SPRING DOUBLE NUMBER

MODERN WIRELESS

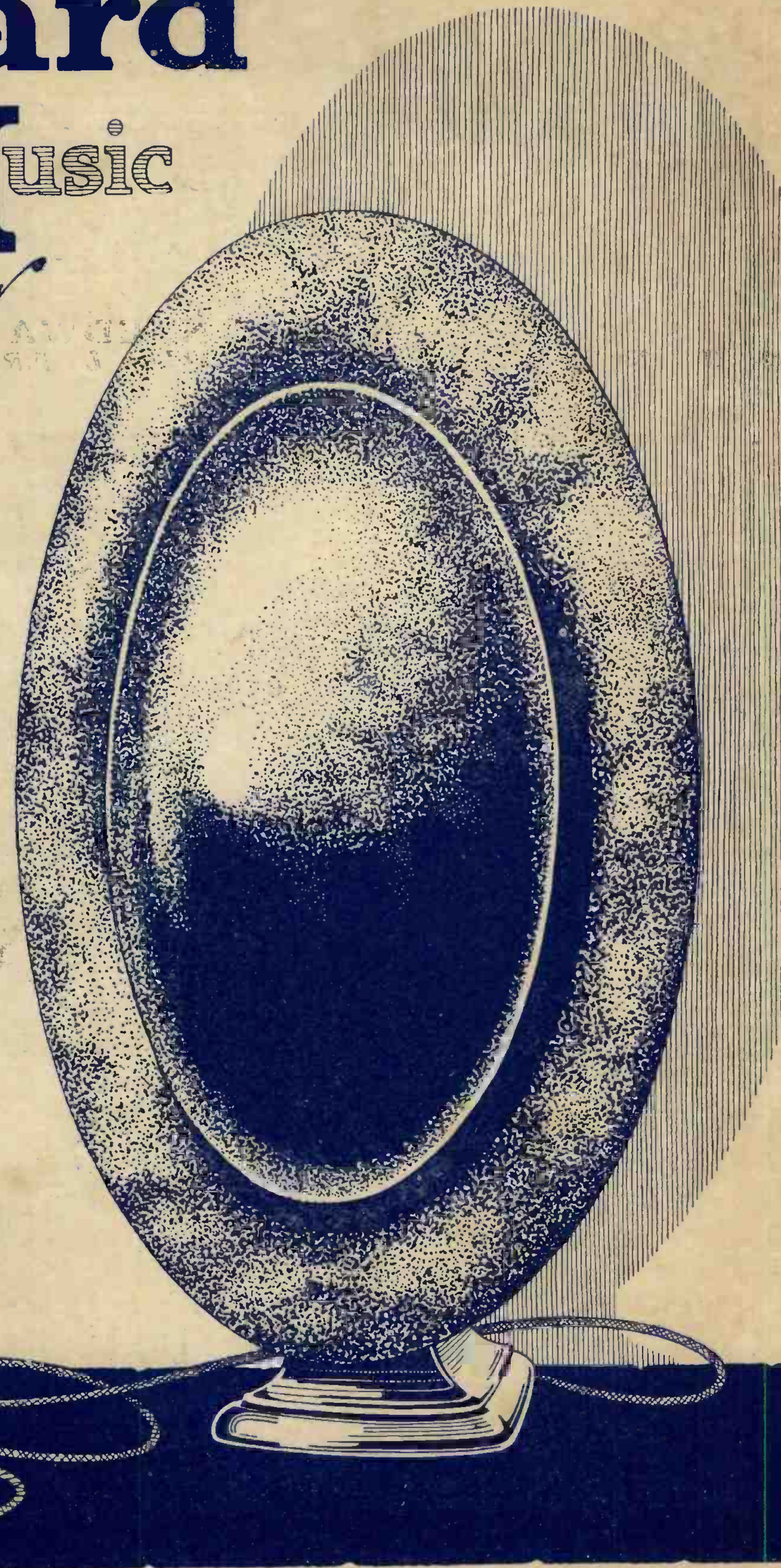
1/6

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

Vol. VII. No. 3. MARCH, 1927.

Mullard

PureMusic Speaker



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

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RADIO NOTES AND NEWS OF THE MONTH

A Feature in which our Contributor brings to your notice some of the more interesting and important Radio News Items of the Month.

Conducted by = = = P. R. BIRD.

Daventry Junior

INQUIRING for Young Daventry, the 400 - metre station that is being erected for experimental purposes, I learn that he is "getting on very nicely, thank you." How long it will be before the young rascal is shouting loud enough for listeners to hear him is uncertain, but there is talk of making this new test station the first of Britain's regional transmitters. If everything goes smoothly it is probable that we shall be getting those longed-for alternative programmes from 5XX Junior in a little over six months' time.

Manchester's Little Flutter

Listeners in the Manchester district have already had a foretaste of the delights of alternative programmes. When the Manchester Radio Scientific Society opened up their new amateur transmitting station, 2HD, it came on the ether with a very nice little concert—much to the surprise of the B.B.C., who imagined that they had a monopoly of that kind of thing! The Post Office people, absolutely staggered by this breach of the ether peace, sent a snorter of a letter to the Society, implying that to entertain the public in this way (free of charge, too!) was a sin! So 2HD, after one glorious flutter, is going warily!

A Short-Wave Whale!

Of all the recent short-wave successes, I particularly like that of Mr. C. W. Goyder (G—2SZ). Mr. Goyder, as you probably remember, hangs out a very pretty aerial at the Mill Hill School, London.

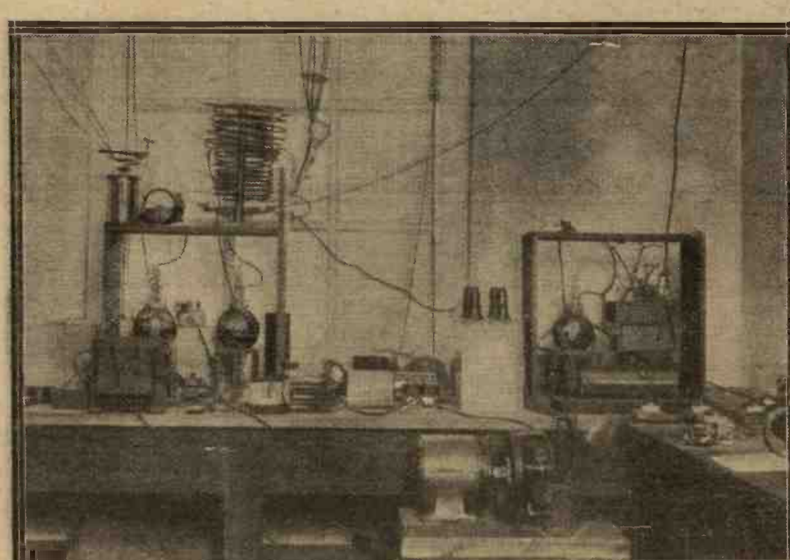
Angling from there one peaceful Sunday afternoon, he threw out some nice bait—in the form of a general call—and waited patiently to see what would rise from the short waves. (He was "fishing" on 32.2 metres.) Suddenly the Sabbath calm was broken by a terrific commotion in the 'phones. He had caught a whale! . . .

How They Hop!

When I say a *whale*, of course I don't refer to one of the old-fashioned "Come-in-Jonah" type, but to a radio-equipped whaling vessel. This one that Mr. Goyder picked out of the ether was down in the Antarctic, whaling away the time, close to the great Ross Barrier. Communication was very clear both ways, the only interruption—funnily enough—being messages to H.M.S. *Renown*, bound for Australia with the Duke and Duchess of York aboard! How those short waves can hop, to be sure!

Two Million—Mostly Bored

According to the Post Office figures the total number of receiving licences in force at the beginning



Short Wave Successes.
A view of the Mill Hill School amateur radio station, which is in communication with wireless enthusiasts all over the world.

RADIO NOTES AND NEWS OF THE MONTH—*(Continued)*

of this year was 2,179,000. It is calculated, too, that included in that number there are at least three people who hold the view that the programmes do not contain too much talkee-talkee!

Telephony by the "Beam"

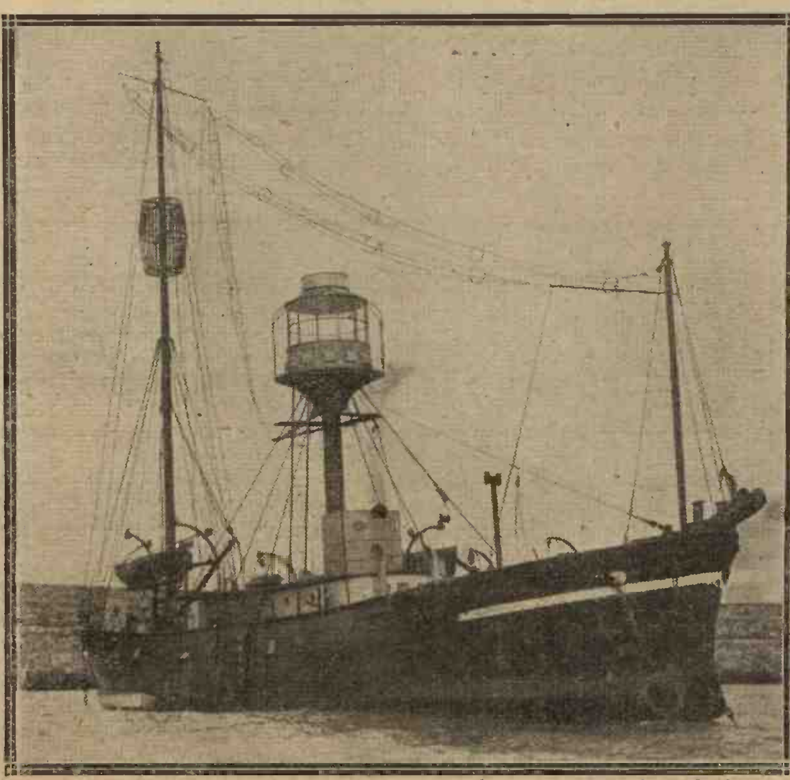
"The Duke of York will be opening the new Houses of Parliament in Australia this year. If a wireless telephony service on the 'Beam' system were established, . . . I can see no technical difficulty in the Duke's speech being sent to London by wireless, and broadcast by the B.B.C." Thus Mr. Kellaway, managing director of the Marconi Company, in an interview with the *Observer*. It would appear that either Mr. Kellaway has got Mark Tapley out-Tapleyed, or else those "Beam" telephony experiments are going on extremely well!

Some Aerial!

I hear that not content with the Postmaster-General's meagre allowance of 100-ft. for an aerial wire, Dr. Ellison, an Ulster experimenter, recently erected a single-wire aerial *two thousand five hundred feet high*. Steel piano wire was used, the free end of the aerial being effectively chaperoned amongst the clouds by a large box-kite. The wire was attached to an iron post for earth, and it is said that when a crystal set was connected to it, the American broadcasting stations fairly shook the old catswhisker!

Revolutionary Radio

Pessimists who thought that radio invention was going to stand still during 1927 have had a bit of an eye-opener with the advent of the new British valve, the KL1. Designed to run off the A.C. mains, it cunningly cuts out all trace of A.C. hum by using a sort of floating filament, not connected to the set at all, but connected through a transformer to the A.C. mains. This floating filament heats up a sort of phantom filament, that stands cheek by jowl, inside the bulb—and it is this "phantom" that emits the electrons and is controlled by the grid. For downright originality the KL1 certainly makes a bold bid for the Peek Frean.



A Wireless-equipped Lightship.
The lightship "Albatross," fitted with a synchronised wireless Beacon Submarine Oscillator, is to be stationed at the entrance to Dublin Bay.

An Empire Short-Wave Station

Amongst the most interesting of the radio possibilities that loom ahead is that of an Empire short-wave broadcasting station. Of course, the old Broadcasting Company—with one watchful eye on its income and the other upon its caustic critics—had to go warily when a scheme was proposed for providing buckshee entertainment for Britons abroad. But, unlike the Company, the Corporation could let itself go on the grounds of sentiment and of technical progress, so we are probably having an Empire broadcasting station, after all.

A Fine Result

Recently the Southampton magistrates, investigating some little irregularities in regard to listeners who had failed to go through the formality of getting a licence, inflicted fines upon half a dozen of these "pirates." And within a week of that more than double the usual number of new licences were taken out in the Southampton area! Of course, the Post Office people didn't *say* anything—but they took the dibs and thought a lot.

"Broadcast" or "Broadcasted"?

Because the Editor of the *English Review* allowed it to appear in an article, a reader wrote to him protesting against the "truly appalling word 'Broadcasted.'"

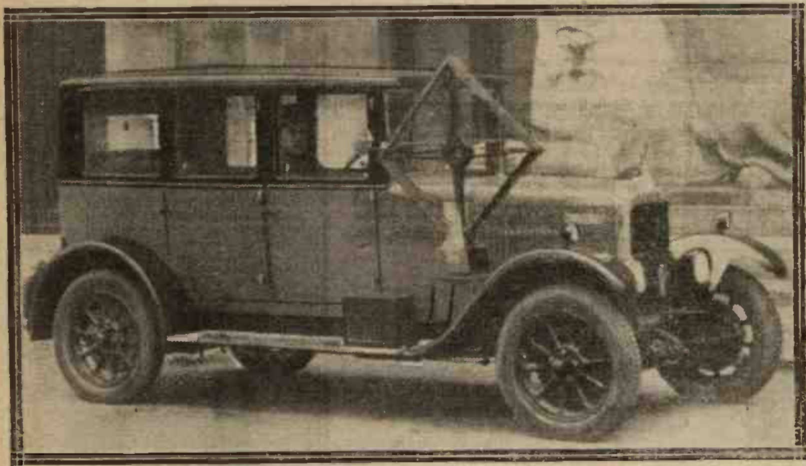
"Many of your readers," he said, "must have felt(ed) bad and almost wept(ed) to see that it had got(ted) past(ed) you. Can it not be lost(ed) and kept(ed) out in future?"

A Brighter Ether

The B.B.C. is certainly taking advantage of the granting of facilities for sporting news. The forthcoming events include a Cup-Tie match (Sixth Round), the Grand National, and the Oxford and Cambridge boat-race. If only the programme people would now cut out the culture-prattle, ter-

RADIO NOTES AND NEWS OF THE MONTH—(*Concluded*)

minate the uplift talks, and drop dirge-like music, the ether would be positively bright and beaming, wouldn't it?



Wireless Awheel.
A celluloid case protects the frame aerial from the weather, and permits of reception whilst travelling at speed.

The Terror by Night

In the course of a fascinating lecture upon Television, Mr. J. L. Baird, the inventor, was telling a large audience at Birmingham University of his method of using infra-red rays.

"Using these rays," he dramatically declared, "you can see a person sitting in complete darkness."

"*Shame*," shouted an undergraduate at the back of the hall—and the audience, all tickled at the same moment, rocked with laughter.

The Technical Queries Department

I am pleased to be able to announce that there has recently been an important extension and revision of the Technical Queries Department. Organised to assist readers with their radio problems, the department has now been enlarged and placed in charge of Mr. G. P. Kendall, B.Sc. All kinds of radio queries are answered for a small fee, diagrams can be drawn up, legal opinions are obtainable, patent advice can be given—in fact, the aim of the Department is to help *you* with your radio difficulties.

Experts to Help Readers

Amongst the experts whose full-time services will be devoted to answering readers' queries are Mr. Johnson-Randall and Mr. L. H. Thomas, both of whom have recently joined the permanent Technical Staff. Further details of the revision appear upon the "Questions Answered" page in this issue. Readers are reminded that in addition to a large permanent staff, the services of eminent consultants are retained, so that helpful and really authoritative answers can be given to all radio queries.

The Unlucky Wavelength

Amongst the wavelengths which Geneva allotted to Gt. Britain was one Jonah-wavelength, which nobody loves. The outcast in question is 326·1 metres. The B.B.C. have bestowed this unlucky wavelength upon Bournemouth and Birmingham, but in both places there has been a great outcry against "Jonah."

THE "COMBINE" FIVE

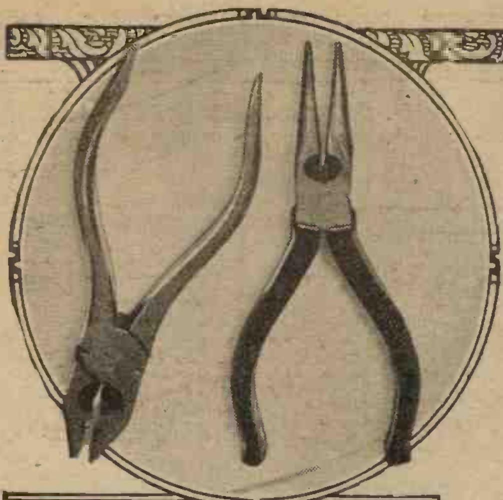
With this, the March issue of Modern Wireless, we are presenting a well-illustrated book free to every reader, in which is detailed the construction of a first-class, up-to-date five-valve receiver. This set, the "Combine" Five, is the result of the careful and close collaboration of ten leading set designers.

Every constructor should keep this book by him; even if he is satisfied with his present set, the time may come when he will want to "go one better."

The "Combine" Five is for use with an ordinary indoor or outdoor aerial, and its loudspeaker range appears to be limited only by atmospheric conditions. It will cut out the local station and bring in practically everything "on the air" without fuss or worry. It does not require an expert to build or handle it. Pure reproduction on the speaker, of really long distance stations is almost inevitable with this "dernier cri" in multi-valve sets.

The Duke's Tour.
The radio receiver which is installed in the "day-room" of H.M.S. Renown.

Practical Workshop Hints



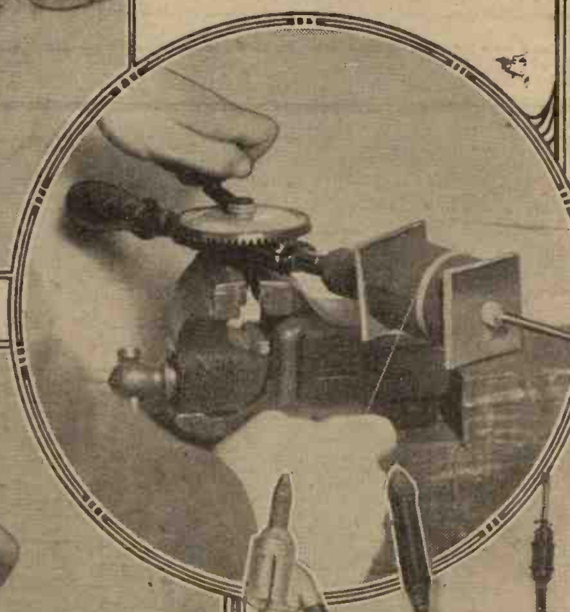
Although wireless sets can be made with ordinary household tools, the constructor would often be saved much trouble by a timely purchase of tools specially suited to his needs.

To the left are some useful cutting pliers, the nearer pair having an insulated handle, and tapering so that wires can be rounded for looping over terminals, etc.

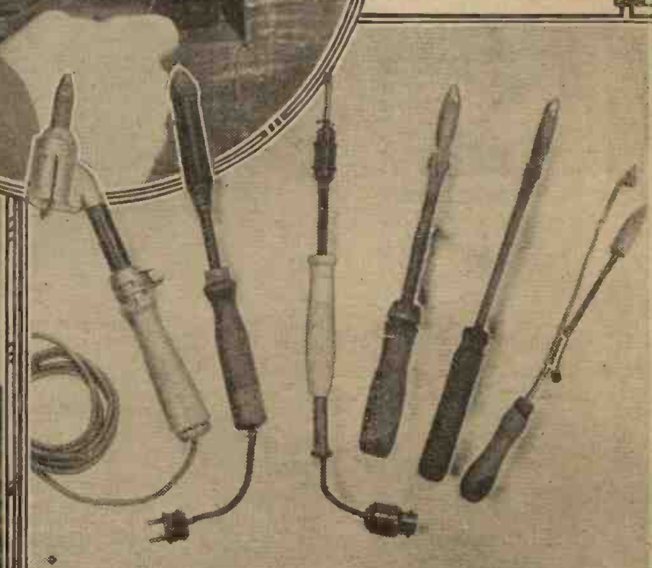
Above (to the right) is a spiral ratchet screwdriver, and beside it is a plain ratchet screwdriver.

A stock, with two dies.

Below is illustrated a useful coil-winding tip, employing a hand drill and vice.



The ordinary small drill can be used for cutting a thread if held in a bench vice and adapted as shown in the above photograph.

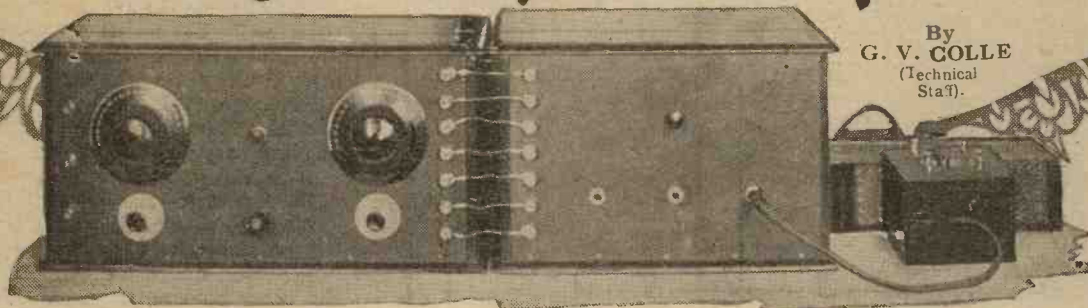


The soldering-irons (to the left) have plugs for electric heating from the mains.

A very novel soldering-iron—the top of which takes off during heating—is that illustrated on the right.

The Skyscraper Amplifier

By
G. V. COLLE
(Technical Staff).



THIS amplifier was designed primarily for use with the "Skyscraper"—described in MODERN WIRELESS last month—but it is also quite suitable for attachment to any other set that does not already include any stages of L.F. amplification, with the exception, perhaps, of a crystal receiver.

In arranging the circuit, first consideration was given to clarity, simplicity of control ranking next in importance.

Good Tone and Volume

A very good tone and volume were obtained with a coupling combination of anode resistance and L.F. transformer, as given in the list of components, but naturally, a great deal depends on the right choice of valves.

Owing to the great volume of sound given by two L.F. amplifying valves when the set is tuned to the local station, some type of switching that would allow the use of only one L.F. valve on such signals is necessary.

Consequently, jacks were fitted for this purpose, and when inserting the plug from the loudspeaker into the centre jack for one L.F. valve, the L.T. to the second amplifying valve is automatically cut off.

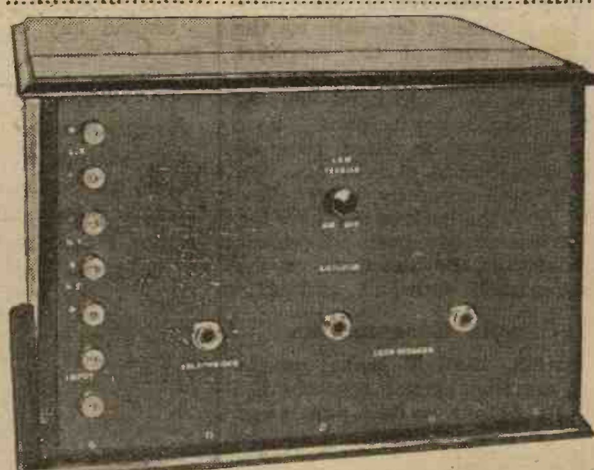
The need of those who desire to listen in on the phones, with the *set* only, has also been studied, and a jack has been arranged on the amplifier panel, so that the unamplified output from the receiver is available, without the need for disconnecting the amplifier.

When arranging a jack for this purpose no provision was made for switching off the filament current, for the following reasons:—

In the first place, many readers will prefer to use the first jack (marked "set only") for tuning in on the phones (using a separate plug), the loudspeaker plug being left inserted in the third jack.

As it takes but a few seconds to find a station when "searching" with phones, the waste of filament current is negligible, and on removing the phone plug, the loudspeaker is immediately put into action at full volume on all valves.

There are times, of course, when it may be necessary to use the set alone for some length of time; should this happen, the amplifier

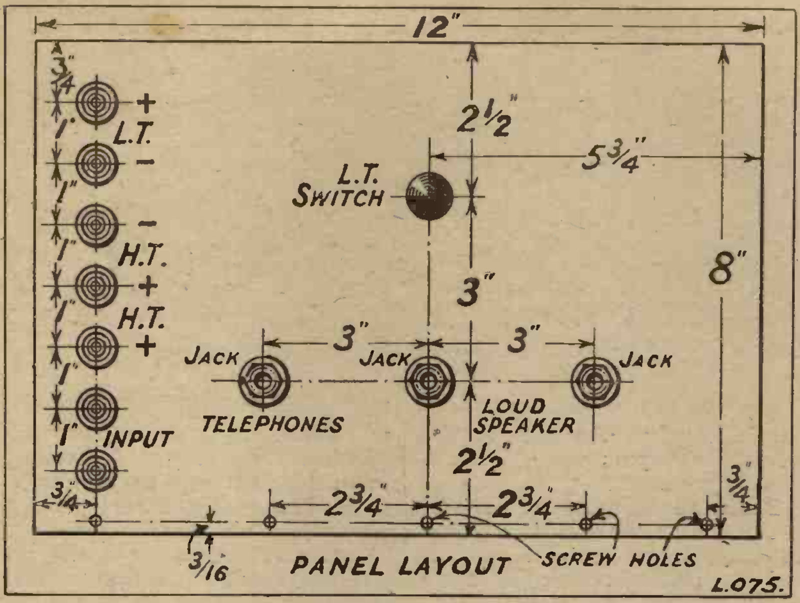


This view of the complete amplifier shows how the terminals are arranged to correspond with those on the "Skyscraper."

COMPONENTS REQUIRED

One cabinet 12 in. by 8 in. by 9 in. deep.
One panel to fit 12 in. by 8 in. by ¼ in.
Two anti-phonic valve holders.
One 250,000 ohm anode resistance.
One .0003 mfd. fixed condenser.
One .01 mfd. fixed condenser.
One .005 mfd. fixed condenser.
Two "Amperites" or fixed resistors.
One L.F. transformer (Ferranti AF3).
One L.T. switch.
One 2 meg. grid leak and holder.
Thirteen terminals W.O. type.
One G.B. battery.
Two grid bias clip holders.
One ebonite strip 12 in. by 1¼ in. by ¼ in.
Three Jacks—1 single closed; 1 double closed, 1 double closed with filament "on" and "off."
Several lengths of No. 18 S.W.G. tinned copper wire, transfers, screws, etc.

THE SKYSCRAPER AMPLIFIER—*(Continued)*



make reference to the list of point to point connections, which agrees in detail with the wiring diagram.

It will be noted that clips are provided for supporting the grid battery on the baseboard; before commencing the wiring they can be removed temporarily so as to allow easy access of the soldering iron to the jacks.

To facilitate the wiring, it is also a good plan to tin the soldering lugs on the jacks, those on the grid leak holder, and the projections on the valve holders, if provided.

The Jack Connections

Good use might be made of the photograph of the "close" up of the jacks, as it is rather difficult to show the arrangement of contacts at their ends on the wiring diagram, though the order in which the wires occur can be seen on the latter.

There is one wire which cannot be seen on the wiring diagram, owing to its point of connection being hidden, and as it concerns the L.F. transformer it would be well to note its position.

The wire in question connects the casing and core of the transformer to the −L.T. lead.

It is not an essential connection, but may prove beneficial in many instances, especially if the amplifier

can be put out of action by the simple expedient of disconnecting the +L.T. lead from the terminal on the ebonite strip at the back of the amplifier baseboard, and taking it to the +L.T. terminal on the main panel that "straps" the amplifier to the set.

Owing to the method adopted of fitting a series of terminals on the left hand edge of the amplifier panel, corresponding to the terminals on the right-hand edge of the "Skyscraper" panel, neat "straps" can be fitted between the two cabinets, thereby avoiding untidy and unsightly wires. The leads from the back of the amplifier baseboard supply both the valves on that unit, and also those on the receiver itself, with H.T. and L.T.

Simple Construction

Further, the L.T. switch on the L.F. amplifier panel controls the filament current to both panels and acts as a master control to the whole receiver.

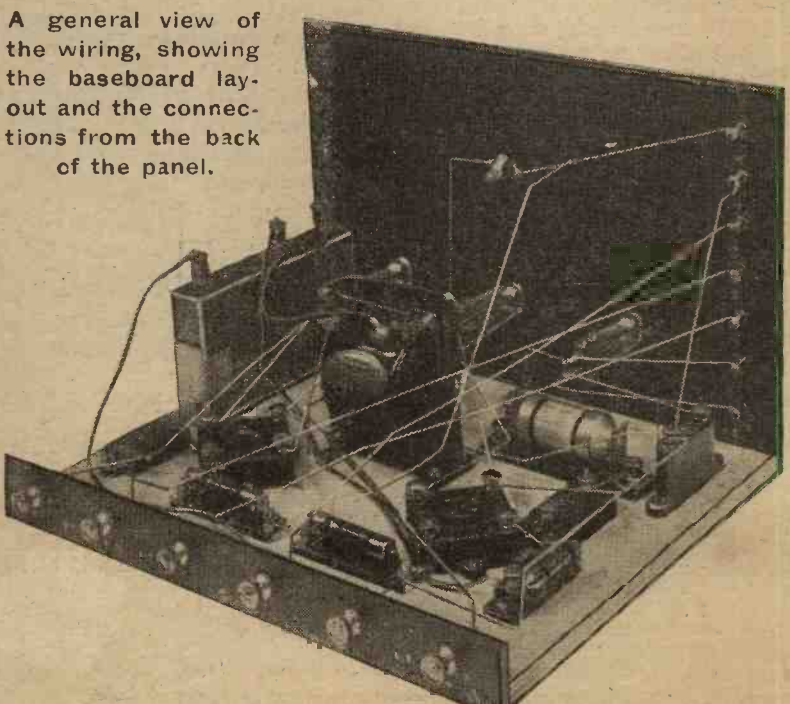
"Amperites" are employed to control the filament current to the L.F. valves. When ordering them (for fixed resistances) it will be advisable to specify the exact valves to be used as well as the voltage of the L.T. battery.

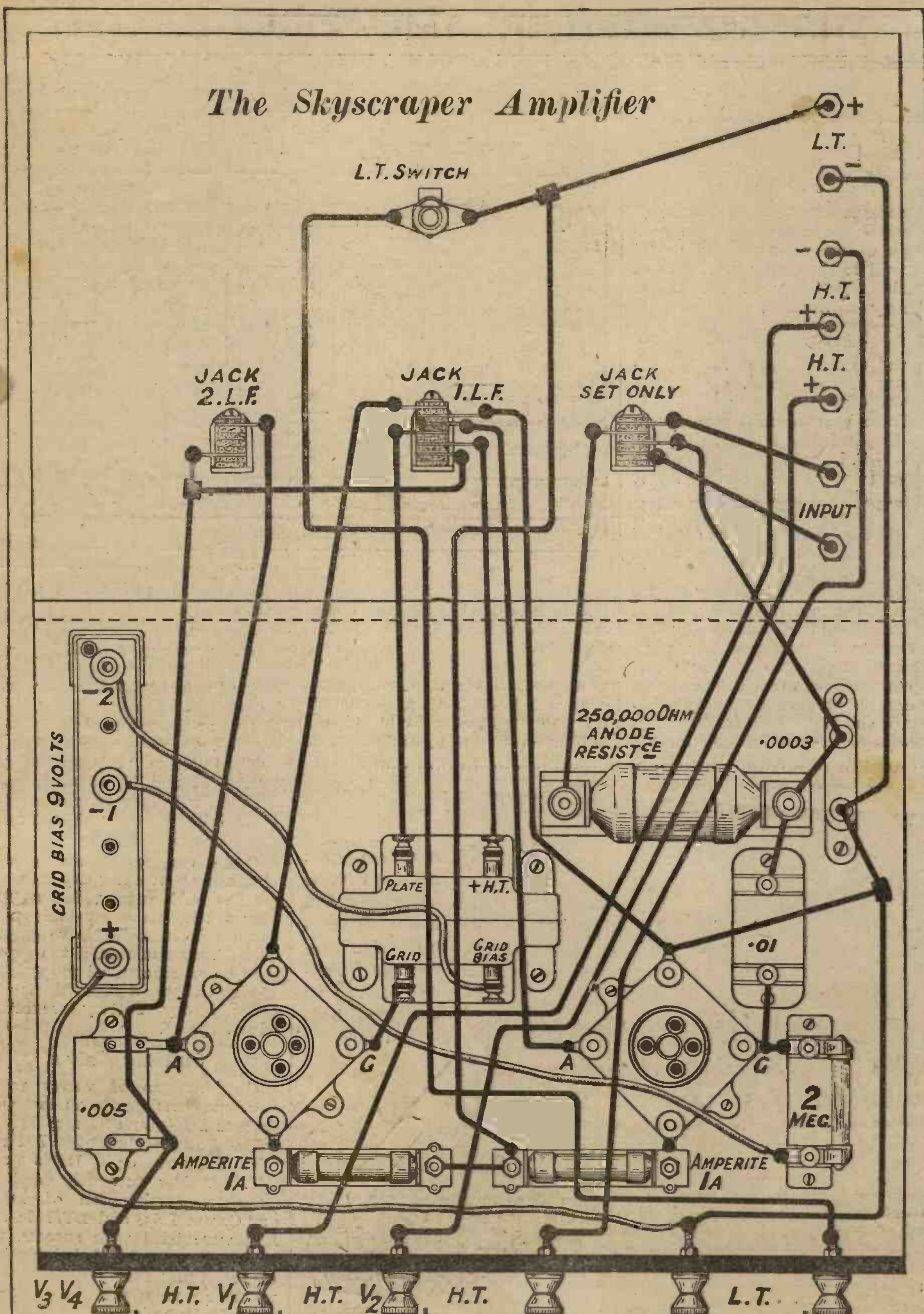
No mention has been made as yet of the actual construction of the amplifier for the simple reason that as photographs, a wiring diagram and panel layout are included with this article, fully detailed instructions are unnecessary.

In any case, there is no "snag" to be met with in construction, the assembling being a plain straightforward job. Wiring can be carried out with No. 18 S.W.G. round tinned copper wire. It will be seen that the leads go straight from point to point, right angle bends generally being avoided.

Should any of the connections not be clear to the reader, he can

A general view of the wiring, showing the baseboard layout and the connections from the back of the panel.





WIRING DIAGRAM.

THE SKYSCRAPER AMPLIFIER—(*Continued*)

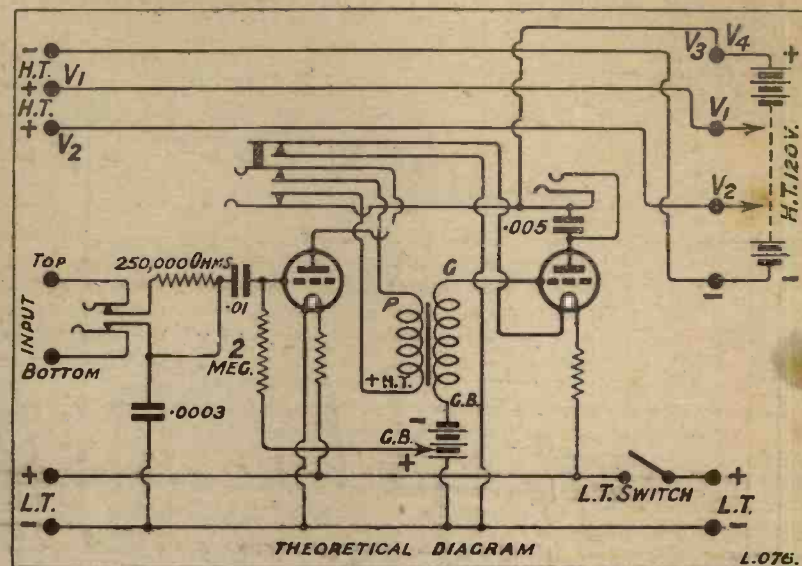
should tend to howl or give distortion.

Should the reader contemplate utilising an L.F. transformer already in his possession which does not incorporate this "earthing" terminal, he can ignore the connection, but otherwise he would do well to remember it in case of trouble from any of the causes already mentioned.

Operating Details

An upright type fixed condenser of ·0003 mfd. capacity is shown connected between – L.T. and the bottom inside contact of the first jack, and is arranged to by-pass H.F. between the anode of the detector valve and earth. As it assists clarity and tends to make the detector valve sensitive, it should not be omitted. It could, of course, have been joined direct across the anode resistance, but, unfortunately, this usually results in a slight loss in quality, and it was arranged as shown.

On the original amplifier a by-pass in the form of a fixed condenser of ·0003 mfd. was also connected across the primary winding of the L.F. transformer. (This condenser cannot be seen on the photographs or diagrams because it is incorporated in the case of the transformer itself by the manufacturers.)



Now, a few words about the H.T. voltages and the L.F. valves.

It was mentioned in the article on the "Skyscraper" that the H.T.'s on the H.F. and detector valves were 108 and 45 volts respectively.

When the amplifier is added the detector voltage should be raised to at least 100 volts (+H.T. V_2) owing to the high resistance that is included in its anode circuit, which in effect reduces the actual voltage applied.

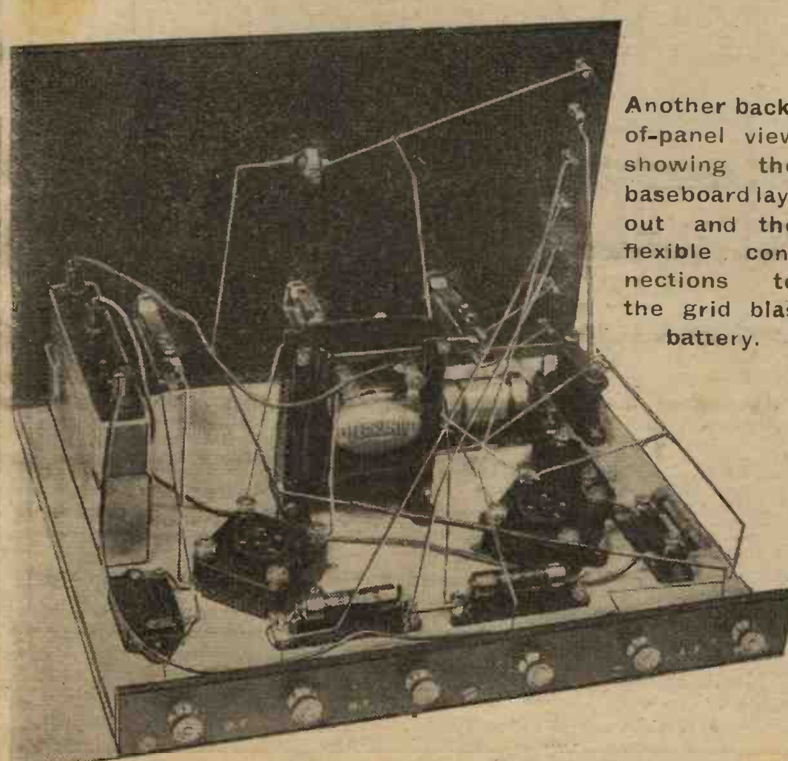
The voltage recommended on valves V_3 and V_4 is a minimum of 120, with the maximum grid bias advised by the makers for that particular H.T. value.

Quite consistent results were obtained when using dry batteries for the H.T. supply, but as four valves take an appreciable plate current it is advisable to employ an H.T. accumulator, if the supply is to be an economical proposition. Failing that, a special triple-capacity dry battery would be advantageous.

Suitable Valves

Combinations of valves which gave excellent results on test were Cosmos DE50 and Osram DE5A, DE50 and Mullard PM/256, S.T. 62 and 63, DE50 and S.T. 63. For extremely loud results a combination of DE50 and Osram LS5, and BTH B4 and LS5 were tried with success, the H.T. voltage on V_3 V_4 being raised to something like 300 volts with up to 40 volts grid bias, and a special Amperite being used in place of the 1A shown for V_4.

Further reference to the choice of valves will be found in the article



Another back-of-panel view showing the baseboard lay-out and the flexible connections to the grid bias battery.

THE SKYSCRAPER AMPLIFIER—*(Concluded)*

"That Valve Problem!" which appears on another page in this issue.

It should be mentioned, however, that when employing the Osram D.E.5a in the last stage it is necessary to increase the grid bias to at least 18 volts, and as a matter of fact voltages up to 27 have been successfully employed.

Use of a Filter

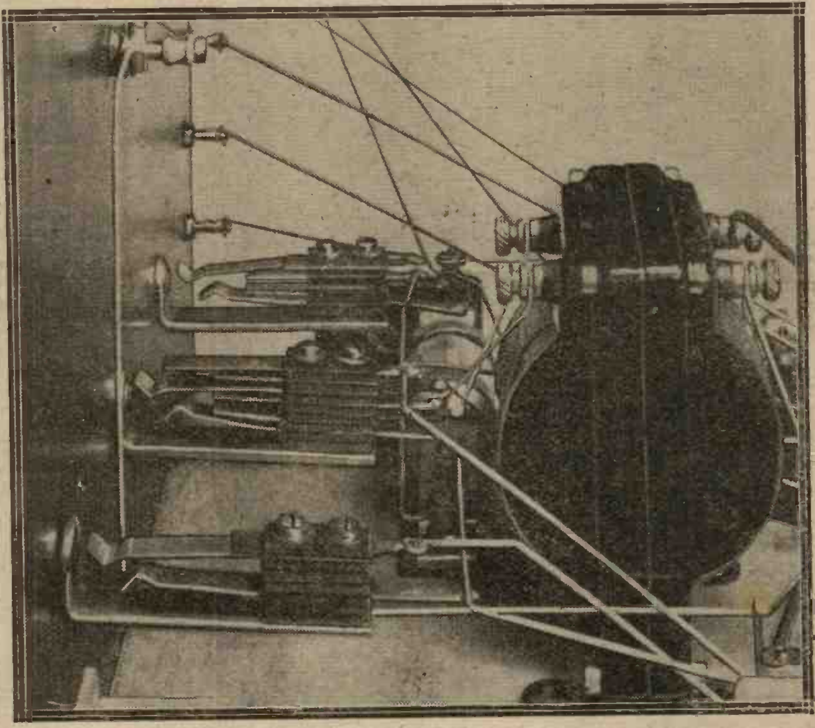
Naturally, the exact voltage would depend upon the H.T. supply to the plate of the valve, but I advise constructors to have at least —18 available. The Cosmos D.E.50 in the first stage required about three to six volts negative bias with 120 H.T.

A valve somewhat similar in operation to the D.E.50, and one which gives an equal clarity in volume, is the Mullard P.M.5; and as a matter of fact this is the valve that the makers of the L.F. transformer used in the set recommended.

No output filter circuit was incorporated in the amplifier, because this would only be available for use in the plate circuit of the last valve, owing to the jack switching arrangements, so that when the plug was inserted in jack No. 1 the filter circuit would not be in use.

If any reader intends to employ such a device either to protect the loud-speaker windings or for a tone control, he is advised to make it up as a separate unit, so that it can be utilised in the anode circuit of either of the L.F. valves and thus protect the loud-speaker in whichever circuit this may be placed.

A final word. Constructors must not forget that if they use a super-power valve in the last stage they will need an H.T. battery of ample capacity and should not attempt to run the set off one of the usual small size. The L.S.5 valve, of course, really needs H.T. from the mains or a high capacity H.T. accumulator.



This close-up of the back-of-panel shows the different types of jacks used and the wiring to these components.

CHECK YOUR WIRING BY THIS LIST :—

+L.T. terminal on panel to one side of the L.T. switch and to one side of each of the Amperites. Remaining sides of the Amperites to one filament tag on each of their respective holders.

– L.T. terminal on panel to one tag of the .0003 mfd. fixed condenser, remaining filament tag of the 1st valveholder, – L.T. terminal on baseboard, +G.B. plug and the second contact (counting from top) on the centre jack. Top contact on same jack to the remaining filament tag of the 2nd valveholder.

– H.T. terminal on panel to – H.T. on baseboard.

Centre +H.T. terminal on panel to the +H.T. terminal on the baseboard marked V_1.

Bottom +H.T. on panel to the +H.T. marked V_2 on baseboard.

Top and bottom "input" terminals on panel to the top and bottom outside contacts respectively of the 1st jack.

Top inside contact of 1st jack to one side of the anode resistance.

Bottom inside contact of 1st jack to the remaining tag of the .0003 mfd. fixed condenser, to the remaining side of the anode resistance and to one terminal on the .01 mfd. fixed condenser.

Other terminal on this condenser to the grid tag of the 1st valve holder and to one side of the 2 meg. grid leak.

Remaining side of grid leak to the 1st –G.B. plug.

Plate tag of 1st valve holder to the 3rd contact (counting from top) on the centre jack.

Fourth contact on same jack to the "plate" terminal on the L.F. transformer.

Fifth contact on jack to the +H.T. terminal on the transformer.

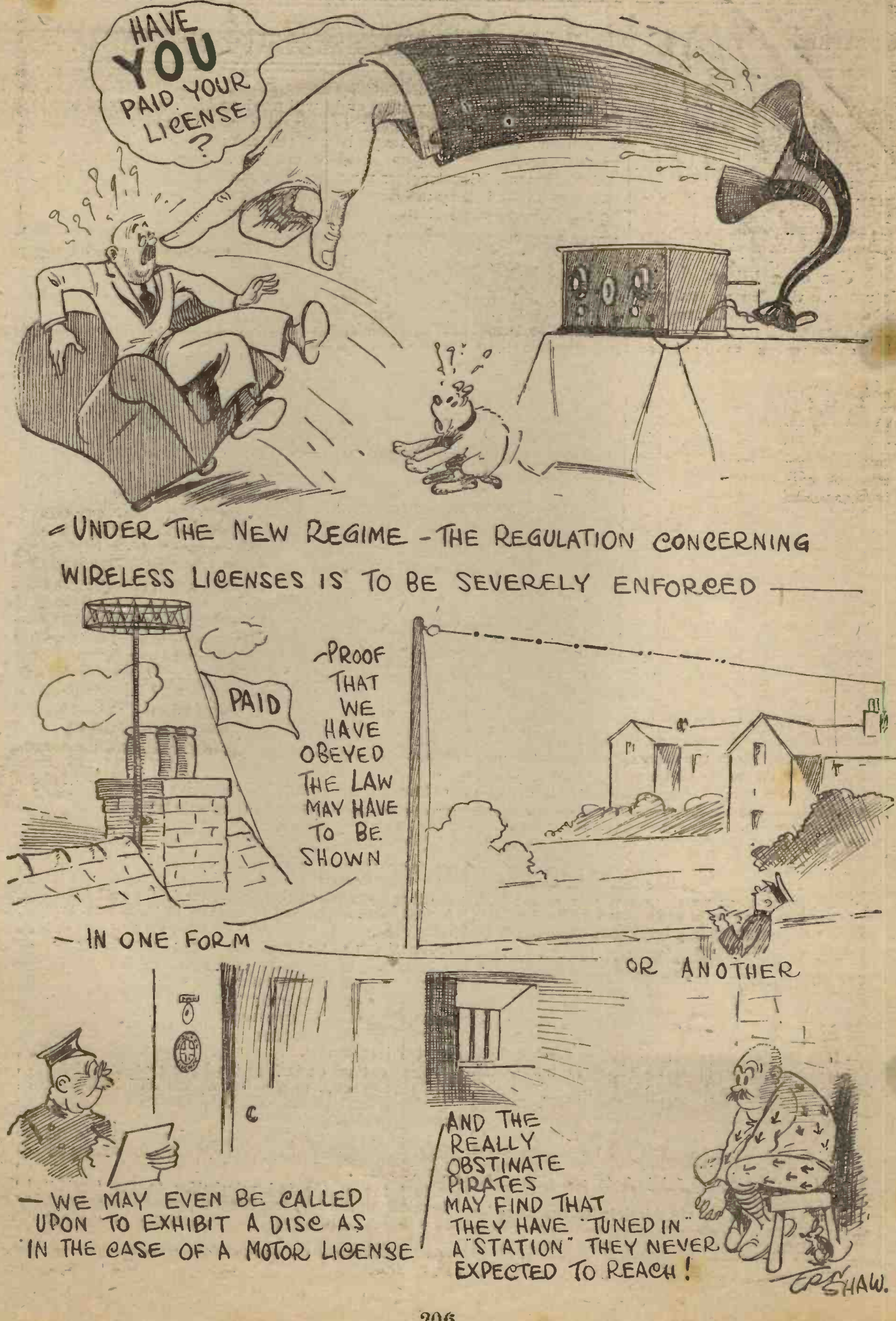
Sixth contact on jack to the bottom contact of the 3rd jack (2 L.F.), to one tag of the .005 mfd. fixed condenser and to the +H.T. terminal on baseboard marked V_3 V_4.

Other tag of the .005 mfd. fixed condenser to the plate tag of the 2nd valveholder and to the top contact on the 3rd jack.

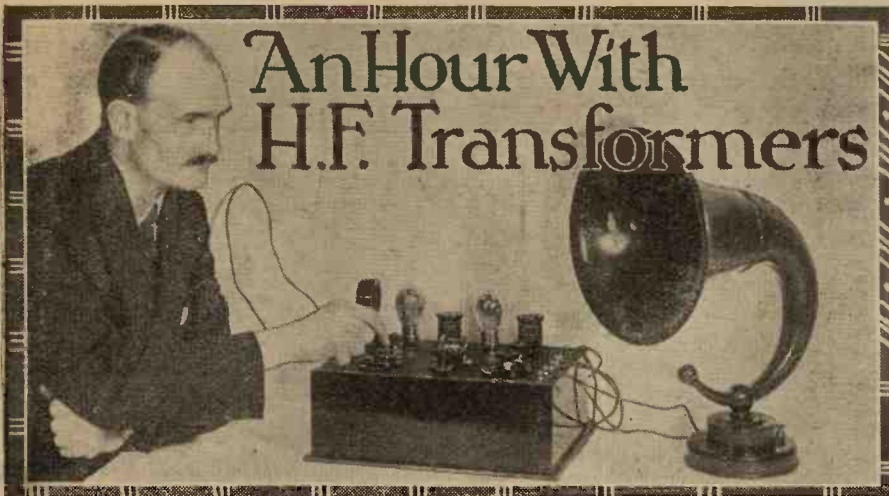
Grid tag of the 2nd valveholder to the "grid" terminal on the L.F. transformer.

"Grid Bias" terminal on the latter to the 2nd – G.B. plug.

This completes the wiring.


HAVE YOU PAID YOUR LICENSE ?
—UNDER THE NEW REGIME—THE REGULATION CONCERNING WIRELESS LICENSES IS TO BE SEVERELY ENFORCED——
PAID
—PROOF THAT WE HAVE OBEYED THE LAW MAY HAVE TO BE SHOWN
—IN ONE FORM
OR ANOTHER
—WE MAY EVEN BE CALLED UPON TO EXHIBIT A DISC AS IN THE CASE OF A MOTOR LICENSE
AND THE REALLY OBSTINATE PIRATES MAY FIND THAT THEY HAVE "TUNED IN" A "STATION" THEY NEVER EXPECTED TO REACH!
E. P. SHAW.

An Hour With H.F. Transformers



The amateur interested in H.F. work will find this article a perfect mine of valuable information. The photographs and diagrams, it will be found, will materially assist the reader in appreciation of the advice given in the Text.

By
PERCY W. HARRIS, M.I.R.E.
(Editor of "The Wireless Constructor.")

WHILE some wireless components may be considered separately, others can only be thought of in relation to their associated circuits. In the latter class comes the high-frequency transformer.

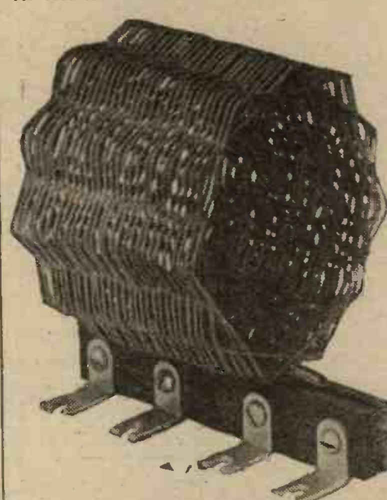
Before the Neutrodyne

I am led to begin this article with such a statement as there has been far too great a tendency to consider, not only high-frequency transformers, but tuning coils of all kinds, as if they were devices possessing self-contained virtues. The high-frequency transformers at present in vogue, highly efficient as they are, owe their development to the evolution of neutralised circuits and would have been very little use to us two or three years ago. In fact, until the arrival of the neutralised circuit their efficiency, of which we now think so much, was almost completely obscured.

I well remember attending a lecture given some years ago at the Radio Society of Great Britain (then the Wireless Society of London) by Mr. A. A. Campbell-Swinton, F.R.S., at which he exhibited a six-valve receiver with three stages of high-frequency amplification coupled by what was then a new type of interstage coupling, the plug-in radio frequency transformer.

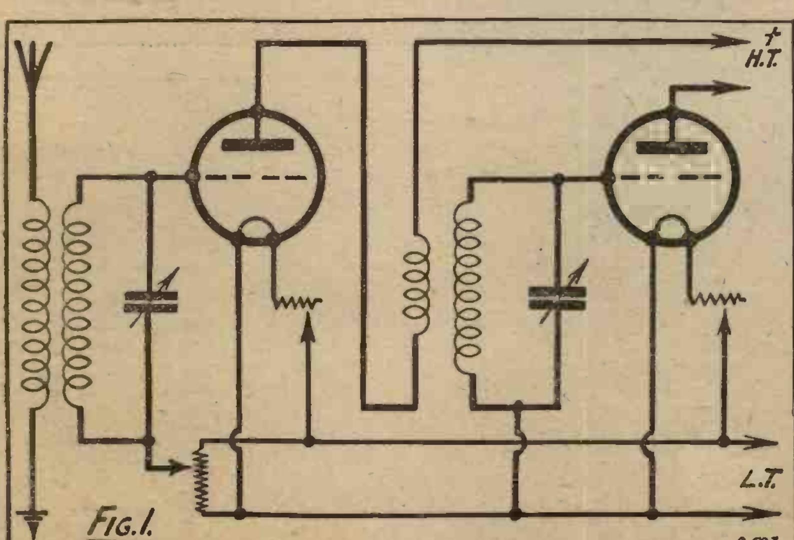
A Notable Invention

These transformers aroused considerable interest, consisting as they did of grooved discs of ebonite on which were mounted four pins of a size and separation identical with those of the legs of a valve. Two of these legs corresponded to the grid and plate pins of a valve and were connected to one winding,



An American commercial H.F. transformer for low wavelengths.

and the two others (equivalent to the filament pins) were connected to the other winding. They were the invention of Mr. Burbury, of Crigglestone, Wakefield (2AW), and were extremely compact and handy.



The potentiometer method of stabilising H.F. stages.

Potentiometer Control

The band of wavelengths then necessary to be covered was very large, for it must be remembered that the lecture took place in pre-broadcasting days, when the work of amateurs was almost entirely confined to the reception of Morse. Selectivity, or "sharpness of tuning" as it was then always called, constituted a point of interest in so far as it related to efficiency, but was not in itself a thing much

AN HOUR WITH H.F. TRANSFORMERS—*(Contd.)*

sought after for elimination of interference.

In the six-valve receiver to which I have just referred, interaction between stages gave undesirable oscillation effects unless a potentiometer was used to obtain stability. The scheme used was that shown in Fig. 1, from which it will be seen the lower ends of all transformer secondaries were connected to the slider of the potentiometer. By thus making the grid positive, grid current flowed, supplying the damping necessary in order to obtain stability.

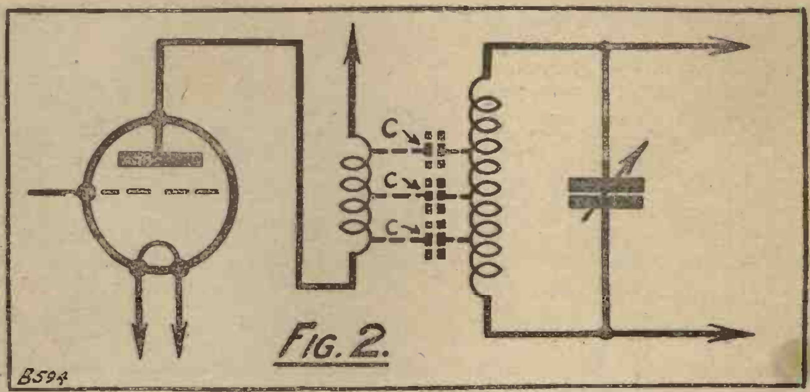


FIG. 2.

Illustrating capacity between windings of an H.F. transformer.

An Ingenious Manufacture

Before long these H.F. transformers were marketed by several firms. Non-interchangeable radio frequency transformers (some of them tapped) were already known in the Services, one particularly efficient form (for that day) consisting of a number of slots turned in a rod of ebonite or other insulation material, sections of the primary and secondary windings being placed alternately. All primary sections were joined in series, and all secondaries similarly. The self-capacity of the windings was considerably reduced by adopting this method.

An ingenious manufacturer then adapted this slotted arrangement with sub-divided primaries and secondaries to the four-pin base introduced by Mr. Burbury, the result being the barrel type of H.F. transformer, which first became popular with the home constructor on the introduction of my "Transatlantic" designs in this journal in the autumn of 1923.

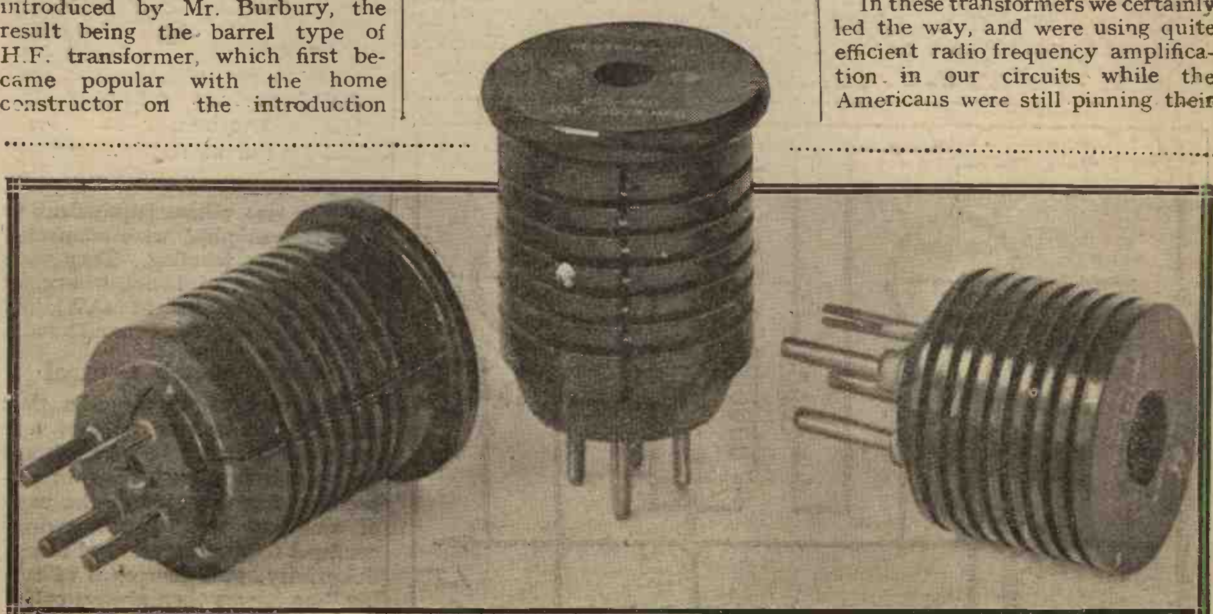
Results with Barrel Types

I would like to emphasise at this stage that these barrel-type radio frequency transformers were wound with very fine wire and were extremely compact. A few experimenters tried winding them with thicker wire to reduce the resistance, as well as in single layer form to reduce capacity effects, but were disappointed with the results obtained. The lower ohmic resistance tended to enhance the tendency to cause instability, while the necessarily greater dimensions when thus wound gave greater interlinkage of fields between stages. To compensate for the feed back introduced by this linkage of fields, still further positive bias on the grid was necessary, so that what was "gained on the swings" was generally "lost on the roundabouts."

Specimen transformers of this type are shown in a photograph accompanying this article, and in their day—particularly in well-laid-out sets—gave really excellent results. The selectivity, however, was quite poor measured against the standards of to-day.

Early American Practice

In these transformers we certainly led the way, and were using quite efficient radio frequency amplification in our circuits while the Americans were still pinning their



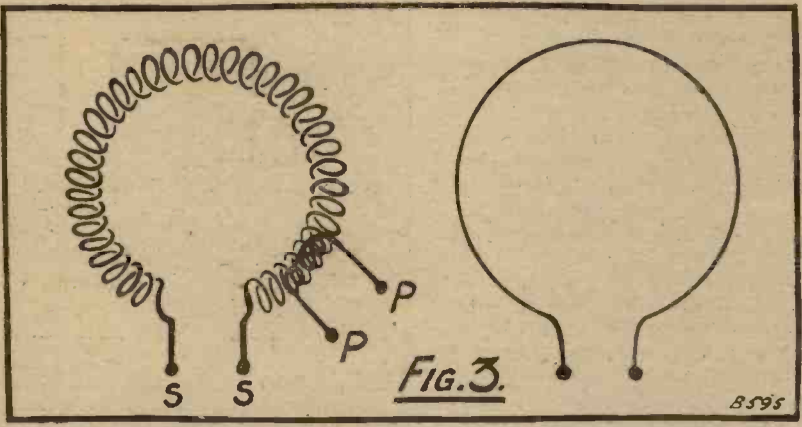
Three specimens of the older type of barrel H.F. transformer.

AN HOUR WITH H.F. TRANSFORMERS—*(Contd.)*

faith to critical reaction in a detector circuit followed by one or two stages of note magnification. This phase in the evolution of American radio design was followed by the introduction of a semi-aperiodic transformer—untuned—and often with iron cores. The gain per stage with these transformers was very low and they never became popular here.

Important Considerations

For a considerable time we for our part continued to use the plug-in small type of fine wire high-frequency transformer, while the Americans began to turn their attention to tuned radio frequency with single layer coils of more efficient design. By this time broadcasting had become an accomplished fact, and whereas we had to make our sets to cover a very wide range of wavelengths—far greater than could be efficiently covered with one coil and condenser—our American friends had a limited band easily covered by one coil. For this reason they did not pay any attention to interchangeability of radio frequency transformers, and for that matter have only taken to this type with the extension of the American broadcasting band.

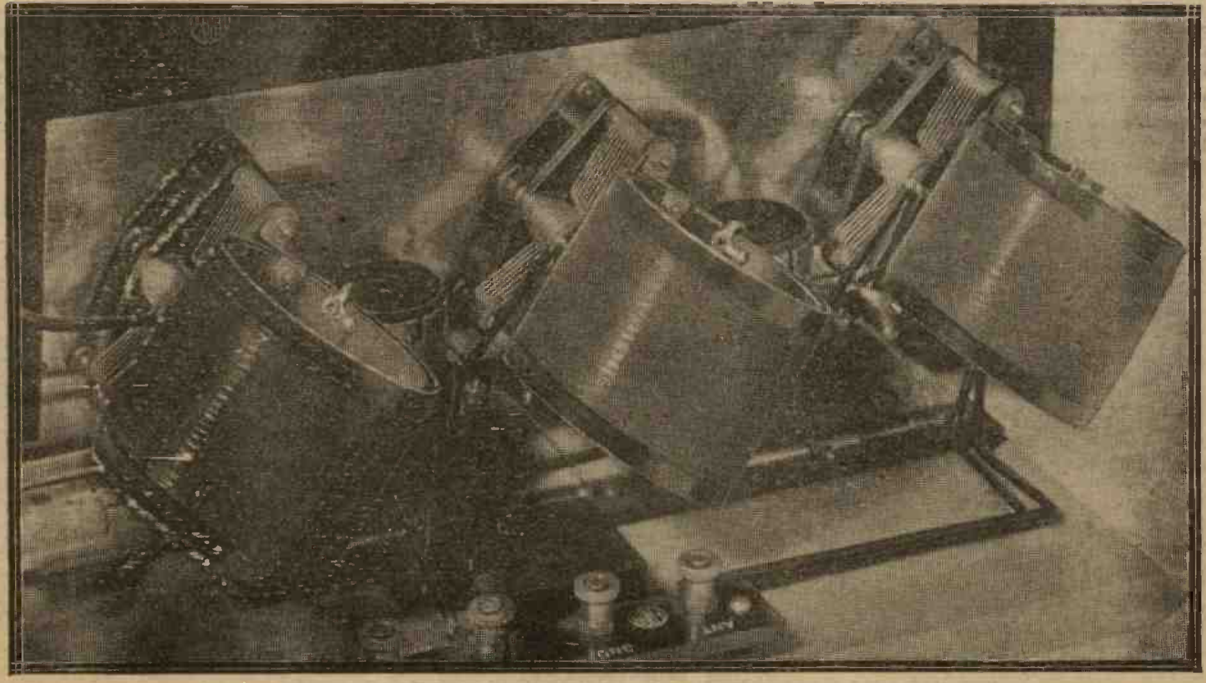


Left, a toroidal coil; right, a single turn giving the equivalent field.

It has been proved by many experimenters that, apart from other considerations, the single layer radio frequency transformer is distinctly preferable to the multi-layer type, having a much lower self-capacity (giving a wider tuning range with a given condenser) and much lower losses. Now a high-frequency transformer, being a means of coupling between one valve and another, has its primary windings in the anode circuit of one valve and its secondary winding connected to grid and filament of the next. A few moments consideration will show why it is so important to consider the conditions under which a particular high-frequency transformer is used and how it is not a device that can be considered alone.

A Neglected Factor

Certain requirements have to be met by both primary and secondary windings. The secondary winding must, of course, have such a value of inductance that it will tune over the required wavelength range with



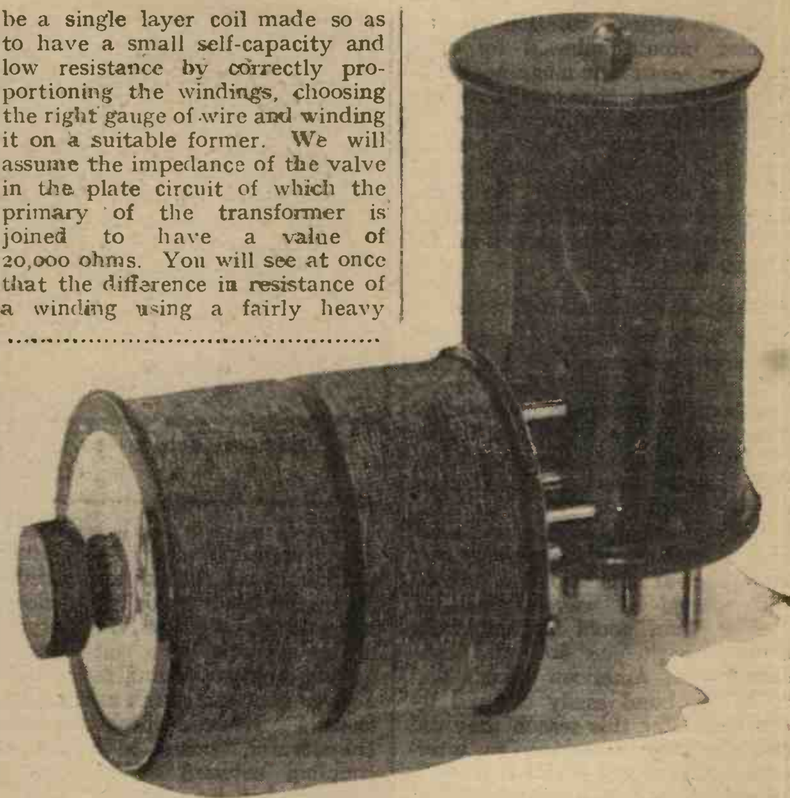
The Hazeltine method of reducing field interaction.

AN HOUR WITH H.F. TRANSFORMERS—(*Contd.*)

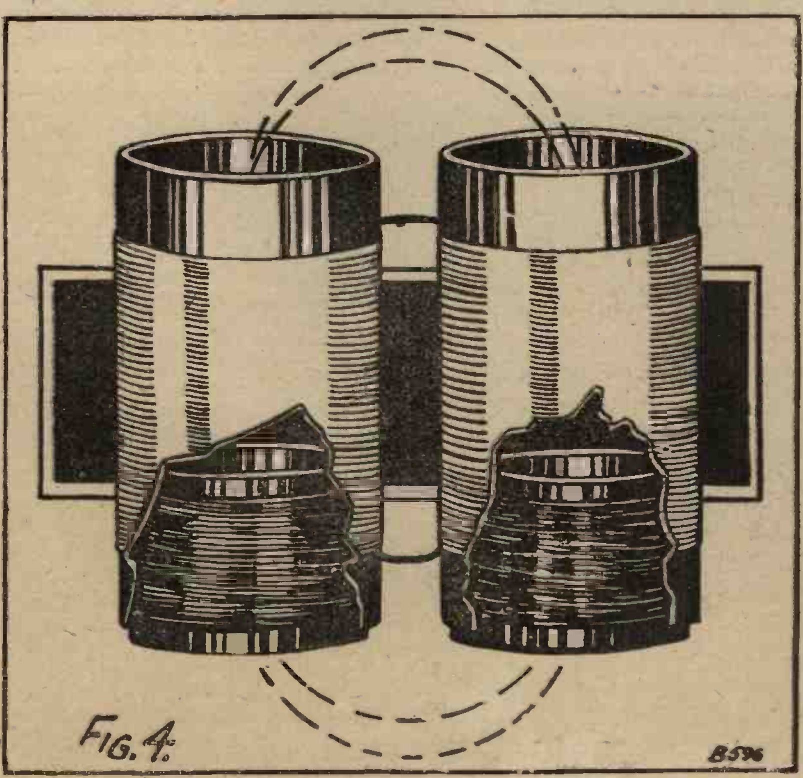
the condenser used. Furthermore, its losses must be reasonably low, otherwise we shall lose in damping too much of the amplification we have so far gained. These two points are fairly obvious. What is so frequently neglected in considering the subject is the importance of the *primary* winding and its suitability for the circuit with which *it* is to be used.

Question of Resistance

A few experiments with a valve show that the plate to filament resistance is a fairly high figure, varying of course with different types of valves, and with the grid voltage applied. The type of general purpose bright emitter receiving valve used when the plug-in type of H.F. transformer was first introduced had a resistance in the neighbourhood of 50,000 ohms. Incidentally, in high-frequency circuits the small capacity between the electrodes must also be taken into account. Let us now consider high-frequency transformers designed to work with a particular valve over a wavelength range of, say, 300 to 600 metres. The secondary winding may well be a single layer coil made so as to have a small self-capacity and low resistance by correctly proportioning the windings, choosing the right gauge of wire and winding it on a suitable former. We will assume the impedance of the valve in the plate circuit of which the primary of the transformer is joined to have a value of 20,000 ohms. You will see at once that the difference in resistance of a winding using a fairly heavy gauge wire and one made of practically the finest wire we can handle will not appreciably affect the H.F. resistance of the whole of the plate circuit in which the primary of the transformer is joined.



Modern single layer interchangeable H.F. transformers.



Dissected binocular H.F. transformer.

Capacitative Coupling.

It can also be shown that to get a very high efficiency in a radio frequency transformer the capacitative coupling between the primary and secondary windings must be reduced as far as possible. The early radio frequency transformers of the plug-in type were frequently made with the secondary winding wound directly over the primary, and even in the slotted forms the capacitative coupling between the two windings was very high. For this reason the actual connections of the windings were very important with these types. Thus, reversing the leads from the secondary winding made a considerable difference in the signal strength, for in one direction the capacitative coupling between the windings was

AN HOUR WITH H.F. TRANSFORMERS—*(Contd.)*

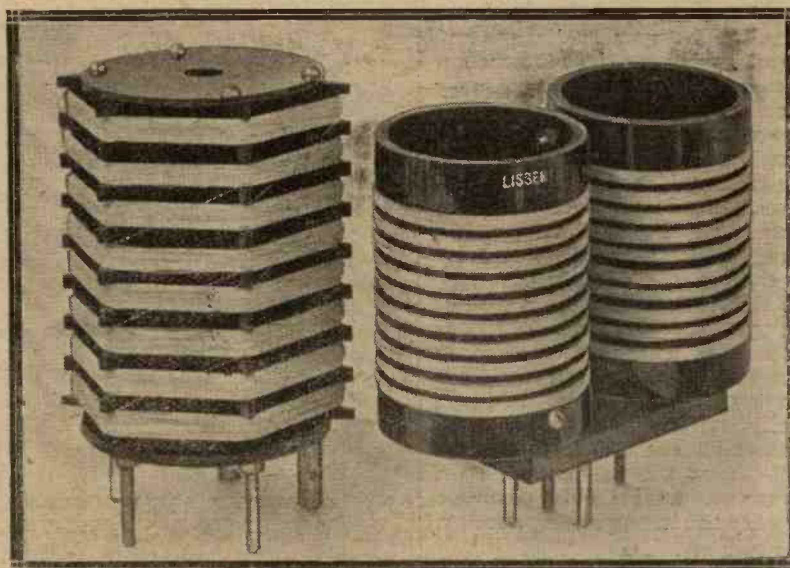
adding to the energy transfer and in the other hindering it. When the capacitative coupling between windings is very small, reversal of these leads makes very little difference to signal strength.

Suiting Valve Characteristics

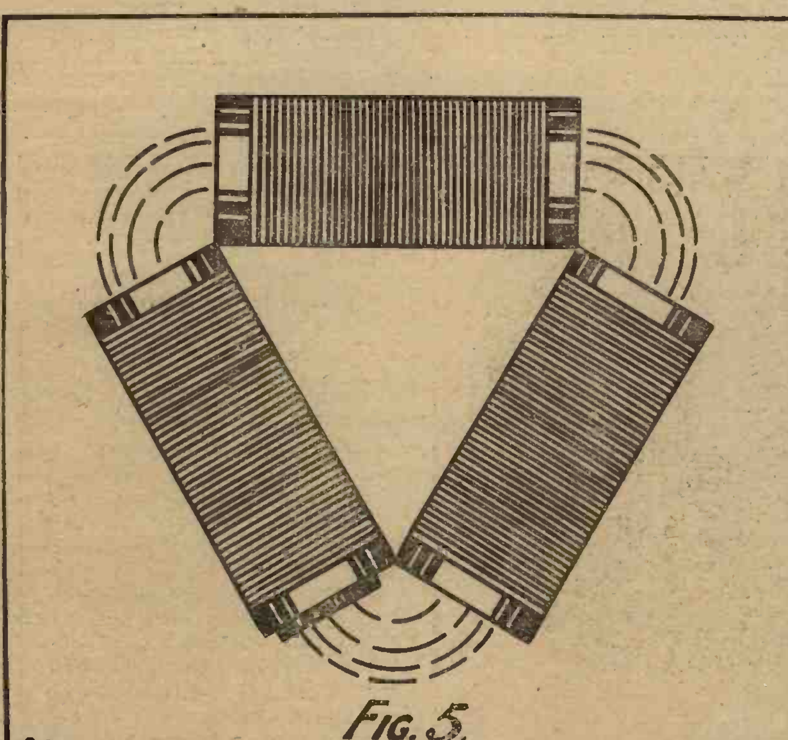
Returning to the question of the size of wire of the primary, it will be understood that a very fine wire enables a number of turns to be wound in a much smaller space than it is possible with a thicker wire, and furthermore the capacitative coupling will be much less with a finer wire (other factors remaining the same).

A very weak magnetic coupling between primary and secondary windings gives a very high selectivity but feeble signal strength. If the coupling be now increased signal strength increases progressively for some time, until a point is reached where it starts to fall again. For this reason it is of importance, if high efficiency is desired, to find the best coupling for signal strength and selectivity.

We now come to a very important point. The optimum coupling for a valve of a certain impedance is not the optimum for another valve of different impedance, and it can easily happen that on changing from a nominal "high frequency" valve to a nominal "low-frequency" valve better signals may be obtained. In England we have a very large variety of valves of different impedances, and different amplification factors, and the impedance of one manufacturer's "high-frequency" valve is often quite different from that of another maker. In America, although there are several makes of valves on sale, there are but two general types used for high-frequency amplification, one known as the "201A" type (corresponding with the Osram D.E.5, Marconi D.E.5, B.T.-H. B.4, Mullard D.F.A.1, etc.), and the other as the "199" type, the equivalents to which in England are the Osram and Marconi D.E.3, B.T.-H. B.5, etc. American set manufacturers and those who make components for home builders have therefore no difficulty in designing radio frequency transformers to suit the valves with which they are most likely to be used. In England there is a much greater difficulty, and a general compromise must be effected.



How long-wave H.F. transformers can be wound efficiently.



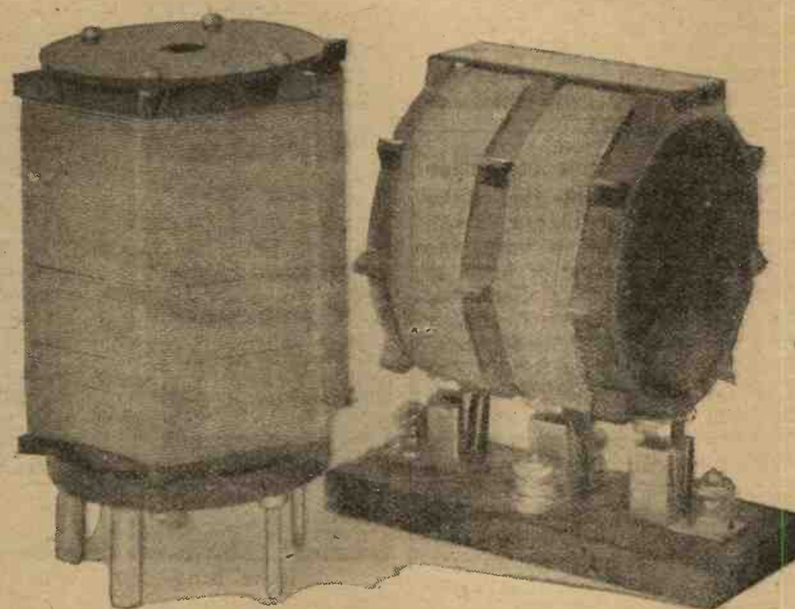
Another "fieldless" type of H.F. transformer of American origin.

Coupling Between Windings

Now as we increase the coupling between the primary and the secondary of a high-frequency transformer from weak to strong we have to take into consideration another important point. If the

AN HOUR WITH H.F. TRANSFORMERS—(*Contd.*)

coupling between primary and secondary is very tight it does not matter much whether the primary or the secondary is tuned. In either case we have the effect of a tuned circuit in the plate lead as well as one in the grid lead of the previous valve. Readers know that when the plate and grid circuits are in tune the inter-electrode capacity of the valve and stray couplings are sufficient to feed back enough energy to maintain a state of oscillation. When the coupling between the primary and secondary winding is weak there may be insufficient feed-back to maintain a state of oscillation, but much depends on the valve used, both in regard to its inter-electrode capacity and its amplification factor.



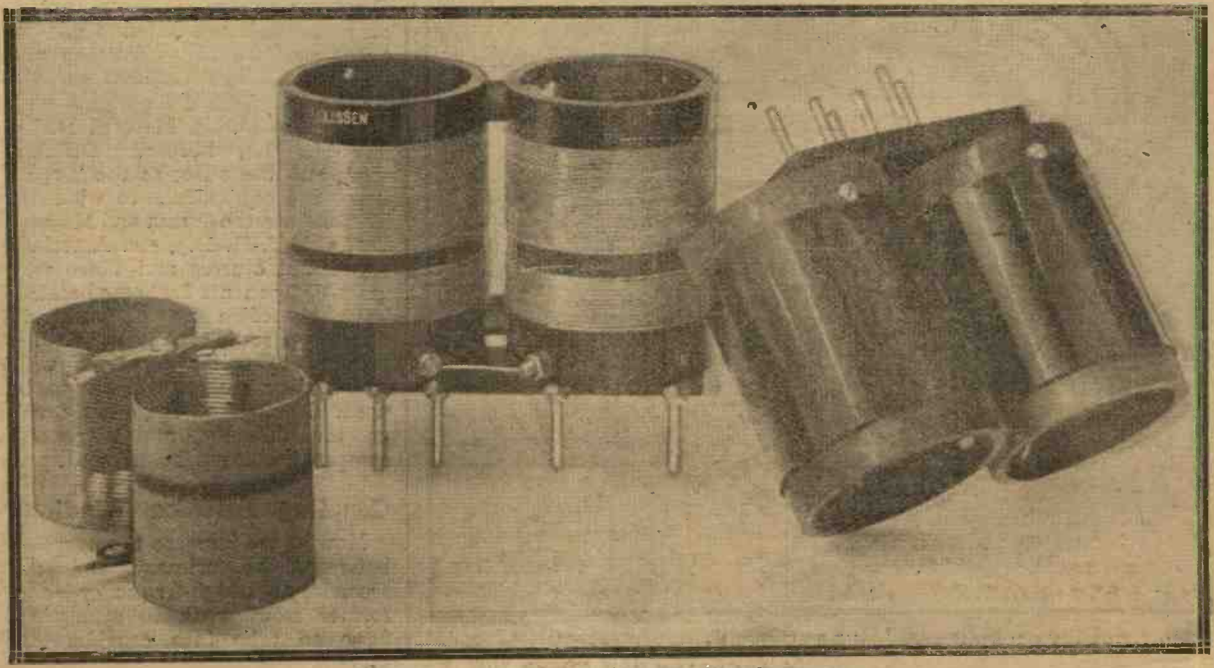
Two H.F. transformers of modern British design. Note the method of "air spacing" the windings.

Limiting Interaction

Before the neutralised and balanced circuits came into vogue, a coupling sufficiently tight to be really useful made the tendency to self - oscillation so high that damping had to be introduced to obtain stability. This damping was bound to mask the relative efficiencies of various high-frequency transformers, and indeed, the relatively large high-frequency resistance of the windings of the earlier transformers, far from being a drawback, was often of distinct value in providing the damping necessary to obtain stability.

Neutralised radio frequency circuits enable us to adjust the coupling between the primary and secondary windings to give the efficiency we desire without having to worry about feed-back due to inter-electrode capacity, and as a result we have been able to design and make far more efficient radio frequency transformers than had previously been practicable.

Still a further important point in high-frequency transformer design concerns the question of a



Modern "binocular" H.F. transformers.

AN HOUR WITH H.F. TRANSFORMERS—*(Contd.)*

field surrounding the windings. Assuming that the windings have been correctly proportioned to suit the wavelength range desired and the valve with which the transformer is to work, and also assuming that by means of one of several available circuits, we have neutralised the inter-electrode capacity of the valve, the fact remains that the field from the coil may spread out and interact with other windings and fields and completely upset all our adjustments. The early H.F. transformers by reason of their compactness, had a relatively restricted field, but the larger single layer windings proved a great nuisance in this regard. Prof. Hazeltine worked out an arrangement by which several radio frequency transformers were arranged with parallel axes, all being placed at a common angle to the line of centres. This angle was worked out mathematically to be 54.7°, but in practice is slightly different from this, due to a variety of causes.

Magnetic coupling between stages may also be reduced by arranging the coils at other angles, depending of course upon their positions in the receiver. There are also two other important ways of avoiding this interaction—one by designing the high-frequency transformers to have a very restricted field and the other by utilising shielding. In shielded high-frequency transformers the work of Mr. J. H. Reyner, B.Sc., is well known to readers of this journal. Here the transformers are of the single layer type, being surrounded by cylindrical metallic shields which effectively prevent

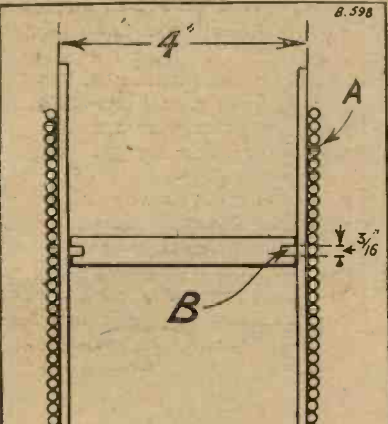
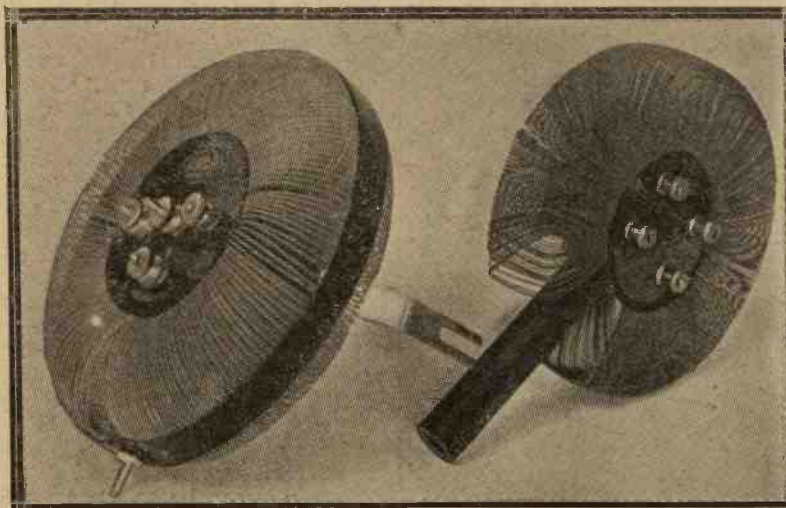
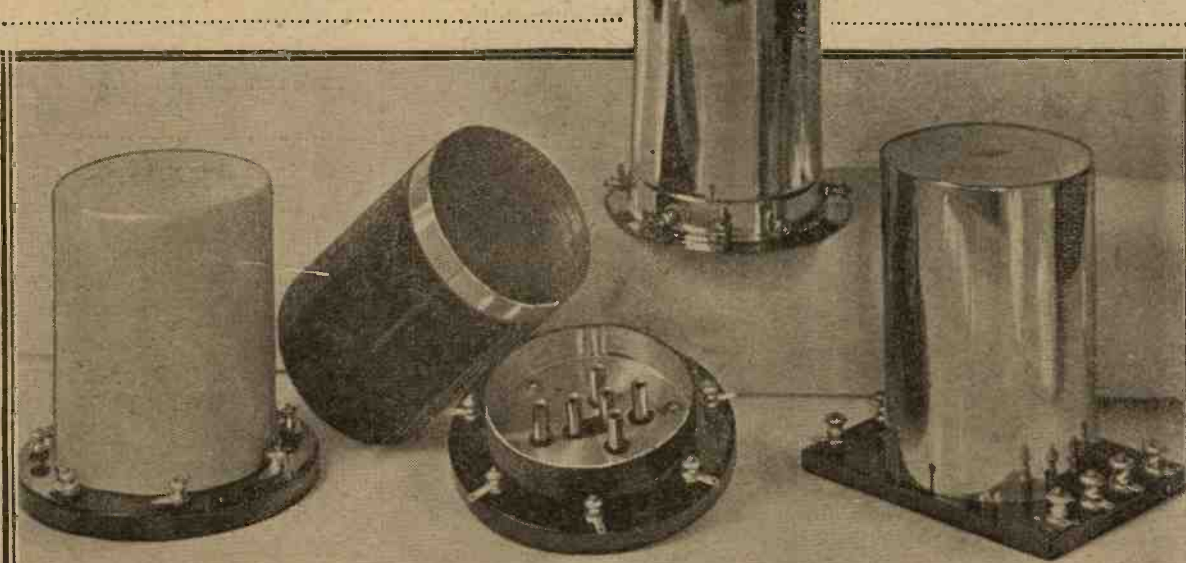


FIG. 6.
A = 65 TURNS OF No. 20 D.C.C. WIRE
B = 20 TURNS OF No. 28 D.C.C. WIRE



Practical Toroidal coils.



Metal screening boxes for H.F. coils.

AN HOUR WITH H.F. TRANSFORMERS—(Contd.

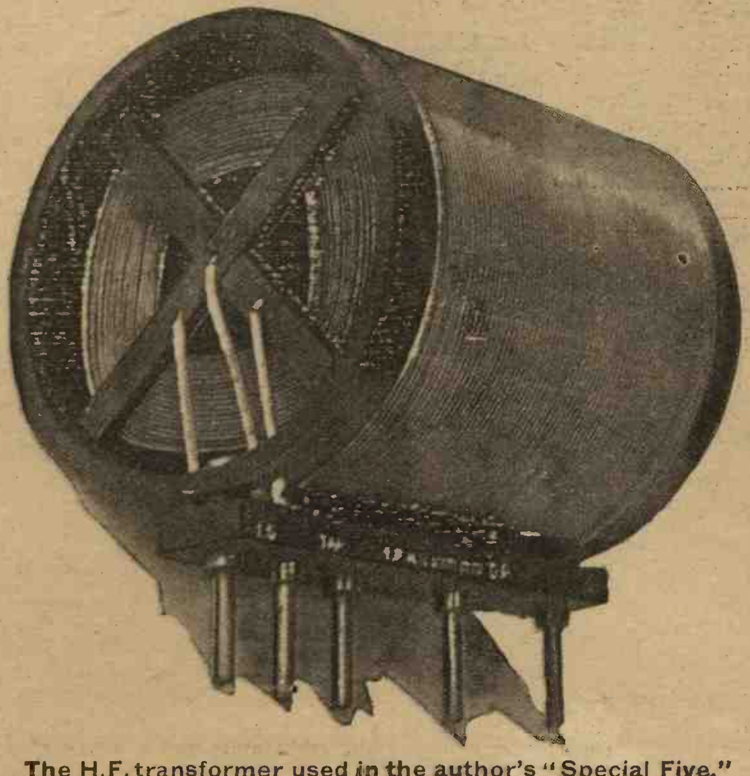
the spreading of the field and consequent interaction with other parts of the receiver. Certain losses are inevitable with such shields, but the efficiency of these transformers is such that in the shields they have a much lower H.F. resistance than the other types without any shields.

Toroidal and Binocular Coils

For several years past experiments have been persistently made to produce high efficiency coils with very restricted fields. For example, if we take a flexible single layer winding and bend it round so as to bring the two ends together we get what is known as a "Toroidal" coil having a very restricted field. Broadly speaking, we may say the field of this coil is no greater than a single turn of wire of the same radius. The trouble with such coils, however, is that their high-frequency resistance is appreciably greater than that of the single layer type, due largely to the fact that considerably more wire is needed to obtain a given inductance. While in America in 1925 my interest was aroused by a particular commercial receiver—the Grebe "Synchrophase"—in which the high-frequency transformers had what were called "binocular" coils. These were a kind of compromise between the single layer coils with spreading field and the toroidals with their very restricted field. In practice these coils were shown to be of sufficiently restricted field to avoid many of the undesirable interaction effects which had previously been experienced, and on my return to England I described them in detail. They are now becoming increasingly popular in this country, being marketed by several manufacturers, and while their high-frequency resistance is slightly higher than a well-designed single layer coil it can be so made sufficiently low to be of very practical use in high-frequency transformer design.

A Cause of Distortion

Another point not generally realised is that in a high-frequency amplifier it is quite possible to have your circuits too sharply tuned. A certain degree of sharpness of tuning may be very effective and introduce no appreciable distortion, but "ultra-selectivity" may prove a great nuisance by cutting off the "side bands." In telephony we have to deal not with one frequency (that of the "carrier wave"), but with a band of frequencies on each side of the carrier wave, so that if our tuning is too sharp, which can easily happen in modern receivers, some of the frequencies may be cut off or their amplification so reduced as to give very noticeable distortion.



The H.F. transformer used in the author's "Special Five."

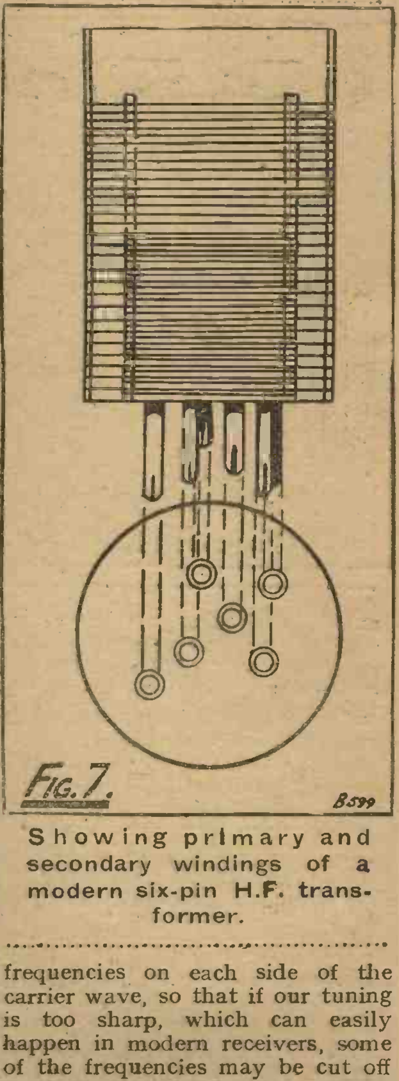


FIG. 7.

Showing primary and secondary windings of a modern six-pin H.F. transformer.

Preventing Over-sharp Tuning

Some manufacturers of American receivers are actually introducing a certain amount of damping in their multi-stage receivers to prevent this distortion due to over-sharp tuning. Incidentally, this cutting off of side bands is very

(Continued on page 320)

RED TAPE & BROADCASTING

Too much stodginess and too little entertainment is the complaint against the present B.B.C. programmes. Is red tape to blame?

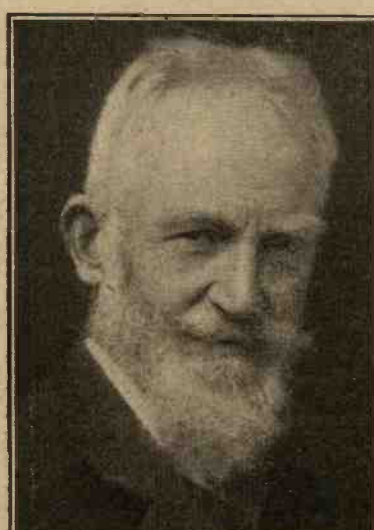
By THE EDITOR.

A DEBATE on the question of the "Menace Of The Leisured Woman" was broadcast a few weeks ago from the Kingsway Hall, London. The debate was between Mr. G. K. Chesterton and the Viscountess Rhondda, and in the chair was Mr. G. Bernard Shaw. Mr. Shaw had a few things to say about broadcasting which again brings into prominence an important question concerning the limitations of broadcasting as at present enforced by His Majesty's Postmaster-General.

"Be Careful"

Mr. Shaw was in a very happy mood that night and he asked his audience to be very specially on their good behaviour because, as he pointed out, it was not only Mr. Bernard Shaw addressing a crowded and prematurely enthusiastic audience, but it was London calling the British Isles and the Universe in general. "If," he said, "any of you allow yourselves to be carried away by shouting out anything in a moment of enthusiasm it will be heard by eight million people. Among those people may be your wife or your husband. Be careful. Now the condition on which broadcasting is conducted in this country is that nothing of a controversial nature must be spoken from the platform or anywhere else except by members of the Government. How any animated, possibly embittered, controversy is to be carried on this evening without either of the speakers becoming controversial I cannot tell you."

Mr. Shaw went on to say that probably the Postmaster General was listening-in. "He is realising that I am speaking. His horror is probably growing with every sentence that flows from my lips. How am I to be stopped? How are the speakers of the evening to be stopped from becoming controversial? Well, I don't know, but it occurs to me that the Postmaster-General may call out the Guard."



Mr. George Bernard Shaw, Playwright—and Broadcaster!

Constitutional Remedy

Mr. Shaw suggested that the remedy was a constitutional one. "You must vote," he said to his audience, "against the Government at the next Election. Some of you may reply that that would be no remedy for you, because you already intend to vote against the Government. Well, you have one more remedy. I believe it to be a strictly constitutional one. I suggest to you that you should all write to the Postmaster-General telling him what you think of him. You will be strictly within the letter of the law, for you will contribute an enormous sum in stamps to the revenue, and you will make it absolutely certain that no Postmaster-General in England will ever attempt to interfere with freedom of speech in England again."

Write to the P.M.G.

Mr. Shaw's suggestion, if not original, is at least a good one. For there is no earthly reason why listeners, amateurs, and all interested in wireless, who are dissatisfied with the conditions under which broadcasting is conducted in this country, should not address a personal letter to Sir William Mitchell-Thomson, the Postmaster-General, strongly expressing their views. There is no law in this country to prevent anybody addressing a personal criticism to a Minister of the Crown.

It would be a joyous thing indeed if the wireless amateurs and listeners in this country to the number of some hundreds of thousands suddenly sent their criticisms and complaints direct to the Post-

RED TAPE AND BROADCASTING—(Continued)

master-General! We venture to think that the Postmaster-General would very soon realise that there is a great deal of dissatisfaction in this country at the moment concerning the conduct of broadcasting.

G.B.S. and the P.M.G.

There are, perhaps, two points which such a method would bring home very strongly to the Postmaster-General, viz., the resentment throughout the country regarding the retention of some thousands of pounds of licence money paid by listeners last year, and which was withheld from the old B.B.C. by the Postmaster-General and which, it is alleged, has been used to meet a deficit caused by the inadequacy of the Rugby high-power station.

The other point which the Postmaster-General would be instructed on if only amateurs would, in their hundreds of thousands, address their grievances direct to him, would be in connection with the very point raised by Mr. Shaw, viz., the restriction imposed upon the broadcasting of controversial matter. Mr. Shaw is undoub ly right when he doubts whether speakers can be stopped from becoming controversial, but on the other hand it is only when a speaker becomes spontaneously controversial that listeners can really enjoy a good argument.

For example, a few months ago Mr. George Bernard Shaw was invited to broadcast on a certain subject, but the Postmaster-General vetoed the speech—he saw it in proof form—in the programme on the grounds that it was controversial. And thus listeners were deprived from hearing one of the greatest literary celebrities of our time because of some footling red tape rule which, by its very imposition, suggests that the British public cannot be trusted to listen to such a strong argument.

Mr. Bernard Shaw's idea of addressing personal letters to the Postmaster-General will probably never be carried into effect to such an extent that it will really carry any weight, for unless somebody organises a direct campaign for communicating with those responsible for these stupid rules which are hindering broadcasting, the full force of Mr. Shaw's suggestion will never be felt.

Unrepresentative Correspondence

We understand that the B.B.C. receive many thousands of letters a week, and from these letters they, by an analytical process, decide upon the types of programmes most suited to the broadcasting programmes. It is quite obvious that the B.B.C. do not receive a representative number of letters from listeners in this country. They may receive thousands a week, or thousands a day, but that is nothing compared to the fact that there are over two or three million listeners in the country and the B.B.C.'s postbag is small compared to the number of their clients.

Sir Gerald du Maurier before the microphone at 2LO.

Since the Broadcasting Corporation came into power, the result has been an increasing stodginess of programmes which has caused another outburst of adverse criticism, and the appointment of what is known as the "Big Seven," or Programme Board, is indicative of this stodginess. The Programme Board at the moment consists of: Mr. R. H. Eckersley (chairman), Mr. George Grossmith, Mr. R. E. Jeffrey, Mr. B. E. Nicholls, Mr. Percy Pitt, Mr. J. C. Stobart and Miss Hilda Matheson.

None of the members of this committee which constitute the "Big Seven" are really qualified for the important task of deciding what the public wants.

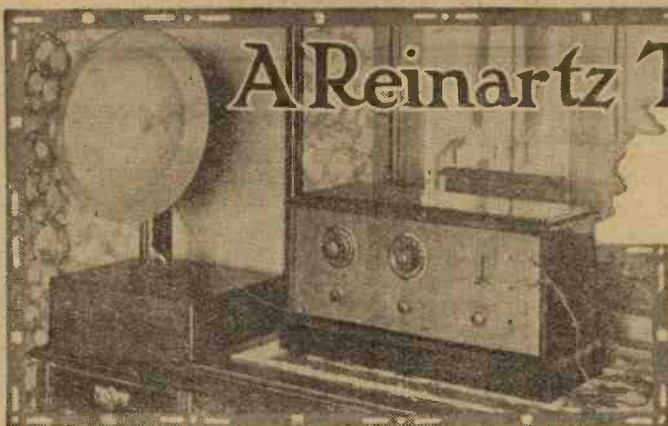
Mr. George Grossmith tunes in.

Few of them are qualified to judge the psychology of the public as regards entertainment. Possibly the only exception is Mr. George Grossmith, who, as a connoisseur of light entertainment, has an experience which should prove valuable provided he is not restricted in his suggestions being put into practice.

The most peculiar and the most inexplicable appointment is that of Miss Hilda Matheson, who seems to have the important qualification of once being secretary to Lady Astor. As Lady Astor is a Member of Parliament and consequently has to do a considerable amount of public speaking, there is probably some subtle reason which has resulted in Miss Hilda Matheson being responsible for the "talks" broadcast by the B.B.C.

"Pep and Punch"

However, we have had a promise from the B.B.C. that they will put more "pep and punch" into their programmes. We can only hope that this will be put into practice at once and that a really big effort will be made to lighten the programmes and to give the public a little more entertainment and not quite such heavy doses of highbrow culture, which, although excellent in its way, is not going to increase the popularity of broadcasting.



A Reinartz Three Valver

A useful broadcast and short-wave receiver designed and constructed by F. H. NEWRICK

Many American and Continental stations are now operating on the higher frequencies, and a set capable of dealing efficiently with both short waves and the present B.B.C. wavelengths should prove useful to many readers. The set described below is both easy and inexpensive to make.

FOR some time now longer hours of darkness have been with us, and the work of overhauling and building of wireless sets has, no doubt, been occupying many an amateur's spare time.

One has to consider, when constructing new apparatus, the possibility of future changes in the policy of the various Broadcasting Companies. Owing to the recent developments in short-wave transmissions, and as tremendous distances can now be covered by comparatively low-powered stations on the short waves, it would seem to be only natural that in the near future many stations may be suitably equipped for this work.

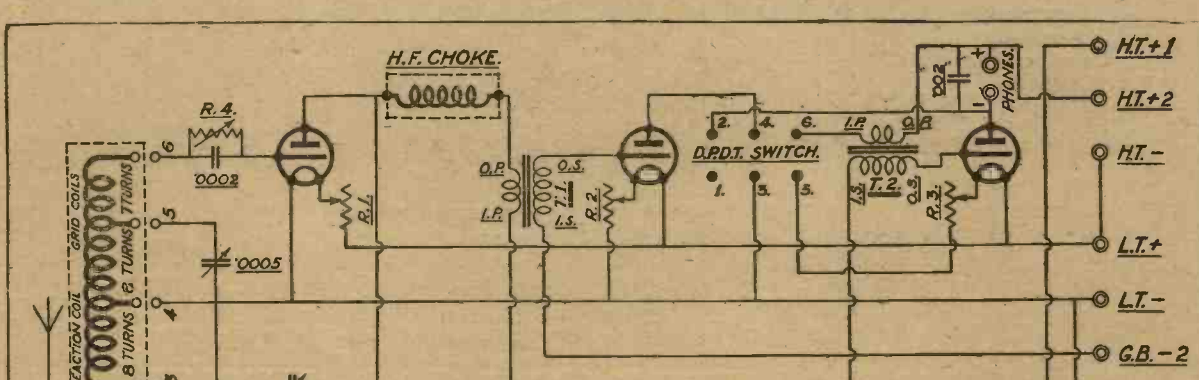
Split Grid Coil

Many American and Continental stations are even now operating on the higher frequencies, and a set capable of dealing efficiently with both the short waves and the present B.B.C. wavelengths would ensure that no fear need be entertained by the fortunate possessor of drastic alterations in the future.

The instrument described does deal with both wave-bands in an efficient manner, although originally constructed as a short-wave set, without interchangeable coils.

If the circuit diagram is consulted it will be seen that a modified type of Reinartz circuit is utilised; a split, tuned grid coil has the semi-aperiodic aerial coil directly and magnetically coupled to it, whilst the reaction coil is directly connected to the grid coil and statically coupled to the plate of the valve.

The use of the split type of grid



A REINARTZ THREE VALVER—*(Continued)*

coil has the effect of giving a very slight step up in the voltage applied to the grid of the valve *via* the grid condenser (which for the short waves might well have been variable, but as the set is intended only for household use several undoubted improvements have been subjected to compromises for the sake of simplicity of operation); it also, in combination with the other features, enhances the selectivity of the set, which is good on the B.B.C. band and very efficient on the short waves.

The reaction control is delightfully smooth in use, and this, together with the use of a good quality silent variable grid leak, does not leave much to be desired in the degree of sensitivity which, can be obtained.

Special coils of low high-frequency resistance and low self-capacity are essential, and a great measure of the success obtained will be due to their efficiency, so that a little extra care bestowed on their making will be trouble well expended.

Winding the Coils

The formers for both coils are clearly shown in the diagrams and are simple to construct and one of the many proprietary honeycomb-coil formers now on the market may be used in lieu of the one shown for the Broadcast coils, if desired, and provided that it is near the dimensions given.

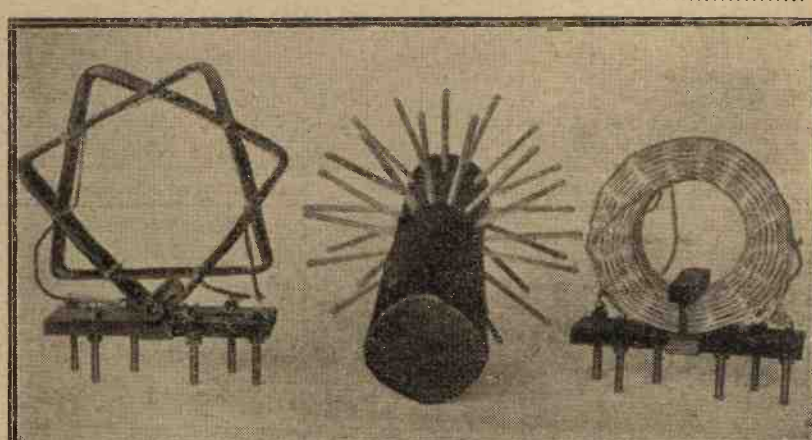
For the short-wave coil a stranded wire consisting of four strands of 26 S.W.G. D.C.C. wire twisted together is used, 30 feet being necessary; the writer fastened four 32-feet lengths of the wire to a staple in a wall, and having pulled them out evenly, tight and straight, simply stuck a pencil through the ends farthest from the staple and twisted it round in a clockwise direction until the wire laid together like a fine rope.

LIST OF COMPONENTS.

- One cabinet, 18 in. by 7 in. by 7 in. internal size.
- One wood baseboard, 18 in. by 7 in. by ½ in.
- One guaranteed ebonite panel, 18 in. by 7 in. by ¼ in.
- One guaranteed ebonite terminal strip, 9 in. by 2½ in. by ¼ in.
- One guaranteed ebonite terminal strip, 3 in. by 1½ in. by ¼ in.
- 10 4 B.A. terminals, W.O. type.
- Two 4 B.A. terminals, telephone type.
- Two angle brackets.
- One sheet panel marking transfers.
- One ·0005 friction control variable condenser (Ormond.)
- One ·00025 ordinary variable condenser (Ormond).
- One "Utility" D.P.D.T. switch (Wilkins and Wright).
- Three carbon compression rheostats (Lissen).
- One ·002 fixed mica condenser (Dubilier).
- One ·0002 fixed mica condenser (Dubilier).
- One variable grid leak (Selected—Lissen).
- Three anti-capacity valve-holders.
- One coilholder for board-mounting (Payne and Hornsby).
- One 3–1 ratio L.F. transformer (Croix).
- One 3½–1 ratio L.F. transformer (Gecophone).
- Eight yards 16 S.W.G. tinned copper wire.
- Solder, flux, screws, nuts, etc.

FOR THE SPECIAL COILS, MOUNTINGS, HOLDER and H.F. CHOKE.

- Three ebonite strips, 3½ in. by 2 in. by ¼ in.
- One ebonite strip, 2 in. by ½ in. by ¼ in.
- One ebonite rod, ⅜ in. dia., by 2 in. long.
- Six valve sockets with washer, nut and soldering tag.
- Twelve valve pins with washer and nut.
- Four 4 B.A. by ¾ in. C.S. head screws.
- ¼ lb. 26 S.W.G. D.C.C. copper wire.
- ½ lb. 22 S.W.G. D.C.C. copper wire.
- 1 oz. 32 S.W.G. S.S.C. copper wire.
- One ebonite coil plug and piece of broom shank 4½ in. long.



On the left is seen the short wave coil, while in the centre is the honeycomb winder for the broadcast coil, seen in finished condition on the right.

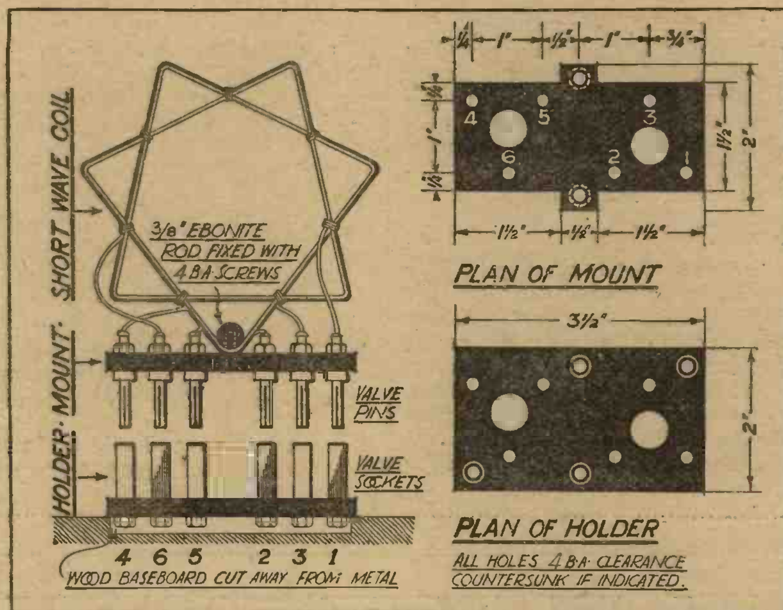
The short-wave coil former need not be elaborate, the one used consisting of a piece of plank with 2½-in. wire nails—without heads—driven into it in the positions shown. The procedure of the coil winding is as follows:—

Commencing at the pin numbered one, take the wire over pin number three and from there to five and seven, as shown in the short-wave coil former diagram, always winding over alternate pins; each time the wire passes pin number one after a complete circuit of the pins one turn has been made; proceed in like manner until seven complete turns have been wound on, when a loop about three inches long should be twisted in the wire—for severance after the coil is completed—and the winding carried straight on until a further eight

A REINARTZ THREE VALVER—(*Continued*)

turns have been completed, at which point a very small loop should be made in the wire for a tapping point and the winding again carried on for a further eight turns and another tapping point taken as before, after which continue for another seven complete turns, which finishes the coil.

The coil must then be stitched together with fine silk yarn before being removed from the former. After this operation the first large loop in the windings may be untwisted and the wire severed in the centre, and the insulation must be removed from the two small loops used as tapping points and the wire so exposed, well cleaned and tinned for connection to the coil mount.



Coil Connections

The various loose ends and tappings must be very carefully traced out and numbered according to the theoretical diagram—which is numbered in conjunction with the details of the coil mountings and the wiring diagram—and are as follows :—

Commencing end "1"; other end of same wire at the point severed after winding—use flashlamp battery and phones for continuity test if in doubt—"2"; remaining end of severed loop "3"; tapping point after first eight turns "4"; tapping point after second eight turns "5"; finishing end of winding "6."

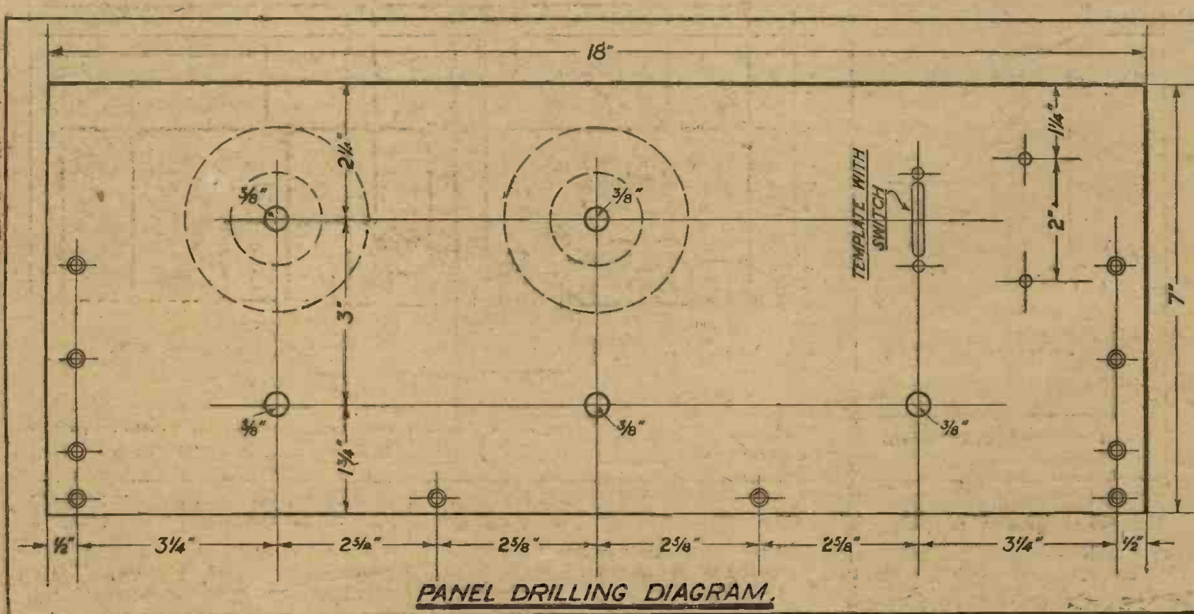
For the broadcast coil the honeycomb coil former should have a piece of cardboard tube 1¾ in. in external diameter and ⅞ in. wide slipped on, as shown, to carry the coil for stitching purposes after the pins have been removed.

The coil is wound in the usual way, the turns for the coils being as follows :—

Aerial coil 1—2, 10 turns.
Reaction coil 3—4, 20 turns.
Grid coil 4—5, 35 turns.
Grid coil 5—6, 35 turns.

22 S.W.G., D.C.C. wire being used.

Coils may be made to suit wavelengths between 30 and 700 metres by adjusting the number of turns—the short-wave former being used for those up to 100 metres.

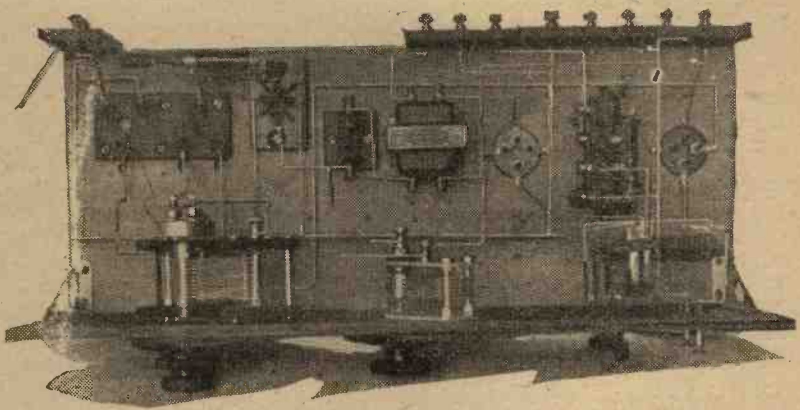


A REINARTZ THREE VALVER—*(Continued)*

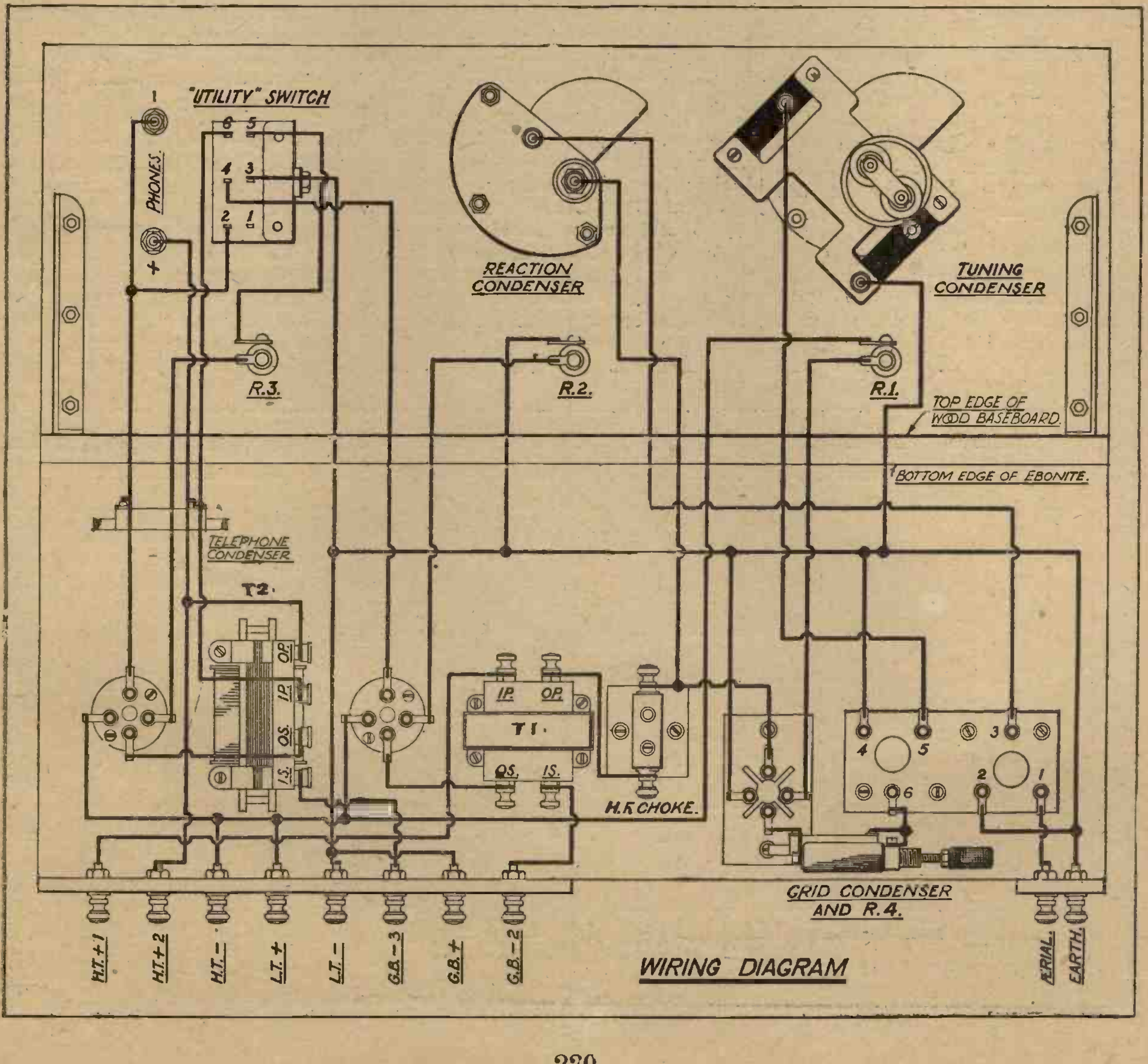
The method of mounting the coils as plug-in units will be readily ascertained from the dimensioned drawings, and care must be exercised to clearly mark both coil-holder and mount in such a manner that the coil will always be inserted in its holder correctly.

The High-Frequency Choke

Separate chokes are required for the two wave-bands, that for the B.B.C. band being an ordinary 250 plug-in coil of any good make, and for the short waves a former 1 in. diameter and 4½ in. long, mounted on an ordinary square ebonite coil plug, as illustrated, and wound with 140 turns of 32



Well spaced wiring is an essential feature of this receiver if satisfactory results are to be obtained.



WIRING DIAGRAM

A REINARTZ THREE VALVER—*(Continued)*

S.W.G. S.S.C. wire in 7 sections of 20 turns each is required, or any low capacity coil of similar inductance value may be used.

Construction

Having proceeded thus far the constructor will now lay out the ebonite panel and wood baseboard in accordance with the dimensions given, having first removed the outer skin from the ebonite panel on both sides if guaranteed ebonite has not been procured.

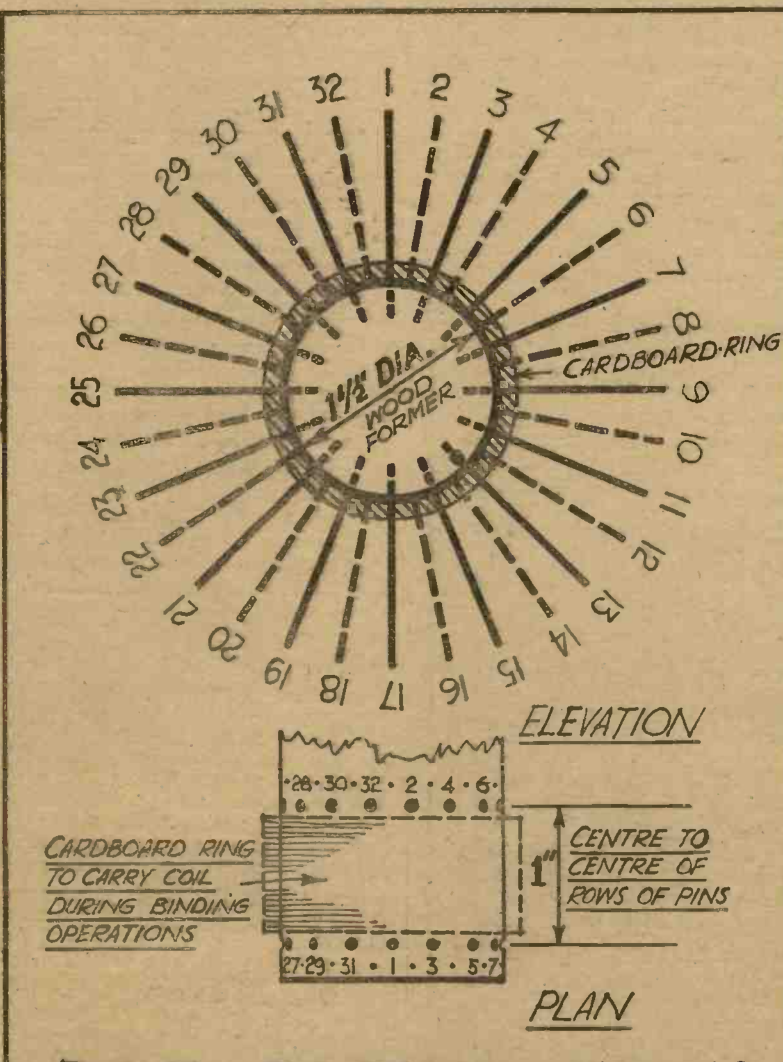
The holes for the brackets and switch are to be actually scribed on the panel from these components themselves.

All woodwork must be cut away from the metal work on the H.F. side of the circuit, ¼ in. holes being drilled in the baseboard to accommodate the nuts projecting from the underside of the coil-holders, etc.

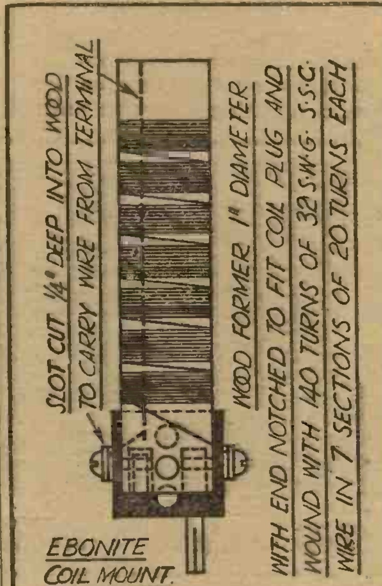
All components may be fixed in position before wiring is commenced, as they are easily accessible for soldering.

Wiring-Up

It is desirable to adhere closely



FORMER FOR BROADCAST COILS.



H.F. CHOKE (SHORT WAVES)

to the diagrams and instructions to obtain good results, although any good quality components of reliable make may be substituted for those specified.

Soldered joints must be adopted throughout and the soldering-tags used on the coil-holders and mounts should be actually soldered to the valve sockets, etc., to which they are attached, else " atmospherics " may develop to an alarming extent through oxidised contacts.

A good quality non-corrosive flux must be used, and as each soldered joint is completed it should be rubbed bright and clean with a rag containing a trace of tallow.

Operating the Receiver

Good spacing of the various wires is necessary and the wiring diagram must be closely followed in conjunction with the photographs and list of point-to-point connections, which are given in the order in which they should be carried out.

In the actual receiver excellent results were obtained and it was found that any of the standard British-made valves will admirably fill the bill.

The correct value of H.T. supply must be a matter for individual experiment, and in the opinion of

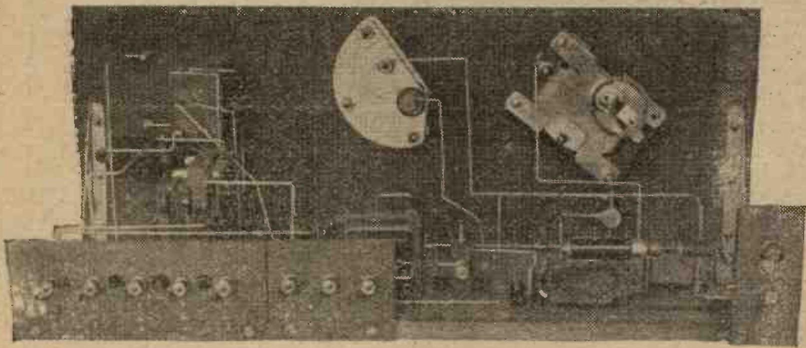
A REINARTZ THREE VALVER—*(Concluded)*

the writer an accumulator is the only really satisfactory source of filament current.

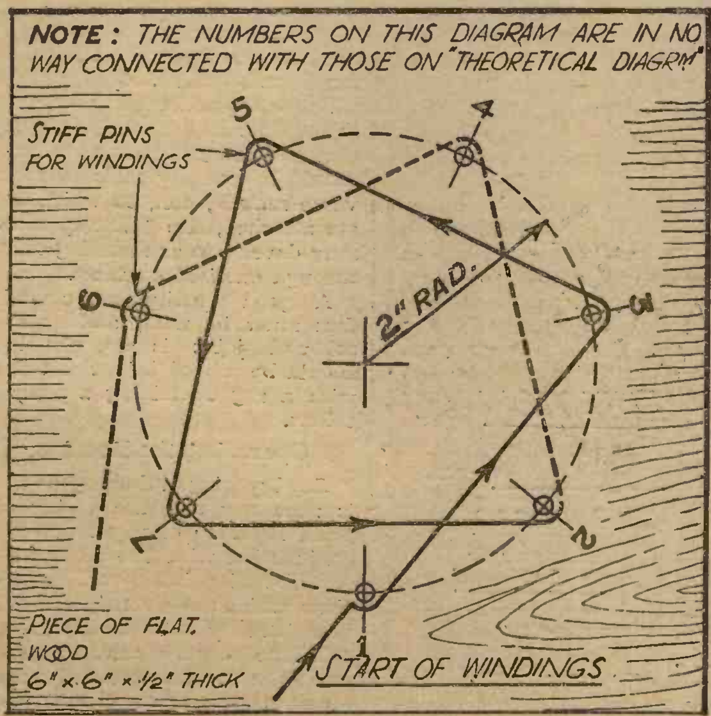
With the reaction condenser near zero setting carefully search on the slow motion tuning condenser until signals are heard, when they may be gradually increased in strength by the judicious use of the reaction condenser. Control is rather critical, and care should be taken to keep the set well away from the oscillation point.

Results

On the short-wave coils K.D.K.A has come in pretty consistently of late, sometimes at remarkable strength, although atmospheric conditions have rendered listening other than a pleasure at times.



A back of panel view of the Reinartz two-valver. The arrangement of the terminal strips is clearly shown.



FORMER FOR SHORT WAVE COILS.

Continental transmissions of telephony, both amateur and professional, can generally be picked up as well as American and Continental morse signals.

On the Broadcast coils the Continental stations are easy prey on most nights, together with many British stations, the local—12 miles away—comfortably working the loud-speaker on two valves.

WIRING INSTRUCTIONS.

Connect rheostat 1 to filament socket of valve 3, to filament socket of valve 2, to H.T.—and to L.T.+ ;

Pole 3 of "Utility" switch to earth terminal, to L.T.— to G.B.+, to Rheostat 2, to filament socket of valve 1, to No. 4 socket of coil mount, to moving plates of tuning condenser and to No. 2 socket of coil mount;

Pole 5 of "Utility" switch to rheostat 3 ; other end of rheostat 3 to remaining filament socket of valve 3 ;

Other end of rheostat 2 to remaining filament socket of valve 2 ;

Other end of rheostat 1 to remaining filament socket of valve 1 ; O.S. of T1 to grid of valve 2 ;

Plate of valve 2 to pole 4 of "Utility" switch ;

O.P. of T1 to one end of H.F. choke holder : other end of H.F. choke holder to plate of valve 1 and to moving plates of reaction condenser ;

Fixed plates of reaction condenser to socket 3 of coil mount ;

Socket 5 of coil mount to fixed plates of tuning condenser ;

I.S. of T1 to G.B.—2 ;

Bottom phone terminal to H.T.+2, and to O.P. of T2 ;

I.P. of T2 to pole 6 of "Utility" switch . top phone terminal to plate of valve 3 and to pole 2 of "Utility" switch ;

I.P. of T1 to H.T.+1 ;

O.S. of T2 to grid of valve 3 ; I.S. of T2 to G.B.—3 ;

Grid of valve 1 to grid leak and condenser ;

Other end of grid leak and condenser to socket 6 of coil mount. A ·002 fixed condenser is connected across the phone terminals. Aerial terminal to socket No. 1 of coil mount.

ARE FILAMENT RHEOSTATS OBSOLETE?

By STANLEY G. RATTEE, M.I.R.E.

Variable Filament Resistances first found favour when bright-emitter valves were in vogue. They are now giving place to Fixed Resistors, but our contributor points out that the Rheostat still has the advantage in certain circuits.

TWELVE months ago practically every receiver, including super-heterodynes, was fitted with variable filament resistances whereas to-day almost every set is fitted with fixed resistances, or resistors, as they are called. Beyond a reduction in filament current consumption, valves to all appearances to-day are the same as they were a year ago. Why, then, has the change been made?

Apart from the fact that in the old days the filament rheostats were used to some extent for purposes of controlling the performance of the receiver, the valve filaments were made in such a way that there was practically no danger of over-running them. For example, if a 3·0 volt valve were connected across the terminals of a 4-volt accumulator without a suitable resistance in series with the filament, the valve would not suffer, but if, on the other hand, we were to connect a modern ·06-3v. type of valve in the above fashion the valve would be injured to some appreciable extent.

Varying Characteristics

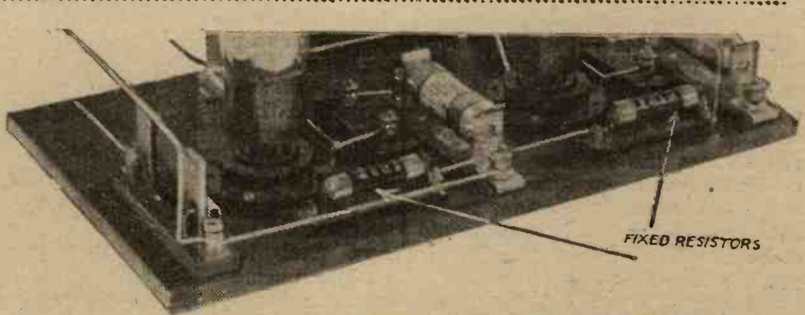
Whereas modern valves are constant in their requirements, the old bright-emitter valves were mostly possessed of characteristics peculiar to each individual valve. Very rarely did one find two similar type valves which gave the best results at exactly the same filament voltage.

Absence of Uniformity

This absence of uniformity in valves of the old days was responsible for the popularity of the filament resistance, but so greatly has the manufacture of valves advanced that so long as the type is retained valves of to-day may be substituted one after the other, with practically the same results in all cases. Whereas with bright-emitter valves the emission from the filament was adjusted to the required standard by means of increasing or reducing the filament voltage by means of the filament rheostat, modern valves are so uniform that with a given fixed filament voltage valves of the same type will generally give the same emission, making therefore the filament rheostat unnecessary.

There are, however, a number of people who still prefer to use the variable filament resistance, believing that the sudden flow of current through the filaments when a switch is closed—an operation which is general when fixed resistors are used—is liable to damage the filaments.

This belief is not altogether without foundation, for should dry cells be used instead of accumulators as the low tension supply, it is possible that the dry cells during their resting period may recover sufficiently to afford a higher voltage than required at the time of switching on, with the possible danger of damaging the filaments.



One advantage of Fixed Resistors is that, unlike the old-fashioned Rheostat, they can be neatly disposed on the baseboard.

ARE FILAMENT RHEOSTATS OBSOLETE ?—(Concluded)

If, on the other hand one anticipates this danger and uses a sufficiently high value of resistor to eliminate the risk, then after a short period of working the voltage of the dry cells will drop a little and the resistor required to be changed for one of lesser value in order that the valves may be worked at their correct current consumption.

A typical Filament Resistance of the type discussed in this article.

The logical conclusion to derive from this is, in the case of valves with dry cells as the low tension supply, variable filament resistances are probably more satisfactory than resistors.

There are, of course, certain types of circuit in which filament rheostats give a certain amount of control over the whole performance of the receiver, and since in these cases the receiver has been designed with variable filament control in mind, for a reader to use resistors instead of rheostats would quite possibly be courting trouble, in that instability may result.

An Awesome Array

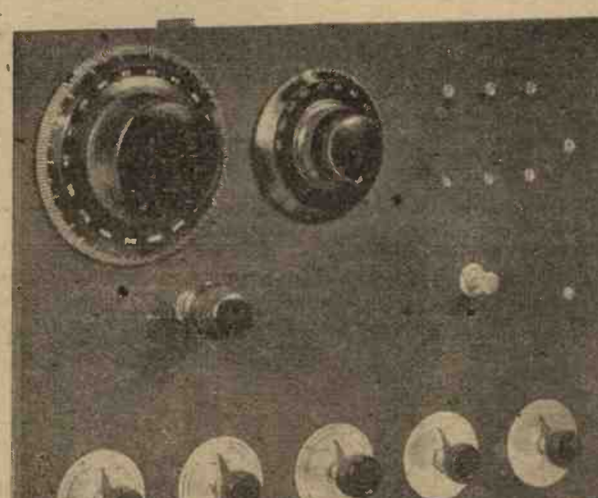
Generally speaking, however, the use of fixed resistors is not only safer from the point of view of the working life of the modern valve but in a multi-valve set reduces to a great extent the number of "variables"; an eight-valve super-heterodyne, for instance, would be somewhat awesome if fitted with filament rheostats, for apart from the fact that there are eight knobs to turn, the difficulty of turning each one just the required amount and no more is no small one.

There were probably more valves over-run twelve months ago than were burnt out, merely because filament rheostats were so popular. The number of dull-emitters in use then was smaller than to-day, and it is fairly safe to assume that most of those valves ended their working days as a result of too heavy a current being passed through them.

A Case in Point

A very good example of the danger of over-running valves was brought to light by a non-technical home-constructor who favours the use of ·06 valves. This enthusiast had been using the "Anglo-American Six," which incorporates variable filament control, that was the custom at the time of publication; desiring to build another receiver, a six-valve set of very well-known design was chosen, the design incorporating fixed resistors. The wiring was checked over and over again, but nothing could be received except the local station and that somewhat indifferently.

Upon learning that he had been using the "Anglo-American Six" with ·06 valves and that the same valves were being used in the new set, it was suggested that new ·06 valves be tried, whereupon the new set worked perfectly. The fact that he had been using variable filament resistances in his old set, and using them without too much regard as to current passing, he had so over-run his ·06 valves that when connected in circuit with the correct value of resistance in series for an ·06 filament they would not work properly.



How the use of Filament Rheostats adds to the number of controls is well shown by this illustration.

The over-running of dull-emitter valves is unhappily encouraged by the fact that the results improve momentarily as the filament current is increased. If, for example, one is endeavouring to receive a weak signal and the valve filament is increased slightly in brightness or glow, as the case may be, it is possible that signals will be a little louder. This increase in volume, however, is obtained at the expense of the working life of the valve.

The tendency in modern design would seem to favour the fixed resistor of interchangeable type.

In big sets where, except in special cases, at least two circuits have to be tuned, the addition of several filament rheostats may quite possibly put the operator "off his stroke," in that one may be turned a little too far, another a little too sparingly, all of which tend to make a receiver very much harder to work.

Summing Up

To sum up. For simplicity in receiver design, for safety and easier operation, the fixed resistor holds the day; but for experimental work, where valves of all types have to be changed quickly and often, the filament rheostat is still the most popular and useful of the two.

SHORT WAVES AND AMATEUR TRANSMISSIONS

By L. H. THOMAS

THE writer has recently heard quite a number of complaints from radio enthusiasts of long standing to the effect that the amateur transmitters, whose tests in pre-broadcasting days used to provide practically the only telephony that was to be heard, have now apparently disappeared.

Perhaps this is true in a way, but they have only disappeared to other—and shorter—wavelengths, and are working now in larger numbers than ever.

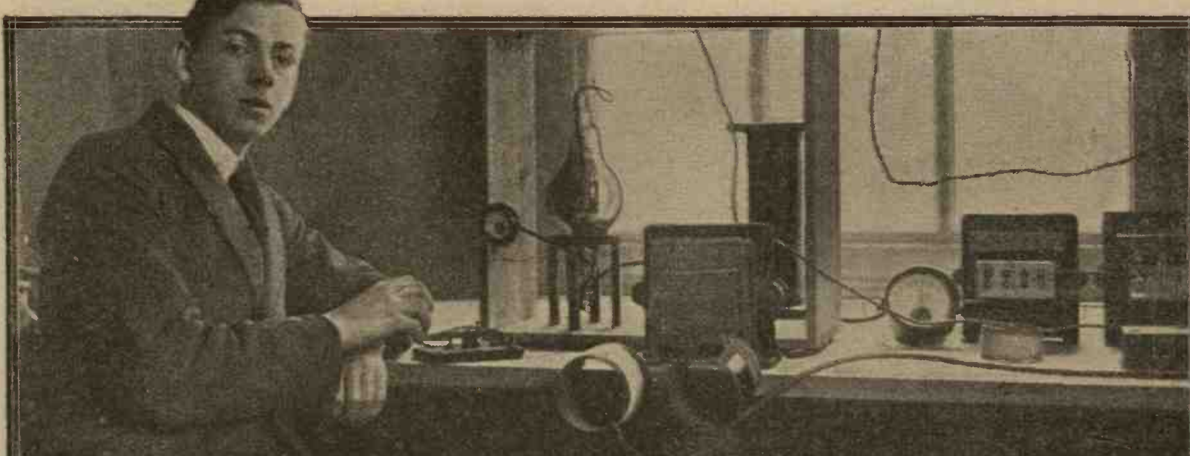
Early Days

For the benefit of those who used to listen to the tests and other work done by the "amateurs," this short account of their work has been drawn up.

It was probably in mid-summer, 1922, the year in which organised broadcasting commenced, that amateur transmission was at its high-water mark, so far as outside interest was concerned. Practically all the work then being done was on 440 metres, although some stations were still occupying the 1,000-metre band that had been used for so long. Three or four amateur stations in particular used to provide quite professional concerts, and came to be looked upon as regular institutions. The ranges obtained in those days were certainly not great, and an amateur with a power of 50 watts would consider himself quite lucky if he managed to make his signals cover 200 miles or so! Practically all the work was of the nature of experiments in modulation and the transmission of the maximum number of gramophone records in a given time! In the late autumn, however, the B.B.C. opened its first stations, and the amateur transmitters seemed to take it as a matter of course that they would be expected to refrain from transmitting during the broadcasting of a programme. In fact, 2LO was so incredibly strong in comparison with anything else that had ever been heard in those days that they had little hope of making themselves heard at all, for selectivity then was not all that it might have been!

A "Surprising Discovery"

After a while the leading lights of the day began to look at the other wave-band for which they were licensed—150–200 metres—and decided, impossible as it might seem, to attempt to get their receivers and transmitters to oscillate at this



One of Britain's earliest short-wave workers, Mr. Cyril Goyder, operating the Mill Hill School transmitter.

SHORT WAVES & AMATEUR TRANSMISSIONS—*(Contd.)*

absurdly short wave length. It was found to be quite a straightforward matter by some, while others, less scientifically minded, took several weeks to get their sets down to the new wavelength. Here, it was found, work could be carried out without much interference from the broadcasting stations, and, after a few weeks at it, the surprising discovery was made that even greater ranges could be covered on this wavelength. Transmitters in London found that with powers as low as 10 watts they could make themselves heard in most parts of the country, and often in France and Holland as well. There were no transmitters in Belgium at this time, and a station working in Bonn, Germany, operated by some French soldiers, was regarded as *le dernier cri*. Towards the end of 1922 the R.S.G.B. erected a special station, 5WS, at Wandsworth, and with it succeeded in obtaining a report on their signals and full verification from the United States. One or two amateur-operated stations followed suit, and quite a large number of experimenters succeeded in hearing the United States stations on this wavelength.

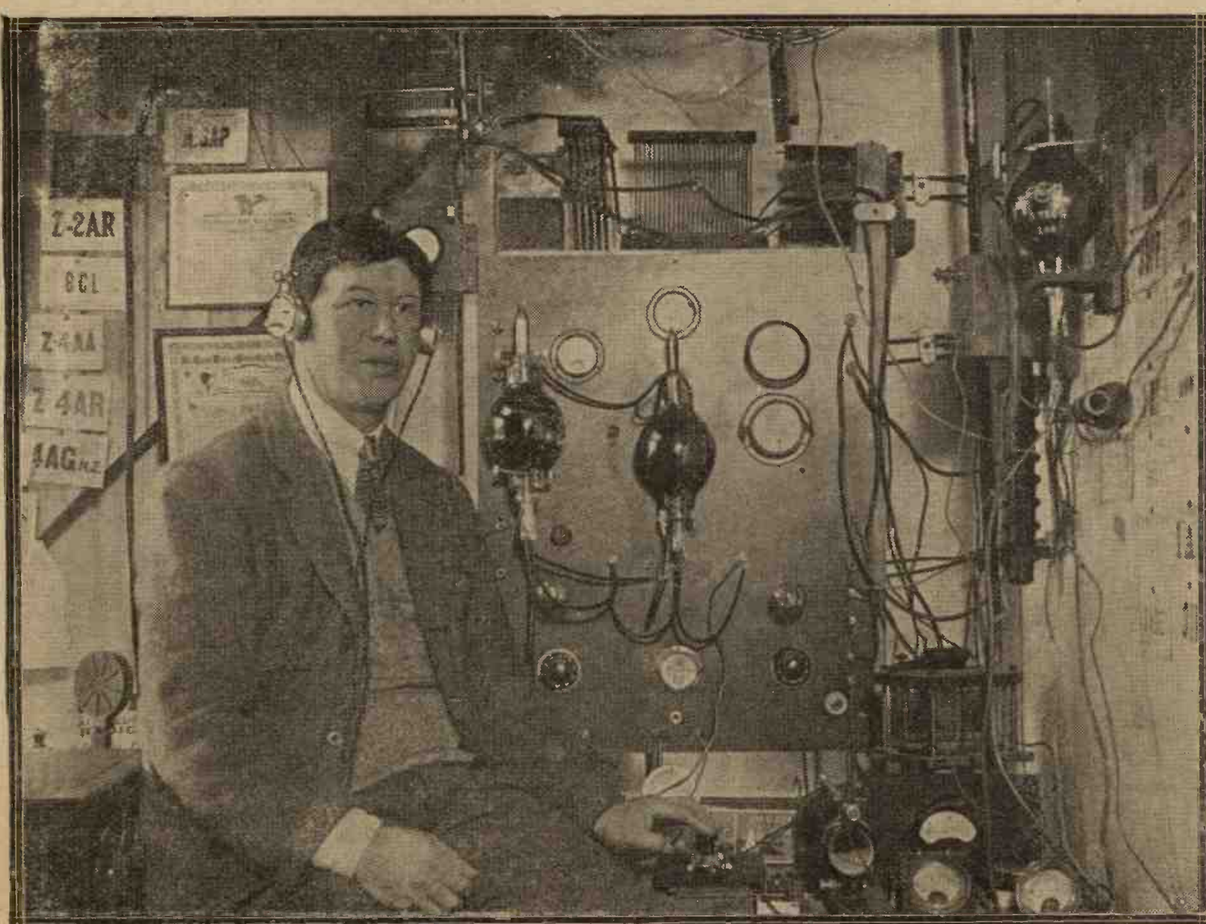
First Transatlantic Tests

As yet, however, no two-way communication had been carried out with the States. This was not successfully established until the autumn of 1923, when M. Leon Deloy, of Nice, operating the famous French station 8AB, succeeded in doing so. He had been patiently experimenting with waves of the order of 100 metres since the spring, and had been convinced that much useful work could be done on these short waves. A long series of tests were carried out between M. Deloy and Mr. Simmonds, 2OD, finally resulting in the determination to make an attempt to "get across." Successful work in both directions was carried out at almost the first attempt between M. Deloy and the American Radio Relay League station, 1MO, at Hartford, Connecticut.

A little more than a week after this, Mr. Partridge, 2KF, won for himself the name of the first British station to effect two-way work with the United States.

Down to 100 Metres

Naturally, after this, the amateurs flocked down to 100 metres in large numbers to see what they could do! All the good work had been carried out in Morse, so that telephony was temporarily forgotten, except by the few who remained "up above."

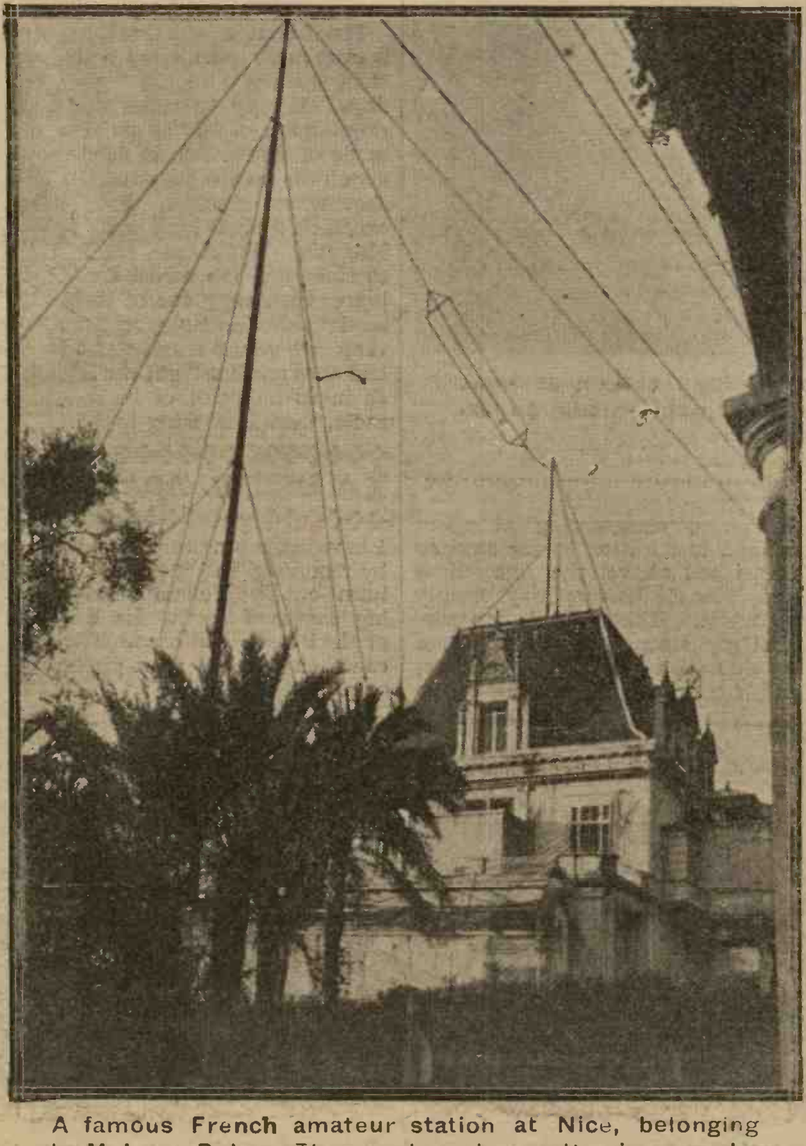


Mr. Gerald Marcuse, of Caterham, at his amateur short-wave station (G2NM), where many world's records have been broken.

SHORT WAVES & AMATEUR TRANSMISSIONS—*(Contd.)*

Almost simultaneously, the high-power stations succeeded in increasing their range from the Atlantic to the Pacific side of America, and the low-power stations discovered that this 100-metre band was a veritable paradise, since with powers as low as 5 watts (it seemed absurdly small then!) they could work with France, Belgium, Italy, Sweden, and, in fact, all the European countries that boasted an amateur enthusiastic enough to set to work on the short waves.

The success of "short-wave" work by then was quite assured. One or two conceived the idea of going still lower, while others were content to see how they could improve the position on the 100-metre band by using loosely coupled circuits and trying out different forms of aerials. It was not long before another great achievement fell to the lot of the British amateur—communication with Australia and New Zealand was established in October, 1924. Though the enormous significance of this was obvious in some ways it was almost regrettable, since it imposed a limit upon the possibilities of "DX" work. If anyone wishes to cover greater distances than these, he will have to find a station in the moon or one of the planets to carry out his tests with!



A famous French amateur station at Nice, belonging to M. Leon Deloy. The counterpoise earth-wires can be seen to the right of the lower leaves of the palm trees.

On 45 Metres

At that time it was unusual to hear the American amateur stations in this country before about 10.30 or 11 p.m., so that the shorter wave of 45 metres suddenly came into prominence when it was found that the U.S.A. stations, who had, of course, been using this wavelength for some time, could be heard well on good evenings as early as 6.30 or 7 p.m.! It was probably this more than anything else that directed the experimenters' eyes towards this wavelength. It is now, of course, common knowledge that 45 metres is an extremely useful wavelength; not only can extremely long distances be covered when "medium power" is used, but distances up to 600 or 800 miles can be covered comfortably in *daylight*. This was by no means the case on the 100-metre band, the limiting distance of *reliable* daylight communication being about 150–180 miles.

It is, in fact, the writer's opinion that 45 metres is, on the whole, a more reliable wave-band than the old 115-130 metre band, and also much better than 90 metres. The fact remains that about 90 per cent. of the active British amateur transmitting stations now work on the 45-metre wave. Hardly ever is one heard on 90 metres—all those who are not engaged on "DX" work on the shorter wave seem to be carrying out telephony experiments on the still higher 150–200 metre band, which was at one time thought to be too short a wavelength to be practicable for transmission!

In conclusion, a few words as to what may be heard, and when to listen for it, on the 45-metre band will probably not be out of place.

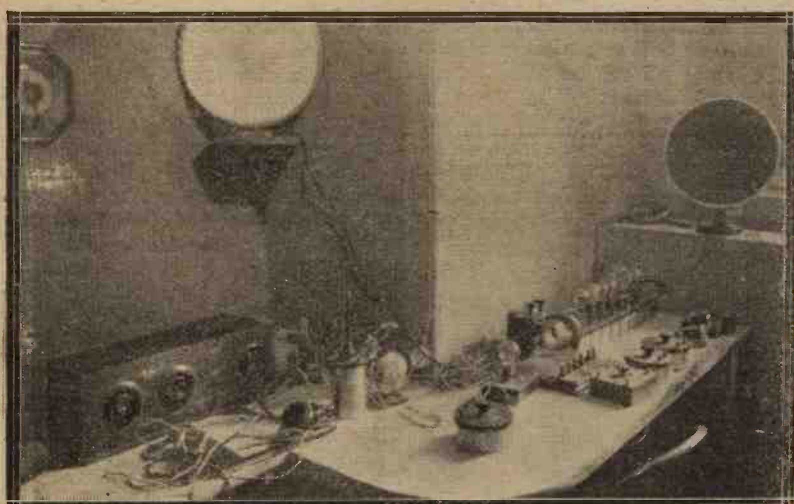
Short-Wave Broadcasting

Practically all the work is carried out in Morse code, of course, although quite a number of British amateurs use telephony, and there are a few distant broadcasting stations to be heard. Those who are not acquainted with the Morse code would be well advised to learn it before attempting any serious experiments on the shorter wavelengths, otherwise they will experi-

SHORT WAVES & AMATEUR TRANSMISSIONS—*(Concluded)*

ence considerable difficulty in finding out exactly where they are !

WGY, the famous broadcasting station at Schenectady, has a "short-wave department" working on 32.79 metres, with the call-sign 2XAF, and also has other subsidiary stations working on 20 metres and other wavelengths between this and 100 metres. 2XAF, however, is by far the most easy to find, and may generally be counted upon to provide quite a good programme. He is usually audible by about 9.30 p.m. at this time of year, and in the summer about 11 p.m. Using a perfectly "straight" two-valve receiver the writer can hear 2XAF some thirty feet from the loud-speaker on a good night. On freak nights signals comparable with those of 2LO, six miles distant, have been received.



An interior view of M. Leon Deloy's station at Nice. The receiver to the right is a home-made super-heterodyne.

An Interesting Wave-band

Another "land-mark" on this wave-band of 30–50 metres is the Canadian station, WIZ, at New Brunswick, who works on 43.02 metres. He may be heard regularly every night calling "ABC de WIZ" *ad infinitum*, starting at 9 p.m., or even earlier.

In between these two stations may be heard innumerable American amateurs as well as a smattering of Canadians, and also several of the South American countries are represented. All these may be heard practically continuously between the hours of 10 p.m. and 6 a.m. This waveband (between 32.79 and 43.02 metres) is without a doubt the most thickly populated and at the same time the most interesting of any. In the early mornings, commencing at about 4 a.m., in addition to the stations mentioned above, the Australians and New Zealanders may usually be heard. Their signals are surprisingly strong—sometimes more so than those of the Americans, and it certainly is not necessary to possess a "super-receiver" to hear them.

D.X. in Bright Sunlight

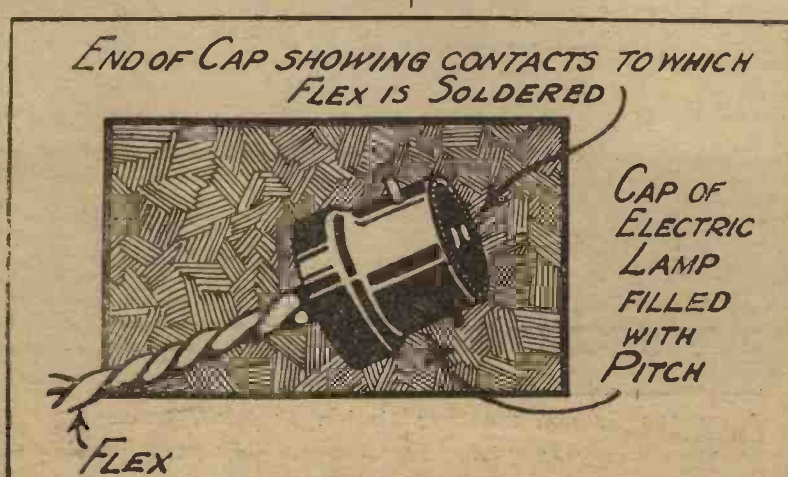
During the daytime this lower waveband is a little quieter; most of the work being carried out on the 43–47 metre band. All the European countries boasting a transmitter may be heard in the late afternoon and early evening, and also most of them in the morning, and even at mid-day. More than once the writer has carried out tests with a Swedish station in bright sunlight at noon.

"Straight" Circuit Ideal

It will be seen from this that there is even more to be heard nowadays than there was in the "good old days," if only one goes the right way about it. It is outside the scope of this article to attempt to give hints on the construction of a short-wave receiver, but many excellent designs have appeared in MODERN WIRELESS from time to time, and the reader cannot do better than copy one of these. A straight circuit employing not more than two valves seems to be ideal, and once one has "got the knack," as in so many other branches of radio, there is nothing to fear.

A USEFUL ADAPTOR

I have made a number of adaptors by removing the glass, etc., from burnt-out electric lamps and soldering lengths of flex to the contacts at the bases of the caps. The caps can then be filled with pitch, wax or plaster of paris. "A.B.C."



A HETERODYNE WAVE-METER

By
E. J. SIMMONDS,
M.I.R.E., F.R.S.A.
(2-OD.).

The instrument described below has a range of from 10 to 500 metres and can be used as a powerful valve generator, as well as for wave-meter work.

FREQUENTLY the success of radio experimental practice depends on accurate radio frequency measurements, and in most of these measurements some form of valve generator or power oscillator is required capable of giving readings over a wide range of frequencies.

This instrument may be used for the measurement of fundamental and harmonic frequencies of coils, aerials and circuits, containing various combinations of inductance and capacity—to indicate only a few of the many applications.

Reliable Circuit

It is of primary importance that the circuit chosen for the generator should be one giving persistent and stable operation throughout the entire range, with ease of control and absence of critical adjustments.

The theoretical diagram Fig. 1 indicates a circuit arrangement which possesses these desirable features and will tune from 10 to 500 metres with suitable plug-in coils.

The essential feature of this circuit is that the grid and plate coils (Lp and Lg) are wound on the same former, both coils being simultaneously tuned by the dual condenser C_2. In order that the losses in the inductances may be as low as possible, they should be wound on paxolin tubes in preference to ebonite or impregnated cardboard, and in the smaller sizes of coils, which are, of course, used for the higher radio frequencies, the turns should be spaced one diameter. Care should also be taken to connect the outside high potential ends of the coils to the fixed insulated plates of the dual condenser.

This photograph shows how the coils are wound, and how the connections are made by means of valve-pins

The Inductance Units

The inductance units, of which four are required, are each fitted with four valve legs, which have the same spacing as the four terminals fitted to the ebonite shelf at the top of instrument. This arrangement facilitates quick changes of the various inductance units, and ensures that the electrical contact shall be a reliable one.

The grid and plate inductances are both wound in the same direction, and the formers should be clearly marked with "G" and "P" (grid and plate), so that they may always be inserted in the terminals in the correct position. If this precaution is not adopted, and the coils are reversed, the calibration will be changed, and the readings become unreliable.

The plate choke R_2 consists of 25 yards of enamelled No. 36 s.w.g. Eureka wire wound on an ebonite former 3 in. by 1 in. diam., and can be seen at the left-hand side of the instrument (from back).

The grid leak is a Zenite resistance rod of 10,000 ohms resistance,

COMPONENTS REQUIRED

- One ebonite front panel, 12 in. by 7½ in.
- One wooden baseboard, 8 in. by 7½ in.
- Four Paxolin tubes, 4½ in. long by 3 in. diameter.
- One dual variable condenser .0003 m.f.d.
- One Indigraph vernier dial.
- One filament rheostat, 6 ohms.
- One grid milliammeter, 0-1.5 milliamperes (Weston).
- One Zenite resistance rod, 10,000 ohms.
- One valve holder.
- Twenty-five yards No. 36 S.W.G. enamelled Eureka wire.
- Ebonite tube, 1 in. diameter by 3 in. long.
- One dozen terminals.
- No. 22 S.W.G. bare tinned copper, for winding spaced inductances.
- No. 28 S.W.G. cotton covered wire.
- Ebonite for shelf and terminal strip, connecting wire, brackets, etc. Screws.

A HETERODYNE WAVEMETER—*(Continued)*

and is placed on the right, immediately behind the grid meter.

The grid milliammeter A is for indicating resonance when the generator is coupled to another tuned or resonant circuit, and is a very valuable addition.

Resonance Indications

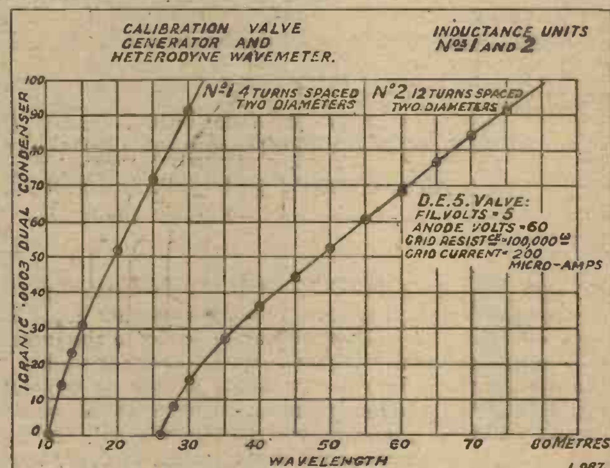
This method of indicating resonance is a very simple one, and it care is exercised in the operation the resonant point can be detected with an error of less than one per cent. As an example of this, suppose it is desired to measure the frequency of a given coil. The coil to be measured should be suspended fairly close to the inductance coil of the valve generator and the wavelength of the valve generator slowly varied over a wide range, carefully observing the grid meter during the process.

As the valve generator approaches the frequency of the coil under measurement, the grid meter deflection will gradually decrease, until a very sharply defined minimum reading on the meter is observed.

This minimum reading accurately determines the resonant frequency of the coil, and the wavelength is obtained by taking the condenser reading of the generator, and referring to the calibration curve.

A milliammeter giving a full scale deflection for about 1.5 to 2 milliamperes should be used, and it is necessary that the selected instrument should be "deadbeat," to facilitate the observation of the minimum readings.

The variable condenser C_2 is of the dual type capacity of ·0003 mfd. in each section, and should be of square law type with insulated fixed plates, and moving plates grounded to the end plates. As the ability of the completed instrument to hold to the original calibration depends largely upon this variable condenser, one should be chosen of robust construction with bearings of ample surface to resist wear, and the electrical connection to the moving plates should be made through a positive soldered pigtail connection.



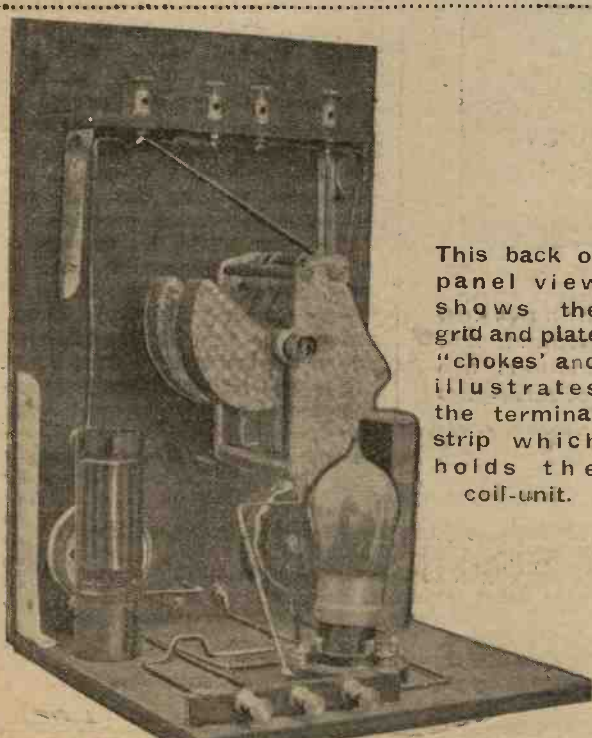
The first and second coil units, in conjunction with a ·0003 variable condenser, cover the wavelength ranges shown by this calibration chart.

The valve holder should be of the low loss type with a minimum of insulating material between the valve legs.

Concerning Construction

Fig. 3 indicates the wiring scheme, and shows the back of panel and baseboard laid out flat, actually the front panel is supported by metal brackets forming an angle of 90° with the wooden baseboard.

Two inches from top of front panel will be seen the shelf (also carried by small brackets at ends), upon which are mounted the four terminals to receive the valve legs



This back of panel view shows the grid and plate "chokes" and illustrates the terminal strip which holds the coil-unit.

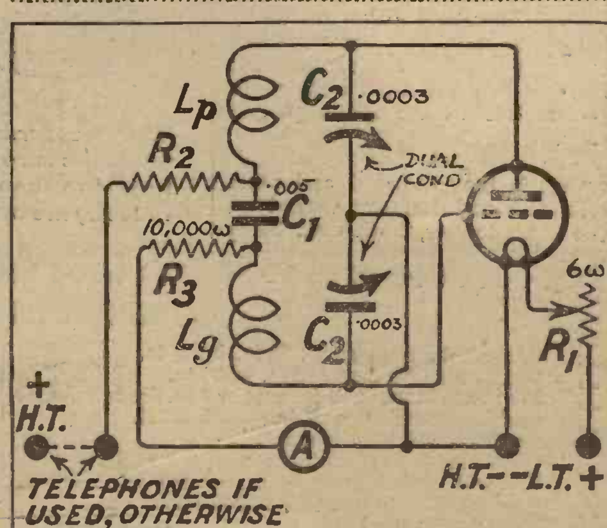
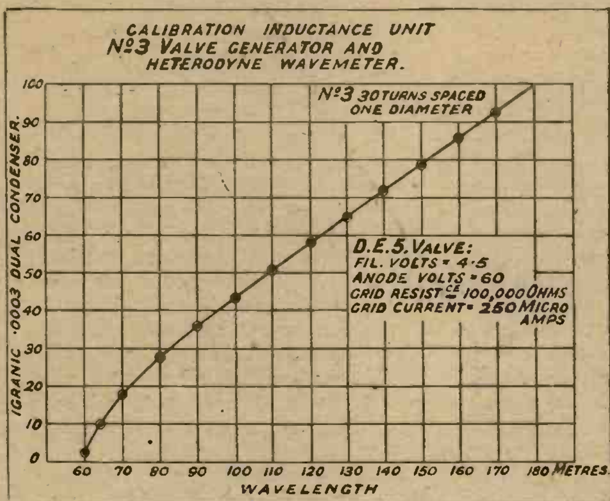
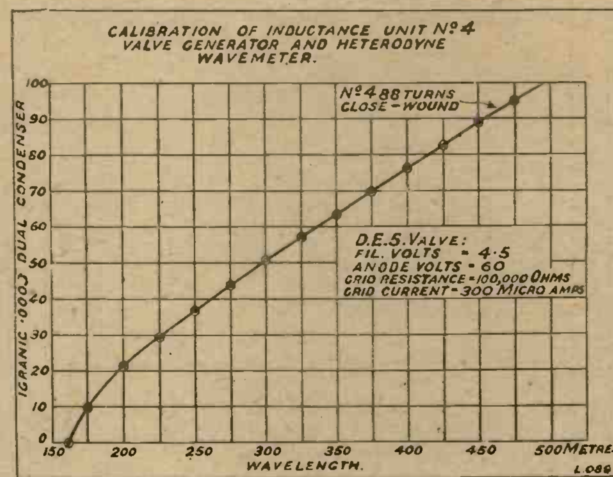


FIG. 1.

A HETERODYNE WAVEMETER—*(Continued)*





fitted to the inductances. The fixed mica condenser ·005 mfd. should be fixed under the shelf, and as close to the two centre terminals as possible. Care should be taken to make the wiring stiff and firm, and wherever possible the wiring should be secured by small celluloid strips to the wooden base or ebonite panel.

The object of these precautions is to avoid any change in the position of the various connecting wires likely to change the calibration of the instrument

The turns should be tightly wound on the paxolin formers, and varnished with a varnish made by dissolving scrap celluloid in equal parts of amyl acetate and acetone.

Final Details

If it is intended to use this instrument only as a wavemeter, an ordinary receiving valve may be used, and in this case the grid resistance should be increased to 100,000 ohms. A suitable resistance for this purpose is the Dubilier wire wound anode resistance, which can then be substituted for the zenite rod. An anode voltage of 60 will be sufficient for operation. When however the instrument is used as a power oscillator, as is necessary in many high-frequency measurements, an L.S.5 valve, used with the components as specified, and with anode voltages up to 300, will provide an ample margin of power.

A complete set of calibration curves are here reproduced for use with this instrument. As indicated on the charts, a D.E.5 valve with 60 v. anode potential and a grid-leak resistance of 100,000^{x}, was used to obtain the calibrations, which were taken from N.P.L. standard quartz crystal oscillators in use at the writer's laboratory.

Calibrating

It must be remembered, of course, that the charts given with this article cannot be taken as direct calibrations for use with the particular wavemeter constructed by any one reader. They are only provided as rough guides so that constructors can see what sort of chart they have to make out in order to make their own wavemeters ready for use. It is impossible to build two instruments so exactly alike that they will be accurately covered by one set of charts. The slightest deviation in wiring up, in the positions of the wires, let alone in coil winding, is

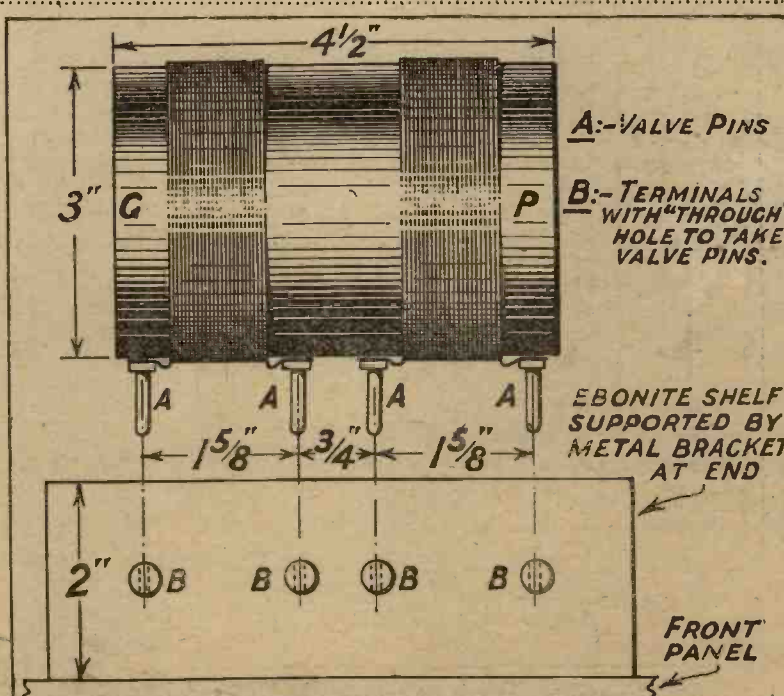


FIG. 2. L.065.

A HETERODYNE WAVEMETER—*(Concluded)*

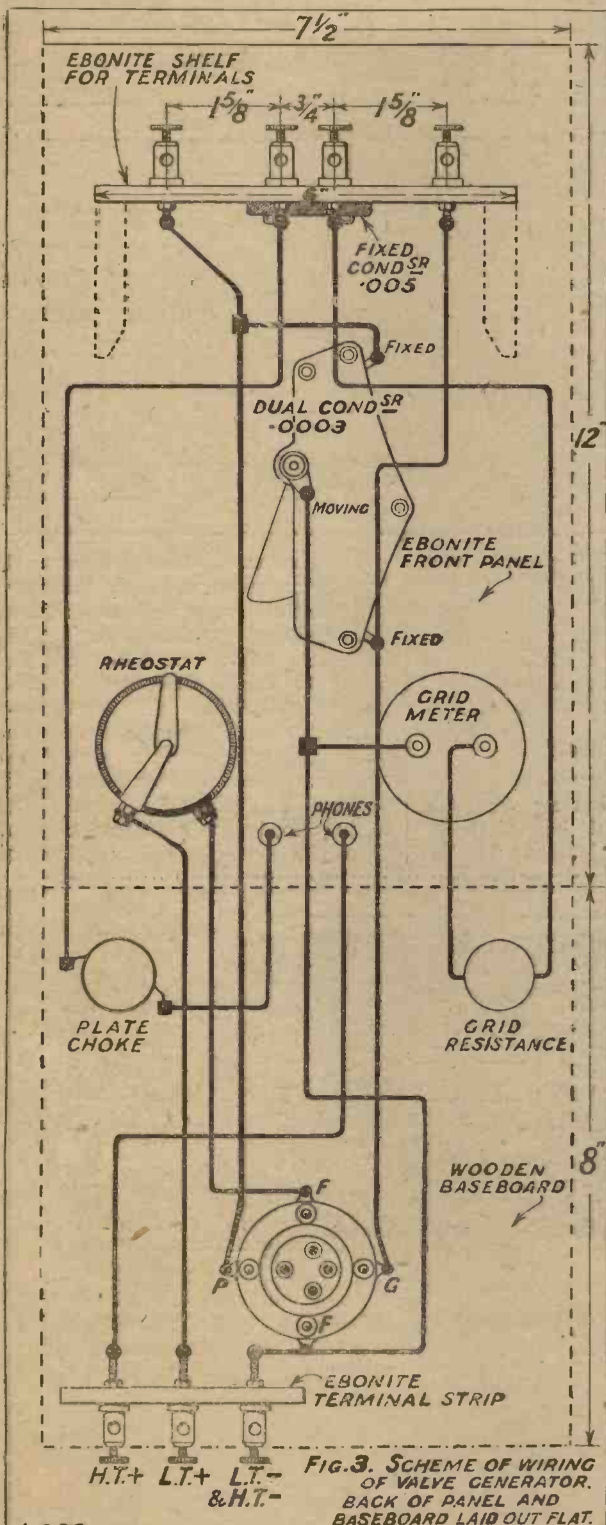


FIG.3. SCHEME OF WIRING OF VALVE GENERATOR. BACK OF PANEL AND BASEBOARD LAID OUT FLAT.

Fig. 3.—Shows how the back-of-panel connections are made. To the right is a photograph of the panel face showing the various controls.

sufficient to throw the calibration right out, and then, of course, there is the valve to take into consideration.

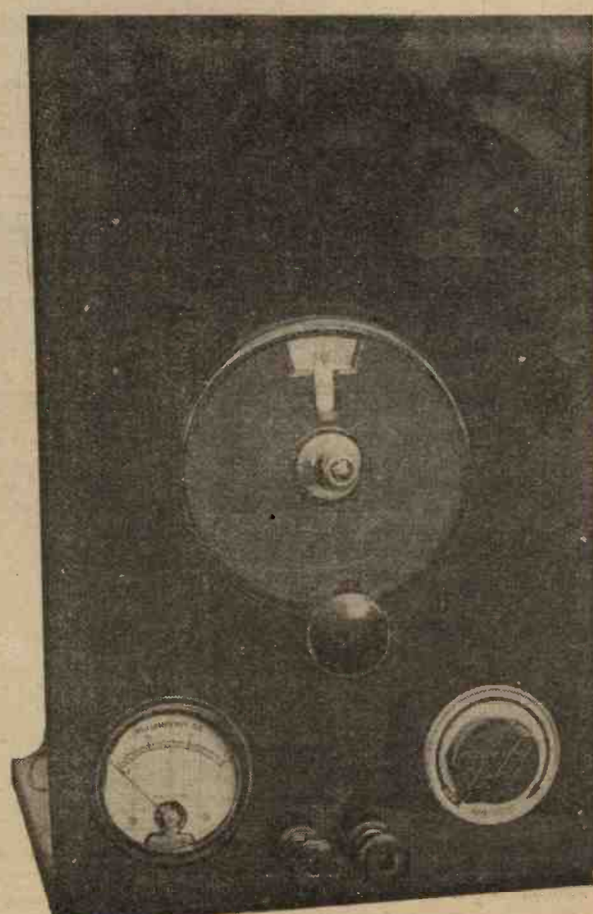
When a suitable valve has been chosen it should be left in position in the wavemeter, for any change of valve will impair the accuracy of the calibrations and a new set of charts will have to be made.

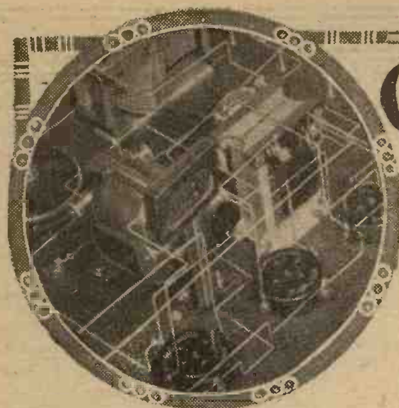
Calibration is best made by means of a standard wavemeter or an oscillating crystal, but quite useful rough charts may be prepared by utilising the various broadcasting stations and calibrating the wavemeter by means of the silent point of the heterodyne between the wavemeter and an ordinary receiver tuned to the particular station required. On the low wavelengths use can be made of the various standard wavelength signals sent out by the various stations, but the borrowing of a standard wavemeter from some laboratory would be most preferable for the average constructor.

The writer believes that for a fee of a few guineas Faraday House or the N.P.L. will calibrate any wavemeter, the fee varying with the ranges over which the calibrations are required.

Details of Coils.

10–32 metres, 4 spaced turns of 22 S.W.G. bare wire; 25–80 meters, 12 turns of same wire; 60–180 meters, 30 turns of same wire; 160–500 meters, 88 turns of 28 D.C.C. close wound.





CURRENT-PATH PROBLEMS

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

FASHIONS in receiver wiring have undergone quite startling changes in the last few years. Not long ago the accepted practice was to use fairly thin bare wire, about No. 24 S.W.G. being a usual gauge. To avoid contacts at undesired points between the wires, they were protected with insulating sleeving, slipped on as the wire was prepared for use. Then the more advanced designers of receivers advocated the use of bare wire throughout for the utmost efficiency, arguing that the insulating sleeving was likely to introduce unnecessary losses owing to the poor dielectric between the various wires.

Square Section Wire

This method of wiring led to the adoption of heavier gauge wire, nothing much finer than No. 20 S.W.G. being rigid enough for the purpose. Square section wire made its appearance, and has proved very popular with constructors owing to the ease with which it can be bent and set to accurate right angles. The modern tendency in wiring is to use either bare wire or wire with a permanent insulating covering, but at any rate to use nothing finer than No. 18 S.W.G.

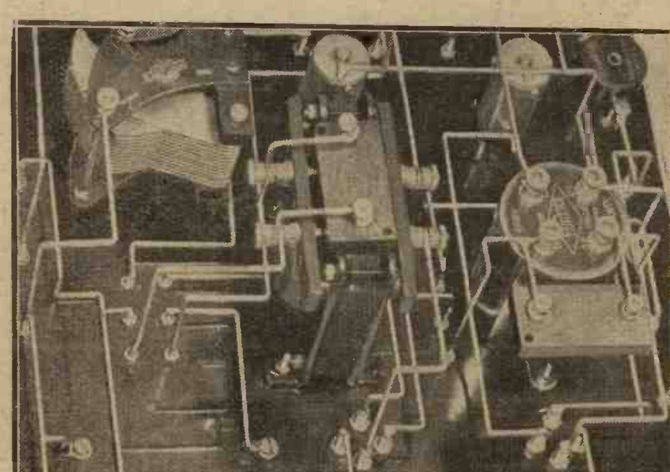
Care in Connecting Up

Practical experience of receivers constructed in accordance with published designs has convinced the writer that a great many set builders do not pay nearly enough attention to the arrangement of the wiring of their sets. They lay out the components as in the design and take great care to get every part in its exact position. But the wiring is often put in almost anyhow, so that the finished set is far from tidy in appearance, and, in addition, its performance is not infrequently adversely affected.

A Practical Example

The vexed question of whether or not to solder the joints does not arise here; it is rather the disposition of the wiring with which we are concerned at the moment. A practical example may be illuminating. The writer was recently called in as "doctor" to diagnose the fault or faults in a multi-valve set with two stages of high-frequency amplification. The receiver had been constructed to a published design, the components recommended had been obtained and the lay-out of the set had been carefully followed. It was not completely out of action, but it would bring in only one or two stations on the loud-speaker, when it should have been possible to hear dozens. The owner of the set was rather inclined to blame the designer for making claims for the set which it could not fulfil, though he was prepared to admit that with the number of valves in use its performance was far below the average.

The first glance over the receiver showed where the trouble was quite likely to be found. In the original set the wiring had been carried out with considerable care, so that the wiring of the high-frequency stages should be as nearly as possible symmetrical, the wires being also well spaced out wherever this precaution was of importance. In the receiver under examination the wires gave one the impression of "wandering" from point to point. The lengths of wire had not been straightened out before they were fixed in position, and in more than one case wires which were at different H.F. potentials ran parallel to each other and unnecessarily close together. One result of this was that although suitable valves and neutralising condensers were in use, it was impossible with one of the H.F. stages to get a low enough capacity on the neutralising condenser to neutralise the valve properly. This was



Fairly complicated wiring neatly carried out with No. 24 S.W.G. square section wire.

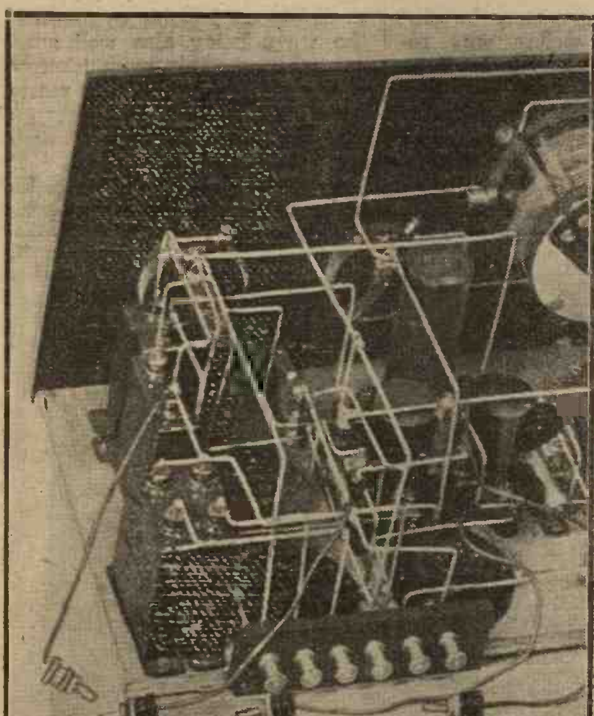
CURRENT-PATH PROBLEMS—*(Concluded)*

quite enough to upset the working of the set, since it made the controls very unstable, and the least trace of reaction made the set practically uncontrollable.

Right-Angle or Direct ?

In the instance quoted a cure was effected by spacing out the offending wires, so that there was no doubt where the trouble lay.

There is really not much to choose between the different methods of wiring which are available. Whatever type of wire you use, it is most important to arrange the wiring carefully. Some people prefer to have nothing but right-angled bends in the wiring of their sets. This makes for neat appearance, but it usually means that at some points it is difficult to avoid running wires parallel which would be better kept apart. A combination of the right-angled and the "direct" methods of wiring is usually the most likely to be satisfactory, both for tidy appearance and efficiency. Wherever it is important to keep the wires short, as in the H.F. portions of the circuit, the wires may best be taken by the most direct route between their points of contact, provided that in so doing they do not become too much crowded together. Wires such as battery connections to components on the panel may be conveniently arranged to run right round the edge of the baseboard to the terminals at the back. There is never any need to keep all the wires close to the baseboard or panel. It is, in fact, preferable to keep them away. In a set built in the "American" style, with a baseboard and a vertical panel, there is almost always a good deal of "waste" space above the rear part of the baseboard, which can well be occupied by widely-spaced wires.



Although the question of interaction is not so vital on the L.F. side of a receiver, great care must be taken when using bare wire to keep all leads well separated in order to avoid short circuits.

Flexible wire seems to exert a curious fascination over those who do not care for soldered connections in their sets, because of the ease with which it can be connected to terminals. It cannot, however, be considered good practice to use flex for wiring up even experimental "hook-ups." The positions of the various flex leads relative to each other are altogether too much a matter of chance, so that a set which works well in the "hook-up" stage may fail absolutely when it is made up in more permanent form with rigid wiring.

It is sometimes convenient to use flex for some connections in a receiver, but in such cases it should be anchored to the panel or to the baseboard as far as possible, to obviate any possibility of its straying from its proper position. There is, of course, no possible objection to the use of flex for external leads to the set, except in special cases, such as in the operation of sets on the very short waves.

Metal-sheathed Wiring

There is one interesting kind of wire which has not so far been mentioned, and that is wire which is insulated and also sheathed in a metal covering. Wire of this type is, of course, in regular use for house electric light wiring, but it is only recently that it has been brought out in a form suitable for wireless sets. In electric supply systems the purpose of the outer metal covering is merely to protect the insulation and the conductor from damage.

In wireless sets it finds its special application in sets which are designed for high selectivity, and particularly for obviating direct pick-up of the transmission from the local station. The wiring of the set is carried out in the ordinary way with the conducting wire, and, in addition, the metal sheathing is connected to earth. Care must be taken in wiring a set with this wire that the outer covering does not come into contact with the inner conductor, except where the conductor is itself connected to earth.

Avoiding H.F. Losses

Some discrimination, too, has to be employed in deciding which wires to treat in this way, and for which to use ordinary unsheathed wire. It would, for instance, be undesirable to use the sheathed wire for every connection in a set employing high-frequency stages, owing to the considerable capacities which would be introduced between the H.F. portions of the circuit and earth. With careful proportioning of the values of the components used, to allow for the additional capacities introduced by the wiring, this metal-sheathed wire should be distinctly useful as an aid to the elimination of a powerful local station.

I DESCRIBED, last month, how I imbued a potato merchant with a sense of shame, a feat of which I am very proud. There, on the one hand, was a perfectly good fellow called Ambo, handicapped by being in the spud trade, and cursed with a pa-in-law (resident on the premises) by the name of Twipe (ye gods!). On the other hand, or I should say on the Twipe face, was enough moss to stuff a *pouffe*. That, then, was the situation when Ambo penned a postcard as follows: "Should be delighted to see you 3rd prox., seven p.m."

"Prox." ! The business touch, I presume. Did he take me for a potato-planter, I thought—or a seller of super-het. kits? Pah! Anyway, prox. came, and after counting three, I called on Mr. Ambo, full of plans to reduce him from a bloated tuber expert to a humble amateur with all the holes in his panel bored a tenth of an inch too big.

Introducing Guddle

As I entered the den a massed smoke-screen came out—mostly shag. I stumbled in, and saw

. . . Ambo was sitting on the table playing a one-string fiddle. . . .

Ambo sitting on the table playing a one-string fiddle. Twipe was there, smoking a meerschaum carved to represent the Durbar of 1897. He had his 'phones, too, and all his whiskers were present and correct.

"Ex-cuse me," I coughed, "is this the Annual Smoker of the A.O. of Gnus, or do you cure bacon in your spare time?"

Ambo gave one last hideous *screech-h* on his fiddle and fell upon me in welcome.

"Welcome, brother," he cried. "We are all waiting for you. Take off your coat. Sit down. Mind the cat. Have a cheroot. Have you brought the valves? This is Guddle, my partner."

Ambo's "Low Passion"

Heavens! More spud sellers! Guddle was smoking a cherrywood pipe of artistic (?) design. If Handel had seen it he would have wanted to play a minuet on it. It is a moot point whether men who effect cherrywood pipes should be admitted to a radio club or even be granted a licence.

I beamed on Guddle, and asked him if he was keen on radio. He repudiated the notion stoutly, and said that he was entirely given over to potatoes, and that his hobby was the crossing of them with currants in the hope of producing a cheap substitute for bottled fruit.

"Well," I said, "I live in hopes of weaning Ambo from his low passion for the succulent root. We begin to-night, don't we, Ambo?"

"Rather, old chap. We've had glorious times since you put the crystal set O.K. What do you say, Pa?"

The Twipe stopped fumigating his face-vines, took his pipe out of the matted branches with a sharp tug, and shouted something through the foliage.

Birds of the Ether

"He says he doesn't want you to interfere with the crystal set because it is perfectly jing. Smatterfact, old boy, I don't see what more one could do to improve it. My wireless paper says that a crystal set is the *ne plus ultra* of a *multum in parvo*. But—I say! haven't the B.B.C. been broadcasting a lot of bird talks lately? I got old Skinnem, the naturalist, to come over, and he says he identified six distinct types of the Patagonian cuckoo, a Lesser Spotted Gasbill and a Chinese Chee-Pee-Foo Bird. Are they on now, Pa?"

The Twipe scrubbed the slider briskly up and down the coil and crouched over the set, looking like the maned African lion about to absorb a small gazelle. Presently strangled sounds were heard trying to pierce the undergrowth.

"He says he thinks they are whistling the overture to *Lohengrin* in the cockatoo cage at the Zoo. Isn't this wireless a marvel? Have a listen. Come on, Pa, hand 'em over," said Ambo.

I felt very sad as I waited while the Twipe tore the crystal-set

. . . I waited while Twipe tore the set out of the ivy. . . .

out of the ivy. I knew what birds he was listening to. Yes, it was a howler's night. Captain Eckersley was away on his holidays, and the whole body of licensees had got out of hand. I explained all this to Ambo, realising that I had undertaken a task bigger than a megohm.

"Well, all I can say is that the Associated Potato Fanciers wouldn't stand that sort of thing for a moment," said Guddle, gravely shaking his head. "Why, I know a man, out Wallingford way, a Big Grower, who had his membership card starred, just because he recommended the wrong fertilizer to the Sub-Committee for the Improvement of 'Mrs. Parker.'"

"By Gum, so they did," muttered Ambo. "Shocking case. 'Mrs. Parker,' too. A fine specimen like that. Dirty dog."

An Argument against Valves!

"All we can do is to educate them," I replied. "Give them a little of the right sort of brain—er—fertilizer, you know."

"That's another argument against valves, isn't it?" asked Ambo, looking wistfully at the map of the world.

"Not at all," I said. "Did the Committee chuck 'Mrs. Parker'? *Neow*! it carried on, after blasting

IN PASSING—(Continued)

the hopes and happiness of the Big Grower by starring his little card."

At this point the Twipe had to go and have his Doxo and biscuit, and with one accord we faced the map of the world, intent on Asia. Ambo pressed his finger on Hongkong and Asia swung outwards on a hinge, revealing its vast liquid resources.

"On the Wrong Wavelet"

"Ah-h," sighed Guddle, laying down his glass and filling up his pipe. "That's most stimulating. Goes bang to the tips of one's adventitious roots, ha, ha! That's a technical term we Growers use; I thought it only right to give you one, as you've been telling us all about this here ossivation on the wrong wavelet."

"Ye-es! thanks awfully," I murmured, thinking that if I didn't begin to preach radio in earnest I might find myself converted to potatoes. Ambo closed Asia gently and sat down. I took the crystal set in my hand and began to expound.

"Look here, Ambo! Last time I was here you professed a desire to get into the radio game, and quit being an ornery piker or goldinged rubberneck. (*That's American, Mr. Guddle; an adventitious root of English.*) Thasso? Well, then, why do you now sit down with that dear old lad Twipe

. . . The Associated Potato Fanciers wouldn't stand that sort of thing for a moment. . . .

—who must be mowed before the winter storms begin—and pretend to be satisfied with this child's fal-lal? Has it never occurred to you that with a real set you can listen to Talks on Tubers from America, the home of spuds, the ancestral land of old Lady Parker? Has it——"

Here Guddle sat up, and Ambo was obviously impressed.

"Has it never struck you that the American Grower may have an earful to say to his cousin on this side of the water? Let me ask you in all solemnity, What have you done for the Potato? Have you informed yourself as to the method of treating Scab in Tennessee? Not by a jugful! Do you know what President Coolidge does when his eagle eye detects the first signs of *Phytophthora infestans* amongst his finest roots? You do not! Do you imagine for one moment that this baby's pretty-pretty will help you to lift more cwts. per acre unless it can inform you what the Potato Princes of Middle West spray the Potato Fly with? I tell you—you have got to *think big*. You have got to get out into the great open spaces where men are Big Growers, where sandy loam and porous sub-soil stretch for countless miles and Bordeaux Mixture is brought up in pipe-lines and squirted on to the plants from airships. That's what!" Here I paused, while I surreptitiously rubbed the crystal with a bit of candle I had noticed amongst the clutter on the workbench.

A Sporting Offer

Both Ambo and Guddle sat entranced, so I took heart and proceeded.

"You think this twopenny souvenir is the last word in radio—the snake's spats, so to speak. Why, you can't rely on it to work properly for two hours together. Look at it, Ambo! Gaze, Guddle! I'll bet you a couple of bottles of Asia it won't work now. Are you on?"

Ambo took the set in one hand, and looked at me as much as to say, "Where's the catch?" "Go on, Julian," said Guddle. "It's a sporting offer." So Ambo hooked up to his aerial and did the scrubbing business with the slider.

"No, no," I remonstrated, "*it won't wash clothes*. Tune in gradually till deafened, and then de-tune till the Uncle sounds like a waiter calling down the service lift. That's the rule."

He then crept along the coil with the slider, looking for all the world like a biologist tracking a new kind of flea.

"Bless my soul, man,' I sneered. "Look at the cat's whisker!" It was pointing to the ceiling.

"Ah!" cried he. "Of course."

"Of course," I echoed. "That's the beauty of a crystal set like yours. Full of little playful tricks!"

"Sounds sort of dead like," he gloomed, as he gouged about in the candle grease.

Enter the Twipe

"Make it a dozen bottles," I said airily, lighting a cigarette. "Call up Mr. Twipe, if you like, and let it nest in his Hanging Gardens, the ninth wonder of the world."

"You try, Guddle," said Ambo in a dead voice. But Guddle declined,

. . . The Twipe wrestled with the set again. . . .

saying that the coil looked too much like a wire-worm for an Honest Grower to play with.

Then enter the Twipe, with his meerschaum dangling from his furze-bush; it reminded me of an old stove-pipe chucked into a tree.

"Ha, the very man," shouted Ambo. "If Pa can't do it, no-one can. Here you are, Pa! Make it work."

The Twipe needed no second invitation, but seized the set and retired with it to his corner, where he began to wear out the slider and coil as usual, after thrusting the telephones roughly into the thickset hedge like a tramp concealing a pair of stolen boots.

Nearly a Tragedy!

"When I was studying Roots, Lewes way," began Guddle, "there was a top-dresser, name of Martin, who could tell sile with his eyes shut. Regular *connooser*, he was, as the saying is. Give him a handful of sile, and he'd ram his nose into it and then p'raps he'd say, 'Yer! ain't 'ad no tarp-dressun this three-four year. Turble bad! Bin 'a grawmblin' un wi thik there narsty muck come outen . . . .'"

Suddenly a squeak broke through the Twipe's *chevaux de frise*

(*Concluded on page* 332.)

That Valve Problem

Owing to the rapidity with which new valves are making their appearance on the market and the consequent growth of the number from which the constructor may make his choice, the picking out of suitable valves for any one receiver is not an easy task. In this article some of the new valves are discussed and general advice is given concerning the valves best suited for use with the receivers described in this issue—

By KEITH D. ROGERS.

As time goes on it is becoming an increasingly difficult problem for the average constructor to choose from the host available the valves for any particular set.

Constant changing of nomenclature, suppression of various types and the introduction of new valves, approximately the same in operation as some just removed, but differing as a rule in a few essential theoretical features, besides the bringing out of totally fresh valves by the various makers, makes the task exceedingly difficult!

For instance, since the last issue of MODERN WIRELESS the Cossor valve list has been revised, and the names of several slightly altered, while five completely new types have been placed on the market, two in each of the 4 and 6 volt classes and one amongst the 2 volters.

I refer, of course, to the special resistance capacity Cossor valve in each class, and to the introduction of the Stentor 4 and Stentor 6. Mullards have brought out the PM5b, a special resistance capacity valve, which has an impedance of something like 74,000 and amplification factor of 37, while S.T.'s have introduced the ST61A with a μ of 40.

Then there is a complete break away from normal practice by Marconi's and Osrams in the production of their KL1 series; valves which operate direct from the mains, the whole of the energy being obtained from the electric lighting system.

"M.W." Sets

With regard to the sets described in this month's issue, precedence must, of course, be given to the Combine 5, the full constructional details of which are contained in the booklet given away with every copy of MODERN WIRELESS.

The valve question as it concerns this receiver is very fully discussed by the authors of the various sections of the descriptive matter, but I should like to emphasise their remarks concerning the importance of using suitable valves for this set, if any hope of efficient results is to be entertained.

Without in any way decrying the capabilities of the 2 and 4 volt valves—they are certainly little wonders in their own classes—I would very strongly urge all constructors of the Combine 5 to stick to the 6 volt types when choosing their valves. It has already been pointed out by Mr. Allinson that moderately high μ valves should be employed in the H.F. stages, while one of the type of the SP55B, or PM5b, will operate best in the Det. position.

The L.F. valves require just as careful consideration, for it must not be forgotten that even the first L.F. valve will have quite a considerable variation in grid volts to deal with, and must, therefore, have a moderately long portion to the straight on its characteristic curve.

Therefore, in this position a valve of the class including the DE5, PM6, ST62 should be used, while in the last stage a super-power valve will be essential if pure results are to be obtained.

As I said before, the various experts in charge of the sections of that receiver enumerate the valves they consider best, and so I need go no further into the matter.

Left: The Marconi D.E.4 Power Amplifier.

This illustration shows the Ediswan P.V.5, an excellent power valve for use with 6-volt. L.T. battery.

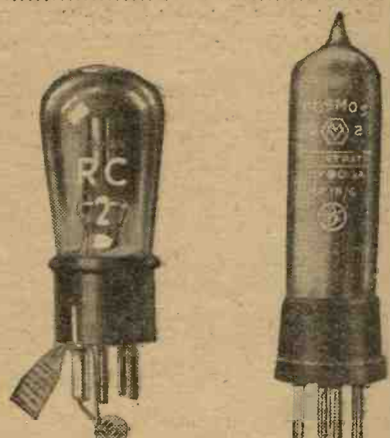
The Osram 4 electrode dull emitter — the D.E.7.

Right: A popular valve for resistance coupling and H.F. amplification: the D.E.5B

THAT VALVE PROBLEM—*(Continued)*.

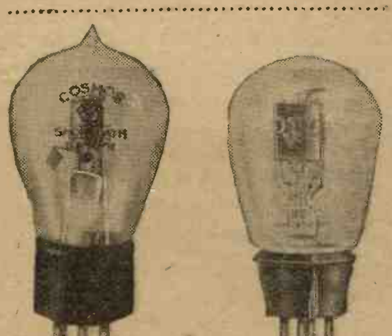
Skyscraper Amplifier.

Many constructors have written giving results they have obtained with the Skyscraper described in last month's MODERN WIRELESS, and several have asked for details of an L.F. amplifier suitable for addition to that set, and capable of providing loud-speaker repro-



Two two-volters. The Ediswan resistance-capacity L.F. valve; and the Cosmos S.P.18G of average impedance and *mu*.

duction to the maximum purity of tone. So a further article giving details of a suitable amplifier is published in this issue, but while I can recommend this amplifier if properly constructed and fitted with suitable valves to the majority of constructors without hesitation, I do not advise its use in conjunction with the Kone loudspeaker, unless the valves are very carefully chosen, owing to this instrument's sensitivity to the output impedance.

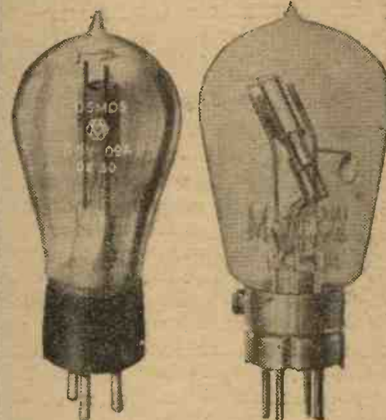


A couple of good power valves for L.F. amplification; the Cosmos 6-volt. S.P.55R with impedance of 3,500 ohms, and the Osram 2-volt. D.E.6 with an impedance of 10,000 ohms.

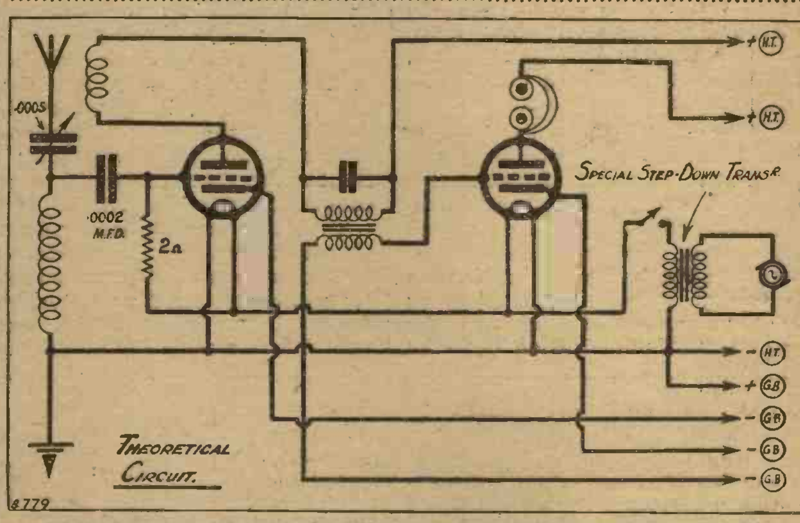
In this amplifier we have, as a study of the theoretical circuit will show, the output from the detector of the Skyscraper resistance coupled to the first L.F. valve, which amplifies via an L.F. transformer to the output valve. As the first L.F. valve will have quite a considerable voltage variation to deal with, it must be capable of handling this without distortion, and so I will suggest the use of a valve of the DE5 class such as the PM6, ST62, and B4, where loud signals are being dealt with; though louder results on distant transmissions would be obtainable by using a DE5B, ST61B, or similar valves. These, of course, might be overloaded when receiving a close station.

It would be advisable also, in view of the fact that a high resistance will be in its plate circuit when the amplifier is in use, to use a high μ valve for the det. position, such valves as the PM5b, ST61A, SP55B, Cossor RC, and Ediswan RC being suitable, though I remember I stated in last month's article that too high an amplification factor might cause distortion when *phones* were being employed in the plate circuit of the detector.

There you have an instance of one of the many problems that beset the searcher for maximum signal strength together with purity of reproduction, and you must choose your valve with this point in mind—either use a moderately high impedance valve for the detector and lower your output when the amplifier is attached, this being perfectly safe when phones *only* are nsed; or else use a valve of really high amplification factor, and risk slight distortion on the edge of oscillation when phones only are employed, this method giving maximum results with amplifier attached. Better still, the valve can be changed according to the required results.



Two new valves—the Cosmos D.E.50 general purpose; and the new Marconi K.L.1 valve for operation direct from A.C. mains.



The theoretical circuit of the receiver wired up for use with the K.L.1 valves now on test in the "Modern Wireless" laboratory. (See page 328.)

(*Continued on page 328*).

Spinning the Electron Stream

In an ordinary three-electrode valve the electron stream flowing between filament and plate is controlled by the electric field from a comparatively minute charge applied to the grid.

Instead of using an electrostatically-charged grid, it is possible to control the plate-filament current by a magnetic field applied from a solenoid winding surrounding the outside of the tube.

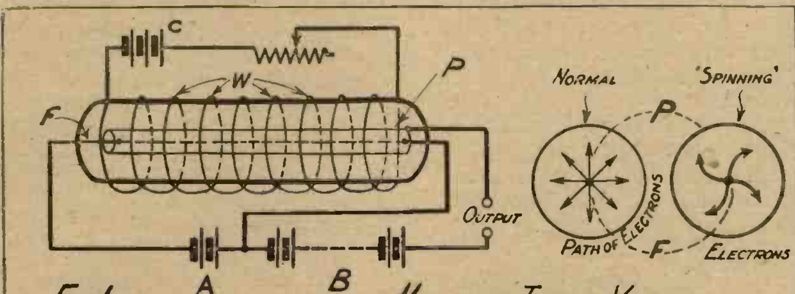


FIG. 1. MAGNETRON TYPE OF VALVE.

For instance, in the so-called magnetron type of valve, shown diagrammatically in Fig. 1, a central filmanent F, heated by a battery A, is surrounded by a cylindrical plate P which is maintained at a high positive potential by means of a battery B. An outside winding W, carrying current from a battery C, provides a control means in place of the grid.

An Outside Control

Normally the electrons emitted by the heated filament will strike straight across to the charged plate in radial lines, as shown at the right-hand side of the figure.

If, however, the outside control windings are energised, the resultant magnetic field passes axially along the tube at right-angles to the radial path of the electrons. The consequence is that the electrons no longer travel direct from filament to plate, but are forced into a curved path which is the resultant of the static attraction of the plate and the magnetic influence of the axial field.

When the latter reaches a certain strength the plate-filament current is entirely cut off. The electrons are swirled round and round the filament in a spiral path, and so fail to reach the plate.

At this stage the internal resistance of the tube is infinitely high. By altering the strength of the control field by means of a rheostat or any similar device, the tube resistance can be varied within wide limits, and in this way the arrangement can be made to function as a relay or amplifying device.

The rotary valve about to be described is an ingenious adaptation of this principle due to the well-known French inventor, M. Lucien Levy, whose name is already known to fame in connection with the superheterodyne circuit.

M. Levy describes his rotary valve as being similar in action to the well-known "Barlow's wheel." Before proceeding further it may therefore be as well to recall this interesting piece of apparatus.

Barlow's Wheel

Barlow's wheel, or Faraday's disc, as it is sometimes called, consists of a thin metal disc, Fig. 2, mounted on an axle between the poles of a magnet. The magnet has been omitted for the sake of clearness, but its field is indicated by the arrows H.

If a battery C is connected to two brushes, one P_1 on the periphery of the disc and the other P on the axle, so that the current passes in the direction of the dotted line arrows, the disc will rotate continuously in a counter-clockwise sense.

This is due to the fact that the path of the current flowing from the axle to the brush P_1 may be considered as a conducting element situated in a magnetic field H. It therefore experiences a torque tending to thrust it sideways according to the well-known Flemings' left-hand rule for motors.

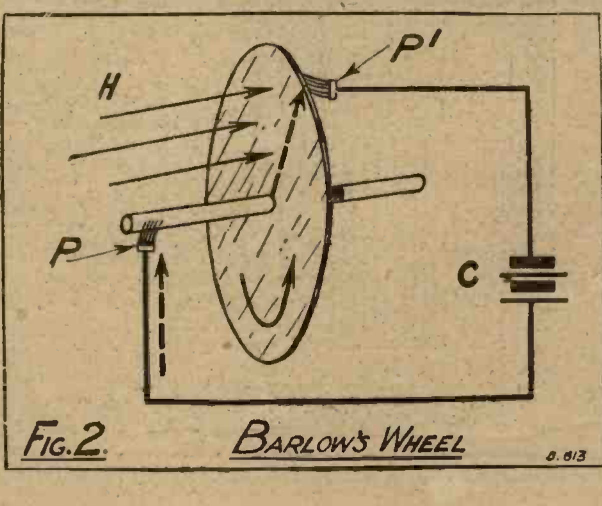


FIG. 2. BARLOW'S WHEEL

SPINNING THE ELECTRON STREAM—(*Concluded*)

In other words the arrangement constitutes an electric motor, in which the armature windings are replaced by a continuous succession of conducting paths formed across the rotating metal disc.

In the Levy valve the metal disc of Barlow's wheel is replaced by a rotating stream of electrons or ions, which in effect form a series of conducting elements.

Gas set into Rotation

As shown in Fig. 3, an evacuated tube A, fitted with an outer circular anode P and a central cathode C, is constructed in the shape of a flattened cylinder. This is placed endways between the two pole-pieces of an electromagnet M so that the magnetic flux passes through the end faces of the cylindrical tube.

Owing to the flat disc-like shape of the tube, the normal electron stream (if a heated cathode is used) or the ionic stream from an unheated cathode, will flow radially outwards from the central electrode to the ring-shaped anode, which carries a high positive potential.

The transverse field from the magnet poles acts, however, to divert each electron from a straight into a curved path, as shown at the right-hand side of Fig. 3. Owing to the effect of friction between the free ions and the molecules of the rarefied gas, the whole of the low-pressure gas inside the tube is thus set into rotation.

As in the case of an ordinary motor, a back electromotive force is created across the anode and cathode which tends, at the limit of rotation, to balance the voltage of the anode battery B.

A varying voltage applied to the magnet winding alters the value of the applied magnetic flux, which in turn varies the effective resistance of the anode-cathode path, and so gives rise to amplified variations in the output coil.

For high-frequency working the tube A may contain mercury vapour or rarefied argon or neon gases. According to the inventor the whirling ionic stream inside the pipe will rapidly acquire a high speed, owing to the extremely low inertia of the moving fluid.

Fig. 4 shows a further application of the "whirling stream" principle. Here the evacuated tube is made in the form of a cylindrical annulus or ring, and is set in a circular recess between the poles of an electromagnet M, the windings of which are shown at W.

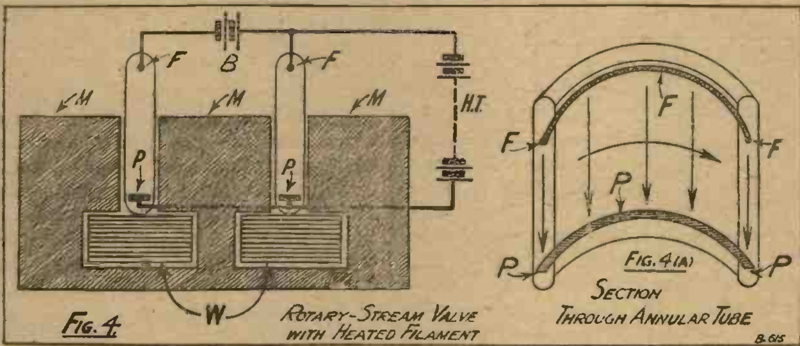


Fig. 4. Rotary-Stream Valve with Heated Filament. *Fig. 4 (a).* Section through Annular Tube.

The filament F is a continuous ring which is heated by a battery B. The plate P is similarly ring-shaped and carries a positive potential from the high-tension battery. The arrangement of the valve and electrodes are shown in cross section in Fig. 4A.

Owing to the annular shape of the tube, the path of the normal electron flow between filament and plate is everywhere at right-angles to the magnetic flux passing between the poles of the electromagnet.

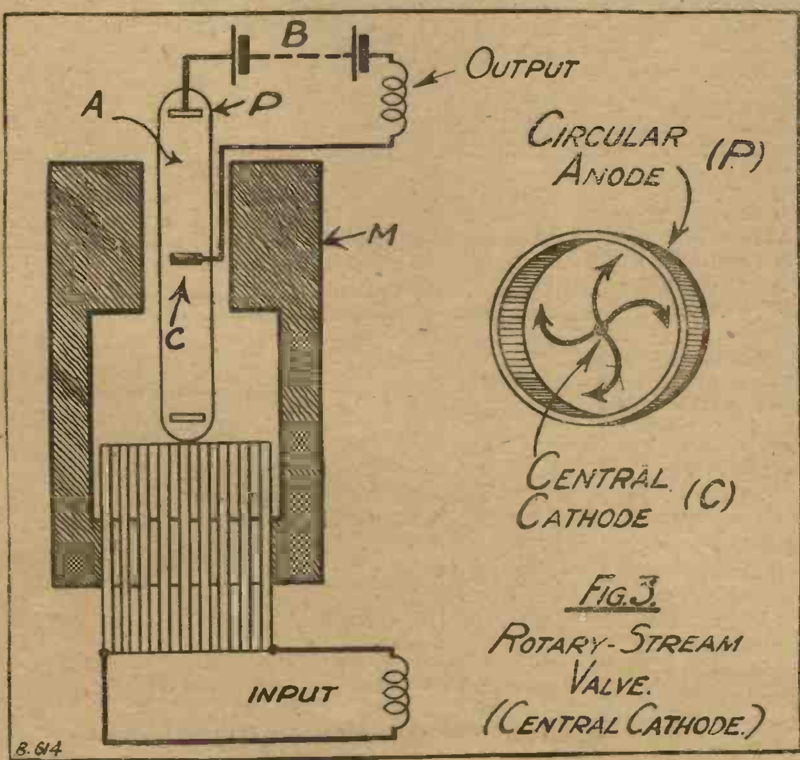
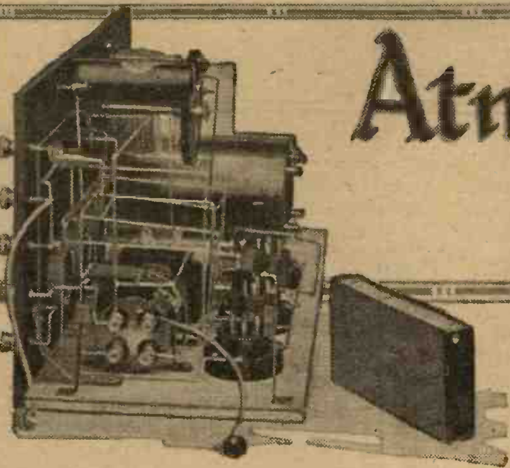


Fig. 3. Rotary-Stream Valve. (Central Cathode.)

No Speed Limit

As a result the whole of the electron stream is subjected to a steady force which tends to urge it laterally round and round the circular orbit of the tube. As the electrons have no inertia there is practically no limit to the speed which can be attained by the whirling stream.

M. Levy states that he has constructed rotary-stream tubes of this type capable of being used (*a*) as relays both for high and low frequency work, (*b*) for converting alternating into direct current, and *vice versa*, and (*c*) for generating high-frequency oscillations. R. S.

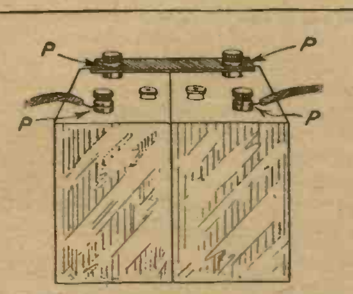


Atmospherics that Aren't

How many of the peculiar noises—apart from signals—that are frequently heard emanating from the loudspeaker or telephones of a wireless set can really be set aside as X's? As our contributor points out, probably most of them are curable and have their origin in the receiver itself.

By R. W. HALLOWS.

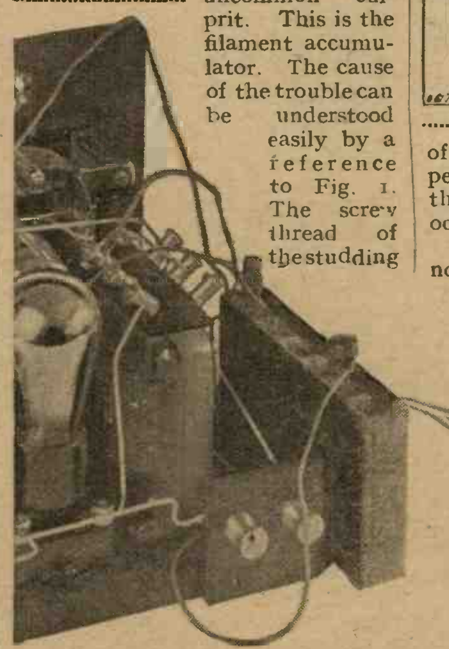
WHENEVER we hear grinding, grating or tearing noises coming regularly or at intervals from the telephone receivers, we are prone to exclaim, "Oh, there are those wretched atmospherics again," and to leave it at that. Now noises closely resembling those caused by atmospherics may be produced in a score of different ways within the set itself, and I am quite sure that much of the persistent atmospheric interference complained of is due really to what I call "atmospherics that aren't."



POOR CONNECTIONS AT ANY OF THE POINTS 'P' MAY BE CAUSE OF 'ATMOSPHERICS'
FIG. 1.

A case in point occurred to me in the early part of the autumn. A friend whose house is quite close to mine is a very keen long-distance worker. Every time that I met him in September and October, he told me with something like a sob in his voice that he could do nothing at all owing to the prevalence of atmospheric interference of the most violent kind. I use my own set for D.X. work on two or three nights each week, and though I had certainly noticed atmospherics at times, they had seldom been so serious as to make reception of distant stations impossible. Certainly I never found them anything like so bad as did my friend, who was using a set very similar to my own.

It was fairly clear, then, that the noises which were so worrying him were not due to genuine atmospherics. We spent a very long time over his receiving gear before we found the cause, but eventually we ran it to earth in a component, which is quite the last that most people would suspect of causing noisiness, though my own experience shows that it is not at all an uncommon culprit. This is the filament accumulator. The cause of the trouble can be understood easily by a reference to Fig. 1. The screw thread of the studding of one of the terminals holding the connecting strap between the two cells (it was a 4-volt accumulator) had become stripped, and it was, therefore, impossible to tighten the nut hard down. The result was that a very "chancy" contact between the two cells was occurring, with consequent fluctuations in the current delivered to the filaments of the valves. Since the temperature of these was not constant the emission varied and noises occurred.



Faulty grid bias battteries, loose transformer connections or faulty transformers are frequent causes of "home-made" atmospherics.

A TERMINAL CLEANER

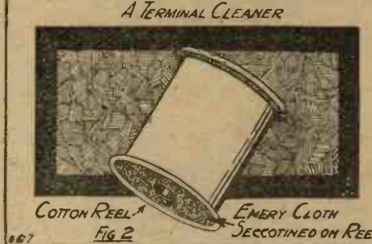


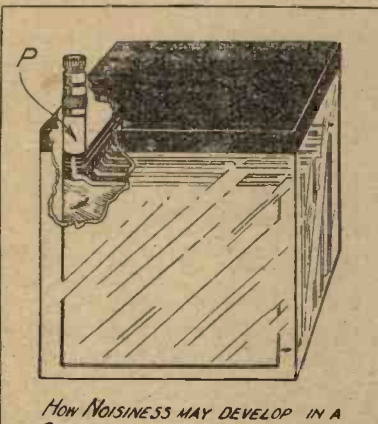
FIG. 2

An accumulator can become noisy even though all the connections are perfectly tight; in fact, I have known a considerable number of cases in which this has occurred. If either the lead strip or the terminals become corroded through the action of acid fumes from the battery there may be very poor connections with consequent noisiness. When, therefore, "atmospherics" are prevalent and your neighbours do not complain of them, one of the first steps that should be taken is to clean thoroughly all the terminals, and the ends of the lead connecting strip, if this is of the detachable type. The simplest way of cleaning terminals is to make use of the handy little device shown in Fig. 2.

ATMOSPHERICS THAT AREN'T—*(Continued)*

It consists of nothing more than an empty cotton-reel with discs of emery cloth seccotined on to either end, holes in them being pierced to correspond with that which runs through the reel. To use the cleaner, remove the milled nut from the terminal and pass the reel on to the shank.

Press it hard down and turn it backwards and forwards two or three times. This will make the seating bright in a matter of seconds. The underside of the milled nut and the surface of the connecting strip should be cleaned by rubbing them on a piece of old emery cloth. Do not forget that the ends of the leads from the



HOW NOISINESS MAY DEVELOP IN A GLASS-CASED ACCUMULATOR FIG.3

filament battery to the set may also become corroded. If they show any signs of this freshen them up either with emery cloth or by scraping with an old knife.

An Accumulator Fault

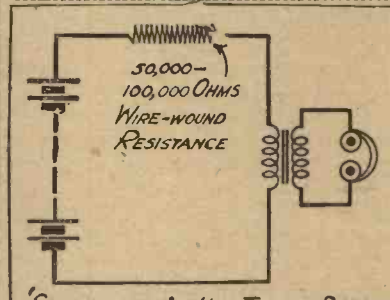
Glass-cased accumulators are becoming very popular nowadays because they do not possess the vice of frothing, which seems to be inherent in most celluloid-cased secondary batteries. A cell of a much used kind is shown in Fig. 3. The top of the case is sealed off with pitch or bitumen, and through this covering pass the lugs which are connected to the two sets of plates. They are held in position by the sealing, and frequently they have no other means of support. If the accumulator is lifted by its terminals, it is only a matter of time for one or both of the lugs to become loosened so that they can be moved up and down besides developing a certain amount of lateral play. Any jarring will now cause the plates to move slightly, and this seems to give rise to noises.

The degree of noisiness for which a battery whose plates have become loosened in this way may be responsible has to be heard to be believed. I can assure the reader that it is quite as bad as that which is due to the worst type of atmospherics. When noisiness manifests itself always make sure, if you are using a glass-cased accumulator, that there is no play in the lugs. If there is, you may feel pretty confident that you have tracked down the main source of the trouble.

The High-tension Battery

It has often been said by expert writers that when noisiness is noticed in the receiving set the first component that should be suspected (and usually the last that is) is the high-tension battery. When it was first made, some years ago, that statement was probably quite correct. High tension batteries in the early days of wireless were exceedingly unreliable, though the average wireless man was inclined to take them for granted, and not to regard them as a likely seat of the trouble until he had exhausted almost every other possibility. To-day matters are rather different. Excellent high tension batteries of both the dry and the accumulator type are now available, and my experience is that they are comparatively seldom to blame.

Naturally, if a small battery is used for working a multi-valv set, so that the drain on its tiny cells is more than they can stand, or if the battery is of some nameless make, it is more than likely that sooner or later (probably sooner!) it will become noisy. Accumulator high tension batteries seldom develop



'STETHOSCOPING' A HIGH TENSION BATTERY. FIG. 4

noisiness unless some of their cells have been "killed" by overcharging, and the best dry batteries of to-day can be run down to less than one volt per cell, and yet remain perfectly quiet. I would say, therefore, that if your high tension battery is a good one, you may regard it as a possible, though not probable, cause of noisiness.

The "Stethoscoping" Method

It has often been said that there is no means of telling whether the high tension battery is noisy or not except by means of the substitution,

A striking photograph of the real thing—a display of nature's forces that will give rise to atmospherics in wireless receivers over a widespread area.

ATMOSPHERICS THAT AREN'T—(Continued)

method. This, again, is not strictly accurate, for the "stethoscoping" method which is shown diagrammatically in Fig. 4 will generally serve to show up a battery that is really bad. To test out a battery in this way it is necessary to use a *wire-wound* resistance of 50,000 to 100,000 ohms. If the battery were connected directly across the primary of a transformer an excessive amount of current would be passed with evil results to the battery and possibly also to the transformer. The resistance cuts down the amount of current taken to a reasonable figure—if a 100-volt battery is being tested a 50,000 ohm resistance will allow something under 2 milliamperes of current to pass and a 100,000 ohm resistance 1 milliampere.

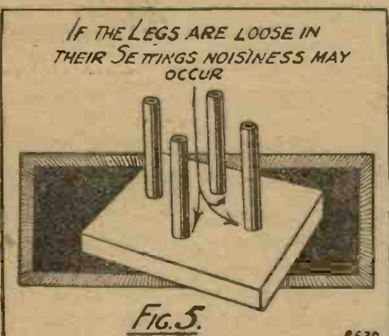


FIG. 5.

Anode Resistances

The transformer should be preferably of a type with a big step-up between primary and secondary so that any voltage fluctuations in the output of the battery may be amplified as far as possible before they are transferred to the telephones. The battery should be tested after it has been under load in the receiving set for half an hour or so, for then its weaknesses will be most apparent. If it is all that it should be no sound whatever will be heard in the telephones, but if its output is fluctuating small noises may be heard. The sounds will never be very loud, and the slightest murmur or crackle should be regarded as a sign that the battery is in bad condition.

It is essential that the resistance used should be of the wire-wound type, for composition resistances may themselves be fertile causes of noisiness. In most of them the high resistance conducting path is made by minute particles of carbon or some similar substance embedded in plaster of Paris. When they are new the path is fairly continuous, but as time goes on slight interruptions may occur in it. When this happens arcs of microscopic dimensions are formed between adjacent particles, the resistance varies, and there is an outbreak of noisiness. Should an anode resistance be suspected of causing noisiness in a set which employs resistance-capacity coupling the most satisfactory method of finding out whether it is or is not to blame is that of substitution.

Substitution Tests

It frequently happens, however, that when the trouble occurs one has not available another resistance to substitute for the first. In such cases the resistance should be removed from its holder, and the secondary of a low-frequency transformer connected by wires to its terminals. The coupling is thus converted into choke-capacity, and the set will continue to function. If noisiness continues then the anode resistance is guiltless, and the "atmospherics that aren't" are being produced in some other part of the set. The grid-leak should also be tested by substitution. Should the noises no longer be heard when either of these changes has been made, the grid-leak or anode resistance, as the case may be, is undoubtedly at fault.

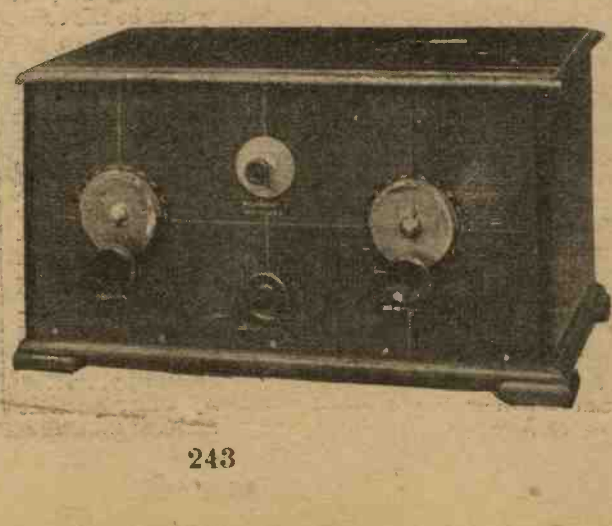
Valve-holders can be a very fruitful source of unwanted noises. Holders of the type seen in Fig. 5, either bought or home-made, are frequently used, and these are perfectly satisfactory, unless one of the legs happens to come loose in its seating in the ebonite. When this occurs the holder may not grip all the valve pins properly, a "chancy" contact resulting from one or more of them. In such cases noisiness manifests itself, particularly when the room is shaken by the passing of heavy traffic or by the footsteps of anyone crossing the floor.

Transformer "Breakdowns"

Vibratory valve-holders also occasionally give trouble of the same kind through the breaking of one of the spring connections between the terminals and the legs. Fortunately, it is an easy matter, as a rule, to ascertain whether valve-holders are responsible for noisiness. Place a finger on the top of each valve in turn and rock it a little, first backwards and forwards, and then sideways. Should there be any defect in the holder loud noises, and possibly a complete momentary cessation of signals, will occur when this is being done.

This test, however, does not always mean that the holder is at fault. It may show merely that the valve pins require splaying with the blade of an old pocket-knife, or that one or more of them have become loosened in the cap. Loose pins can often be set again with a little Chatterton's compound.

A cause of noisiness which is not uncommon is to be found in a breakdown in the windings of a low-frequency choke, or in the primary of a low-frequency transformer. For a long time it was not understood how "burn-outs" could possibly occur since the load passing through windings is never more than a fraction of what wire of the gauge should be able to withstand indefinitely. When a broken-down transformer is taken to pieces, it is nearly always



However simple a receiver may be any pencil lines on the panel should be carefully removed before testing the set.

ATMOSPHERICS THAT AREN'T—*(Concluded)*

found that there are obvious signs of corrosion in the neighbourhood of the break. After a good deal of research the cause has now been found and preventive measures have been taken.

The Only Real Test—

In order to wind the fine wire evenly and tightly on to the former the operator must feed it on through hand. Now the human skin is never perfectly dry. If the wire passes through the bare hands a small amount of perspiration is absorbed by the silk or cotton covering, and may make its way to the wire within. Here it sets up corrosion and eventually the wire is eaten through. Winders are now provided with special silk gloves or other devices, and since this precaution has been adopted breakdowns have been far less frequent.

The general symptoms of a choke or transformer break-down are that noisiness is as a rule comparatively slight when it first manifests itself. It becomes steadily worse and worse and is at length succeeded by complete silence, neither signals nor noises being heard owing to the break down. The only real test for a partial break-down in the windings is that of substitution; a complete break down may be found by the ordinary test for continuity.

Loose Leads

Loose leads can cause the most violent kind of "atmospherics that aren't." When jarring increases the amount of unwanted noise coming from the set test out the valves and their holders first of all, as recommended above. Should these be found to be above suspicion one may feel practically certain that a lead is not properly connected to its terminal. Here is a simple and very effective way of discovering just which of the many wires within the cabinet requires attention. Switch on the set, and with a pencil or wooden stick work over all the leads, touching each lightly and moving it a little to and fro. Even in a big set which may contain a large number of wires a loose connection can be found by this method in a matter of a few minutes. It is advisable, however, to conduct the search methodically.

The best way is to begin with the high and low-tension busbars, and then to go to the high-frequency end of the set. Test all the leads in the grid, plate and filament circuits of each valve in turn. Be particularly careful to try connections soldered to jacks, where these are used. The tags of some jacks are nickelled, and if soldering has been done without removing the nickel covering a dry joint is very likely to occur.

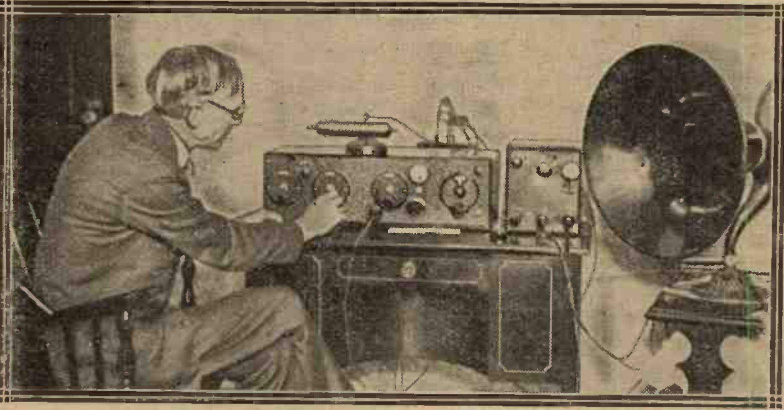
Grid Batteries

Do not forget to renew your grid batteries periodically. Though the current load on them is almost infinitely small they do not last for ever since dry cells deteriorate in time even when on open circuit. It is a safe rule to throw away any grid battery which contains even one cell whose E.M.F. has dropped to one volt or less. The grid batteries should certainly be tested every three months, and twelve months should be regarded as about their maximum useful working life. A faulty grid battery can be the cause of a prolific crop of noises.

Due to Dust

Noises exactly like atmospherics are frequently caused by the accumulation of dust between the vanes of variable condensers, for some of the little particles are fairly good conductors so that small short-circuits take place. Besides causing noisiness an accumulation of dust between the vanes of a neutralising condenser may also lead to a somewhat expensive firework display involving several valves.

There are many other possible causes of noisiness, though space prevents me from doing more than mention just a few of them. If the marking out of an ebonite panel which is in contact with "live" portions of components at considerable potential differences has been done with a lead pencil, "atmospherics" are more than likely to occur, since the pencil deposits on the ebonite graphite, which is a fairly good conductor. Marking out should always be done, therefore, with a scriber. Good ebonite of known make can be relied upon, but if you are foolish enough to buy cheap stuff of unknown origin you may be bothered by noisiness. Lastly, do not forget that the trouble may be caused by a broken or partially broken lead to your 'phones or loud-speaker.



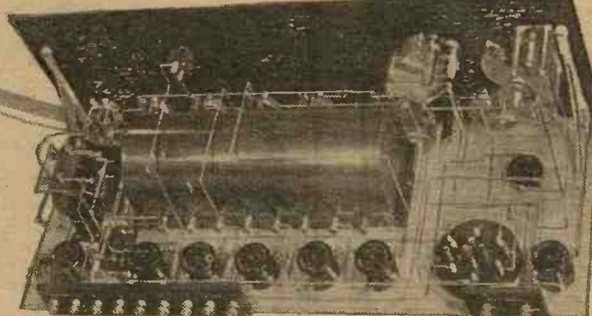
Nothing is more irritating than to find, on trying to tune in a programme, that one of the variable condensers is faulty and either making bad contact or shorting.

Not at all Reliable

To see whether the fault is here, switch on and go carefully over the leads by taking a length of about six inches at a time between the hands, moving it about and twisting it slightly. If there is a break you will soon locate it in this way, for when you reach the length in which it has occurred movements of the wires will cause an outbreak of very violent noises.

By the way, the old test of disconnecting the aerial and earth in order to discover whether the noises heard are due to atmospherics or not is not completely reliable, for powerful atmospherics may still be heard owing to direct pick-up effects.

Modern H.F. Practice



A review of the practical progress made in dealing with H.F. problems.

By C. P. ALLINSON, A.M.I.R.E.

WHEN one reviews the progress that has been made in the science of wireless during the last year, one outstanding feature appears to be the extraordinary progress made in high-frequency amplification.

A year ago the neutralised circuits which were available were frequently as tricky to handle as the unneutralised ones, and they were little used and generally mistrusted by the unexperienced.

Thanks to the efforts of a number of independent research workers, it is now possible to construct receivers employing many stages of high-frequency amplification with the certainty that the completed set will be stable and easy to handle.

Queer Practice

It seems queer when one looks back and remembers that such methods as detuning and applying positive bias were used in order to control oscillation. It seems much queerer, however, when one notices how even to-day one sees similar methods still practised. As an actual fact, I saw a set quite recently in which a stage of tuned anode H.F. was used, and the method of controlling oscillation was by dimming the filament by means of the filament rheostat, a practice that is absolutely inexcusable in these enlightened days.

In the bad old days we had inefficient components that oscillated in spite of themselves, and to cap it, we used potentiometers as a means of stopping these (comparatively) feeble oscillations.

It is curious to note that the era of low loss instruments coincided almost exactly with the introduction of neutralising circuits for high-frequency work, and is fairly obvious that without these latter low loss coils and condensers would have done us but little good.

One of the first neutralised circuits which was published in England was the Hazeltine neutrodyne circuit. Practical details were at first difficult to get, but in due course they became available. In common with many other experimenters I made up a 2 H.F. set using this scheme and found, as the others did, that it was stable without the use of the neutralising capacities.

Tuned Anode Neutralisation

This was due to the totally different characteristics of the valves which were in use over here as compared with those current in America.

The next circuit that became popular was the tuned anode neutralised circuit, and for the benefit of those who may be interested in the question, but do not quite recollect the arrangement, it is shown in Fig. 4. The aerial is shown auto-coupled to an inductance L_1, tuned by a variable condenser C_1, which forms the grid circuit of the H.F. valve. The tuned anode coil L_2 (tuned by C_2) has coupled to it a coil L_3 which is connected between grid and filament through a neutralising condenser C_2 as shown. The next valve is

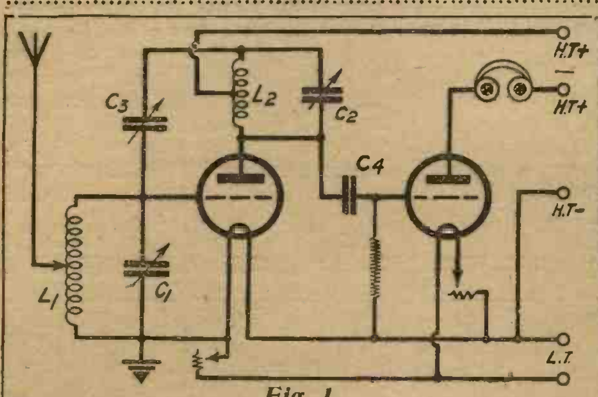


Fig. 1.

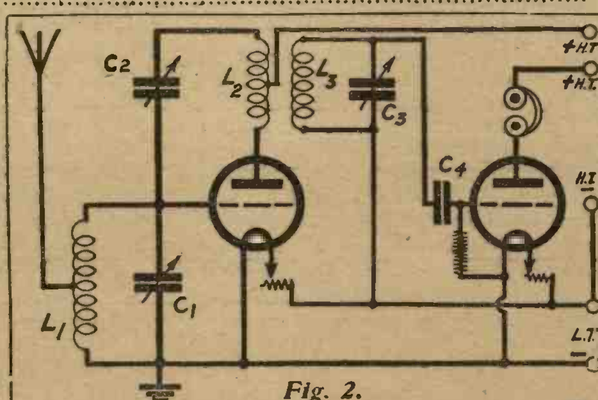
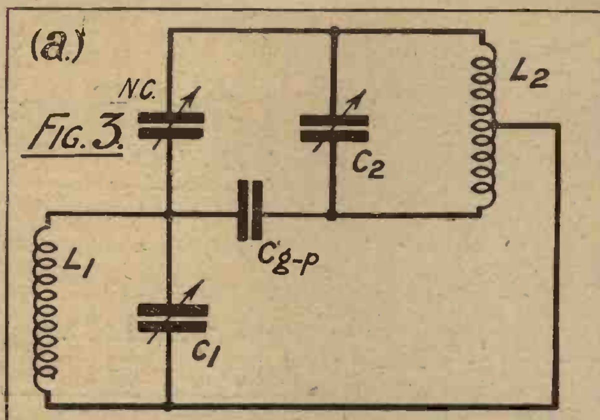
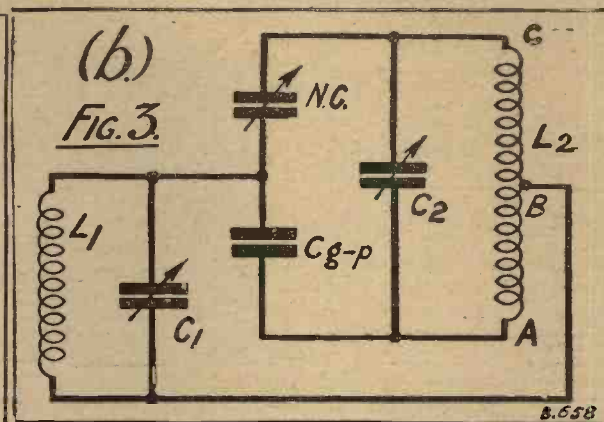


Fig. 2.

MODERN H.F. PRACTICE—(Continued)





hcwn functioning as a detector, but it may, if desired, be a further stage of H.F. amplification.

This arrangement was found to be considerably more satisfactory than waiting for the set to stop oscillating, and it could be used up to three stages of high-frequency at a pinch, though it was frequently found to be uncertain in action.

The Split Coil Method

Early in 1926 the split anode and grid coil method of neutralisation were first used over here to any extent, and these circuits ushered in a new era in high-frequency amplification. Naturally enough certain difficulties were at first encountered, but the circuits as then employed are practically the same as we are now using. We have merely found out certain things that either must be done or must not be done.

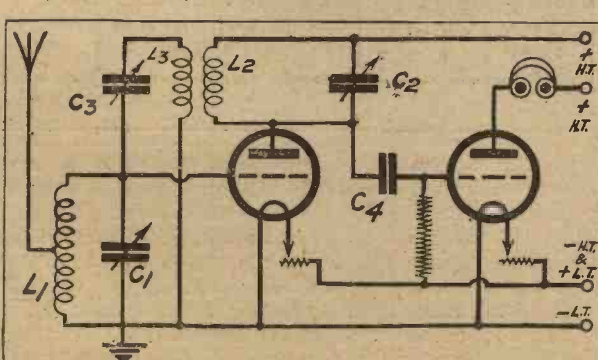
Take, for instance, the neutralised stage of H.F. shown in Fig. 2. This employs the split anode coil neutralising scheme. The grid coil L_1 (tuned by C_1) is connected between grid and filament of the H.F. valve. In the plate circuit of this valve is a coil L_2 which is coupled to the grid circuit of the detector valve (or maybe a further stage of H.F.) by L_3. Instead of the high tension being connected to the end of the anode coil opposite to the anode, it is taken to the centre point, the far end being connected back on to the grid through a small neutralising capacity shown as C_2. By substituting a capacity as shown by its theoretical symbol for the grid to plate capacity and redrawing, we get the diagram shown in Fig. 3 "a" and by re-arranging it slightly, we get Fig. 3 "b."

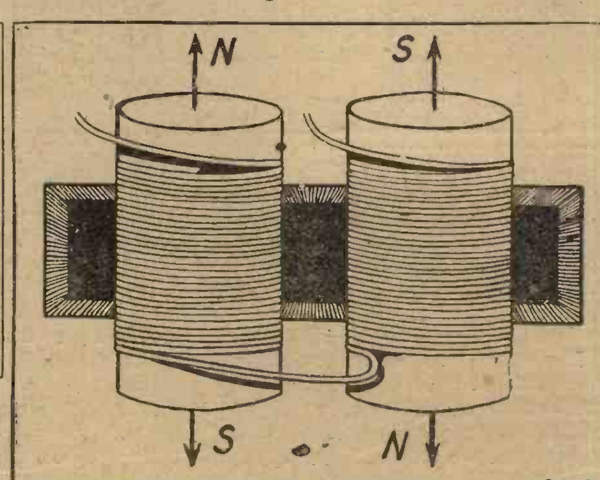
It will be seen that this gives us a capacity potential divider for H.F. currents. L_1 C_1 is the input circuit and L_2 C_2 the ouput, while Cg-p is the grid-to-plate capacity, and N.C. the neutralising capacity. It is merely necessary, therefore, to get the proportions of N.C. to Cg-p equal to AB to BC for a balance to be obtained, so that the energy fed back through the inter-electrode capacity will be equal and opposite in phase to that fed back through the neutralising capacity. Since, however, a capacity has a higher impedance at a lower frequency, and vice versa for an inductance, it is necessary that the point B be as near as possible at the centre of the inductance L_2.

The Grid Return

Referring back to Fig. 2, the conditions required by this circuit are, firstly, that the sense of L_2 be correct with regard to L_3, i.e., the coupling must be in the right direction, and, secondly (an equally important point), the coupling between the two coils must be tight enough. If one of these conditions is not observed, it may not be found possible to obtain a balance at all frequencies, if at all.

One of the most successful circuits of this type that I have used is one that I originally described as the result of some research work that I carried out on H.F. amplification in which I found that.





Above (Fig. 4.) is the tuned anode neutralised circuit—one of first of its kind to become popular in England. To the right is a field-less coil showing how the halves "cancel out."

MODERN H.F. PRACTICE—(*Continued*)

by leaving the grid of the H.F. valve free, I could get a higher degree of amplification.

This increase, I found, could be retained either by using a H.F. choke or a high resistance in series with the grid return.

The first practical receiver in which I used this circuit was in conjunction with fieldless coils, and I have since, experimentally, used this circuit for three stages of H.F. amplification without any difficulty.

The circuit of a receiver employing this scheme is shown in Fig. 5, and it will be seen that the inclusion of H.F. chokes in the grid returns largely help to eliminate, or prevent the formation of, parasitic oscillations.

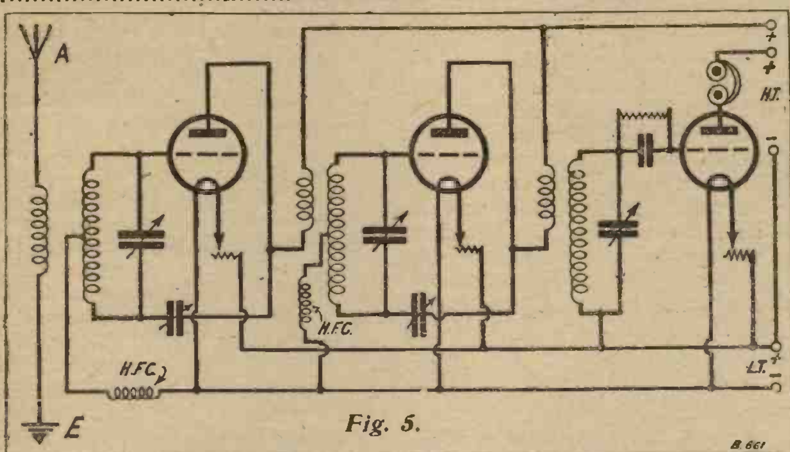


Fig. 5.

Suitable for Reflex

The use of these chokes has, however, certain disadvantages on the long waves, and in such cases the use of resistances is to be preferred. A suitable value for these is in the neighbourhood of 100,000 ohms, but the circuit is not then quite so suitable for short wave work, though I have been as low as 60 metres on occasion without any real difficulty.

This circuit, it will be seen, lends itself very well to reflex work, for the L.F. impulses are fed into the H.F. circuits at the nodal point of the grid coil, so that any stray coupling between stages owing to the self capacity of the L.F. transformer is reduced to a negligible quantity. The result is that it is a simple matter to use two fully reflexed stages of H.F., and provided that they are correctly neutralised as regards their H.F. functions they are also neutralised for L.F. work. This means, of course, that low-frequency chain reaction does not occur, and it is possible to make the detector valve oscillate in the conventional manner by the use of reaction without those devastating howls and groans which are so often experienced in the old types of reflex receivers, being generated.

I have made up a receiver experimentally with this circuit, in which two H.F. stages were reflexed, the first resistance-capacity and the second transformer, following up with a further stage of transformer coupled L.F. without any trouble as regards L.F. oscillation occurring. The only trouble I did have was on the local station, and this was due to overloading of the dual valves forcing them into oscillation. By using valves of the D.E.5a type, it was found to be a fairly simple matter to stop this, and valves of this type are usually to be recommended where a two-stage reflex receiver is used for local work.

Improvements in this circuit have largely been made in the method of winding the anode coil—splitting it into two portions wound one over the other—one for the anode coil, and one for neutralisation, for example, ascertaining the correct number of turns to work with certain valves, the correct degree of coupling, and so on.

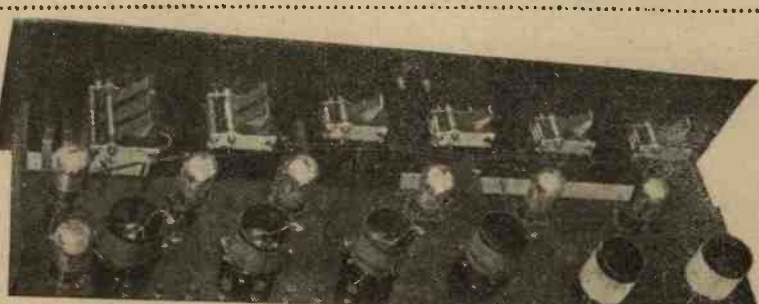
Getting the correct coupling is by no means an unimportant matter, since, if the coupling is too loose, correct neutralisation may not be obtained, while if it is too tight, selectivity will be lost.

Development of Fieldless Coils

The adaptation of this circuit to the tuned anode method of high-frequency coupling is shown in Fig. 1, and this was found to be an extremely successful circuit as long as it was confined to one, or at the most two stages. More than this number, it was found, gave rise to parasitic oscillations with the result that the set went dead. This trouble was also experienced to a certain extent with the Fig. 2 circuit if more than two stages were used, and it is the generation of these parasitic oscillations that is one of the bugbears of multi-stage neutralised high-frequency circuits. The question of fieldless coils may prove of interest here, and as I designed one of the makes now on the market, I can give some idea as to the chief requirements of fieldless coils.

The point that attracted my attention to fieldless coils was the

(*Continued on page* 330)



The design of modern multi-valve receivers, with their tuned radio-frequency stages, calls for great care in the spacing of the different circuits

"I HAVE BEEN ASKED———"

A selection of readers' queries answered by a member of the "M.W." Technical Queries Staff.

When winding lattice coils, are the spacing turns counted?

No; zigzag spacing turns have negligible inductance, and may be neglected when counting the turns of the coils mentioned.

I am employing a voltmeter of moving coil type to measure the voltage of my H.T. battery, but am informed that I should place a resistance in shunt with the meter to obtain a correct reading. Can you tell me what resistance I should use?

None. A resistance across your voltmeter will increase the current taken from your battery. To decrease the current a resistance could be employed in series with your instrument. If a series resistance of equivalent resistance to the resistance of the meter were used the reading on the latter would have to be doubled to give the voltage of the battery. If your meter is of high resistance—*e.g.*, of the order of 60 to 100 ohms per volt—no series resistance will be necessary.

Recently I have altered my set (detector and two-note magnifier type), by adding an H.F. valve using tuned anode coupling. Originally the set oscillated smoothly, but since the addition, despite a reversal of leads and the trial of a larger reaction coil, I cannot obtain oscillation. Where shall I look for the fault?

Probably you have omitted to alter your grid leak connections. The parallel connection will function well with the detector arrangement, but when a tuned anode coupled valve is added one end of the leak—namely, that not connected to the grid of the detector—must be taken to L.T. +. If this is not effected considerable positive bias from the H.T. battery is impressed on the detector grid and unusual stability with loss of reaction effects will result.

How can one tell at a glance the nominal voltage of an accumulator battery?

The nominal voltage of a single cell of an ordinary type accumulator battery is two volts, so that the working voltage is given by the product of twice the number of cells. By a single cell is meant a single compartment in which a given amount of electrolyte and a given number of plates are confined.

A single test-tube cell with only two plates (*e.g.*, of an H.T. battery) gives a voltage of the order of two just as much as does a large cell with several plates used for filament lighting. The number and size of the plates in a single cell determines only the current which the cell will give and does not affect the voltage. To determine the approximate voltage which can be obtained one is, therefore, only concerned with number of cells.

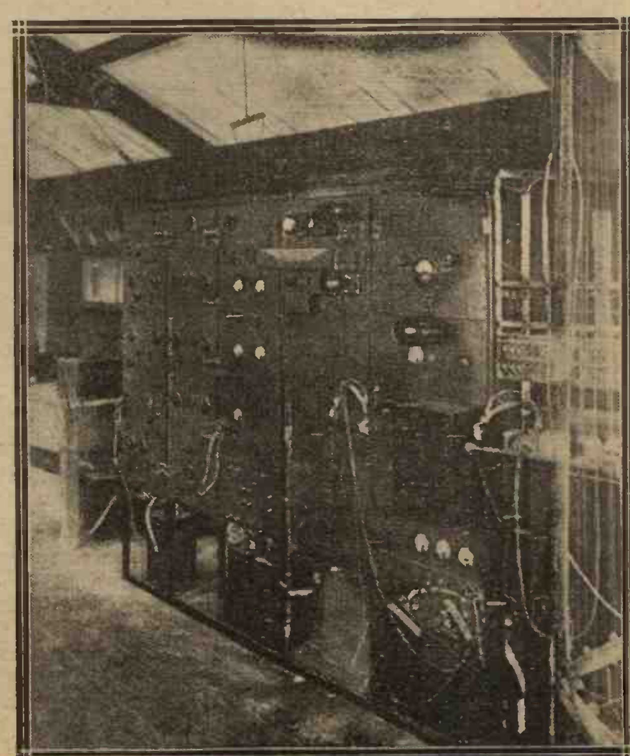
To obviate frequent battery charging I wish to employ dull emitter valves in my set which I made for bright emitters. I am told, however, that my variable resistances will have to be changed for 30 ohm types. Is this correct?

A change is necessary only if you wish to use ·06 ampere valves. With these valves worked from a 4-volt accumulator or a 4½-volt dry cell 30 ohm rheostats are required. Your resistances are probably of 5 or 6 ohms type, and should be quite satisfactory to control the filament current of either 6- or 2-volt valves run respectively from a 6- or 2-volt supply.

The minimum resistance required may be obtained by subtracting the working filament voltage of the valve or valves from the voltage of the L.T. supply and dividing the figure thus obtained by the normal filament current in amperes of the valve or valves.

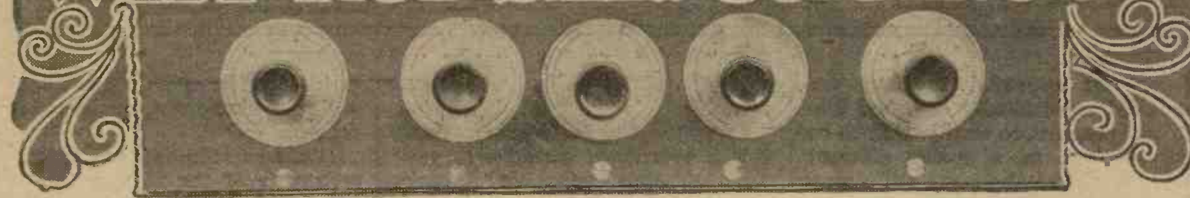
What is meant by a "burn-out" of an L.F. transformer winding?

A breakdown in, or discontinuity of a winding is often erroneously referred to as a "burn out," this latter being a misnomer. The gauges of wires employed for transformer windings are sufficiently generous to preclude of any actual fusing due to inability to carry the currents present in practice. A generally accepted explanation of such failures is that fluctuating currents in the primary windings give rise to correspondingly fluctuating magnetic fields, and these react upon the turns of the windings themselves, setting up actual mechanical vibrations which may give rise to stresses, finally resulting in fracture of the wire.



The Trans-atlantic Telephone Service. Some of the control panels at the new Houlton-Maine station, which works in conjunction with Britain's giant G.P.O. station at Rugby.

WHY NOT S.L.R. CONTROL ?



By G. V. DOWDING, Grad.I.E.E. (Technical Editor).

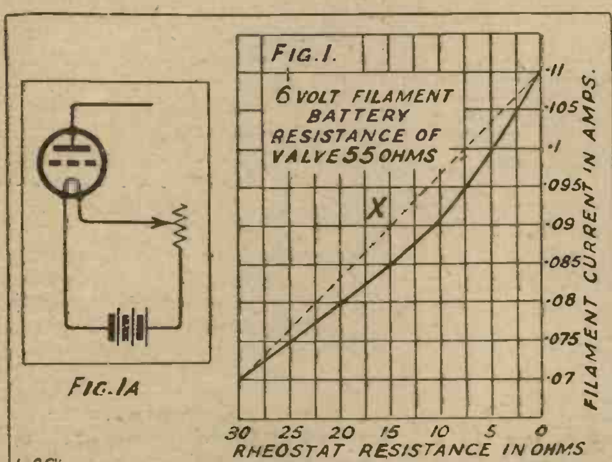
THESE are days of super-efficiency, and we appear to have sailed through the era of startling invention and to be forging along the road of steady development. In the radio world every component and every accessory that goes to make an up-to-date receiver has been hauled on to the research bench and peered at with microscopes. Little bits have been chipped off condenser vanes and variables passed on to sales managers labelled "New ultra low loss, super straight line," transformers ticketed "Curve now straightened" and so on.

A Controversial Subject

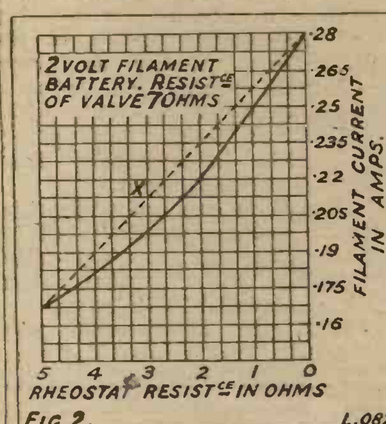
But should I have said *every* component? What about the filament rheostat, that faithful article so long taken so much for granted and now ruthlessly pushed aside to give light and air for those clever little barreters and those awkward little resistors (which are never just the value they should be when we want to use them for these new valves!).

Now many articles have been written on the controversial subject of whether or not the rheostat should be regarded as obsolete, but the fact remains that in some cases a rheostat is essential. For instance, there is no method of adjusting an anode bend rectifier equal to that of using a filament rheostat—in fact, for such a purpose it is almost essential.

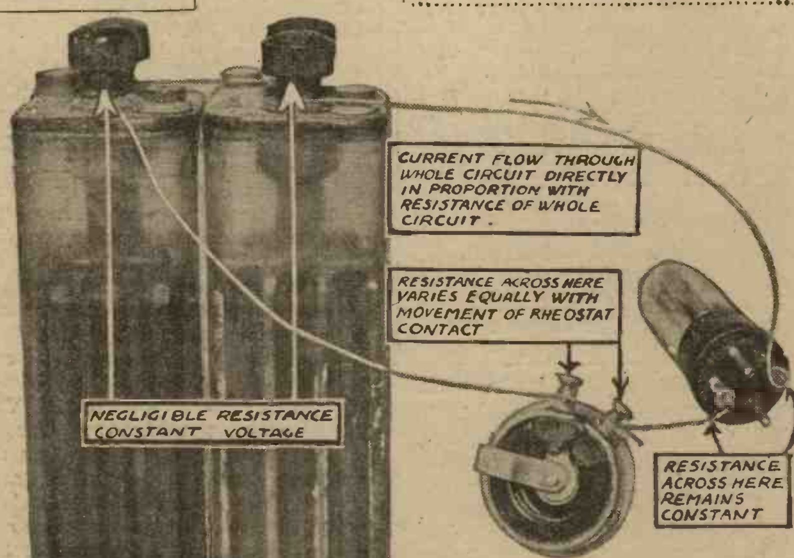
Many modern sets demand anode bend rectification, but so far they



The curve shown on the left indicates graphically the current supply control a 30 ohm rheostat has over an average 6 volt ·1 amp. valve.



Above is shown the "steepening" curve relative to a 2 volt ·25 amp. valve used with a 5 ohm rheostat.



This "photographic diagram," consulted in conjunction with the accompanying text, should help the reader to visualise why the average rheostat fails to provide S.L.R. (Straight Line Rheostat) Control.

WHY NOT S.L.R. CONTROL ?—*(Continued)*

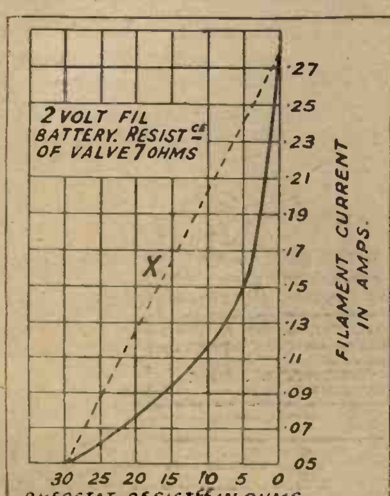
have not appeared to have demanded scientifically designed filament rheostats to enable this to be carried out in a really efficient manner. And there are still many other circuits that are very popular in which one or more filament rheostats are essential.

What Is Wanted

Of course, filament rheostats have "progressed" a little. What amateur nowadays would use one of those pre-broadcasting atrocities? Certainly the little milled-knob turns more or less smoothly and the moving contact of the present-day rheostat no longer makes and breaks the circuit as it passes over the resistance wire; but apart from these purely mechanical improvements, little else has been done to it.

In my opinion a truly "Straight line" rheostat would be of far more value than, say, a so-called "low-loss" coil or, for that matter, a low-loss variable condenser.

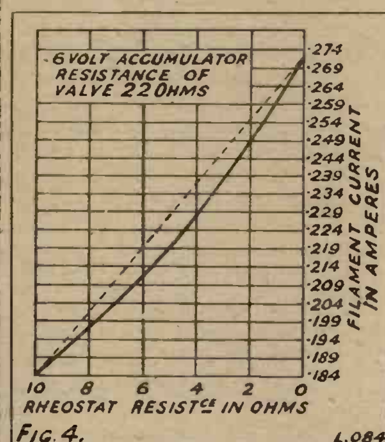
Most filament rheostats give "straight line" variations of re-



A terrible steepness results when a 30 ohm rheostat is used with a two-volter. But even this steepness, which will cause no surprise, does not give an indication of the true state of affairs.

sistance simply because the resistances of most of their windings are directly proportional with their lengths of windings. A 30-ohm rheostat, "half in," will give 15 ohms, "quarter in" 7½ ohms, and so on.

But then the old semi-circularly vaned variable condenser gave "straight-line capacity" variations. The modern variable condenser is designed so that it takes into consideration those external



A ten ohm rheostat is frequently used with a 6 volt ·25 amp. valve. Above is the result.

factors with which its own property is to be intimately linked. Not so the rheostat; this article has, and always has been, asked to give nothing but *straight line resistance variations* up to various maximums.

"Logical Control"

"Smooth control" has been the cry of countless filament rheostat manufacturers, but what one has quietly and triumphantly come forward with "logical control"? And no filament rheostat, to my knowledge, takes into account factors external to it and provides a control equivalent to S.L.F. variable condenser tuning.

In America a rheostat has been introduced which is styled a "straight line" rheostat. The description is misleading, for it merely provides a straight line resistance variation as do most other types. However, it does provide a very fine or "vernier" control, but still not what I would call a logical control.

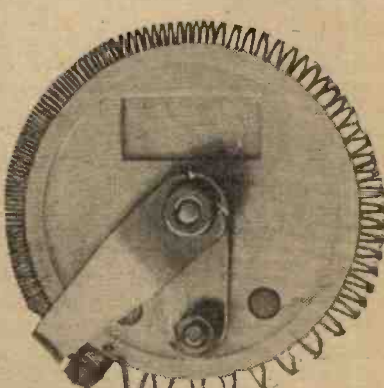
A filament rheostat controls resistance, but this resistance variation is merely a means to an end. It would be better to regard a rheostat purely as a filament current or filament temperature or, best of all, as a filament electron-emission control.

It must not be forgotten that the resistance of the filament rheostat forms but a part of the resistance in the filament circuit and is, in a sense, the least important and most wasteful. The resistance of the valve is the primary consideration, as this directly limits the valve's current consumption.

Controlling Current Consumption

Now let us see exactly how an average rheostat, by introducing additional and controllable resistance, plays its part in *controlling* this current consumption.

Take as an example a valve rated at 5.5–6 volts ·1 amp. An actual valve of this type I have tested takes exactly this ·1 amp. at 5·5 volts. Now per Ohm's Law, volts divided by the amperes gives ohms, therefore this valve has a resistance of $\frac{5\cdot5}{\cdot1}$ or 55 ohms. Now if we place this valve in series with a 30-ohm rheostat and a 6-volt accumulator, as per Fig. 1 (such a combination is frequently advised in the case of anode bend rectification, we find



A rheostat modified to true S.L. requirements. Even this component is not, however, by any means graduated with sufficient "balancing steepness."

that the rheostat resistance-filament current curve is as shown in Fig. 1. And remember that the divisions of resistance shown (0, 5, 10, etc.) represent *equal* movements of the rheostat knob and pointer.

It will be noticed that the curve becomes much steeper towards the

WHY NOT S.L.R. CONTROL?—(Continued).

top—just when it should be less steep. The dotted line x is drawn in merely to make this point clear.

But a 6-volt valve is not always used with a 30 ohm rheostat (or should I reverse this!). So let us see what happens when a 5-ohm rheostat is used with a 1·8–2 volt valve taking ·25 amp at 1·8 volts. And this is a common and quite a sensible practice, remembering that a freshly charged accumulator cell may give quite 2·2 volts.

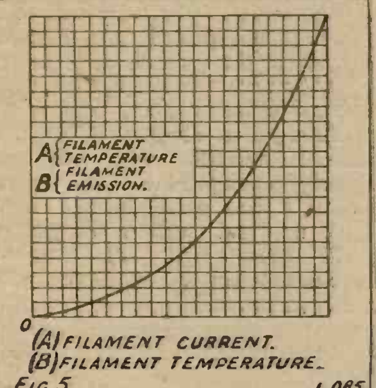


Fig. 5.

The same sort of curve illustrates both the Fil. Amps.-Fil. Temperature and Fil. Temperature-Fil. Emission characteristics referred to in the text. The above curve is not, however, true of any special valve.

As Fig. 2 indicates, the resistance-current curve rises with nasty steepness from about ·2 amps. when compared with the section between just above ·16 and ·2, which represents an area that matters very little.

Alarmingly Steep

Should we use a 30-ohm rheostat with this little two-volter, then the R.-C. curve becomes absolutely alarmingly steep towards the upper range, as Fig. 3 shows. But then this is only to be expected!

Filament rheostats having maximum values of 10 ohms are, however, frequently used with 6-volt valves taking ·25 amp. Fig. 4 indicates how steep the R.-C. curve tends to become even in this instance.

I hope my readers will appreciate the importance of these curves. In Fig. 4 the five spaces between 0 and 10 along the base line represent five equal movements of a rheostat having a maximum value of 10 ohms. When the knob is turned one-fifth of its total movement from the "Off" or maximum position, the resistance of the component in circuit falls by exactly one-fifth, *i.e.*, 2 ohms, or down to an effective total of 8 ohms. Turning it to a halfway point, 5 ohms would be in circuit, and so on.

Further Considerations

Now for a two-fifths of its movement (from 10 to 6 ohms) the control is moderately gradual, but this covers filament current variations when these seldom matter—in this case between ·184 and ·21 amp. Obviously it is just above and just below ·25 amp (the working point of the valve) that the control should be gradual and not, comparatively speaking, such that it can be accused of "steepness."

But the case against the average rheostat has not yet been presented at its worst. The heat of the filament will rise more or less as with the square of the filament current. The curve involved would resemble Fig. 5. But, further, the electron emission from the filament also increases rapidly with increases of temperature giving a somewhat similar curve, so that filament current increases cause very considerably greater emission increases. There are many considerations involved which I cannot enter into here, but it is a fact that the steepest path on Mount Everest is a billiard table to the steepness of the curve of filament current-filament emission.

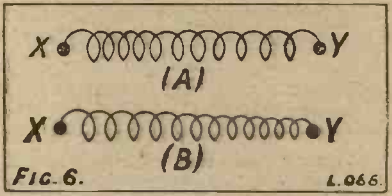


Fig. 6.

Showing two methods of designing "logical control" rheostats.

Therefore, if you look at Figs. 1, 2, 3 or 4, and mentally steepen the top parts of any one of them to anything you think would look really magnificent and quite im-

(*Concluded on page* 335.)

A reader's Airedale enjoying the reproduction given by a "Modern Wireless" six valve set.

PROBABLY the above title will require some explanation. An "earth dope" is, I take it, a recently coined expression for denoting a chemical substance which, if dissolved in water and poured over the ground in the vicinity of the earth-plate of a receiving installation, is supposed to improve the efficiency of the earth connection, and, therefore, to increase the all-round efficiency of the set itself.

That such materials do exert some beneficial influence upon the earth connection of a receiving set is, in some cases, true. But it may be added that this is only the case in those instances in which the earth connection is a poor and inefficient one. The reason for this we shall see more clearly later.

Common Soda

A few weeks ago I had occasion to analyse a sample of a dirty grey-looking powder which was being sold as a material for improving the efficiency of an earth connection. This material you simply dissolved in a bucket or two of water, and then poured the resulting solution gently but firmly, so to speak, over the surface of the ground in which the outside earth connection of the radio set was situated.

To cut a long tale short, this wonderful preparation turned out to be a concoction of soda and lime, about 80 per cent. of it being ordinary washing soda, powdered up, the remainder comprising slaked lime—and dirt! Soda is a pretty ubiquitous and versatile sort of substance. It forms the basis of a host of preparations, such as bath salts and other water-softening compositions, baking powders, photographic chemicals, medicinal preparations, and a multitude of other products of modern civilisation. But soda in its very latest role, that of a radio earth connection reviver or improver—well, that is quite a new application of this dauntless commodity!

Now, it is very easily possible that preparations of this type really carry out everything which is claimed for them, and thus that they do effect an improvement in the earth connection of a set. Nevertheless, the fact remains that, unless the earth connection happens to be situated in very unfavourably disposed ground, if an earth connection is radically improved by this sort of treatment, then something is very wrong with that earth connection.

For Poor Soil

And the reason for this is simple. If you bury an iron plate in the ground, and then pass a current into the plate, the current will leak out freely (more or less) into the surrounding earth, always provided, of course, that the earth or soil is reasonably conductible, as is any average mass of soil to the currents which the radio set deals with. But if the soil is dry, or if it is poorly conductible, or, again, if inefficient contact exists between the iron plate and the surrounding soil, it will necessitate an extra conductible soil to enable the currents to pass out from the iron plate as freely as they would do under ordinary circumstances. If, however, under such conditions, you impregnate the soil with a solution of a metallic salt, you thereby render it very conductible, and thus losses occuring in other directions are made up for.

Bad Connections

This is the sort of thing which happens with a badly constructed earth connection to a set. The deeper layers of the soil, where the earth plate or plates should be, are very seldom dry enough to render electrical connection impossible, but if the earth plate or earthing system of wires is badly connected, if it is not placed at a sufficient depth in the ground, or if its area is not extensive enough, then, under those circumstances, and under others of a similar nature, the aerial currents will not pass freely enough into the earth. Thus a bad earth connection is set up, and such a connection will show signs of improvement in electrical efficiency when the soil is impregnated with a solution of a conductible salt.

The New Air Service to India.
Wireless operators for the giant airplanes that fly from Egypt to India are here shown in their training school.

A Better Method

The thing, therefore, is not to seek a panacea for earth connection troubles in dopes of this nature, although for temporary purposes their use can be recommended.

No man ever cured a long-standing digestive trouble or any other

(*Continued on page* 330)

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.

Psychic Experiments

FOLLOWING the experiment in mass telepathy by broadcast on February 16th, it is probable that further and more ambitious experiments will be undertaken by the B.B.C. acting in co-operation with the Society for Psychical Research. It is hoped ultimately to use the microphone in connection with attempts to communicate with the dead ; but these are not likely to be made for a year or two.

An Imperial Development

The announcement that the B.B.C. are anxious to establish a short-wave transmitter to reach the Dominions and Dependencies has been enthusiastically received throughout the Empire. The B.B.C. state that this has always been part of their policy, and that plans to this end had been framed as long as eighteen months ago. This being so, what a pity it was that they kept the thing so secret. The policy of reticence on imperial broadcasting has induced many people to believe that "Little England" was firmly entrenched at Savoy Hill. Such, however, is not now the case. Perhaps the former reticence was due to consideration for the Post Office engineers' views. Such restraint should not be necessary any longer. When the interests of the Empire are in conflict with the views of a few Post Office officials, then the B.B.C. cannot afford to desert the Empire.

The recent B.B.C. statement cautiously added that as soon as experiments have concluded and as soon as the funds were available the Empire short-wave transmitter would be installed. Most experimenters will agree that this promise does not err on the side of rashness. There is now no doubt as to the efficiency and consistency of short-wave transmission for distance work: the cost of the apparatus would not be greater than £1,500—surely not out of proportion either to the present revenue of the B.B.C. or to the magnitude of the cause being served. Captain Ian Fraser, M.P., C.B.E., the popular blind parliamentarian, has made a close study of Empire broadcasting, and is of opinion that it should be arranged through co-operation with the Beam system. The subject is to be raised in Parliament.

Broadcasting Sport. The white-clothed conductor controlling community singing at a broadcast football match.

The Sports Narratives

The sports narratives introduced by the B.B.C. at the beginning of the year under the new arrangement with the Press, have been as conspicuously and consistently successful as any other of the more popular series of novelties ever put on the air in this country. It is understood that they have become so popular with the public that already there is something approaching a small-sized boom in the sale of wireless apparatus. This was very welcome indeed to the trade, and it is hoped that the pendulum will swing still farther. Prospective sports broadcasts include (from 2LO and 5XX) England v. Scotland at Rugger at Edinburgh, March 19th; Grand National (2LO, 5XX), March 25th; University Boat Race (2LO, 5XX), April 2nd.

Running commentaries on notable social occasions, motor-races, etc., are being arranged. Altogether this side of broadcasting promises to become its mainstay in the public regard. Licence statistics already reveal the growth of the broadcasting constituency

MY BROADCASTING DIARY—(Concluded)

The Aldershot Tattoo

There have been few single programme items more popular than the Aldershot Military Tattoo excerpts taken on previous years. This year the broadcast will be rendered much more vital by the addition of a descriptive narrative.

Catholics and the B.B.C.

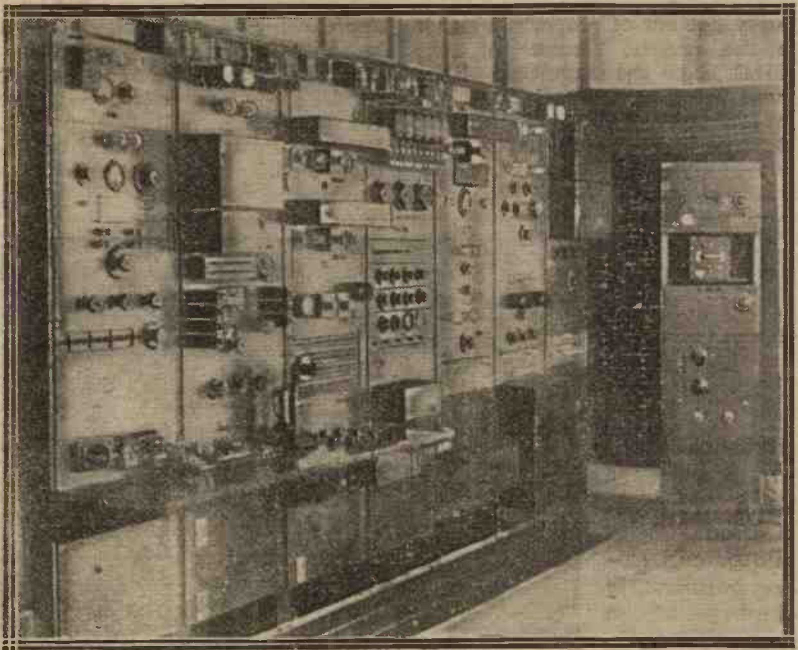
Roman Catholics generally are taking very keen interest in the B.B.C. It is now announced that the Brompton Oratory has lifted the ban hitherto in operation against the microphone. For the future any service may be relayed from that Church. Catholics are very anxious to arrange soon for the broadcasting of High Mass.

Sir Gerald du Maurier

Sir Gerald du Maurier's decision to appear at the microphone in a special dramatic production late in the spring is yet another indication of how old prejudices are giving way. Sir Gerald had been by no means keen on broadcasting. Apparently the occasions on which he had listened to the performances of some of his eminent stage colleagues were unfortunate, and he did not entertain any high regard for the possibilities of clear reception. Now, however, it is understood that these doubts have been cleared away to the great prospective enrichment of the microphone.

Bridge by Wireless

Mr. George Grossmith has suggested the broadcasting of a game of Bridge played by four eminent people. The idea has been accepted and the search for the eminent players is now in progress. The game will be put out from London in March.



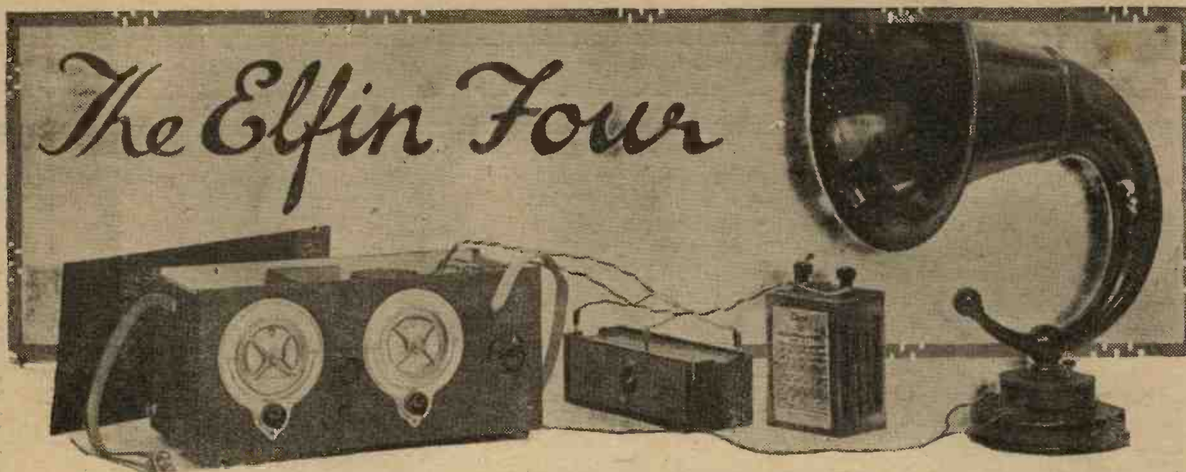
Rugby's "Opposite Number."
A view of the power supply board at the Houlton-Maine station, where British telephony is received and relayed to the American telephone subscriber.

Charles Lapworth at Savoy Hill

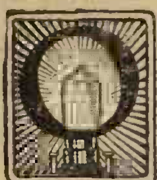
Charles Lapworth, well known erstwhile as a film impresario, and producer, has thrown in his lot with the B.B.C. This is an interesting appointment in several ways. Mr. Lapworth fought a long campaign for his ideas to establish the British film in its rightful position, but as he was against the "quota" proposal as a remedy he soon found himself out of sympathy with most of those engaged in the British film industry. The idealism and enterprise at Savoy Hill naturally attracted Lapworth. His influence should soon be felt in the B.B.C.

The Problem of Alternatives

A marked public reaction against the idea of clear-cut alternative programmes has set in. The B.B.C. have got into the habit of hailing the advent of alternative programme facilities as the dawn of the broadcasting millennium, in which there can be no grousing and even no Press attacks on dull programmes. For a while most critics have been prepared to take this at its face value. But now that alternatives are getting closer, and the days of the present system of distribution are numbered, people are naturally trying to work out the basis of reasonable alternatives. Some would say generically, highbrow versus lowbrow, but the snag here is that there are hardly any two people who would be in complete agreement as to the dividing line. This sort of division will never do. A better general division as a starting-point is to separate the general entertainments from the specialist and purely informative items. It should be noted that general entertainment certainly includes a good deal of material which normally is more of the highbrow than of the lowbrow variety. Subject to a simple distinction such as this, the programme builders would be wise not to deviate radically from the present constitution of programmes. Any suggestion of regimentalising items will be most unpopular. By the way, the first alternative programme from Daventry will be working in November for certain, and possibly in October. Its programme character has not yet been determined. Throughout next year the instalments of the new system of high-power regional distribution should follow on with fairly close regularity.



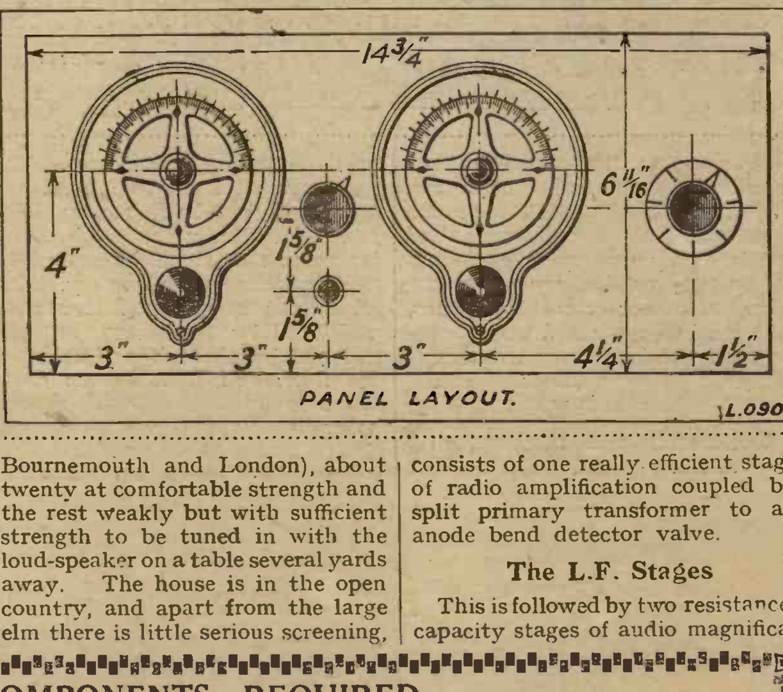
By DONALD STRAKER



ON a recent Sunday I took this receiver to cheer up a damaged friend. He was propped up on a couch and could use one bandaged hand, and his thirst was great, for he had been divorced from radio for three weary months. The best aerial I could manage consisted of a forty-foot length of flex. The free end was hitched to a string, and a hammer supplied the projectile. A range of garden frames rather cramped my style, but the third shot took the projectile well and truly over the spreading elm selected for the support. The home end was merely taken in through a window, and the hot-water radiator supplied a fairly good earth. A small 120-volt H.T. accumulator, and 2-volt Exide D.F.G. and an Ellipticon loud-speaker completed the outfit. I then gave my friend a table showing the settings of the transformer tuner for seventy European stations and left him to it.

What the Set Will Do

A few days later I received his report, which was distinctly gratifying. On the loud-speaker he had tuned in nearly all the seventy stations on my list and had found four more which I had missed. Twelve stations came in at a volume which necessitated the use of the volume control (Stuttgart, Hamburg, Rome, Munster, Antwerp, Hilversum, Frankfurt, Cologne, Daventry, Radio-Paris, Bournemouth and London), about twenty at comfortable strength and the rest weakly but with sufficient strength to be tuned in with the loud-speaker on a table several yards away. The house is in the open country, and apart from the large elm there is little serious screening, consequently the conditions were similar to those usually experienced when using a receiver under picnic conditions. This incident is recorded because it gives a very good idea of the capabilities of the Elfin Four.



The circuit, which is quite simple, consists of one really efficient stage of radio amplification coupled by split primary transformer to an anode bend detector valve.

The L.F. Stages

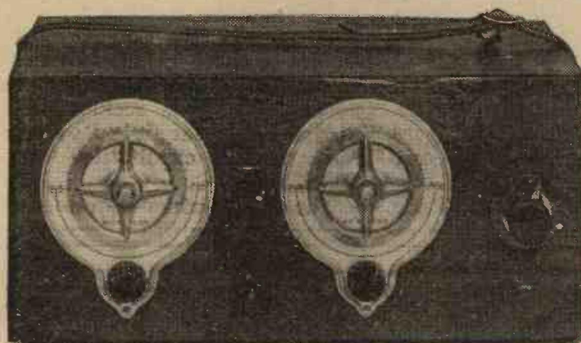
This is followed by two resistance-capacity stages of audio magnifica-

COMPONENTS REQUIRED

- Containing-case (to measurements).
- Two .0003 m.f. variable condensers (Bowyer-Lowe square law).
- Two Igranic-Pacent vernier dials.
- One Neutrovernier condenser (Gambrell).
- Four valve-holders (Benjamin).
- One rheostat, 7 ohms.
- One rheostat, 30 ohms (Lissen or similar compact type).
- Two Varley wire-wound anode resistances, 250,000 ohms.
- Two Dubilier 610-type fixed condensers, .006 m.f.
- One Dubilier 610-type fixed condenser, .0005 m.f.
- One Dubilier 610-type fixed condenser, .0001 m.f.
- Two grid leaks, 2 megs.
- One 9-volt grid battery (Ever Ready GB4).
- Two or more Paxolin tubes, 3½ in. long, 3 in. diameter by 1/16 in. (Messrs. Micanite & Insulators Co., Ltd., Blackhorse Lane, E.17).
- No. 30 and 36 d.s.c. wire for coils.
- Seven valve-sockets.
- Four or more valve-pins.
- Two Clix sockets, with red and black bush.
- Glazite wire.
- Piece of 22 gauge soft copper sheet, 6⅝ by 10½ in., for screen.
- Brass screws, ⅜, ½ and ¾ in. (No. 3).
- Four rubber buffer feet.

THE ELFIN FOUR—*(Continued)*

tion. The first valve is neutrodyned and fitted with a volume control rheostat which gives the necessary reduction of volume on the nearer stations without adversely effecting the quality of reproduction. Although the handle of the neutrodyne condenser projects through the panel it is not intended to be used as a reaction control, but since a receiver of this kind is used with aerials having very widely different characteristics slight readjustment is useful.



This illustration of the complete set shows it to be very neat and compact, with all controls accessible.

A point in the design is that standard six-pin transformers can be used if desired. Perhaps one must sacrifice a certain amount of efficiency by employing the plug-in system, particularly when the pins are rather crowded together, but the Daventry and other long-wave transmissions are so exceedingly useful in outdoor reception that the sacrifice is worth making.

Home-made Transformers

However, in the test already mentioned home-made transformers were used, and as these give an appreciable increase in volume over the commercial article their construction is described in detail in a separate article in this issue.

The Containing Case

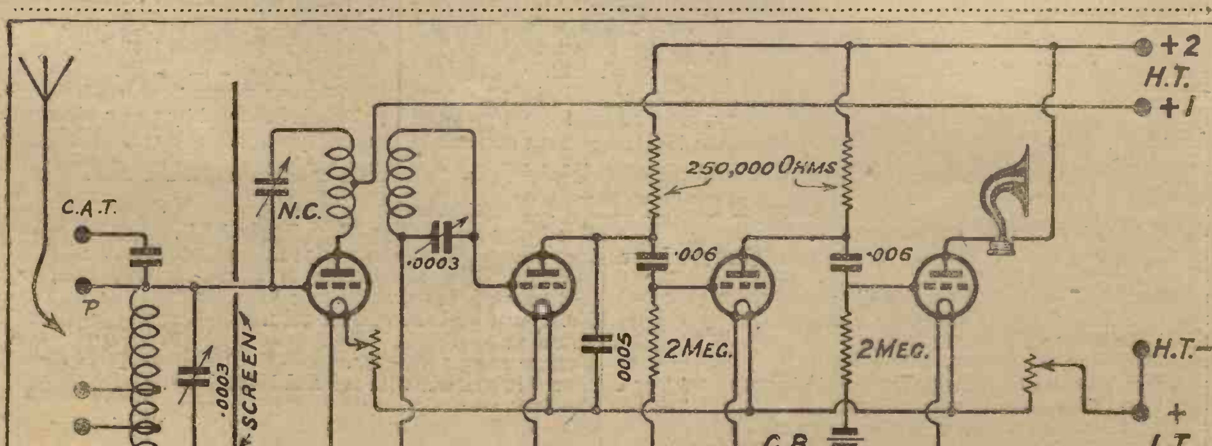
The containing case is made of three-ply wood for strength and lightness, and its dimensions are shown in the drawings. The bottom and two ends are ⅜ in. in thickness, while the other parts are of the ordinary $\frac{3}{16}$ in. stuff. The parts are all fixed together by a number of fine brass screws, ½ in. and ¾ in. (No. 3) and the holes for these should all be drilled to avoid splitting the three-ply. The lid is not hinged but is merely positioned by the battens at each end and by the top projection of the front and back of the case. When complete the outside should be well rubbed down with glass cloth and either painted or varnished. The inside should receive a coat of spirit varnish to keep the wood from absorbing damp.

The front and back should then be unscrewed for the fitting of the components. Although the radio frequency end is well spaced out the audio frequency part is tightly packed, and the drawings should be very carefully followed, as there is little room to spare. Any good tuning condensers can be used provided they are fairly compact, but in any case it is advisable to mount the panel components and try the panel in position, to make sure that everything clears. The copper screen should be left until the last, as it is much easier to run the wiring before it is fitted. The soldering tags on the valve-holders are only used for the filament wires so the grid and plate tags should be bent up out of the way of the neighbouring filament tags.

A Useful Tip

A plain soldered joint is often a weakness in a portable receiver, and it is much better to bend the end of one wire into a hook which can be squeezed over the other when in position. A touch of solder will then ensure good electrical contact, while the hook takes care of the mechanical part of the job. The Dubilier grid leaks on the third and fourth valves are held by the clips which are supplied by the makers.

The clips on the third valve should be bent up slightly to keep the leak clear of the Varley resistance alongside. To avoid complication the two ·006 mf. coupling condensers are only indicated by

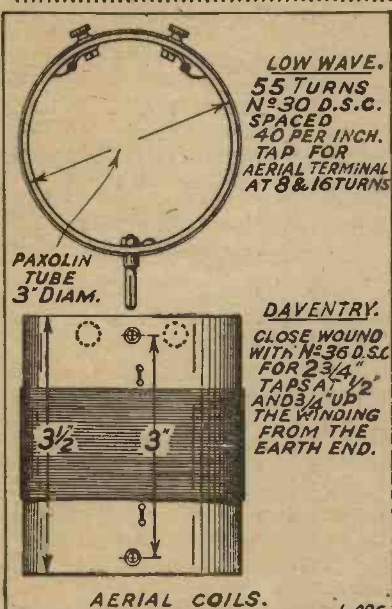


CIRCUIT DIAGRAM.

THE ELFIN FOUR—*(Continued)*

symbols on the wiring diagram. They are placed edgewise between and about ½ in. above the valve-holders, and are held in position with their own connecting wires, which should be of stout wire for this purpose.

The Clix sockets for the loud-speaker are fitted directly in the wood of the end piece. The holes are well countersunk outside the case and the sockets have red and black bushes to indicate their polarity. The by-pass condenser



AERIAL COILS. L.096.

across anode and filament of the detector valve must be fitted before the panel is finally screwed on as otherwise it is difficult to get at. The best way to wire underneath the transformer base is to fit approximate lengths of wire with nuts and washers to each socket, before the base is mounted. Then keep on trying the base in place, shaping the wires little by little until the whole assemblage is ready to be screwed down permanently.

The Aerial Coil

Note that the grid return leads to both detector and third valves are taken to filament negative, as the particular valves used in these positions require no other bias. The copper screen is, of course, connected to earth as shown, and the hole through which the connecting wire passes to the first grid should be large enough to give a slight air spacing all round the wire in addition to its Glazite insulation.

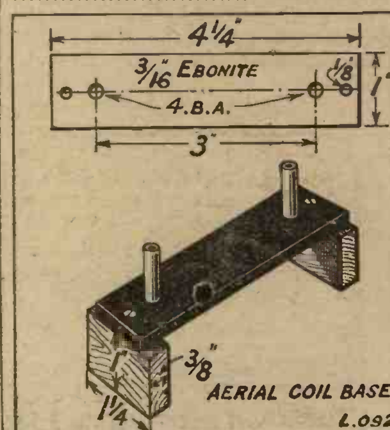
Any good aerial coil of low-loss type can be used in this receiver for aerial tuning, but the coil illustrated gives exceedingly good volume. The former is made of Paxolin tube of the size shown, and two valve pins are fitted to it to suit the holder illustrated. If a screwcutting lathe is available, the spaced winding can be done very easily but it is also quite possible to wind the coil by hand if a spacing thread be wound on simultaneously with the wire.

The tappings are made by passing a loop of the wire through small holes in the former and soldering the loops to tags under the terminals. Each end of the winding is anchored by passing it through small holes in the usual way. A few very narrow bands of shellac varnish will keep the turns in position. The Daventry coil is wound on a similar former, but the No. 36 d.s.c. wire used is close wound for a space of 2¾ in. and the tappings are taken off at ½ in. and ¾ in. up from the earthed end of the winding.

Power Valve Essential

Battery leads made up from flex are permanently fitted to the terminal strip with appropriately marked spade tags and wander plugs.

For the first holder use one of the modern H.F. valves with an impedance of about 25,000 ohms (S-T21, P.M.1, etc.). Resistance-capacity type valves with a high amplification factor must be used in the second and third positions. (Cosmos Blue Spot are particularly suitable here.) Owing to the large voltage swing which the last valve has to handle a small power valve is essential in the last holder (DEP-215, S-T-23, etc.). The anode of the first valve should receive 80-90

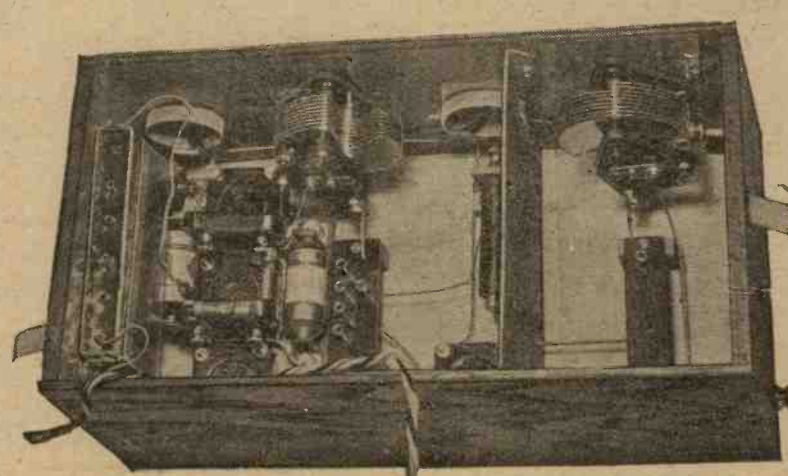


L.092.

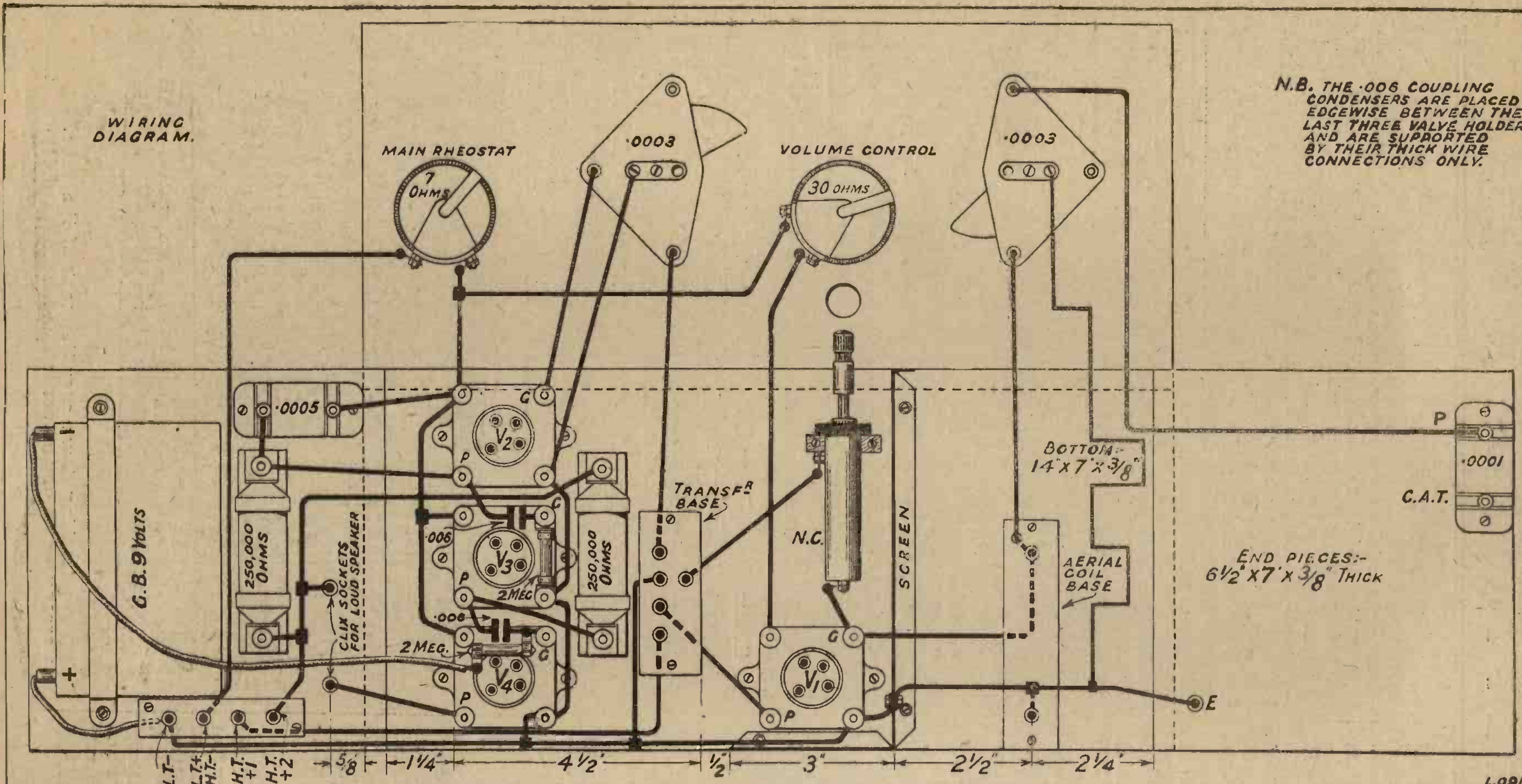
volts positive, while a full 120 volts should be used on the last three valves. The power valve will probably require a grid bias of 9 volts negative. This receiver is very modest in its H.T. requirements, the total load for the four valves being very low.

Stabilizing the Set

Stabilising is very simple. With some loud transmission coming in, turn out the first valve and then



Looking down over the back of the case.
The arrangement of the screen and baseboard lay-out will be clear from this and the following photographs.



CHECK YOUR WIRING OF THE ELFIN FOUR BY THIS LIST :—

L.T. plus and H.T. neg. terminal should be connected to the main rheostat.

The other side of this rheostat is joined to the 30 ohm rheostat, the .0005 fixed condenser, and to one filament socket on the V2, V3 and V4 valveholders.

The remaining side of the 30 ohm rheostat goes to one filament socket of V1 valve holder.

L.T. neg. terminal is connected to G.B. plus, the remaining filament terminals on each valve-holder, to the moving vanes of each variable condenser, to the earth terminal, to one contact on aerial coil base, to metal screen, and to one secondary contact on H.F. transformer base.

"P." terminal of the .0001 fixed condenser to fixed vanes of 1st variable condenser, and to remaining contact on aerial coil base. Thence a lead is taken underneath the base (through the screen) to the G. terminal of V1 valve-holder and to one side of N.C.

The other side of N.C. goes to the "staggered" contact on the H.F. transformer base.

Plate contact of V1 valve-holder is connected to one primary contact on H.F. transformer base. The remaining primary contact is connected to H.T. plus (1).

The remaining contact on H.F. transformer base (nearest panel) to fixed vanes of 2nd variable condenser, and to G. of V2 valve-holder.

"Plate" contact of V2 valve-holder to 250,000 ohms resistance, to remaining side of .0005 fixed condenser, and to the .006 fixed condenser.

Remaining side of the 250,000 ohm resistance to H.T. plus (2), to one loudspeaker socket, and to the 2nd anode resistance.

The remaining side of .006 fixed condenser is joined to G. socket of V3 valve-holder, and to the 2 meg. grid leak.

The opposite end of grid leak is connected to the minus filament socket of V3 valve-holder.

Plate socket of V3 valve-holder is connected to the 2nd .006 fixed condenser, and to the remaining end of the 2nd anode resistance.

The remaining side of the 2nd .006 condenser is joined to G. socket of V4, and to the 2 meg. leak.

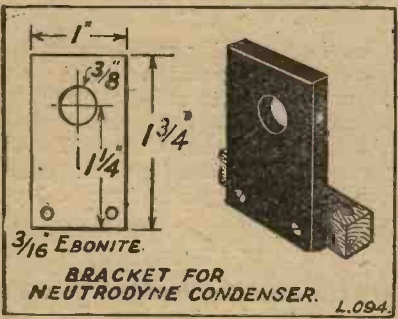
G.B. neg. is connected to the remaining side of this leak.

P socket of V4 valve-holder is joined to the remaining loud-speaker socket.

This completes the wiring.

THE ELFIN FOUR—(*Continued*)

adjust the neutrodyne condenser until signals disappear. Then turn up the first valve and tune in a weak transmission somewhere about the middle of the range. The neutrodyne condenser can then be screwed in a fraction until volume is at its best without being actually on the verge of oscillation. With the original set the point was found when the neutrodyne condenser

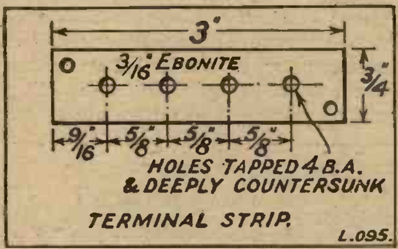


BRACKET FOR NEUTRODYNE CONDENSER. L.094.

was about one full turn in from its "all out" position. To preserve the good quality of reproduction the filaments should not be over-run.

The Volume Control

I find the following a useful dodge. With the volume control full "on" tune in some transmission of average strength. Then reduce the main rheostat until signals are not quite on the verge of reduction. With the high resistances in the anode circuits the electron emission



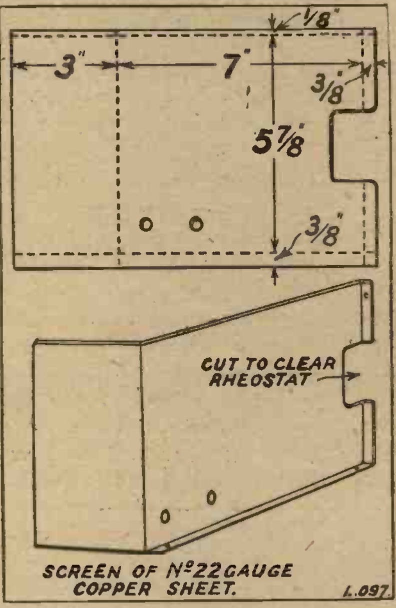
TERMINAL STRIP. L.095.

required is very small and there is little to gain and much to be lost by running the filaments at a higher temperature than is really necessary. On all really loud transmissions the volume control must be used freely.

Aerial Connections

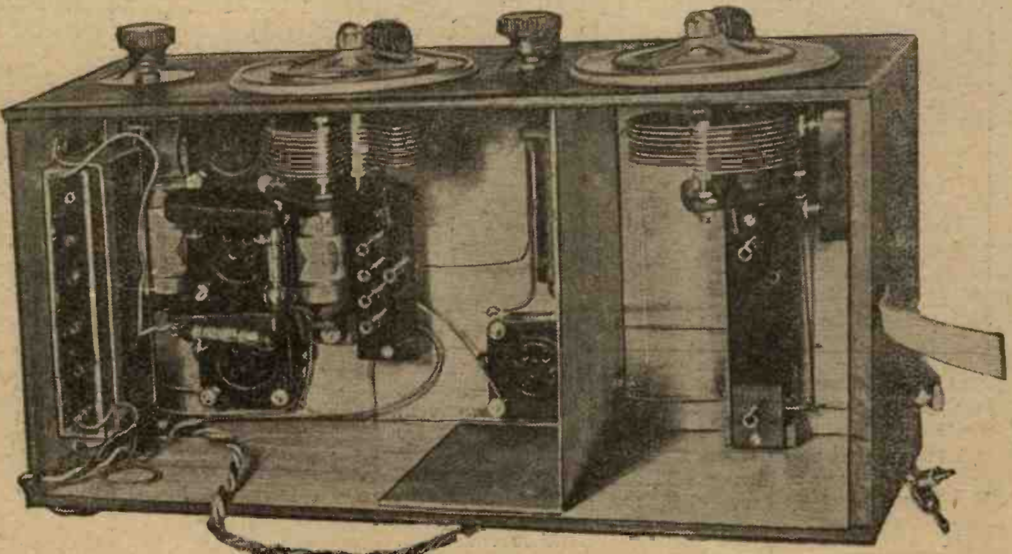
As the Blue Spot type of valve is inclined to be microphonic, the loud-speaker should be directed away from the receiver and should not be placed too near to it. Individual valves vary much in this respect, and it is always advisable to change over the valves in the second and third holders, as one of them will probably be found better than the other as a detector.

When using very small aerials better signals will probably be obtained by connecting the aerial to the C.A.T. terminal for waves between 350 and 550 metres. The tappings on the coil can be used for the lower waves. On Daventry a very small aerial will give better signals when connected to terminal P. The aerial coil is proportioned so that this is possible. In situations where it is impossible to hang up any kind of aerial at all, Daventry and some of the more powerful low-wave stations can be received at moderate volume in the following manner.



SCREEN OF No. 22 GAUGE COPPER SHEET. L.097.

Connect a piece of flex, about 20 or 30 ft. long, to the terminal P and throw the free end down on the floor, keeping the end as far away from the receiver as the room will allow. No earth connection should be used. If the batteries and loud-



The method of supporting the grid battery, and the positions of the coil bases will be seen in this photograph, which also shows how the anode resistances and grid leaks are spaced.

THE ELFIN FOUR—*(Concluded)*

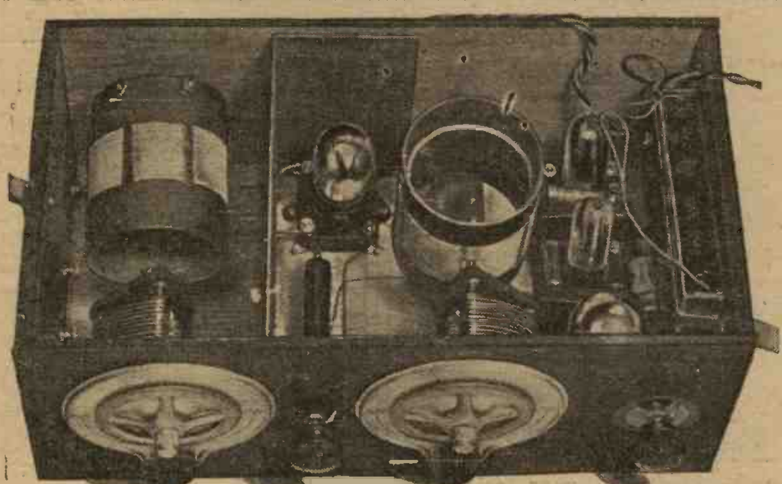
speaker can be placed on some support as high above the receiver as possible, their leads will collect an appreciable amount of energy. Under these circumstances reaction can be usefully applied by adjusting the neutrodyne condenser.

For the benefit of those constructors who desire to make their own H. F. transformers to fit into standard coil-bases, a special article dealing with this subject has been written, which appears on another page of this issue of MODERN WIRELESS. The different steps in the coil-making can be treated at full length in a separate article of this kind, and as the writer has found these H.F. transformers to be of exceptionally high efficiency, the constructor is advised to try his hand at making his own coupling units. Even if he has made no previous attempt of the kind, no difficulty should be experienced, as the illustrations will be found to show the whole process quite clearly.

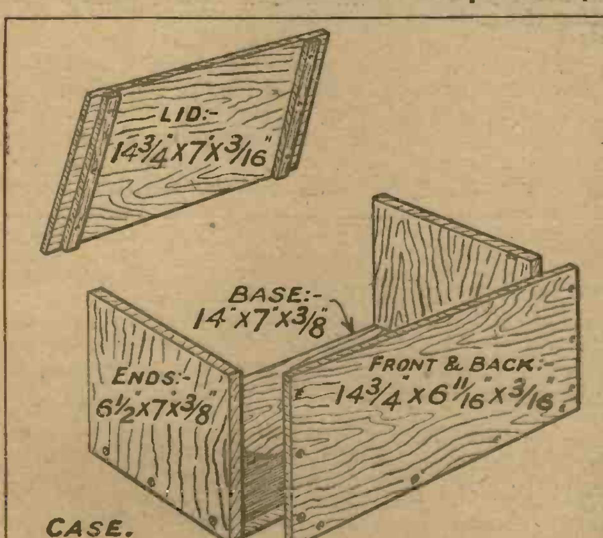
Finally, it may be advisable to emphasise one rather important feature of the Elfin Four, namely, the fact that the set was designed to economise space, so care must be taken in choosing components of the right size. Otherwise difficulty will be experienced in fitting the various parts into the case, and for this reason the list of components on page 255 contains manufacturers' names, to enable readers to duplicate the actual apparatus used by the writer.

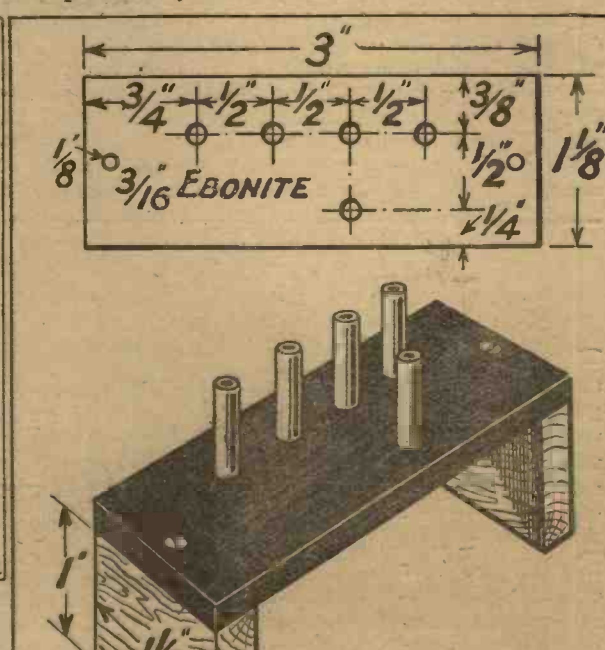
It is not, of course, necessary that the set should be duplicated in every detail in order to get good results. No doubt the more experienced set-builder will desire to make modifications here and there, especially as regards size and layout.

If, for instance, he already has components on hand which would be too large by comparison with those named, allowance can be made when making the containing case. Provided such modifications are carried out carefully, there is no reason why the set should not work just as well as the original Elfin Four, which has proved itself to be an extremely efficient receiver.

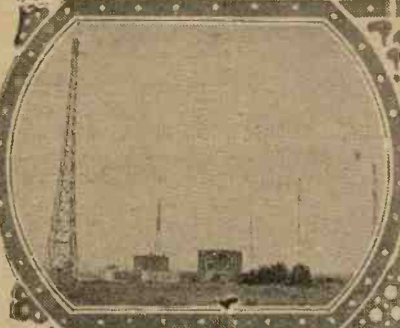


This ready-for-action view shows the interior with the coils and valves in position.





The dimensions of the case are given above, and to the right is a sketch that will enable the constructor to make his own H.F. Transformer base.



Constructing H.F. Coupling Units

By DONALD STRAKER

IN describing the "Elfin Four" in this issue of MODERN WIRELESS, the writer mentioned the H.F. transformers which are illustrated here. By suitable design it has been found quite easy to make a transformer which gives a good deal more volume than any of the commercial articles which the writer has tested, chiefly owing to the fact that compactness entered so largely into the design of the latter. But the transformers illustrated here are much too large to fit into the standard screen, so their use is not recommended in any receiver which includes more than one H.F. stage as the magnetic field is considerable and may lead to instability (even with one stage) unless the components are well spaced out or a capacity screen is used between the tuned circuits with their tuning condensers.

Each transformer requires two Paxolin tubes, the larger, which carries the tuned secondary winding, being 3 in. diameter by 3½ in. long. The smaller tube for the primary and neutralising windings is 2¾ in. diameter by 2 in. long. The walls of these tubes are 1/16 in. only in thickness and they can be obtained from Messrs. Micanite and Insulators Co., Ltd., of Blackhorse Lane, E. 17. A strip of ¼ in. ebonite, 1¼ in. wide, five valve pins and a small quantity of wire are also required, so that the cost of each transformer is about three shillings.

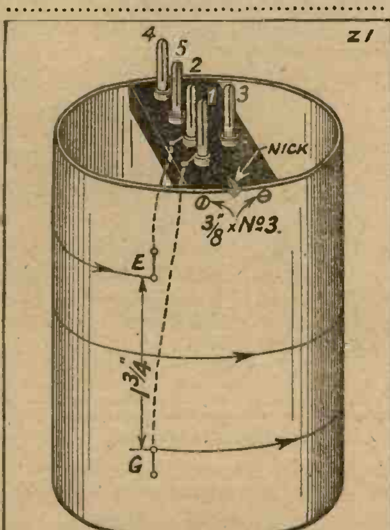


FIG. 1. SHOWING EBONITE STRIP CARRYING CONTACT PINS FITTED TO SECONDARY TUBE.


Showing a complete aerial coil ready for use.

The Low Wave Unit

We will first tackle the low wave unit. Begin by placing the 3 in. tube centrally over the ebonite strip and mark round the inside curve of the tube on the ebonite with a scriber. Then with saw and file reduce the ebonite to the scribed line until it will just fit comfortably into the end of the tube. With the ebonite in place hold it gently in the vice and fit the four ⅜ in. (No. 3) brass screws which secure it. Use a 7/64 in. drill and allow it to pass through the Paxolin and into the ebonite about ⅛ in. Deepen the hole to a full ½ in. with a 5/64 in. drill and countersink the Paxolin to allow the screw to sink in flush with the outside. Drive the screw gently, turning it backwards and forwards as it goes in to enable it to cut its own thread.

When all four screws are fitted file a nick to serve as a replacement mark and take the ebonite out again in order to fit the five valve pins. Hold it in the vice with the nick upwards. The holes for the valve pins ought to be tapped 5BA, but if no tap is available drill the holes 7/32 in., put the valve pin in the drill holder and screw it in. Drill a 1/16 in. hole beside each pin to bring the connecting wires through, placing them as shown in Fig. 2. After re-fitting the ebonite in its tube drill the two pairs of little holes (E and G, Fig. 1) in the wall of the tube. In relation to the pins they should be placed as shown in Fig. 1. The distance between the pairs is 1¾ in. This completes the secondary former.

Preparing the Primary

To prepare the smaller tube cut a long strip of brown paper ¼ in. wide and seccotine it round and round each end of the tube until a flange is formed which will just push into the interior of the 3 in. tube. When the seccotine is dry drill four pairs of very small holes (a broken needle makes a good drill for this) in the positions shown in Fig. 3. The two central pairs have a

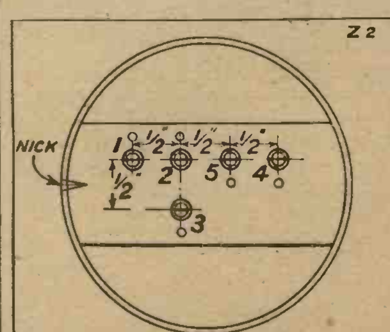


FIG. 2. SPACING & NUMBERING OF CONTACTS TO SUIT STANDARD SIX POINT BASE, SEEN FROM PIN END

CONSTRUCTING H.F. COUPLING UNITS—*(Continued)*

clear space of an inch between them, the pair P is about 1/16 in. nearer the flange than +1 and the pair NC is 1/16 in. nearer the bottom flange than +2. The former is then ready for the winding. If a screw-cutting lathe is available the job is simple, but in its absence the experimenter is strongly advised to set up a winder such as that shown in Fig. 4. It will save a great deal of time in this and most other winding jobs. The frame can be made up with Meccano strip and a wood turner will make the discs with flanges to carry various sizes of tube.

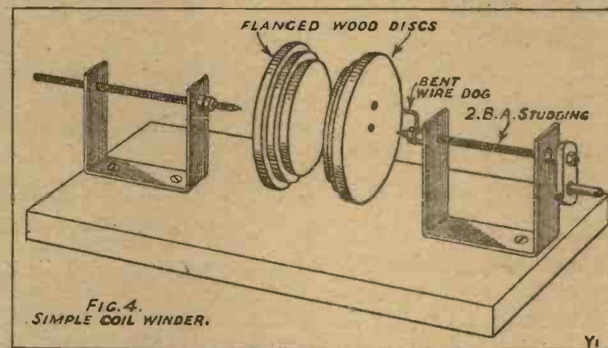


FIG. 4. SIMPLE COIL WINDER.

The secondary is wound with No. 30 d.s.c. wire, spaced 40 turns per inch. Two stout nails driven into a block of wood will hold the spool of wire and a reel of stout cotton for spacing. The wooden fairlead shown in Fig. 7 is useful. It is held in the left hand, tension being regulated by pressure of the thumb while the winding is fed on. The end of both wire and cotton is anchored by passing them through the holes G. Then mount the tube in the winder with G to the left and turn the crank clockwise until 68 turns have been wound with the spacing cotton lying between each turn. Cut the wire, anchor it at E, and remove the former from the winder, keeping the end of the cotton in place with finger pressure. Then with a small brush paint six very narrow bands of shellac varnish across the winding. In a few moments this will become tacky and the spacing cotton can be carefully removed. Six inches of wire should be left at each end of the winding for connecting to the valve pins.

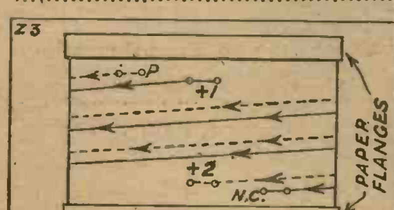


FIG. 3. LOW WAVE PRIMARY TUBE SHOWING ANCHORAGE HOLES AND DIRECTION OF WINDINGS

No. 40 d.s.c. wire is used for the primary and neutralising windings and 12 ft. of the wire should be cut off and wound on a spare reel. Anchor the end of the main reel at P and the end of the spare reel at +1, and mount the tube in the winder with the anchored wires to the left. If the fairlead is employed three pins should be used at its end so that the two wires feed on with the thickness of the central pin separating them. Turn the winder clockwise and lay on fifteen turns of the twin wire, slowly sliding the fairlead to the right to space the turns. It will, of course, be impossible to space quite regularly, but the essential idea is to secure *some* spacing while keeping the wires side by side and preventing them from crossing over each other as they run on.

Another view of the complete aerial coil.

Spacing the Turns

This may sound difficult, but in practice, with a little care, it is simple enough. The wire from the main reel which began at P is anchored at +2 and that from the spare reel, which began at +1, is anchored at N.C. Then with a slip of wood cut to a chisel edge go over the turns and separate any that may be touching and generally improve and even out the spacing as much as possible. Gently twist the ends +1 and +2 together so that they form a single connection and push the smaller tube bodily into the top end of the larger tube.

The Connecting Pins

The end of the secondary at G should be pulled up and turned over outside the tube to keep it from being trapped. Take great care to avoid touching the thin wire with the top edges of the larger tube as it slides in. It should be pushed down until it just touches the anchored wire at E, and the relative positions of the connections should be as in Fig. 5, which is as they appear when looking down into the open top of the larger tube. The smaller tube should be put in with the end N.C. nearest to the contact pins. Fold back the end G inside the smaller tube and carry it to its proper pin, No. 1, as in Fig. 5. The numbers on the pins correspond with the numbers on the standard six-point bases. E goes to No. 2, N.C. to No. 3, P to No. 5, and the twisted ends from +1 and +2 are both con-

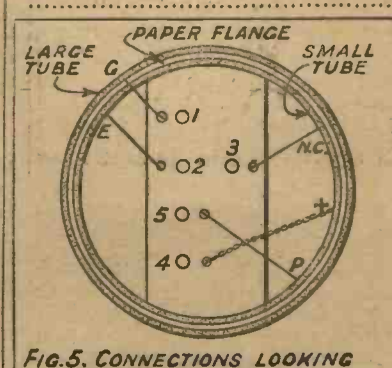


FIG. 5. CONNECTIONS LOOKING DOWN INTO THE OPEN TOP END OF TRANSFORMER.

CONSTRUCTING H.F. COUPLING UNITS.—(*Concluded*)

nected to No. 4. Do not try to make these connections by laying the wires under the shoulders of the valve pins. The fine wire is easily broken in that way, and solder should be used.

The Daventry Unit

The former for the secondary of the Daventry unit is similar to that used for the low wave except that the anchorage holes are placed nearer to the ends, leaving a clear 2½ in. between for the winding. This is of No. 36 d.s.c. close wound,

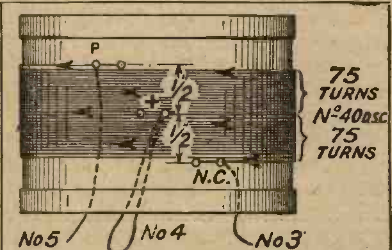
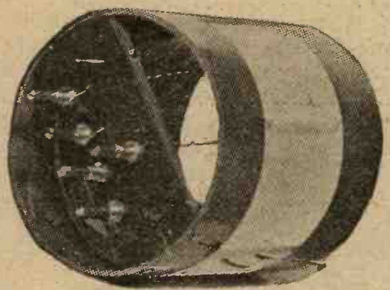


Fig. 6. Primary for Daventry transformer. The turns are wound close without spacing.

and as this wire normally lies about 100 turns per inch there will be about 225 turns if the space between the anchorages is filled. The exact number to a few turns is not material. Hand winding will be found tedious, but on the winder it only takes a few minutes.

Securing the Wire

For this unit the primary and neutralising windings are close wound, and the former should have anchorage holes as in Fig. 6. First anchor the end of the No. 40 d.s.c. at the point P, and wind on 75 turns clockwise with the turns close, and then pass a loop of the wire through the right-hand + hole, out again through the left-hand hole and back again into the right-hand hole. Then continue the winding for another 75 turns, finishing off at N.C. Push the smaller tube into the larger, allowing the end N.C. to enter first as before. Make the connections as Fig. 5, and the Daventry unit is complete.



A view clearly showing the construction of one of the H.F. units.

For the Lower Waves

The low wave unit will tune from Meunster to Vienna with a .0003 tuning condenser. At present there are few programmes below Meunster, but for experimental work it is interesting to make a special unit to tune down much lower. For this the secondary may have 50 turns and the primary and neutralising windings twelve turns each. This unit will include the lowest of the Stockholm relays, Karlskrona, and it is interesting to note how well these short wave transmissions come in on an indoor aerial with a single stage of tuned high frequency.

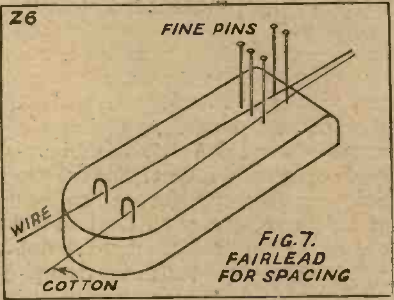


Fig. 7. Fairlead for spacing

A LEATHER WORK REVIVER.

THE following preparation, which can be easily and quite inexpensively prepared at home, will render all types of leather articles, such as accumulator straps, permanently immune from the bad effects of acid vapour and splashes.

It is also of the greatest use for the purpose of maintaining leather cabinet or box hinges in a supple condition. Carrying straps of portable set and other radio apparatus are also rendered waterproof and immune from deteriorating atmospheric influences by its use.

Here is the recipe :—

Pure castor oil	..	2 ozs.
Paraffin wax..	..	½ oz.

Cut the wax into very fine shreds, and then place it, together with the castor oil into a convenient-sized bottle. Immerse the bottle in a pan of hot water, and shake the bottle repeatedly until the wax dissolves in the oil, which it will be found to do fairly readily.

When the above mixture is cold, it will be found to assume the form of a paste. In order to use it, it should be warmed by allowing it to stand in a pan of hot water. A little of the fluid mixture is then poured on to the surface of the leatherwork to be treated, and then vigorously rubbed in.

There is no need to be too sparing about the application of the mixture to the leatherwork. The leather will absorb the mixture readily, and, in many cases, like Oliver Twist of old, it will " ask for more."

In any case, if an overdose of the mixture is applied to the leatherwork, it can always be rubbed off with a soft rag, and in this event any slight stickiness of the leatherwork will entirely disappear within the course of a day or two.

RADIO ABROAD

A Monthly Feature Reviewing Wireless Progress in Foreign Lands.

By a Special Correspondent.

A FEW days ago I was looking through a magazine published in one of the Western States and I noticed that one of the well-known manufacturers was specialising in metal panels. In this country we seem to keep to the ebonite or other form of insulating panel, and although there are many excellent types of hard-rubber panels there is a good deal to be said for the metal panel, not merely on the ground of its beautiful appearance, but also because of its electrostatic shielding properties.

In this subject, as in many others, ideas have undergone considerable changes. At one time you had to have an insulating panel, simply because the various components mounted on the panel required to be insulated from one another.

The next idea was to provide shielding for the internal parts of the set by pasting tinfoil upon the interior of the cabinet and also upon the back of the panel. It is therefore a fairly obvious step to make the panel entirely of sheet metal, introducing insulating bushes where necessary.

Bronze Panels

The particular panels referred to above are made by the Crowe Nameplate and Manufacturing Company, 1749, Grace Street, Chicago, and are made in brass and bronze. The manufacturers claim that on actual laboratory tests by leading radio engineers these metal panels have given the highest rating for general all-round satisfactory performance. They shield the set from interference and reduce body capacity effects to a minimum. They do not break, split or warp, whilst as regards their appearance, they are capable of being produced in a great variety of finishes to harmonise with all the most popular styles of cabinet work. In some cases the metal panels are elaborately etched.

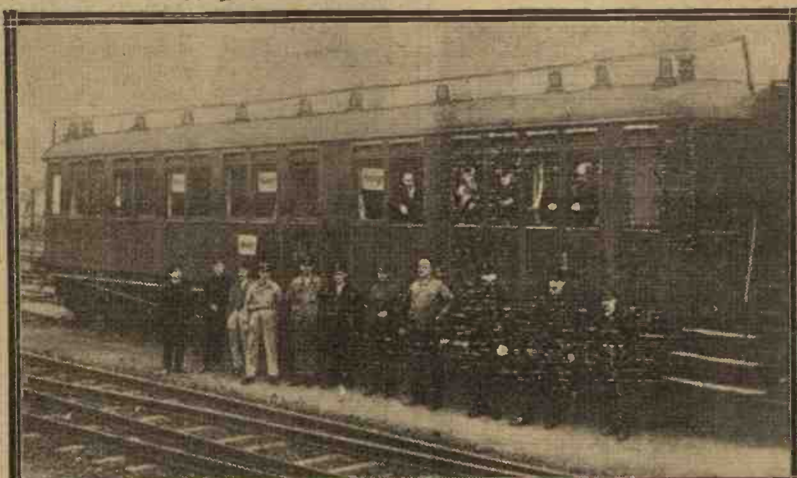
Of course, metal panels are by no means unknown in this country, but it seems likely that in the near future they will come into much greater favour.

Regulating Wavelengths

It is not very long ago that the first announcements were made of the use of quartz crystals in oscillating circuits for the purpose of controlling the wavelength of transmitting stations, but progress has been so rapid, and the method has proved such a practical and valuable one, that it is not surprising to find that quartz crystals, suitable for the purpose in question, can now be purchased in a commercial way at quite a reasonable price.

The standardising of transmitting wavelengths is a matter of international importance, and the ether is now becoming so congested that many stations are separated by almost the minimum wavelength difference. It is obviously becoming increasingly important that every transmitting station should keep to its assigned wavelength, otherwise hopeless confusion would arise. The quartz crystal oscillator, therefore, particularly since it has proved such a practical proposition, has assumed great importance. These crystals have been made to oscillate down to a wavelength of about 50 metres quite easily, and transmitting stations have recently been arranged to depend entirely upon a quartz crystal oscillator for controlling the wavelength output. An example of such a station is WGY (belonging to the General Electric Company of America), where a tiny piece of quartz, only about an inch square and ⅛ in. in thickness, controls the wavelength.

This little crystal is contained in a metal case and is included in an oscillating circuit using only a five-watt valve, the output being, of course successively amplified until the main transmitters are controlled.



The Austrian express trains are being fitted with wireless telephones for the use of passengers. The aerial, as can be seen, is run along the roof of one of the coaches.

RADIO ABROAD—(*Continued*)

Quartz Crystal to Order

The Scientific Radio Service, Box 86, Mount Rainier, Maryland, U.S.A., advertise these quartz crystals, ground to a guaranteed accuracy of less than 1-10th of one per cent. The crystals are so ground as to produce their maximum vibrations, thereby making them suitable for use in power circuits, besides being excellent for frequency standards. The crystals may be obtained ground to any frequency between 40 and 10,000 kilocycles at a price of about £10. Experimenters interested in the subject should write to the Scientific Radio Service mentioned above for full particulars.

Dustless Condensers

Most English manufacturers of wireless variable condensers make the open type without any covering. So much stress is laid upon the importance of keeping out dust from condensers that it is rather surprising that the closed-in or covered condensers have not become more popular. I notice in certain of the Continental papers, particularly a German journal, that the closed condensers are superseding the open type. In some cases the covering is made of glass, but more usually it is a bent sheet of celluloid or some other similar transparent composition.

Father of Telephone Industry

Mr. L. M. Ericsson, who was well known in the telephone and wireless industries, died recently at Stockholm, aged 80. He founded his first company in 1876, and twenty years later the original factory was taken up by the L. M. Ericsson Company. Mr. Ericsson, although he did not actually invent the telephone, has been described as "the Father of the Telephone Industry."

Safety First Radio

The United States Lighthouse Service has lately been carrying out tests with some new devices made by the Federal Telegraph Company of California, for the purpose of preventing collisions at sea during fogs. The new instrument is really a short-range transmitter which is automatically operated and sends out wireless signals corresponding to the characteristic light signals sent out from a lighthouse. The signals are, of course, received on the ship's receiver and the bearing of the lighthouse is obtained by means of a simple direction-finding apparatus. The arrangement is effective at distances up to 10 to 20 miles, and according to the tests was found to be entirely satisfactory.

Heaving up the submarine oscillator which is used in conjunction with the wireless beacon for direction finding at sea.

A German Loud-Speaker

Herr Eugene Reisz, the well-known German engineer, has recently perfected a remarkable loud-speaker which depends upon a principle somewhat novel as applied to loud-speakers. The sound radiator is a rubber sheet diaphragm, and this is placed in very close proximity with a metal diaphragm. The interior surface of the rubber diaphragm is coated with very small carbon granules, which are secured to the rubber by means of an electrically conducting adhesive. In this way, although the rubber is an insulator, its inner surface is made conducting. The two conducting plates—the metal plate and the carbon surface of the rubber—are then used as the plates of a condenser and the speech current is delivered to these two plates. Consequently, the rubber is made to vibrate in accordance with the speech currents and gives out a reproduction which is said to be extremely faithful to the original. Laboratory investigation of the amplification range of the Reisz loud-speaker shows that quite a good uniformity is obtained between about 200 cycles and 8,000 cycles per second, which, of course, includes the speech and musical range. One of the advantages claimed for this loud-speaker is that, like the cone speaker, it radiates over its entire surface and consequently the objectionable directional effect sometimes so noticeable with horn speakers is avoided. The uniformity of the amplification over a considerable range gives it also another important advantage.

Tuned Radio Frequency

Those about to go in for experimental circuits, particularly tuned radio - frequency and heterodynes, will appreciate the convenience of a fixed condenser which is not really fixed but adjustable. I see the X.L. Radio Laboratories of 2426, Lincoln Avenue, N. Chicago, Ill., have put a condenser of this type on the market. It is to all appearances like an ordinary fixed condenser, but the insulation separating the plates is slightly resilient, and through the centre of the condenser is a small screw by means of which the plates can be tightened together, thus increasing the capacity. All you have to do is to take a condenser the range of which includes the values you most probably want (these condensers are made with different ranges of adjustment); fit it in circuit and

RADIO ABROAD—*(Concluded)*

then adjust it afterwards by means of a small screwdriver. It is in this way equivlent to a series of fixed condensers and has the great merit that you can adjust it whilst it is actually in circuit without having to pull it out and substitute another.

"High" Capacity

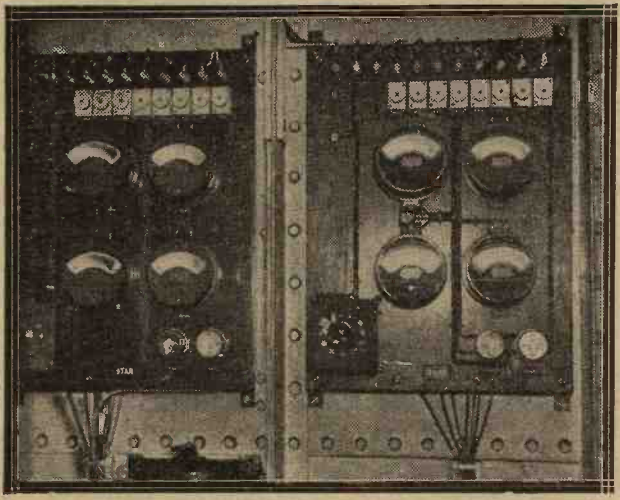
I wonder how many readers have any idea what a one farad plate condenser would look like? A well-known foreign journal gives some interesting figures which show that if the variable condenser were made as high as the Woolworth building in New York (about 800 feet) and the plates were 1-25th inch thick and were spaced 1-25 inch apart, there would be about 117,000 plates required, the area of each plate being equal to the ground area of the Woolworth building.

Twisted Radio

Some little time ago considerable interest was aroused by the announcement of the discovery by Dr. E. F. W. Alexanderson of the fact that polarised electric waves suffered a twisting effect during transmission. In his description of the effect Dr. Alexanderson says :—

"We have found that the space wave from a 50 metre station twists in its plane of polarisation about 20 to 30 degrees in 10 miles. From this we conclude that it would acquire a twist of 180 degrees in 60 to 80 miles. It is therefore reasonable to assume that a space wave emitted from a broadcast station would acquire a twist of 180 degrees in 100 miles. The earth bound wave, on the other hand, proceeding from the same station, will maintain its vertical plane or polarisation due to the proximity and guidance of the earth. The earth wave and the space wave may thus arrive 180 degrees out of phase and cancel each other.

"If all conditions were constant we would thus have a permanent 'dead spot' of reception such as is sometimes observed. Variations of the conditions which control polarisation will, however, cause the signal to fade intermittently. From this reasoning it might be expected that these phenomena would repeat themselves at a distance of 300 miles from the station where the plane has twisted another 360 degrees. At that distance, however, the earth bound wave has been so largely absorbed that it is of a lower order of magnitude than the space wave and therefore cannot produce full interference. Much will undoubtedly become known in the next few years which will enable us to pre-determine more readily the phenomena of shifting wave polarisation and fading."



The two switchboards for controlling the submarine oscillator shown in the photograph on the previous page.

Multiple Broadcast Wave-lengths

It is believed by some experts that when we understand more about these horizontally polarised waves, broadcasting stations will not use a single aerial or even a single wavelength, but will adjust their transmitters to send out certain wavelengths for certain hours in order to cope with the varying conditions caused by daylight and darkness.

A Chain of Stations

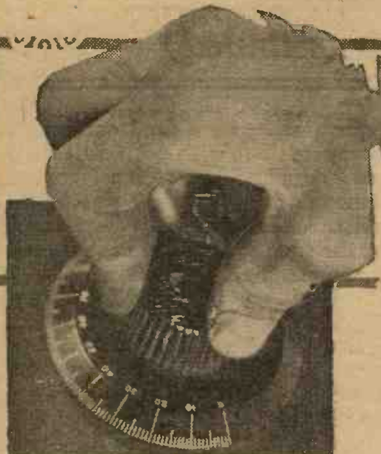
So successful have the tests been at Schenectady that the Radio Corporation of America has decided to build a chain of short-wave stations to link the islands of the Pacific with the mainland. The experimental station built near Schenectady by the General Electric Company for the purpose of exploring polarised and short-waves is capable of operating with seven transmitters simultaneously on different aerials and on different types of aerial.

A German Portable

I see an interesting type of receiver is gaining favour in Germany which utilises the metal horn of the loud-speaker as an aerial. The set is, of course, of the portable variety and includes two high-frequency stages such as would be used with a small frame aerial. Instead of a frame aerial, however, the loud-speaker horn is mounted from the cabinet by means of an insulating support and is used as a collector of electro-magnetic energy. This new arrangement has been developed by the Carl Lindstrom Aktiengesellschaft.

American Practice

The battery eliminators and direct - from - the - mains devices which are now becoming popular in this country have become quite an established practice abroad, particularly in the States, so much so that "eliminator testers" have appeared on the market, designed to enable the dealer to adjust the eliminator to the customer's requirements before selling it. The test consists of a suitable milliammeter connected in series with an adjustable load, and a volt-meter so arranged that it shows the voltage available at the eliminator terminals under actual operating conditions. This eliminator tester has been produced by the Jewell Electrical Instrument Company, 1650, Walnut Street, Chicago.



Zero Beat Reception

This interesting article throws light upon the mystery of silent-point reception, a condition which has, at one time or another, puzzled every enthusiast.

By Captain H. J. ROUND
(Chief of the Research Department, Marconi Co.)

ALL those with experience of single reacting valve reception, either for C.W. purposes or for telephony, have noted the effect that between two adjustments of the tuning condenser no heterodyne note is produced, and that these two positions get nearer and nearer together the stronger becomes one's reaction, and the farther apart they get the stronger one's signals.

"Driven into Synchronism"

In the reception of telephony this results in the curious phenomenon that, although the set is normally oscillating quite strongly, the minute one gets in tune with a station that station is received quite clearly with no trace of heterodyne note.

We sometimes hear the explanation that the receiver is "driven into synchronism" with the transmitter, but although this may be one view taken of the phenomenon it does not really explain things.

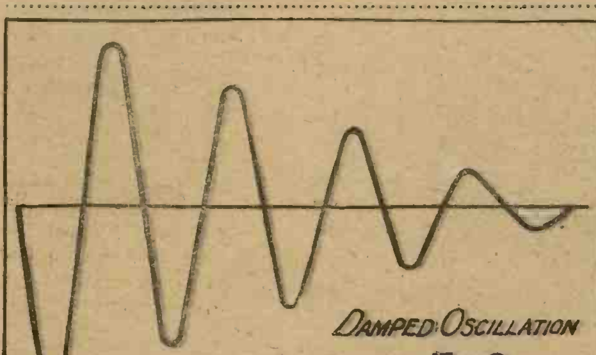
The whole process is due to the fact that valves do not behave the same for strong as for weak signals. Currents through an ordinary wire follow changes of voltage applied very nearly proportionally, but currents through valves are by no means proportional to the voltages.

Brief Description of "Reaction"

This is the reason why characteristics of valves are necessary, because we cannot express the value of currents at different voltages in a simple way like we can do with a piece of wire. It is not necessary for every wire manufacturer to publish "characteristic curves" of their wires; the law is so simple that just a number is sufficient to give the facts.

Let us examine what happens in a tuned circuit such as we use for reception.

A tuned circuit consisting of a coil of wire shunted by a condenser (Fig. 1) can be made to oscillate electrically in several ways, such as by the old spark way of charging up the condenser and letting it discharge across a gap in the circuit.

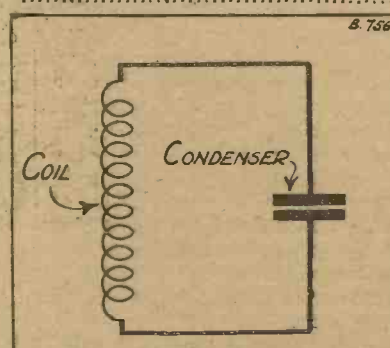


DAMPED OSCILLATION FIG. 2. B767

Resistance losses in a circuit cause oscillations to die away, as shown here.

Or we can pass a current through the coil of wire and suddenly break the current, a method of exciting used extensively in connection with a buzzer in wavemeters. Owing to resistance losses in the coil and condenser, any oscillations thus excited will die away quite rapidly (Fig. 2).

By means of the valve we have learned how to keep these oscillations from dying away, for by allowing the potential of the oscillations to act on the grid of the valve we can control the current flow in the plate circuit of the latter, and from the plate circuit we can throw sufficient energy back into the coil and condenser circuit in the right phase to keep up the oscillations. This operation is now usually called reaction.



SIMPLE TUNED CIRCUIT. FIG. 1

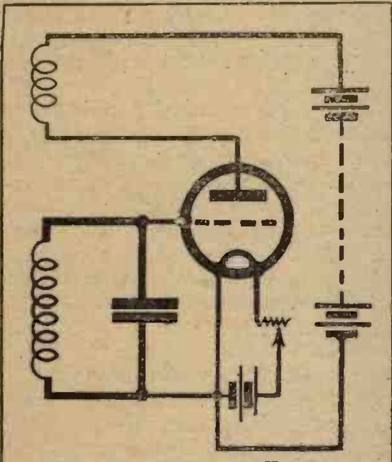
It is quite obvious that if we supply energy to this coil and condenser circuit in the right way from a valve, we can prolong the oscillations until finally, if we supply enough energy, the oscillations will go on at the same amplitude for ever. Incidentally, the lower the losses in the original circuit the less the energy we shall have to supply. In Fig. 3 is a simple valve reacting circuit which I am considering in all my discussions.

Negative Resistance

One way of looking at such a circuit with a valve reaction attachment is to temporarily forget the valve and imagine we have a circuit

ZERO BEAT RECEPTION—*(Continued)*

of lower resistance than its actual resistance, this resistance being lower and lower the more the reaction we apply.. But though such a circuit will superficially act as if its resistance were lower, a detailed examination will show that the effect is not quite the same as a circuit of really lower resistance. Wherein does the difference lie?



REACTION CIRCUIT. FIG. 3.

Suppose we take a real low-resistance circuit and induce a signal into it of a certain strength, the result will be a current of, say, a certain value. Twice the strength of signal will result in exactly twice the strength of current, and so on. But consider what happens with a higher resistance circuit brought to a low resistance with a reacting valve arrangement.

Apparent Resistance

When the signal makes a current in the circuit, the resulting voltage on the condenser acts on the grid of the valve and varies the current flowing through the small choke coil in the plate circuit.

Referring now to Fig. 4, suppose we are arbitrarily set at a grid voltage and plate current represented by the point A, and then examine what happens if we put an alternating current on the grid.

When the alternating force is weak say, when the grid voltage is varying from X to Y, then the current change is a certain amount. But if we change from X[1] to Y[1], which represents, say, four times the grid change in the first case, a little measurement will show that we have nothing like the proportionate change of plate current.

If we were to plot another curve between the change of plate current and the change of grid volts we should get a curve like Fig. 5. What is the result in our reaction circuit?

We have adjusted our reaction coil to send back sufficient energy to prolong any oscillation a certain amount, or in the other way of looking at it, reduce the resistance of the circuit to a certain figure.

But if our initial oscillation were four times as strong, it would only produce twice as much change in the plate current. Only twice as much energy would be sent back, with the result that proportionately the oscillations would not be maintained so long—or again, in other words, the circuit would now be of higher resistance. In fact, the apparent resistance of the circuit would increase with increase of signals.

A Curious Effect

Such a state of affairs is liable to lead to curious complications, as, for instance, in the simple case of a strong impulse applied to the circuit.

At first the oscillation will die away quickly, then more and more slowly, the law being obviously very complex and quite unlike a real low-resistance circuit.

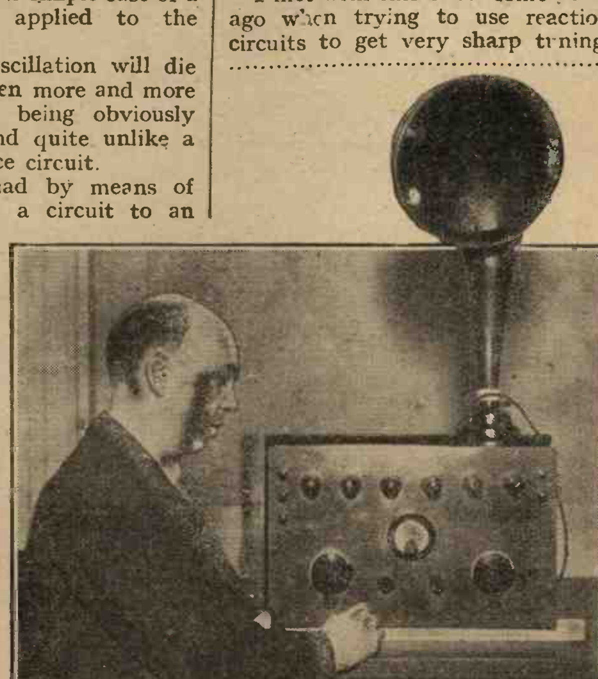
Suppose we had by means of reaction reduced a circuit to an apparent resistance of 1 ohm for weak signals and we now applied an alternating voltage of 1 volt to the arrangement. If our circuit were a real copper one we should expect, and get, a final current of 1 ampere; but with our fictitiously low-resistance reaction circuit, although for the weak signals its resistance may seem to be 1 ohm, by the time the current has reached ½ ampere the resistance may be 2 ohms, and so the current will stop there and not increase to 1 ampere.

Let us see what happens when two sets of signals at once are induced. In the real low-resistance circuit the two sets of signals will arrive at current values for each, just the same as though the other signal were not there. But in the reaction circuit if each alone arrive at, say, 1 ampere, then the two together may only come to 1½ amperes.

Selectivity and Reaction

In practice this will mean that if one signal were a steady dash and the other were morse, then the morse of the second signal would vary the current of the first signal. Obviously a bad thing to happen, because we are giving to the first signal a varying character which it does not really possess.

I met with this effect some years ago when trying to use reaction circuits to get very sharp tuning. They turned out to be of small use, because the signals one was trying to separate by means of the circuit got tangled up with one another, and I was forced to use real low-



Major Armstrong, who developed the super-heterodyne, and has made extensive researches into Zero Beat Reception.

ZERO BEAT RECEPTION—*(Continued)*

resistance coils instead. I could write indefinitely about the effects one obtains with variations of this simple reaction device.

Thus many valves in parallel show the effect much less than one valve. Big power valves are better than small valves.

Then, again, we are not confined to setting ourselves in the one place in the characteristic, but we can arrange that the apparent resistance *falls* instead of rising with the amplitude. But whatever we do we can never imitate exactly the true low-resistance coil.

All this is leading up to the limiting condition when we are just going to oscillate or actually oscillating.

Controlled by the Signal

Suppose we set our reaction coil so that we are actually oscillating, then in our tuned circuit will be flowing a certain value of current.

But here we are with a circuit with a current flowing in it, but we are not inducing a signal into it.

Remember, when I say this I am hiding my eyes to the fact that there is a valve there.

Ohms law says that the current is equal to the $\frac{\text{voltage}}{\text{resistance}}$ and as the current is a definite value and the induced voltage zero, we can say that for that strength of current that particular circuit must be zero resistance, because to make the equation

current $= \frac{0}{\text{resistance}}$ true the resistance must be o also.

Now, if we do induce a signal of the same frequency as the circuit, the current will rise a little, and now we have a finite current equal to $\frac{\text{a small voltage}}{\text{resistance}}$ so that the circuit must now have a positive resistance. A zero resistance current does not, therefore, exist in practice. And although the circuit is a self-oscillating one, we can say that when a signal in tune is induced the whole of the resulting current is controlled by the signal, but of course not proportionally.

So far I have only considered a signal being induced which is absolutely in tune with the circuit being used. Suppose we induce a voltage slightly out of tune with the circuit, the resulting current, of course, is controlled no longer by the resistance, but by the impedance, and as the circuit is of low resistance this impedance is chiefly due to the condenser and coil.

The resulting condenser voltage forces itself upon the valve grid and changes the plate current, and any current the valve wants to change to keep itself oscillating will be now proportionately less than before because of the bent valve curve. In fact, the induced oscillation crowds out the self-oscillation.

Dr. Lee de Forest, who made reaction possible by inserting a control electrode into the Fleming valve.

If the impedance of the circuit to the out-of-tune signal is low enough to permit of a current approximately equal to the previous self-oscillating current, then the self-oscillation will be stopped.

The impedance for an out-of-tune signal increases with the divergence from the tune value (the resistance term in the impedance is rather indefinite), so that the induced signal will steadily decrease as we go out of tune, and a time will come when the resulting amplitude is less than the natural oscillating current, and then we shall get oscillating current which will squeal with the induced signal. Or, of course, weakening the signal will start the squealing at any value of signal frequency.

The "Squealing Points"

This effect will happen on both sides of the tune position, and the squealing points will be wider and wider apart the stronger the signal.

A very simple piece of reasoning will show that strengthening our reaction will bring the squeal points nearer together, because by itself the circuit would obviously oscillate to a greater amplitude.

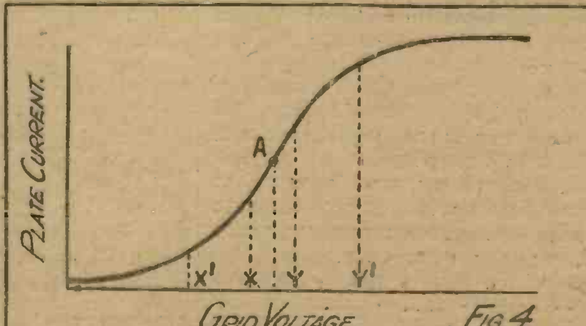
It certainly seems, however, as though it is quite impossible to bring these squeal points closer than a finite amount, for in the end at the point of tune the signal takes complete control.

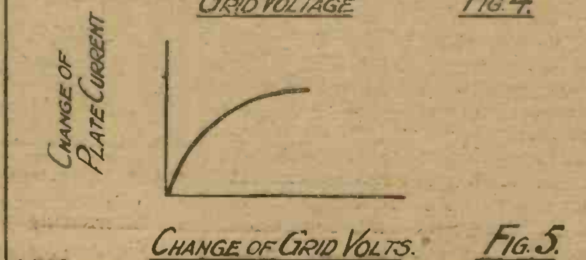
Reception of Telephony

Let us see what happens when we are receiving a modulated C.W. (telephony) which can be considered as a pure C.W. carrier plus other waves out of tune with this carrier.

Our receiving valve is self-oscillating and we tune up to the carrier. At once the current in the circuit can be considered as due to the carrier, and no amount of strengthening of reaction will take this control away—in other words

(Continued on page 334.)





OUR MISINFORMATION DEPARTMENT

By C. P. ALLINSON, A.M.I.R.E.

WORRIED, N.W. 4, complains that his two-stage L.F. amplifier produces a faint high pitched whistle that spoils reception. The trouble is, of course, obviously due to the transmission; if it weren't there, it could not be spoilt. We therefore recommend Worried to disconnect his aerial and turn out the detector valve. Failing this, the addition of a third stage of transformer coupled L.F. will no doubt eliminate the whistle entirely while the resulting screech will successfully cover up the transmission.

* * *

L.F., Norwich, finds that when the second stage of resistance capacity amplification is switched on, a regular ticking noise is heard in the loud-speaker, these ticks or clicks being separated by exactly 1 23-37ths seconds. Your set, L.F., appears to be suffering from a bad attack of Death Watch Beetle. It should first be soaked in paraffin, and then both sides of the panel and all the components should be sprayed with arsenious sulphide. We shall be glad to hear the results; they should be interesting.

* * *

BEGINNER, Prittlewell, has just completed a nineteen valve superheterodyne, as he understands this type of set is particularly suitable for use by the unskilled. He encloses the circuit, which was taken from an American comic paper, and says he gets no signals at all. What is wrong?

The circuit you send is somewhat complicated and is far too difficult for us to decipher; anyhow, we're busy; try next door.

* * *

NIPPY, Lyons, has constructed a three-valve set in a dumb waiter, but when she switches it on she hears nothing but a kind of ringing, tinkling sound. It would appear, Nippy, that your valves have become Lionised. The only cure for this is to bore a hole in the glass with a corkscrew and let some fresh air in. When next turned on the valves will burn for about two seconds and then go out. When this occurs buy some new ones. These will entirely cure your trouble.

* * *

DIPPER, Margate, has a portable receiver that he takes sea bathing with him. The set is, however, extremely prone to emit howls and squeals.

We are of the opinion from the other symptoms that Dipper describes that the receiver has had its little toe nipped by a crab while its back of panel diagram has been stung by a jelly fish. The best we can suggest is that he apply grease to the affected parts twice daily till all signs of inflammation have disappeared.

* * *

PUZZLED, Droitwich, is just installing a set and wishes to know the best type of aerial, earth, etc., to use.

Your aerial should preferably be as high as possible, not more than 6 feet from the ground. It should be kept parallel to itself and under no conditions should it be longer than a piece of stick. Your earth connection may be taken to a window box, failing this try the coal scuttle. For valves any good steam chandler will supply you with suitable types, the best, of course, being the Pool and Bitter type. For further details we suggest that Puzzled write to one of the wireless papers which give advice on these matters.

* * *

PATRONISING, Tooting Bec, informs us that the circuit diagram shown in No. 15 of vol. 31a on page 28943, is incorrectly drawn.

Thank you, Patronising, we noticed the mistake exactly eleven minutes before going to press, but as we did not wish to deprive you of the pleasure of being able to point it out we did not think it worth while to incur the heavy expenses of holding the issue up for a couple of hours while we did a new drawing. We note that you have burnt out four valves owing to this error.

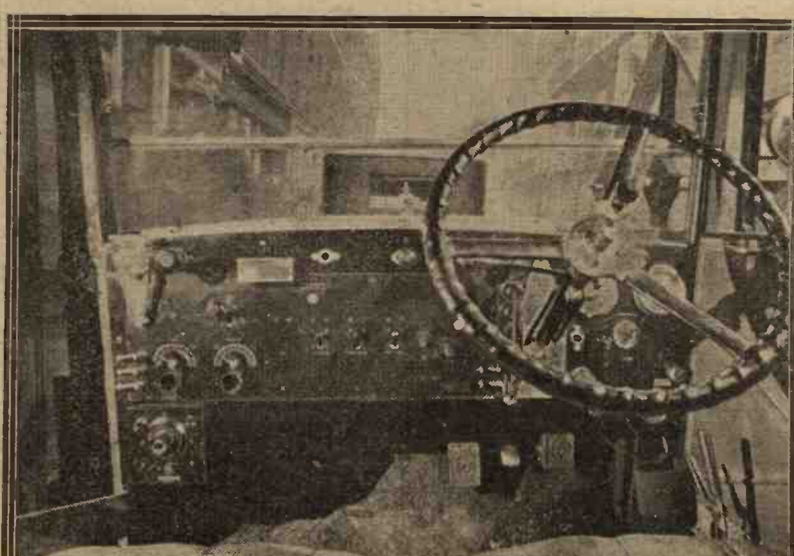
* * *

N. PARKER, Whitechapel. In answer to your question we would say that we are in no way financially interested in any valve manufacturing firm.

* * *

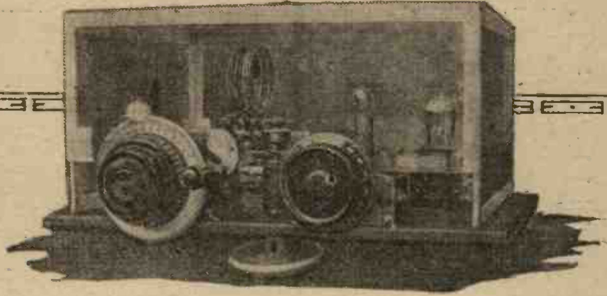
OPTIMUS, Golders Green, finds

(*Continued on page* 322.)



A nine-valve super-het forms part of the "dash" of this wireless-equipped car. The speedometer, clock, oil-gauge and switchboard have been placed to the right of the steering column, to make room for the set.

For the D.X. Listener



A list of all the European broadcasting stations

Compiled by— *DUDLEY KEITH*

STATIONS BETWEEN 180 AND 250 METRES.

Wave-length.	Name of Station.	Remarks.
180	Beziers	—
196	Karlskrona (SMSM) ..	Relays Stockholm.
201.3	Jönköping (SMZD) ..	Do. do.
202.7	Kristinehamn (SMTY)	Do. do.
204.1	Gavl (SMXF) ..	Do. do.
211.9	Kiev	Most evenings.
218	Orebro	Relays Stockholm.
221	Karlstadt	Do. do.
222.2	Strasbourg	Tues. & Thurs., from 9 p.m.
225.6	Belgrade	Irregular.
229	Umea	Relays Stockholm.
229	Helsingborg	Do. do.
230	Juanlespins	Every evening, 9 p.m. onwards.
233	Uleaborg	Relays Helsingfors.
238.1	Bordeaux	Relays Paris (PTT).
240	Helsingfors	Mon., Wed., Fri., 6—8 p.m.
241.9	Muenster (MS) ..	Every evening.
243.9	Trondjhen	—
245.9	Toulouse ("Radio Toulouse")	—
250	Gleiwitz	Relays Breslau.
250	Eskilstuna	Relays Stockholm.

The majority of these stations are low-powered relays. Plug-in coils of between 25 and 40 turns with either parallel or series aerial tuning will be required. Many of these stations can be heard every evening, and especially on Sunday evenings, on a Det. and L.F. straight circuit. Muenster is easily recognised by the gong signal between items, and the Morse sign – – . . . at intervals of 5 seconds.

STATIONS BETWEEN 250 AND 300 METRES.

Wave-length.	Name of Station.	Remarks.
252.1	Saffle (SMTS) ..	Relays Stockholm.
252.1	Stettin	Relays Berlin.
252.1	Montpellier	Every evening after 8.45 p.m.
252.1	Kalmar (SMSN) ..	Relays Stockholm.
252.1	**BRADFORD (2LS)** ..	**Relays station.**
254.2	Kiel	Relays Hamburg.
260.9	Malmö (SASC) ..	Most evenings, Sundays, 11 a.m.
265.5	Antwerp	Relays Brussels.
270.9	Posen	—
272.5	Cassel	Relays Frankfurt.
272.7	Klagenfurt	—
272.7	Danzig	Daily, 10 a.m. onwards Relays Koenigsberg.
272.7	**SHEFFIELD (6FL)** ..	**Relay station.**
275.2	Angers (Radio-Anjou)	—
275.2	Norrköping (SMVV)	—
275.2	**NOTTINGHAM (SNG)**	**Relay station.**
277.8	Trollhättan (SMXQ)	—
277.8	**LEEDS (2LS)** ..	**Relay station.**
283	Dortmund	Relays Muenster.
288.1	**EDINBURGH (2EH)**	**Relay station.**
291.3	Lyons (Radio-Lyons)	From 7.15 p.m. onwards.
294.1	Uddevalla	Relays Stockholm.
294.1	**SWANSEA (5SX)** ..	
294.1	**STOKE (6ST)**	**Relay stations.**
294.1	**DUNDEE (2DE)** ..	
294.1	**HULL (6KH)**	
294.1	Dresden	Relays Leipzig.
297	Agen	Tues. & Fri., 8.30 p.m. onwards.
297	Jyvaskyla	Relays Helsingfors.
297	Varborg	Relays Stockholm.
297	Hanover	Relays Hamburg.
297	**LIVERPOOL (6LV)** ..	**Relay station.**
300	Radio-Vitus	Sun., Wed., Fri., 9 p.m onwards.
300	Kosice	—

Those stations relaying Hamburg can be recognised by a gong being sounded between the various items and the one stroke on the gong before each item. Most of these stations are easily audible on two valves in this country and come through exceedingly well. Coils of 25-50 turns for the aerial (parallel or series tuning) and 35-50 for a secondary or tuned anode are suitable. Hanover announces by the call "Hier Norddeutsche Sender, Hanover," and the intervals are denoted by gong strokes so arranged as to denote minute intervals. The Morse sign H R (. . . . . – .) is also sent out when not relaying Hamburg. Dresden announces D R in Morse (– . . . – .).

FOR THE D.X. LISTENER—*(Continued).*

STATIONS BETWEEN 300 AND 400 METRES.

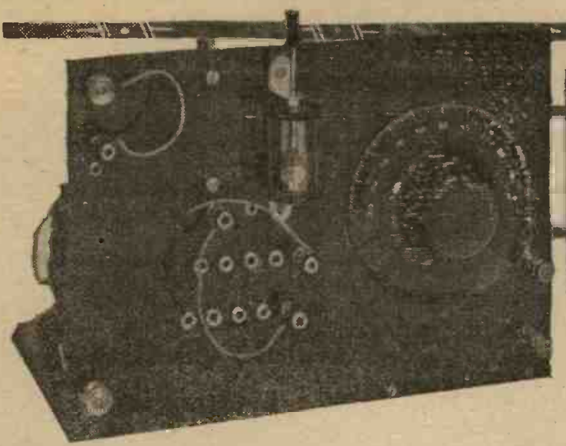
Wave-length.	Name of Station.	Remarks.
303	Koenigsberg	Daily, 7.10 p.m. onwards.
303	Madrid (to be changed to 500 metres) (EAJ12)	Every evening.
306.1	**BELFAST (2BE)**	**Every day.**
309	Marseilles	From 9 p.m. onwards.
310	Zagreb	From 7 p.m. onwards.
312.5	**NEWCASTLE (5NO)**	**Daily.**
315	Upsala	Relays Stockholm.
315.8	Milan (1MI)	8 p.m. onwards.
319.1	**DUBLIN (2RN)**	**Daily from 7.30 p.m.**
322.6	Breslau	From 7.25 p.m., Sunday, 10 a.m.
325	Saragossa (EAJ 23) (to be changed to 566)	—
325	Barcelona (EAJ1) (to 344.3)	Daily, 6 p.m. onwards.
325	Malaga (EAJ25) (to be changed to 254.2)	—
326.1	**BIRMINGHAM (5IT)**	**Daily.**
329.7	Nuremburg	Relays Munich.
333.3	Reykjavik	—
333.3	Naples (INA)	8 p.m. onwards.
335	Cartagena (EAJ16) (to be 277.8)	8.30 p.m. onwards.
337	Copenhagen	Do.
340	San Sebastian (EAJ8) (to be 434.8)	2.30 to 10 p.m.
340.9	Petit Parisien	Sun., Tues., Thurs., Sat., 9 p.m.
343.9	Seville (EAJ17) (to be 277.8)	—
348.9	Prague	Daily, from 7 p.m.
350	Paris (Radio LL)	Mon., Wed. and Fri. evenings, 10 p.m.
353	**CARDIFF (5WA)**	**Daily.**
357	Seville (EAJ5) (to be 400)	—
357.1	Graz	Relays Vienna.
360	Cadiz (EAJ3) (to be 297)	Daily, 7—9 p.m. Often tests at 12 midnight.
361.4	**LONDON (2LO)**	**Daily.**
365.8	Leipzig	Daily, 7.30 p.m. onwards.
368	Tammafors	Relays Helsingfors.
370.4	Bergen	Most evenings.
373	Madrid (EAJ7) (to be 375)	Daily, 2.30 p.m. onwards; Sun., 7.30 p.m.
375	Madrid (EAJ4) (to be 275.2)	—
379.7	Stuttgart	Daily, 7 p.m.; Sun., 10.30 a.m.
384.6	**MANCHESTER (2ZY)**	**Daily.**
389.6	Toulouse (Radio du Midi)	Daily, 12.40 p.m. onwards.
394.7	Hamburg (HA in Morse)	Daily, 7 p.m. onwards.
400	Salamanca (EAJ22)	Daily, 9.30 p.m. onwards.
400	**PLYMOUTH (5PY)**	**Relay station.**
400	Mont de Marsan	8.30 p.m. onwards.
400	Falun (SMZK)	—
400	Bremen	Relays Hamburg.
400	Bratishaven	—

It will be noted by the above that the Spanish stations have not yet taken up their allotted wavelengths; the present wavelengths are shown in the columns, and the wavelengths to be taken in brackets with the names of the stations. Larger coils will be necessary for these stations, Nos. 35, 50 and 75 proving best for the average set, according to whether series or parallel tuning is employed. Always use a coil as large as is possible with the minimum of condenser. Barcelona calls in Spanish, the name being clearly emphasised. Very often a woman announcer is to be heard. Copenhagen announces in Danish, and closes down with the Danish for "Don't forget to earth your aerial." San Sebastian has a lady announcer, bids "Good night" in English and other languages. Petit Parisien frequently announces in English. Seville (EAJ5) often has lady announcer. Prague announces "Radio Praha" between items, and closes down with short Morse signal. Leipzig has a metronome ticker for an interval signal. Madrid (EAJ7) bugle call or chords on piano. Madrid (EAJ4) has a prolonged tuning note. Stuttgart has a preliminary signal of C D G (– . – . – . . – – .). Hamburg has a gong in intervals indicating minutes, and H A in Morse (. . . . . –).

STATIONS BETWEEN 400 AND 500 METRES.

Wave-length.	Name of Station.	Remarks.
405.4	**GLASGOW (5SC)**	**Daily.**
411	Berne	7 p.m. onwards; Sun., 6.30 p.m.
416.7	Göteborg (SASB)	Every Thurs., 8.15 p.m. Relays foreign stations.
418	Bilbao (EAJ11) (to be 294.1)	Most evenings.
419.5	Bordeaux (Lafayette)	Most evenings.
420	Moscow	—
428.6	Frankfurt-on-Maine	7.15 onwards.
436	Bilbao (EAJ9) (to be 400)	Most evenings.
440	Reval	Irregular.
441.2	Brunn	Daily, 6.30 p.m.
443	Rjukan	Irregular.
449	Rome (1RO)	8.30 p.m. onwards; Sun., 8 p.m.
450	Moscow	Trades Union station.
454.5	Stockholm (SASA)	8.15 p.m. onwards.
458	Ecole Superieure (FPTT)	Daily, from 9 p.m.
460	Barcelona (EAJ13) (to be 500)	Most evenings.
461.5	Oslo	Daily, 7 p.m.
468.8	Langenburg	German 25 kw. station. Every evening.
476.2	Lyons (La Doua)	Mon., Wed., Fri., 8.45 p.m.; Sun., Tues., Thurs. and Sat. Relays Ecole Superieur.
480	Riga	Daily, 6—8 p.m.
483.9	Berlin (Witzleben)	Every evening.
491.8	**BOURNEMOUTH (6BM)**	**Daily.**
494	Zurich	Daily, 2 p.m., except Tues.; Sun., 7 p.m.
500	**ABERDEEN (2BD)**	**Daily.**
500	Linköping	Relays Stockholm.
500	Helsingfors	Daily.

Among these stations the following can be easily recognised:—Berne; opening signal a post-horn or tuning note, each item preceded by two strokes and closed with one stroke on a gong. Bilbao has an abbreviated call between each item. Frankfurt opens with three strokes on a gong, interval signal F in Morse (. . – .). Rome has an oscillating valve tuning note, followed by "Pronto" repeated several times, announces "Radio Roma" between items. Stockholm has an interval signal of a rapidly ringing bell. Oslo opens with "Hallooo Oslo." Langenberg has the same gong signal as Muenster. Berlin occasionally chimes the hour. Zurich has a gong interval signal. *(To be concluded.)*



An Experimental Crystal Set

The Crystal Set described in this article is easy to make, but at the same time affords the amateur ample scope for experimenting.

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

IN the eyes of a good many people a crystal set is a crystal set, and that is all there is "to it." Such people are mostly to be found in the ranks of the contented listeners, who are happy in the possession of a crystal set which gives them their local station programmes, and this is all that they expect or desire. If they live within range of the coastal spark stations or shipping, their contentment is probably qualified!

There are even some who have long been enthusiasts in the building of wireless sets and who would never dream of "going back" to a crystal set. Such a step would be to them as though they were entering their second childhood.

Admittedly the crystal set has its limitations, as compared with a good modern valve receiver with the enormous benefits conferred by reaction. It need not, however, be regarded as in any sense a back number, and experiments with a suitably designed crystal set will show that a few departures from the conventional type of circuit will work wonders.

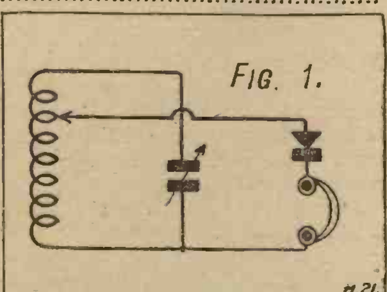


FIG. 1.

The crystal set described and illustrated on these pages will furnish the means of making a number of experiments, though the construction of it is not at all complicated. The principal advantage of the crystal set, that it entails no running expenses, need not be stressed here. Against this must be set its failings, the chief of which is the flat tuning associated with the average crystal receiver.

Reducing Crystal Damping

We can leave out of account here the fact that a crystal set of the ordinary type does not amplify, since we are concerned mainly with the reception of the local station. It may be argued that in this case good selectivity is no advantage. The interference from Morse stations experienced round our coasts is a sufficient answer to this, while the possibility of the establishment of alternative programme broadcasting stations in the future must not be overlooked.

Now if we design a tuned circuit, consisting of a coil and variable condenser, for example, to have a reasonably low H.F. resistance, we can expect that under suitable conditions it will provide us with sharp tuning when included in a receiver.

If, however, we shunt across it a resistance of rather low value, when we build it into the receiver we shall find that the tuning is flattened. This is what happens in the ordinary crystal set. The impedance offered by the crystal detector to H.F. currents will be much lower than that offered by the tuned circuit at any given frequency, the result being what is commonly called the "damping" effect of the crystal on the circuit, flat tuning and poor selectivity.

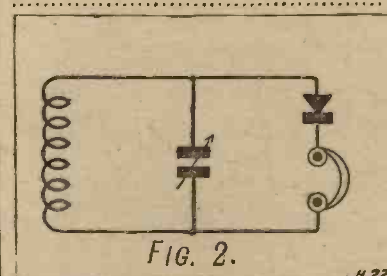


FIG. 2.

Since there is only a limited amount of energy available for the operation of a crystal set, namely, that which is picked up by the aerial system, we must make the best use we can of this energy in order to obtain the best results.

COMPONENTS REQUIRED.

One panel, 10 in. by 7 in., by 3-16 in.
One baseboard, 10 in. by 5½ in.
One .0005 S.L.F. variable condenser.
One No. 1 Dimic coil and one 25-turn Unimic coil with bases.
One "Permatector."
One glass-enclosed crystal detector, with galena crystal.
Four terminals (two of telephone type).
One 4-in. plain dial for condenser.
One loading coil socket for base mounting.
One multiple-fixed condenser.
Fourteen Clix sockets and four Clix plugs.
Wire, screws, etc.

AN EXPERIMENTAL CRYSTAL SET—*(Continued)*

The damping effect of the crystal detector, which has the greatest effect when the crystal is shunted across the whole of the tuning coil, as in Fig. 2, can be considerably reduced by shunting the detector across part only of the coil, as shown in Fig. 1. The actual point at which to tap the crystal on the coil will depend on the detector in use, so that a number of tapping points should be provided, and the best position found by experiment on signals.

Use of Auto-Coupling

We can now turn to the circuit of the set described, which is given in Fig. 3. It will be seen that the tapping points are provided on the tuning coil L_2, the whole of this coil being tuned by the variable condenser C_2. The aerial, too, may be connected at any suitable tapping point on the coil, thus making use of "auto-coupling," and decreasing the damping due to the aerial in a manner similar to that already described.

An Easy Change-Over

For the purpose of comparative experiments other refinements are included in the design. The coil L_1, which is untuned, permits of the testing of loose aerial coupling as an aid to selectivity. A series condenser may also be inserted in the aerial lead, when the aerial is connected to L_2. Furthermore, since constancy of the detector setting is required when making comparative tests, a permanent detector is fitted. Any doubts about the efficiency of the permanent detector may be settled by direct comparison with the results given with a catswhisker detector of conventional pattern, to which an easy change-over can be effected.

A standard coil socket is wired in series with L_2, to hold a loading coil for reception on the longer wavelengths. This is normally short-circuited with a metal plug.

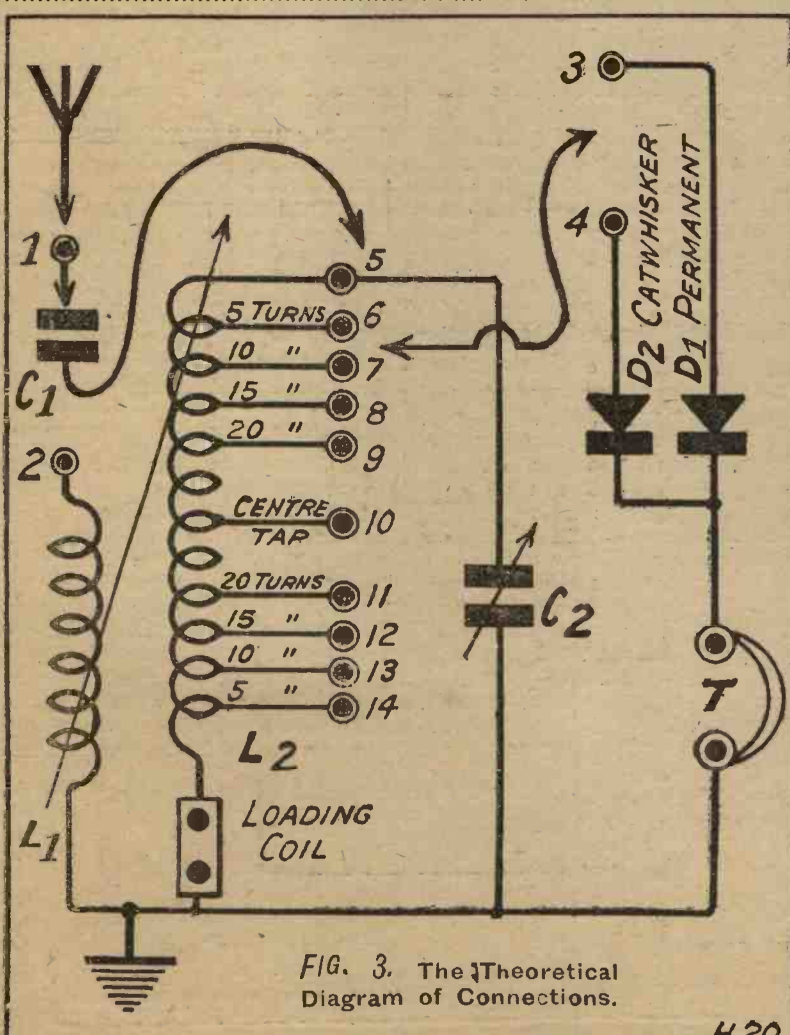


FIG. 3. The Theoretical Diagram of Connections.

Construction

The first operation to perform in the construction of the set is the marking and drilling of the panel in accordance with the drilling diagram. The dimensions given apply, of course, to the particular coils and condensers used. The Dimic and Unimic coils shown are very convenient for the set, since they are of "low-loss" design, and the former coil is quite simple to tap. The method of mounting the base of the Unimic coil was to tap two "blind" holes from the back of the panel (see Fig. 5). inserting 4 B.A. bolts to hold it in position. An alternative method is to drill clearance holes through the panel, put in bolts with countersunk heads and secure the coil base with nuts. Be sure that the panel you obtain is free from surface defects. A guaranteed panel is recommended.

The dimensions given should be carefully followed, since these provide for bringing the two coils co-axial when the panel and baseboard are screwed together. For the mounting of the variable condenser a template is supplied by the makers, Messrs. Beard and Fitch, three 4 B.A. clearance holes being needed.

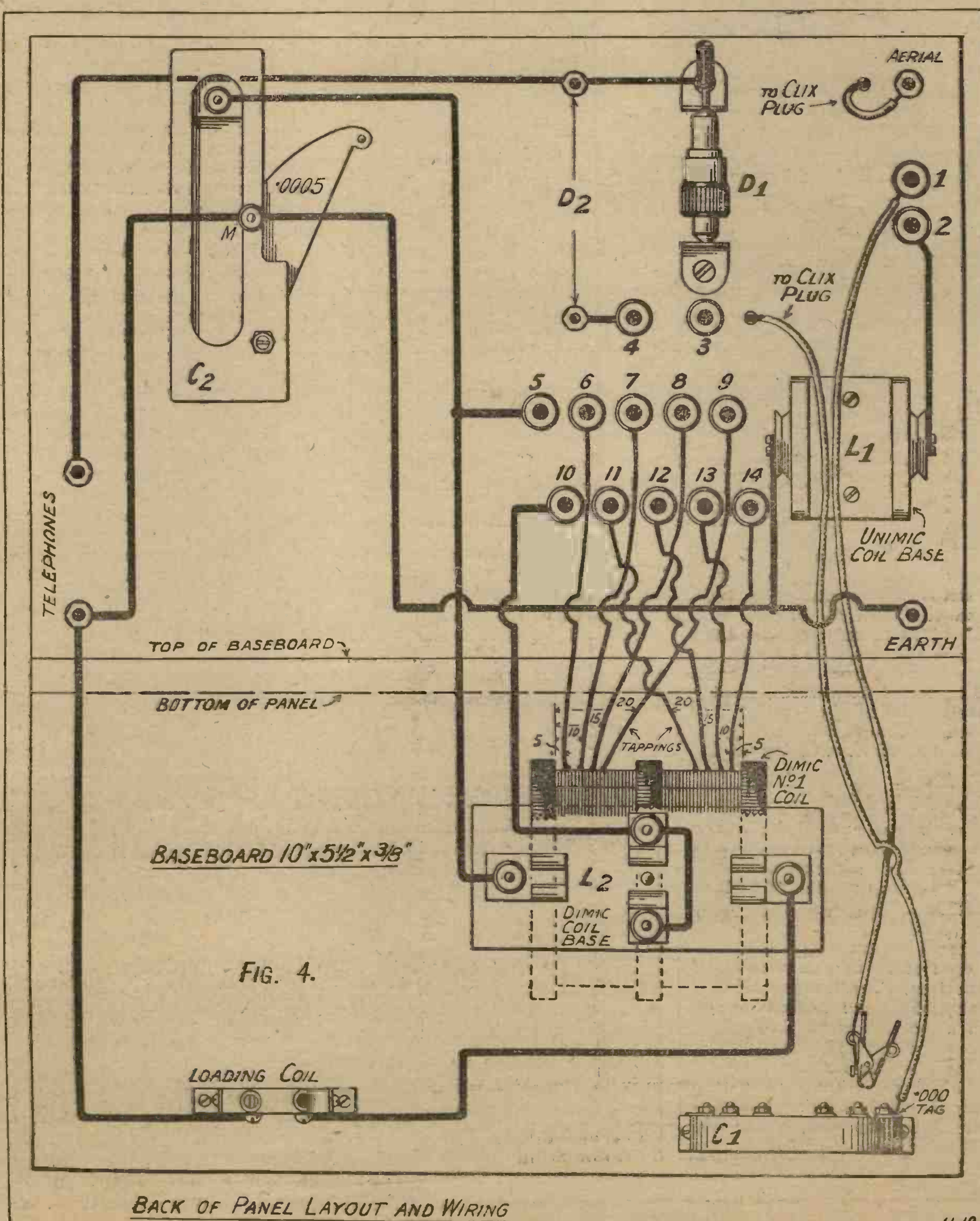
Tapping the Coil

When the panel is drilled, fix it to the baseboard with wood-screws in the holes along the lower edge. The components on panel and baseboard should then be mounted, reference being made to the photographs for guidance. Then put in the rigid wire connections. The wires going to the base of the Dimic coil must be taken well out from the base before turning towards their fixing points, to avoid fouling the coil when it is put in.

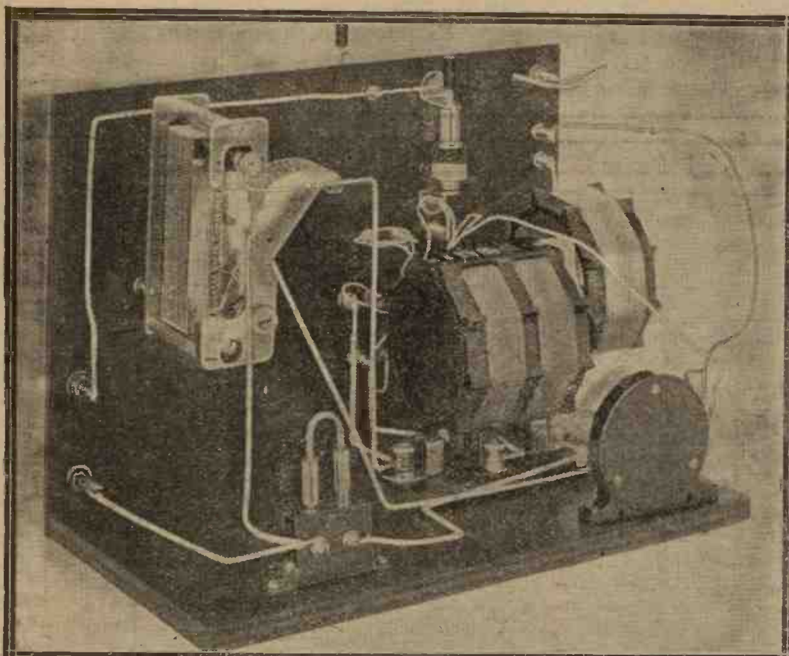
We next come to the tapping of the Dimic coil, and this operation, while not difficult, requires a certain amount of care. The tapping connections are lengths of 28 s.w.g. D.C.C. wire, and eight pieces

AN EXPERIMENTAL CRYSTAL SET—(*Continued*)

each of about 4 in. long will be needed, the insulation being removed for ½ in. at each end. The tappings are all taken on one "face" of the coil, the actual points being at 5, 10, 15 and 20 turns from each end of the coil. About ½ in. of the insulation has to be removed from these turns, and the best tool with which to do this is a sharp-pointed penknife. With the knife very gently scrape away



AN EXPERIMENTAL CRYSTAL SET—*(Continued)*



Most of the point to point wiring is shown in this back-of-panel view. The socket for the loading coil will be seen in the foreground.

the insulating covering till the bare wire shows; there is no need to strip off the insulation right round the wire, so long as it is removed from the top. As little pressure as possible should be exerted, as otherwise the turns will be forced downwards, making it more difficult to solder the connections, and, incidentally, to loosen the whole winding of the coil.

The Final Connections

Now tin both ends of the lengths of 28 gauge wire, and solder them to the Clix sockets numbered 6, 7, 8, 9, 10, 11, 12, 13 and 14 in Fig. 4. Apply a very little flux (powdered resin will do) to the bared points on the coil and tin each of them with a touch of a hot iron. The iron should not be applied to the turns for more than a moment when tinning the turns or when soldering the connections, or the insulation of the neighbouring turns may be damaged. Before fixing the connections to the coil, place the latter on its base. The connections can then be easily attached, since both the wires and the turns have been tinned. Any superfluous flux should be removed from the coil with a small stiff brush The wiring of the receiver is then complete, with the exception of the flex leads, the arrangement of which will be clear from Fig. 4.

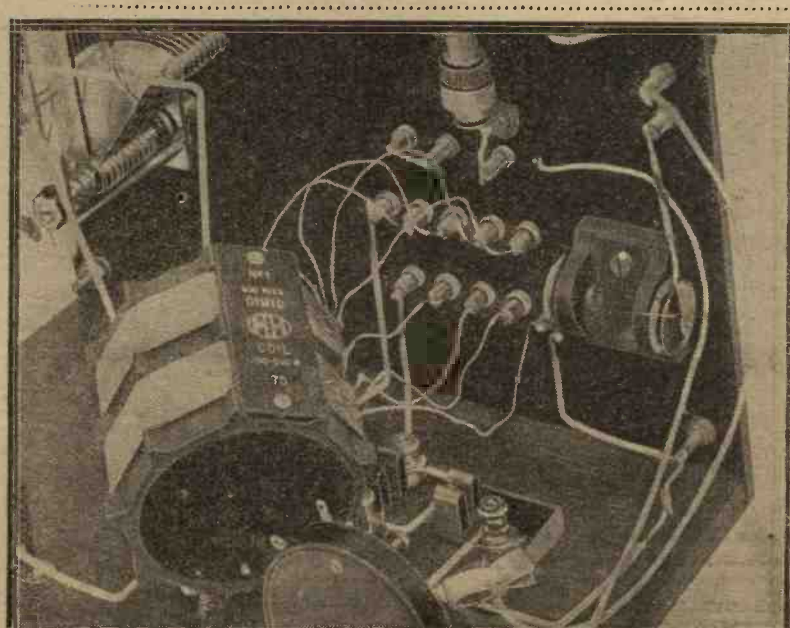
In addition to the three longer leads, do not forget to make up one 3 or 4 inches long with a Clix plug at each end. This is for connecting either of the crystal detectors to the tappings on the coil.

The series condenser shown is of the multiple-fixed C.A.V. type, from which the required capacity may be selected by means of the spring clip. No cabinet is included in the list of components, since experiments with the set would be somewhat hampered if it were enclosed.

Testing

A preliminary test should be carried out to see that the wiring and detectors are in order. Attach aerial, earth and telephones and put the aerial and crystal plugs in socket 5, the other end of the crystal plug going to the permanent detector. The series condenser plug is left disconnected.

Search for the local station, rotating the variable condenser till signals are picked up. If no signals are heard, or if they are only audible at the lower end of the scale, with no very definite tuning point, move the aerial and crystal plugs further down the coil. It will probably be found that the tuning is quite flat, that is to say,



The method of taking the coil tappings will be clear from this illustration.

AN EXPERIMENTAL CRYSTAL SET—*(Continued)*

that the signals are audible over quite a wide variation of the condenser. Before proceeding, test the catswhisker detector as well as the other.

Improving Selectivity

Having ascertained the aerial tapping which will bring in the local station fairly low down the scale of the tuning condenser, try the effect of altering the crystal tapping. In the set described the best position for the permanent detector was found to be at the centre of the coil, socket 10, the other detector being better suited in socket 11. A very noticeable improvement in signal strength was effected in this way, as compared with the results obtained with the crystal tap in socket 5.

Next bring the series condenser into circuit, trying a value of ·0001 mfd. to start with. Plug the aerial into socket 1 and the series condenser plug into socket 5. Make adjustments as before to get the best signal strength. With this arrangement it will be found that the tuning of the set will be considerably sharpened, especially when the crystal tap is situated well down the coil. For extreme selectivity the crystal tap may be put so far down that signal strength is somewhat reduced. Normally, however, a point will be found at which selectivity is greatly improved, while there is no noticeable decrease in signal strength.

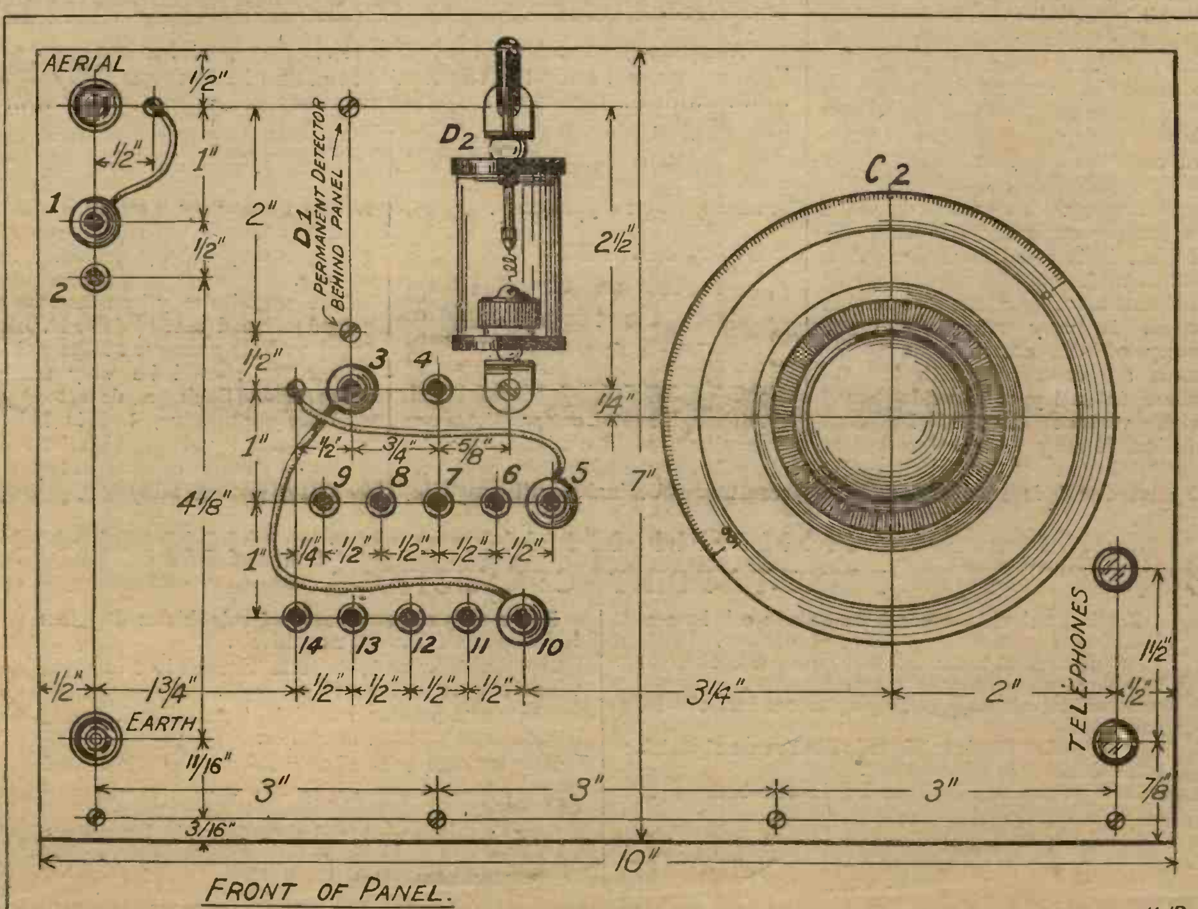
Effect of Loose Coupling

It is interesting to compare the series condenser circuit with the loose-coupled aerial circuit. For this latter leave the series condenser plug disconnected, put the aerial plug in socket 2, and start with the crystal plug in socket 5. Tests of this circuit indicated that there is not much to choose between it and the series condenser circuit, so long as the coupling between L_1 and L_2 is the closest allowed for in the design of the set. By swinging L_2 away from L_1 tuning could be still further sharpened, while signal strength was very little weaker.

The tests of the set by the writer were carried out on an aerial about 90 feet long and 10 to 15 feet high at a distance of little over a mile from the aerial of the London station, to the north of it. In this situation it is of course normally difficult to cut out London; it is in fact possible to hear the programme transmitted with the help of a single valve, no tuning coil and no high-tension, the circuit being otherwise conventional!

Cutting out the Local Station

Under these conditions with the first circuit, with direct coupled aerial and the crystal at the top end of the coil, London was plainly audible over the whole scale of the tuning condenser. A slight improvement was effected by mov



AN EXPERIMENTAL CRYSTAL SET—*(Concluded)*

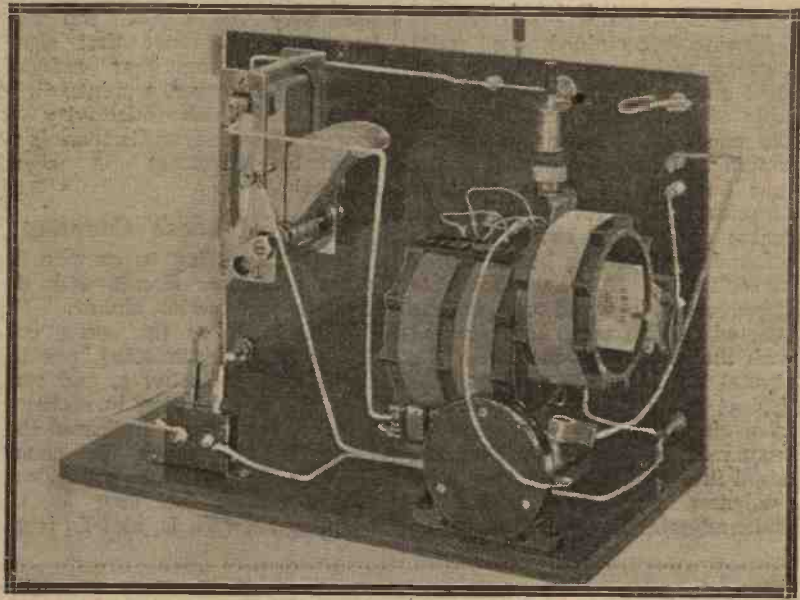
ing the crystal tap down, both in sharper tuning and better signal strength.

The inclusion of the ·0001 mfd. series condenser and adjustment of the crystal tapping made the remarkable difference of narrowing the band over which London could be heard to 2 degrees on either side of the exact tuning point, while signal strength was every bit as good as previously. Incorrect adjustment of the crystal tap flattened the tuning, so that London could be made audible over about 20 degrees of the condenser.

Many Possibilities

With the closest position of the loose-coupled aerial coil, the "audibility band" was 4 degrees, as above. By turning the Unimic coil upwards till its upper edge was about ½ in. above the upper edge of the Dimic coil, this band was further reduced to 2 degrees, that is to say, 1 degree on each side of the tuning point. If the coupling was loosened more than this, the tuning was made slightly sharper, but signal strength was considerably weakened.

Enough has been said to indicate the possibilities of circuits of this kind. The inclusion of several circuits in one set has advantages which will be obvious to the experimenter, one of which is that it is possible with such a set to make rapid comparisons of different arrangements, a provision which is very necessary when many of the comparisons to be made are concerned with the relative intensity of sounds heard with various circuits. In conclusion, it may be mentioned that the title of "An Experimental Crystal Set" is not intended to convey the idea that any special skill is required to construct and operate the set, but rather that anyone who has thoroughly investigated the possibilities of the circuits available may reasonably claim thereafter to be something of an expert on crystal sets.



Another general view of the wiring of panel and baseboard, showing the flexible lead and clip for C1.

Notes on Crystal Contacts.

(From a Correspondent.)

Although metal catswhiskers are generally used in conjunction with the galena-type of crystal, excellent results are obtainable with graphite, silicon, or with another piece of galena.

As the majority of the popular crystals now on the market are of the galena class, experimenters may be glad to know that probably the most sensitive crystal contact of all is that formed by a coarse-grained galena crystal, with a piece of graphite very lightly touching its surface.

The graphite may be taken from a good soft lead pencil (of the B.B.B. type) and its pressure at the point of contact should be very finely adjustable. Such a detector is extremely sensitive, but is liable to be upset by strong signals, and is altogether too critical in adjustment for general adoption.

POINT-TO-POINT CONNECTIONS.

Earth terminal to one end of Unimic coil base and to moving vanes of variable condenser. Moving vanes of variable condenser also to one side of loading coil plug and to lower telephone terminal.

Other side of loading coil plug to one end of Dimic coil base.

Other end of Dimic coil base to fixed vanes of variable condenser and to Clix socket 5.

Both centre terminals of Dimic coil base to Clix socket 10.

Other end of Unimic coil base to Clix socket 2.

Top telephone terminal to top ends of both crystal detectors.

Lower ends of permanent and catswhisker detectors to Clix sockets 3 and 4 respectively.

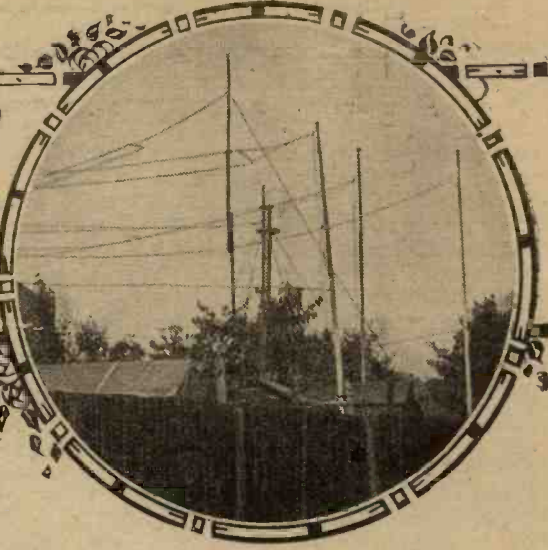
Flex lead from aerial terminal through hole in panel, with Clix plug on the end.

Flex lead from Clix socket 1, terminating in spring clip on multiple-fixed condenser.

Flex lead from terminal "000" of multiple fixed condenser, through hole in panel, terminating in a Clix plug.

Taps on loading-coil end of Dimic coil to Clix sockets 14, 13, 12 and 11 in this order. Taps on other end of Dimic coil to sockets 6, 7, 8 and 9 in this order.

Double or Single Wire Aerials



In this article the important question of aerial design is discussed and the results of some interesting experiments and measurements with different types of aerials are detailed.

By G. R. STANLEY

On many occasions listeners have debated within themselves as to the type of aerial which would best suit their individual circumstances, and judging from the many varieties of aerials which one sees when looking along an average street of houses, opinion upon the subject is not lacking in diversity.

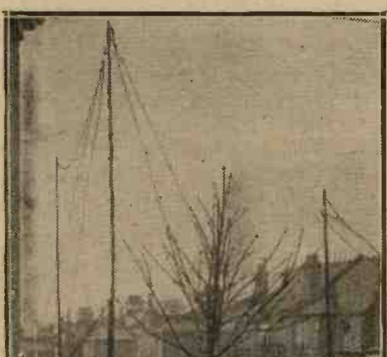
Some Practical Tests

Though all the gardens are approximately the same length, though all the houses are roughly the same height, though the conditions of screening are similar in most cases, some aerials are longer than others, some higher, some made with a single wire, others double, some slope downwards at the far end, others upwards, and some enthusiasts utilise only half or less of their available length.

What can it all mean, and do all these aerials give exactly the same results?

To determine whether or not there was any appreciable difference in the results given by single and double wire aerials of various lengths and heights, it was decided to carry out certain experiments in the Crystal Palace district of London in parts where reception of 2LO is decidedly poor unless a valve set is used.

The aerial which was taken as being suitable for opening the experiment was a single wire arrangement, free of buildings, trees, and other obstacles. The horizontal length at the top was approximately 30 feet, and the height from the ground was 50 feet. With a view to obtaining some definite information as to signal strength this arrangement was connected to a good commercially-made crystal receiver. In series with the telephones was connected a micro-ammeter for actually measuring the rectified current, and after finding the most sensitive spot on the crystal, and after tuning-in, the maximum current obtained was 30 micro-amps. So much for experiment No. 1.



A high aerial of the single "L" type erected in a South London garden.

The second aerial which was tried was the same height and length as the first, but two wires were used, separated from each other by means of six-foot spreaders. The receiving apparatus was in this and in all other cases referred to, exactly the same as that used for the first experiment, the same earth and so on also being used.

In the case of the second aerial, the maximum rectified current obtained was 32 micro-amps, a slight increase on the previous measurement but not enough to make any audible difference in the phones. An interesting fact which came to light in comparing the results of these two arrangements was that whereas in neither case was tuning very sharp, tuning was, nevertheless, much more critical with the single wire aerial than with the double, indicating that the single wire was the more selective without any appreciable difference in signal strength.

Height and Selectivity

It was next decided to reverse the arrangement of these aerials, that is to say, to make the horizontal top 50 feet and the height 30 feet, but the results indicated poor selectivity in both cases in that morse interference from ships working on 600 metres at Gravesend was experienced even when the set was tuned at 2LO; the double wire aerial being particularly poor from this point of view. The rectified current obtained in the case of these two aerials was a little lower than with the previous arrangements, 28 micro-amps being obtained with the single wire and 29 micro-amps with the double wire.

An aerial with a horizontal top of 40 feet and a height of 60 feet was next erected, thereby using the full 100 feet of wire available

DOUBLE OR SINGLE WIRE AERIALS—*(Concluded)*

in a single wire aerial. The rectified current rose to 38 micro-amps and tuning was relatively sharp for a direct coupled crystal receiver, of the type used for all the tests.

A double wire of these dimensions was next erected, the two wires again being separated by six-foot spreaders, when a rectified current of 43 micro-amps was obtained, but the selective properties of the single wire arrangement has gone, morse interference being distinctly audible.

The Best Aerial

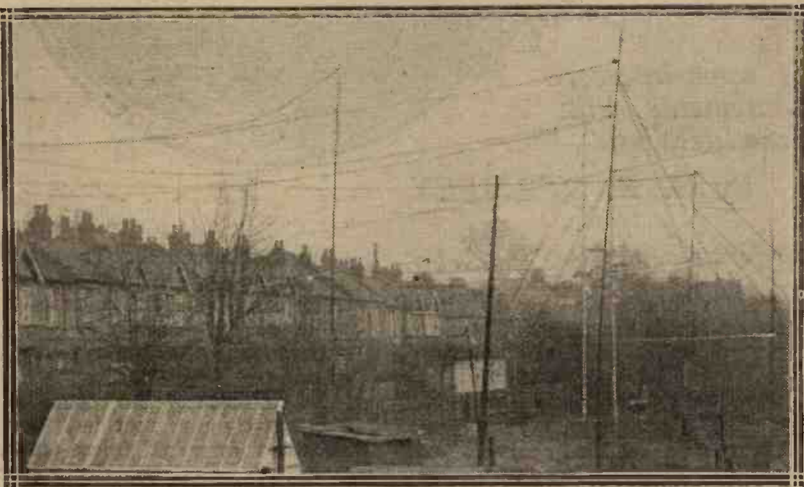
The horizontal top of the double aerial was reduced five feet at a time until the interference was eliminated, and it was not until 20 feet had been cut away from each arm that reception was free from interference. The various readings for the different lengths of horizontal top were as follows :—35 feet = 41 micro-amps; 30 feet = 39 micro-amps; 25 feet = 36 micro-amps; 20 feet = 32 micro-amps.

One of these two wires was next taken down, leaving therefore a single wire aerial 60 feet high with a 20 feet horizontal top, which arrangement permitted a rectified current of 31 micro-amps to be obtained.

So far, the best results in so far as signal strength and selectivity together are concerned, are shown by a single wire aerial 60 feet high with a 40 foot horizontal top, the current being 38 micro-amps. On the other hand, a double wire aerial of these same dimensions gave a reading of 43 micro-amps; an increase in signal strength, but with a decrease in selectivity.

In an endeavour to bring about a compromise of these two results it was decided to retain a single wire arrangement as being the more selective, but to increase its height to 70 feet, at the same time reducing the horizontal top to 30 feet, and the arrangement gave a measured reading of 47 micro-amps, still retaining its selective properties.

Increasing the length of the horizontal top was next tried, and though the selective properties were quickly lost, no appreciable increase in the rectified current was obtained. It may be gathered from this that by increasing the height of the aerial, either by itself, or in conjunction with the horizontal top, larger rectified currents *may* have been obtained, but unfortunately it was not possible to erect an aerial higher than 70 feet and the experiments were then concluded.



The problem of erecting an efficient aerial in some of the suburbs of large towns is well illustrated in this photograph. Most of the aerials shown are far too long and would give better results if considerably shortened.

The Importance of Height

In order to show these different results in a form in which they can be visualised as a whole, and compared with one another, a table has been prepared showing the various readings. This is reproduced below, and it shows very clearly that the shape and type of aerial has an enormous effect upon the strength of the received signal.

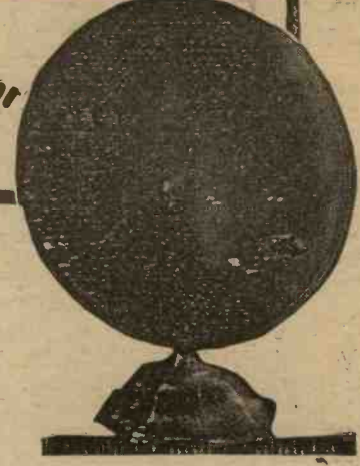
The worst aerial of all—30 feet in height and having a 50 ft. top—gave only a little more than half the current obtained with the best aerial. Even although the reader may be unable to erect an aerial similar to the last one shown in the table, they will be able to judge the comparative efficiency of the different types.

The results were obtained with good local conditions so far as the immediate neighbourhood was concerned, and though in individual cases the results may prove to be somewhat different on account of neighbouring buildings and so on, it would appear to be fairly safe to assume from these results that a single wire aerial with as much vertical height as possible and a relatively short horizontal top is superior as to results than a double aerial of the same dimensions, or to a single wire with a long horizontal top.

SUMMARY OF RESULTS.

Aerial. Height.	Aerial. Length.	Type.	Rectified Current in Micro-amps.	General Observation.
50 feet ..	30 feet ..	Single Wire L...	30	—
50 ,, ..	30 ,, ..	Double ,, ,, ..	32	Non-selective.
30 ,, ..	50 ,, ..	Single ,, ,, ..	28	Non-selective.
30 ,, ..	50 ,, ..	Double ,, ,, ..	29	Very non-selec-
60 ,, ..	40 ,, ..	Single ,, ,, ..	38	— [tive.
60 ,, ..	40 ,, ..	Double ,, ,, ..	43	Non-selective.
60 ,, ..	35 ,, ..	,, ,, ,, ..	41	Non-selective.
60 ,, ..	30 ,, ..	,, ,, ,, ..	39	Non-selective.
60 ,, ..	25 ,, ..	,, ,, ,, ..	36	—
60 ,, ..	20 ,, ..	,, ,, ,, ..	32	—
60 ,, ..	20 ,, ..	Single ,, ..	31	—
70 ,, ..	30 ,, ..	,, ,, ,, ..	47	—

Getting the best from a "Cone"



By *A. JOHNSON-RANDALL.*

THE popular "cone" type of loud-speaker properly handled is one of the best aids to faithful reproduction that the up-to-date broadcast listener can possess.

To obtain a proof of its increasing popularity one has only to examine the advertisements in any technical journal, when generally an announcement introducing yet another type of "cone" will be noticed. In addition to this, numerous broadcasting stations in Europe and in the United States of America employ "cones" in their control rooms in order to check quality.

totally unsuitable for the reproduction of the wide band of frequencies with which a well-designed "cone" is able to deal.

For some months past I have been trying various circuit arrangements and adjustments with a view to obtaining the most pleasing and natural reproduction from the local main station, the standard of strength being taken as that adequate for a room 15 feet square; in other words, full-room strength.

Responding to the Low Notes

My investigations have mostly been conducted with two "cones," each employing the popular balanced armature movement.

Since this principle has been adopted by a number of makers, a few words regarding the operation will not be out of place.

A large permanent magnet has balanced between its pole pieces a light armature, which is placed so that there is no constant pull due to the permanent magnet.

To one side of the armature is attached a short stiff rod, the other end of which is rigidly fixed to a flexible metal strip. A little way along this strip is soldered a straight rod which passes through the cone at its apex and is held tightly with the aid of a collar and thumb screw.

The operation is quite simple. The signal impulses in the output circuit cause the armature to vibrate. These vibrations are imparted *via* the short rod and flexible strip to the "driving rod" and then to the cone itself.

Now, a "cone" has one great advantage, and that is it is capable of responding to the lower musical frequencies; but if these frequencies are actually to be reproduced they must be present in the output circuit of the receiver.

The first step, then, is to make quite sure that your receiving apparatus is delivering undistorted signal energy.

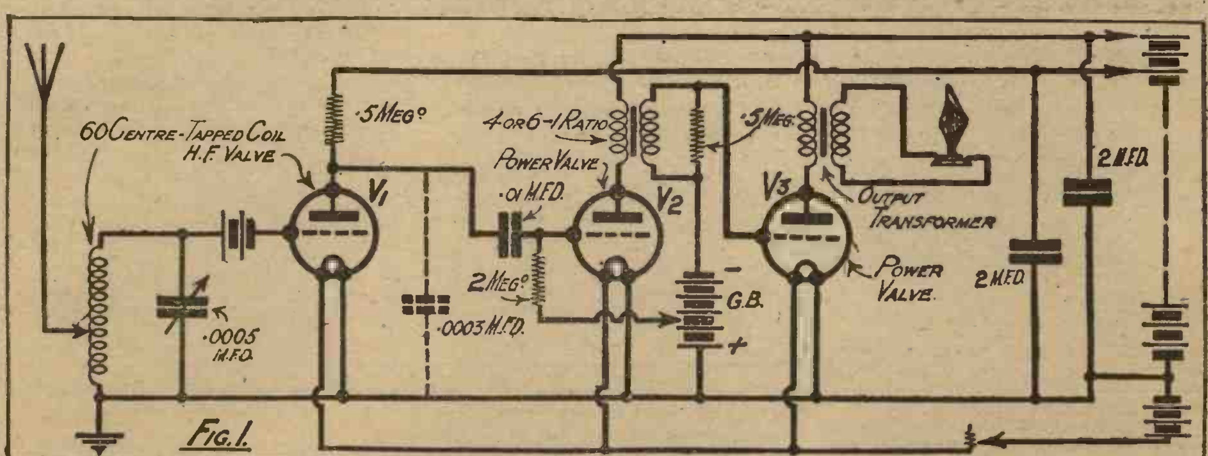


Fig. 1.

From conversations with owners of cone loud-speakers, and from correspondence received, I have come to the conclusion that many purchasers are not by any means getting the best possible results.

The Standard of Strength

The reasons for this are in all probability due: First, to the fact that the average "cone" is a somewhat fragile piece of apparatus and is, in consequence, easily damaged by inconsiderate handling.

Secondly, that the instruments are employed in cases where the output from the receiver is

H.F. Distortion

If the set employs some form of high-frequency amplification, distortion may be produced by excessive reaction, and by inherent instability. Assuming the receiving apparatus to be of modern type, it is probable that one of the many forms of neutralised coupling will be incorporated.

GETTING THE BEST FROM A "CONE"—(Continued)

For good reproduction it is absolutely essential that the neutralisation shall be complete, otherwise there will be a tendency towards self-oscillation. Such a tendency is, of course, equivalent to an excessive reaction effect.

Anode Bend Rectification

In the same way the actual reaction control, whether it be magnetic or capacitative, should be kept as near the minimum setting as possible. A set which requires a large amount of reaction in order to obtain sufficient signal strength is not suitable for loud-speaker work. The remedy is to add another stable high - frequency valve.

Turning now to the detector, two alternative methods are possible. The first makes use of a grid condenser and leak. The other is known as anode bend rectification. This latter method is shown in Figs. 1 and 2, and of the two gives the purer reproduction. In a reaction circuit, however, oscillation control becomes rather "tricky," so I personally prefer the grid condenser and leak in any arrangement utilising some form of reaction.

I like to keep the value of the grid condenser as low as possible, say in the neighbourhood of ·0001, and I use a leak of about ·25 megohm. The bottom end of this resistance I prefer to connect to a separate tapped grid battery or to the sliding contact of a potentiometer. By taking negative tappings one can obtain the purity of the anode bend method.

If, however, an anode bend rectifier is used in series with the primary of a transformer-coupled low-frequency stage great care must be taken in the choice of a detector valve. With a grid condenser and leak, with the bottom end of the leak taken to some positive value, a high-impedance type of valve, will give excellent quality, within the limits of this method of rectification, provided the transformer primary has an inductance in the neighbourhood of 50 henries.

If anode bend rectification is employed, the impedance of a valve of this type may become as high as 100,000 ohms. Therefore, in order to obtain good quality, it is essential to use a low-impedance valve. For this reason I prefer to use a resistance in series with the anode of the detector valve, utilising a transformer-coupled stage later.

The Best Form of Coupling

When more than one stage of transformer coupling is used, the uniform amplification of all frequencies becomes an exceedingly difficult problem, and one that can only be tackled successfully by experts. I always advise home constructors who desire the very best reproduction to employ a combination of resistance-capacity and transformer coupling, or alternatively straight resistance-capacity amplification throughout. These remarks apply to every type of loud-speaker.

With the "cone" type in particular it is essential to use a method of low - frequency magnification which ensures that the lower musical frequencies are being reproduced, otherwise the special advantages of the "cone" will not be realised.

Two Excellent Circuits

There are two circuits which I have found to give excellent results. These are shown in Figs. 1 and 2. Fig. 1 shows a combination of transformer and resistance coupling. V_1 is an anode rectifier, an anode resistance of ·5 meg., being connected in the anode circuit of this valve. A tapped grid battery giving values of 1·5–3 and 4·5 volts should be joined, as shown in the first grid circuit.

The other valves may be as marked. V_2 can be a power valve of from 6,000-8,000 ohms impedance, and the low-frequency transformer may have a high-ratio provided it is of good make. With a valve of the 8,000 ohm impedance type, I would prefer the 4 : 1 ratio.

A resistance of about ·5 megohm across the secondary will tend to improve quality, but at the expense of amplification. If the "cone" has a low-resistance winding, and it is desired to use it in conjunction with valves of various impedance values in the last stage, an output

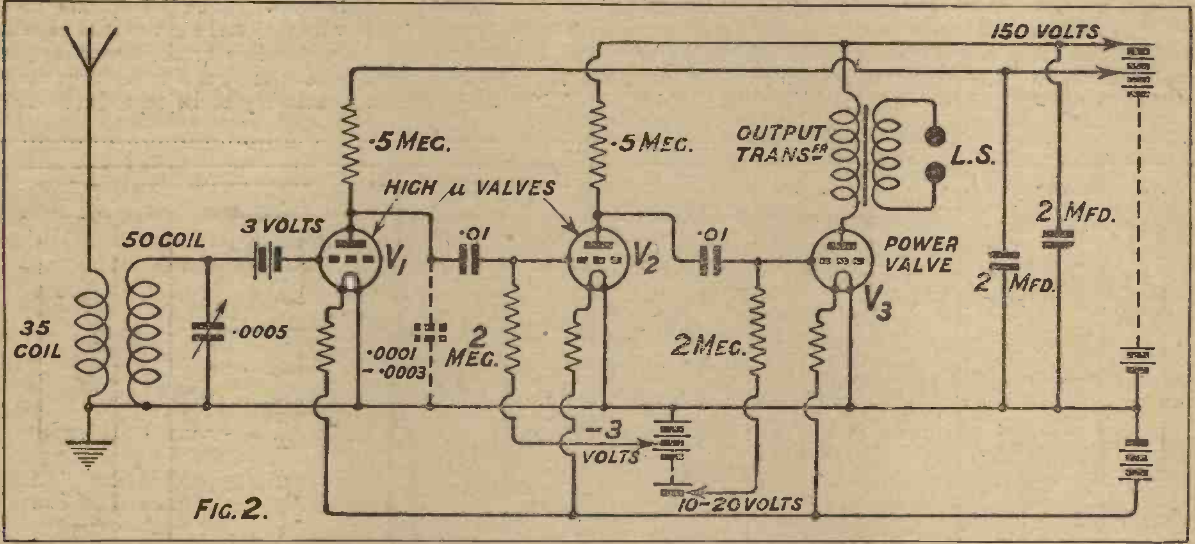


FIG. 2.

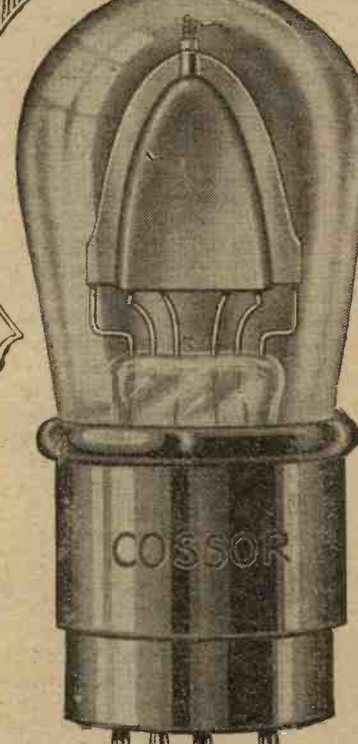
No more "lost" Chords

Cossor Valves — with the wonderful new Kalenised Filament—bring you the superb technique of the living Artiste

YEAR by year the barriers to perfect Radio reproduction are being broken down. No longer can it be said that Broadcasting suffers from mechanical limitations. With the vast improvement in the design of Loud Speakers and the development of choke or resistance capacity amplification, Radio enters upon a new phase. Every note in the harmonic scale can now be reproduced with the living naturalness of the concert hall or the studio. There are no more 'lost' chords.

But this method of amplification demands a valve specially designed for the purpose—the wonderful new Cossor 2-volt R.C. This new valve has an exceptionally high amplification factor of 40—higher than any other valve of similar type. Due to the prolific emission from its Kalenised filament it will give a richness of tone such as you have never heard before. From the deep fascinating rhythm of the lower octaves of the organ to the surprisingly sweet high notes of the violin. Every note is there, none is missing.

If your Receiving Set utilises the choke or resistance coupling method, use this superb new Cossor R.C. Valve at once—and hear Radio with a charming freshness and vitality which must amaze you.



The new Cossor 2-volt R.C.

Consuming ·1 amp at 1·8 volts Impedence 70,000 ohms. Amplication factor 40 **14/-**

Other Cossor Valves

For 2-volt Accumulators

210H.F. (Red Band) H.F. use	14/-
210D (Black Band) Detector	14/-
215P (Stentor Two) Power Valve	18/6

For 4-volt Accumulators

410HD (Red Band) for H.F. or Detector	14/-
410RC (Blue Band) For Resistance or Choke Coupling	14/-
410P (Stentor Four) Power Valve	18/6

For 6-volt Accumulators

610P (Stentor Six) Power Valve	22/6

N.B. All above valves consume ·1 amp. except the 215P which consumes ·15 amp.

Cossor

— the valve which serves you longest

A. C. Cossor, Ltd. Highbury Grove, London, N. 5.

Gilbert Ad. 7906

GETTING THE BEST FROM A "CONE"—(Concluded)

transformer is desirable. For the Western Electric "Kone" a transformer with an output impedance of 2,000 ohms should be employed.

If it is preferred to place the loud-speaker winding directly in series with the valve, then a really low-impedance valve should be chosen —5,000–6,000 ohms is the maximum allowable value. I have personally obtained excellent results with a valve of the Cosmos 55/R type, which has an impedance of approximately 3,500 ohms, and with one or two of the super power valves.

Reducing Anode Current

With super power valves, however, I usually keep the anode voltage down to about 100 volts, and in addition use a high value of negative bias in order to reduce anode current.

Fig. 2 shows a straight resistance capacity coupled circuit. The volume obtained is slightly less than with the Fig. 1 arrangement; but of the two I prefer the second circuit. In practice it is almost possible to overload a "cone" loud-speaker with this circuit at a distance of 15 miles from 2LO, using a good outdoor aerial. For greater distances a stable high frequency stage can be added.

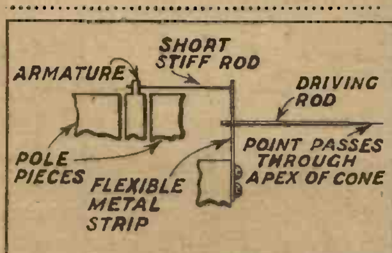
The following valves have been tried and found satisfactory in both these arrangements:—

V_1.—Cosmos Blue Spot, D.E.5b, S.T.61, Burndept H.512, D.F.A.4.

V_2 in Fig. 1.—Any good small power valve (not super-power valve).

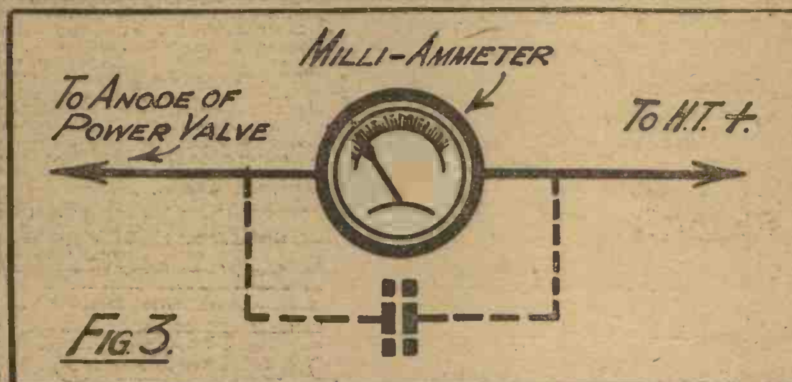
V_2 in Fig. 2.—Cosmos Blue Spot, D.E.5b, S.T.61, H.512, D.F.A.4, or any equivalent type.

Before passing the energy output from the set as being O.K., it is a good plan to insert a milliammeter in the anode circuit of the last valve, if such an instrument is available. Fig. 3 shows how the meter may be joined in circuit.



How the "Cone" works.

A milliammeter will indicate two sources of distortion, due to the valve. If the needle "kicks back" in the case of a resistance amplifier, grid choking is occurring, and the remedy is to increase the grid bias until these "back swings" stop. If the needle gives sharp kicks over to the right, distortion is liable to occur through "blasting," i.e., over-running the straight portion of the valve characteristic, and coming on the bends. Increasing or decreasing the grid bias may be necessary, or, alternatively, cutting down the input by means of a volume control or detuning the H.F. circuit. The object should be to keep the needle absolutely steady.



The connections for a milliammeter, to show whether grid-choking or "blasting" occurs.

Adjusting the Cone

If, after taking all the necessary precautions in the amplifier circuit, the results are still unsatisfactory, it is probable that the "cone" itself is not correctly adjusted.

As already explained, there are two thin rods in the case of a balanced armature movement. Both of these rods must be quite straight. It is a simple matter to examine the movement.

The rear portion of most "cones" incorporates a round inspection cover which is held in position by means of five or six screws. Upon detaching this cover, four large screws which secure the movement to the frame will be observed. Release the locking screw, the apex of the "cone" itself, so as to free the needle, and then withdraw the whole movement by removing the four large securing screws. The two rods can then be examined, and if necessary straightened.

Now replace the unit, carefully slipping the driving rod through the metal sleeve at the apex of the "cone," to prevent straining. Place the "cone" in a position with the apex downwards, in order to keep the weight of the unit off the driving rod until the screws are tightened up.

Switch on the set and adjust the position of the movement until (with the locking screw at the apex unscrewed) only a "dither" is obtained on speech or music.

This is the test which indicates when the driving rod is correctly centred.

The movement can then be secured into position, and the locking screw tightened.

With the paper cone type of loud-speaker, many of the annoying "dithers" and "rattles" are produced simply by the fact that a washer or nut on the cone frame is slightly loose.

I improved one of my own cones on certain musical notes by stretching a thin rubber tube over the driving rod.

The Cure for "Dithering"

If the needle presses against the side of the metal collar at the apex the balanced armature may be pushed nearer to one magnet pole and a "dither" may result on loud signals.

This should not occur with the driving rod correctly centred. Another point to bear in mind is the expansion and contraction of the paper cone, due to atmospheric changes. Shrinkage of paper may quite conceivably strain the driving rod. The remedy is to release the locking screws occasionally.

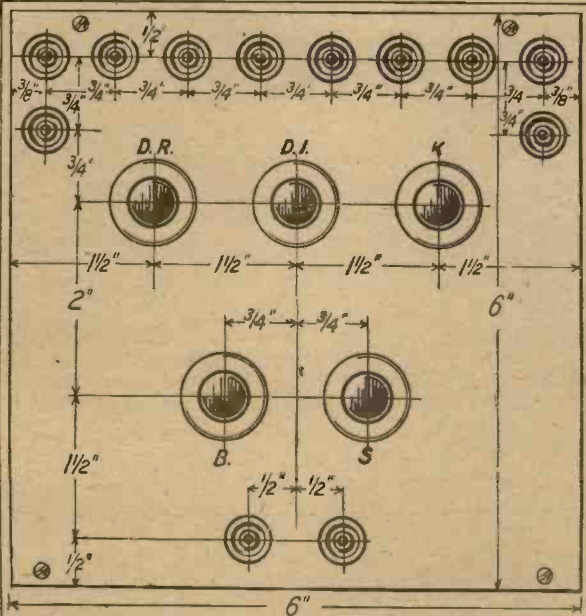
A LOUD-SPEAKER SWITCHBOARD

Some Useful Instructions :: for :: Constructors

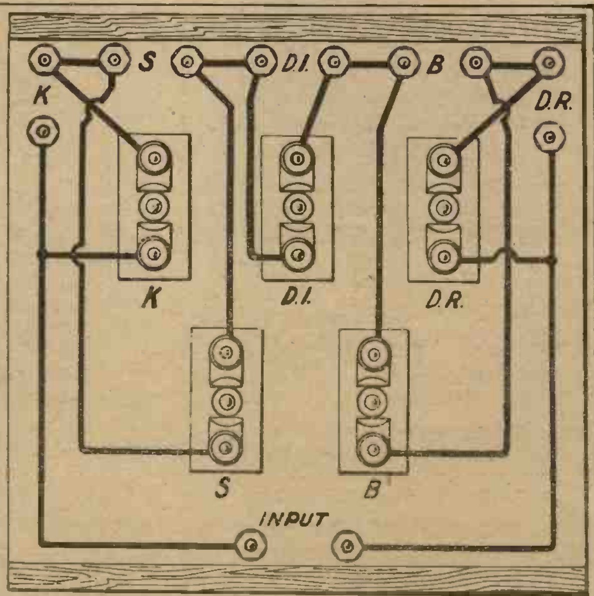
The complete Loudspeaker Switchboard, ready for mounting upon the wall. The device controls five loudspeaker extension leads any one or more of which can be switched in or out of circuit.

WHEN a house is more or less completely "wired up for wireless" and loudspeaker extension leads run to at least five rooms from one central point where the receiver itself is situated, it is very useful to have some form of control switchboard. If this is carefully designed it can be sufficiently simple to allow anyone to operate it. The one we are going to describe in this short article is simple in general design, easy to make and perfectly straightforward in operation.

The original model is mounted on the wall of the wireless "den" close to the set. This latter is provided with a simple "On-off" switch so that when any members of the household require music



PANEL LAYOUT



WIRING DIAGRAM

THE THRILL OF DISTANCE MEANS MORE THAN GOOD PARTS—IT MEANS LISSEN PARTS

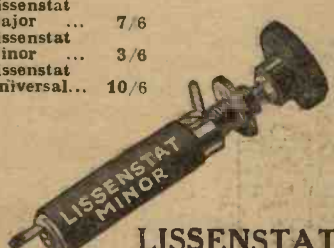
By using the right parts you can take care of the energy picked up by your aerial—you cannot afford to lose any of this minute energy—guard it against loss at every point of the path along which it travels—only too easily will it leak away—the thrill of distance means more than good parts—IT MEANS LISSEN PARTS.

MAKE YOUR TUNING RAZOR SHARP.

With LISSENSTAT control your valve is made sensitive to a touch—responsive to every fractional turn of a knob. Electronic emission—that vital force in the correct working of a valve—is accurately controlled. You open the way to fine detection—signals from farther away are brought in stronger, sharper than ever before—THROUGH A BACKGROUND OF DEAD SILENCE.

SOLD IN THREE MODELS :

Lissenstat Major ...	7/6
Lissenstat Minor ...	3/6
Lissenstat Universal...	10/6



LISSENSTAT

LISSEN, Ltd.
20-24, Friars Lane,
RICHMOND, SURREY.
Managing Director—
THOMAS N. COLE.

LISSENSTAT

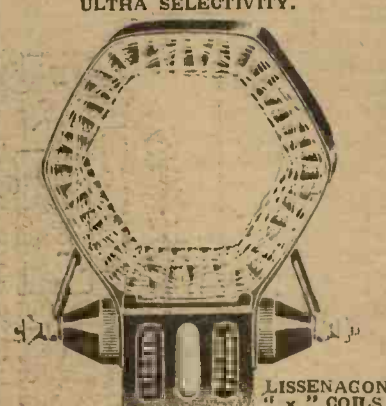
COILS THAT CATCH SIGNALS

Some coils may be good enough for right-on-top-of-you stations, but hopelessly inadequate for distant ones. For sensitive work your coils must pick up minute energy . . . and not waste it. Put a micro-ammeter in series with the telephones of a crystal set—test your usual coils one by one—watch the delicate needle flickering as each coil passed on—then note the greater deflection of the needle when you put on LISSENAGON coils, indicating greater signal strength and PRONOUNCED SUITABILITY FOR SENSITIVE WORK.
LISSENAGON Coils are the Coils which intensify tuning.
They are interchangeable with other coils of the same number—but THEY ARE MUCH MORE SENSITIVE THAN ANY.

LISSENAGON COILS.

No.	Old.	New.
25-40	4/10	3/3
50-75	5/4	3/6
100	6/9	4/-
150	7/7	4/3
200	8/5	5/-
250	8/9	5/6
300	9/2	5/9

ULTRA SELECTIVITY.



LISSENAGON " x " COILS.

No.	Old.	New.
50 x	6/-	6/-
60 x	6/4	6/4
75 x	6/4	6/4
250 x	9/9	9/9

There are also LISSENAGON " x " Coils—a series introduced where very fine tuning is desired. When stations three metres apart have to be separated you can do it with the appropriate LISSENAGON " x " type.

This is the complete

LISSENOLA LOUD-SPEAKER

Price

34/-

The LISSENOLA Loud Speaking Unit (13/6 separate) is inside the LISSENOLA Stand.

Or you can buy the three component parts for it as and when you wish. Here are the Horn and Stand.

LISSENOLA UPRIGHT HORN

Big and powerful, with 14 in. flare only. The LISSENOLA Loud Speaking Unit, with this new upright horn and new stand, is the only British made Loud Speaker of FULL POWER SIZE AND ACTUAL FULL POWER PERFORMANCE of high-grade manufacture selling to-day, complete for 34/-. Price of LISSENOLA Upright Horn, 14 in. flare, 17/6.

LISSENOLA STAND

For those who have already made an upright horn themselves from the full-size patterns and clear instructions enclosed with each LISSENOLA Unit, or who, having the LISSENOLA Unit, desire to buy the LISSENOLA Upright Horn. Price 3/-.

BUILD WITH ALL LISSEN PARTS—

and your receiver will yield clearer and louder signals than ever you can get with parts of assorted make, because every LISSEN part will pull strongly with the other.

L.260

WHEREVER RADIO PARTS ARE WANTED—USE LISSEN—

NO matter what may be mentioned or used in any circuit of any booklet or periodical you may be building from, remember that the best parts have not necessarily been used. There are many advertising manufacturers—all expect a share in the use and mention of their products, and they usually get it. LISSEN gets a share, too, but obviously it is not possible for the periodical to use all one maker's parts, although they may be known to be the best. Remind yourself of that when building—remember, too, that the best parts are LISSEN, and that if you build with them you will use all the energy available, and get louder, clearer signals from near and far in consequence.

FACTS OF IMPORTANCE ABOUT LISSEN PARTS—

LISSEN FIXED CONDENSERS.

Fixed condensers should be leak-proof, and if they are LISSEN which DELIVER *ALL* THEIR STORED-UP ENERGY *ALL* THE TIME, nothing is lost. Note the case in the LISSEN condenser, how it can be clipped into the LISSEN COMBINATOR in resistance circuits, how it can easily be used upright or flat. Then the price of LISSEN FIXED CONDENSERS is half what it was a year ago. The plates are properly laid in a LISSEN—they are homogeneous with each other, and cannot move or come apart.

Capacities .0001 to .001, 1/- each (much reduced).
Capacities .002 to .006, 1/6 each (much reduced).
DEMAND LISSEN FIXED CONDENSERS.

Lissen Valve Holder.

Has both low losses and also low capacity, twin virtues found in few valve holders. Sent out ready for baseboard mounting, but can also be used for panel mounting by bending springs straight.
Patented, previously 1/8, NOW 1/- each.

HOW TO MAKE H.T. BATTERIES LAST LONGER.

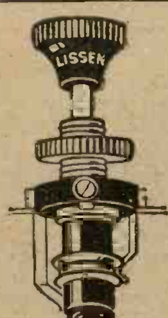
Every ordinary H.T. battery can be made to yield more energy if a LISSEN 2 mfd. (or 1 mfd., but the larger capacity is the better) is put across it. It will absorb all the noises when the battery gets old. Your dealer will be pleased to show you how to connect it easily.

LISSEN (Mansbridge type) Condenser 2 mfd. 4/8; 1 mfd. 3/10.

.01	2/4	.1	2/6
.025	2/4	.25	3/-
.05	2/4	.5	3/4

Specially moulded case makes it impossible for the condenser to short circuit on to case—a feature exclusive to LISSEN.

LISSEN SWITCHES



LISSEN 2-way switch.

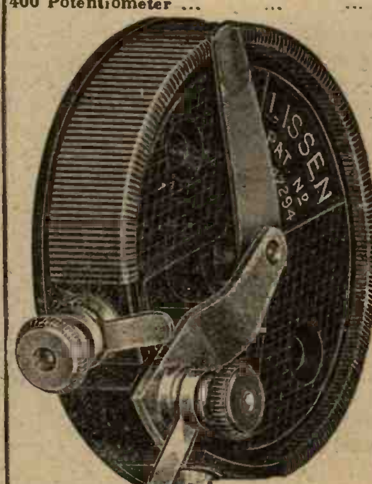
There is one for every switching need in radio. Designed for radio work where currents are small—they will not waste current. They fit easily—take up little room. LISSEN ONE HOLE FIXING, OF COURSE.

	Previously.	NOW.
LISSEN 2-way	2/9	1/6
LISSEN Series-parallel	3/9	2/6
LISSEN Double Pole Double Throw	4/-	2/6
LISSEN Key Switch	2/6	1/6

BASEBOARD RHEOSTATS Reduced from 2/6 to 1/6

To popularise baseboard mounting resistors, LISSEN has now just reduced the price. Baseboard type are without knob, dial and pointer, which are not needed for baseboard.

	Previously.	From Jan. 24.
Prices 7 ohms	2/6	1/6
35 ohms	2/6	1/6
400 Potentiometer	2/6	1/6



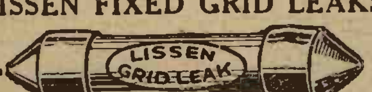
Quality Rheostats for Panel Mounting previously 4/- NOW 2/6

LISSEN quality—look how they are made, and note the irresistible appeal of price.

	Previously.	NOW
LISSEN 7 ohms, patented	4/-	2/6
LISSEN 35 ohms, patented	4/-	2/6
LISSEN DUAL, patented	6/-	4/6
LISSEN Potentiometer, patented	4/6	2/6

LISSEN ONE HOLE FIXING, OF COURSE.

LISSEN FIXED GRID LEAKS.

1/-  1/-

They do not alter—they are perfectly silent. You can put a LISSEN half-megohm leak in circuit direct on to a 220 volt supply and leave it on indefinitely—it will not alter. It can then be put straight into a critical radio circuit—it will be absolutely silent. LISSEN grid leaks have been further tested by exposure to rain and sun on the roof of the LISSEN factory. They never altered, never varied. Patented.

All resistances—Previously 1/8, NOW 1/- each.

USE ANY CIRCUIT BUT ONLY LISSEN PARTS, NO MATTER WHAT ELSE MAY BE NAMED, and you will gain in volume and eliminate distortion. LISSEN PARTS—WELL THOUGHT OUT, THEN WELL MADE.

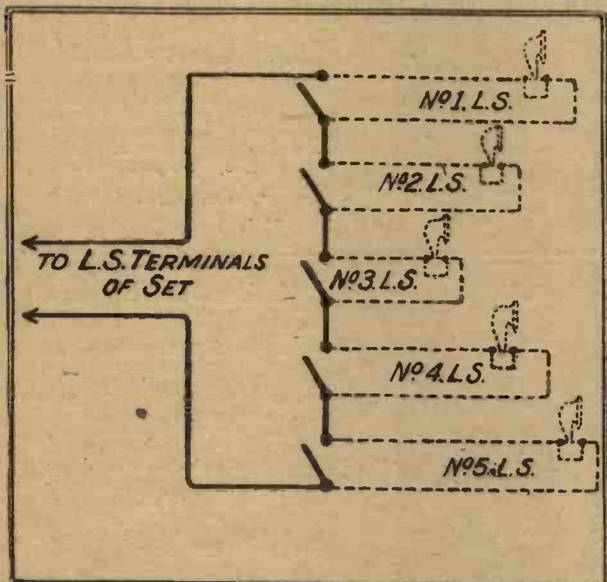
LISSEN LIMITED, 20-24, FRIARS LANE, RICHMOND, SURREY.

Managing Director: THOMAS N. COLE. L. 259.

A LOUDSPEAKER-SWITCHBOARD—(Continued)

they merely switch on the set and press in the switch knobs on the small switchboard, corresponding with the rooms in which they require to hear the transmission. Each room has its own loudspeaker telephone receiving on those occasions when it is desired to make adjustments by this means. Another pair can be used to connect up experimental loudspeakers, and so on.

A choke-condenser bypass will be used in the receiver (this or a transformer is a necessity when long extension leads are used), so that placing all the loudspeakers in series is quite an efficient practice. It is more than this from a practical point of view when several pairs of leads are in use, for were they all in parallel, a short in one would cause the whole lot to be shorted out of action. With the series system any defective pair can be shorted without affecting any of the others.



The system is simplicity itself, as the first and theoretical diagram shows. As will be seen, all five pairs of "output" terminals are in series with those two to which are connected the loudspeaker leads running from the set itself. Five push-pull switches are employed, one directly across each of the five extension lead terminals. Those leads which it is not desired to use are merely "shorted out" by pulling out the appropriate switches.

Simple Wiring

Twelve ordinary terminals, five push-pull switches and a small ebonite panel, measuring 6 in. by 6 in., are all that is required. The panel should be drilled in accordance with the panel drilling diagram that is supplied, or the layout can be varied to suit individual requirements.

The wiring is simplicity itself as the wiring diagram and the under-panel photograph clearly show.

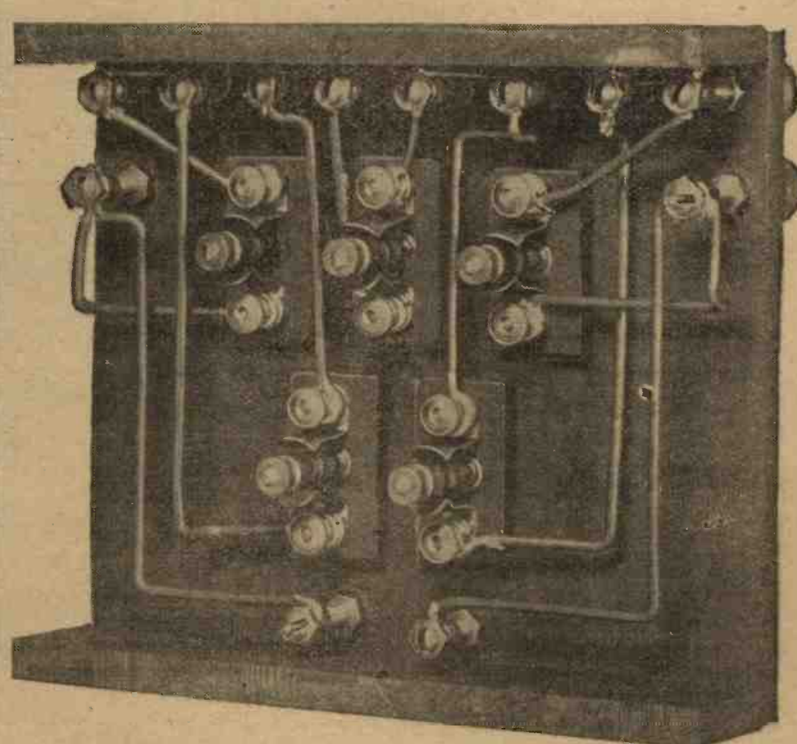
(*Concluded on page 290*).

permanently connected. In addition, each room has a remote control switch and a loudspeaker shorting switch, and although the possibilities of such a combination are obviously immense we fear that few amateurs would take the trouble to instal such a system. In any case, where so many wires are involved it is as well to have them "built" into the walls by the builders when decorations are carried out.

Controlling the Extensions

However, a simple extension control switch can be made and installed by anyone who has two or more pairs of extension leads in use. The switch we are going to describe is capable of dealing with five pairs of leads which can serve five rooms. In the one specific instance these are — drawing-room, dining-room, kitchen (ground floor), bedroom, and study, and the panel is lettered accordingly. But even although it is thought that at most only two or three extensions will be required, it is advisable to provide for at least five against the even remote possibility of future elaborations.

In addition, one pair of "output" terminals can serve for



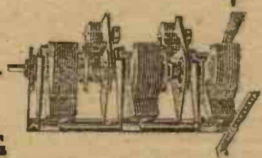
The very simple nature of the connections is clearly shown by this back-of-panel photograph.

IGRANIC
Triple Honeycomb
INDUCTANCE COILS
are made in 17 sizes and cover all wavelengths from 100 to 25,000 metres.
The prices are very low, the smallest sizes are only 2/9 each.

Igranic "NONMIC"
(Anti-microphonic)
Valve Holders
3/- each.

Igranic-Pacent
Porcelain Rheostats
6, 10, 20, 30 & 50 ohms, 2/6 each.

IGRANIC
Centre Tapped
"XLLOS" COILS
Specially suitable for Neutrodyne circuits. Five sizes for wavelengths of 110 to 3,350 metres.
Prices from 7/- each.



IGRANIC
GANG CONDENSERS
Fitted with special balancing devices for equalising the tuned circuits.

Twin Gang	...	£2 10 0
Triple Gang	...	£3 15 0

IGRANIC
PRESET RESISTOR
(Fixed-variable.)
Maximum resistances of 6, 10, 20, 30 and 50 ohms. Variable over whole range.
Price 1/8 each.

To build A GOOD RECEIVING SET you must use GOOD COMPONENTS

RADIO IGRANIC DEVICES

IGRANIC
Variable Condensers
Low Loss Sq. Law.

.00015 mfd.	... ...	17/-
.0003 ,,	... ...	18/6
.0005 ,,	... ...	21/6
.001 ,,	... ...	25/-

IGRANIC
"Indigraph" Vernier Knob and Dial.
Price 7/6

IGRANIC
"E" Type
Low Frequency Transformers
for full volume and outstanding purity of tone.
Ratio 1 : 5 ... 16/-
,, 1 : 3 ... 15/-

YOU WILL RECEIVE A DESCRIPTIVE IGRANIC CATALOGUE IF YOU WRITE, GIVING REFERENCE "DEVICES," TO—

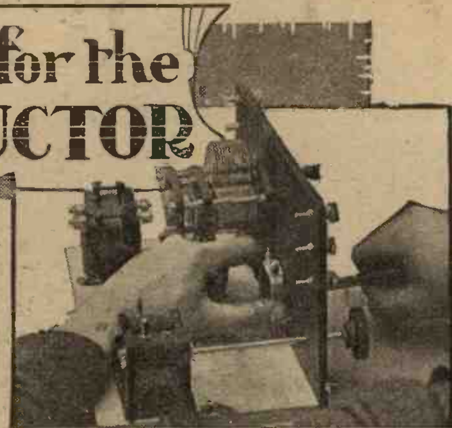
IGRANIC ELECTRIC Co., Ltd.

149, Queen Victoria Street, LONDON.
Works: Elstow Road, BEDFORD.

IGRANIC
FIXED CONDENSERS and FIXED GRID LEAKS
Fixed Condensers.

.0001 to .002	...	1/6 ea.
.003 to .006	...	2/- ea.
Fixed Grid Leaks		2/3 ea.

NOTES for the CONSTRUCTOR



Testing Fixed Condensers.

ALTHOUGH the cheaper fixed condensers on sale to-day are infinitely more reliable than those on the market a year or two ago, poor specimens are not altogether unknown. Even with condensers of reliable manufacture, too, defects may be caused by careless handling in transit, or in the shop.

For this reason it is a good plan to test all fixed condensers before they are built into a set, particularly those which may cause serious trouble if their shortcomings are not detected. A leaky grid condenser in the grid circuit, for example, will make all the difference between good reception and bad reception, and a faulty condenser across the High Tension Battery may prove very expensive.

An Insulation Indicator

A simple test will suffice to prove that the insulation of a condenser is good. Put the condenser across the H.T. battery for a second, remove it and let it stand for a few moments then apply the ends of a pair of phones to the terminals of the condenser two or three times in succession. The ends of the phones should not be held in the fingers when the test is made, and the terminals of the condenser should not be touched by the hand. If the condenser is perfect, a distinct click will be heard when the phones are first connected across the condenser, and nothing will be heard thereafter. The loudness of the click will vary, of course, with the capacity of the condenser, but if nothing at all is heard, even with a ·0001 condenser, the condenser is imperfect.

Checking Capacity

Small condensers may be roughly tested as regards capacity, if there is any reason for doubting their marking, by inserting them in parallel or in series with the tuned circuit, noting the difference made in the reading of the variable condenser (or variometer) in the circuit, and comparing this with the difference made by another fixed condenser or variable condenser of known capacity. The values of condensers of larger capacity (*e.g.*, ·005 or ·01) may be estimated, if one has a fairly accurate ear, by placing them across the loud-speaker and noting the effect upon tone.

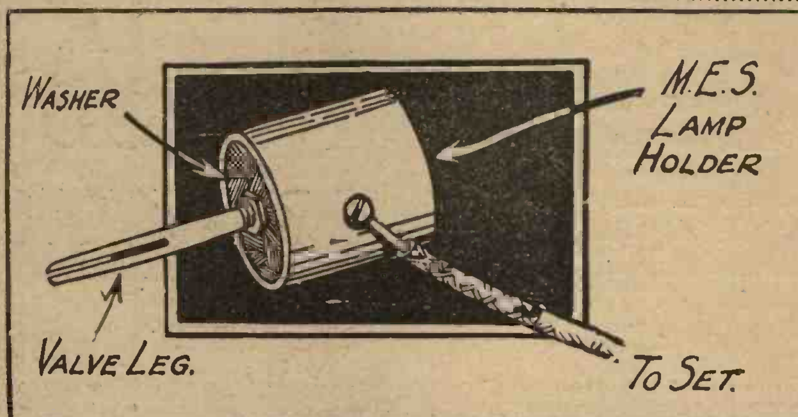
These methods, rough and ready as they are, may sometimes be found useful in testing out home-made condensers.

An Easily-made Valve Protector

THIS useful component can be cheaply made from a M.E.S. lamp-holder and valve leg, and may save the "life" of many a valve.

Remove the stand and screw from holder, then screw a valve leg into the hole and screw nut up to washer tightly, connect the H.T. neg. lead to side screw and insert ordinary flash lamp bulb.

Insulating tape can be wound round the barrel of the device and a short length of rubber tube slipped over it in order to provide against "shocks" and "shorts."



This simple device, described above, is a safety-fuse for filaments.

A LOUDSPEAKER SWITCHBOARD

(*Concluded from page* 288).

Glazite or ordinary bell wire can be used, and soldering is not essential. The push-pull switches will be provided with screw terminals, while Belling-Lee "sub-connectors" can be used for the terminals. These little devices, which cost but a few pence a dozen, fit on to the screws of the terminals and securely hold the wires in position. They can be seen in the back-of-panel photograph. Two one-inch strips of ebonite were screwed to the panel of the original model, and to these wall angle brackets were fixed. The device was securely mounted on the wall by means of ordinary screws and "Rawl-plugs."

If desired, "feet" of ebonite or wood could be fitted and the device stood on the table. In any case, it is really quite a simple "one-evening" sort of task, and only a few tools are necessary to complete it.

In some cases perhaps it might not be convenient to have all the terminals situated at the top of the panel; it might be handier to have them along the bottom with an "input" pair at one side or at the top, but such variations in design are of no consequence whatever providing that the wiring remains essentially the same.

It is not essential that loudspeakers be permanently connected to the ends of each pair of leads. One or two loudspeakers can still be moved about from room to room, for it doesn't matter at all what happens to the extension leads when they are shorted out of circuit.

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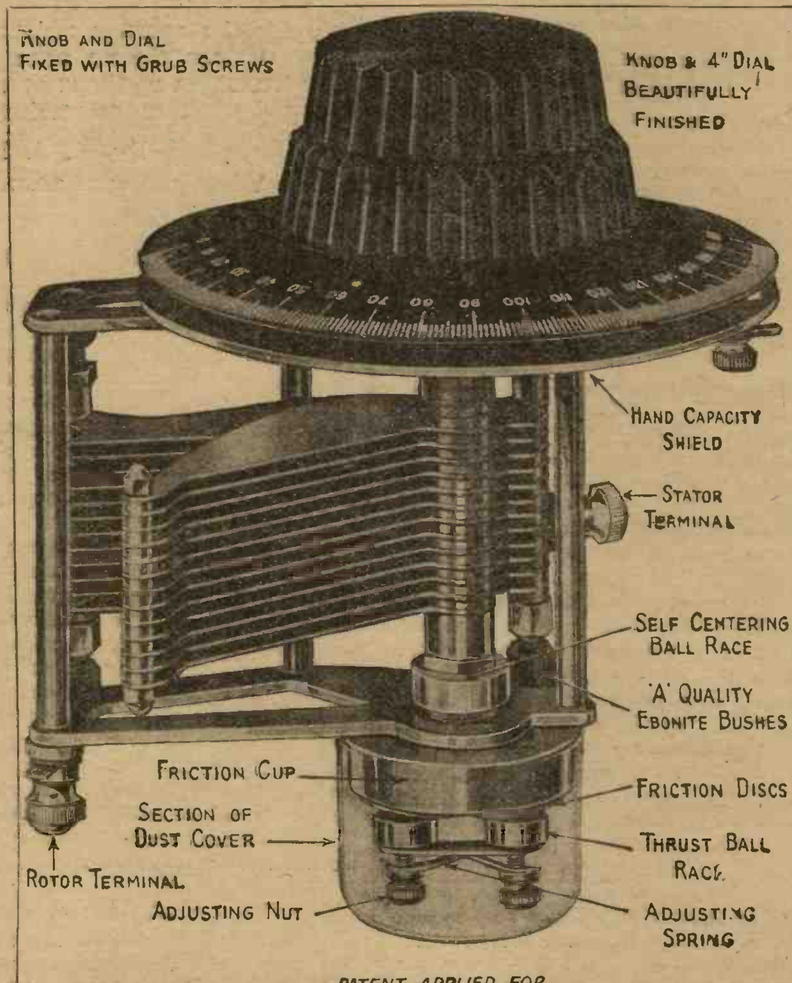

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THE "COMBINE FIVE"

Simplifying Wireless Calculations

To the average constructor the mathematical side of wireless theory often appears a formidable subject. That this need not be so is proved by our contributor 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.

THE purpose of this article is to indicate to readers how simple it is to employ a particular mathematical principle which will enable them to make calculations dealing with certain portions of alternating current and wireless circuits which otherwise would appear somewhat difficult. Too often we meet people who endeavour to discuss these problems without an elementary notion of the basic laws, so to be conversant with them is a condition which should be cultivated.

When we come to analyse the principles of wireless we constantly meet with the fact that since the advent of thermionic valves much of the previous tedious calculation work is simplified because we can apply the ordinary laws of alternating currents. The only difference to bear in mind, of course, is that the minute capacities and inductances which are entirely ignored by the ordinary "heavy" electrical engineer become important to the wireless engineer because of the enormously greater frequencies.

For example, the effect of a capacity of one micro-micro-farad ($1\ \mu\mu F$) may be quite perceptible, especially on short-wave work. It is the capacity in air between two sixpenny pieces spaced about 3/32 ins. apart. Now, at a frequency of 50 cycles per second it would require over three million volts (3,200,000) to drive a mille-ampere through this capacity. At 30,000 kilo-cycles, however (10 metres), the same current would flow by the application of about 5·3 volts.

Now to get to the fundamental laws of alternating current and see how they may be applied in wireless work. If we have a number of resistances in series and an ordinary battery is connected across the extremities a certain flow of current will take place. It should be fairly obvious that this current in *amperes* will be the result of dividing the total voltage of the battery in *volts* by the total resistance in *ohms*. Expressing this fact symbolically we have the expression :—

$$I = \frac{E}{R_1 + R_2 + R_3 + R_4}$$

and is the case shown in Fig. 1.

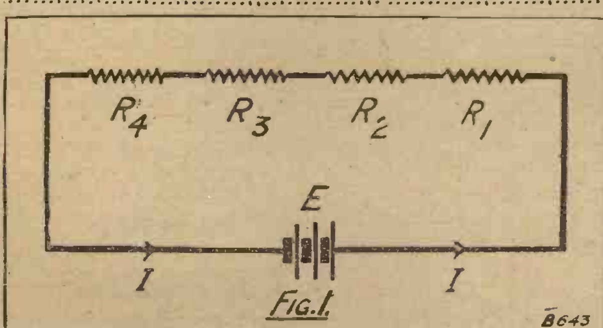
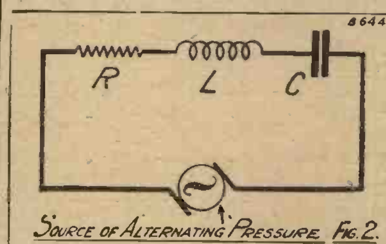


FIG. 1.

If the battery is now replaced by a source of alternating pressure, *e.g.*, an alternator or a valve generating oscillations, the same expression still holds for the current flow so long as it is borne in mind that the pressure E and the current I are R.M.S. (Root Mean Square) values, such as would be measured by suitable alternating voltmeters and ammeters.

Suppose we now introduce into this current an inductance L and a condenser C, what modifications are brought about? In the first place it can be shown quite easily that these two quantities offer a definite resistance to the flow of the alternating or fluctuating current. We do not, however, speak of the resistance of a condenser or the resistance of an inductance unless



SOURCE OF ALTERNATING PRESSURE. FIG. 2.

in the case of the former we have in mind the effect of a leak or in the case of the latter the actual resistance of the wire employed in manufacturing the coil.

Concerning Impedance

To simplify matters in the problem under review, we are going to imagine that both the condenser and inductance are "perfect," and then we say the condenser has a certain *impedance*, and the inductance has a certain impedance, to the flow of the alternating current. The impedance of the condenser is given by the expression $\frac{1}{2\pi f c}$ where

f = the frequency of the alternations in cycles per sec.

c = the capacity of the condenser in *Farads*.

$\pi = 3{\cdot}14159 \left(\frac{22}{7} \text{ approximately} \right)$

Again, the impedance of the inductance is $2\pi f L$ where π and f have the same meaning as above and L is the inductance of the coil in *Henries*.

A FEW EXAMPLES of their manifold uses

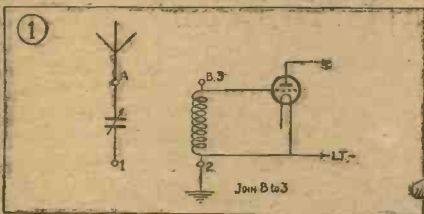


Fig. 1.—Enables the Tuning Condenser to be used in series or parallel with Aerial Tuning Inductance.

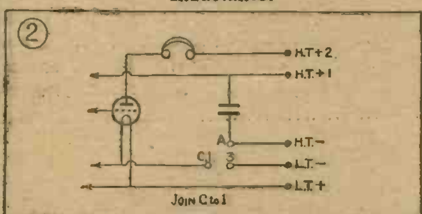


Fig. 2.—L.T. and H.T. "on" and "off" gives the additional safeguard obtained by switching off H.T. and also avoiding leakage.

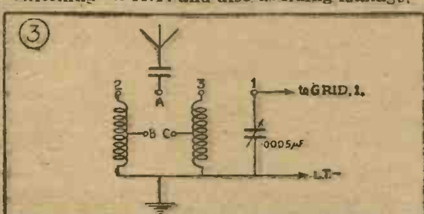


Fig. 3.—Gives alternative use of two Aerial Tuning Coils, permitting quick change over from normal Broadcast range to Daventry range, for example.

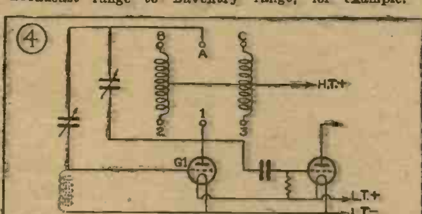


Fig. 4.—As for Fig. 3, but applied to two "tuned anode" Coils ("balanced capacity" Dimic Coils).

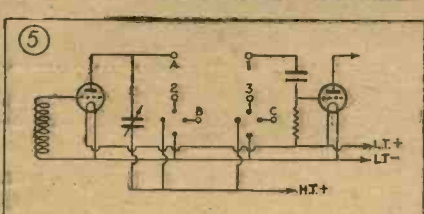
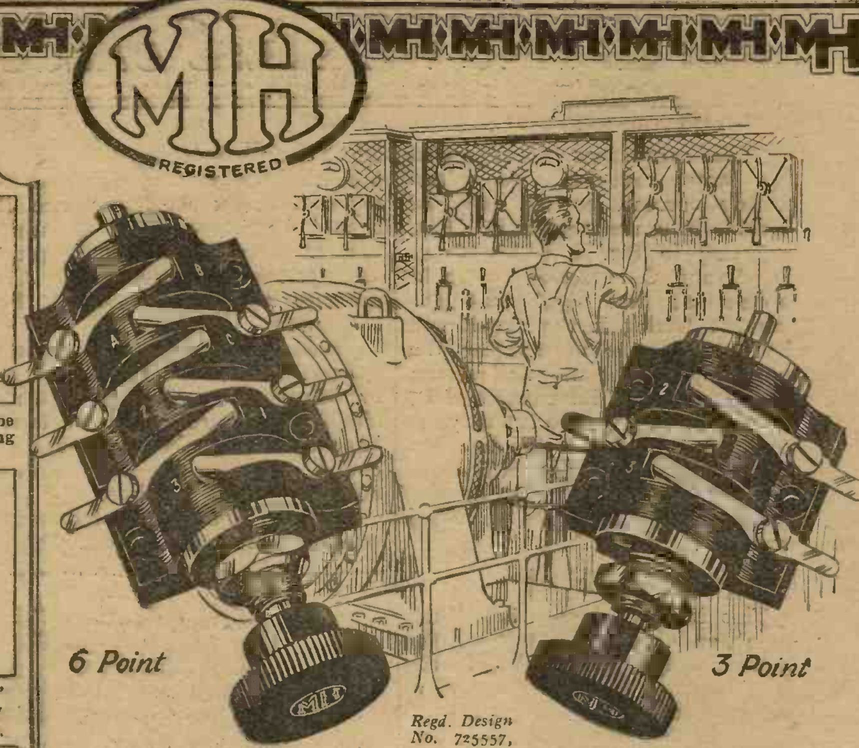


Fig. 5.—Change over from one range to another, using MH barrel-type H.F. transformers.

NOTE—When the Knob is "pushed" contact is made A-B and 1-2.
When the Knob is "pulled" contact is made A-C and 1-3.



Switch Efficiency

Hitherto experimenters have (not without good reason, perhaps) been reluctant to include more switches than are absolutely necessary in their receivers.

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It has a large variety of uses, five of which are shown on this page. Others will follow in subsequent announcements.

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SIMPLIFYING WIRELESS CALCULATIONS—*(Contd.)*

These expressions are expanded by any text-book on alternating current, so we will not trouble to prove them here. Now, referring to Fig. 2, which shows R, L and C in series, it would appear at first sight that the current flowing in the circuit will be the outcome of dividing the pressure E by the arithmetical sum of the individual impedances of R, L and C. This, unfortunately, is not the case, owing to the fact that the current and pressure in L and C are not in "phase," *i.e.*, do not increase and decrease in value together.

Current Lag

This is an extremely important point, so let us examine it a little more closely. Taking first of all the inductance, if we apply a pressure suddenly to a coil it will be found that the current does not rise immediately to its full value, owing to the influence of the coil's magnetic field. Hence the current "lags" behind the pressure rise. Again, if the pressure is suddenly switched off from an inductance, the current will take an appreciable time to die down, *i.e.*, the current still lags behind the pressure.

Now, an alternating pressure, as we all know, varies continuously, and hence this fluctuating pressure will cause the current to fluctuate in a similar manner and yet exhibit the lagging properties just mentioned. Another way of impressing this fact on one's mind is to compare the pressure and current variations with two men walking together.

They can take the same number of steps per second, this corresponding to the frequency, but instead of being exactly in step, one man can be just half a step behind the other. This will correspond to the 90° phase difference between pressure and current, the pressure always leading on the current, or, what is exactly the same, the current always lagging on the pressure for inductances.

Having got this point clear in our minds, let us turn our attention to the condenser. If we switch on a pressure across a condenser the current immediately starts to flow into the condenser to charge it. The full pressure is not produced across the condenser, however, until it is completely charged. We thus have exactly the opposite effect to an inductance, and following out a somewhat similar reasoning to that for the inductance, it should be immediately apparent that the current leads on the pressure, or, put in other words, the pressure lags on the current, for condensers.

These two effects being exactly opposite to one another will account for many phenomena in wireless circuits, which to the uninitiated appear puzzling. In a resistance, of course, both current and pressure are in phase all the time.

We seem to have deviated somewhat from our original problem, as indicated in Fig. 2, but if the reader is now clear on the subject of phase difference the time will have been well spent, for it is particularly important.

Tackling the Problem

Because of these factors, then, it is not possible to obtain the correct answer by adding together arithmetically the value of the resistance in ohms to the impedances of the inductance and condenser.

Now there are three ways whereby this problem may be tackled, viz.:

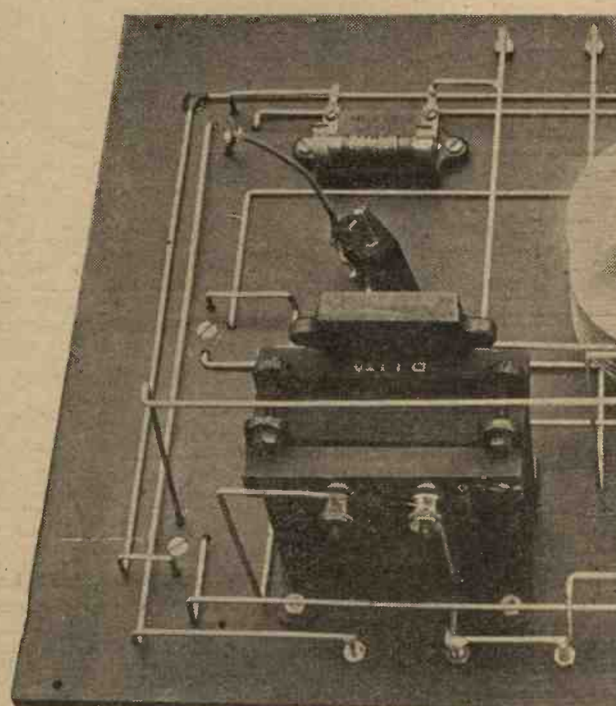
1. *The Analytical Method.*—This involves a knowledge of differential equations and hence will not be discussed here.

2. *The Vectorial Method.*—Here we must employ drawing instruments so as to be able to draw the vectors or lines at their correct angles to one another, and also with their proper lengths, so at present we will not worry over method 2.

A Magic Symbol

3. *The Vector Algebra Method.*—This is really a method whereby the ultimate results of 1 and 2 can be achieved by a simple algebraical process, and I now propose to show how to employ this without giving a lengthy proof as to why we do certain operations.

Instead of writing $2\pi fL$, or, better still, wL, where w represents $2\pi f$, for the impedance of the inductance, we substitute jwL in vector algebra working, and for the impedance of the condenser we write $\frac{j}{wC}$ or $\frac{1}{jwC}$, since both the expressions are really identical, and w has the same meaning as above. Now the magic symbol "j" has a mathematical significance, being actually the square



An example of a receiver where grid leak and condenser rectification is employed. The effect of a parallel resistance and capacity can be calculated by the methods described in the article.

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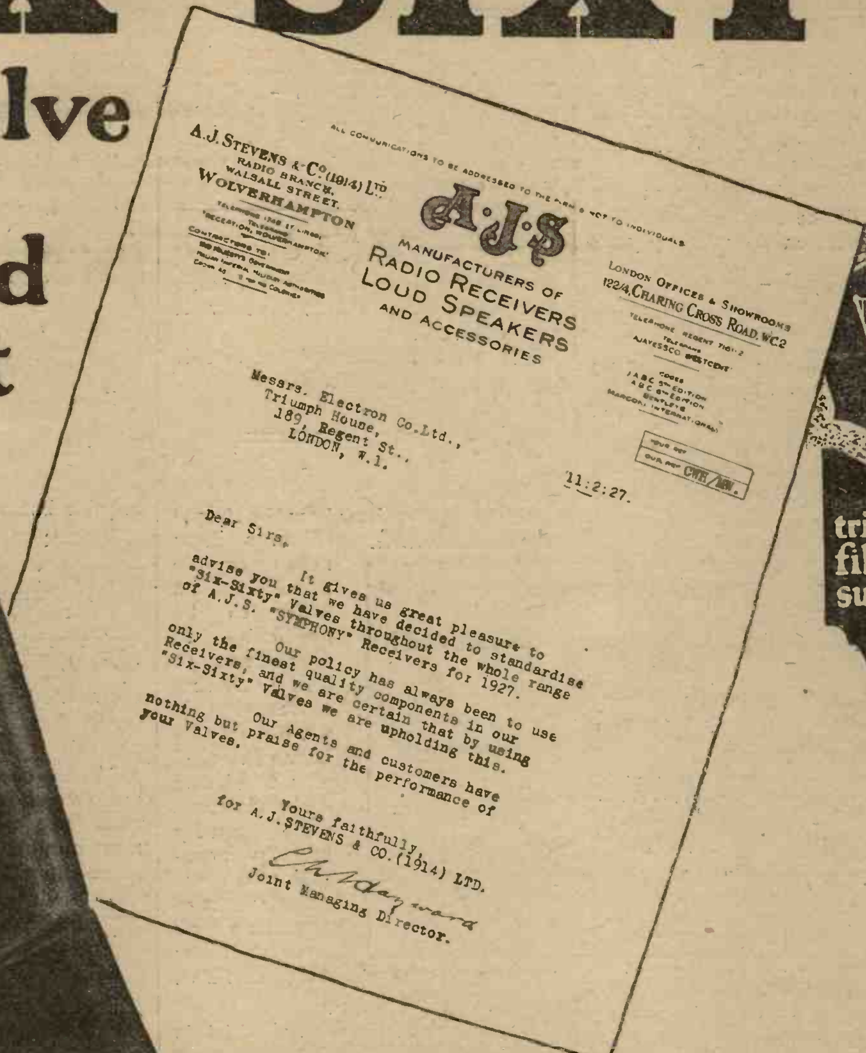

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SIMPLIFYING WIRELESS CALCULATIONS—*(Contd.)*

root of minus one ($\sqrt{-1}$), but since the square root of a minus quantity is imaginary, do not let us worry about it. Only think of it as a means to an end.

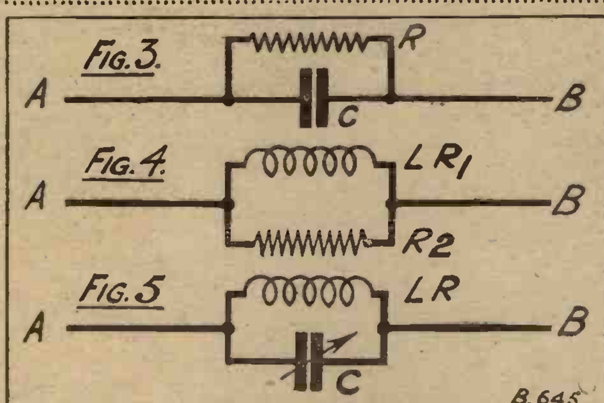
Under these circumstances the total impedance for the circuit of Fig. 2 is written down simply as

$$R + jwL - \frac{j}{wC}$$

or

$$R + jwL + \frac{1}{jwC}$$

and this is called the *vectorial impedance*. This expression is still not in a form suitable for ordinary calculations, so we make use of one or two simple rules which should be committed to memory for future use.



Having written down your vectorial expression, which may be complicated or otherwise, collect all the terms present with j as the first letter, or in the numerator where fractions are present, and add these together to form one expression. Now collect all the terms without j and add them together as another expression, taking care in both cases to see whether the preceding sign for each set of symbols is positive or negative and retaining it in the ultimate expressions. Now forget all about j and square both the expressions with and without j, add them together, and put a square root sign over the whole lot and this will be the desired answer. It takes much longer to read how to do this than it does to perform the actual operation.

Applications

Case 1.

For example, coming back to Fig. 2, what is the total impedance?

Vectorially it is $R + jwL - \frac{j}{wC}$

The working expression then follows in this manner :—

Terms with j $\quad j\left(wL - \frac{1}{wC}\right)$

Terms without j $\quad R$

Hence impedance $= \sqrt{R^2 + \left(wL - \frac{1}{wC}\right)^2}$

How many times have we seen this expression and wondered how it was derived?

The current flowing in the circuit is now readily seen to be

$$I = \frac{E}{\sqrt{R^2 + \left(wL - \frac{1}{wC}\right)^2}}$$

and it serves to show how the simple Ohm's Law needs to be modified in order to be applicable to wireless or alternating currents. It should be borne in mind that these calculations are only strictly accurate when the alternations of pressure or current follow a true sine law.

Case 2.

For the circuit of Fig. 3, which is really that of a leaky condenser, in order to find the resultant impedance between the points A and B we must apply the ordinary law for parallel impedances. Calling this resultant impedance Z we have :—

$$\frac{1}{Z} = \frac{1}{R} + \frac{1}{\frac{-j}{wC}} = \frac{-\frac{j}{wC} + R}{-\frac{jR}{wC}}$$

Therefore

$$Z = \frac{-\frac{jR}{wC}}{\frac{-j}{wC} + R} = \frac{\frac{jR}{wC}}{\frac{j}{wC} - R}$$

Hence the useful quantity we require becomes

$$\frac{\frac{R}{wC}}{\sqrt{\frac{1}{w^2C^2} + R^2}} = \frac{R}{\sqrt{1 + w^2C^2R^2}}$$

by the application of the previously mentioned rules.

Case 3.

In the case illustrated in Fig. 4 we have an inductance with its own resistance which is shunted by a non-inductive resistance. Once more the parallel law must be used.

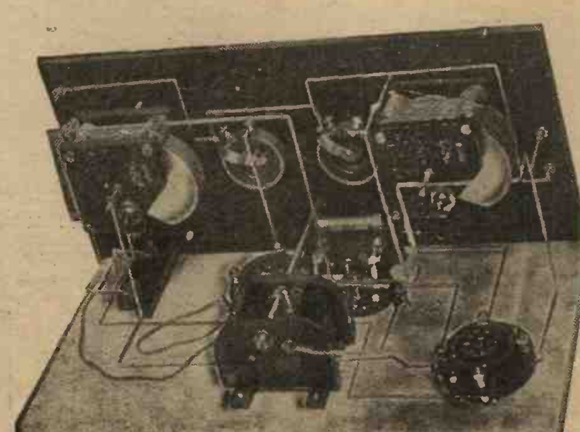
$$\frac{1}{Z} = \frac{1}{R_1 + jwL} + \frac{1}{R_2} = \frac{R_2 + R_1 + jwL}{R_2(R_1 + jwL)}$$

Therefore

$$Z = \frac{R_2R_1 + jwLR_2}{(R_2 + R_1) + jwL}$$

(*Continued on page* 333.)

A two-valve receiver employing tuned anode tuning which is fully discussed by the author of the accompanying article.

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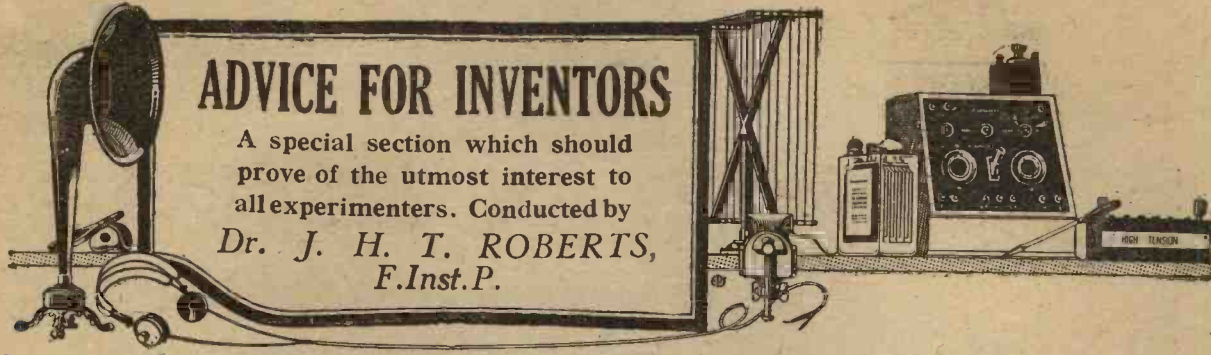


ADVICE FOR INVENTORS

A special section which should prove of the utmost interest to all experimenters. Conducted by

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

Readers sending in inventions under this Department should state clearly whether they are willing for their inventions to be published and discussed in this Journal. Otherwise, so far as is possible, communications will be treated in confidence, but at the same time it must be clearly understood that no responsibilty whatsoever is, or can be, accepted either by this Journal or by the Author in connection with any patents or suggestions submitted, or in connection with any matters arising out of the same, and all persons making use of this Department or communicating with it in any way are to be deemed thereby to have accepted the foregoing conditions.—EDITOR.

By the number of communications I have had from readers, not only in this country but abroad, it seems that there are far more inventors than I thought and that they welcome the opportunity of having assistance with their difficulties.

Some of the questions relate to purely technical points, but by far the majority are concerned with the commercial possibilities of the invention and the best means of realising the same.

The subjects dealt with are in great variety, many of them, as might be expected, being associated with the valve in one form or another.

I have chosen a number of inventions submitted, with the consent of the authors, and have discussed these in a way which I hope will prove useful to the majority of my readers as an indication of the general considerations arising.

In order to facilitate the working of this Inventors' Department, I should be very much obliged if my correspondents would :

(1) Give name and address quite clearly.

(2) Write their letters as clearly and shortly as possible, setting out definitely on what particular points they desire to be advised.

(3) Preferably have their letters typewritten, though this is not absolutely necessary.

(4) State whether the invention is patented or protected, and also whether they are agreeable to it being published in this section of MODERN WIRELESS. It is very important that this question be answered quite definitely.

(5) State whether they are willing for their names and addresses to be published in connection with the invention.

With regard to the question of publication of the invention, it must be borne in mind that if it is desired to obtain a patent for an invention, an application for the patent must be made before the publication, as prior publication may be held to invalidate a patent.

If application for patent has been made, there is usually little objection to publication, although in certain special cases, details of which I cannot very well go into at the moment, it may be, and often is, desirable to avoid any public disclosure.

Acceptance of Responsibility

If inventions submitted are to be published in this Journal it is necessary that the inventor gives his written consent. At the same time, if the inventor gives his written consent to the invention being published it must be understood that the responsibility rests entirely with himself and neither this Journal nor the present writer can undertake any responsibility whatsoever in respect of communications with regard to patent matters. As far as possible, all communications (other than those where the inventor specifically states that he is willing for the invention to be published) will be treated in confidence, but, as stated above, no responsibility whatsoever can be taken by this Journal or the present writer, and the inventor himself must accept all responsibility. It is to be understood that in making use of this "Advice to Inventors" service the inventor accepts the above-mentioned conditions.

* * * *

No. 21. The invention submitted in this case is a variable condenser the maximum capacity of which can be adjusted by varying the spacings between the vanes. The invention is illustrated in Figs. 1 and 2. In these drawings only the movable set of vanes is shown for the sake of simplicity, but, of course, the same principle applies to the fixed set of vanes. In Fig. 1 the vanes are shown mounted upon the central spindle and spaced by rubber washers instead of by the usual solid metal distance pieces. A nut is provided at one end of the shaft, and by means of this nut the vanes can be pressed closer together, the rubber washers yielding under the pressure. In Fig. 2, instead of the rubber

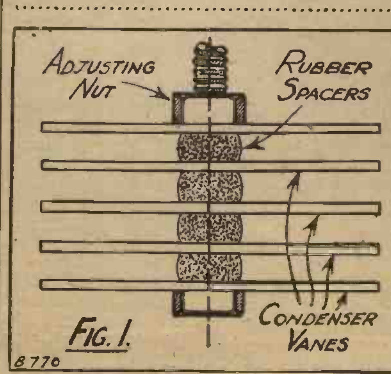


Fig. 1.

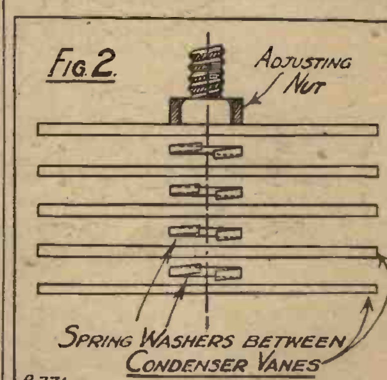
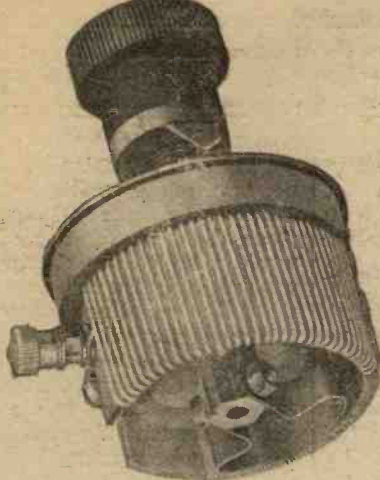


Fig. 2.



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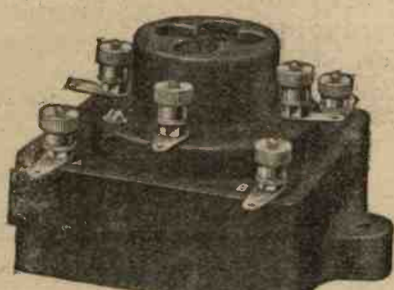
The "Cosmos" Permacon.



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Double "	20	.4 "	5s. 0d.
" "	34	.2 "	5s. 0d.
Potentiometer	300	—	6s. 0d.

The "Cosmos" Permacon is an ideal fixed condenser, being light in weight, of guaranteed accurate capacity, and having the lowest possible losses.

The dielectric is mica, and each condenser is tested at 500 volts during inspection. Nickel-plated cases give them a particularly neat appearance.

.0001 mfd.	1/6	.001 mfd. ..	1/8
.0002 "	1/6	.002 " ..	1/10
.0005 "	1/6	.005 " ..	2/8
.0003 " (with clips for grid leak)	1/8	.01 " ..	3/9

The "Cosmos" Resistance Coupling Unit. Real purity of reproduction can only be obtained with resistance capacity coupling. The "Cosmos" Coupling Unit with a suitable valve is as effective as an ordinary transformer-coupled stage. It avoids all distortion and effects considerable economies in first and operating costs. Designed primarily for use with the "Cosmos" S.P. Blue Spot Valves, it can be used successfully with any valve having an amplification factor of 30 or more. Special attention is directed to the following advantages of the "Cosmos" Coupling Unit:

(1) It takes up little space in a set.
(2) It is not liable to be broken.
(3) It has permanent resistance values.
(4) It allows for simplified wiring.
(5) It is economical in L.T. current (S.P. Blue Spot Valves consume 0.09 amps).
(6) It is economical in H.T. Battery consumption (less than 1/20 normal).

And lastly its use results in purity of reproduction without loss in volume.

Type "O," the Unit alone .. .. 8/6.
Type "V," the Unit incorporating spring valve holder (*as illustrated*). 10/6.
Suitable valves for use with this unit are "Cosmos" S.P. 18/B and "Cosmos" S.P. 55/B.

Metro-Vick Supplies Ltd.

(Proprietors: Metropolitan-Vickers Electrical Co., Ltd.)

METRO-VICK HOUSE,
155, CHARING CROSS ROAD, LONDON, W.C.2 R/P 60

ADVICE FOR INVENTORS—*(Continued)*

washers, spring washers are used, which are intended to have the same effect.

I have been asked whether it is worth while to proceed with a patent in this invention. This is an interesting invention for discussion in these columns for the reason that, unlike so many inventions, it is one where there would be good commercial possibilities, but where the real difficulty is of a technical nature. Usually in inventions the technical difficulties can be surmounted fairly easily, but there are little or no commercial possibilities. In the present invention it is the other way round.

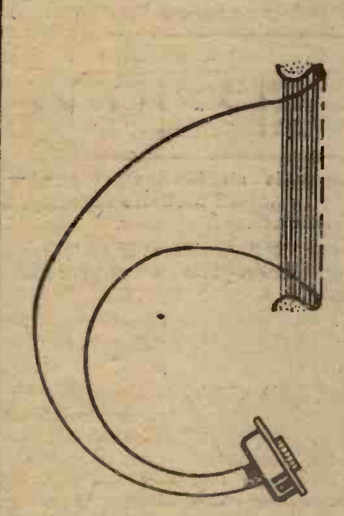


FIG. 3. B.772

I am of opinion that a variable condenser for wireless purposes, the maximum capacity of which could readily be varied in some quite convenient way, would undoubtedly have considerable commercial value.

Ingenious but not Practical

The present invention is certainly ingenious, and of course is based upon a perfectly correct scientific principle, namely, that the capacity may be varied by varying the spacing between the plates.

Unfortunately, however, the method by which it is proposed to provide for the adjustment is one which, in my opinion, is mechanically unsound.

Taking the rubber spacers—it is almost always undesirable to use rubber in a mechanical device if it can possibly be avoided. Secondly, owing to the very small clearance between the plates of the average variable condenser, it is essential that the plates be accurately parallel to one another, and I am afraid that on tightening up the adjusting nut it would be found that the parallelism of the plates would be completely destroyed. In other words, the rubber spacers would not be compressed equally and uniformly.

A Bad Feature

The spring washer is a better mechanical job, but here again similar considerations apply, and it is very doubtful whether the parallelism would not be even more difficult to secure with the spring washers than with the rubber spacers.

This invention, although ingeniously conceived and quite adaptable to ordinary methods of manufacture, is one which, in my opinion, would fail owing to the fact that it would throw too much upon the skill and patience of the user—a feature which is always very bad.

For reasons such as those set out above, I should say that the invention was one which would not be a commercial success.

This is an invention which would not have many possibilities for the following reasons:—In the first place, the metal of the loudspeaker would tend to absorb the energy which is intended to be received by the frame aerial and consequently the sensitivity of the device as a pick-up for wireless waves would be reduced. Secondly, comparatively few sets employ frame aerials and the loudspeaker manufacturers would not be interested to provide the channel on the edge of the loudspeaker for carrying the windings of the aerial. Thirdly, a loudspeaker provided with this extra feature would have little or no enhanced value as a saleable article. Fourthly, the arrangement would only appeal to the experimenter, and any experimenter could perfectly easily wind his frame aerial in some such way as that illustrated without buying a loudspeaker especially so equipped.

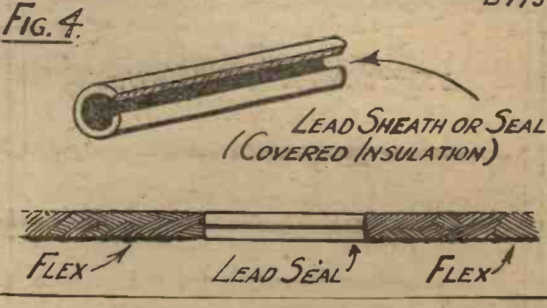
Moreover, I believe that something of this kind, but arranged in a more convenient way, was invented and placed on the market some time ago. I cannot give references to this, but I seem to recollect having seen illustrations of it.

An Extension Cable

The idea of the kind illustrated in Fig. 3 might possibly be useful to manufacturers of complete sets including loudspeakers, but even

The time wasted in twisting together pieces of flex is saved by the use of this neat connecting seal.

FIG. 4. B773



No. 23. In the invention No. 23, which is illustrated in Fig. 3, the flare of the loudspeaker trumpet is made use of to carry the frame aerial. Apparently this is the principle of the invention, but in a particular case, as illustrated in Fig. 3, a channel is provided around the rim of the loudspeaker in which to wind the frame aerial.

then it would only be applicable to sets of the frame aerial portable type which, as we remarked a moment ago, are very much in the minority.

No. 34. This invention relates to an extension cable for connecting the loudspeaker to the set and enabling the loudspeaker to be used in a different room from the set.

ADVICE FOR INVENTORS—(*Continued*)

I do not think that this invention would be of much commercial interest, as the article itself is quite a low-priced one and furthermore it has little advantage over a piece of ordinary cable used with any necessary choke or condenser in a well-known manner. In other words, there is, in my opinion, very little room to make much money out of a patent cable of this kind for the purpose mentioned.

A Patent Connector

No. 58. This invention, which is illustrated in Fig. 4, relates to a simple means of connecting flexible or other wires together. Every experimenter or electrician knows that a good deal of time is spent in twisting together the bared ends of flexible wire and taping over with insulating tape. According to the present invention, a number of split lead sheaths are provided (about the size of "rawlplugs"). These are of slightly different sizes for different purposes. When it is desired to join together the ends of two pieces of flex, these ends are introduced into the lead sheath through the open slot and the sheath is then compressed together with a special hand tool (similar to the tool used for pressing lead seals on Post Office mail bags), thus forming a tight mechanical and electrical joint. In a modification of the invention the lead seal may be coated on its outer surface with flexible enamel or other insulating material, so that the joint when made is already insulated on the outside, and in a further modification of the invention the sheath consists entirely of a tough insulating material which serves to form a mechanical joint and at the same time to insulate the joint after it has been made. With this latter form, however, it is necessary to ensure that the two bared ends of the flex are brought into proper electrical contact with one another before the sheath is applied.

This invention strikes me as being one which might have some commercial possibilities, although I think it would be necessary to make certain improvements in the article, and in the method of its application. Moreover, I am not sure that something of the kind has not already been used. I do not think the article would have a very large sale amongst wireless users, although it might have important applications in electrical and telephone engineering. I should say it would be well worth an Application for patent and a certain amount of investigation in the patent files.

It has the advantage, from the commercial point of view, that although the actual price of the individual connectors is extremely small, if the invention proved successful there might be a very large field of application, and, furthermore, it could be so arranged that it would be necessary for the purchaser to buy the hand tool for closing the connectors.

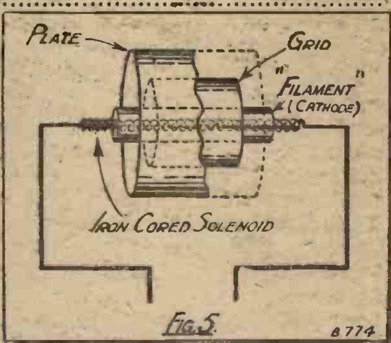
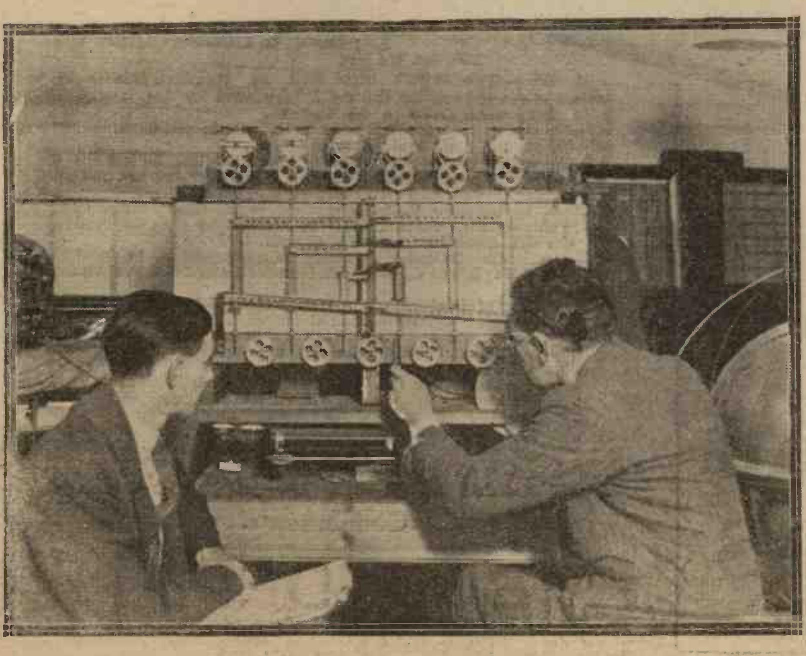


FIG. 5.



A Wave Machine.

This machine, installed at the Marconi Wireless College, Chelmsford, enables students to see how waves are made up, and how they can be modulated.

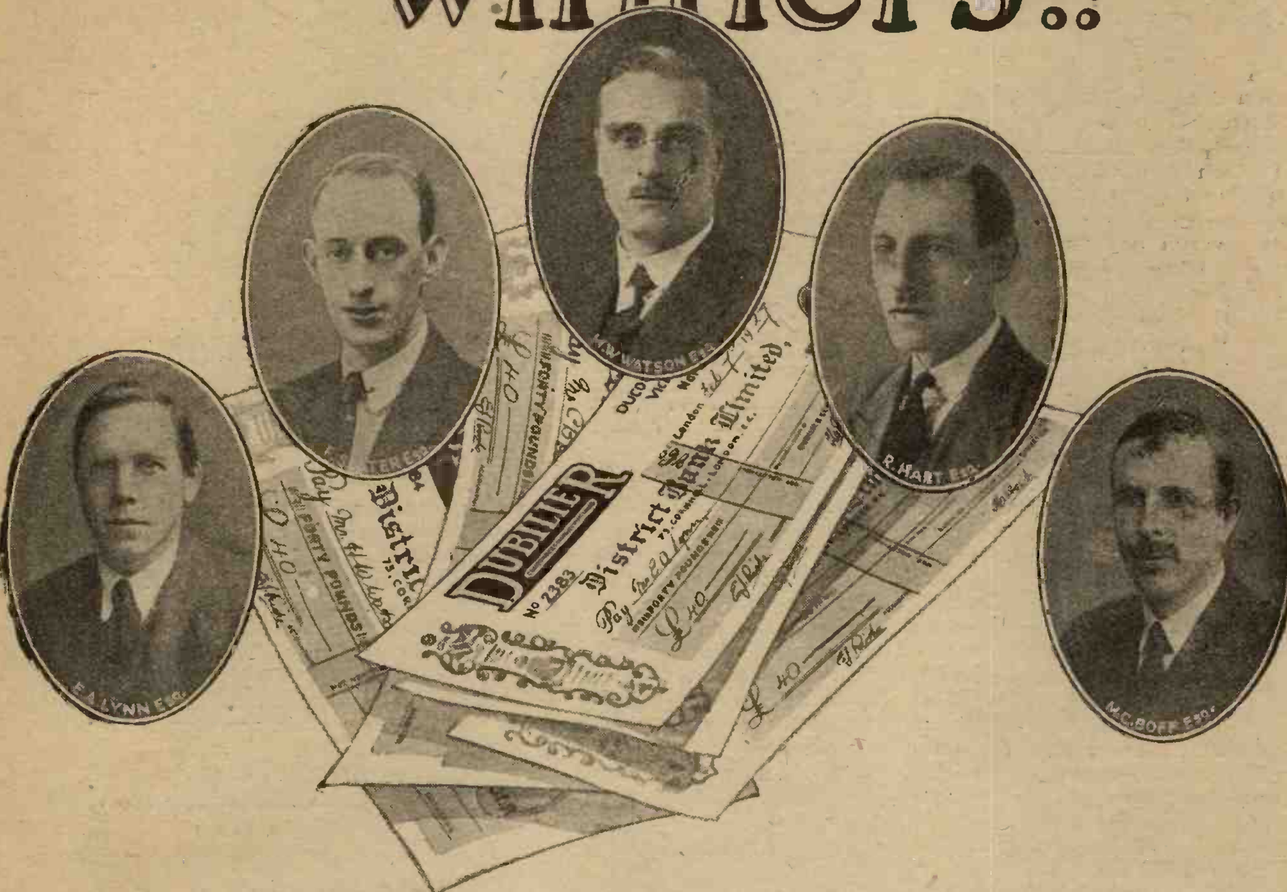
A Novel Valve

No. 63. This is a very interesting invention relating to a wireless valve. Many attempts have been made—some successfully—to produce a wireless valve capable of operating directly from the alternating current electric-light mains or, alternatively, of operating from the A.C. current from a small step-down transformer. Usually these valves have been based upon the principle of a heater operated from the electric light mains, and communicating its heat, by radiation or otherwise, to the cathode (which takes the place of the filament in an ordinary 3-electrode valve).

In the present invention, however, instead of a heater an electromagnet "inductor" is used, having an iron core, and the cathode (that is the electron-emitter) surrounds this inductor, the combination of the inductor and the cylindrical or ring cathode being equivalent to a step-down transformer. The cylindrical or ring cathode is heated by the currents induced in it from the inductor. Outside the cathode is a cylindrical grid and outside that again is a cylindrical anode in the usual way.

(*Continued on page* 318.)

Winners!!



The Dubilicon Competition.

THE DUBILICON

An extremely useful condenser, containing eight separate capacities from which many hundreds of resultant capacities may be obtained. Indispensable for experimenters.

Price 30/-

The result of the highly successful Dubilicon Competition can now be announced.

Each of the five gentlemen whose portraits appear above correctly worked out the number of different capacities obtainable from various arrangements of the first five capacities of the Dubilicon Condenser.

The correct number was—475.

The prize of £200 has accordingly been divided between the five winners, each of whom receives a cheque for £40, together with our hearty congratulations.

DUBILIER

REGISTERED TRADE MARK

ADVERT. OF THE DUBILIER CONDENSER CO. (1925), LTD., DUCON WORKS, VICTORIA ROAD, NORTH ACTON, W.3.

M.C. 268.

The "Sparrow" Two

This set has been specifically designed to suit the requirements of the average listener. It is essentially a "simple" set—both in construction and operation, but on test it has proved itself well worthy of inclusion in "Modern Wireless."

By KEITH D. ROGERS.

A GREAT many constructors hesitate before building a wireless receiver because they think that if they are to make a really good job of it it will necessarily mean a heavy financial layout and entail considerable upkeep expenses. This might be the case if a really elaborate cabinet receiver were required. But in order to get good results —even loud-speaker results—from the local station and the high power stations there is no necessity to build an expensive or elaborate receiver.

Extremely Simple

The set described hereunder was designed to suit the requirements of the average listener who does not know much about wireless construction, and merely wants a neat little receiver which will give him good loud-speaker results from his local station, and, if he requires it, bring in some other broadcasts on the telephones.

As the photographs show, the receiver consists essentially of a small wooden cabinet fitted with flat panel upon or under which are mounted all the components. These latter are as few in number as is consistent with good reception, and the prices have been kept down to a minimum. The list of components will show how very cheaply the set can be made.

Preliminary Preparations

It is advisable when purchasing the components always to buy the panel and case at the same time. This ensures that the former will fit into the latter and obviates the necessity for the constructor of trimming up to his own panel. If he does not buy these two components together he will probably find that either the panel or the cabinet is slightly out in one direction or another and that probably the panel is not exactly square at the corners.

In order to trim this panel up he would have to employ a set square or a similar instrument for the edges and file them down until a proper edge was obtained. After this, final trimming by means of sandpaper would have to be done before the panel could be said to be finished. This does not sound a very difficult job, but it is a tedious one, and should be avoided if possible.

The drilling of the panel is of course carried out by means of metal working twist drills, and should be done in accordance with the front of panel diagram.

This diagram does not, of

The "Sparrow" Two ready for test. A Daventry tuning unit is shown in position on the left of the panel

THE "SPARROW" TWO—*(Continued)*

course, give the exact or even relative sizes of holes that will be required, but merely indicates their positions. The actual sizes will depend upon the components purchased and will present no difficulty to the constructor.

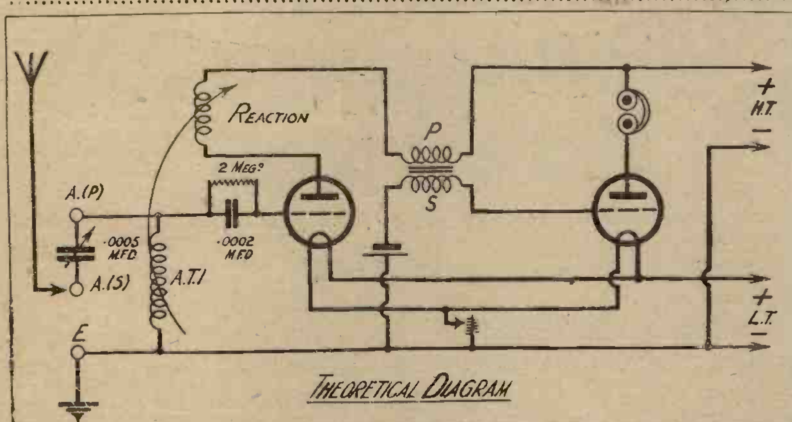
Drilling the Panel

It should be remembered that a somewhat larger drill will be necessary for the holes mounting the rheostat and variable condenser, though if the constructor does not wish to go to the expense of buying the necessary ⅜ in. drill he can make a smaller hole and enlarge it by means of a reamer, an instrument which should find a place in every workshop.

The drilling of the panel should take place from the front surface so that in the event of the drill breaking through rather rapidly on the reverse side the appearance of the panel will not be impaired. The marking of the panel can be carried out by means of a pencil if desired, though a proper scriber and centre punch will be more preferable.

LIST OF COMPONENTS

- 1 Panel, 10 in. by 8 in. by ¼ in. and case, 4½ in. deep (approx.)
- 1 Peto-Scott .0005 S.L.F. variable condenser
- 1 Mellowtone coupler (No. 35)
- 1 Mellowtone coupler (Daventry)
- 1 Lissen L.F. transformer
- 1 Lissen grid condenser (.0002), with leak (2 meg.)
- 1 Precision rheostat (C. Ede & Co.)
- 3 Security valve holders (S. J. Bulgin)
- Terminals, wire, screws, etc.



The L.F. Transformer

If a pencil is used all the marks should be removed immediately after drilling and before mounting the components by well rubbing the panel with thin oil, wiping perfectly clean afterwards with a clean rag. The presence of pencil marks between components might lead to noisy reception and other peculiar faults due to the leakage which might occur down the lines.

It will be noticed that no drilling positions are given on the diagrams for the screws holding the L.F. transformer, nor is any method of mounting shown for the grid leak and condenser. This is because the L.F. transformer should be mounted from the underside of the panel, the instrument itself being placed on the panel in its correct position and the two necessary holes drilled through the hole provided in the transformer. Afterwards the instrument is mounted and held in position by a couple of 4 B.A. countersinking bolts and nuts. The grid leak and condenser are kept in position by the wiring alone.

Wiring Up

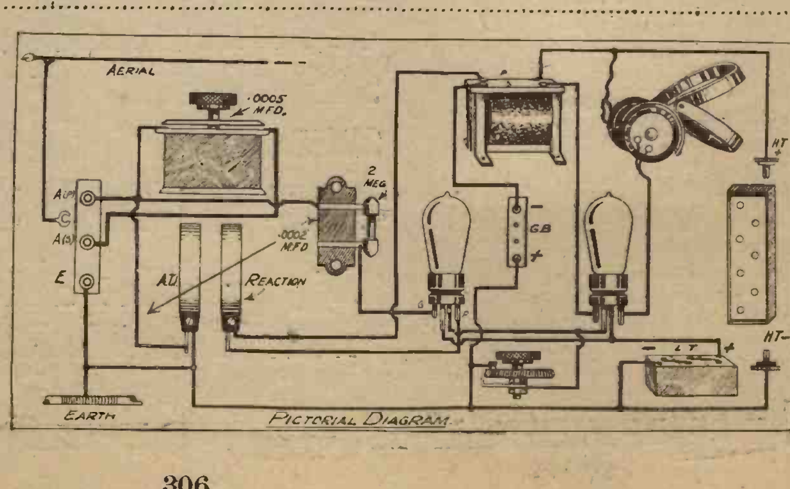
The actual wiring of the receiver shown in the photograph is carried out by means of 16 gauge square tinned copper wire, but though this type of wire certainly makes for a neat under-panel appearance there is no need from an efficiency point of view to use quite such a heavy gauge and round wire will do equally as well.

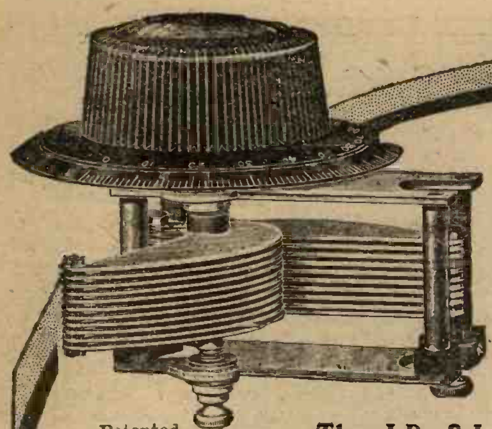
It is advisable to solder all the connections if the constructor feels equal to the task. It is not a difficult one, but it should be borne in mind that a badly soldered wireless set is about the worst thing on earth as far as wireless is concerned, and is practically bound to cause all sorts of trouble.

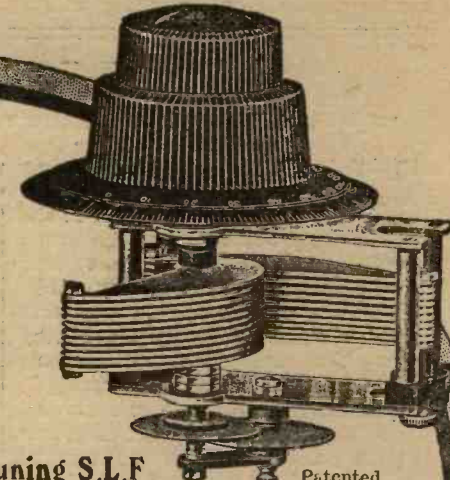
If he decides not to solder, the constructor should take every wire to the terminal or screw to which metallic connection from that wire has to be made, and he should use a wire having a gauge not heavier than twenty.

Checking the Connections

If he does decide to solder he must be careful to use clean flux (fluxite is very good) and tinman's solder; those very soft solders which are often sold "for wireless purposes" should be avoided like the plague, unless it is tolerably certain that they do not contain a high percentage of bismuth, which metal very often causes the







The Final Condenser.

All round the dial the stations come in without the least suspicion of crowding anywhere. Here at last is the final condenser—the J.B. S.L.F.—which enables you to log stations with real accuracy.

Patented

The J.B. S.L.F.

The consistent popularity of this famous condenser is the real index mark of its perfect design, efficiency, and finish. The vanes in this model, as well as in our slow motion type—the J.B. True Tuning S.L.F.—are specially designed to spread the stations evenly over the dial, and are supported at the tips to ensure accurate spacing.

A noticeable feature is the complete absence of backlash. Side or end play in the centre spindle is impossible.

PRICES, complete with 4 in. Bakelite Dial.
·0005 mfd. 11/6. ·00035 mfd. 10 6
.00025 mfd. 10/–
For Short-wave Receivers. ·00015 mfd. 10/–

The J.B. True Tuning S.L.F.

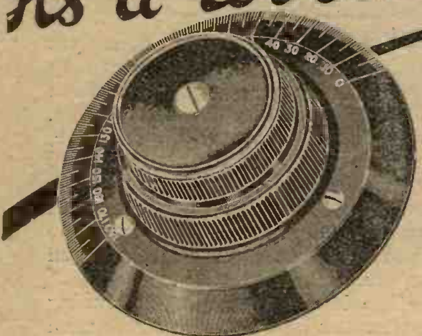
Patented

All the fine points of perfect design and workmanship found in the J.B. S.L.F. are incorporated in this slow motion model. The J.B. True Tuning S.L.F. is fitted with a double reduction friction drive—ratio 60-1, giving remarkably close tuning. Precision in the design and construction of the friction surfaces results in an absolutely positive drive. The slow motion device is controlled by a 2 in. Bakelite knob, while for coarse tuning the instrument is fitted with a beautiful 4 in. Bakelite Dial.

PRICES, complete with 4 in. Bakelite Dial
·0005 mfd. 16/6. ·00035 mfd. 15'6
·00025 mfd. 15/–
For Short-wave Receivers ·00015 mfd. 15/–

JACKSON BROS.
8, POLAND ST.–OXFORD ST.
LONDON – W.1
Telephone:– GERRARD 7414

Read this "It's a revelation"



A letter recently received from a keen experimenter is so packed with interesting points that we give it in full below.

The "Utility" Micro-Dial
Price 7/6

"Utility" Condensers
Price. .0005 15/-
.0003 14/-
.00025 13/6
.0002 13/-

When fitted with this Micro-Dial.
When ordering, the diameter of spindle it is intended to fit should be stated.

"I rigged up a powerful microscope with a peculiar reflecting system which enables me to follow a magnified movement of the rotary plates, and by operating the vernier control minutely, I measured movements of a thousandth part of an inch quite accurately, but of course that alone is not of great value, but I was able to at will return to the original position, by reversing the pressure, backlash being absolutely non-existent: I repeatedly did this making the movement with perfect ease, from a zero point to minus or plus one thousandth part of an inch. Obviously such a degree of accuracy of control would never be required, but compared with three or four other makes I repeatedly experimented with it is a revelation."

Insist on "Utility" Guaranteed Components.

N.B. If any trouble is experienced in obtaining our goods, please communicate with us direct.

WILKINS & WRIGHT LTD
KENYON ST. Utility WORKS BIRMINGHAM

For non-metallic
leak-free
dead true
surface
brilliantly polished
black and
mahogany
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REDFERN'S
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NON-METALLIC SURFACE
RADIO·PANELS
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BELFAST—2, Sandy Row.

THE "SPARROW" TWO—*(Continued)*

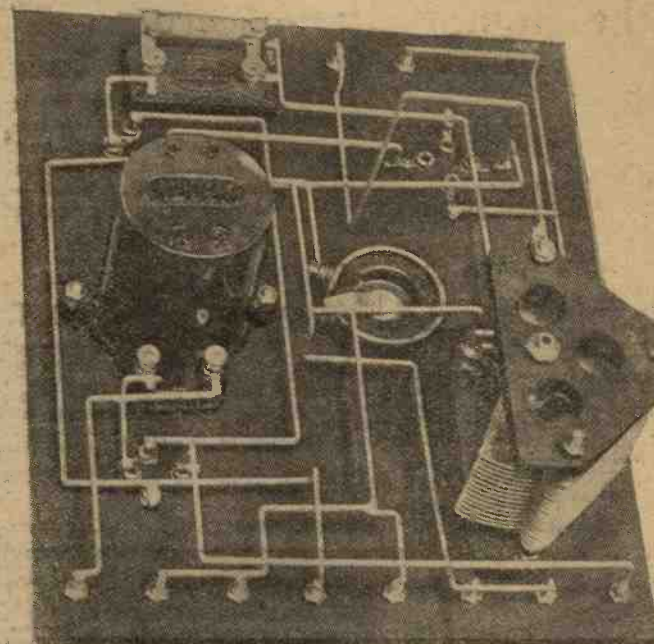
joint to crystallise and break away from the connecting surface.

The wiring is clearly seen in the diagram provided where the actual relative positions of the various wires are shown as nearly as possible. The constructor should therefore experience no difficulty in following out the connections, and when he has finished and has thoroughly cleaned up the receiver, removing all traces of flux, and has tested each joint for mechanical strength he should be ready to check up his connections with those given in the wiring instructions.

Easy to Operate

This latter process should be carried out with extreme care, as it forms an infallible test for wrong connections, and if the wiring passes the scrutiny it receives during this checking process the set can be connected up to the batteries and aerial and earth, the valves put in position and tested out.

No discussion has been entered into with regard to the circuit employed in this receiver, for it will have been seen from the theoretical diagram that it is exceedingly simple, merely consisting of a detector valve with series parallel tuning followed by a one valve L.F. amplifier, both valves being controlled by the same rheostat and taking the same H.T. These latter points make the set exceedingly simple to operate, so that the veriest tyro need have no qualms about the handling of the receiver.

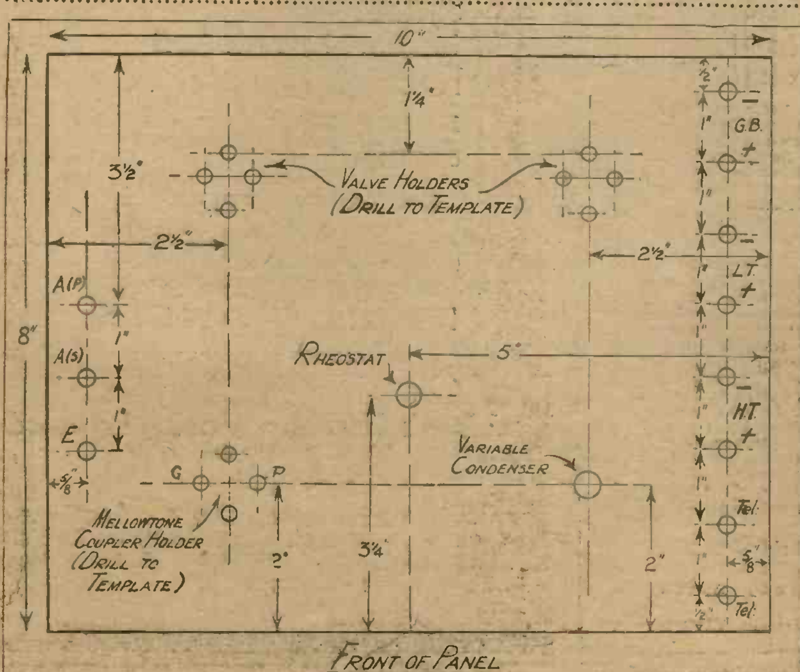


This under-panel photograph will prove invaluable when the wiring of the receiver is being undertaken.

Choice of Valves

The choice of valves must remain with the constructor himself, as it will depend to a large extent not only on his pocket but upon the facilities he has for supplying those valves with filament current. He will not go wrong, however, whatever type and voltage of valve he may decide upon, as long as he remembers that he must have a valve suitable for detector purposes in the left-hand position of his set and a suitable low-frequency amplifier in the second position if he is to obtain the best results. The L.T. battery will, of course, have been chosen to suit the valve or *vice versa*, while if a 72 volt H.T. battery and a 4½ volt (tapped every 1½) grid bias battery are provided the set can be relied upon to give full satisfaction.

The Mellowtone plug-in tuning unit must be chosen to agree with the wavelength it is desired that the set shall cover, as this unit takes the place of the more usual and more bulky plug-in coils and two-way coil holder.



Series-Parallel Connections

It may be as well to explain the method of using the two aerial terminals so that either series or parallel tuning can be obtained. The choice as to which method of tuning is used will depend on the local conditions under which the set is to be employed together with the wavelength of the station it is desired to receive.

As a general rule it can be taken

Single Radio Transformers of the highest impedance give the best results.

IT is sometimes advised that a transformer should be used in the second L.F. stage of different type or ratio from that employed in the first. In regard to type, whilst it is conceivable that the defects of two inferior transformers might cancel out, there is no reason for any difference of type when good transformers are used. The question of transformer ratio is affected by the fact that the impedance of the transformer primary should exceed that of the valve as much as possible to ensure maximum amplification ratio. If the transformer ratio is high, the impedance of the primary must necessarily be low at low frequencies and the greater step-up of the high ratio transformer will be annulled by the reduced amplification ratio obtained with a high impedance valve, or, if a low impedance valve be used, by its lower amplification factor. Moreover, these low impedance valves are power valves costing more initially and to maintain.

FERRANTI

AF3 25/-

AF3 25/-

IMPEDANCE.

AT 100 PERIODS 50,000 OHMS.
AT 500 PERIODS 410,000 OHMS.

NO BETTER TRANSFORMER IS AVAILABLE AT ANY PRICE.

FERRANTI, LTD.,

HOLLINWOOD, LANCASHIRE.

FERRANTI ELECTRIC LIMITED, TORONTO, CANADA. FERRANTI, INC., NEW YORK.

ELEGANT SIMPLICITY

A child can operate this cleverly designed receiver supplied complete, ready for use, leaving ample room for spare components.

It is an enviable possession to be treasured by the most discriminating lovers of music and good furniture.

A duplicate tuning system enables any two selected stations to be tuned in, and either can be reproduced by operating the control switch.

Height, 31 *in.* *Length,* 27 *in.*
Width (front to back), 20 *in.*

RECEIVER COMPLETE, including loud-speaker, 4-volt 40/80 amp. Accumulator, two 60-volt H.T. Batteries, three Valves, and Plugs for aerial, earth and extra Loud-speaker.

Price, in Mahogany or Oak **£25 0 0**
Marconi Licence .. **£1 17 6**

Satin wood and figured walnut, can be supplied at extra cost. Catalogue supplied on application.

C.A.Vandervell & Co., Ltd.,
ACTON, LONDON, W. 3.

West End Depot :—
224, Shaftesbury Avenue, W.C.2.

And at Birmingham, Belfast, Bristol, Dublin, Glasgow, Leeds, Manchester, Newcastle-on-Tyne.

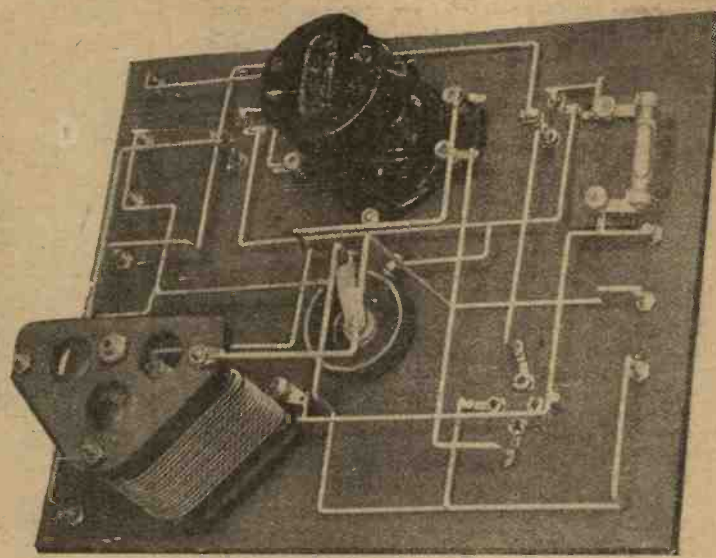
THE "SPARROW" TWO—*(Concluded)*

that the parallel method will be most satisfactory to all stations down to about 400 metres, while below that the constructor should test each method, finally using the one that gives him the best results.

The connecting up of the two aerial terminals and the earth terminal is simplicity itself, as will readily be seen from the theoretical diagram. For parallel tuning the aerial lead in is connected to the top, that is, the A.P. terminal, the earth to the terminal marked E, and this terminal and the centre one are joined together by a small piece of wire. For series tuning the top terminal is left unconnected, the aerial is taken to the centre one, which is disconnected from the earth terminal, and the earth lead is taken to this latter.

Results Obtainable

Tuning is carried out by means of the condenser dial on the right-hand side of the panel, while the usual reaction effects are obtained by varying the coupling of the Mellowtone unit. That is to say, the flat disc on top of the unit which is connected to a short extension handle is moved about over the other disc until loudest results are obtained, while at the same time the variable condenser is rotated to keep the signals at maximum strength at any given instant.

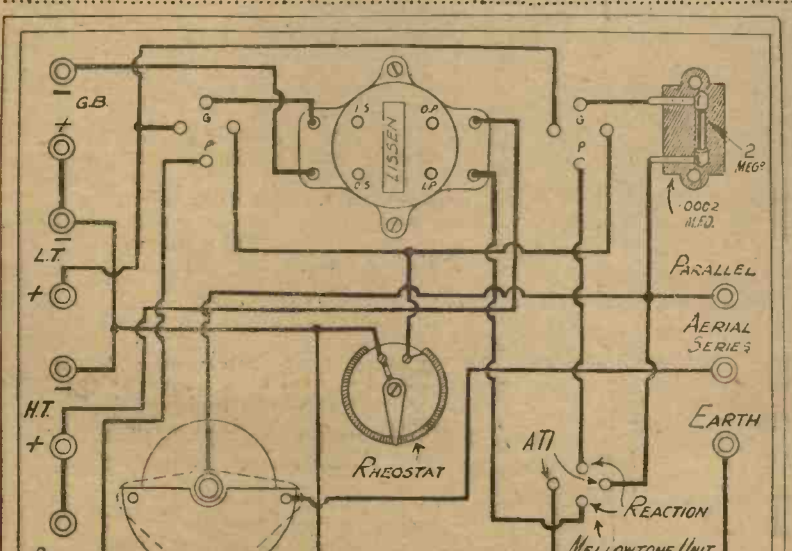


A second photograph of the wiring showing the relative positions of the various components.

The filament control on this set is not by any means critical, though the valves should be turned on so that they are no brighter than is necessary for best results.

About 3 or 4½ volts negative grid bias will be required if the full 72 volts H.T. are employed.

As regards range the set should be capable under good conditions with aerial and earth of moderate efficiency of providing really good loud-speaker strength up to 12 miles from a main broadcasting station and 60 miles from 5XX. Longer ranges will be obtained on occasion as the figures given are on the conservative side, and, of course, far greater distances can be covered if telephones are used instead of a loud-speaker.



Wiring Diagram.

WIRING INSTRUCTIONS

Connect aerial parallel terminal to moving plates of variable condenser to one A.T.I (grid) socket of tuner unit holder and to one side of grid condenser and leak. Other side of condenser and leak to grid socket of first valve holder.

Aerial series terminal to fixed plates of variable condenser.

Earth terminal to other A.T.I (plate) socket of tuner unit holder, to one side of rheostat, to L.T. negative, and to H.T. negative and to G.B. positive. Other side of rheostat to one filament socket of each valve holder. Remaining filament sockets to L.T. positive.

Plate socket of first valve holder to one reaction (filament) socket of tuner unit holder. Other reaction socket to I.P. terminal of L.F. transformer. O.P. of L.F. transformer to H.T. positive. I.S. terminal of L.F. transformer to grid socket of second valve holder. O.S. terminal to G.B. negative. Plate socket of second valve holder to one phone terminal. Other phone terminal to H.T. positive.

In Our Test Room

Gecophone L.F. Transformer

THE G.E.C. people recently sent us a Gecophone L.F. transformer having a ratio of 4-1. It is essentially a component of careful design and construction. Every detail, from its hermetically sealed casing with its crystalline black finish to its ample and scientifically arranged windings with a primary of a high order of inductance, bear evidence of careful craftsmanship. The product of a great firm such as the G.E.C. can so easily become blatantly "mass production" that it is a pleasure to examine a component originating from a firm of this kind which might well be the work of one highly skilled super-efficient master mechanic.

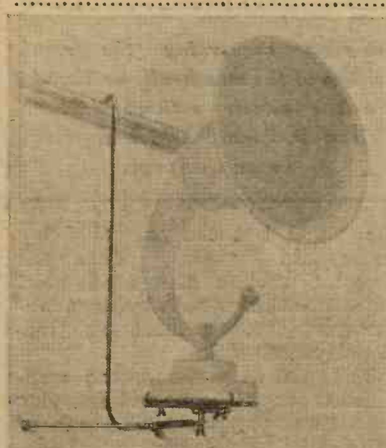
Not that this Gecophone transformer has a "hand made" appearance—it just seems to convey that air of individuality which makes it difficult to think of it in thousands.

The Gecophone 4-1 ratio Low Frequency Transformer.

And it functions excellently, too. Used in a second stage of L.F. amplification it gave evidence of a high degree of energy transference with very slight wave distortion. Personally, we are of the opinion that with transformers such as these available resistance-capacity is as many miles away from being a real "man-in-the-street" proposition as ever. In inexpert hands "R.C." can produce distortion such as even the cheapest "hedgehog" transformer was never guilty of. That is a Solemn Thought! The price of the 4-1 Gecophone L.F. transformer is 22s. 6d.

Useful Loudspeaker Accessory

It must take a great deal of courage to place a device such as the "Speakabrak" on the market. We should imagine that it is one of those articles which must either prove very successful or fail entirely. Everybody will admit of the usefulness of such a device, but it is a psychological problem as to whether or not everybody will agree that it is ornamental. And this is the primary consideration in the circumstances, as it must inevitably occupy a fairly prominent position in a room.



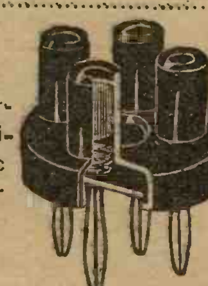
Showing how the "Speakabrak" is used.

As its name implies, the "Speakabrak" is a loudspeaker bracket. It can be suspended from a picture rail or from a hook driven into the wall. It certainly solves the problem of placing the speaker in an ideal position and it forms a very secure support. Nevertheless, many listeners are nowadays turning their attention to speakers of artistic design whose disposal demands a compromise between technical efficiency and purely æsthetic considerations.

However, it is probable that the "Speakabrak" will appeal strongly to a large number of amateurs who possess the horned types. It is a very well made article, is reasonably priced at 10s. 6d., and deserves the popularity which we trust it will gain.

An Antimicrophonic Adaptor

Probably there are still a number of sets which embody the old-fashioned valve socket or holder of a rigid character. Owners of such will be interested to learn that Messrs. Harlie Bros., of 36, Wilton Road, Dalston, London, E.8, have produced an adaptor which, plugged into an ordinary valve holder, gives it "anti-microphonic" properties. This little component is quite well made and is quite efficient in use. One of its most attractive features is its price, 1s. 3d.



Messrs. Harlie Bros. anti-microphonic valve-holder adaptor.

"Junit" Wire

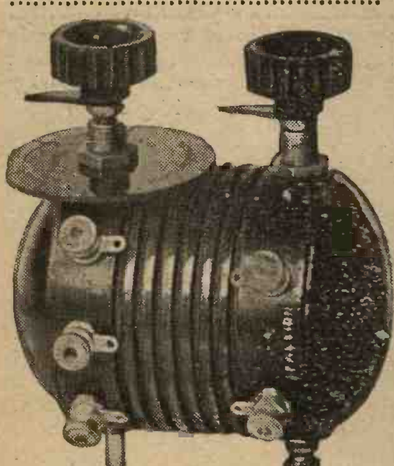
The Rexo Engineering Co., of 2, Ravenscourt Square, London, W.6, recently sent us a supply of "Junit" wire, a unique material which requires no solder. At least we should have said no *additional* solder, for it carries its own supply of this in grooves. We found that

IN OUR TEST ROOM—*(Continued)*

t renders neat, strong joints a simple matter to obtain. A touch of flux, then a hot iron and the task almost completes itself. "Junit" is sold in two sizes, viz., 17 and 18 S.W.G. (square section). A coil of No. 17 costs 1s., and 2 ft. lengths of No. 18, 2d. each.

An Interesting Tuning Unit

To the Wireless Apparatus and Battery Charging Co., of 256, Narborough Road, Leicester, is due a very interesting tuning unit. It is known as the Imperial All Purpose Coil. It is quite compact and can be mounted on a panel or plugged into an ordinary coil holder, yet it embodies both a tuner and a reaction control capable of covering a waveband of from two hundred to above three thousand metres when used for aerial tuning. Three sizes of reaction coil can be



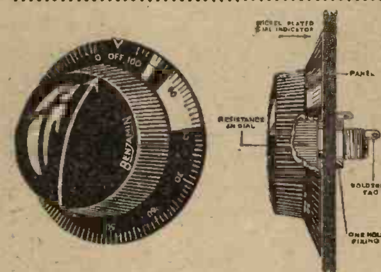
The Imperial All Purpose Coil. The right hand knob controls reaction.

obtained by various connections to three terminals and this renders regeneration smooth over the whole range. The unit can be used for anode tuning with or without reaction.

It is very nicely assembled and is a "clean job" all through. Mechanically the switch and controls work smoothly, and electrically the device is efficient. Its retail price is 22s. 6d.

Benjamin Self-contained Rheostat

One of the most common sources of trouble in an average filament rheostat arises from the general design of its moving components. In many cases the fixing and adjustment of these have to be attended to every time the component is mounted on or removed from a panel. The consequence frequently is that constructors find it difficult to obtain the satisfactory



The Benjamin Self-contained Filament Rheostat.

movement such an article should have. There are exceptions, of course, and we have one in the new Benjamin.

Here all the moving parts are contained in the dial of the component, and nothing projects behind

> *Reports concerning the new valves of the month will be found in the article entitled "That Valve Problem," which appears on another page.*

the panel but the central fixing screw and its nut. Thus the rheostat retains the mechanical adjustment given to it by its manufacturers through most constructional vicissitudes.

The dial is a handsome well-finished one and lends an improving appearance to a panel. The makers' chief claim for this component concerns its space-saving properties, but, in our opinion, this is by no means its most important advantage. Its rigidity and permanently mounted contact arm are surely the more important points in its favour.

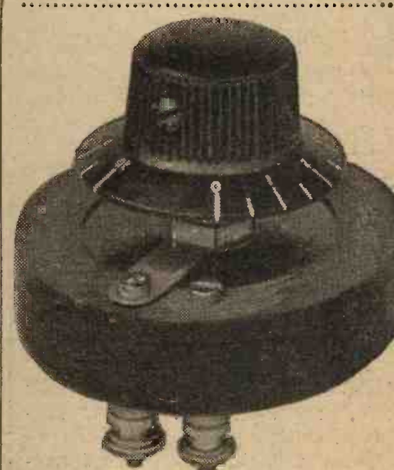
Those values are obtained with 6, 15 and 30 ohms at the standard price of 2s. 9d.

P.D. Wavelength Balance

The Automobile Accessories (Bristol), Ltd., recently sent us one of the above. It takes the form of a small-sized variable condenser of ·001 m.f.d., so made that it can be attached to an aerial lead-in tube to occupy a series position in the aerial circuit. Thus it provides an easy means of introducing "C.A.T.", and it can of course be employed in conjunction with as existing series condenser. It is a fairly well made component although its adjustment (at least in the sample submitted) is a little irregular towards a "minimum" position, but naturally it is not intended as a tuning control. Its retail price is 5s.

The "Duvolcon"

Messrs. Dubiliers have recently produced the "Duvolcon," which is a variable resistance, similar in all respects, excepting in value, to the Duvarileak, suitable for use as either a reaction or volume control. It operates very smoothly



The "Duvolcon"—a variable resistance for volume control.

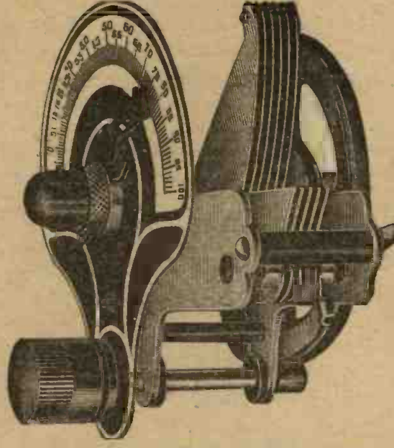
indeed, and provides a very consistent and positive series of adjustments. In either capacity it operates satisfactorily and is in all respects a dependable component. Its retail price is 7s. 6d.

Lamplugh Variable Condenser

Messrs. S. A. Lamplugh, Ltd., of King's Road, Tyseey, Birmingham, recently sent us two of their S.L.T. variable condensers. They are of efficient, modern design and incorporate slow motion movements. They operate smoothly and positively, and their maximum capacities very closely approximate their rated values. Their minimums are very low and their inter-vane resistances extremely high. At the price of 13s. (·0005 m.f.d.) and 12s. 6d. (·0003 m.f.d.) they represent very full value for money, in our opinion.

MAKES TUNING EASIER

Lamplugh S.L.F. Condensers.



Perfectly designed and beautifully finished, Lamplugh Condensers are unequalled for efficiency and ease of tuning. Built of brass with ball and cone bearing shaft. Copper indicator scale. Lamplugh S.L.F. and S.L.T. Condensers possess a remarkably efficient Slow Motion device. It is absolutely noiseless in operation, has a positive drive and backlash is impossible.

PRICES .0005 mfd. 17/-. .0003 mfd. 16/-. .0002 mfd. 15/6.
Lamplugh .0005 mfd. Twin Gang S.L.T. Condenser, complete with dial 33/6.
Lamplugh .0005 mfd. Triple Gang S.L.T Condenser, complete with dial £2 10 0.

Particulars of Lamplugh Twin Gang and Triple Gang S.L.F. Condensers on application.

Economic Electric Ltd 10, FITZROY Sq. LONDON W.1.

"Silvertown"

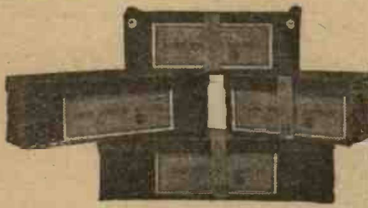
WIRELESS ACCESSORIES

Quality guaranteed by over 50 years' electrical manufacturing experience.

SILVERTOWN WIRELESS ACCESSORIES

INCLUDE—

- Batteries (High Tension).
- Condensers (All Types).
- Crystal Holders.
- Dials and Knobs.
- Earth Plates.
- Inductance Switches (10-way, etc.).
- Insulators ("Everdry," "Featherweight," Cone Lead-in, Window Pane, etc.).
- Potentiometers.
- Rheostats, Filament (One-hole fixing, etc.).
- "Silvervox" Loud-Speakers.
- Testing Buzzers.
- Transformers (All Types).
- Valve Holders, Anti-Microphonic.
- Verniometers, Etc., etc.



HIGH TENSION PRIMARY BATTERIES

(Dry Cells)

No.	Volt.	High.	Price.
1720	15	9⅛ in. by ⅞ in. by 2¾ in.	3/6
1721	30	6½ in. by 2¾ in. by 3¼ in.	7/6
1722	50	10½ in. by 2¾ in. by 3¼ in.	10/-
1723	60	12½ in. by 2¾ in. by 3¼ in.	13/-
1724	100	10½ in. by 5 in. by 3¼ in.	21/-

The 15-volt Battery forms one unit, but the larger batteries can be tapped every 4½ volts, and are provided with two "wander" plugs to each.

THE SILVERTOWN CO.,
106, Cannon Street, London, E.C.4.
Works: Silvertown, E.16.

Belfast; Birmingham; Bristol; Cardiff; Dublin; Glasgow; Leeds; Liverpool; London; Manchester; Newcastle-on-Tyne; Portsmouth; Sheffield.

Amsterdam First Prize Winner approves Lewcos Screened Coils

Mr. R. Waldo Emerson, winner of the first prize at the Amsterdam Wireless Exhibition.

Mr. Emerson writes:

Dear Sirs,

I have now finished experimenting with an All-British Six which I made, and decided to use your Split Secondary Transformers, and no doubt you would be pleased to hear the result.

Using S.T. valves throughout, I am able to get Leipzig free from London on an outdoor aerial one mile from London, and using the telephone as a capacity aerial, I have been able to receive Cardiff with a slight trace of London in the background.

The set remained perfectly stable over the entire wave-band, and I can honestly say the coils have given every satisfaction.

Yours faithfully,
(*Signed*) R. WALDO EMERSON.

Comparative tests prove that LEWCOS Screened Coils and Transformers have a lower H.F. Resistance within their screens than any other coil on the market.

Use LEWCOS Screened Coils in your set. Obtainable from all wireless dealers. Full particulars and prices sent on request to:

THE
LONDON ELECTRIC WIRE COMPANY & SMITHS, LTD.
Playhouse Yard, Golden Lane, London, E.C.1.

LEWCOS

Screened Coils

JUDD

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.

My Five Valver

DEAR SIRS—I thought the most interesting item in last month's MODERN WIRELESS was Captain Round's article on how to arrange 5 valves for pure reception.

I should like to see this article enlarged on, as I am a keen follower of the school of listeners in search of pure reproduction of highest quality.

Could I receive answers to one or two points arising from Captain Round's article ?

1. Could he give some further details regarding the H.F. transformers and how these should be designed ?

2. Regarding Fig. 1: The Marconi people in a letter to me have recommended with D.E. 5B valves not more than 100,000 ohms anode resistance with a grid leak of ·552. I notice the suggested values in ten figure are very different. I should like to know what type of valve he recommends.

3. Does Captain Round recommend the use of the popular screened coils in H.F. stages.

I should be so grateful for guidance on these points.—Yours truly,

JOHN D. DAVIES.

Lyth Hill, Shrewsbury.

Capt. Round's Reply:

[Below we publish Captain Round's reply to the above letter.—Ed.]

The article in question was very general and the diagrams only theoretical.

I am now writing an article on the subject of the 5 valve amplifier for pure quality with much more specific detail, but I append brief replies.

Question 1:

In a forthcoming article I will give exact details of H.F. transformers.

Question 2:

If three valves as follows are used -
Rectifier D.E. 5B;
1st note magnifier D.E. 5B;
2nd note magnifier D.E. 5B

a perfectly straight frequency characteristic up to 6,000 $\sim$ from 70 $\sim$ can be obtained with the following leaks and condensers:—1st stage anode ·1 Ω, ·002 condenser and 2 Ω leak; 2nd stage ·25 Ω anode, ·002 condenser and 2 Ω leak. But as a slightly falling characteristic is generally liked I rather tend to increase the value of the plate resistance [the one in the rectifier has the most effect] up to the values shown in the article. A lot depends on whether one's loudspeaker is high pitched or not.

My present preference is for D.E. 8 H.F., D.E. 8 H.F., D.E. 5.

Question 3:

Screened coils are good, and should always be used, but I have no experience with those being sold.

H. J. ROUND.

German Broadcasting Good

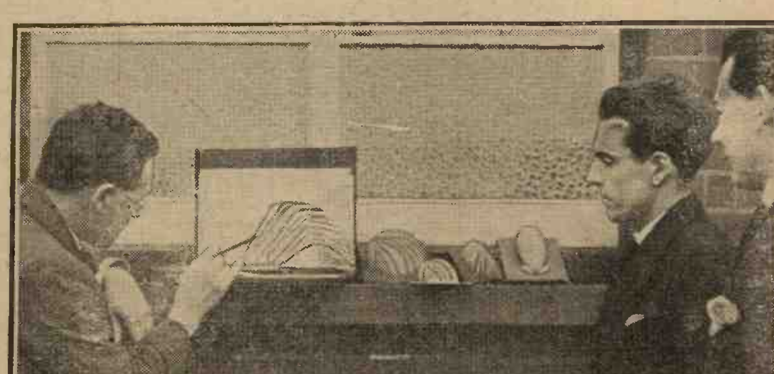
SIR,—I entirely disagree with your broadcasting correspondent's suggestion of poor quality on the part of German broadcasting. The quality of the higher-powered stations at least is as good as our own with the added advantages that power brings with it.

I have heard such music from Prague, although this is not German, recently, as puts our own in the shade.

Broadcasting of music is more than an electrical problem; it includes, amongst other factors, musicians and instruments. Further than these the receiving set is of vital importance, and no set in which reaction has to be employed in order to make up for inherent shortcomings will give the listener quality. The cry of "one valve per mile" though admittedly Utopian is, in principle, sound.

JOHN P. HILLHOUSE,
M.I.Mech.E., M.I.A.E.

Kings Heath, Birmingham.



Radio Operators for Air Liners.
A lecture and demonstration at Chelmsford Training College, the subject being waves and wave-forms.

Explore the Ether—

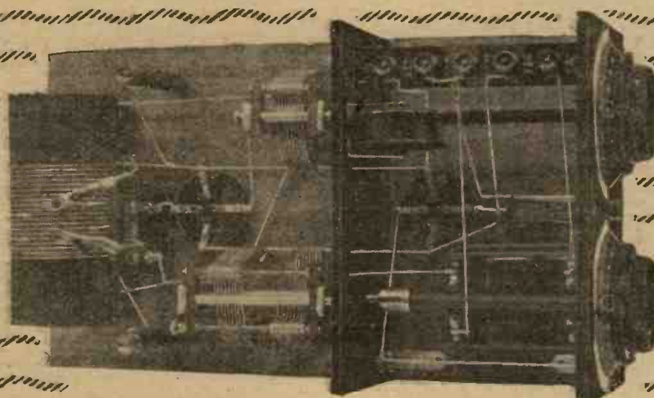
—ON A SHORT WAVE RECEIVER

The Bowyer-Lowe Short Wave Receiver is compact & easy to operate. It's performance is remarkable, being made up of the famous Bowyer-Lowe Components.

AN OPINION FROM THE TRADE

...."We have built up a model for demonstration purposes & must confess that it is the best Short Wave Set we have handled. It is as simple to use on an ordinary aerial as a set which has been designed for receiving broadcast. We wish you every success"....

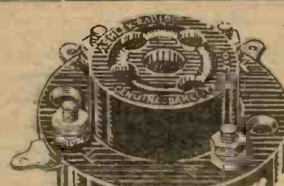
Send 1/- for booklet with constructional details and blue print – and explore the ether from your armchair.



TESTED RADIO **Bowyer-Lowe** APPARATUS

ANNOUNCEMENT BY THE BOWYER-LOWE C° LTD, LETCHWORTH HERTS

The Modern Valve Holder



In the light of developments in the majority of modern Valves it is no longer necessary to purchase specially constructed, but doubtful, non-vibratory holding devices, the stage has been reached analogous to that which led to the vetoing of similar gadgets in the development of the filament lamp.

The new Ashley Valve Holder possesses every required refinement. Constructed throughout of *genuine bakelite* and non-oxydising metal, the valve sockets are surrounded by air throughout 90% of their length. Sockets and connections are stamped complete out of *one piece* of non-oxydising metal, provision being made for wiring to terminals or soldering to tags. Moreover, a special safety groove is provided to ensure the valve legs engaging with the corresponding sockets.

1/3d

Ashley Radio

Use in every stage (except detector) and save 1/6 per Valve

Ashley Wireless Telephone Co. (1925) Ltd. Finch Place, London Road, Liverpool

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The only Accumulator which has all these seven features:

1.—Charged ready for use—merely add acid.
2.—Laminated buckle-proof plates
3.—No leaking away of charge when not in use.
4.—Large coloured terminals and special spray-proof filter cap.
5.—Rapid charging and slow discharging.
6.—Stout glass cell requiring no separators.
7.—All plates made under the special activation process

Charged in 8 hours.

Laminated plates permit thorough and instant penetration of acid. Other accumulators with thick plates must be charged slowly over 30/40 hours. The O.V.D. can be charged in 8 hours. Time and money saved to you.

2 volts—for use with Dull Emitter Valves Dimensions 6 in. by 3 in. by 2½ in. 10 amp. hours. **5/6**

OLDHAM & SON, LTD., DENTON, MANCHESTER.

London Office and Service—6, Eccleston Place, S.W.1

Special Activation Process Batteries

OLDHAM

G.A. 8112.

ADVICE TO INVENTORS

(*Continued from page* 302)

This invention is very ingenious, and I am not aware that I have seen the same principle described before, although instinct tells me that it would be surprising if the principle proved to be novel.

I should say that if it were technically successful it would undoubtedly have considerable commercial possibilities, although it suffers from the obvious commercial disadvantage that it is restricted to use on alternating current supply.

I believe this invention would fail, however, entirely on technical grounds. In the first place, it would be a difficult matter to make the inductor sufficiently small and yet operable from the electric light mains. In the second place, I should say it would be a still more difficult matter to heat the cathode by induction in this way at ordinary frequencies. And in the third place, I should imagine that even if the valve were got to work, the reproduction would be completely swamped by the A.C. hum. Certain methods for eliminating or at any rate minimising the A.C. hum suggest themselves, but on the face of it I imagine that the invention would be one which would require months of laborious experiment before it could be got even into a successful laboratory form. It is a very suggestive invention, however, and one which might prove well worth careful consideration.

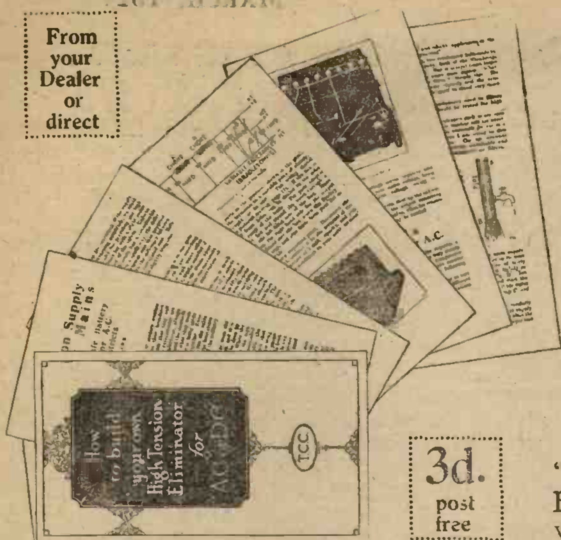
Another Valve Invention

No. 68. This is another invention relating to valves, It is intended to provide a considerable electron emission in a valve by the agency of a comparatively small heating current. A filament, heated in the usual way, emits electrons which are directed by means of an electrostatic field on to another cathode. The electrons acquire considerable velocity in the electrostatic field and hitting the second cathode they give rise (according to the inventor) to a much greater electron emission, which, in turn, is passed through the usual grid to the anode.

This invention suffers from very many technical disadvantages, and even if these could be overcome, it would suffer from manufacturing disabilities and furthermore would, in my opinion, have little commercial application. It is, therefore, an example of an invention which suffers from almost every possible defect. Although very interesting theoretically, it is one on which I consider that time spent would be decidedly in the nature of a speculation.

In the first place great difficulties would be encountered in getting the initial electron stream to behave itself in the docile way indicated it should be remembered that there are other high potential electrodes within the valve, and it is not clear why the electron system should choose to follow so obediently the path indicated. Secondly, it is very doubtful whether much more copious emission of electrons would be obtained from the second cathode; this would depend upon the nature of the material with which that cathode was coated, and in that respect alone a considerable research might have to be undertaken. Thirdly, the electron stream between the cathode and the anode would be complicated by stray electrons from the filament. Fourthly, the advantage of a smaller filament current is offset by the necessity for using a high-tension battery between the filament and the cathode. And there are, indeed, a whole host of other technical objections which the reader will have no difficulty in seeing for himself.

From your Dealer or direct



3d. post free

Build your own H.T. Eliminator

Here's a book that will show you how to do it!

WHY continue buying H.T. dry batteries when right in your own home is current waiting to be used. Enthusiasts everywhere, now, are saving money by obtaining H.T. Supply from their electric light mains. At little cost and without skill they are building their own H.T. Eliminators which enable them to obtain constant H.T. supply at very little cost.

There is a little book available which gives clear consise instructions and easy-to-follow photographs and diagrams which enable them to build their own units. It is called "How to build your own High Tension Eliminator for A.C. or D.C.," and is written by Mr. Percy W. Harris, M.I.R.E., for appropriately enough, the makers of T.C.C. Condensers.

Write for this booklet—or get it from your Dealer's—and with very little study you'll be able to build an eliminator which, because it is designed and described by an authority, is absolutely efficient and which, because it employs the special T.C.C. 600 volt D.C. Test Condensers, is perfectly safe and reliable. Get your copy to-day. It only costs 3d.

T. C. C. Condensers for Battery Eliminators

Advt Telegraph Condenser Co., Ltd., Wales Farm Road, N. Acton, W. 3. G.A. 7931

Sold by Test

Every Wireless Dealer cannot stock every make and type of Loud Speaker, but both they and you can obtain one of our

Orphean

LOUD SPEAKERS FOR SEVEN DAYS' FREE TRIAL

without expense or obligation. Test one on your own set at home. For purity of tone, for volume, for finish and appearance there is no finer value offered.

R. Waldo Emerson, Winner of the World's Championship at the Amsterdam International Competition, says:

"I should like to add my appreciation to the numerous letters you must receive regarding your 'Orphean' Loudspeaker. I must say they are more than value for money, as the volume and tone they produce are wonderful."

ORPHEAN
Model De Luxe.
Height ... 24in.
Flare ... 14in.
PRICE 70/-

ORPHEAN
Model No. 12.
Height ... 21in.
Flare ... 12in.
PRICE 50/-

ASK YOUR DEALER TO GET YOU ONE.
Call his attention to this advertisement.

LONDON RADIO MANUFACTURING CO., LTD.
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Build a Better and Brighter Set BY USING TROLITE

RADIO PANELS & MOULDINGS DE LUXE

PRICES:
Polished Black
$\frac{3}{16}$"—$\frac{5}{8}$d.
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Mahogany Walnut Cube Wavy
$\frac{3}{16}$"—$\frac{7}{8}$d.
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per square inch.

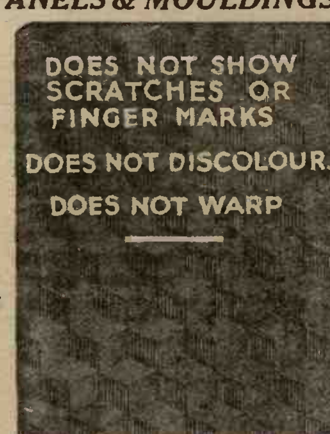

Illustration Cube Design.

5 FINISHES:
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Polished Mahogany
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Wavy Etched Black
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Standard Panels stocked by leading dealers.

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Telephone: MUSEUM 8630-1-2. Telegrams: "Distancing, Wesdo, London."

AN HOUR WITH H. F. TRANSFORMERS

Continued from page 214

noticeable in many supersonic heterodyne receivers and accounts for the poor quality given by some.

Nor must we forget that coupling efficiency increases with the increase of frequency. A coupling that proves excellent on, say, 250 metres, may be too loose for 500 metres. A realisation of this fundamental fact has led American designers to produce H.F. transformers with automatically variable coupling between primary and secondary windings, the coupling progressively increasing as the tuning is taken from shorter to longer wavelengths. The variation is brought about by attaching the whole as part of the primary winding to the same shaft as the moving plates of the variable condenser, and arranging the relation of the two windings so that coupling is tightened as more of the condenser plates are brought into mesh. Another method is to actuate the moving coil by a cam action from the condenser shaft.

I have already occupied more space than I intended in a general discussion on some of the points affecting the design of high-frequency transformers, and even now I have only been able to touch upon the more important aspects. Sufficient has been told to show how misleading may be experiments conducted by those who are unacquainted with the basic principles of high-frequency design. For example, the change from one type of valve to another may give, in a high-frequency stage, a great improvement in results, leading the experimenter to think that for this particular purpose one valve is greatly superior to another.

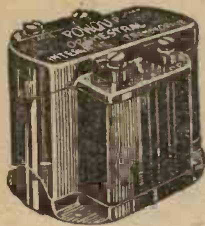
Future Development

All that may be shown is that the primary of the transformer used is better suited to one valve than to the other, whereas if two separate transformers were designed, one for each valve, results with both might be equally good. Again the comparison of two sets with different high-frequency transformers may suggest that one set of transformers is much better than the other, whereas the real cause of the difference may be that in one set the coils are better spaced than in the other. I have also known cases where experimenters have claimed extraordinary stability for a particular type of transformer, whereas the actual facts were that the positions of the windings brought the metal end plates of the condensers directly in the field, stability being obtained by the losses due to the eddy currents so set up!

In my opinion, future developments in radio frequency amplification will be largely connected with the shielding of each stage, not merely of coils but of all valves and wiring, while shields will be kept well away from the coils themselves. Probably, too, the size of the shields will be kept reasonable by using transformers with restricted fields.

Meanwhile there is still room for a mass of experimental work by any intelligent experimenter, and the ability to choose from a considerable number of tappings on the primaries of high-frequency transformers or some other method of varying coupling would appear to be an advantage in view of the multiplicity of valves now available.

Within 2·2 per cent of Absolute Efficiency



The officially certified efficiency of the "Powquip" Orchestral Transformer — expressed as the co-efficient of coupling between the primary and secondary windings — is 0.978 — i.e., within 2.2 per cent. of absolute efficiency. For so truly reproducing broadcast music, song, and speech there is no equal to

The case is stamped from high-grade electrolitic copper, and is polished, buffed and lacquered.

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THE POWER EQUIPMENT COMPANY, LIMITED, KINGSBURY WORKS, THE HYDE, HENDON, N.W.9.

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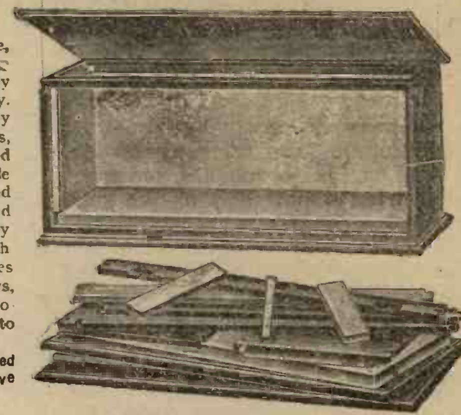

"American" Type, specially designed, in well seasoned highly polished mahogany. Lid provides easy access to components, which are mounted on a baseboard made to slide out. Supplied in sections, tongued and grooved ready for assembly, with all necessary holes drilled; brass screws, hinges, etc., are provided, in addition to full instructions.

Can be assembled ready for use in five minutes.

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LECLANCHE WET H.T. UNDER 3½d. VOLT.

Complete Wet H.T. Cells, with LARGE capacity Sacs. Will last years. Sal ammoniac solution only used. Every Cell fitted with Brass Screw Terminal. No soldering needed. Most efficient H.T. on market. Dead silent in use. Ideal for multi-valves. Voltage 1.5, Price 5/- per dozen. Carriage extra. Lists free. Sample Cell 6d.

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Elwell 4 Valve Receiver, "Aristophone" Model No. 150, Wave Band, 300—4,000 metres. Mahogany Case, Plug and Jack switching, complete with Valves, H.T. Batteries and Accumulator. Shop soiled only. **Cash Price £33**

List Price .. .. £43 3s.

Fellows' 5 Valve Receiver, Complete with Valves, H.T. Batteries, Accumulator, Full Set of Coils, Plug and Jack Switching. Any number of Valves can be used. Aerial equipment included. Contained in handsome walnut Cabinet with glass doors. Valves protected. .. **Cash Price £19 10s.**

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Makers of the ORIGINAL world-famous

BECOL LOW LOSS FORMER

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Size 3 inches diameter to outside of wings.

Prices

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Up to 36-inch lengths.

NOTICE

Do not be put off with an imitation. Ask for BECOL and use the Former with a reputation.

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THE BRITISH EBONITE CO., Ltd., Hanwell, London, W.7

Ebonite Rods, Tubes and Sheets, Panels guaranteed free from surface leakage.

OUR MISINFORMATION DEPARTMENT

Continued from page 270

difficulty in receiving American stations in January. They come in well on the headphones, but when he tries to put them on the loud-speaker the results are very poor.

The trouble is due to your loud-speaker being unable to handle the American accent. Try putting about twice as much negative grid bias as is necessary on the L.F. valves during ordinary reception, place a little chewing gum on the diaphragm and always refer to your valves as "toobs" in its hearing. This will accustom it to the language, and after a few weeks you should have no further trouble.

* * *

N.B.G., Penzance, complains that his H.F. stage is uncontrollable, as it oscillates violently. It seems from the other details he gives that this valve is working too efficiently for stability. We, therefore, suggest that he introduce the following switches, which should be of the Dewar pattern: Series-parallel, tune-stand-by, long-short wave, H.F. on-off, reaction on-off, reaction reverse and grid condenser rectification to anode bend. These alterations should give your receiver the desired stability, though it is, of course, possible that they will make it oscillate worse than ever. That, however, does not worry *us*.

* * *

DELIGHTED, Bolton, Lancs, writes to say that he has successfully used his wire mattress as an aerial and wonders if anyone else has had a similar experience. Yes, Delighted, there are exactly 15,073 mutts who have tried this wonderful discovery and have communicated the results to the press. Other substitutes for aerials that have received an almost equal degree of publicity are thimbles, needle cases, front door knockers, trousers presses and coffee machines. Forget it, Delighted, forget it.

* * *

DETERMINED, Windermere, has constructed a five-valve set of special design which will not work. He describes the various efforts he has made to get the set to work, and asks us to help him.

We would suggest, Determined, that the following experiments be tried to see if they will assist you to locate the trouble you are experiencing.

1. Reverse aerial and earth connections and short them.
2. Reverse the connections to the variable condensers tuning the H.F. circuits. This should introduce hand capacity effects. Since these effects cannot be present in the absence of a signal the signal should appear.
3. Reverse the connections to grid and plate of the first two valves. This will give you increased stability and freedom from self-oscillation as you thereby obtain a form of reversed feed-back.
4. Short your accumulator since its voltage is too high for use with the type of valve you are employing.
5. Try three reaction coils in series, alternate coils being reversed from each end.
6. If this results in a noisy background reverse the H.T. battery This will give absolute silence and thereby considerably increase the selectivity of the set.

If all these expedients fail, drop the set on to a concrete pavement from a height of fifty feet, it will then give you no further trouble.

* * *

CANDIED FRIEND, Oxford, complains that his loudspeaker emits a series of howls and squalls; how can he stop it? Put a sock in it.

* * *

Other queries that have unavoidably been held over owing to lack of space will be dealt with next month. (Perhaps.—Ed.).

Questions Answered

Parasitic Oscillations

W. G. K. (Ealing).

"I have recently completed the construction of a five-valve set using two H.F. stages with 6 pin coils (screened) and neutralised by the usual method. While results are not bad considering my location, I am not altogether satisfied that the set is giving me all that could be obtained from five valves, using a 2-v-2 circuit. The control is quite easy, but there appears to be a certain deadness on some of the readings of the condensers, while there also appears to be an undercurrent of oscillation going on in the H.F. stages. This oscillation is difficult to describe because it does not appear to occur on the wavelengths to which the set is tuned, though I am certain that the set is oscillating, because on touching certain of the leads inside the set this peculiar effect ceases and signals are increased in strength. What is likely to be the trouble?"

As you do not give full details of the circuit which you are using it is almost impossible to place the fault at any particular part of the set, but from your description we should say that you are being troubled by what are known as parasitic oscillations. Exactly how these arise we cannot say without a thorough overhaul of your set, but in order to do away with the trouble once and for all we suggest that you alter the circuit of your receiver so that the H.F. side has its stages coupled by means of transformers having not too tight a coupling between the primaries and the secondaries, the sections of the latter being centre tapped. The centre taps on these secondaries will then be connected via resistances of about 100,000 ohms to the filaments of the valves, the two ends of the secondaries being connected to the grids of the valves and the neutralising condensers respectively.

You will find a very suitable circuit in the book given away with this month's issue of MODERN WIRELESS. This circuit has been specially designed so as to render parasitic oscillation impossible and special H.F. transformers (fully described in the articles dealing with the set) have been constructed so that maximum efficiency is obtained.

* * *

Anode Bend Rectification

D. V. C. (Catford).

"I am considering the construction of a three-valve set using a Det. and 2 L.F. stages, the latter being resistance coupled, and I wish to employ anode bend rectification on the Det. valve. In order to obtain sufficient signal strength would it be advisable to employ reaction, and what value of grid bias will be necessary on the L.F. valves in order to give best results?"

We do not think you will find it necessary to employ reaction, and where an anode bend detector is being used it is usually best not to have any form of regeneration between the plate and grid circuits of that valve. If you decide to use reaction we advise the use of the Reinartz type of feed back, as this is more useful in the circumstances than that where an ordinary coil in the plate circuit is coupled back to the grid coil.

With regard to the grid bias, this will depend upon the type of valve you are employing and the actual H.T. voltage available at the plate of the valve. You should follow the valve-maker's specification in this respect, as the value will depend upon the resistance employed in the plate circuit of the valve and the applied H.T. voltage, besides the emission characteristics of the valve itself. We would advise you to employ one of the new high *mu* valves recently brought out for the purpose of resistance coupled amplification, such as the Cossor RC's, Ediswan RC2, Cosmos SP 55 B, PM5 B, etc., for the first L.F. stage, as well as for the detector

* * *

Overcoming Aerial Resistance

T. F. C. (Middlesbrough).

"I am contemplating the construction of a three-valve set of quite conventional type, using H.F. Det, and one L.F. valve. As my aerial is rather poor and somewhat screened, I have been advised by a friend to employ reaction on the aerial rather than on the anode of the H.F. valve. Which do you think would be the better?"

From the point of view of efficiency as well as selectivity we would advise the use of reaction on the aerial for the simple reason that you can keep the H.F. resistance of the anode circuit within reasonable limits when constructing the set; but the resistance of the aerial will always tend to decrease the sensitivity of the receiver. By applying reaction to the aerial circuit you will in some measure negative this resistance and improve the all-round efficiency of the installation.

* * *

DX in the Country

B. G. S. (Haywards Heath):

"Can you recommend me a very

(*Continued on page* 326.)

QUESTIONS ANSWERED

Continued from page 324.

simple two-valve set, employing two or more ordinary plug-in coils, that is capable of receiving distant stations on the phones here? My location is roughly 45 miles from London, and I understand that reception is quite good in this particular part of Sussex."

As you only wish to receive on the phones, a set consisting of H.F. amplifier and Det. would meet your requirements and bring in a great number of transmissions.

The circuit can be arranged so that the H.F. valve is coupled to the detector by means of an H.F. transformer. The aerial circuit can simply consist of a plug-in coil (with a ·0005 variable condenser across it), to which is coupled a reaction coil. These two coils can be fitted in a two-way coil holder, the reaction coil being made movable.

If necessary, you could try the effect of placing the variable condenser referred to in series with the aerial lead, but this will not be necessary unless the set refuses to oscillate or else you experience bad interference. For the B.B.C. band of wavelengths we suggest you employ a 35 or 50 turn coil in the aerial circuit, a 35 or 50 in the reaction, and use a 300-600 metres H.F. transformer. It may be advisable to try the effect of joining the secondary winding of the H.F. transformer to + L.T. instead of – L.T., as certain detector valves operate best with these connections.

Avoiding Hand Capacity

CONSTRUCTOR (Oulton Broad, near Lowestoft).

"I have built several sets of different kinds, mostly with one or more H.F. stages, and I am often up against the hand-capacity trouble.

"Generally I can cure the effect by reversing leads to one of the tuning condensers, but this means altering the set after it has been made up. I am wondering if there is any rule I could follow in wiring up, so as to avoid the necessity of changing over after the set has been made?"

Yes. A good rough and ready method of avoiding hand-capacity effects is to notice whether the various leads in the receiver, as they are being placed in position prior to soldering, are to be connected directly to earth, or are separated from earth by a tuned circuit.

In the former case, the wires may be brought near to the panel, and hand-capacity will not be found troublesome; but any lead which is separated from earth by an intervening tuned circuit is liable to give rise to hand-capacity effects, if it is brought too near to the tuning controls.

The reason for this, of course, is that the hand, or indeed any part of the body of the operator, is "earthed." And if brought near to that side of a tuned oscillatory circuit which is also earthed, there is little likelihood of disturbance of tuning, etc.

But, on the contrary, if the earthed hand of the operator is brought too near to any point in the circuit where the signal potential is varying with regard to earth, tuning is very liable to be upset by every movement of the hand.

For instance, in the case of the H.F. wiring in a two valve and crystal set, in which one side of the aerial coil and condenser is connected directly to earth, the wires to these points could be brought near to the front of the panel with impunity. Hand-capacity would not affect these wires.

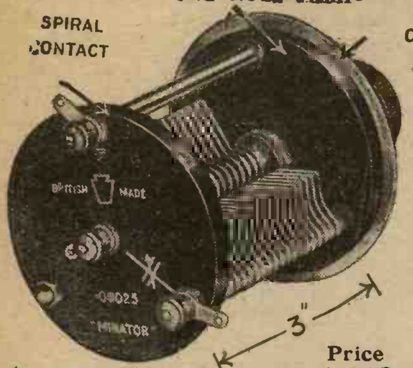
Similarly, if the H.T.+ side of the tuned anode coil and its condenser are connected to earth (*via* the H.T. battery), hand-capacity trouble is not likely to arise with these leads either.

The aerial side of the aerial coil and condenser (*e.g.*, the grid connection) *has* a tuned circuit between it and earth. Consequently if the hand is brought near to the grid wiring, hand-capacity effects are marked.

In the same way the plate lead from the tuned anode to the first valve, and the grid connections to the second valve, are separated from earth by the tuned anode circuit, so all this wiring is likely to give rise to hand capacity effects.

It should be noted that the steady potential of the H.T. battery wiring is relatively unimportant. What matters is not the voltage applied, but the *difference* in voltage that exists at any moment across the tuned circuits, due to the signal impulses flowing in the circuits.

Constructors! Here is a real precision Condenser

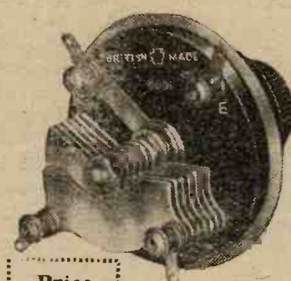


Price 10/6

HERE is something new. A condenser which effectively meets every need, and which incorporates every advantage possible. It is the Keystone "Minator" Precision Condenser. In a capacity of .00025 mfd., it employs square-law tuning. A stout shield is provided to withstand all hand-capacity effects. The Keystone "Minator" embodies spiral contact and employs the well-known method of one-hole fixing. **Its extremely small dimensions ensure very little panel space being occupied.** A real example of precise highest-quality all British workmanship, the Keystone "Minator" Precision Condenser will appeal to every constructor who appreciates a fine instrument. It is invaluable for reactance tuning, H.F. coupling, and, in fact, for all work where a precision condenser is required. .00025 mfd.

Another new Condenser—the "Keystone Midget"

HERE is another new Peto-Scott production. It is the Keystone "Midget" Panel Mounting Condenser. It is designed with the same minute care and eye for detail which marks the "Minator," and utilises the same square law method of tuning. Its unique taper bearing ensures a delightfully smooth movement. The hand capacity shield is an effective guard against injurious capacity effects from the hand. Another fine example of British workmanship. .0001 mfd.



Price 5/6

Have you built your Solodyne yet?
If you are about to build the well-known Solodyne Receiver you should send for our full-size Wiring Diagrams. Post free 1/6 each.

OTHER KEYSTONE COMPONENTS

Keystone H.F. Choke

A unique form of low capacity winding makes this choke very efficient for all wavelengths between 300–2,000 metres. Recommended for use in the Solodyne, All-British Six, and many other well-known Sets.
Especially suitable for split coil circuits. Price **8/6**

Special Six-pin Base

To replace the more expensive standard screened coil base in sets where the actual screen is not required. Standard spacing with terminals arranged for easy accessibility **2/9**

Keystone Fixed Resistors

In varied resistances, suitable for every type of valve

Price **2/6**

Details of many up-to-date sets appear in the new edition of the "Pilot Manual." Fully illustrated and containing much useful advice, this book should be in the hands of every enthusiast. Send for it. Post free. **6D.**

THE PILOT MANUAL

PETO-SCOTT Co., Ltd., 77, City Rd., E.C.1. *Branches:* 62, High Holborn, London, W.C.1. WALTHAMSTOW: 230, Wood Street. PLYMOUTH—Bank of England Place. LIVERPOOL—4, Manchester Street.

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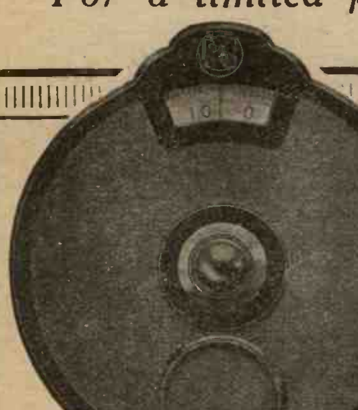

The 'Samson' Vernier Dial.

Ratio 10-1. Diam. 4 in. Fits any condenser with ¼ in. spindle. Dial housing of Best Black Bakelite to harmonise with any panel. Hair-line indicator calibrated 100-0-100, enabling the dial to be used on either clock or counter-clockwise condensers. Free from back lash. One hole only required in panel for fixing.

Special price 6/- each. Postage free on orders over 10/- in value.

Send for New Season's List. 66 pages fully illustrated, and containing new circuit diagrams. Free and post free.

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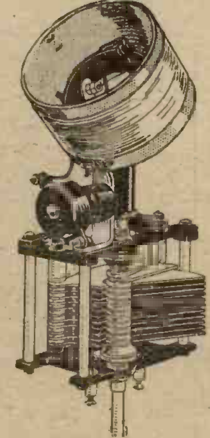
FOR THE "*PARADYNE FOUR*"
as described in "Wireless Magazine"—March, 1927



PARADYNE H.F. TRANSFORMER

If you want a circuit unequalled for constant sensitivity and stable tuning try the wonderful "Paradyne Four," described in the March issue of the "Wireless Magazine."

For this circuit the Cyldon research laboratories have produced a new variable condenser on the logarithmic principle—better than either Straight Line Wavelength or Straight Line Frequency. It is the CYLDON LOG MID-LINE CONDENSER.

Two Paradyne Units have been designed, of which this Condenser is an essential part. Both are fixed to the panel in the same way as a variable condenser, and wiring-up is extremely simple. They are the:

PARADYNE AERIAL COUPLING UNIT £1 12 6

PARADYNE H.F. TRANSFORMER £1 17 6

CYLDON TEMPRYTES—the best means of valve control—are suitable for the PARADYNE FOUR. Ask your dealer for free chart showing resistance required for the particular valve you are using.

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(Pronounced SIL-DON)

If any difficulty in obtaining Cyldon products locally, write direct to:—

SYDNEY S. BIRD & SONS,
CYLDON WORKS, SARNESFIELD RD., ENFIELD TOWN, MIDDX.
Telephone: ENFIELD 0672.

That Valve Problem

(Continued from page 238)

With regard to the last valve, this, of course, must be of the super-power type, having a long straight portion to its curve and provision must be made for at least 18 volts grid bias.

Reinartz Three-Valver

The Reinartz three-valver is merely a detector followed by two transformer coupled stages of L.F. Here a fairly high μ valve should be used for the detector, and one of less impedance and μ for the first L.F. A good combination would be a PM5 or DE5B in the det., and a SP50 in the second, or a DE5 or Cossor 610D. The last valve should be of the power or super-power type, such as the ST63, PM256, B4, SP55R, PV5DE, Stentor 6, etc. So much for the 6-volters, though the 2- and 4-volt valves will give excellent results, provided they have characteristics similar to those mentioned, for it is impossible to give all the valves by name in the space at my disposal. In any case, a power-valve should be chosen for the last stage.

New Valves

Now just a word about the new valves that have been brought out during the last month. Let's take the most interesting of all—the Marconi or Osram KLI, which is, undoubtedly, an important addition to the range of valves now on the market. This valve is designed for operation direct from the A.C. mains, only a small alteration in the circuit of any receiver being necessary to make it suitable for use with this valve.

Under test these valves have given good results in a det. and L.F. receiver, using the circuit shown on page 238, with the transformer supplied by the manufacturers. As yet, of course, it is too early to give a full report of the valves, as it remains to be seen how long they will last under operating conditions.

The heating element is kept at a fairly high temperature, and the cathode obtains its heat by radiation, glowing at a dull red. Thus, although only a few volts are necessary, the filament is kept at a considerable strain, and I should not like to say more about this valve at this juncture than to state that those on test have so far behaved excellently, though, of course, they have only been in operation for a short time.

Owing to the heavy current flowing in the filament circuits of the set (2 amps. for each valve used) fairly stout rheostats will be necessary, and any on and off switch included should be of heavy construction or serious arcing at the contacts will take place.

On test three valves took about 27 watts from the mains and about 7.7 to 8 watts per valve in filament consumption. Running H.T. and L.T. from the mains with these valves needed about 36 watts.

Two other valves that were placed before the public recently are the DEH612 and DEL612, which come under the 6 volt .12 amp. class, and are designed for H.F. or resistance coupling and general purpose requirements respectively.

On test the H.F. valve gave excellent results, both in neutralised and straight circuits.

The L.F. valve (DEL612) makes quite a useful detector if the impedance in its plate circuit is not too high, and quite a good first L.F. valve. It is in this capacity (transformer coupled to the detector valve) that I have found it to operate best. It cannot be expected, of course, to be capable of acting as a power valve and must, therefore, not be placed in the final stage of a receiver if more than one L.F. valve is being used.

At the reasonable figure of 14s. each, these valves can be thoroughly recommended.

Additional Cossor Valves

Messrs. A. C. Cossor, Ltd., are evidently determined to make up for their past deficiencies in the matter of 6-volters, and very shortly their 6-volt range will be one of the best on the market. At the present moment I am not at liberty to give the full details of these valves, but I have already tested some of the "advance copies" and am very pleased with the results.

Among this series is a resistance-capacity valve having an impedance of 80,000 or so with the excellent magnification factor of 50. Further down the scale comes an H.F. valve with a μ of 20 and an impedance of about 20,000, and this has given very good results as both H.F. amplifier and in second stage resistance coupling. Finally, before we reach the Stentor 6 at the bottom of the scale, we have an intermediate L.F. valve with a μ of 8, or thereabouts, and an impedance of just about a thousand times that figure. In short, these valves represent a very important step towards real efficiency in valve design.

A LETTER

FROM

"UNCLE ARTHUR"

SIR,—My attention has been drawn to a paragraph attributed to your paper, which says:

"Incidentally, it is stated at Geneva that the Germans propose to ask the Broadcasting Union to take up the matter of the international pooling of licence revenue. Their particular object is to get something out of the listeners in France and England who make a practice of taking German programmes."

We will be grateful if you will afford us the opportunity for stating that not only has *no* proposal been made by Germany or any other country which is a member of this Union on the lines indicated above, but that such a proposal is unlikely to be made, it being contrary to the spirit animating European broadcasting.

On the other hand, we are sure the readers of MODERN WIRELESS will be happy to hear that Germany is missing no opportunity for collaboration in giving European listeners irrespective of their whereabouts and licensing regulations the best of which the new art is capable.

In such cases, too, where her research promises a useful contribution to the technique of broadcasting, Germany does not hesitate to give such information as may be helpful to other European broadcasters.

Most friendly relations exist amongst the European broadcasting organisations, and licensed listeners may be sure that no additional demand is likely to be made from them for the privilege of listening to programmes in foreign countries.

Yours truly,

A. R. BURROWS,

Secretary General,
Union Internationale de Radiophonie,

6, *Rue Du Rhone*, 6,
(1, *Passage des Lions*)
Geneva.

:: MODERN :: H.F. PRACTICE

(Continued from page 247.)

fact that they provided a simple and cheap means of constructing inductances for use in a multi-stage high-frequency amplifier which would practically eliminate magnetic coupling between successive stages, while losses were not introduced by the use of metal masses in the shape of screws being placed in their fields.

With ordinary inductances, plug-in transformers, etc., this coupling may play an exceedingly important part in its effect on the performance of the receiver. Not only does it make it difficult to stabilise the set by the usual neutralising methods, but it also destroys selectivity, partly by direct pick-up and partly by the direct transfer of the interfering signal from one circuit to the next, both capacitatively and magnetically.

Minimizing H.F. Resistance

Starting then with the knowledge that a fieldless coil is easily constructed by winding two solenoids in the same direction, placing them side by side, and connecting them in series as shown in the sketch, it was necessary to find out the best proportions for the windings, the best way of keeping their high-frequency resistance down and also, for H.F. transformers, the most favourable coupling and number of turns for the primary.

From the drawing, it is obvious that if a steady current were passed through the windings so that the polarity of the left-hand coil was as shown, that of the right hand one would be the opposite. Then, since unlike poles attract, the lines of force of the two coils will link up tightly, leaving very little external field.

No Direct Pick-up

Similarly, if placed in a fluctuating field, the direction of the currents induced in the two halves of the coil will be equal and opposite, producing, therefore, a resultant of zero, so that not only is interaction almost entirely eliminated, but direct magnetic pick-up is also got rid of. That this is so in practice was soon found out, for on constructing a receiver with two stages of high-frequency amplification using coils of this description, I found that without aerial and earth it was only just possible to pick up 2LO at weak phone strength, using a stage of low-frequency, the receiver being located at about 2 miles from this station. The difference between this and an ordinary receiver was, indeed, most marked, for an ordinary three-valve set would work a loudspeaker on 2LO without aerial or earth.

The Importance of Spacing

Since it was found that the high-frequency resistance of a fieldless coil was more than twice that of either half, a considerable amount of work had to be spent on reducing this to a minimum value, and various gauges of wire and different spacings were tried before the final design was reached.

The use of fieldless or screened coils is not only important in multi-stage H.F. amplifiers, but also in cases where only one stage of H.F. is used, for instance, in front of a super-heterodyne receiver. If there is any coupling between the frame aerial and the H.F. inductances, trouble is sure to result, for every time the frame is swung the tuning and damping of the high-frequency circuit are affected.

I have often been asked as to the correct valves to use on the high-frequency side of a receiver, and though I personally favour the high-impedance high-amplification type, this is not always the right type to use. Many receivers are designed to be used with small power valves of the D.E.5, B4 types, and these must, therefore, be employed under such circumstances.

High-impedance Valves

Where the anode inductance is likely to have a high impedance, as in tuned anode H.F. coupling, for instance, then a high impedance valve is certainly indicated. The same applies if the coupling between an untuned anode coil and a tuned grid coil is tight, for then the anode coil will be tuned by reflection, with the result that it will have a high impedance at the frequency of the desired transmission.

EARTH DOPES

(Continued from page 252.)

similar internal complaint just by pouring a bottle or two of medicine down his throat, and also no one ever effected a permanent cure for an inefficient earth by the use of a mere dope.

After all, even if a conductible

solution is poured over the ground in the vicinity of the earth lead, the rain soon washes it away, and thus any good effect which it produces is quickly lost.

Little and Often

If, however, there be any reader who considers that his earth connection would prove rather more efficient for a little dope treatment, it is surely the most logical plan to devise a means whereby the soil is impregnated with small quantities of the dope at a time, this supply being kept up over a long period. The truth is, there is no excuse for a badly constructed earthing system, and that, after all, it is far better to make a really big job of the earth system construction, once and for all, than to spend one's time in a perpetual tinkering about with the earth connection in an endeavour to improve a badly made one.

Soil Conductivity

That is, of course, for the average radio man. But for the individual who is interested in the question of soil conductivity, a few experiments in the use of earth dopes will be of much interest. There are a host of mineral salts available for this use—salts of iron, copper, aluminium, and various other metals, and it is quite within the bounds of practical possibility that some interesting facts might be brought to light by patient experiment in this direction. Such, however, is a line of experimental work which concerns the few more than the many.

Proprietary Earth Dopes

And as regards the few proprietary earth dopes which one sees occasionally on the market, it is very definitely not the purpose of these lines to disparage their manufacture. They have their uses, and for temporarily improving earth connection efficiency there is no doubt that many of them are valuable. However, a good earth should not need a dope, just as a man who is physically fit should not require any drugs. If, therefore, the earth connection of your set is poor and inefficient, go to the root of the matter once and for all.

The Real Cure

Dig up the offending earthing system, and replace it with one of more efficient construction. Only then will you be permanently free from that often mysterious and perplexing radio complaint—a badly functioning earth system.

J. F. C.

IN PASSING

(Continued from page 236.)

"Heavens!" I thought, "he's worked through the grease and I'm down two bottles of Asia. Time to act."

"He's hurt himself," I said, hastily getting between Twipe and Ambo. "These cheap sets *do* leak sometimes and give you a nasty shock. Let me see to him."

I grabbed the set and began to rub the Twipe's back vigorously, feeling about on the set meanwhile with my thumbnail. In a twinkling I had found the end of a winding, and nipped it neatly through. "Feeling better?" I enquired, as I rubbed. "If you experience a sort of hot feeling down the spine, you may be sure you had a pretty stiff shock." Here I jabbed him on the lumpy part of his braces, tangled the crystal set well into his brushwood and turned to Ambo.

"Well," I said, "it's a lesson to you, I hope. Who would have thought the thing would round on him like that?" Ambo looked pale, for the Twipe was the apple of Mrs. Ambo's eye. Guddle fussed up and down calling for glasses of water and bottles of smelling salt. The Twipe wrestled with the set, which clung on tighter the more he pulled at it.

"Great Scott! he's trying to eat it," I said.

"Pa!" cried Ambo in alarm. "Calm down, there's a sport. Don't let Mary hear. What? You heard the birds again? Oh, never mind them. Take the set out of your mouth."

"Nonsense," I hastened to remark. "That was the singing in his ears. It's a common phenomenon in cases of crystal shock; scientists call it the 'Snitz effect,' because Professor Snitz of Baden-Baden-Wiesbaden first noticed it after being shocked by a crystal of quartz. Hit him in the left ear."

"I knew a man, Romsey way, name of Glark, who was hit on the ear with a 'Honeyball's Wonder'—no! a 'Lord Lufton!'—fine tuber, too—and he used to go about saying . . ." began Guddle.

"Oh, dry up," said Ambo, "let's get Pa free." He gave a good wrench and to the accompaniment of a shrill scream from the Man in the Hairy Mask the set came away. He pitched it out of the window.

"A rare sport, you are, Mr. Twipe. Glad you pulled round. What do you think, Ambo? Can we let him into the mystery of Asia? After all, you know, he's going to help us make your first valve set."

Ambo winked slowly—volumes. "I think not. Not yet, anyway. You agree, Guddle?" Guddle said, "It's your funeral, Julian." "No," went on Ambo, "but Pa shall have my one-string fiddle. Lor! I'm so relieved that he's not hurt. I wouldn't have a hair of his head hurt."

"Don't say that, Ambo," I pleaded. "You know we must get the hay in before winter. He *can't* solder all festooned like that."

"All right, boy. What you say goes, after this. And I'm much obliged to you. But if you can clip the shrubbery by fair means, I give you best. *I* can't get him to hear of such a thing."

"Oh, after he has seen the start of real wireless he'll yearn for a raw face; he'll want to look like one of those 'discriminating men' who buy new shapes of collars. Two bottles, was it? Or did you make it a dozen? Good-night, Ambo. 'Night, Mr. Guddle."

Yes! I made progress that evening, I think. But I had yet to gather the Twipe's hay crop. Of which, more next month."

SIMPLIFYING CALCULATIONS

(Continued from page 296.)

And again the useful quantity becomes

$$\frac{\sqrt{R_2^2 R_1^2 + w^2L^2 R_2^2}}{\sqrt{(R_2+R_1)^2 + w^2L^2}}$$

Case 4.

In the circuit illustrated in Fig. 5 there is an ordinary inductance shunted by a variable condenser, so that the circuit may be tuned. This particular circuit has many applications, one important case which can be called to mind being that of the tuned anode high-frequency amplifier. From the parallel laws

$$\frac{1}{Z} = \frac{1}{R+jwL} + \frac{1}{-\frac{j}{wC}}$$

$$= \frac{-\frac{j}{wC} + R + jwL}{-\frac{j}{wC}(R+jwL)}$$

SIMPLIFYING CALCULATIONS—

(Continued).

Hence

$$Z = \frac{\frac{j}{wC}(R + jwL)}{\frac{j}{wC} + R + jwL}$$

$$= \frac{\frac{L}{C} - \frac{jR}{wC}}{R + j\left(wL - \frac{1}{wC}\right)}$$

(It is important to note that $j^2 = -1$)

Thus the useful impedance becomes

$$\frac{\sqrt{\frac{L^2}{C^2} + \frac{R^2}{w^2C^2}}}{\sqrt{R^2 + \left(wL - \frac{1}{wC}\right)^2}}$$

It is particularly interesting to see what this impedance becomes at resonance, *i.e.*, when the circuit is "timed" and the condition $wL = \frac{1}{wC}$ or $w^2LC = 1$ is satisfied.

Our expression now becomes

$$\frac{\sqrt{\frac{L^2}{C^2} + \frac{R^2}{w^2C^2}}}{R} = \frac{\sqrt{w^2L_2 + R_8}}{RwC}$$

Now w^2L^2 is usually very much greater than R^2, so that if we neglect R^2 the expression is approximately reduced to

$$\frac{wL}{RwC} = \frac{L}{RC}$$

Substituting w^2L for $\frac{1}{C}$ we have

$$\text{Approximate impedance} = \frac{w^2L^2}{R}$$

It is thus possible to see very clearly that when the circuit is tuned it really becomes a rejector circuit, *i.e.*, it offers a very high impedance to the frequency of the oscillations across the terminals A B.

After a Little Practice

Many more circuits where this important principle may be applied will no doubt suggest themselves to the reader, and he is strongly advised to work out a few problems, such as determining impedances and the resultant pressures and currents. This will familiarise him with what should prove a useful dodge to simplify calculations and enable the design of wireless currents to be undertaken with a greater degree of ultimate success in their working. It is, perhaps, a little difficult to appreciate at once how much time and patience are saved by this method, but this will come after a little practice.

ZERO BEAT RECEPTION.

(Continued from page 269.)

the valve is not self-oscillating—the side waves will appear as currents, decided chiefly by the inductance and capacity, and if they are sufficiently strong they will react back on the strength of the carrier—a condition which obviously does not lend itself to distortionless reception. The currents at different side frequencies will not be the same for the same voltages, in general falling off rapidly with increase of frequency difference—tending, in consequence, to give low toned, muffled reception.

On the top of these effects is now superimposed another one, when we are using the self-oscillating valve as a rectifier. Efficiency of rectification depends upon the amplitude, so that if our valve was a simple rectifier without reaction, any rapid general rise and fall of signals will result in an increased apparent rise and fall in the telephones.

Captain Trevellen pointed out recently to me that the results of fading on an ordinary set using high-frequency amplification were large compared with these effects in zero beat reception, and this is undoubtedly due to the fact that any increase of signal strength acting on a zero beat circuit results in a smaller rise than would occur in a straight circuit, thus tending not only to minimise fading defects there, but to decrease the accompanying change of efficiency in the detector.

Actually, I think the actions in these circuits are still more complicated than I have given here, and they become very complex indeed when we are trying to understand super-regenerative circuits which employ this type of circuit in its unstable condition just as it is going to start oscillating.

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WHY NOT S.L.R. CONTROL?

(*Continued from page* 251.)

possible in an ordinary amplifying valve curve, then you will have visualised the real state of affairs. And if you find that with your "smooth-as-velvet" ultra-efficient rheostat you do all the useful work on comparatively hairs-breadth movements, you now know the reason why.

In my very humble opinion every rheostat, whatever its maximum value, should have its winding arranged either like Fig. 6A or Fig. 6B. In the former instance the turns are crowded towards one end—the end representing maximum resistances (nearest to the "Off" position). In Fig. 6B the turns of resistance wire are made greater in diameter towards this same point.

Designed for Average Purposes

The exact degree of graduation requires to be very carefully thought out in each individual case of rheostats of varying maximum values, taking into consideration the *average* purpose for which they will probably be used.

There are, indeed, many points that would need to be taken into the calculations of any manufacturer sufficiently progressive to consider the subject worthy of more or less intensive research.

The filament rheostat may be obsolescent, but that is no reason why it should be old-fashioned in design. It is still worthy of better treatment than it has so far received.

In conclusion, if I have omitted to mention certain things which may appear to some of my readers to be relevant to the discussion, my excuse is that, in my opinion, and I have studied the matter closely, such do not affect the *principles* involved, and would be out of place in this comparatively brief résumé of the subject.

PEROXIDE FOR HEADPHONES

THERE is perhaps nothing more repugnant to the eyes (and the ears) of a sensitive individual than having to wear a pair of headphones the earpieces of which have been allowed to get into a dirty condition.

Dirty headphones are things commonly to be seen nowadays. And no wonder. For when it is remembered that the human skin under any degree of heat or pressure exudes small amounts of natural oil and grease, it will readily be seen that such natural exudations must in time accumulate upon the surfaces of the 'phone earcaps, and also upon the diaphragms, thus producing "dirtiness."

A Simple Remedy

Now, 'phones which are allowed to remain in this condition are apt to suffer in actual working efficiency in the long run, owing to the fact that the metal diaphragms become attacked by the natural grease of the skin.

Fortunately, there is a very simple method of getting rid of this undesirable condition of affairs. Give the affected 'phones a rough wiping over with a soft piece of rag. Then carefully unscrew the earcaps, and place these, together with the 'phone diaphragms, in a bath of weak hydrogen peroxide solution. This solution may be prepared by diluting one part of ordinary commercial hydrogen peroxide with three or four parts of *cold* water.

After Illness

The 'phone diaphragms and earcaps should be completely immersed in this solution for two or three hours. Afterwards they should be removed from the solution, carefully rinsed in *cold* water, and then wiped *perfectly* dry with a clean rag.

The result of this hygienic treatment will be that the diaphragms and earcaps of the 'phones will be retained in a clean and sweet condition, they will be perfectly sterile, and any slight corrosion which may have set in on the surfaces of the diaphragms will be cleared away.

In the normal course of events, there is no need to conduct this treatment more than once in about two or three months, although, of course, if an invalid suffering from a bad cold or a more serious infectious disease has made use of the 'phones, the above cleansing and disinfecting treatment should be given before the 'phones are used by any other person.

It is not absolutely essential to use peroxide of hydrogen for the above purpose. A weak solution of potassium permanganate (of such a strength that the liquid is coloured a pale pink) can be employed instead, and is rather less expensive. The one disadvantage about the permanganate treatment, however, is that this solution has a tendency to produce a greening of the ebonite or composition earcaps of the 'phones, especially if such materials be of inferior quality, as, unfortunately, with excessively cheap headphones, is very often the case.

Beware of Carbolic

Do not, however, under any circumstances, employ carbolic acid or similar solutions for the purpose of disinfecting headphone earcaps. The disinfecting part of the job will be performed efficiently enough, but, unfortunately, powerful disinfectants of this latter nature have an injurious effect upon ebonite and ebonite compositions, and thus their use on 'phone earcaps would most likely bring about unwanted consequences.

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Being an R.I. product, it has all the features necessary to give improved working of this circuit, for, as it is used virtually in parallel with the tuned circuit, it is important that the high frequency resistance and self-capacity are negligible in order to maintain selectivity and efficiency.

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It is only by using a transformer with a range of ratios and impedance values allowing of its use in any circuit and with any valve, plus a minimum self-capacity, that you can hope to obtain the kind of reproduction which will please you.

Fit the R.I. Multi-Ratio Transformer to your set to-day and notice how immediately the reproduction reaches so closely the distinctness and quality of tone of the original.

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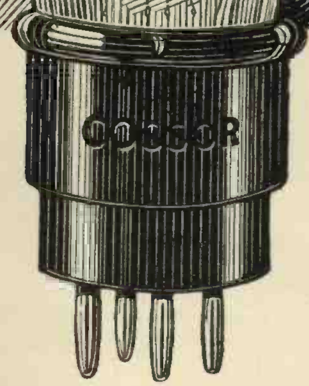

His clutching, thieving fingers cannot harm this new Cossor Kalenised filament——

NORMALLY the filament of a valve is a slender thread of metal subjected to intense heat. From the time the first valve was made, heat—in the form of an electric current—has been required to produce the necessary electron emission from the filament.

But Heat—although a good servant—is a bad master. His thieving fingers have robbed every filament of many hours of useful life. Through excessive heat metal becomes crystallised. When in this brittle state it is susceptible to the slightest knock. Even expansion and contraction under tension is sufficient to cause a fracture. That is why the ordinary valve has only a comparatively short life.

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THE new Stentor Four power valve is now available. Co-axial Mounting (exclusive to Cossor) ensures life-long uniformity. Even under the hardest blow it is absolutely impossible for the elements to move independently—they are securely anchored to each other in permanent alignment. The Kalenised filament ensures a terrific electron stream, which in turn means the greatest possible volume with a remarkable purity and freedom from background noises. Filament voltage 3·8 volts. Consumption ·1 amp Impedence 5000 ohms. Amplification Factor 5. **18/6**

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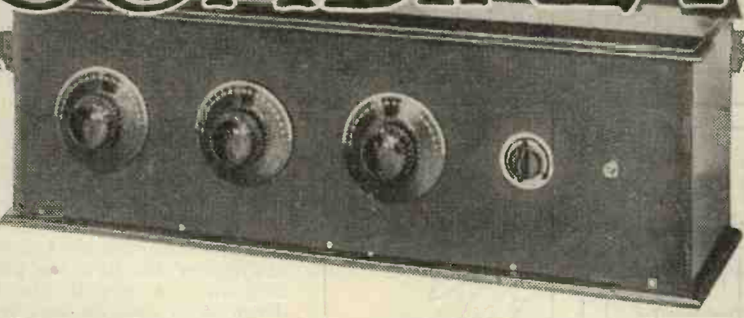


This set is the "last word" in reliability and efficiency.

Ease of control, reasonable cost, and purity of tone are leading features of this receiver.

An Introduction

By J. H. T. ROBERTS, D.Sc., F.Inst.P.

THE wireless receiver which is described and illustrated in this book is one which is intended to represent for its class (2-v-2) the last word in present-day design and practice. In stating that the object in view has been achieved, one must exercise great caution, and it is a statement which I certainly should never make had I not satisfied myself as to its correctness.

The design of the present-day radio broadcast receiver is very different from that of some three or four years ago, when broadcasting first commenced. In those days we were given to understand that a detector was necessary, and that one or more stages of high-frequency amplification might be employed to precede the detector and one or more stages of low-frequency amplification to follow it; "valves" were to be employed, these to be mounted in some unspecified way, whilst "coils," of stated value but unstated character, were to be used as inductances in the high-frequency parts of the circuit; these various components were to be "connected together" according to a circuit diagram, the output of the receiver being supplied into headphones or a loud speaker which, in appropriate circumstances, delivered a fair imitation of the transmission from the station.

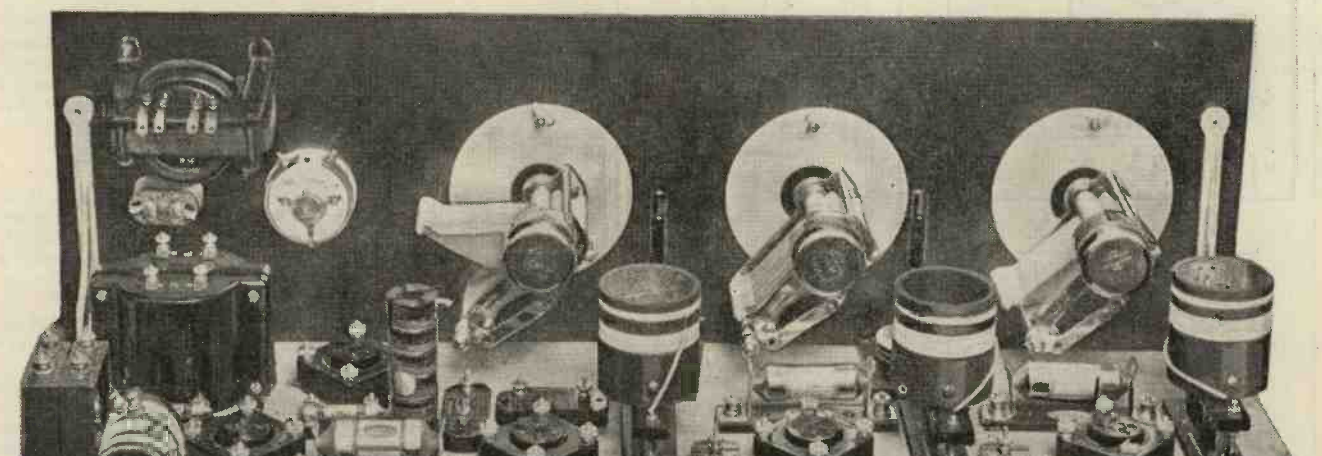
It would be correct to say that no branch of science has ever been subject, in the comparatively short space of some three or four years, to such concentrated attention from thousands—perhaps millions—of eager and intelligent experimenters as has been the case with the science, or scientific hobby, of broadcast radio reception. It was inevitable, therefore, that progress should have been remarkably rapid; scarcely a week—certainly never a month—passes without some important development or improvement being brought forward.

The development of radio practice as applied to broadcast reception may conveniently be compared to the development of the science or art of medicine, notwithstanding that the one dates back to antiquity, whereas the other, as we remarked a moment ago, has practically the whole of its history compressed into a very few years. In medicine, the immense increases in knowledge which have resulted from research work have rendered more and more difficult the work of the general practitioner and have more than ever made it necessary for individuals to specialise in different departments of the art.

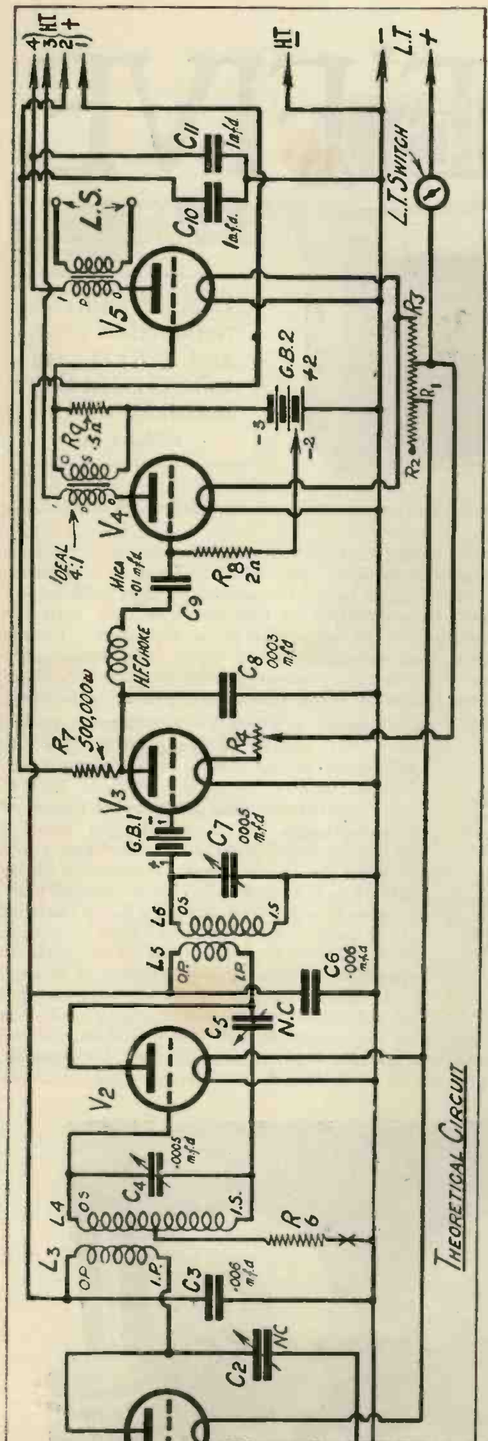
A similar state of affairs has been reached in radio science and, indeed, many specialists in different departments of the science already carry well-known and well-deserved reputations. If a manufacturing company, for example, be faced with a problem in audio-transformer design, they call in the

FOR the first time in the history of radio it has been possible to concentrate the activities of practically all the leading wireless-set designers in the country on the construction of one Super receiver.

Each one of the recognised authorities concerned in this work has specialised on one specific section of the set. The result is the Modern Wireless "Combine" Five—a receiver which embodies everything that is best in up-to-date radio practice.



Immediately Mr. Harris, with the assistance of other experts, had completed the arrangement of the various components, the above flashlight photograph was taken in order to obtain a permanent and accurate record of this very important stage in the work of assembly.



services, not of a "radio engineer," but of a transformer specialist; it would be invidious, perhaps, at this point to refer to particular names, but the mention of transformers calls up at once to the mind of the well-informed experimenter several familiar names. The same remarks may be made with regard to valves, and again with reference to loud speakers. Indeed, we have already specialists in the different departments of radio science just as definitely and as inevitably as we have specialists in the different departments of medical science.

The Technical Editor of MODERN WIRELESS, when he set out to produce *le dernier cri* in 5-valve receivers of this type, adopted the only proper course in calling in the aid of specialists. The names of the authors of the sections in the following pages are all well known to the wireless public, and each is an authority upon the subject with which he has undertaken to deal.

No part of the wireless receiver is more important than the high-frequency coils, and I should say that it was in this feature of a receiver that there was perhaps the greatest liability for inefficiency to creep in. In the receiver to be described, the design of the coils has been undertaken by Mr. G. P. Kendall, whose name alone is a guarantee that the coils specified are as efficient and as suitable for their purpose as the present state of knowledge permits. Mr. Kendall has not only written widely on the important and difficult subject of high-frequency coil design but, what is more, he has devoted an immense amount of study and experiment to this subject, of which he has made himself a master.

Components Required

- **Panel (26 in. × 8 in. × ¼ in.) with Cabinet, Baseboard and Brackets (Carrington Mfg. Co.)**
- **3 S.L.F. Slow-Motion Condensers ·0005 (Ormond)**
- **1 20-ohm Rheostat (Igranic-Pacent)**
- **1 On-Off Switch (Igranic or Lissen)**
- **1 4:1 L.F. Transformer (Marconiphone Ideal)**
- **1 Telephone Transformer (Pye)**
- **2 100,000 ohm Anode Resistances (Varley)**
- **1 500,000 ohm Anode Resistance (Varley)**
- **1 H.F. Choke (Varley)**
- **2 1-mfd. Mansbridge Condensers (T.C.C. or Lissen)**
- **1 ·01-mfd. Mica Condenser (Dubilier Type 610)**
- **2 ·006-mfd. Mica Condensers (Lissen or Dubilier)**
- **1 ·0003-mfd. Mica Condenser (Lissen or Dubilier)**
- **1 2-meg. Resistance (Dubilier Dumetohm)**
- **1 ·5-meg. Resistance (Dubilier Dumetohm)**
- **5 Valve-Holders (Benjamin)**
- **3 5-pin Coil Plugs and Bases (Peto-Scott)**
- **2 Baseboard-Mounting Neutralising Condensers (Peto-Scott)**
- **1 piece Ebonite Tube, 1½ in. dia., 2½ in. long**
- **4 6 B.A. Terminals**
- **11 Eelex Terminals (J. Eastick & Co.)**
- **3 Terminal Strips (1 7 in. × 2 in. × ¼ in., 2 2 in. × 2 in. × ¼ in.)**
- **Screws, Wander Plugs, etc.**
- **1 oz. 24 S.W.G. Eureka Wire (Double Cotton Covered), or one complete tapped resistor to "M.W." specification (Wright and Weaire)**

Acknowledged Experts.

In the design of the low-frequency amplifying stages there is room for considerable diversity of opinion: some constructors pin their faith to transformer-coupled stages, others to resistance coupling, whilst others, again, believe that improved purity is obtainable by a judicious mixture of the two. Mr. Johnson-Randall is a noted expert in low-frequency amplification, and his design of this part of the circuit may be taken to represent the most efficient arrangement in conjunction with other parts of the circuit.

The stages of high-frequency amplification are the special charge of Mr. Allinson, whose name is so well known in association with the design of this type of circuit. It is unnecessary to say that in Mr. Allinson's hands all the details which make for H.F. amplifier efficiency have been given every consideration.

Mr. P. W. Harris has given the benefit of his unrivalled experience in the matter of the layout of components, and although Mr. Harris' name and reputation are an adequate guarantee that the matter has been handled most ably, I may remark that he has devoted even more care to the layout of this particular set than in the case of perhaps any of the numerous sets with which he has been so successful. Although the components are compactly arranged into a small space, nothing has been sacrificed to "crowding," and all spacings have been defined to a fraction of an inch

The valves for the set are under the special care of Mr. Keith Rogers, who possesses a most extensive knowledge of present-day valves, their characteristics and their suitability for special purposes. Mr. Rogers has carried out very considerable investigations with valves since days prior to the advent of broadcasting.

There is, I think, a tendency amongst constructors to regard the condensers in a set—particularly the fixed condensers—as components which, apart from what may be called their mechanical or constructional features, are much of a muchness. This, however, is far from being the case, and there may be as much difference between the similar condensers as between chalk and cheese. The proper choice of condensers, and their use in the set in the proper way, are vitally important factors in determining the efficient working of the circuit as a whole. The reader will therefore be pleased to know that Mr. Barton Chapple—whose reputation needs no comment—makes himself responsible for the supervision of this particular section.

Leaving No Room For Doubt.

Mr. J. F. Corrigan, whose articles on crystals, as well as on a variety of other interesting subjects, are always so much appreciated, has dealt broadly with the considerations to be borne in mind in *wiring* the set. Although the connecting together of the various components into an united whole might seem to be a simple matter (it is one which is too frequently completed in a scramble, in order that the final strains of the Savoy Bands may be caught for "testing" before 11 p.m. !) there may be all the difference between efficient and poor operation in the manner in which the wiring is carried out.

Mr. C. E. Field, who is an authority on the subject of loud-speaker reproduction, undertook the supervision of that section of the "Combine" set with which this subject is intimately concerned.

Finally, upon Mr. G. V. Dowding has fallen the onerous duty of collating the contributions of the various experts mentioned, and the launching of the receiver as a masterpiece of concerted effort.

So many designs and circuit-diagrams of multi-valve receivers have been put forward during the past two or three years that the constructor contemplating the making of a set is apt to be bewildered by the variety offered for his choice. It is to be hoped therefore, that this 5-valve receiver, representing, as it does, the united and considered decisions of a team of experts, will leave no room for doubt or perplexity, but will commend itself to the prospective constructor as *the* 5-valve set of the present day

THE H.F. STAGES

By C. P. ALLINSON, A.M.I.R.E.

ALTHOUGH, at first sight, the design of an H.F. amplifier may appear to be a somewhat simple matter, there is a considerable number of considerations which have to be taken into account if really consistent and satisfactory operation is to be obtained from this side of the receiver.

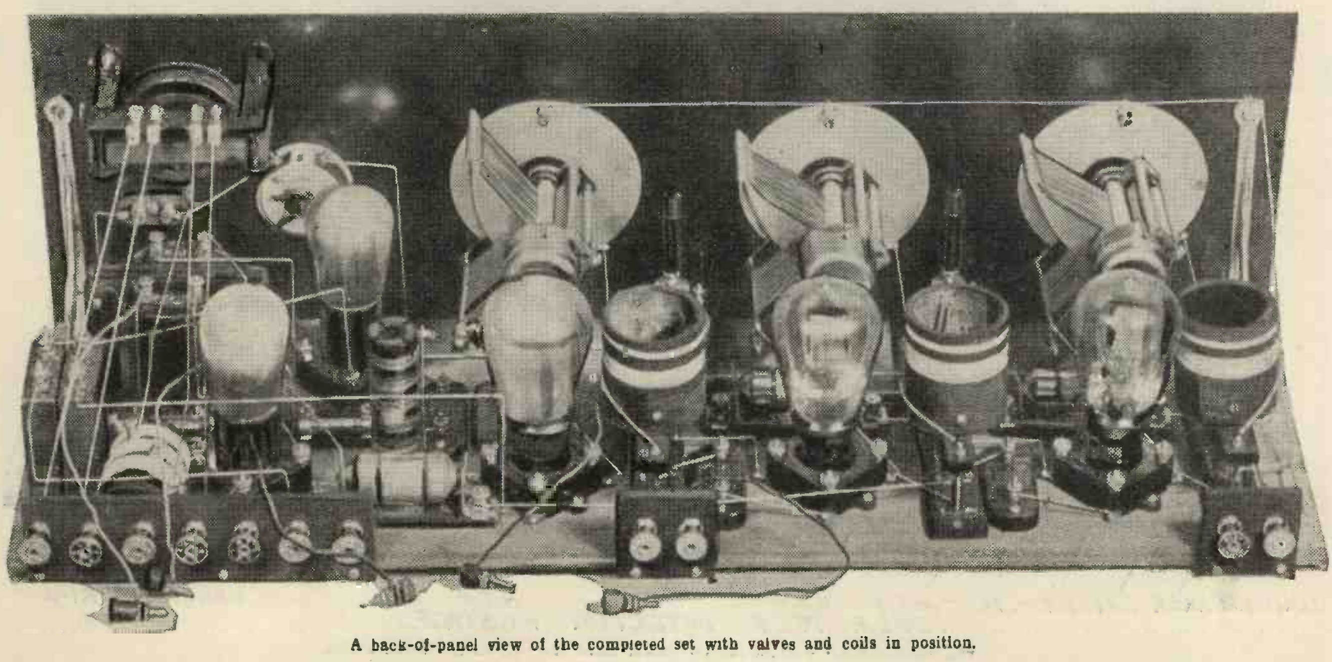
For the H.F. circuit of the "Combine" Five I have chosen a scheme which I first used some months ago, and it is the outcome of a considerable amount of research on my part into the question of H.F. amplification. A description of how this circuit came to be evolved has been given in "Modern Wireless," its development being dealt with in detail and certain variations of the circuit also being given.

The scheme which was worked out in this way has been incorporated in several receivers which I have designed from time to time, while I have also used it to a considerable extent in my own private work.

The intending constructor, therefore, can have every confidence in the performance and reliability of this circuit, since it has been tested and tried out in actual practice over a considerable period. Needless to say, it is of the neutralised type, and I would like to emphasise here that if the utmost efficiency as regards range and power is to be obtained from the H.F. side of a receiver, the use of neutralised or stabilised H.F. amplification is certainly to be advised. It has a number of advantages, among which are increased selectivity, the greatest amplification from the H.F. valve, and ease of control.

Suitable For All Wave-lengths.

A form of trouble peculiar to neutralised circuits which occurs in some cases, even when only one stage of H.F. amplification is used, is that due to parasitic oscillation, and it is most important that any circuit used be entirely free from any risk of this occurring, otherwise the efficiency of the H.F. side of the receiver is completely nullified. It is also important that the circuit be suitable for use on the long waves, for there are, no doubt, a number of experimenters who desire to receive the long-wave stations, such as Daventry, Hilversum, Radio Paris, etc. Certain circuits, although satisfactory



A back-of-panel view of the completed set with valves and coils in position.

for use on the short broadcast wave-lengths, are, however, not suitable for use on the long ones.

The circuit I have used is entirely free from any trouble of this description, and it has been proved in practice to be entirely free from parasitic oscillation, even when using three or more stages, providing always that due care is given to the construction of the receiver when a large number of stages is being used, while it may be used with equal success on the long waves as on the short ones.

An important point in the design of an H.F. amplifier is the question of the coils, and the actual design of these has been entrusted to Mr. G. P. Kendall, who is an acknowledged authority on the subject.

A Few Operating Notes.

It is the usual practice nowadays to employ a valve of the high impedance, high amplification factor type for H.F. amplification, and the popularity of this class of valve is well deserved. Assuming, therefore, that these valves will in nine cases out of ten be used for this receiver, the constants of the inductances used in the H.F. circuit have been designed to work with valves of this description.

It should, therefore, be borne in mind when using this receiver, that if the best results are to be obtained a valve of this description should be employed, for the coils have been designed with the correct turn ratio between the primary and secondary windings, the correct degree of coupling, and a suitable H.F. resistance to match with this type of valve.

At the same time the values are not extremely critical, and valves having impedances lying between 20,000 and 30,000 ohms, with amplification factors of from 15 to 25, are entirely suitable for use in this set. Other valves, however, may be used, but if the very utmost is to be obtained from the receiver, then the valves recommended are certainly to be advised.

Let us turn to the theoretical circuit diagram, as it may be of interest to discuss one or two of the points of this receiver. It will be seen that between the centre points of the two grid coils, L_2 and L_4, two resistances, R_5 and R_6, are connected. The values of these resistances are 100,000 ohms each, and it is important that they be of reliable make, otherwise trouble will be introduced. It may be found in some cases that an advantage will be obtained by using a small amount of negative grid bias with the two H.F. valves. This will help to sharpen up the tuning in cases where interference is experienced, and also will result in economy in plate-current consumption—a very vital factor when a multi-valve receiver is being employed. The actual value employed should not exceed 1½ volts, and this only when H.T. voltage of 80 volts or more is used with the H.F. valves. A couple of dry cells may therefore be inserted at the two points marked with a cross, and should be connected so that the negative terminal goes to the resistance and the positive one to the L.T.—busbar.

In consonance with modern practice, two small shunting condensers, C_3 and C_6, are connected between the H.T. positive side of the anode coils, L_3 and L_5, and H.T. negative, and although these may not be absolutely essential to the functioning of the receiver, I would strongly advise you not to leave these components out.

The neutralising capacities are shown at C_2 and C_5, while the three tuning condensers, C_1, C_4 and C_7, are all of the same value.

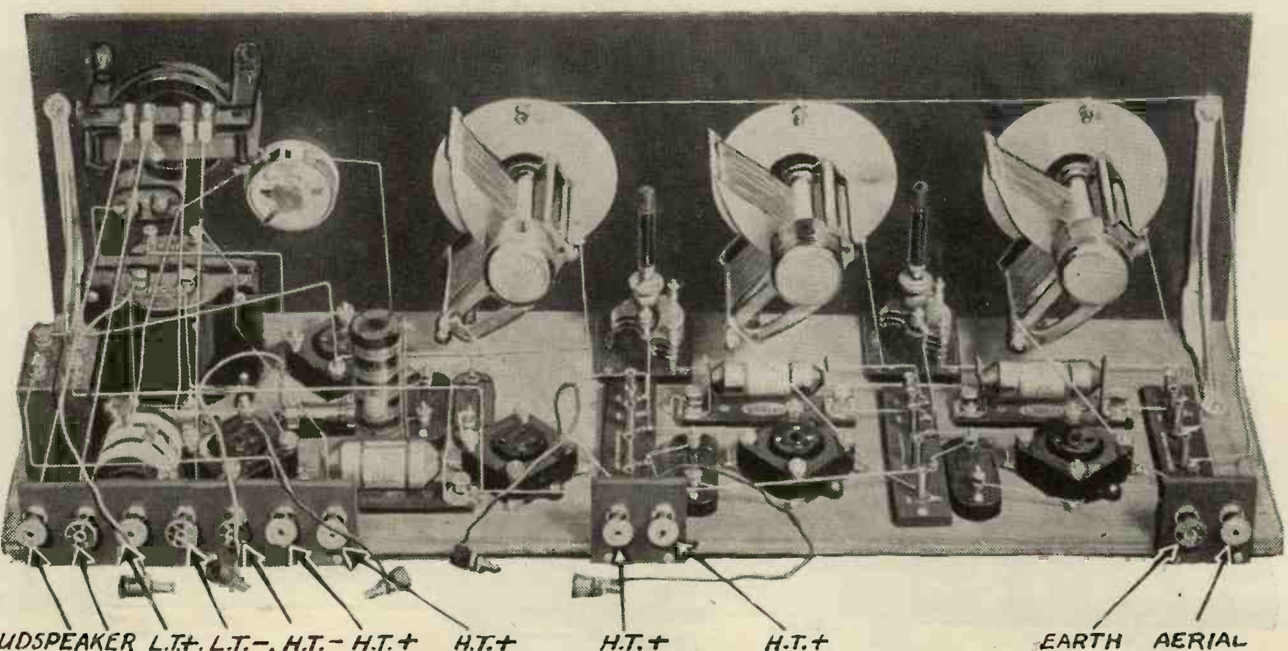
Anode-bend rectification is used with the detector valve, and a small battery, $G.B_1$, is connected in the grid lead as shown, and enables the correct bias to be obtained.

A few operating notes may be of use here, and the first thing to do is to get the receiver properly stabilised. I will assume, therefore, that you have completed the receiver, which has passed through its preliminary tests, and you have now connected it to the aerial and earth preparatory to using it.

Tune in your local station and adjust your three tuning condensers until the signal is at its maximum strength. Now break the first H.F. valve filament circuit by wrapping a piece of thin paper round one of its filament pins and rotate the neutralising condenser, C_2, till a position is found at which the signal is at minimum strength or else entirely inaudible. At this point the capacity of the valve is exactly neutralised and this stage of H.F. amplification will be free from any tendency to oscillate. The second H.F. valve is neutralised in the same manner, and it will now be found that the whole set is completely stable at all settings of the tuning condensers

Stable At All Frequencies.

It will, however, be found an advantage in many cases slightly to reduce the capacity of the two neutralising condensers. This will enable a small amount of natural reaction to be introduced into the two H.F. circuits, thus reducing their resistance and increasing their efficiency. This should be done with care, however, and the whole wave-band should be explored with the three condensers every time the neutralising capacities are reduced to see that the set does not go into self-oscillation at any point. The correct setting of the neutralising condensers should be noted, so that when it is desired to use either of them as a reaction control when carrying out distant reception, you may, if you desire, easily reset the condensers at values which make the set completely stable at all frequencies.



This back-of-panel view of the set should assist the constructor in the wiring.

THE L.F. STAGES

By A. JOHNSON-RANDALL.

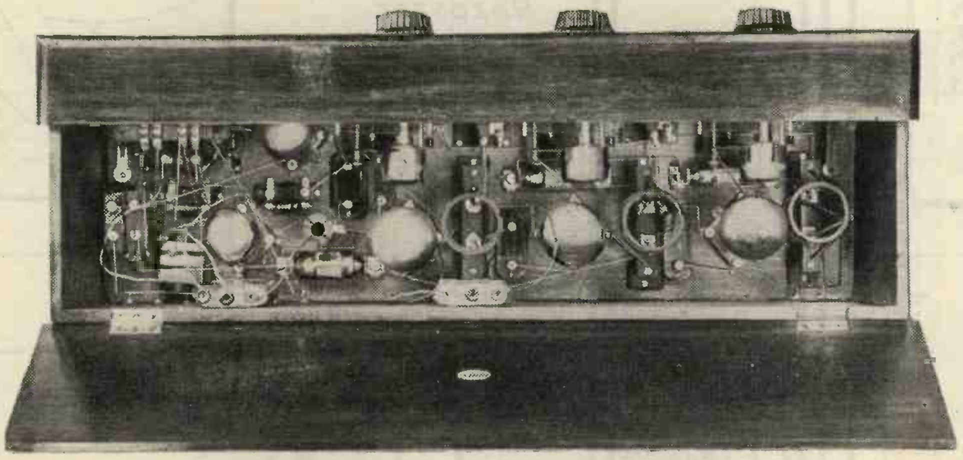
IN designing the L.F. portion of this receiver, I have endeavoured to meet the requirements of practically every class of reader.

If I had chosen I could have arranged the circuit to give enormous amplification with reasonable quality. Alternatively it would have been a fairly simple matter to have designed a circuit giving a perfectly even amplification of all frequencies with a fair degree of magnification.

I, however, decided to compromise by employing an arrangement which I have found to be very efficient from the point of view of signal strength, combined with good quality. With suitable valves, the amplification is very even over a wide band of frequencies, although not quite so good as would be obtained with pure resistance coupling on the bass notes. This is counterbalanced by the fact that the average loud speaker, with a tightly clamped diaphragm, will not reproduce the lower musical frequencies even if they are present in the output circuit.

The balanced armature "cone" type of instrument is a much more promising arrangement. I have noticed, however, that in the case of large cones there is a pronounced tendency to over-emphasise the bass, coupled with falling away of the higher notes.

With one "cone" of large diameter an objectionable form of bass resonance has been observed when using a resistance amplifier. This could be eliminated by using a transformer in the last stage. Again, with a transformer in the last stage, I have found it easier to avoid distortion on moderate H.T. voltages, when compared with resistance coupling. This is a distinct advantage to the listener not in possession of a milliameter to enable him to diagnose distortion arising from the valve characteristic.



The grid-bias batteries can be held to the back of the cabinet by means of brass clips. The battery on the left (for L.F. stages) should be of at least 18 volts if a super power is used although in this photo only a small battesy is shown.

Some Notes on the Circuit.

Referring to the diagram, V_3 is an anode-bend rectifier, a small dry-cell battery of about 4½ volts, tapped at every 1½ volts, being employed to apply the necessary negative potential to the grid of the valve.

This valve has connected in its anode circuit a non-inductive wire-wound resistance of 500,000 ohms, R_7, and the voltage variations across this resistance are applied across the grid and filament of V_4 and magnified. Results could be obtained with an anode resistance of lower value, but the amplification would be considerably less. A radio-frequency choke is joined in the grid lead of V_4 in order to prevent H.F. from getting through into the L.F. portion, and the H.F. component in the anode circuit of V_3 is by-passed through a *small* fixed condenser, C_8, joined between the anode and negative filament leg of the valve. This condenser must be kept small, since it will otherwise cut off the higher frequencies, and in addition, decrease the amplification.

For the transformer-coupled stage I have chosen a Marconi "Ideal," having a ratio of 4:1. The primary inductance is sufficiently high for it to be used with satisfactory results in conjunction with the majority of small power valves at present on the market. Across the secondary of this transformer is shown a 0·5 megohm leak, R_9, its presence tending to prevent any resonance effects at the higher frequencies. Much can be achieved with a resistance of this nature, and by decreasing its value a control of volume is obtained.

In the output circuit I have shown an output transformer stipulating an impedance of not less than 20 henries. This impedance value permits a number of different types of valves to be employed with success.

So much for theoretical considerations; and now for the actual operation of the L.F. stages.

The valve used as the rectifier should be of the high mu type. Amongst those which come into this class may be mentioned the following: Cosmos S.P.55/B (blue spot), and P.M. 5.B which have magnifications of about 35; Marconi and Osram D.E.5.b, Mullard D.F.A.4, and the S.T.61. (The S.T.61 A will be more suitable, but at the time of writing is not on the market.) These are all 6-volt valves, and on test in a resistance circuit especially constructed for experimental purposes the S.P.55/B type gave the loudest signals when used as an anode-bend rectifier.

Concerning the L.F. Valves.

This valve, however, is rather microphonic and requires a carefully chosen valve holder. Used as an amplifying valve, it does not suffer from this disadvantage, nor does the P.M.5.B.

The D.E.5b; D.F.A.4 and S.T.61 all make good anode rectifiers, and there is little or nothing to choose between them. The louder signals in the case of the P.M or S.P.55/B are only to be expected, on account of their impedance and magnification values. Any valve designed for H.F. work can be employed, but it should be remembered that the best results are likely to be obtained with one specially designed for resistance coupling.

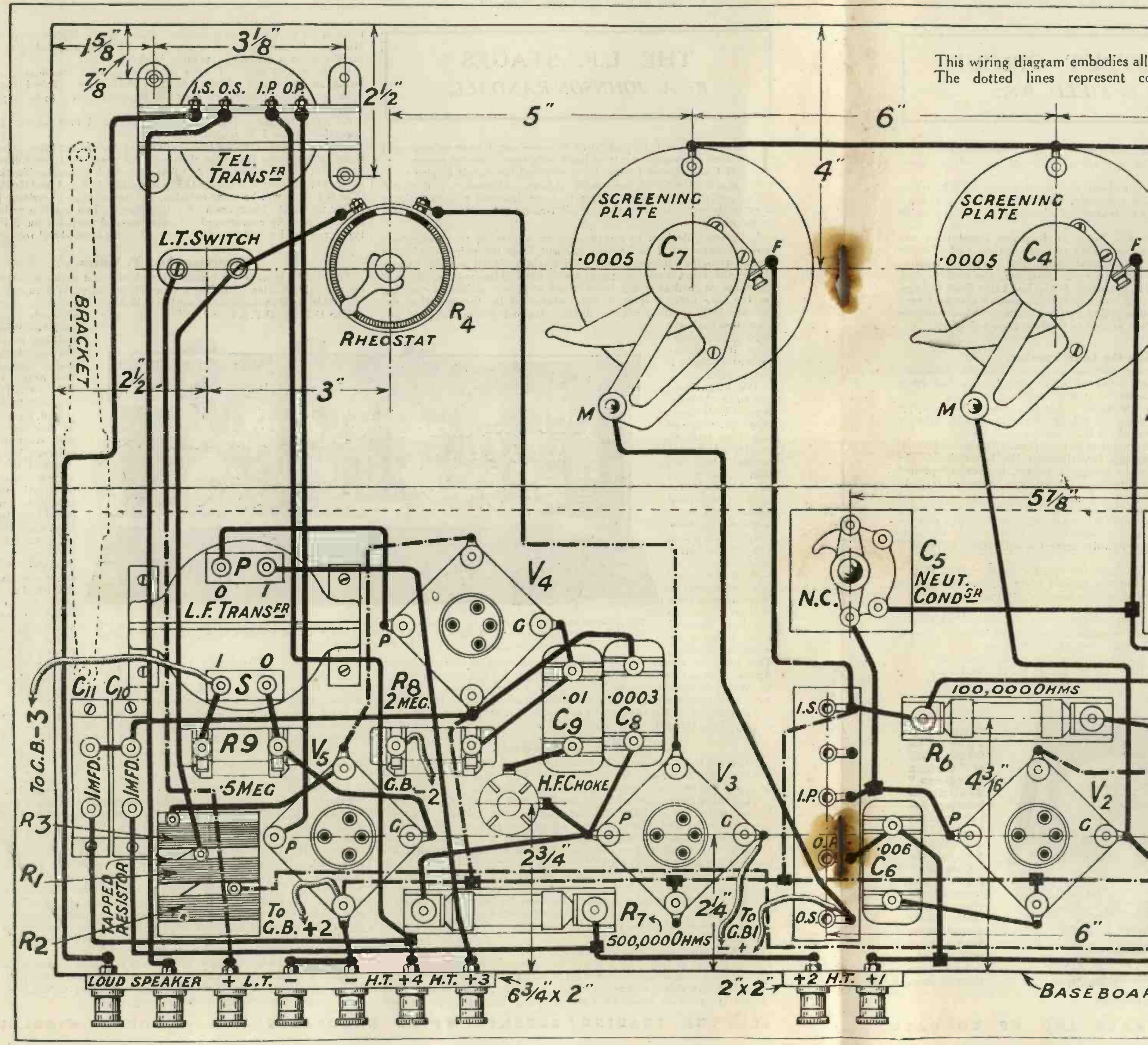
With 120 volts H.T. I find that about 3 volts negative grid bias is about right with the D.E.5.b, D.F.A.4 and S.T.61 valves. In the case of the Cosmos S.P.55/B, 1½ volts gives good results. For V_4, the first L.F. valve, the Marconi or Osram D.E.5, Mullard P.M.6, B.T.H. B.4, Cosmos S.P.55/R, S.T.62, Burndept L.525 will give good results.

In the last stage, if signals are very strong a considerable grip swing will have to be dealt with, and if such is the case I recommend you to use a super power valve, such as the D.E.5A, S.T.63, or L.L.525.

If you prefer to use 4-volt valves, then for the two L.F. stages two Cossor Stentor Fours or a Stentor Four and a super power valve, such as the S.T.43 or its equivalent may be used.

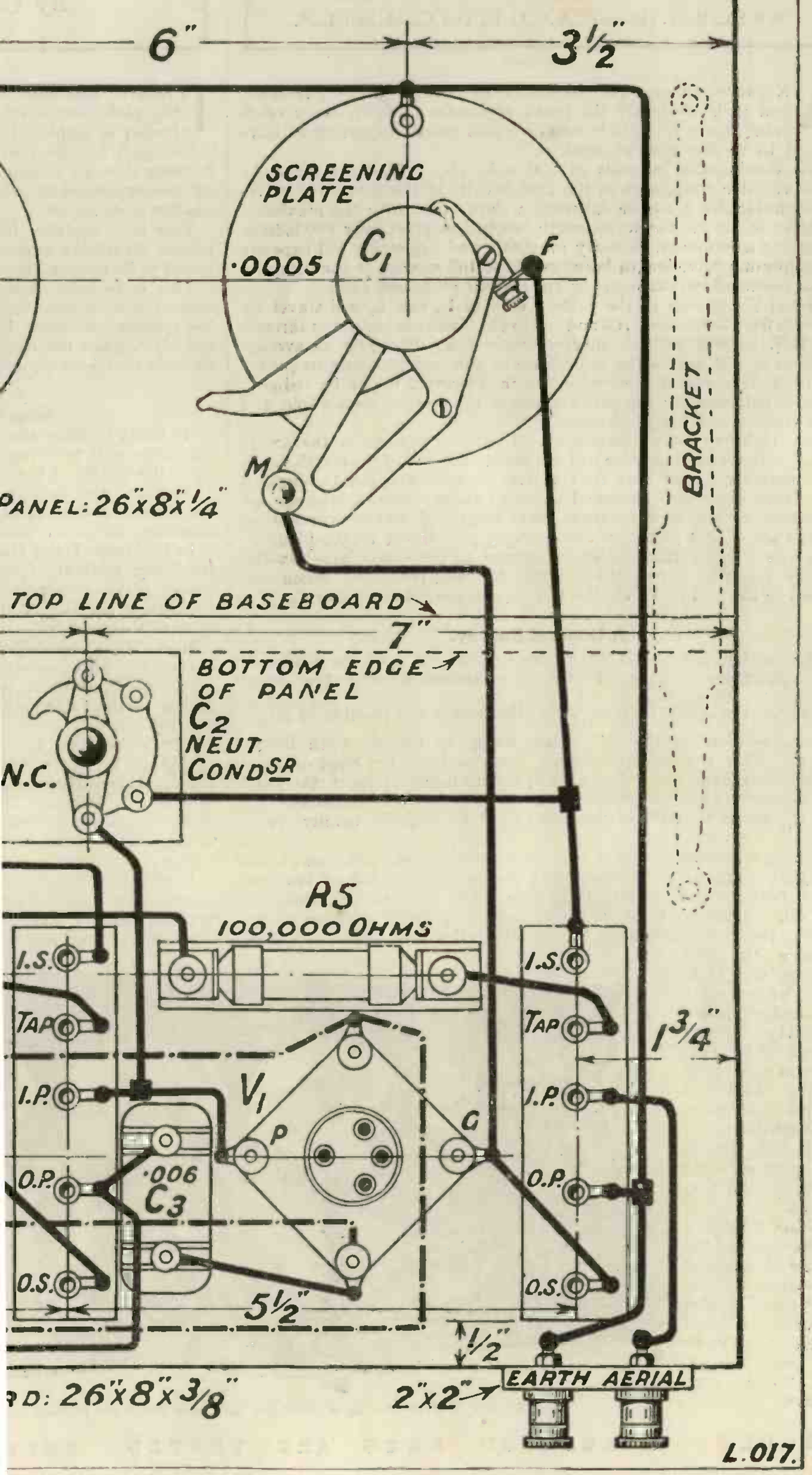
I recommend you to use an H.T. value of not less than 120 volts for the two L.F. valves. You may have some slight difficulty in deciding what grid bias to use for V_4 and V_5. Let me tell you how I decide mine. I make use of Captain H. J. Round's "rule of thumb" method. You know your H.T. voltage and you also know the amplification factor of the valve, since this is marked on the makers' carton or pamphlet. Divide your H.T. voltage by twice the amplification factor of the valve, and add to your answer about 1½ volts. This will give you a good working value for the grid bias. In this way you will find that with 120 volts H.T. a negative bias of 10½ volts for V_4 and 16½ to 18 volts for V_5, if you are using a super power valve, is about right. Remember that when you are using a super power valve, a 9-volt grid battery is inadequate. You must have space for at least two 9-volt batteries in series.

If dry cells are to be used, then one of the super batteries must be employed, if satisfactory working is to result. Remember that with the modern multi-valve set, employing two power valves, the total anode current may easily be 20 milliamperes.



This wiring diagram embodies all
The dotted lines represent co

panel drilling details and baseboard-layout measurements.
nnecting wires which pass *underneath* the baseboard.



CONCERNING THE CONDENSERS

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

An examination of the circuit reveals many interesting features, and it is obviously the result of careful thought, every effort being made to include details which recent experiments have proved to be the most efficient.

The combination of coils of 200 m.h. (L_2, L_4 and L_6) tuned by ·0005 variable condensers in the grid circuits of the first three valves is admirable, for a simple calculation shows that with the maximum capacity in circuit the wave-length reached is practically 600 metres. Assuming a minimum capacity of ·00003 and neglecting coil capacity the minimum wave-length becomes about 150 metres, so the complete range meets all requirements on the normal broadcast band.

The H.F. currents at the battery ends of L_3 and L_5 will travel via the ·006 fixed condensers (C3 and C6) to the filaments instead of through the H.T. battery with its inherent resistance. Choosing an average medium of 400 metres the impedance at the corresponding frequency is about 35 ohms, a fair value, which, however, might be reduced, without detriment to the performance of the receiver as a whole, and even effect a slight improvement.

Any high-frequency components of current present in the anode circuit of the rectifying valve will not pass to the grid of the fourth valve, since they are forced back by the H.F. choke. The H.F.C. offers an impedance of several thousand ohms to these currents, whereas the condenser at the same average wave-length of 400 metres has an impedance of 700 ohms, so the currents pass direct to the filament. This leaves the rectified pulses of current to produce a large low-frequency potential across the 0·5 megohm resistance R_7, which are passed to the grid of V_4 via the H.F.C. and the ·01 condenser C_9.

A General Survey.

The exact impedance of this circuit will depend upon the resistance and inductance of the H.F.C. in combination with the series condenser ($Z=\sqrt{R^2+(WL-\frac{1}{WC})^2}$). Hence it is not possible to give a definite opinion on the ·01 value, owing to the unknown factor, H.F.C. This condenser, however, is certainly of the right order.

The neutrodyne condensers C_2 and C_5 will naturally be of the usual low capacity, while the reservoir effects of the 1 mfd. condensers C_{10} and C_{11} across the H.T.+tappings and H.T.−will be readily appreciated.

Taking a general survey of the condensers, the variable ones should naturally conform to the accepted present-day canons of low-loss, which do not need recapitulating here. The insulation resistance of the ·006 condensers must be above suspicion, for in addition to upsetting the performance of the receiver, the H.T. battery located between the first tapping and H.T. will be short-circuited, and hence rapidly become useless. The same remarks will apply to the ·0003 and the ·01 condensers, although damage to the H.T. battery is not quite so acute owing to the presence of the ·5 megohm resistance in one case, and the ·5 and ·2 megohm resistances in the other case. Similar reasoning will of course apply to the insulation of the 2-mfd. condensers.

THE OUTPUT CIRCUIT

By C. E. FIELD, B.Sc.

It will be seen that the loud speaker is not connected directly in the plate circuit of the last valve, but that an output transformer is employed.

So much has been written about the shortcomings of L.F. transformers that an output, or telephone, transformer is often avoided by the experimenter who is desirous of obtaining the best possible quality from his set.

This is a mistake, however, for a good output transformer will almost invariably improve the quality of reproduction, and, if really suited to its position, may give quite an appreciable increase in volume.

This is because, if no transformer is employed, the steady plate current flowing from the H.T. battery to the last valve flows through the speaker windings. In the ordinary type of speaker this may very quickly weaken the magnets, giving reduced volume, or else saturate them so that loud signals are unable to produce their full effect.

Selecting the Loud Speaker.

In many hornless and other speakers employing a moving armature, the latter will be given an initial set which may have a bad effect upon the quality if the movement is at all delicate.

Another, and perhaps the most important, reason for using a transformer is that by so doing the risk of a breakdown in the speaker windings, due to the voltage of the H.T. battery, is avoided.

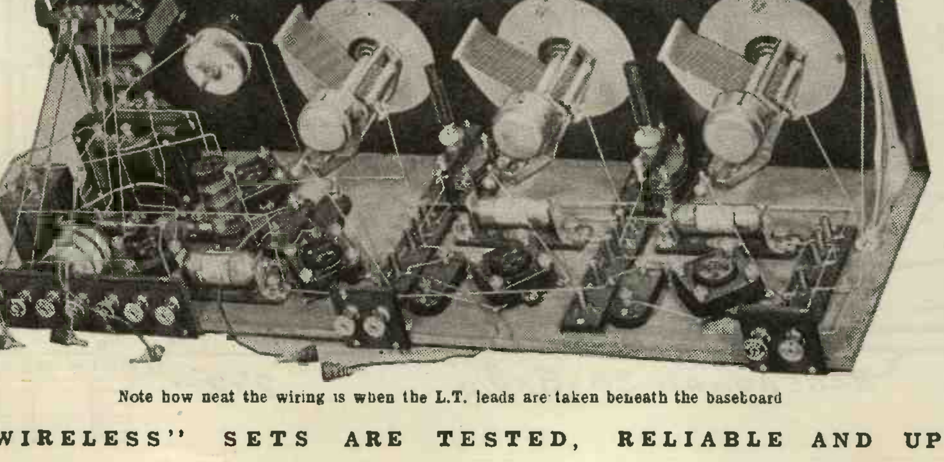
In this respect the transformer is to be preferred to the choke-and-condenser method of coupling, for, although the latter shunts the steady plate current from the speaker windings, it does not protect them from the H.T. voltage unless a condenser is connected on both sides of the speaker.

Moreover, a suitable choke for the output circuit of a power valve is very difficult to construct, for, if the winding is sufficient to give the high impedance which is so necessary for an anode choke, the plate current of the valve may very easily halve the inductance by saturating the core.

Very little need be said about the speaker itself, except that it should be a good one, for at the present stage of development the loud speaker is the weakest point in a wireless receiver.

This set, although not unduly elaborate, embodies practically every refinement which experience has shown to be worth while, and is capable of taxing a loud speaker to its utmost capacity, and of giving a quality of reproduction to which few speakers will do justice.

It therefore behoves the experimenter who is purchasing a speaker to try several on the set itself before making his choice, for the most perfect receiver cannot make an undersized or badly designed speaker give good results.



Note how neat the wiring is when the L.T. leads are taken beneath the baseboard

Articles will appear in future issues of "Modern Wireless" dealing in greater detail with the handling and calibration of the "Combine" Five, and letters from readers describing their experiences with the set will be published from time to time.

THE "LAYOUT"

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

(Editor of the "Wireless Constructor")

At one time, to speak of the "layout" of a wireless receiver would be to use a phrase of no particular meaning. In all the early wireless receivers the disposition of parts was settled purely by convenience, often by the size of the box available, and very rarely had any relation to electrical considerations. It was not realised how important was the exact placing of parts and how the same circuit could work in half a dozen different ways, according to the manner in which the parts were disposed.

The layout of the "Combine" Five has been most carefully considered in the light of our most recent knowledge of inter-action between the various parts of a highly efficient wireless receiver. Two leading considerations have to be borne in mind. On the one hand all wiring must be kept as short as possible, and on the other, while keeping to this shortness as far as possible, parts which are liable to harmful inter-action must be kept at sufficient distance from one another. Other less important but still desirable considerations, are a good appearance and a symmetrical layout.

In a circuit consisting of two stages of radio-frequency amplification, a detector and two stages of audio frequency, the first consideration will always be the best disposition of the radio frequency side, as inter-action is far more pronounced in those parts. In looking at the circuit it will be seen that we have three tuned radio-frequency circuits and three radio-frequency transformers (for the aerial coupler is really to be considered as such).

Mr. G. P. Kendall, B.Sc., in designing the coils, had in mind that they should not be screened, but that their disposition should be such that inter-action between fields would be reduced as far as possible. A fairly wide spacing was thus desirable. Now these coils have to be tuned by three variable condensers, and it is also desirable in this particular circuit that these should be well spaced. Thinking matters over, it occurred to me that the best procedure would be to take the baseboard and panel of the set, and to start with the output end, arranging the detector- and audio-frequency portions of the circuit as close together as possible commensurate with efficiency, in this way leaving the maximum space for the radio-frequency side.

An examination of the practical wiring diagram will show that it was found possible to arrange the various components in the detector and audio-frequency circuits with extremely short leads and in a very compact way. A problem that gave me some little worry related to the placing of the output transformer, and in the end I decided that this should be carried on the front panel in the position shown.

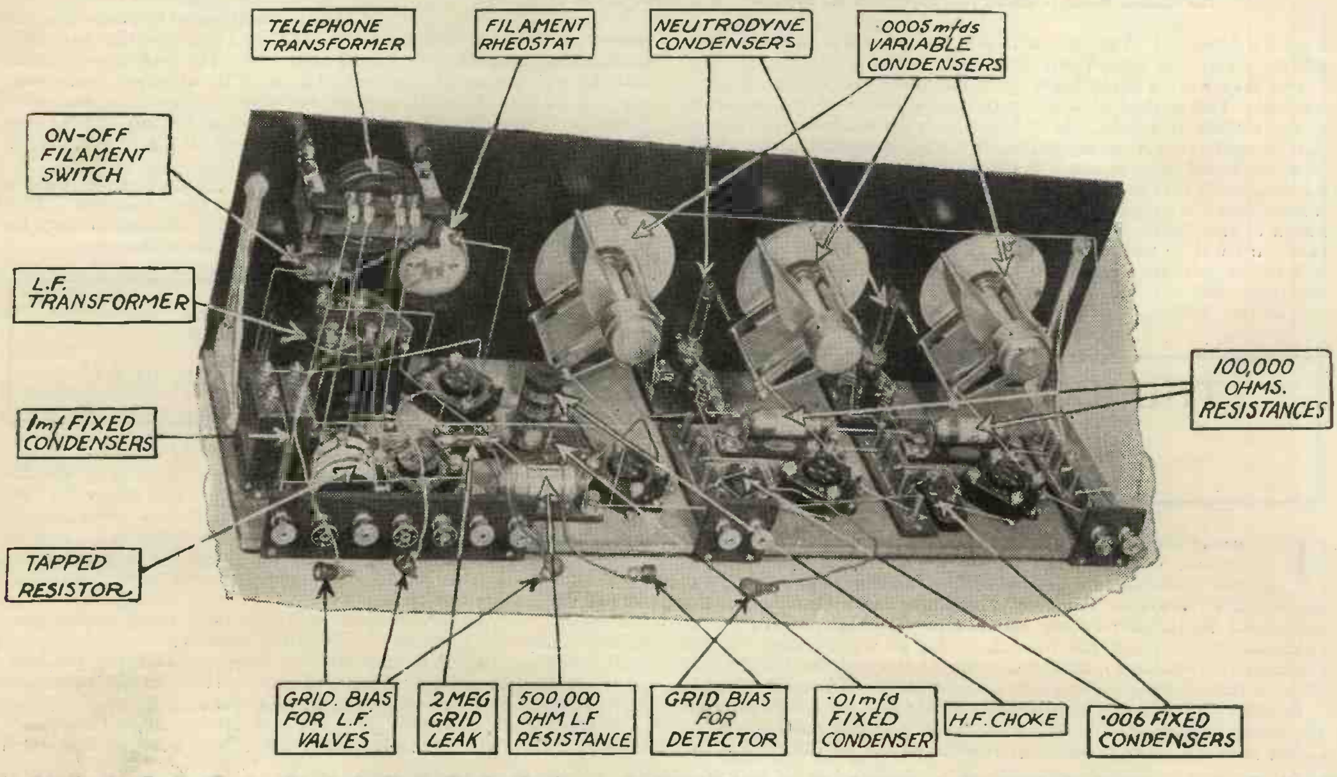
With one end of the receiver laid out in this manner, it then became much easier to start on the radio-frequency portion. There was available, roughly, a little more than half of the baseboard and panel, and this obviously determined the positions of the coils and their bases. The condensers had to be placed where shown so as to keep the leads for the three radio-frequency circuits of approximately the same length.

The valve sockets, fixed condensers, high-frequency choke, stabilising resistances and neutralising condensers, seemed to fall naturally into the positions shown, while ideals of symmetry led to the choice of indicated positions for the on-and-off switch and the filament resistance.

Construction Quite Straightforward.

From this brief sketch of the considerations leading up to the choice of layout shown, let us see how to proceed with the work of making the receiver. Fortunately this is far simpler than with many sets using the same or a smaller number of valves. The front panel should first be marked off according to the drilling diagram, and the condensers, variable filament resistance, and on-and-off switch fixed in position, not forgetting to drill the holes for the securing screws for the brackets. Personally, I always drill these first, and as they need to be drilled accurately the following procedure is recommended.

Take the baseboard of the set and stand the ebonite panel upright in front of it. Then, from behind, make a mark indicating the position of the top of the baseboard. Place the panel flat on the table (with some sort of protection underneath it, such as a pad of newspaper), and scratch along the lower end a straight line corresponding with the top edge of the baseboard. Now take a bracket and hold it against the panel in such a way that the projecting portion, which

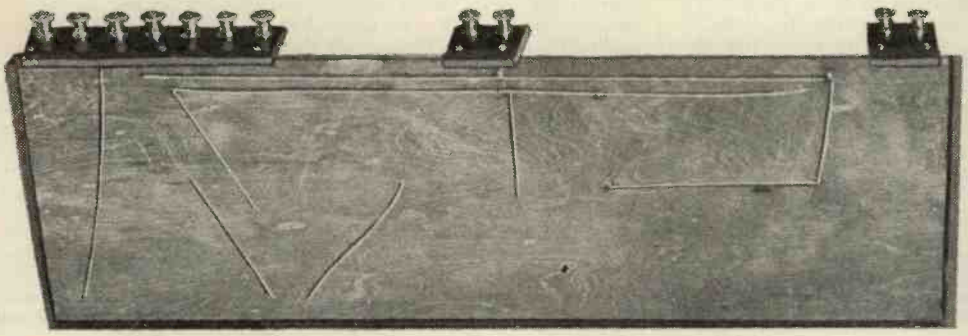


will ultimately be screwed to the baseboard, is in its correct position. The scratched line will serve as a guide for this.

Holding the bracket firmly in place with the thumb, make two marks through the holes in the bracket. On removing the bracket, you will have the exact positions for the holes for the securing screws Follow the same procedure with the other bracket and drill holes just big enough to take 6B.A countersunk-head metal-screws. Countersink the holes on the front of the panel either with a special bit or some substitute, such as the end of a larger drill.

Before securing the brackets in position, drill the three holes which take the wood-screws that hold the panel against the edge of the baseboard. These holes should be drilled midway between the scratched line and the bottom edge of the panel. The holes for the variable condensers, variable filament resistance, and on-and-off switch should now be drilled, whereupon you are ready to fix the components and brackets into position.

I would recommend you to secure the panel to the baseboard at once, as the positions of the projecting parts will be a useful guide in placing the baseboard-mounted components in position. With the practical wiring diagram as a guide you will have no difficulty in mounting these parts, and you will find that in most cases half-inch No. 5 round-headed wood-screws will be suitable. In a few cases, such as the Mansbridge condensers, half-inch screws will be a little too long, but if you place a fairly thick pad of paper underneath the baseboard when screwing these components down, you will not injure the table beneath. When all parts are screwed down, turn the baseboard on end and file off any projecting points.



The filament wiring is mainly run underneath the baseboard, as is shown by this photograph.

You may have a little difficulty in mounting the Varley choke in position. The method of securing this is by means of a wood-screw in the bottom of a tube, and this can only be reached with a long, thin screwdriver. A more satisfactory way of mounting this choke on a baseboard is to abandon the wood-screw altogether and to drill a hole about 3/16th in. diameter in the position the choke is to occupy. A metal-screw is supplied with the choke, but as this is only of sufficient length to grip the choke when passed through a $\frac{1}{4}$-in. panel, and as the baseboard will be thicker than this, you will have to countersink the hole in the bottom of baseboard rather deeply. The metal-screw can then be passed through the baseboard and screwed into the threaded hole in the choke.

THE COMBINATION RESISTOR

By K. D. ROGERS

THE use of the variable filament rheostat in modern sets is rapidly dying out, except in those cases where critical adjustment of filament temperature is essential. Therefore, in the design of the MODERN WIRELESS "Combine" Five it was decided to eliminate this component as far as possible, and not only to eliminate it, but to eliminate its successor, the resistor, as far as was feasible. It was considered advisable to employ a variable rheostat for the detector stage, as the rectifying valve has to operate on the anode-bend principle.

In order to suit every constructor, should he vary somewhat from the specific valves used in the original set, a special resistor was designed so that a series of different resistances can be obtained. This is made possible by winding the resistor in three sections and so utilising those sections and carefully choosing their resistances that a variety of resistances can be obtained sufficient to cover the use of any valve By a series-parallel arrangement of connections to the four terminals on the rheostat a variety of twelve different resistance values can be obtained.

Those available on the resistor used in the original "Combine" Five are, in ascending resistances, 0·387, 0·545, 0·568, 0·75, 0·8, 1·02, 1·3, 2·0, 2·08, 2·3, 2·75, 4·08 ohms. These are obtained by winding the resistor in three sections on a slotted former, using 24-gauge cotton-covered "Eureka" resistance wire, and winding on sections of 10 turns, 16 turns, and 24 turns, giving ohmic values of $\frac{3}{4}$, $1\frac{1}{3}$, 2 ohms.

The resistor is wound on an ebonite bobbin $1\frac{1}{2}$ in. in diameter and slotted $\frac{1}{8}$ in. deep. so that three slots are obtained about $\frac{3}{8}$ in. wide. Four small terminals are fixed to the ends of the three windings, so that a resistor having two tappings is obtained.

Values Advised.

For the actual valves used in the tests the resistor was connected in circuit so that the H.F. valves (D.E. 5B type) had $1\frac{1}{3}$ ohms in series with them, and the L.F. valves (D.E. 5 and S.T.63 respectively for first and second stages) had $\frac{3}{4}$ ohm. This is easily obtained by taking the L.T. positive connection to the second terminal from the $\frac{3}{4}$-ohm end. Then the end terminal at that end will feed off the current for the L.F. valves, and the third terminal (the remaining inside one) is connected to the filament leads to the H.F. valves.

The following resistances for valves in parallel may be useful to constructors, as they are all obtainable with the resistor described (the detector, as before mentioned, has a separate rheostat, though it *could* be run from the same resistor if desired) D.E.5 B, D.F.A.4, S.T.61, etc., $1\frac{1}{3}$ ohm. D.E.5B, S.P.55 B., used as first L.F. with either L.L.525, S.T.63, S.P.55 R. for last stage will require $\frac{3}{4}$ ohms in series with their L.T. supply. If B.4 valves are employed no resistance is required, and the L.T. can go straight to the valve filaments.

A useful resistance for power valves can also be obtained by connecting the resistor so that $1\frac{1}{3}$ is obtained for the H.F. and then the other two resistances are connected to give 2 and $\frac{3}{4}$ in parallel. This gives a resistance of 0·54 ohm—a very useful value indeed if two S.T. valves are being used, say S.T. 62 and S.T. 63 together, or power valves requiring more current. It would be advisable to use this value for any of the above last-stage valves if used with either the S.T.62, D.E.5, P.M.6, etc., in the first L.F stage.

This short description will serve to show the constructor what a flexible arrangement the resistor designed for the "Combine" Five is, and he will be able by use of the various terminals to vary his resistance to suit any valve recommended for use in this set.

THE WIRING

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

THE amateur undertaking the construction of this latest "M.W." super-receiver will, no doubt, have his own particular ideas upon the wiring of the components. However, as in any receiver a very large amount of the success gained is due to efficient wiring, it will not be out of place here to jot down a few notes on the subject of the wiring of this set, and, indeed, on the topic of wiring in general.

In any multi-valve set there are present three main systems of wiring, viz. :

1. Wires carrying steady direct currents, these being usually only to be found in the filament circuits of the receiver.

2. Wires carrying H.F. currents of a frequency of many hundreds of thousands per second. These, of course, occur in the aerial and H.F. sections of the receiving circuit as a whole.

3. Wires dealing with rapid pulsations of currents. These wires constitute the audio- or low-frequency side of the circuit, and, although

such currents may be uni-directional, still the current pulsations reach a high order, amounting to anything up to ten or twelve thousand pulsations per second.

When wiring any multi-valve circuit it is always advisable to bear these three distinct component parts of the circuit well in mind. Whenever possible, each division of the circuit should be completely wired before starting on the next one.

For instance, in dealing with the present receiver, it is best to begin the work of wiring, after most of the various components have been assembled on the panel and baseboard of the instrument, by undertaking the wiring of the filament circuits. Some of these wires are run beneath the baseboard, and it is quite immaterial whether they are covered with insulating sleevings or not.

In dealing with H.F wiring, the one important thing we have to remember is that all H F. currents are much more difficult to insulate and to prevent from dissipating themselves away than are steady or L.F. currents. If two wires carrying H.F. currents are run parallel to each other for any length, a condenser effect is set up between the two, and a portion of the current from each of the wires is short-circuited.

Thus, in all H.F. wiring it is of the utmost importance not to have two wires running parallel. Keep all such wires well apart and run them to and from their various points of connection by the shortest possible route.

Naturally, all wire connections in a receiver such as the present one must be well and efficiently soldered.

Ordinary tinned round wire of 18's S.W.G. should be used.

Finally, there are one or two further important practical points in connection with the wiring of this set which should be noted, but I have left Mr. C. A. Meadows to deal with them. Mr. Meadows was mainly responsible for the actual assembly of the Combine, so it is fitting that he be allowed to say a few words regarding this part of the work.

MAKING THE COILS

By G. P. KENDALL, B.Sc.

THE coils for the "Combine" Five were required by Mr. Allinson to provide a certain definite degree of coupling between primary and secondary, a certain corresponding H.F. resistance being stipulated. Beyond this, their arrangement and construction were left in my hands, and the first question which came up for settlement was to decide whether to attempt to make them ultra-efficient or whether to decide upon a design which should present the minimum of difficulty to the constructor.

It was felt that a reasonable compromise should be effected, for the factors of cheapness and ease of construction were considered to be of paramount importance. It was obviously useless to produce a design in which all sorts of losses had been cut to a minimum if the resulting coil was to be so troublesome and difficult to make that the average home constructor would feel that he could not attempt it, and would therefore be driven to a considerable outlay for ready-made ones (such a coil would necessarily have been rather expensive).

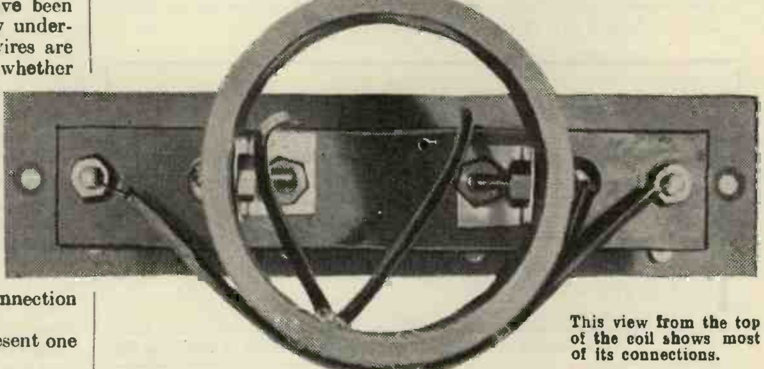
On the other hand, to be in keeping with the rest of the design, the coils were required to be of reasonably low H.F. resistance, and the compromise which was decided upon produces a coil which is satisfactory in this respect, and which can be made with only the tools which most constructors possess. The only difficulty in the whole job lies in the handling of some rather fine wire, and just a little care and patience are called for in consequence.

Any reader who is not familiar with the more recent practice in coil design may perhaps be surprised at the mention of fine wire, with memories of the fat conductors used in some alleged "low-loss" coils, and the point should perhaps be explained before proceeding further. It has been found that if a *short* length of wire can be made to give the desired inductance it will often produce a coil of higher efficiency than a coil wound with a greater length of thicker wire, but of only the same inductance.

This may seem surprising, but actual tests have shown that the advantage conferred by a small number of turns in a small space is sufficiently great to ustify the use of gauges of the order of No. 32 or 34 for coils of the size used in "closed" circuits, *i.e.* tuned anode and secondary circuits.

The gauge used for the "Combine" Five coils is No. 34, D.S.C., except the aerial coil, which is No. 30.

A further point requiring a little explanation is that of the material used for the formers on which the coils are wound. It will be seen that these are plain ebonite tubes with no special claim to ultra low-loss construction. Here again the decision was made on the factors of ease of construction and efficiency. As a matter of fact, however,

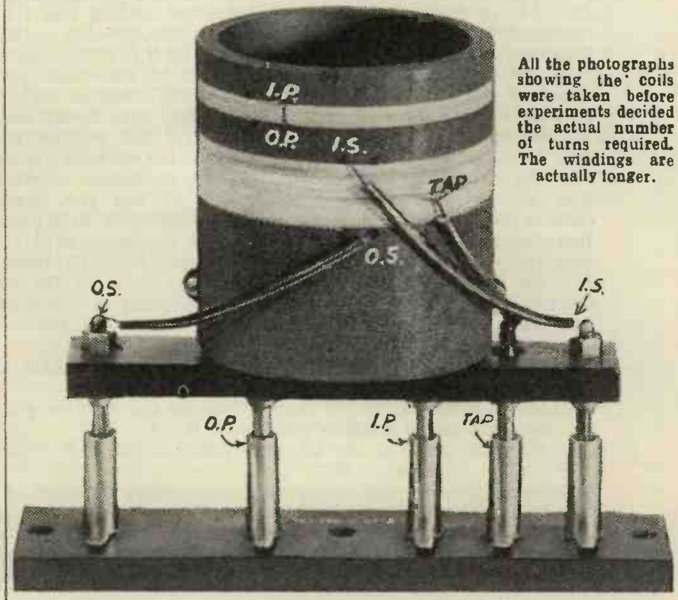


This view from the top of the coil shows most of its connections.

tests have shown that losses resulting from the use of a solid as compared with a skeleton former are extremely small if the insulating material is good.

The coils are arranged to be interchangeable in circuit, an existing type of 5-pin base and socket having been chosen. This is the fitting originally produced for a special transformer used in one of Mr. Harris' sets (the "Special Five"), and the necessary three sockets and six bases can be obtained from a number of different firms (Burne-Jones, Peto-Scott, etc.).

The coils consist of two separate windings constituting the primary and secondary of an H.F. transformer, each being a simple single layer winding. The primary consists of 30 turns, and the secondary of 80 with a tapping at the centre. (This only requires to be located with a moderate degree of accuracy, half a turn either side makes little difference). These are the windings for the 200—550 metre band, for which the diameter of the tube is 2 in. and its length 3 in. The exact connections are shown clearly in one of the photographs, but it should also perhaps be explained that the base is fastened to the coil tube by means of two little brass angle pieces. These are easily bent up from brass strips about ⅜ in. wide and 1½ in. long, and one end of each is gripped under the nuts of the I.P. and O.P. pins of the base. The other end of each is attached to the tube with a small screw and nut.



All the photographs showing the coils were taken before experiments decided the actual number of turns required. The windings are actually longer.

The constructor should keep this photo before him when he is winding the coils.

The aerial coil winding is provided with tappings. These are at 15, 20 and 25 turns. The tappings are made by twisting up small loops in the wire as winding proceeds, and connection is made to these with a tapping clip. The lead from the I.P. pin of the coil base consists in the case of the aerial unit of a short flexible lead carrying this clip upon its end. A dab of Chatterton's Compound at each tapping point will serve to hold the loops firmly.

Details of the Daventry coils and instructions for adjusting the coils to suit special conditions, valves, etc., will be given in an article to appear shortly in "Modern Wireless."

SOME GENERAL CONSTRUCTIONAL NOTES

By C. A. J. MEADOWS.

THE drills necessary for drilling the panel, etc., are given in the following table.

Component	Size of Drill	C/Sinking Size
Var. condensers	½ inch	None
On-off switch	⅜ inch	None
Rheostat, centre hole	5/16 inch	None
,, outer holes	3/16 inch	None
Tel. trans. screws	5/32 inch	5/16 inch
Bracket screws	,,	,,
Wood screws	⅛ inch	¼ inch

One other drill besides those given above will be necessary to make the holes in the baseboard through which the filament leads pass; this should be 1/32 in. in diameter.

After drilling, the panel and baseboard may be screwed together: countersunk-headed brass screws, ½ in. long, No. 5 gauge, are used for this operation. It is worth mentioning here that this size of screw is used throughout, with either round or countersunk heads, according to the components with which they are employed.

Before screwing the panel and terminal strips to the baseboard, however, glue two narrow strips of wood underneath the baseboard, as shown in the photographs. These strips should be ½ in. wide and 1/16 in. thick, and provide clearance for the L.T leads under the baseboard. Start the holes for the panel fixing screws with the 1/32 in. drill to ensure that they will not tend to run downwards, as if this happens the points will break through below the baseboard.

When mounting the Ormond variable condensers, the boss on the nut must be inside. It is for this reason that a ½ in. drill is necessary.

The L.T. leads which pass below the baseboard should be connected first. The lead from the resistor to the filaments of the H.F. valves is soldered to two dome-headed pins, as owing to its length it might, if unsupported, come in contact with the L.T. negative lead and short-circuit the accumulator. In most cases the connections to the valve holders can be made to the soldering tags provided; the exceptions are the leads from the plates of the L.F. valves to their respective transformers.

After all the other wiring has been carried out, the telephone transformer and the Mansbridge condensers may be mounted and their connections made. The only flex leads in this set are those to the two grid-bias batteries, which are mounted in the back of the cabinet by means of brass clips.

Before putting the set into the cabinet remove the fillets, as the brackets are mounted close to the edges of the panel and will foul them unless they are removed.

WIRING INSTRUCTIONS

Join the L.T. negative terminal to the filament terminal nearest back of baseboard on each valve holder, and to H.T. negative.
Join the remaining filament terminals of the first two valve holders to the appropriate terminal on the resistor.
Join the filament sockets of the last two valve holders to their appropriate resistor terminal.
Connect one side of the rheostat to the remaining filament terminal of the detector valve holder.
Join the L.T. positive terminal to one side of the on-off switch.
Connect other side of switch to remaining side of rheostat and to remaining inside terminal of resistor.
Join the aerial terminal to the I.P. terminal of the aerial coil holder.
Connect the earth terminal to O.P., also to the screening plates of the variable condensers.
Join O.S. terminal of aerial coil holder to grid of 1st valve holder, and to moving plates of 1st ·0005 variable condenser.
Join I.S. to fixed plates of same condenser and to one side of neutralising condenser.
Connect "tap" terminal to one side of 1st 100,000-ohm resistance.
Join plate socket of 1st valve holder to I.P. of 1st H.F. transformer holder and to the remaining terminal of the 1st neutralising condenser.
Join O.P. to one side of 1st ·006-mfd. fixed condenser, and to H.T.+1.
The other side of this condenser is taken to L.T. negative lead.
Join the O.S. terminal to grid socket of 2nd valve holder, and to moving plates of 2nd variable condenser, fixed plates of which connect the I.S. terminal to one side of 2nd neutralising condenser.
Join "tap" terminal to one side of 2nd 100,000-ohm resistance.
Join the remaining terminals of the two resistances together, and to L.T. negative lead.
Join plate of 2nd valve holder to I.P. of 2nd H.F. transformer, and to remaining side of 2nd neutralising condenser.
Connect the O.P. terminal to one side of 2nd ·006-mfd. fixed condenser and to H.T.+1.
Join the remaining side of the 2nd ·006 condenser to L.T. negative lead.
Join the O.S. terminal to moving plates of 3rd ·0005 variable condenser and to the positive lead of the 1st grid bias battery.
Join the fixed plates of the 3rd variable condenser to the I.S. terminal of the 2nd H.F. transformer, and to L.T. negative.
Connect the grid socket of the 3rd valve holder to the negative lead of the 1st G.B. battery.
Join plate socket of 3rd valve holder to one side of H.F. choke, to one side of 500,000-ohm anode resistance, and to one side of ·0003 fixed condenser C8.
Join the other side of anode resistance to H.T.+2; the other side of H.F. choke to one side of ·01 fixed condenser; the other side of ·0003 condenser to L.T. negative lead.
Connect the remaining side of the ·01 fixed condenser to the grid socket of the 4th valve holder, and to one side of the 2-meg. leak, the other side of which is joined to G.B. –2.
Join the plate socket of the 4th valve holder to the O.P. terminal of the L.F. transformer.
Join the I.P. terminal to H.T.+3.
Connect the ·5-meg. resistance across the secondary terminals of the L.F. transformer, and connect the O.S. terminal to grid socke of 5th valve holder; I.S. is joined to G.B. –3, G.B. +2 to L.T. negative.
Join plate socket of 5th valve holder to O.P. of telephone transformer; I.P. to H.F.+4.
Connect the two secondary terminals of the telephone transformer to the two loud-speaker terminals.
Join one terminal of 1st 1-mfd. condenser to H.T.+2; one terminal of 2nd to H.T.+4. Connect the two remaining terminals to L.T. neg. lead.

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Valve Set Owners Are Fast Learning This Secret ✶

✶ the secret of increased range and greater economy in the operation of their radio receivers

It must have struck you at one time or the other that the radio results of certain of your friends who have sets based on the same circuit and the same number of valves, were better than those from your own receiver. The answer to the following question will give you the key to the secret of improved reception :

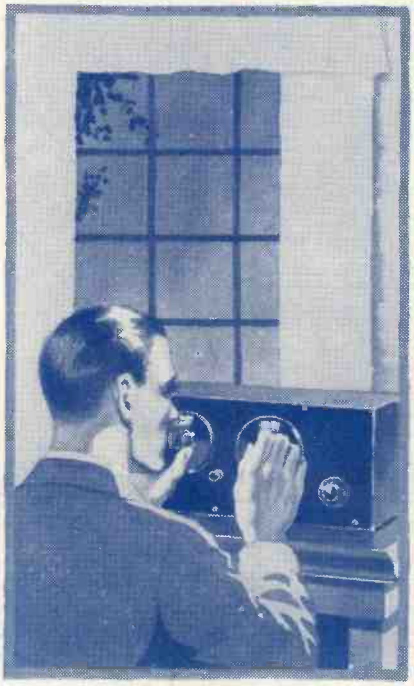
" How copious is the emission given by the filaments of your valves over a range of filament temperatures ? "

IT may seem strange to you that the emission of a valve filament can make a marked difference in the way your receiver operates and in the cost of its upkeep.

If, for example, your set is "all out" when receiving a station, say 100 miles away, you have small hope of securing weaker distant stations as your friends may do, moreover, your battery consumption is naturally at its highest under these conditions.

Why great emission makes all the difference

When a valve filament gives a copious and sustained emission at the correct filament temperature, a rich field of power is placed under your control which enables the best conditions to be secured to deal with the incoming signals, so that your receiver is adjusted to suit the particular circumstances existing at the time.



The local station may be tuned in purely and strongly with the minimum of energy expended because valves that possess a huge emission are able to function perfectly at considerably less than their full capacity.

Then, as you reach out for more distant stations or weaker signals, you are able to adjust the operating energy of your high emission valves, particularly in the detector stage, to suit the exact demands for ideal reception. It will be realised that by the use of Mullard P.M. valves with their abundant electron emission you will save upkeep costs since your receiver will only consume minimum energy from your batteries.

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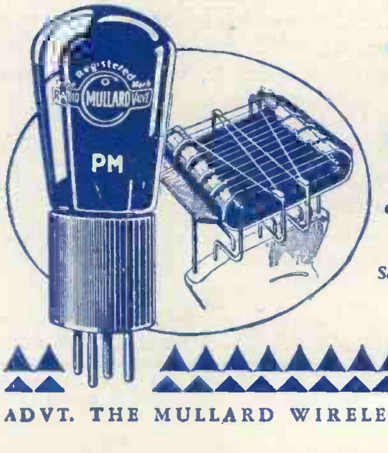

Sectional view of P.M.5 showing generous proportions of P.M. Filament

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