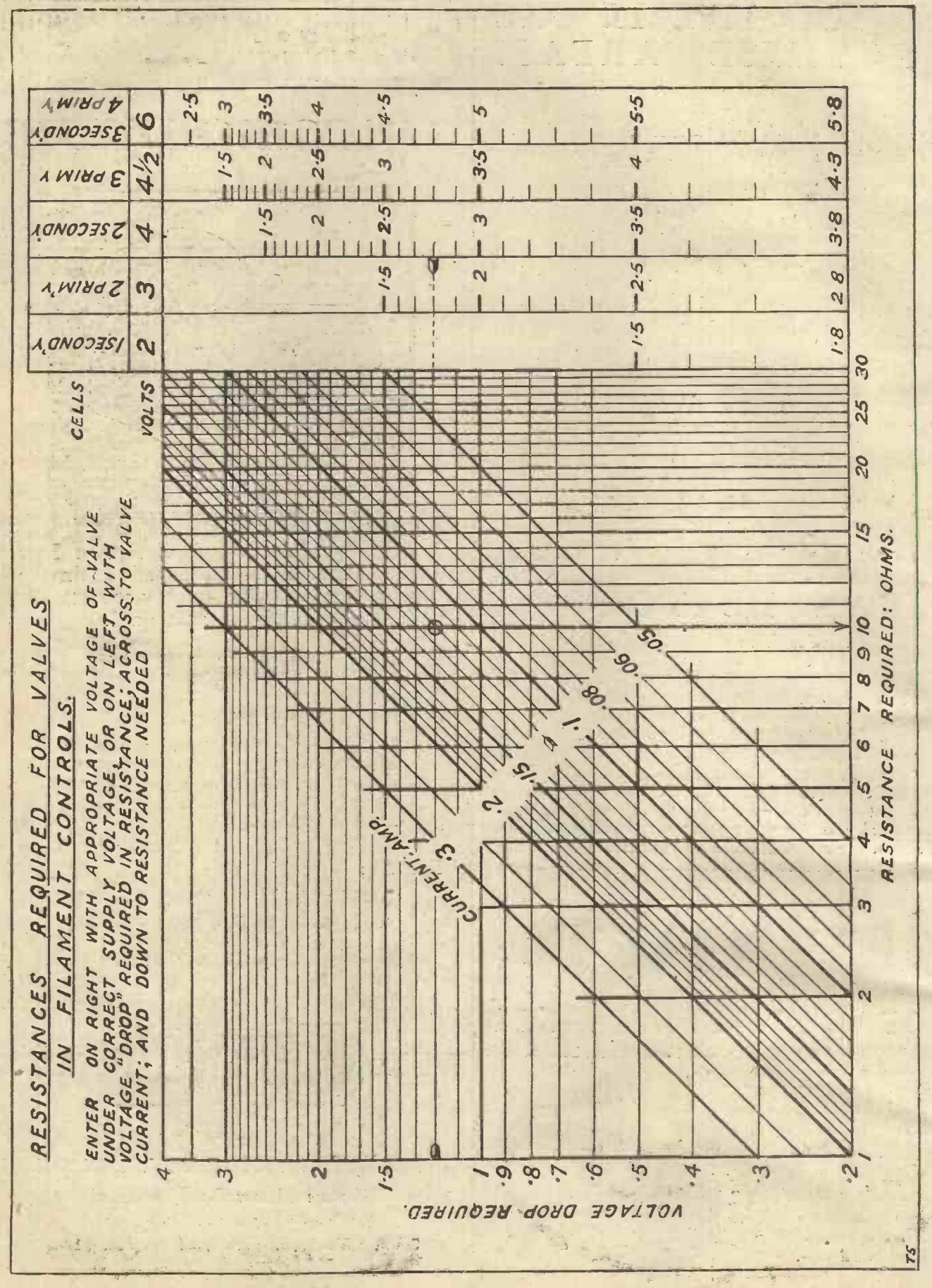

RESISTANCES REQUIRED FOR VALVES
IN FILAMENT CONTROLS.
ENTER ON RIGHT WITH APPROPRIATE VOLTAGE OF VALVE UNDER CORRECT SUPPLY VOLTAGE, OR ON LEFT WITH VOLTAGE "DROP" REQUIRED IN RESISTANCE; ACROSS TO VALVE CURRENT; AND DOWN TO RESISTANCE NEEDED
CELLS
VOLTS
1 SECOND'Y
2
2 PRIM'Y
3
2 SECOND'Y
4
3 PRIM'Y
4½
3 SECOND'Y
4 PRIM'Y
6
CURRENT. AMP.
VOLTAGE DROP REQUIRED.
RESISTANCE REQUIRED: OHMS.

An article on the vexed subject of L.F. transformer ratios.

By D. R. PROCTER.

A GOOD deal of argument constantly takes place around the question of the best ratio of L.F. transformer to be used in a particular position in the L.F. amplifying portion of the circuit. You will often see it stated that a high-rate transformer is not necessarily best, that better results are frequently obtained with low-ratio transformers and, furthermore, that the *desideratum* is rather a high impedance than a high ratio.

It is probably excusable for the beginner to suppose that a high-ratio transformer must necessarily give better results than a low-ratio, since it would certainly appear at first sight that a high-ratio transformer, giving a higher voltage increase, would therefore result in a higher overall voltage amplification.

Impedance Important

Perhaps it might be as well to explain at once, before going into any more detailed discussion of the matter, that it is not so much that a high ratio is objected to, as the fact that a

A "Geco-phone" L.F. transformer.

high ratio usually involves a reduction of the impedance of the primary. It is true that a high impedance primary could be used and a correspondingly larger number of turns in the secondary, but this would be undesirable for two reasons. In the first place the bulk of the transformer, as well as its cost, would be unduly increased, and in the second place, capacity effects in the secondary, particularly on the higher frequencies, would tend to defeat the object in view.

I mention these points in this preliminary way so as to enable the reader to follow the discussion of the problem more easily.

Let us now imagine a circuit containing the plate circuit of a valve, with the primary of a transformer, in series. Then the total impedance, as far as these two components are concerned, is equal to the sum of their impedances.

Now the impedance of the valve will depend upon the input, and the impedance of the primary of the transformer will vary with the frequency, so that we have an impedance varying with the load, in series with an impedance varying with the frequency.

The voltage produced in the secondary of the transformer will, of course, bear a definite relation to that produced in the primary, but the voltage in the primary will depend upon the conditions which we have just mentioned above. If a valve and a transformer primary have impedances which, for the sake of example, bear the relation to one another respectively of 1 to 2, we may reckon that the voltage in the circuit divides itself in proportion approximately to the impedance of the part across which the voltage is measured: thus in the case we are considering we should have about two-thirds of the voltage across the primary of the transformer and one-third across the plate circuit of the valve.

Capacity Effects

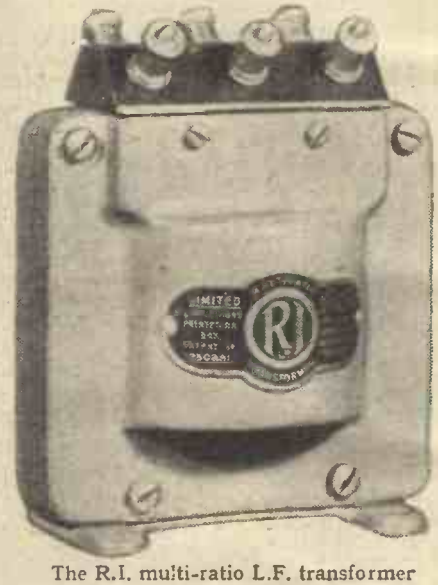
Owing to the variation of the impedance of the primary of the transformer with frequency (the impedance increases as the frequency increases) the voltage across the primary, and consequently the voltage across the secondary, tends to increase as the frequency is raised, so that the curve showing the variation of voltage with frequency gradually rises. This curve would go on rising but for the fact that the voltage, after passing the maximum, begins to decrease as the frequency is still further raised.

The factor or consideration referred to, which causes this drop in the voltage as the frequency passes the optimum point, is the *capacity effect* in the windings in the secondary of the transformer. It is well known that this capacity effect tends to bypass alternating current energy, and the bypass effect increases with the frequency, so that as the frequency is raised beyond a certain point, the secondary begins to act as though the actual number of turns in it were being gradually *reduced* as the frequency rises.

Obtaining Even Amplification

The maximum possible voltage will not usually be reached in the absence of some resonance effect, which will be equivalent to a reduction of the impedance in the circuit at or around some particular frequency.

Now comes the important point. If the impedance of the primary is considerably increased (the impedance of the valve remaining as before) the minimum voltage produced in the secondary approaches more nearly to the maximum voltage (or to put



The R.I. multi-ratio L.F. transformer which enables a number of ratios to be obtained.

the matter the other way-round, the maximum or peak voltage is little higher than the minimum voltage). In other words *the curve showing the variation of voltage with frequency becomes much flatter.*

It is thus clear that, in order to obtain a flat curve, it is desirable to

LOW OR HIGH RATIO?

—concluded from page 538.

use a large value for the impedance. It is, of course, very desirable to obtain as flat a curve as possible, as this means that more or less uniform amplification is being given to notes of widely different frequency and consequently distortion, by the transformer, is being avoided.

Further Considerations

One way to increase the impedance is to increase the number of turns in the primary and (if the same turns-ratio is to be preserved) to increase the number of turns in the secondary by the same factor. This, however, as I mentioned at the commencement of the article, means making a more bulky and expensive transformer and, since the impedance of the primary is evidently highly important, we at least gain something by increasing the number of turns on the primary without increasing those in the secondary, even though this has the effect of lowering the turns-ratio.

Furthermore, if the number of turns in the secondary were correspondingly increased in order to maintain the ratio, we should probably gain the advantage which (theoretically) should be given to such ratio, because of the capacity effect which I have already mentioned and which tends to nullify the voltage increase.

I think it will now be clear to the reader, in a general way, why a low-ratio ransformer sometimes gives better resnlts than a high-ratio transformer with the same amplifier. The advantage, where such a case is met with, is in the higher impedance of the lower-ratio transformer.

Of course these remarks can only be taken in a general way as indicating the considerations which have to be borne in mind in designing a transformer and in employing it in any particular circumstances. Apart from the mere number and ratio of turns, the actual gauge of wire and nature of thickness of insulation have

A popular French L.F. transformer, the "F.A.R."

an important effect, as well as the nature, and cross-sectional area, and design of the core.

By-pass Condensers

At one time it was considered that a high-ratio transformer should be used in the first stage of a L.F. amplifier, that is between the detector and the first L.F. valve, and a low ratio in the second and subsequent stages. Owing, however, to the fact that the detector valve will usually be of higher impedance than the first L.F. amplifier it may be desirable to use a transformer of higher impedance even though of lower ratio.

Another point to be borne in mind is that the impedance required in the transformer depends upon the impedance of the valve, and a transformer with low impedance may work fairly well with a valve of low impedance, whereas it should not work well with a valve of medium or high impedance.

A condenser is frequently connected across the secondary of a transformer in order to flatten the curve and so improve the uniformity of voltage amplification, but where this is done the improvement in quality, if any, will usually be at the expense of actual amplification. A condenser placed across the primary has a somewhat similar effect.

Varied Opinions

The capacity value of such a condenser is not a matter which can be stated very accurately, but for a by-pass condenser of this kind an all-round value would be 0·001. With the better types of transformer a condenser across the secondary should not be necessary.

Perhaps I ought to add, before concluding this article, that there is still a certain amount of difference amongst experts as to the best value for the impedance of a L.F. transformer, and also as to the advantage to be gained by using a higher ratio of, say, 5 or 5½ to 1 as compared with the use of a ratio of 2 or 3 to 1. The foregoing article is intended to bring out the main considerations, but I must not be too dogmatic on this subject, as it is one of those matters which depend so much upon particular circumstances and conditions, and upon which, as I have already mentioned, opinions, even well-informed opinions, differ fairly considerably.

CEMENTING MICA

By "AMEC."

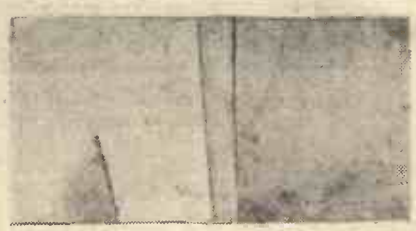
It is often very convenient to be able to join two pieces of mica together, and especially is this the case in the construction of fairly large flat fixed condensers. Sometimes it is difficult and costly to procure mica in sheets which are large enough for the purpose required, and, in such instances, larger sheets of the material may be made by joining up smaller sheets by means of a mica cement.

There are several types of mica cements available for the amateur. In the first place, a strong-setting cold glue may often successfully be used for the purpose. So also may a thick celluloid varnish. In either of these cases the overlapping edges of the mica sheets should be thoroughly cleaned beforehand, and they should also be roughened up by means of a piece of *clean* sandpaper in order to allow the cement to "bite."

A rather more troublesome but nevertheless a more efficient means of permanently cementing sheets of mica together is as follows:

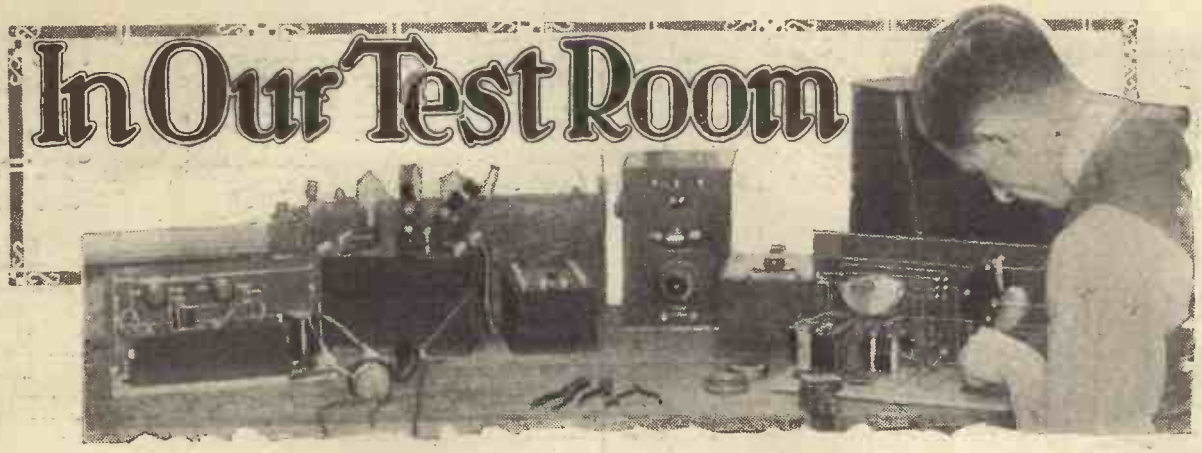
Dissolve a few thin strips of pure gelatine in a small quantity of hot, strong acetic acid. The gelatine will dissolve better if it is allowed to soak for twenty-four hours in the acid before the latter is warmed up. Finally, the hot liquid should be thoroughly stirred up until it attains a fairly thick consistency.

Apply the cement liberally to both sheets of mica. Put a heavy weight on the mica thus joined, and leave it undisturbed for twenty-four hours.



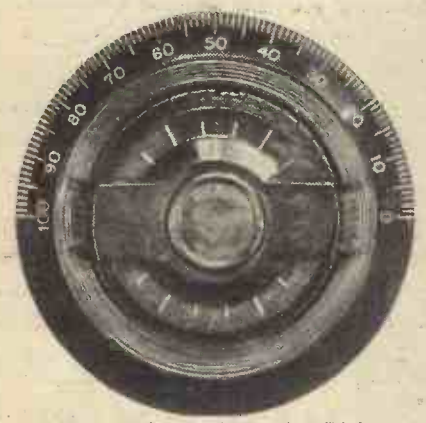
Two small sheets of mica cemented together.

In Our Test Room



A New Amplion Loud Speaker

The Amplion people seem to have the happy knack of being able to make a horn-type loud speaker look attractive. Not one of the large Amplion range can be accused of looking the least like the picture that probably the average man mentally associates with that class of speaker which really deserves the title of "Radio Trumpet." And the latest addition to the Amplion family, the A.R. 65.0, is as distinctively pleasing in appearance as the rest of that group. As a matter of fact, the oak flare is identically the same as that fitted to the popular A.R.19.



The "Microfix" Vernier Dial.

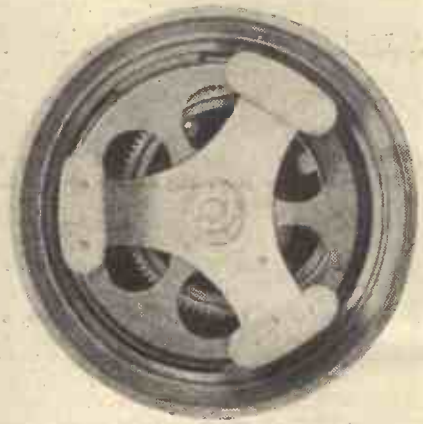
Probably the Amplions owe a great deal of their success to their heavy sound conduits, which, in the case of the A.R. 65.0, has the familiar crystalline chocolate finish which blends nicely with an oxydised copper base. The speaker has an excellent projection, and speech is clear, while it reproduces strings with a pleasing mellowness. It is sensitive and has a close adjustment, but there is no "blasting" on any but the very low notes, and even here perhaps the term is rather too harsh, and "frequency suppression" might be happier. In fact, for its type, the A.R. 65.0 has a most commendable reproduction curve. The average listener would have no fault to find with it whatever. The price is £3 18s. 6d., at which figure it easily represents the value accorded to five guineas or more for such an accessory a year or so ago.

"Microfix" Vernier Dial

With most modern sets, especially those employing a stage or two of H.F. amplification, fine tuning dials for the variables are almost essential if the condensers themselves are not fitted with "vernier" movements. Of the many fine tuning dials on the market now the new "Microfix," due to Messrs. Harlie Bros., 36, Wilton Road, Dalston, London, E.8, stands out as being of rather more than usual interest. In the first place it costs but 5s. 9d., which is a reasonable figure for such an article.

Then again, the construction and design of this Harlie product are both of the highest class. Practically no metal at all is used in this dial, and the movement is quite velvety. The gearing has a ratio of 1 to 120, and provision is made for the usual direct drive. The dial measures a full four inches in diameter, and has a large control knob with which the fine adjustments are carried out. This latter has its own clear indication markings.

The New Amplion A.R. 65.0.



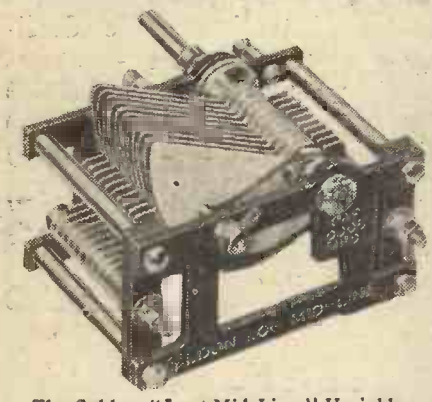
The reverse side of the "Microfix." The gear wheel is not made of metal.

A New "Cyldon" Variable

Messrs. Sydney S. Bird and Sons have recently produced a new variable condenser to which they have given the name of "Log Mid-Line." The vanes are shaped to give a capacity variation approximately between those provided by the Square Law and Straight Line Frequency types. The object in view is to allow for the self-capacities existing in average circuits so that the ratio of adjustment to capacity variation is kept constant. This makes it more easy to obtain identical readings over complete tuning ranges in multi-valve receivers. The scheme is not a new one; variable condensers designed on these lines have been on sale in the United States for some time now and have proved most successful. A few other British makes also incorporate a similar compensating compromise.

IN OUR TEST ROOM—*continued*

By the way, there is one feature of the Cyldon variable which particularly appeals to us and that is the nice stout vanes with which it is



The Cyldon "Log, Mid-Line" Variable.

fitted. These are so robust and rigid that it would take a serious accident to cause them to be bent out of truth. This latest Cyldon is quite as well made as all the other Cyldons in other respects too, and has a similar smooth movement free from mechanical defects.

The prices of the "Log, Mid-Line" is 16s. 6d. the ·0003 mfd., and 17s. 6d. the ·0005 mfd.

The "R.C. Twosome"

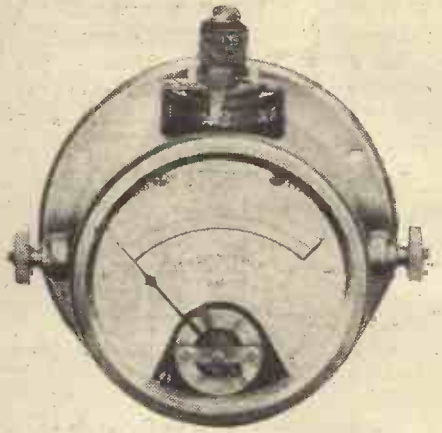
We recently received from The Edison Swan Electric Co., Ltd., an "R.C. Twosome" unit built up ready for use together with the necessary Ediswan valves. It is a two-stage amplifier unit for use with a crystal set. The design is very simple and straightforward. There is first the input L.F. transformer which is connected to the first valve. Between the first and second valves the coupling is by means of a resistance-capacity coupling unit. The amplifier is not supplied ready made to the public but the full set of components is available at any radio store for the low figure of 25s. or so. The Ediswan Electric people supply a folder which contains a clear blueprint and full assembly instructions free of charge. The unit presents no difficulties in construction, it is indeed, one of the simplest designs we have examined, and should be well within the scope of even those constructors who have hitherto not ventured into the realms of valve work.

We are not going to criticise the circuit employed or the values of components introduced. Opinions are sharply divided over such questions, in fact, we ourselves do not quite agree with Messrs. Edison Swan's selections, but what the prospective constructor of such a unit will no doubt be more interested in are the results given by it during its actual operation. With this in view our tests were carried out strictly in accordance with the maker's recommendations for the use of the amplifier, and the R.C.2 and P.V.2 valves were employed. We must qualify the above few sentences by adding that if improvements suggested themselves to us, these would have in the majority of cases necessitated increases in the cost of the device. Bearing in mind the cheapness of the Ediswan hook-up, any detailed criticism might tend to be more destructive than constructive.

However, on test we found the amplifier to be very good. Average crystal signals were brought up to full loud speaker strength, and reproduction from average loud speakers was in every way satisfactory and markedly superior to that obtaining from the use of two stages of transformer coupling of any but the very highest quality. This "R.C. Twosome" is not difficult to place in commission, and providing the constructor adheres to the maker's recommendations, no trouble should be experienced.

A Useful Milliampmeter

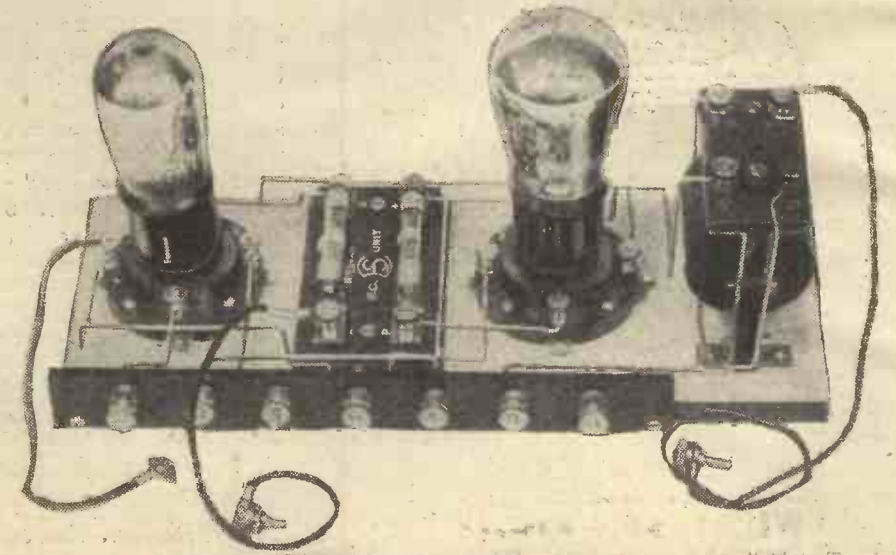
Messrs. A. H. Hunt, Ltd., of Tunstall Road, Croydon, have recently placed a treble scale milliampmeter on the market. It is of the moving coil, dead beat type, and provides a full scale reading over three ranges. A small switch is fitted to the top of the instrument, and this brings in either one of two shunts as required. The three ranges are 0-5, 0-10, and 0-25 milliamps. These ranges make



Messrs. A. H. Hunt's Treble Scale Milliampmeter.

the instrument most suitable for radio work. On test we found the meter gave accurate readings on the two lower readings with very slight errors on the lower portion of the scale when the 0-25 shunt was in circuit. In view of the existence of a full scale covering these readings which could immediately be switched in, this is of no great consequence. Indeed, the whole test proved most favourable for such a comprehensive instrument which costs but 42s.

(*Continued on page 558.*)



The "R.C. Twosome" as made up by the designers, The Ediswan Electric Co., Ltd.

IN PASSING—(concluded from page 488)

"Some whiskers," I remarked, as he exploded.

"Oo-er!" he gasped. "Ain't that horrid?"

"Ambo, you don't mean to say you keep those young cobras loose in that box? This house isn't safe, what with Uncle William half-loony, and violent at that, and Gert the python roaming around free and easy. By the way, did you ever find that scorpion?"

Our Male Learner—the P.M.G. will correct me if I miscall the rank—had some pluck. Yes, I'll say that. For he got up and rescued his hat, shook it free from scorpions and cobras, and said, "Well, why do you keep an aerial if you don't use wireless?"

"Come upstairs, my friend, and be convinced," I replied. ("*Julian, does that spotted Galooza on the landing still snap at strangers?*")

"Oh, I expect he'll be asleep by now," replied Ambo. "Anyway, our young friend here seems to be pretty nippy on his pins, and can dodge past."

So we went upstairs in semi-darkness. At the landing, I said, "Hullo, Ambo, he's escaped!" and as though my words had been overheard there came a terrifying howl from higher up. "It's young Bert," whispered Ambo to me. "Got the collywobbles because of his first tooth."

By the time we reached the upstairs "den," L. B. Bones was anxious to leave us. He perspired freely and tried to ingratiate himself by making humorous remarks about the Zoo.

The Inquisitor Departs

We entered, and there, true to his trust, sat Pa Twipe, with the telephones on his ears and a box beside his elbow.

"Well, what do you call that?" said Leonidas B. Bones, G.P.O., triumphantly.

"Hey?" said Twipe.

"Speak louder," I suggested, "he's pretty deaf."

"Are you listening-in?" yelled Leonidas.

Twipe nodded his head.

"Yes, very wet weather," he replied.

"I'm afraid these gadgets for the deaf are not really much good," I said sadly. Then I turned to Pa Twipe and shouted:

"Mr. Twipe, this young man wants to know what the mast and wire are for."

Twipe twinkled.

"Why, to train them plaguey snakes of Julian's, of course."

"There you are, Lulu—er—Leo," I said. "You ought to be satisfied with that. Before long this vast metropolis will be staggered with the aerial evolutions of Ambo's Giant Wire-worms. Would you like to see Gertrude perform?"

As Leonidas left, I handed him an old Demand Note from the tax-collector, which I happened to have in my pocket.

"If there is any trouble at the office, give them this," I said magnificently. "That will clear you."

Yes, a great evening—but quite a set-back to my plans to make Ambo a wireless fan.

THE "K.L.I." TWO

—concluded from page 485

point connections, the aerial and earth should be connected, and correct sizes of coils, plugged in their sockets. Do not connect up the negative grid-bias plugs, but place the positive in the maximum position tapping. Connect the mains to the two transformer primaries by means of a long, flexible lead and a two-pin plug, or a bayonet holder.

Switching On

The three rheostats should now be placed in the off position, and the mains switched on. Slowly rotate the rheostat on the extreme right of the panel controlling the rectifying valve until this valve glows fairly brightly. The K.L.I.'s should also be adjusted, and after about thirty seconds a dull cherry-red glow will appear at the top of the cathode electrodes. Now connect up the loud speaker or 'phones, and a loud hum will be heard.

Plug in the negative grid-bias plugs, and arrange these until the hum is at a minimum. Readjust the three rheostats, keeping the K.L.I's as dim as possible, consistent with good results. Unlike most receivers of this type employing the mains even for H.T., the tuning is unusually sharp, so that the condenser dials must be carefully rotated to ensure that the station is not passed. When searching, it is advisable to place the reaction condenser on the right of the panel at zero.

When switching off the set there is no need to touch the rheostats, as it will be found that these very rarely require adjustment. Now that the set has given the desired results, the small panels to fit in the spaces left on each side of the panel must be considered. The foundation of these panels consists of copper gauze or perforated zinc, over which is arranged a piece of fancy fretwork to hide the former material.

No doubt each will have his own particular ideas regarding the best way of overcoming this ventilation problem. The fig. shows two alternative designs. The back of the cabinet should be treated in a similar way, and no doubt a really excellent and attractive finish to such an uncommon set will result. When ordering the transformers it is essential that the exact frequency and voltage of the mains should be stated. This is best obtained from the meter, although, to make doubly sure, it is advisable to inquire at the local electrician's. Suitable rectifying valves are Marconi U5 and the Mullard DU2, although no doubt any four or six-volt double-wave valve would give good results.

Good Earth Essential

A set of this nature is not intended for the reception of distant stations; but, nevertheless, several other stations have been received, although such results could not in every case be guaranteed. One great advantage is claimed, however. When once constructed and working correctly, it should never need to be touched for eight or nine months, and then only to replace the grid-bias battery.

Make quite sure that the earth is as good as possible, not only in the actual earth employed, whether direct or water-pipe, but the actual contact with the earth wire. If an indoor aerial is to be used, it should, if possible, be run at right-angles to any electric-light wiring carried out across the ceiling, even although it may not be favourably disposed relative to the local broadcasting station.

ADVERTISEMENTS

As far as possible all advertisements appearing in "M.W." are subjected to careful scrutiny before publication, but should any reader experience delay or difficulty in getting orders fulfilled, or should the goods supplied not be as advertised, information should be sent to the Advertisement Manager, "Modern Wireless," 4, Ludgate Circus, London, E.C.4.

THE SUMMERDYNE

—concluded from page 458.

The arrangement of the battery leads will present no difficulty when the photographs and drawings are examined.

Preliminary Tests

As in all super-heterodynes the selection of valves has to be carefully undertaken, and with the General Radio intermediates I have found D.E. 2 L.F. or the Cossor 2-volt Black-band valves particularly suitable. A good arrangement of valves is as follows:

For the oscillator (first socket on left looking from the front): Cossor Red-band or D.E. 2 H.F.

First detector: Cossor Black-band or D.E. 2 L.F.

Three intermediates: D.E. 2 L.F. or Cossor Black-band.

Second detector: Cossor Black-band or D.E. 2 L.F.

Last socket: Stentor Two or D.E. 215.

For the preliminary tests the fixed resistors should be placed at the zero position and the potentiometer about half-way round. Those who are accustomed to handling a super-heterodyne will soon recognise the familiar symptoms—e.g. the two positions on the oscillator dial for each reading of the frame aerial tuning condenser, and the oscillation of the intermediates when the potentiometer is fully over on the negative side. It will generally be found that the set will work best when the frame is maintained at approximately right angles to the cabinet, the whole cabinet being turned round in this fashion when the best position of the frame is sought. This only applies, however, when the frame is used in the lid of the box. When a separate frame outside is used, the position of the lid is not important.

Results

This set was designed to give at least one station on the loud speaker anywhere in the country and a large number of others in the telephones. During my own tests I have repeatedly heard about a dozen other stations on the loud speaker, but this, of course, has been after dark. In daylight ample loud-speaker strength is obtainable from the station that is nearest to you—after all, the main consideration with a set for outdoor use!

ACCUMULATOR POLARITY

If you are ever in any difficulty in the determination of the polarity of the plates of an accumulator, it is well to remember the fact that the positive plates in a healthy accumulator are generally of a dark-brown colour, whilst the negative plates of the accumulator have a greyish appearance.

Of course, all accumulators should have the polarity of their plates carefully marked, but it happens occasionally that the +ve and −ve markings wear off the cases. Hence the need for some distinguishing indication.

In accumulators which possess more than two plates, it will be noticed that some of the plates are connected to one common bar, whilst the rest are connected to another bar. It is easily possible to tell which is the positive and which is the negative plate grouping of an ordinary accumulator, provided that more than two plates are present in the cell. In such cases, the *positive group* of the accumulator has always one plate less than the negative group.

A NEW H.F. COUPLING METHOD

—concluded from page 472

tapping across the fixed condenser will thus yield half the total voltage.

Now if the capacity of the variable condenser be *reduced*, the voltage across that condenser will be *more than half* the total voltage, or, putting the matter in another way, the voltage across the *fixed* condenser will be *less than half* the total.

As this point may seem a little perplexing at first, and as it is vitally important in the theory of this Loftin-White circuit, perhaps a little further explanation may be useful.

If in a circuit a certain voltage is distributed across two inductances in series, the voltage across either inductance will be proportional to the value of the inductance, and therefore if one inductance be increased relative to the other, it will carry at its terminals a correspondingly larger proportion of the total voltage across the two.

The Coupling Change

With condensers, however, the exact opposite is the case, and the way in which to increase the voltage across the condenser is not to *increase* the capacity of the condenser but to *reduce* the capacity. Perhaps it will make this matter still simpler if we consider what happens when the capacity of the condenser is made infinitely large. According to what I have just said, if the voltage across the condenser decreases as the capacity of the condenser increases, the voltage should become zero when the capacity becomes infinite. That this is so will be at once seen, for a condenser of infinite capacity is, in fact, the same thing as a direct connection or short circuit, in which case, of course, no potential difference would exist across it.

I think it will now be clear that by the arrangement indicated in Fig. 2 the variation of the capacity of the variable condenser will have the effect not only of tuning the circuit, but also of adjusting the capacity coupling. What is more, as the capacity of the variable condenser is reduced (so as to tune for shorter wave-lengths or higher frequencies) the capacity of the fixed condenser is made relatively larger and therefore the voltage across the fixed condenser, and consequently the amount of the capacity-coupling, is made correspondingly less. So that as the circuit is tuned for shorter wave-lengths the capacity coupling is reduced.

Counterbalancing Effects

Now we have seen already that the magnetic coupling is *increased* when shorter waves (higher frequencies) are being received, so if we use the magnetic coupling together with a capacity coupling of the type indicated in Fig. 2, we have a system whereby the tuning of the circuit produces at one and the same time an *increase* in the magnetic coupling and a *decrease* in the capacity coupling, or *vice versa*.

This, then, is the fundamental basis of the new circuit, and the ingenious and extremely simple arrangement shown in Fig. 2 of the tuning condenser in series with a fixed condenser, the latter condenser being used for the purpose of capacity coupling, is the essence of the Loftin-White circuit.

In Fig. 4 is shown a simple circuit in which the Loftin-White capacity coupling is used.

Figs. 3 and 4 are two simple explanatory circuit diagrams given by Messrs. Loftin and White in their first accounts of their new discovery. Fig. 3 represents the conventional tuned radio-frequency; whilst Fig. 4 shows the corresponding Loftin and White method of balancing the inductive radio-frequency stage.

Other Advantages

The many advantages which arise from this achievement will be evident to the reader; one or two have already been mentioned above. Loftin and White point out that in all receivers there are inductive and capacity couplings which are not desired (which we call "stray couplings") but which are present owing to the practical necessity of placing the components fairly close together and connecting by conductors. These parts of the set couple—inductively and capacitatively—with one another. Owing to the fact that the Loftin-White circuit contains both inductive and capacity couplings, and to the fact that a phase-shifting reactance is obtained, we have three elements which may be adjusted to offset undesired inductive and capacity couplings and stray feedback. When proper adjustments are made we are thus able either to reduce the shielding necessary for H.F. stages or, in some cases, to dispense with shielding entirely.

ARE YOU OVERLOADING?

—concluded from page 518

Fig. 3 shows how this may be done. Place the instrument in the plate circuit of the last valve, between points C and D, tune in the local station, and watch the needle. If nothing is wrong it will remain practically steady; but should overloading be occurring it will move, especially when loud musical passages or sibilant consonants are being reproduced.

The milliammeter used in this way should always be shunted by a large fixed condenser, for its windings have both resistance and a natural frequency of their own, which may lead to curious effects if the condenser is omitted.

A Milliammeter Test

Should the needle be found unsteady, try the effect of altering the grid bias. If this does not produce the desired effect, do not jump to the conclusion that the last valve is not up to its work; it may be the first note-magnifier that is being overloaded, the distortion caused by it being passed on to and amplified by the last valve. Test the first L.F. valve in the same way by placing the milliammeter between the points A and B. As soon as you have got the needle steady here, either by altering the grid bias or by replacing the valve with another, you are in a position to say definitely whether the last valve is or is not up to its work.

If the loud-speaker is small and signal strength fairly great it may be impossible to prevent the diaphragm from coming into contact with the pole pieces of the magnets at frequent intervals. Whenever this happens a hideous buzzing noise takes place.

Cure for "Blasting"

The second form of loud-speaker overloading is due to magnetic saturation. Here again horrible distortion results. If you have satisfied yourself that your L.F. valves are up to the work that you are asking them to do, and if there is still "blasting," harshness and woolliness when a strong signal is coming in, you may feel pretty sure that the loud speaker is being overdone. The only remedy is either to be content with moderate strength, or to acquire a loud speaker capable of dealing with a bigger output from the receiving set.

THE "HEY PRESTO!" FOUR

—continued from page 470

tried without much difficulty, the switch serving as the control.

After the wiring of the receiver has been completed and checked against the wiring diagram and wiring instructions, turn the "on—off" switch to a neutral position (in the original set this is done by pushing the switch in), turn the filament rheostats so that the whole of the resistances are in circuit, and connect both H.T. and L.T. batteries across their appropriate terminals, using about 60 volts for H.T.+1 and 120 volts for H.T.+2.

Connect the grid battery in circuit, using voltages suitable to the valves with an anode voltage of 120; plug in a pair of telephones so that three valves are being used, insert the valves, connect aerial and earth, and turn on the filament current.

Commencing with the condensers all set to a zero reading, slowly turn C_1 and C_2 one or two degrees at a time until "something" from the local station is tuned in to its loudest. The description "something" means to convey that at this stage signals may not only be weak but also distorted, and, using this reception as a guide, slowly turn the moving vanes of C_4 until signals improve in volume, not forgetting to retune upon C_1 and C_2 at each step, if necessary.

How to Neutralise

When the maximum signal strength has been obtained in this manner, extinguish the H.F. valve by turning the rheostat in the appropriate direction and adjust the neutralising condenser so that no signs of the local station are heard, irrespective of any further adjustments of C_1, C_2, or C_4. Relight the H.F. valve and retune to the local station, when it will be found that satisfactory results are obtained. In making these adjustments it is important to remember that the H.F. valve must not be removed from the set, and beyond extinguishing it nothing further should be done.

For purposes of making these adjustments the coil for L_1 may be a No. 35 and L_2 a No. 60, the screened coil, of course, being one suitable for use upon the 250—550 metres range. After the local station has been tuned to its best and loudest, the value of coil most suitable for L_1 with existing aerial conditions should be found experimentally, remembering that generally speaking the larger the value of L_1 the poorer the selectivity (within limits) and the smaller the value the weaker the signal strength. The object is to compromise so that both selectivity and strength are obtained, the most suitable coils to try being Nos. 25, 30, and 35.

For reception upon the 250—550 metres range a No. 60 coil may be used for L_2 in conjunction with a suitable H.F. transformer as explained, but for reception of Daventry or other long-wave stations L_2 should be a No. 250 coil with either a No. 75, 100, or 150 for L_1. The H.F. transformer will also, of course, require to be changed for one covering the long wave-lengths.

Reaction Adjustment

By slowly turning the condensers C_1 and C_2 together the signals which one may be listening to will quickly disappear, and the condensers should now be turned at such relative speeds as will keep the circuits in resonance, which fact is indicated by a slight breathing sound in the 'phones or loud speaker, when quite soon a distant transmission should be picked up at good strength; whereupon adjusting the reaction condenser by turning in a clockwise direction will still further increase the volume.

An interesting fact regarding the present receiver is that so long as the H.F. valve is correctly neutralised there is little need to worry about the adjustment of reaction, for no appreciable interference is likely to be caused to others. The adjustment should, however, be made with care, for the sake of one's own quality of reception. The reaction adjustment will be found to be independent of the tuning—that is, variations in the adjustment of the reaction condensers will not in general call for retuning upon C_1 and C_2, a fact which is highly important in distance work.

When working the set for the first time in an attempt to pick up foreign stations, it will probably be found easier to obtain results if four valves are used, reducing to three when the station has been properly tuned in.

Cutting Out "The Local"

The receiver has been used now for some time in south-east London and also in south-west London, the latter place being two and a half miles from the aerial at 2 L O. Reception was found to be easy and the elimination of the local station in no way difficult even at two and a half miles.

The stations whose names are given here have been received time and

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THE "HEY PRESTO!" FOUR

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time again, in addition to many others whose identity is unknown. For purposes of identification a station has been listened to for many hours before the announcer made known who he was, and only then was the name added to this list. Only those stations which have been received on the loud speaker are given, and names bearing an asterisk were received at good strength on three valves only.

The receiver does not call for any particular skill in its working, the C_1 and C_2 dials reading approximately the same with the sizes of coils given, and no difficulty will be experienced in tuning in many foreign stations upon the loud speaker.

WHAT READERS THINK

—concluded from page 466.

It has been decided to go forward with the printing of a first edition of this Directory at mid-summer, but much still remains to be done. It is recognised that completion in any one subject is well-nigh impossible in so short a time. It would, however, greatly further this end if libraries, organisations, firms and individuals possessing special information on any subject and willing to answer inquiries thereon, which have not yet been in touch with us would communicate with me at 38, Bloomsbury Square, W.C.1.

Yours faithfully,

G. F. BARWICK.

General Editor, Late Keeper of Printed Books, British Museum.

World's Worst Blind Spot

Sir,—I am a wireless operator, and in congratulating you upon MODERN WIRELESS, which I only discovered for myself last February, I should like to mention with particular pleasure the H.F. articles that have appeared since then.

Re "Blind Spots," the worst I ever struck is just to the east of Ceylon, which has the reputation of being the very worst Blind Spot in the world.

Yours faithfully,

"SPARKS."

THE SEARCH FOR QUALITY

—continued from page 498.

consequent flattening of the characteristic curve.

Raise as we may the anode volts, always the switching on of the carrier wave will set us on another curve before modulation ever starts. This means a definite disadvantage, since the "bottom bend" will be apt to be sloppy and the curve flatter.

If we use a *choke* of large value in the anode instead of a resistance (the choke must be of *very* large value if the bass is to be properly reproduced), we overcome this disadvantage, because, compared with a resistance, a choke has no D.C. resistance, although under modulation it has considerable impedance. There is no "drop" when the carrier wave comes on before modulation, and we can set ourselves on the point A (Fig. IV), and remain there even when the carrier wave comes on.

Effect of Impedance

When modulation comes on naturally the voltage on the anode will rise and fall; if it did not, it would be a pity! We shall not work up and down on curve 1 (Fig. IV), but our curve will, nevertheless, be steep, as there is practically no D.C. resistance drop to take into account.

There are one or two points to note.

Firstly, that the choke has to be large. Consider it this way. A choke presents an impedance proportional to the frequency. If a choke has an impedance of 10,000 ohms at 1,000 cycles per second, then its impedance is, disregarding self-capacity, 100,000 ohms at 10,000 cycles per second, but only 1,000 ohms at 100 cycles or 500 at 50.

An impedance of 10,000 ohms may be a suitable impedance for all values dealt with by the rectifier, but 500 ohms may be a ridiculous value. It is therefore imperative to have choke of sufficiently high value at the lowest frequency, and as we know that this value can be anything as long as it is greater than five or six times the valve impedance, we see that we have to design the choke for the lowest value. Another way of looking at it is to say that if there is any difference in conditions between high and low frequencies, there will be some distortion of the amplitude

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THE SEARCH FOR QUALITY

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frequency curve of the rectifier, and hence of the receiver.

Secondly, we must consider phase change, and realise that with an inductive choke the volts and current may be out of phase, and a still higher value of choke is therefore necessary.

The valve should be of medium high impedance, so that the bottom bend may be abrupt; but, at the same time, two or three volts negative bias is necessary to stop grid current. Choose, therefore, a valve that has a characteristic that gives just no current with two or three volts negative at an H.T. of 100-150 volts on the anode.

Grid Leak and Condenser

A method of rectification both convenient and popular is that shown in Fig. V. Here a comparatively open mesh valve is worked without any grid negative, but a resistance is inserted in series with grid filament circuit. The carrier wave comes on, and half-cycles of the H.F. cause the grid to become positive and the opposite half-cycles caused the grid to become negative to the filament.

The positive half-cycles make the grid attractive to the electrons, and some that do not fly between the interstices of the grid spiral, and so find their way to the solid anode, collect on the grid. The resistance in the grid circuit is of so high a value that these do not immediately return to the filament, and a crowd of electrons collect upon the grid, making it gradually negative. This cumulative effect produces at once rectification. The action is really that modulation of the carrier wave automatically slides back the grid potential, and so gives a corresponding reduction of anode current.

There is really little difference in effect between grid leak and anode-bend rectification. In one case we use the positive half-cycle, cutting off the one side by choosing a suitable point on the rectification curve, and thereby working on increments of anode current; on the other hand, we use a reduction of anode current.

Reaction Effects

In the case of grid rectification the impedance of the associated circuits is greater than in the anode method, and also in grid rectification amplification follows rectification, which it does not in the anode method. In each case, in order to pass H.F., the resistance, be it grid or anode resistance, or anode choke, is shunted by a small condenser. This condenser has to be of a certain value, and its effect when in the grid circuit is more deleterious for high frequencies than when it is used in the anode circuit. One essential difference to the advantage of the grid method is that reaction can be applied more easily. The anode method, by its very nature, forbids reaction, since the valve has to be of such very high impedance, which ill accords with favourable oscillating conditions.

I am unaware that reaction is really necessary if perfect quality is desired, and I am convinced that for whatever reason it may be, the bottom-bend method gives better quality. Too often the mistake is made of choking the whole system, even though greater sensitivity accrues, by using too high a value of resistance in the grid leak.

RADIO ABROAD

—continued from page 512

Some of the tests were made at 15 metres, and on this wave-length no reports were received regarding daylight reception within a radius of 900 miles, indicating an apparent "skip-distance" of this value. It is concluded from this that the signals are reflected from the conducting layer in the upper atmosphere and reach the earth again at a distance of not less than 900 miles from the transmitter. At night-time the distance of the 15-metre waves was found to be 1,000 metres.

About 1,000 odd observations were made on a wave-length of 26 metres, and here the skip-distance was found to be 1,000 miles in the daytime and 450 miles at night.

At 33 metres about 5,000 reports were sent in showing a skip-distance of 100 miles in the day and 400 miles at night.

The curious thing is that at a wave-length of 50 metres no skip-distance was indicated at all, and the useful day range at this transmission was definitely shown to be over 1,100 miles, whilst at night the audibility was good at 2,650 miles.

Tests at 109 metres showed that these waves behaved similarly to those used for broadcasting. Day

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RADIO ABROAD

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and night audibilities were rapidly attenuated, the former reaching the lower useful limit at 400 miles, whilst the latter was sufficient for satisfactory signals at 1,000 miles.

K D K A's Screens

An elaborate trapping and shielding system is used at Arlington for the reception of time signals from N A A for re-broadcast on K D K A's 309-metre wave-length. A receiving set is placed at a distance of about 100 feet from the transmitting station, and two extended aerials are used, one for long and the other for short waves. In order to tune-in N A A a wave-trap for each wave-band is installed before the receiving set. Outside wires are sheathed in lead, and the whole apparatus is screened by means of sheet metal covering. A metallically-sheathed cable conducts the signals to K D K A's transmitter.

Japan and Australia

D X listeners are interested in J O A K, the Tokio broadcasting station, and certain Australian stations. The Tokio broadcasting station operates on a power of 1,500 watts; Japanese stations are confined to waves between 360 and 385 metres.

3 L O, Melbourne, Australia, works on 371 metres, and 7 Z L, Hobart, on 390 metres.

Moscow

The Moscow broadcasting station, R D W, working on 1,450 metres, is rated at 12,000 watts. This station causes a certain amount of interference in England on wave-lengths in the vicinity of 1,450. It is found that in some cases the German station Koenigswusterhausen blankets the transmission from R D W, notwithstanding the difference in wave-lengths. The Moscow station frequently closes down with the "Internationale" on the Kremlin carillon.

Record Reception

A radio amateur in Manhattan Island; notwithstanding the enormous number of high steel buildings, has succeeded in logging 436 broadcast stations, having received up to date 368 verification stamps. This is all the more remarkable since there are 47 stations in the New York area, most of them broadcasting each night,

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RADIO ABROAD

—concluded from page 557

and these form a barrage which necessitates constant manipulation of the dials to get through the waves.

Interesting Papers

In the "Proceedings of the Institute of Radio Engineers," Volume 15, No. 1, will be found two very interesting papers, one by Brown and Knipp on the "Behaviour of Alkali Vapour Detector Tubes," and another by Crossley on "Piezo-electric Crystal-Controlled Transmitters." These papers contain a considerable amount of useful information, and are well worth consulting by those experimenters who are seriously interested in the subjects mentioned.

CHOOSING YOUR VALVES

—concluded from page 520

"more efficient" brother the 6-volter. My correspondents are quite right—there is a tendency to forget the wonderful 2-volter, and though the 6-volt valve may give that little extra "punch," it is certainly only second in popularity to the 2-volt valve, and, taking everything into consideration, I think rightly so. Till recently, however, there has been a dearth of 2-volters in certain classes. For instance, the 6-volt high amplification valve had, in some cases, no counterpart among the 2-volters, and the very low impedance 6-volter was "alone in the world." Nothing of the 2-volt class could really take its place, but the advent of the S.P.18/RR has changed this, and no doubt others will follow.

Now, except in special circuits, it is possible to change over from 2 to 6 without serious loss of efficiency, and often this loss will be mainly imaginary. But in changing over, note the characteristics of the present valves and replace these with valves of as nearly as possible the same characteristics, and then I think you will find that wherever a set is described or discussed and valves are mentioned, the voltage can be altered to suit your own taste, and for any valve mentioned another, in either of the other two classes, may be found to take its place.

IN OUR TEST ROOM

—concluded from page 544

"Griphco" Permanent Detector

Quite the best permanent crystal detector we have tested for a very long time is that one mentioned at the heading of this paragraph. It is manufactured by A. W. Griffin and Co., of Redditch, England. It is permanent in the strictest sense of the word—to the purchaser it is just as permanent as well—a grid leak, for instance. It is merely a small cylinder with a terminal screw at each end which is used for both mounting and connecting purposes. Despite the permanency of the device it yields loud, clear signals, and is not thrown out of adjustment when used in a crystal-valve circuit and when subjected to fairly heavy inputs.

Vibration does not appear to affect this detector. The samples received for test have been under observation for a number of weeks, and at times have been fairly roughly handled, but not one shows signs of deterioration. Messrs. A. W. Griffin state that their "Griphco" detectors are guaranteed indefinitely, and that they are prepared to readjust any that become insensitive through accident or short circuit, merely stipulating that postage both ways must be paid on detectors sent them for this purpose. The price of the "Griphco" is 2s.

"Elka" Plug-In Coils

We recently examined and tested a range of Elka coils, a product of L. Kremner, of Shudehill, Manchester. They are claimed to be indestructible, and undoubtedly they are as rigidly assembled as anything of the nature we have seen. The plugs and sockets are mounted directly upon solid former structures. These latter carry the windings in spaced sections. Solidity is an undoubted advantage in a plug-in coil, for such a component is liable to receive a fair amount of rough handling during its life. We are all apt to whip such accessories out of their holders, well, shall we say hastily, during a period of exciting DX work, and it has been a fault of some coils of the past that they tended to come adrift under such treatment. These "Elkas" will stand up to more than the usual hard work with equanimity, and on test we found them to be well up to standard from an electrical point of view.

RADIO NOTES AND NEWS OF THE MONTH

—*continued from page 499.*

themselves. Rome, the most recent recruit, has been testing its new high-power station on about 1,250 metres, and concerts from this source should be well worth listening to, if the station comes over as well as its younger brother does on the shorter waves.

More Overseas Items?

Although little is being written about it, there seems a steady trend of opinion towards the regular inclusion of "foreign" items in British programmes.

The Keston relays of America on Tuesday evenings, for instance, have been exceptionally well spoken of, and the B.B.C.'s recent switching-in to a Vienna concert was a pronounced success. Several Continental stations are now falling into the habit of picking-up and relaying British broadcasts, and this and the recent conference upon the interexchange of programmes all point to developments in this direction ere long.

A Novel Programme

Amidst all this talk about brightening up the programmes, I have not seen a more original suggestion than that put forward by a provincial newspaper, which recently announced that, "What listeners really want really is Htlemtton% G£ ½]£@cZ."

Well, it would make a nice change from *conversazioni*, and this chamber-music, wouldn't it?

Empire Telephony

A very pleasing feature of recent wireless developments has been the tendency to interaction between different sections of radio work. Take the "Beam," for instance.

At first glance it would appear to be of little interest to the average listener—until we learn that Senatore Marconi has been trying to superimpose an ordinary broadcast programme on to the Beam telegraphic trunk-line across the oceans. And, extraordinary as it may seem, the Beam appears to be quite capable of carrying a programme across to Australia just as well as it does the dots and dashes for which it was designed!

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RADIO NOTES AND NEWS OF THE MONTH

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Australia on a Crystal?

Such a stunt as this opens up unlimited possibilities. It is going to bring the marvels of the Beam right home to us, and places Australia within crystal-set distance!

Very few of us ever want to *telegraph* to New Zealand, or South Africa, so we cannot be too terribly thrilled just because we know there is a Beamish-Boy sitting in the London Central Telegraph Office who is in constant communication with the ends of the world by beam radio. But if it transpires that this young fellow-my-lad has *programmes* up his sleeve—music from the Cape, songs from Canada, and Empire greetings all round—why then, this "Beam" business gets really interesting, don't you think?

"Daventry Junior"

The B.B.C.'s experimental station at 5 X X, generally known as "Daventry Junior" seems likely to be in for a busy life.

Report already says that when this station has finished the present tests in connection with the scheme for "regional broadcasting," it is earmarked for short-wave Empire experiments. Whether or no this conversion to the short waves takes place, there is every sign of a nice big etherfull of interesting developments for many moons to come!

The Corporation's Progress

From "The Average Listener's" point of view, programmes of late have been very disappointing. The "Average Listener," as you know, is the chap who writes to the papers on the least pretext, grumbling about the broadcast programmes. And lately he has been rather hard put to it to find real excuse for grumbling!

The fact is that the new Corporation has settled down to try and make British broadcasting perfect. Of course, they won't do it. But at the moment there is a very healthy zest and zip about the programmes and procedure that speaks well for the future.

Wireless Figures

Amongst the figures recently made public were interesting ones relating to the Transatlantic radio 'phone service—257 calls westward, and 398 eastward, up to April 1st.

On the same date the number of ordinary broadcasting licences issued stood at the uncommonly respectable total of 2,234,988. In addition 4,403 free licences for the blind have been issued.

The Concert of Europe

Including the new Irish relay station at Cork (400 metres) the total number of broadcasting stations in Europe is 164, according to a census recently taken. And by the time these lines are in print that number will probably have been greatly exceeded!

Moreover, Europe's radio progress cannot be judged by numbers alone, for most of the old stations have caught the More-Amps. Fever, and are gingering up their power as much as the law will allow and the aerial insulators will stand!

A Milan Monster

Germany is busy with super-power stations, it having recently been decided to raise the power at Berlin-Witzleben to 30 kilowatts. The Danes have a high-power station up their sleeve that is expected to take the air in July, and the Greeks, having finished the Athens station, are contemplating the erection of five more transmitters to cover the country.

Then Milan, tired of being interfered with, is putting the finishing touches to a regular Mussolini of a station with 7 kilowatts in its aerial!

Hungary, Too!

Not to be outdone, the Jugo-Slavs—or should it be Jugo-Slavians?—have saved up all their dinars to provide a nice new station for Belgrade. And across the way, the Hungarian Post Office, in a "huff-you-for-not-taking-me" mood, are right now at work upon a big 60-kilowatter, to be ready by the end of the year!

3-Valve Set for 6d.

I hear that the Birmingham No. 1 Branch of the British Legion is getting up a fund for a children's outing day-in-the-country stunt, and for every 6d. you send your name goes "in the hat."

On July 15th Mr. J. Smedley Crooke, M.P., will draw from these, and the lucky number gets a complete 3-valve set for a prize!

Donations to the fund may be sent to the Number 1 Branch, British Legion, "Hope and Anchor," New Canal Street, Birmingham.

Historic Broadcast

When the Duke of York opens Australia's new Houses of Parliament at Canberra, on May 9th, his speech will go out on to the ether from every broadcasting station in the country.

By means of the radio link the whole nation will join in singing the National Anthem, led by Australia's own great prima donna, Dame Nellie Melba.

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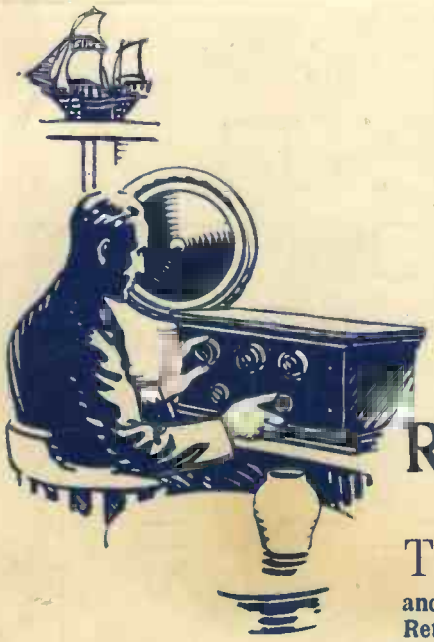

Right, First Turn

THERE is no quicker or easier way of finding any station between 200 and 4,000 metres than with the R.I. Retroactive Tuner. Right, first turn, is the rule with this time-, and money-saving instrument.

All bother with coils is eliminated and a greater efficiency is gained, for the R.I. Retroactive Tuner secures the correct aerial reaction over the whole range of wave-lengths covered. In addition this tuner costs appreciably less than a set of coils with coil holder to cover the same range.

The R.I. Retroactive Tuner provides the easiest, most efficient and most economical method of tuning which you can incorporate in your set. Follow the lead of all the famous set designers and constructors and improve your tuning arrangements from to-day with the R.I. Retroactive Tuner.

PRICE 39/6

Write for the R.I. Green and Gold Catalogue.

THE MARK OF RI BETTER RADIO

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Printed and published by the Amalgamated Press, Ltd., Fleetway House, Farringdon St., London, E.C.4, on the 1st of each month. Address for Advertisements only: John H. Lile, Ltd., 4, Ludgate Circus, E.C.4. Telephone: City 7261. Registered for transmission by Canadian Magazine Post. Subscription rates: Inland and Abroad, 17/- per annum; 8/6 for six months. Sole Agents—Australasia: Gordon & Gotch (Australasia), Ltd.: South Africa: Central News Agency, Ltd.; Canada: Imperial News Co. (Canada), Ltd.—May, 1927. R/R