The Wireless Constructor

6D MONTHLY

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

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TWO SETS TO CHOOSE FROM

The 1930 "STRAIGHT LINE" FOUR

By Percy W. Harris M.I.R.E.

and

THE "FEATHERWEIGHT" PORTABLE

Also in this Issue

THE KING "CUT-OUT"
BY VICTOR KING

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

Chief Radio Consultant: Capt. P. P. ECKERSLEY, M.I.E.E.

THE WIRELESS CONSTRUCTOR

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

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THE EDITOR'S CHAT

The 1930 "Straight-Line" Four—The "Featherweight" Portable Set—The King "Cut-Out"—Victor King's Next Set.

WHAT do you look for in your ideal wireless set? Certainly your answer will be "Quality, range and selectivity!" This trio of virtues is undoubtedly possessed by the 1930 "Straight-Line" Four, full details of which appear for the first time in the present issue.

A Straight-Line Straight Tip

The enthusiasm we feel for this handsome yet simply constructed receiver will, we are sure, be shared by the many readers at home and abroad who have asked for such a set, while in addition to the three virtues named it possesses such other attractions as simplicity of operation, first-class reproduction of the programme from a powerful nearby transmitter (by no means a common feature in sensitive sets!), and economy of maintenance.

Naturally it includes a simple wave-switching scheme which obviates coil changing; and smoothly-operated differential reaction, together with a volume control which does not distort, are noticeable refinements. Although we have many receivers available, this particular model, in conjunction with the "Stedipower" low-tension and high-tension units, proves to be an indispensable part of the Editor's laboratory equipment.

The Really Portable Set

Speaking of summer leads us to thoughts of the great "out-of-doors" and the need of a "portable" which does not turn the word into a joke! The "Featherweight" portable is something more than an extra-light receiver of the self-contained type—although this alone should ensure its popularity.

It contains a feature of considerable technical interest—this being the combination of a screened-grid valve choke-coupled by a method already popularised in the WIRELESS CONSTRUCTOR to one of the remarkable multiple valves now manufactured in this country, and which in one bulb contains not only the detector, but also a pair of low-frequency stages!

This, of course, effects considerable economy in space, weight and wiring. Frame aerials for the two wave-bands, an ingenious switching scheme, and a loud speaker contained in the case, have all been carefully worked out for the special benefit of the home constructor, the high quality speaker being of the home-constructed variety.

POLICE RADIO

The new radio transmitter at the Chicago Central police station. The transmitter is used for communicating with Flying Squad cars.

Does Brookmans Park still worry you on your old set? Victor King is displaying his usual ingenuity this month by producing the King "Cut-Out," a worthy addition to the long line of useful accessories described in this journal. If you think of interference elimination only in terms of the older inefficient wave-traps, you will have no idea of the remarkable discrimination shown by this King of Cut-outs.

Watch Your Friends!

When you have made it—and it costs but a few shillings—bring in your friends and hear their envious remarks! And don't lend them your copy of the WIRELESS CONSTRUCTOR to built it by, or you won't get it back!

Another article of considerable interest in the present number is that entitled "The L.S.D. of S.G.'s," drawing attention to the often overlooked matter of the greediness of the later screen-grid valves in the way of high-tension current.

These valves vary considerably not only among makes, but among specimens of the same make in regard to this point, so that if the user is dependent upon high-tension dry batteries for his H.T. supply he may be draining them to a much greater extent than he realises.

Next Month's "Three"

Next month Victor King will describe a new wave-change three-valver designed to take in the very short waves—a type of set for which we have recently been asked a good deal. While it will not light lamps in Sydney, it will give good signals from that city, and at least your eyes will light up when you try it! See that your newsagent books your copy early!

THE BAIRD TELEVISOR

Below are some details of preliminary tests carried out in the "Wireless Constructor" laboratories with one of the first of the new televisors to be issued by the Baird people.

READERS of the WIRELESS CONSTRUCTOR are probably aware of the fact that the various technical wireless publications have each received a Baird televisor for test.

Two Waves Now Used

For some weeks past now we have had one of these televisors on a test bench in our Research laboratory, and every morning at 11 o'clock the television transmissions have been tuned in. In view of the fact that by the time this issue of the WIRELESS CONSTRUCTOR is on sale the Baird Company will be exercising the privilege, granted to it by the B.B.C., of utilising two wave-lengths, one for television and one for the accompanying speech and music, and that more televisors will probably be available to the public, it seems an opportune moment to publish a few preliminary remarks concerning our experiences with one of these televisors.

Special High-Power Amplifier

To begin with we found it necessary, in order rigidly to adhere to the technical stipulations of the Baird Company, to build a special high-power amplifier. Without going into detailed technicalities, it may be interesting to point out here that a high-tension supply of some 400 volts was necessary, and it was some days before this amplifier, which is really somewhat of the type necessary for loud-speaker public-address systems, could be built, tested and wired up to the televisor.

Therefore, from practical experience, we can assure our readers that in order to test a televisor in accordance with the instructions of the Baird Company an amplifier adhering to their specification has to be built—and it cannot be built in five minutes.

Very Interesting

Consequently, we have not rushed out a report, but have preferred to take our time and do full justice to the opportunity afforded us by the Baird Company of testing one of the early televisors.

And let it be said right away, that from the laboratory point of view this televisor has proved very interesting indeed. It required one or two efforts before the technical department could get the "hang" of the necessary adjustments; in particular the synchronising control which regulates the speed of the motor revolving the televisor disc.

Unless this motor regulator is dealt with most carefully it is quite impossible to obtain with any clearness or certainty the television images sent out, and we feel pretty certain that the average listener would not find it at all easy to regulate the motor control with the precision required until he has indulged in quite a considerable amount of practice.

However, that is a detail, though nevertheless an important one.

The actual television images received can only be seen when looking into an aperture which in size is approximately 6 in. by 8 in., or perhaps a little more. At the back end of this aperture is a circular lens with a small magnification factor, sufficient somewhat to enlarge the images.

P.O. PICTURES!

There are now regular services of still-picture transmissions to the Continent, and this picture shows a G.P.O. engineer telephoning Berlin to prepare for a photograph.

Behind this lens, when one begins to receive television signals, there appears a most astonishing display of dots and dashes and streaks and lines brilliantly coloured orange, due, of course, to the neon lamp.

"Lines of Fire"

As the regulator control is manipulated, and as one's skill in manipulating it increases, so, as the images are transmitted, these lines of fire resolve themselves into reproductions, of, for example, the faces of persons being televised at the transmitting end. The image flickers very considerably, but there are moments when, having made a particularly fine and satisfactory adjustment of the motor regulator, and the other control for "framing" the picture, the image becomes reasonably steady—steady enough for one clearly to determine that, for example, a lady's face is being televised.

Telling the Time

Of course, only head and shoulders can be seen, and, as far as we can ascertain, only one person at a time with any degree of clarity.

The actual televised image, when it appears, is only a few square inches in area, and is, of course, coloured very vividly in orange, with dark blotches here and there supplying the contrast in tone of colour.

We were able to tell the time when a clock face was televised, but we should hesitate to guarantee, during the course of half an hour's transmission, to recognise any particular friend who happened to be televised, unless his features were of a very characteristic nature.

Some Eye Strain

For example, it would not be difficult to recognise, say, Mr. George Robey's face, because imagination would lend itself very considerably to the effort, and Mr. George Robey's eyebrows alone would perhaps give the clue as to the identity of the person being televised.

We found, however, that peering into the aperture led to some eye strain, but we regard this as of no considerable importance when viewing the televisor as an interesting experimental mechanism. From the point of view of public entertainment, however, we feel that a televisor will not satisfy public requirements.

As a laboratory instrument there is no doubt it is of interest, and we advise all our readers who are keen

(Continued on page 52.)

THE 1930 "STRAIGHT-LINE" FOUR

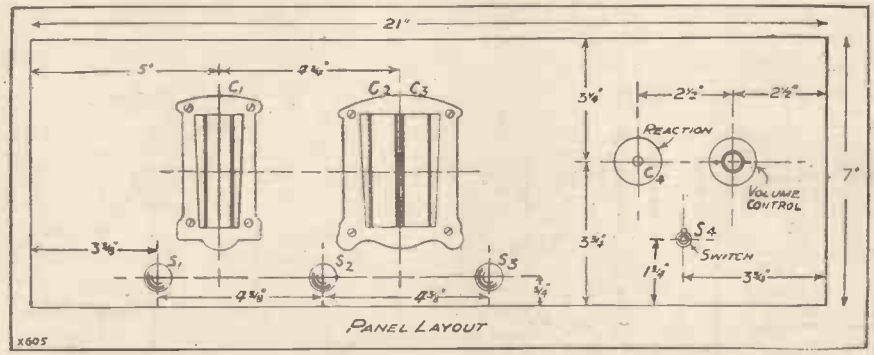
You remember the famous "Straight-Line" Four which created such a furore some years ago? Well, here is a modernised version of that magnificent receiver, completely re-designed and brought up to date.

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

WHEN the original "Straight-Line" Four was published in the December, 1927, issue of the WIRELESS CONSTRUCTOR, the interest it aroused was due not only to its exceptional performance in sensitivity and purity, but also to the fact that it was the first home-constructional design of a popular character to incorporate two of the then novel screened-grid valves.

road towards perfection in sensitivity, selectivity, and high quality.

DO YOU LIKE THE LAYOUT?



Everything is arranged for easy handling, S_1, S_2, and S_3 being the wave-change switches and S_4 the on-off switch. The drum-drive condensers make tuning a pure joy!

Officials of a number of leading wireless societies were invited to the first demonstrations, and expressed without reserve their delight that such a design was made available. "The quality is all that can be desired, and the power of selectivity is such that one's choice of programmes is so varied that the only difficulty is to decide which to enjoy," wrote the secretary of one important society in the Home Counties.

Quality of Reception

"What impressed me particularly was the quality of reception accompanied by considerable volume," wrote the secretary of a London society. "Your set is certainly a great advance," wrote a third.

It is not surprising that such a receiver should have remained standard with many people up to the present time, but it is never our intention to stand still. A great deal of experimental work has been carried out in the Editor's laboratory with the idea of proceeding still farther along the

The 1930 "Straight-Line" Four represents the fruit of this research, and is put forward confidently as a receiver to meet every need of the discriminating listener. The purity of reproduction, both on home and distant stations, will come as a revelation to those who have not handled the original "Straight-Line" Four, while these latter readers will still further appreciate the increase both in sensitivity and selectivity, the simple wave-change scheme, the added simplicity of construction, and many other refinements.

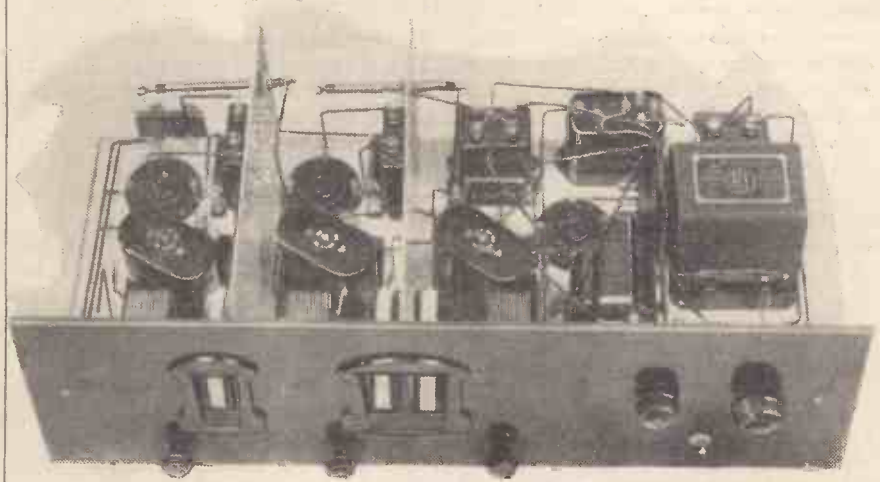
Wonderful Performance

As to the actual performance of the receiver, it is difficult to describe this adequately. When used on local station work the quality is equal to the finest obtainable on any modern set, and really requires the highest grade of loud speaker to bring out all its refinements. Unlike many highly sensitive receivers, no sacrifice whatever is made in quality on the local station—a point which cannot be too strongly emphasised, for many people have shunned highly sensitive receivers, as many such sets sacrifice quality on local reception, which seems to overload them.

It is worth while digressing a moment here to explain why many highly sensitive receivers, capable of picking up the distant stations at good strength, suffer so badly when used on the "local."

The voltages set up in an aerial from the powerful signals of the local

FORE AND AFT



The pleasing simplicity of the front of panel is matched by the neat baseboard layout and the simple screening of the high-frequency stages.

The 1930 "Straight-Line" Four—*continued*

stations are relatively large, and while these can generally be handled without distortion quite successfully by a single high-frequency valve, the voltage swing applied to the second high-frequency valve, by virtue of the amplification given by the first valve, is such that heavy valve overloading takes place and the signal is considerably distorted before it reaches the detector.

Here again, by detector overloading, further distortion occurs and a final signal as delivered to the loud speaker is quite distressingly mangled.

Any volume control depending upon preventing unwanted feed-back effects.

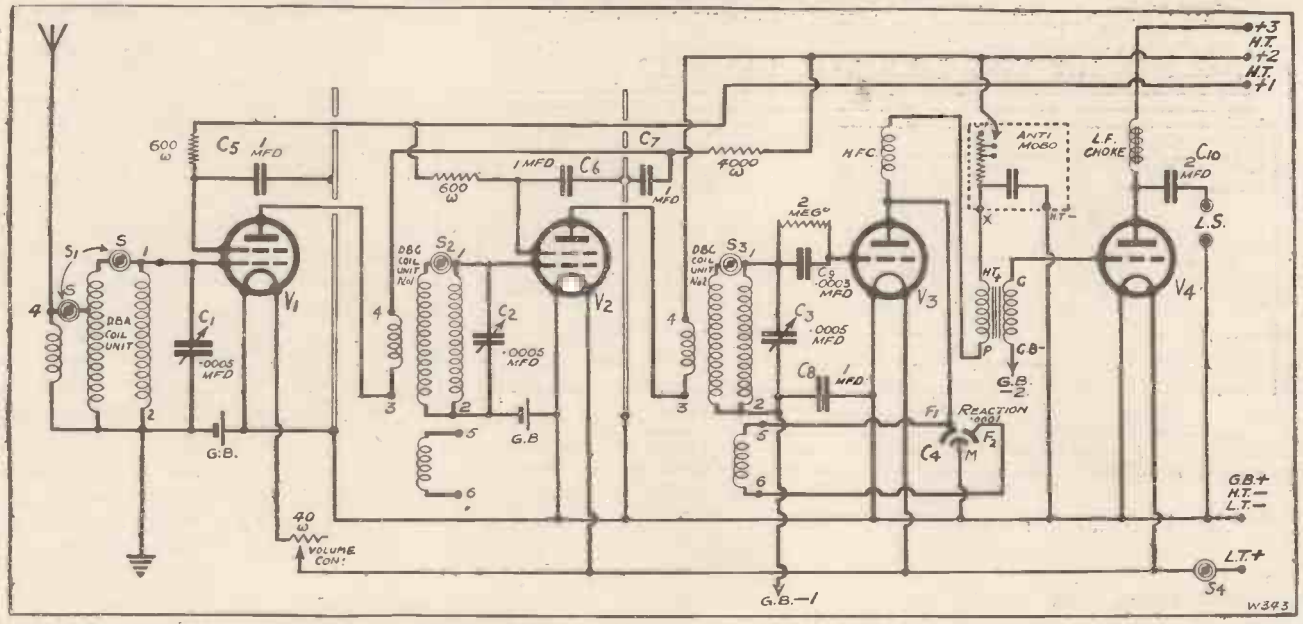
Efficient Volume Control

A 40-ohm filament resistance connected to the filament of the first high-frequency valve provides the necessary smooth volume control. It should be pointed out that the value chosen for this is important, 40 or 50 ohms being the correct value; 10-, 15-, or even 30-ohm resistances, while satisfactory for 2-volt valves, are inadequate for smooth volume control on the 6-volt types; and as a large number of readers will desire to use

At the same time it would be foolish to pretend that it gives the maximum, theoretically or even practically, obtainable with a screened-grid valve, although it certainly does represent what I consider to be the highest practicable degree of amplification, without calling for such a degree of screening as to make the design and construction a factory job.

Furthermore, the design of the special coils adopted for this receiver is such that simple wave-change by switching is possible, while in the detector stage reaction can be used

THE CIRCUIT IS THE SOUL OF THE SET!



The first and second valves are H.F. amplifiers, while the detector can work on the anode-bend or the grid-leak principle. The output of the last valve is choke-condenser coupled to the loud speaker, and careful de-coupling ensures perfect stability. It will be seen that a differential condenser controls reaction, and much of the set's distance-getting properties are due to this refinement.

a resistance across the loud speaker or a potentiometer across the secondary of the low-frequency transformer will be powerless to check distortion arising earlier in the set, and the success of the volume control in the 1930 "Straight-Line" Four is that, without being novel, it goes right to the root of things, and prevents distortion at the outset.

Two S.G. Stages

The 1930 "Straight-Line" Four utilises two screened-grid stages, a detector, and one transformer-coupled low-frequency stage. The design and screening of the set have been carefully worked out to be efficient while yet simple; special decoupling methods

6-volt valves, they should choose a 40- or 50-ohm rheostat as recommended. This gives a very uniform and smooth control of volume. A good make should be chosen.

The method of coupling the high-frequency valves differs from that adopted in the original "Straight-Line" Four, in which the "parallel feed" was adopted, but now that good designs have been worked out for transformer coupling this has been chosen for the present set. The degree of amplification obtainable with these transformers used in conjunction with the modern screened-grid valve is very high, and represents a distinct advance on the method of coupling used in the original set.

by those who desire to get the last ounce out of this set. Normally, however, the reaction knob will scarcely be touched, because the stations will "roll in" when the dials are turned.

Pure Reproduction

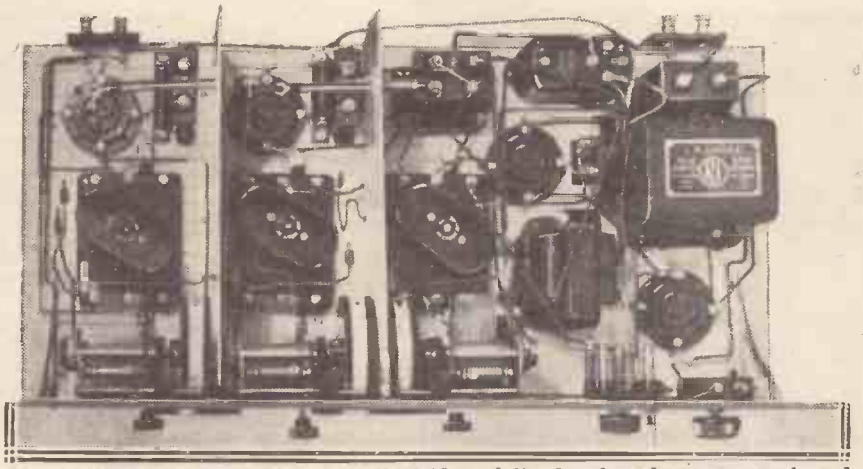
The adoption of L.F. transformer coupling for the single low-frequency stage as against the resistance coupling in the original set was decided upon after very careful study of low-frequency amplification under modern conditions.

The modern high-grade transformer will give as good a quality (so far as the ear can detect) as any resistance stage, while giving a degree of

The 1930 "Straight-Line" Four—*continued*

amplification impossible with resistance coupling. Choke output is provided, for reasons which have been explained on many occasions.

Considering the circuit diagram in detail, it will be seen that the aerial comes to the primary of the high-frequency transformer, the secondary of which is tuned, and is applied to a screened-grid valve.



This photograph gives you an excellent idea of the baseboard arrangement, and shows how the set looks after the completion of the wiring.

Notice that very careful bypassing is adopted for the screening grid, a 600-ohm resistance being placed in series with the high-tension positive lead supplying the positive bias to this grid, the resistance being shunted to earth by a 1-mfd. condenser. The bypassing at this point is very important, particularly in a set using two screened-grid stages.

Careful Decoupling

Note also that a decoupling resistance and condenser is used in the plate circuit of this valve after it has passed the primary of the high-frequency transformer. It is useless with modern high-efficiency screened-grid valves to adopt fieldless, or relatively fieldless, coils and screening if high-frequency currents are allowed to stray all round the set through the batteries, thus giving unwanted feed-back, and the decoupling methods used were adopted only after careful experiment.

It might appear at first sight that the value of 1 mfd. is needlessly high here, seeing that high-frequency currents are being dealt with, but experience has shown that the possibility of low-frequency currents feeding back on the screening grid of this valve is not to be ignored, and thus the value of 1 mfd. was chosen deliberately.

By the adoption of vertical screening and a special screened lead for the plate lead of the valve it is possible to use the valves in a vertical mounting, thus considerably simplifying constructional work. Notice that in the second high-frequency stage a similar 600-ohm resistance and 1-mfd. condenser are used for bypassing the screening grid, the plate circuit in this case going straight to the battery, this being the only plate circuit high-tension so connected.

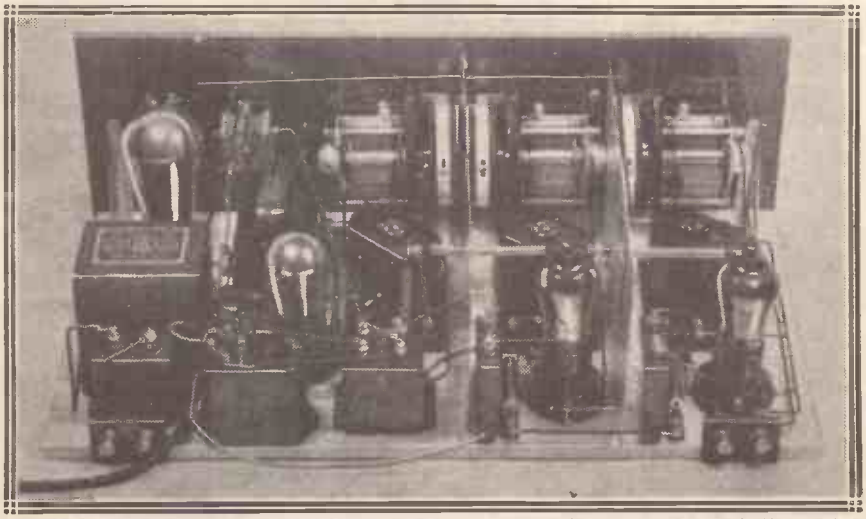
The detector has one or two points of interest, but before discussing this we should point out that provision is made for grid bias on both of the S.G. valves, as the modern screened-grid valve is rather greedy of high-tension current, and the use of 1½ volts grid bias in each case affords a very substantial reduction in consumption of high tension—a point of considerable importance to users of batteries.

Mr. K. D. Rogers refers to this question in another article in the current issue, so I need not enlarge upon it here.

Grid Leak or Anode Bend

The detector circuit is so arranged that either anode-bend detection or grid-leak condenser rectification can be used at will. The grid return being brought to grid-bias negative 1. By connecting grid-bias negative 1 to the positive terminal of the grid-bias battery, and putting the normal grid-bias positive plug in 1½ volts negative, the set will function excellently as grid-leak and condenser rectifier, whereas by substituting for the grid leak a shorting link such as a piece of a wooden skewer the same diameter as a grid leak, with tinfoil wrapped round it, or any other device which occurs to you, and placing grid-bias negative in a suitable negative tapping (depending on the valve), anode-bend detection is obtained. This latter is generally to be preferred, although in the majority of cases there will be very little to choose between the two methods.

A BEHIND-THE-PANEL VIEW



If during construction you compare this photograph and the one above with the wiring diagram which appears on a following page you can be sure of making your version of the 1930 "Straight-Line" a close copy of the original.

The 1930 "Straight-Line" Four—*continued*

Differential reaction is fitted to this set, as to most sets in the WIRELESS CONSTRUCTOR since the advantages of this method were pointed out, but reaction should be used with discrimination, as the sensitivity of the set is such that in the great majority of cases you will get all you want without having any recourse to it.

The chief value of reaction in this set is not to bring about a big increase in volume, but to give just a little additional sharpness of tuning for the separation of distant stations, and just that slight additional sensitivity for very long-distance reception.

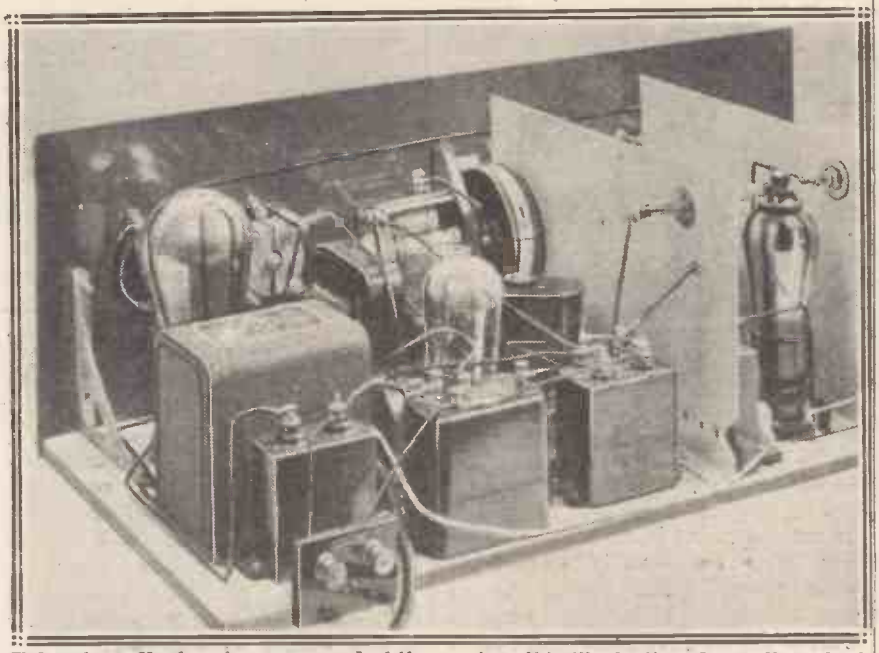
Increasing Selectivity

An example of the use of this reaction adjustment to obtain the additional selectivity will be found in tuning in a station very near to that of the powerful local transmission. If the volume control is "full on," the local station will be overpowering over quite a band of wave-lengths on either side of its true tuning position.

If now the volume control is turned down so as very appreciably to weaken the local transmission, and if reaction is used at the same time, there will be no difficulty in bringing in stations, free from interference, which otherwise would be swamped by the powerful signals of the "local."

A proof of the effectiveness of the design in preventing stray pick-up will be found when the volume control is turned right "off." This, of course, extinguishes the first valve, but leaves the second screened-grid valve, the detector and low-frequency stage all active and in circuit.

If now you attempt to tune-in the local station on a big aerial you will hear practically nothing, even at the most accurate tuning position. The reason is that the only passage for the signal (through the first screened-grid valve) is cut off.



Taken from the low-frequency end of the receiver this illustration shows the output and other large condensers. Note also the connection to the anode of the S.G. valve in the screened compartment.

Perfect Tuning

In designing this set very careful consideration was given to the question of control, and whether or not ganging should be adopted. There are, it will be observed, three tuned circuits (first, second and third circuits respectively), and as similar coils are used in each case, with the same maximum value of variable condenser, it might appear that all three condensers can be ganged, thus giving the simplicity of single control.

A few moments' consideration, however, will show that this is not quite so practicable as it sounds. First of all, the dead accurate matching of coils as well as condensers is not

PARTS FOR THE 1930 "STRAIGHT-LINE" FOUR

Cabinet with 10-in. baseboard (Camco, or Pickett, etc.).

Panel, 21 in. × 7 in. (Trolite, or other good material).

3 ·0005 drum-type condensers as illustrated, with one single and one double escutcheon (Polar).

1 ·0001 or ·00015 differential reaction condenser (Lissen, or Lotus, Dubilier, Ready Radio, Wearite, Bulgin, Formo, Polar, etc.).

1 40-ohm panel-mounting filament resistance (Varley, or similar type).

1 On-and-off switch (Igranic, or Lissen, Lotus, Benjamin, Wearite, etc.).

1 Pair small panel brackets (Bulgin or Ready Radio, etc.).

1 D.B.A. coil (Lewcos).

2 D.B.G. coils (Lewcos).

4 Valve holders (Lotus, or granic, Benjamin, Lissen, Formo, Wearite, Magnum, etc.).

2 Screened-grid valve safety connectors (Bulgin).

4 1-mfd. condensers (T.C.C., or Lissen, Dubilier, Hydra, Ferranti, etc.).

1 2-mfd. condenser (T.C.C., or Lissen, Dubilier, Hydra, Ferranti, etc.).

2 600-ohm resistances and holders (Ready Radio, or Wearite, Paroussi, etc.).

1 4,000-ohm resistance and holder (Ready Radio).

2 Vertical screens, 10 in. × 6 in. (Ready Radio, or Magnum, Paroussi, Wearite, etc.).

1 ·0003-mfd. condenser and clips or grid-leak holder (T.C.C., or Lissen, Igranic, Dubilier, Graham Farish, etc.).

1 Grid leak, 2 meg. (Lissen, or Dubilier, Igranic, Graham Farish, Mullard, etc.).

1 "Antimobo" unit (Varley).

1 R.F. choke (Igranic, or Lissen, Lotus, Lewcos, Dubilier, Magnum, R.I., Graham Farish, Varley, Ready Radio, Wearite, Bulgin, etc.).

1 L.F. transformer (Lissen 2½ to 1, or Igranic, Telsen, Cossor, Lotus, Varley, Lewcos, R.I., Mullard, etc.).

1 L.F. choke (R.I. 28/14, or Wearite, Varley, Ferranti, etc.).

2 Terminal strips, 2 × 1½, with two terminals each.

1 9-way battery cord (Belling-Lee).

VALVES:

2 Screened-grid valves.

1 R.C., H. or H.L. valve.

1 Super-power valve.

The 1930 "Straight-Line" Four—*continued*

practicable in home-constructed sets unless the receiver is built and adjusted in conditions of a high order, and, secondly, if such a matching is adopted then there must be an appreciable sacrifice of efficiency in order to make the individual circuits fairly bluntly tuned.

Just that Little More

Furthermore, the keen amateur likes to feel that he personally can adjust the set to get the best out of it, and there is always the feeling in a ganged receiver that a little individual adjustment of the various circuits would bring in a better signal. Some receivers compromise by having small adjustable condensers in parallel with the various grid circuits, so that while a general rough tuning is effected on the single control, a fine setting is obtained by "trimmers" or small adjustable condensers in each circuit. This is a useful scheme in a factory-built set, but it adds both complication and expense to a home-constructed receiver.

Easy Control

In the 1930 "Straight-Line" Four, three separate tuning condensers are used, but as it is very easy to move both the second and third drums simultaneously by means of the thumb, and as all three condensers read, for the most part, practically the same figures, searching is really quite simple, while the final adjustment of the three condensers to get the best signals and sharpest tuning adds considerably to the pleasure of operating the receiver.

Note, too, that all the condensers are fitted with vernier controls—a refinement which must be used to be appreciated.

Constructional Details

As special care has been taken to make the construction simple, this can be embarked upon without fear by any reader who has not previously built a wireless set. The list of parts given separately contains the names of the components actually used in the receiver illustrated, as well as a number of suitable recommended alternatives where these are available.

For example, while a particular high-grade low-frequency transformer has been chosen for the model receiver, any other high-grade make can be substituted successfully. The particular coils, however, are vital to this design, for which reason no alternative is given.

Both panel and baseboard are of standard size. After all components have been assembled stand the panel up against the front edge of the baseboard, being careful that it does not project unequally at the ends, and mark the positions for the securing holes for the panel brackets.

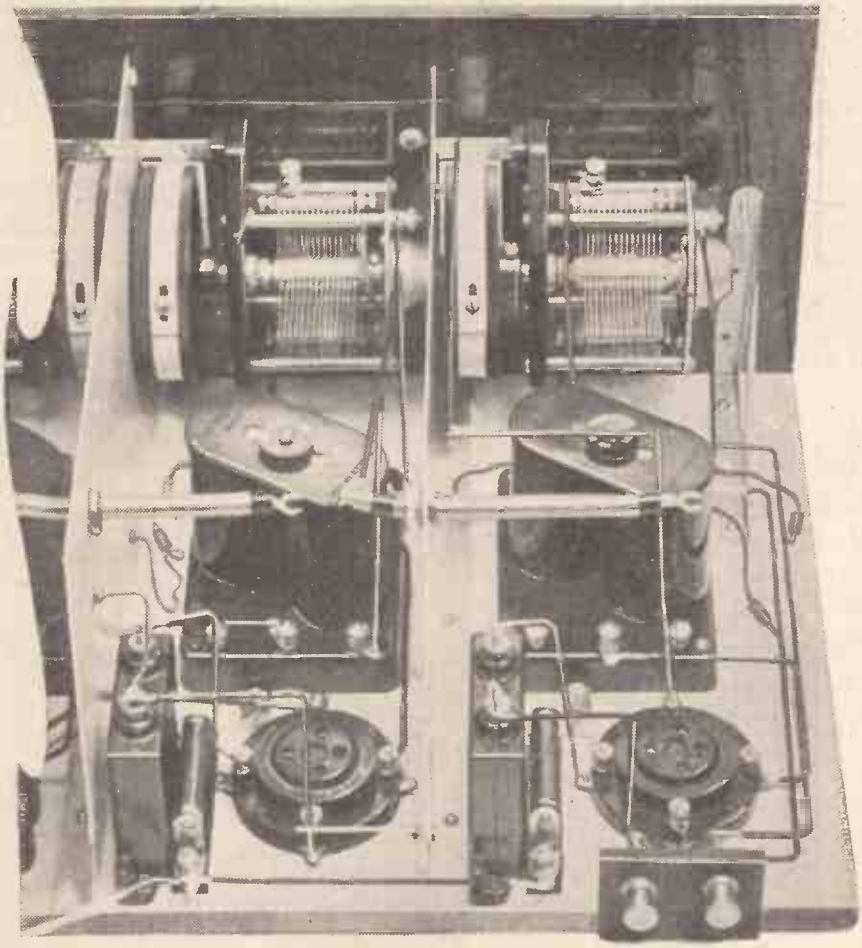
This is best done by screwing the panel brackets firmly to the baseboard at the first step, then holding the panel firmly against the front edge, and marking the position for the holes through the holes in the brackets themselves.

Next mark the position for the securing screws of the three condensers, and also mark the positions for the holes which must be cut out in order to allow the escutcheon plates to be mounted. The positions can also be marked for the holes for the reaction condenser, volume control, and the on-and-off switch. Small holes, slightly larger than the rods of the wave-change switches, will also be needed in the positions shown.

Mount all the components on the front panel before proceeding further and attach the panel to the brackets and to the front edge of the baseboard by the necessary screws. I always use round-headed black screws, ½ in. long, for holding the panel against the front edge of the baseboard, while countersunk brass screws and nuts will hold the panel to the brackets.

The next step is to fix the screen in position. One screen is so placed that it comes immediately between the two

WHERE WEAK STATIONS ARE STRENGTHENED

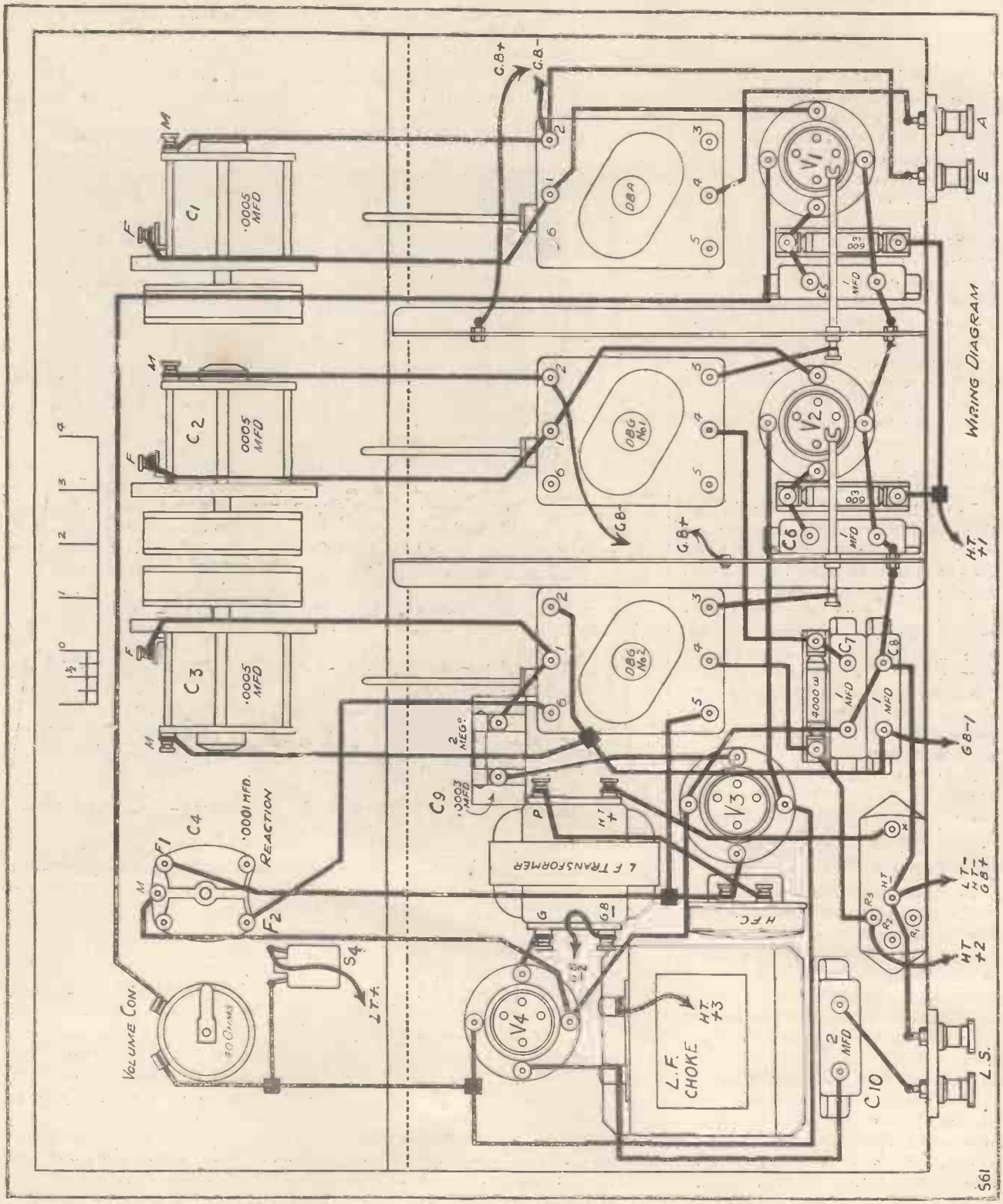


Correct spacing at the H.F. end of the set is of great importance, and this photograph was specially taken to illustrate the "run" of the various wires in this very important section of the receiver. Note also how the screens separate the different tuning condenser sections.

The 1930 "Straight-Line" Four—*continued*

variable condensers right against the panel. As the back of the escutcheon plate projects somewhat it will be necessary to cut away a little metal from the front edge of this screen.

This can easily be done with a pair of tinsmith's snips, which can be borrowed for the purpose, or, at a pinch, an old pair of scissors can be used. Cut only just sufficient metal from the screen to allow it to come up against the back of the panel while yet not projecting at the back of the baseboard. A little trimming may possibly be needed for the second.



The 1930 "Straight-Line" Four—*continued*

Before screwing the screens to the baseboard it will be necessary to drill two ⅜-in. holes in them to take the special screened plate leads used to make connection between the plate of each screened-grid valve and the next circuit.

The positions for these holes can easily be determined after the various valve holders have been placed on the baseboard in the positions shown. A screened-grid valve should be placed in its socket and the position of the hole so marked that it will allow the special screening lead to project horizontally.

Adjusting the Switch Rods

These leads are fitted into bushes, and by rotation can be made to project either side just as much as is required. Note that the forked portion of each is on the same side as the cap of the screened-grid valve to which it connects.

With the holes in the screen drilled, screw the leads in position and place the other components in the positions marked. Before putting the binocular coils in their places unscrew the small nuts from the end of each switch rod and pass the rods through the holes in the panel and adjust the positions of the coils so that the switch rods come in the right places. One nut goes on each side of the projecting clip, the front of which is bent vertically.

You will find that these switch rods are a little longer than is necessary, and a very convenient way to shorten them is to cut off the excess of the threaded portions at each end. You will soon find how much to cut off, and how best to do it, by a practical trial of the rods in position.

Special Battery Connections

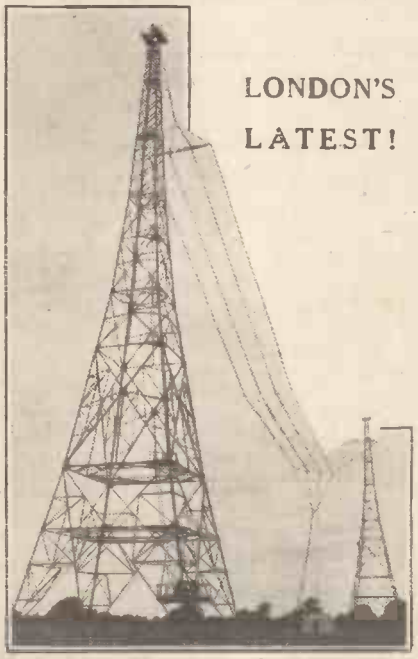
There is not much more to say about the actual constructional work and by now the reader will have noticed that no conventional terminal strip is used. Every set needs connecting leads for the battery or eliminator, the terminals being only a means to an end, and in the present set a special Belling-Lee nine-way battery cord is used.

These cords are very conveniently made with a braided covering, the individual cords having distinctive colours. At one end wander plugs or spades are fitted, at the other end the leads are free, the free ends being taken to the convenient points on the set. It will be noticed, too, that low-tension negative, high-tension negative, and grid-bias positive are all connected to the same cord.

Terminals are, of course, fitted for aerial and earth and for loud speaker, but all other connections are made by means of this battery cord.

When wiring up, work progessively from one end of the set to the other, and with the wiring diagram in front of you pencil out (preferably with a coloured crayon) each lead as you make it. A glance at the chart will then show you, at any time, what leads still remain to be placed in position, and whether you have missed anything.

In some of my earlier screened-grid sets I adopted the principle of one high-tension positive, reducing the voltage for the screening grid through a fixed resistance. When the screened-grid valves were first marketed they all took approximately the same current for the screening grid, and therefore one could specify a particular value of fixed resistance in order to bring the voltage down from the maximum to that required.



The 1930 "Straight Line" Four is an ideal set for listening to the Regional and National programmes. It is selective as well as sensitive and the quality is all that could be desired.

For example, if the maximum voltage happened to be 120 and that required for the screening 70, the necessary 50-volt reduction could be obtained by placing a resistance of 100,000 ohms in circuit, as in most cases the screened-grid current was about half a milliamp, and this resistance would drop the volts desired.

Now, however, screened-grid valves vary tremendously in the current they take, and in the present set I have adopted three H.T. positives: H.T.+1 being for the screening grids, H.T.+2 for the plates of the S.G. valves and the detector, while H.T.+3 serves solely to supply the necessary high-tension current to the output valve.

Methods of Detection

The advantage of having a separate H.T. lead for the output valve is that where a mains unit is available we can often use 200 volts on a super-power valve, thus enabling a very big grid swing to be handled without distortion, although this voltage is too high for use on the other valves.

It will be noticed that there are two G.B.— connections, although there is only one L.F. stage. G.B.—1 is really the grid return of the detector valve, and, as previously explained, enables us to use either anode-bend detection (when this is plugged into a negative voltage) or leaky grid-condenser rectification (when it is placed in a socket which is more positive than grid-bias positive).

There is not a great deal of difference between the two methods, so far as quality and sensitivity is concerned, when used with a detector which follows two screened-grid stages. If, however, the set is used for local work the anode-bend method will be found the better, the slight additional sensitivity of the leaky grid-condenser method being an advantage when searching for distant stations.

The Order of Coils

When placing the binocular coils in position be careful to note that the first is marked D.B.A., and the second and third D.B.G. It is essential that these should be placed in the proper order.

Note also that some leads are attached to the screens and others pass through them. Where the leads pass through, care should be taken to use short lengths of insulated sleeving to prevent the wires coming into contact with the metal screens and thus being shorted. This precaution should be adopted even when ready insulated

(*Continued on page 53.*)

Some typical radio faults reviewed and questions answered.

By P. R. BIRD.

Why L.T. and Not H.T.?

"WHAT has been puzzling me a long time is why switch off the low tension, which always has to be done, and say nothing about the high tension? To anyone like myself who knows nothing about wireless it seems strange that you should always take trouble with low tension (whatever that is!) and leave high tension alone. I should like to switch that too!"

Thus writes a London reader who might be sneered at by some of those superior wireless people until they saw his name, when they would recognise it as a world-famous one, which usually has a string of letters following it. Although wireless terms may not convey much to him, the writer of this letter is a very distinguished man indeed, in his own profession.

Perhaps the best way to clear up this particular point is to try and visualise an electrical *current* simply as a flow of little electrons, the *circuit* as the path along which they flow, and the *battery* as a convenient means of driving them along that path.

The Current Cut-off

The low-tension circuit is a continuous pathway from the low-tension battery via a switch across the filament of the valve and back to the L.T. battery. If the switch is "off" the circuit or pathway is broken, and consequently although the battery is ready to put a pressure across the circuit there is no continuous pathway for the electrons to follow. When the switch is "on" you can picture the electrons leaving the negative terminal of the low-tension battery, flowing along the wires to one filament leg of the valve, across the filament, across the switch, and so back via the wiring to the positive side of the low-tension battery.

This filament of the valve is placed inside a vacuum, and it is made hot by the current flowing through it. In this condition electrons can be detached from it and are free to float about in the vacuum of the bulb.

Placed at the other end of the valve's vacuum is a plate, attached to a high-tension battery, and as this battery is exerting an electrical pressure between the filament and the plate some of the electrons will leave the filament for this plate in response to this "side pressure."

If we wish to close down the programme, we pull out the low-tension switch, which breaks the path of the electrons from the low-tension battery, and the L.T. current stops flowing. Directly this happens the filament gets cool, electrons are not given off from it, and consequently the high-tension current stops also, because the hot filament was an essential part of that circuit, too. In fact, by cutting off the L.T. flow (across the filament) we automatically cut off the H.T. flow (from filament to plate) as well.

Getting back now to this particular instance, it is amusing to note that the instinctive desire to switch off H.T.—although it has no justification theoretically—is not at all bad practice. For theoretically all insulators are perfect, but often in practice they leak!

And so a switch in the H.T. negative lead is sometimes more effective in stopping H.T. batteries from running down too quickly than any amount of theoretical "proof" that the H.T. circuit is broken by the L.T. switch.

"Comin' Thro' the Rye"

"What can you make of a set that does not need either a loud speaker or telephones, but gives you the programme from *inside the cabinet*, where there are no sound-reproducing devices at all?" This is the problem that faces a Scottish reader who has been extremely puzzled by persistent programmes from nowhere.

There was no other wireless set within half a mile, no 'phones in the house, and yet with the speaker completely disconnected the local programme could be heard distinctly! Thoroughly interested, this reader decided to investigate as carefully as possible, and finally he discovered that the sounds were coming from the output choke.

"It is a first-class choke," he says, "and as it was made by Radio Instruments, Ltd., it may truly be said that the programmes were 'coming through the R.I.'"

Although the reader in question had never heard of a case of this kind, no doubt other readers will remember that the effect has been referred to in the WIRELESS CONSTRUCTOR on several occasions; and at various times has been traced to different low-frequency components, usually those employing large windings, such as L.F. chokes and large L.F. transformers. The sound is due to the fact that somewhere in the component there is a slight movement of its material in conformity with the currents flowing through it, and this movement is sufficient to set up sound waves in the same way as a diaphragm.

THE TECHNICAL QUERIES DEPARTMENT

Are you in trouble with your set?

Have you any knotty little Radio problems requiring solution?
The WIRELESS CONSTRUCTOR Technical Queries Department is now in a position to give an unrivalled service. The aim of the department is to furnish really helpful advice in connection with any radio problem, theoretical or practical.
Full details, including the scale of charges, can be obtained direct from the Technical Queries Department, WIRELESS CONSTRUCTOR, Fleetway House, Farringdon Street, London, E.C.4.

A postcard will do. On receipt of this all the necessary literature will be sent to you, free and post free, immediately. This application will place you under no obligation whatever. Every reader of the WIRELESS CONSTRUCTOR should have these details, which will enable him to ask his questions so that we can deal with them expeditiously and with the minimum of delay.

London Readers, Please Note: Application should not be made by telephone or in person at Tallis House or Fleetway House.

The NORTH REGIONAL

The experimental broadcaster on wheels that the B.B.C. used for testing out sites for this new station.

The next step in the development of the wonderful new B.B.C. scheme of high-power broadcasting is the completion of the North Regional dual-transmitter—an event that is being awaited with the greatest interest. Here is an article telling all about it, written by the one man who does know all about it.

By NOEL ASHBRIDGE, B.Sc. (Eng.), A.M.I.C.E.
(Chief Engineer of the B.B.C.)

THE North Region is a title which the B.B.C. has given to a group of important counties consisting of Lancashire, Yorkshire, Derbyshire and Cheshire, and parts of several others.

From the point of view of the service which will be given by the new dual wave-length transmitting station, the Region could be defined in broad terms as that part of the country included in a circle having a radius of 80 miles with its centre near Huddersfield. It is hardly necessary to point out, however, that when it is stated that a station would have a range of 80 miles it does not mean that the service ends abruptly at precisely that distance in every direction.

Problem of Fading

At some places over 100 miles away reception will be excellent, while at a few places at a distance of only 70 miles it may be found that the shorter of the two wave-lengths fades a little after dark. Following the scheme of working adopted for the London station, the Regional programme will be radiated on the longer wave-length and the National programme on the shorter.

It has been stated frequently that the limit of range of a broadcasting station working in the band of wave-lengths between 200 and 550 metres is determined by the distance at which fading actually interferes with the programme, but the effect of fading on the received signal depends on the strength of the ground ray. Since attenuation along the ground is not the same in all directions the effect of fading will also vary.

It is interesting to note, in passing, that the signal from any station may fade to a considerable extent before there is any noticeable effect in the loud speaker or telephones.

What the Meter Shows

No doubt many of my readers who have a meter connected in the detector-valve anode circuit, showing the value of the rectified current given by various stations, have noticed that the meter shows considerable variations before there is any noticeable effect on the programme itself as judged by ear.

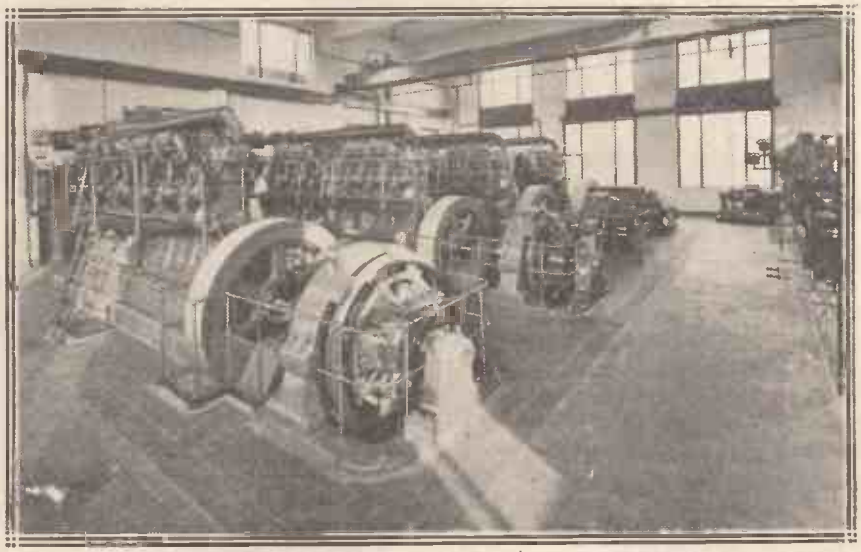
When a station is fading badly from the point of view of listening, then the meter usually shows very heavy variations in the rectified current. Since fading effects depend on the strength of the ground ray, and since the short wave will attenuate more rapidly than the long, the latter will have a greater effective range. However, when the short wave becomes too weak or fades too much for good reception its place is taken by 5 X X, which will always radiate the same programme.

Turning now to the question of a site for the new station to serve the North Region, it has to be borne in mind that the existing service to this part of the country is given by several small stations all situated in densely populated centres. Owing to the scarcity of wave-lengths several of these have to work on the same wave-length. Moreover, several additional stations in other parts of the country also have to work on this wave-length.

Replacing the Relays

It is certainly somewhat of an engineering feat to control the wave-length of these stations to a degree of accuracy which in practice amounts to about five to ten parts in a million, in spite of the fact that the wave-length of each transmitter is

POWER FOR THE PROGRAMMES



These are the four huge Diesel engines, coupled to four big generators at Brookmans Park. A similar power equipment is being installed at the North Regional station. Enough power is developed by such a plant to run the lighting of a small town.

The North Regional—*continued*

controlled by a separate tuning-fork equipment.

This system has solved a very difficult problem and it is almost certain that further use will be made of it, both in this country and on the continent. However, so far as the North Region is concerned, there are certain disadvantages. The field strength is not evenly distributed, and "mush" areas, where reception has to be taken from Daventry 5 X X, are bound to exist, however well the stations are synchronised.

Preliminary Considerations

Nevertheless, when considering the site of a high-power station to replace these small transmitters it has to be remembered that they each provide a strong local service, although there are fairly large areas where the service is very much weaker.

Again, the important centres served by these existing stations, and other densely populated districts which do not possess at present a station of their own, lie on either side of the Pennine Chain, which is liable to act as a kind of wireless barrier owing to the rapid attenuation which occurs over mountainous country.

It was necessary, therefore, to find a site among the hills which was suitable for a high-power wireless station from the engineering point of view, and yet so situated as to give a good service on both sides of this natural barrier.

Before a final choice was made, several sites were tested by taking measurements of the radiation from a mobile transmitter, erected on the spot on which the new station would be placed, and during these tests great care was taken to discover whether any important district was likely to get less than its fair share of field strength.

Naturally there are other requirements in addition to the necessity for symmetrical radiation. For instance, one site was satisfactory in this and other respects, but the soil was of such a nature that radiation efficiency was low. Again, there must be an abundance of water for engine and valve cooling, the sub-soil must be suitable for the mast and building foundations, and, above all, it is essential to be within a mile or two of one of the modern Post Office underground cable routes.

Ultimately a site was chosen about two miles from Slaithwaite, and four miles from Huddersfield, over 1,100 feet above sea-level. The radiation tests were better than from any other site considered, and it is anticipated with confidence that the results will be satisfactory.

The Station Itself

With regard to the station itself, the layout of the plant will be similar to that at Brookmans Park, and any slight changes which have been introduced are in the nature of improvements adopted as a result of the experience gained during the last few months. However, the service range of the station will be appreciably greater than that given by the London station. The reasons for this are as follows.

In the first place the restrictions applying to masts in the London area do not apply in the North, and for this reason the masts will be about 500 ft. high, which is two and a half times the height of those in London. Again, although the exact wave-lengths which are to be used are not finally settled, it is certain that they will be longer than those allocated to London.

Work started on this station about three months ago, and, as was anticipated, progress has been slow due to the severe weather experienced on a site of this description. Nevertheless, a lot of valuable preliminary work has been done, particularly in road construction and excavation for the foundations, and as soon as the weather improves very rapid progress is anticipated.

Like London

No important alterations in the technical equipment are contemplated, since there is no part of the London station which has been in any way unsatisfactory.

When the new station begins its tests there will be the same minor dislocations as have occurred in London. For instance, the strength within a mile or so of the Manchester transmitter will be weaker, although the actual strength will be more than adequate for reception on the simplest receiving equipment, provided that a reasonably efficient aerial can be erected.

The same effect will occur in the other towns at present possessing relay stations, but here the areas will in most cases be small, owing to the fact that these stations are very low in power and work on a short wave-length.

The new station will provide appreciably better musical quality than that of any existing station in the North Region.

THE OLD 2LO TRANSMITTER

We say "old" because this outfit had to give way to the new high-power transmitters at Brookmans Park. But it was, only quite recently, reckoned to be a first-rate outfit. It was a 12-kw. transmitter, although, of course, the aerial power developed in the normal way was only a portion of this.

NEXT MONTH—

"PLANS FOR THE FUTURE"

By Noel Ashbridge, B.Sc., A.M.I.C.E.

The KING "CUT-OUT"

The ordinary type of wave-trap is not good enough for the more adverse conditions met with now the new high-power stations are at work. But here is a new device, just as simple to make and use as any wave-trap, that really does do the job. Wherever you are, this Cut-Out will cut-out any one of two locals, however powerful, without reducing the strength of those distant stations you want to receive.

Designed and Described by VICTOR KING.

HAVE you ever felt like the inspired poet who wrote :

" With a pleasure that's emphatic
I retire into my attic
With the satisfying feeling that my
duty has been done."

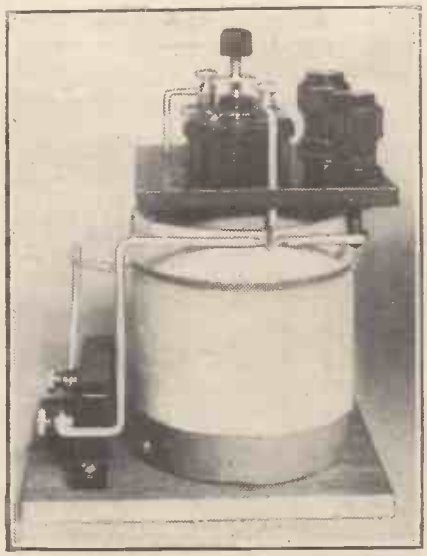
Well, *that's* how I felt when I finished the " Cut-Out ! "

An ordinary compression-type variable condenser, a fixed condenser, a home-made coil, and a few odds and ends—that, in short, is the " Cut-Out," which costs only 5s. or so and makes it possible to wipe out at will either of the Regional programmes !

Completely Satisfactory

There are only five connections, and possibly half an hour's constructional work, but the result is a unit which ends your interference troubles.

YOU CAN MAKE IT

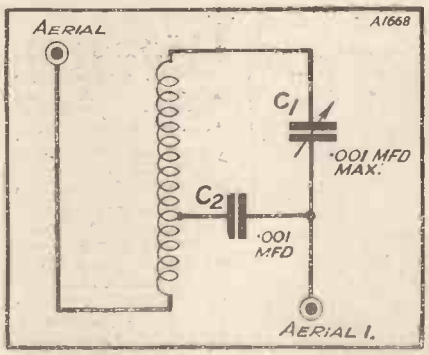


The construction of this remarkable "Cut-out" really is extremely simple and the parts cost only a few shillings.

No longer need your set be adversely affected by the Regional conditions.

Like most good things—and, on the whole, it is only fair to say that the Regional Scheme *is* a good thing—the inauguration of the powerful twin

A NOVEL CIRCUIT



The " Cut-out " is not an old idea hashed up. It is something quite new evolved to meet the severest of modern interference problems.

transmissions has been accompanied by many disappointments. Perhaps you know by experience the difficulties of separating the two programmes with a standard set ?

Owing to the high power now employed, an almost complete wipe-out of the foreigners on adjacent wavelengths now occurs in many cases.

These Things Aren't Cures

Indeed, the introduction of the Regional Scheme would be something of a menace to long-distance listening were it not for the fact that there are ways of overcoming the attendant difficulties.

In general, the alteration of a standard detector circuit to aperiodic or auto-coupling is not sufficient completely to overcome the difficulties of separation, certainly not for those situated within a radius of fifteen miles from Brookmans Park. Then, again, reduction of aerial size, the use of series aerial condensers, etc., although helpful to some extent, are to be regarded more as palliatives than cures.

Adjusted in a Moment

What *does* offer a really satisfactory solution is the King " Cut-Out."

It can be fitted to your existing set without making any alterations to the actual receiver, and it is but the work of a few moments to adjust it to the station it is desired to eliminate.

ONLY ONE CONTROL

There is only the one little adjustment. You turn that little condenser knob until your interfering station is suppressed.

The King "Cut-Out"—*continued*

The whole unit is really built up on the coil, so that without a doubt it is best to commence the construction of the unit by winding the necessary turns on the coil former. For this purpose you will require some 24 gauge D.C.C. wire (¼ lb. will be ample), and after having secured the end of the wire at a distance of roughly half an inch from one end of the former, wind on 50 turns.

Fixing the Coil

This should be followed by another winding of 20 turns of the same wire, carried out in the same direction as the first coil and separated from this latter by not more than ⅛ in. You can, if you like, make it one continuous winding of 70 turns, with a tap at the 50th turn, since such a departure will not be likely to affect the efficiency of the finished device.

Victor King, designer of the "Vi-King" Three (described in the "Wireless Constructor" last month), and of the King "Cut-Out," at work in his laboratory. He has designed an exceptionally efficient and unusually interesting set which will be described next month. The Victor King set designs are causing great interest in the world of radio, and are undoubtedly giving a great fillip to home-construction.

With the windings completed it will next be necessary to prepare two wooden discs of a diameter that will enable them to be fitted fairly tightly into the ends of the former. The lower one of these, with the former in a vertical position and the smaller winding at the top, can be finally secured to the tube by means of screws or glue.

Next obtain the 3 in. by 4 in. piece of wood which is to form the base, and fix the lower wooden disc, again by means of screws or glue, to the appropriate position on this base-board. (The diagrams will help you accurately to determine this position).

With the coil thus securely fixed to the wooden mount, you can proceed by screwing into position the second wooden disc, this time at the top end of the former. But make quite certain before you carry out this latter operation that the ends of the coils are protruding from the *outside* of the former, otherwise you may feel just a little annoyed when the wiring stage is reached!

The ebonite support at the top of the coil on which the compression type condenser and the terminals are mounted is 2¾ in. square, and it is secured to the wooden disc at the top end of the former by means of two countersunk screws.

It is practically impossible to force wood screws into ebonite, and in consequence the screws holding the compression-type condenser in place should pass through holes drilled in the ebonite, and should be screwed into the wooden disc.

When you have fixed the terminals and the fixed condenser you can pass on to the simple wiring to be done. The connections are clearly shown in the diagrams, and it is hardly necessary to say anything else in this direction.

With the wiring completed your King "Cut-Out" is quite ready for use.

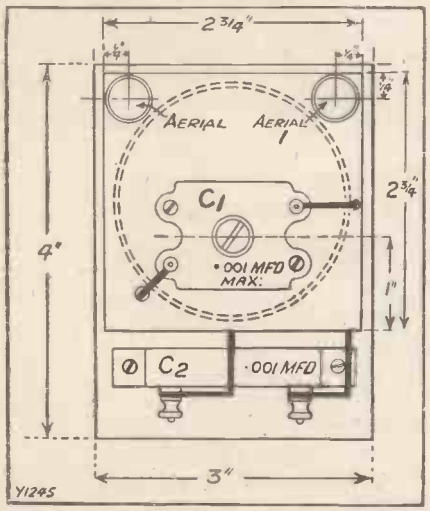
Tuning out the "Twins"

Disconnect the lead which goes to your present aerial terminal, and join it instead to the terminal marked "aerial" on the unit.

The remaining terminal on the unit—that is, the one marked "aerial"—should then be connected to the aerial terminal on your set. Tune your set to one of the Brookmans stations, and slowly rotate the knob on the compression type variable condenser until the signals become weak and finally disappear, or almost completely disappear.

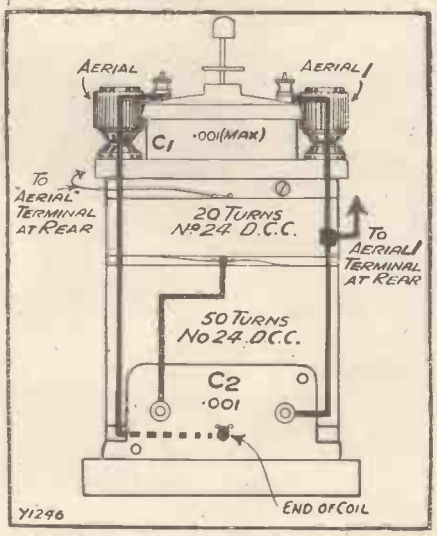
It may still be possible faintly to hear the station, but not, if the "Cut-Out" is working correctly, over more than two or three degrees. In most cases, however, it will not be possible to hear the station at all once the "Cut-Out" has been adjusted, and without touching it you can now tune your set to the other Brookmans station, and you will find it coming through without the slightest interference from its "twin brother."

THE TOP PANEL



Here is the wiring as seen from a "bird's-eye" view.

COMPLETE WIRING



And here you see the complete diagram of the very simple wiring.

SAVOY HILL NEWS

Check to Centralisation—Survivors of Kut—Struggle of the Flitches—Brighton on the Air—Manchester University Jubilee—Best Organ Music—Mr. Harold Nicholson's Courage—Captain Eckersley at Savoy Hill—Admiral Carpendale in New Role.

By OUR SPECIAL COMMISSIONERS

Check to Centralisation

THE stirring of opinion in the North of England seems to have made a profound impression on the Board of Governors of the B.B.C., who are by no means anxious to sustain another ordeal of the kind they encountered in Birmingham.

Apart from continuing to advocate the merits of the general theory of centralisation, Savoy Hill has been very careful to say nothing about the application of the theory to the North of England. But there has been a feeling that the Northern Wireless Orchestra was in danger.

This feeling has been converted into certainty by the terms of a letter sent by Mr. Roger Eckersley to an official of the Musicians' Union. The terms of the letter soon came to the knowledge of the members of the Northern Wireless Orchestra at Manchester.

Second Thoughts

Curiously enough, the B.B.C. officials in the north, from the Regional Director downwards, had their first notice of this communication from the members of the orchestra.

I gather the letter said the orchestra would be disbanded in September, about six months before the North Regional transmitter will be working on its twin-service. This probability is only just beginning to be appreciated in the industrial north; when it "gets through" there will be far more serious difficulties than were encountered on the axing of the Birmingham orchestra.

Hence it is not surprising that the governing body of the B.B.C. is thinking again, and very seriously indeed, about the wisdom of going steadily against public opinion in achieving complete centralisation. I am told that Lord Clarendon or Lord Gainford will accompany Mrs. Snowden and Sir John Reith on a thorough tour of the north in order to gauge public opinion on the spot.

Survivors of Kut

The survivors of Kut are to dine at Anderton's Hotel on a date near the end of April or in the first few days of May. The speeches are to be broadcast by the B.B.C. An effort may be made to include representatives of the besieging forces as well, on the analogy of the dinner to the survivors of the East African campaign.

RAILWAY RADIO

Big broadcast receivers are now fitted to some French trains, and the passengers can listen in on telephones. Above you see a scene at the departure of a Lyons express.

Struggle of the Flitches

I hear there is a great gathering of forces on behalf of the claims to broadcasting by the rival Flitches of Dunmow and Stonehenge. Previous broadcasts of both have been interesting.

The Dunmow has perhaps some advantage in historical and romantic association; but as against this, the Stonehenge Flitch is much better adapted by circumstances and situation for good relaying by broadcast, so the B.B.C. is thinking seriously of taking the Stonehenge Flitch Trial from Salisbury Guildhall on Saturday, July 5th.

Brighton on the Air

After years of anxious waiting, there is now a good chance of Brighton finding a regular place in the broadcasting programmes. It seems the claims of the Brighton Municipal Orchestra have not been recognised at Savoy Hill until Mr. Boult came on the scene.

He has a high opinion of the playing of this orchestra, and the result will be the appearance regularly in the programmes of performances from Brighton, starting this summer

Manchester University Jubilee

It may well be doubted whether the B.B.C. is wise to withhold national broadcasting facilities from the ceremony of the Manchester University Jubilee on May 23rd. Honorary degrees are to be bestowed on the Chancellor of the Exchequer, the United States Ambassador, and Dame Ethel Smyth, among others.

The occasion is regarded with the greatest interest in the north, and with a good deal of interest elsewhere.

Savoy Hill News—*continued*

But all the B.B.C. will do is to allow it to be relayed by the stations of the north region. Apparently the objection to making the broadcast "national" was that it would interfere with the previously arranged "schools broadcast" from three to four-thirty in the afternoon.

The tyranny of rigid long-standing arrangements is again exemplified. Actually, of course, it would be infinitely more educational for all the schools of the country to hear the speeches of the famous folk at Manchester than the stereotyped lessons of some etheric pedagogue.

Dame Ethel Smyth would thrill every schoolgirl in the land to do something really big and unselfish. I give due warning to Savoy Hill that if they do not check at once the tendency of the uplifters to settle programmes months ahead there will be serious consequences.

Surely it is high time the B.B.C. shed the various councils and committees of professional educators and uplifters that have become a menace to what should be, and what professes to be, a service of entertainment.

Best Organ Music

After extensive tests, Mr. Gerald Cock, the competent head of "Outside Broadcasts" at Savoy Hill, has decided to award the palm for excellence in the origination of organ music to All Saints', Margaret Street, London, S.W. The B.B.C., acting on Mr. Cock's advice, will gradually drop relays from all other organs.

Mr. Harold Nicholson's Courage

Those who have been clamouring for the B.B.C. to take advantage of its right to broadcast controversy and controversial views should find no cause for complaint in the weekly talks of the Hon. Harold Nicholson on "Men and Things."

Mr. Nicholson began by offending those who thought Britain should intervene on the side of persecuted Russian Christians. Before the clamour caused by this eruption had died down, Mr. Nicholson administered a severe lashing to Mr. Arthur Henderson and the Labour Government for their "mishandling" of the Russian situation.

But, mark you, Mr. Nicholson is amazingly skilful in the way he does these things; his balance of subtleties and nuances would attract the envy of the most polished essayists of pre-Revolutionary France. And there is no doubt he is rapidly securing for himself a wide public of keen followers. It remains to be seen whether Savoy Hill's nerve will hold out.

YOUNG ANNOUNCERS AT WORK

A number of the German stations employ staffs of children to assist in running "Children's Hours." And at least one, as you see above, arranges for the children to answer, in front of the microphone, the many letters they receive.

Captain Eckersley at Savoy Hill

During a recent visit to Savoy Hill I came across Captain Eckersley going through the long, high corridor that separates the administration and engineering branches from the programme and information branches.

The brilliant pioneer of broadcasting was in his best old-time form. He spoke of the Regional Scheme with the same confidence, enthusiasm, and authority as usual, and I had difficulty in convincing myself that he was not still in command of the engineering destinies of our broadcasting service.

He is, of course, still retained by the B.B.C. as a specialist advisor on engineering problems, and is constantly in and out of Savoy Hill and the various new stations. His long-established intimacy with Noel Ashbridge, the new Chief Engineer, is in no way relaxed; it is, if anything, rather closer than before.

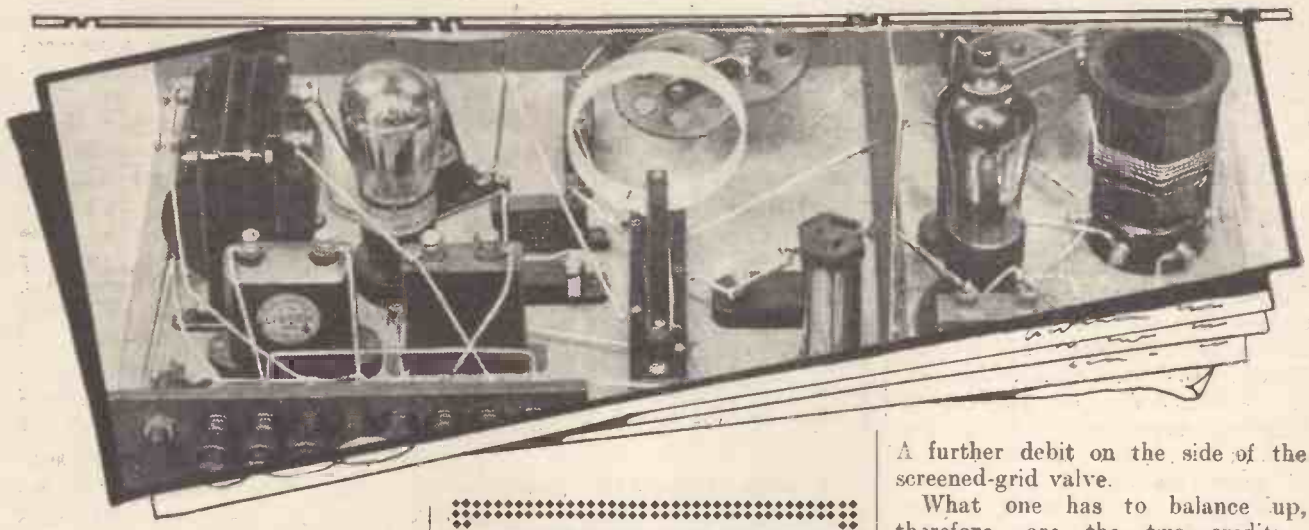
To friends who ask me how long it will be before Captain Eckersley is persuaded to return to broadcasting, my reply is that I hope to see him restored to a responsible status on the staff early in 1931. I tip him as the chief of a new experimental department, combining research work in engineering with similar activity in programmes.

Admiral Carpendale in New Rôle

Vice-Admiral C. D. Carpendale, C.B., Controller of the B.B.C., reputed one of the greatest disciplinarians in the history of the Royal Navy, and more recently celebrated for the iron discipline among all hands above and below deck and athwart the gunwale of broadcasting, has now become the recognised intermediary and peacemaker in all the hundred and one difficulties, big and little, which the B.B.C. throws up in its daily work.

The gallant admiral is believed to be particularly successful with the Board of Governors and the artistes.

THE L.S.D. of S.G's



Have you ever considered what it costs you to use a screened-grid amplifier? It can be quite an expensive proceeding unless you take certain precautions. But there are ways of reducing the cost by a considerable amount if you carry out the ideas expressed in this article.

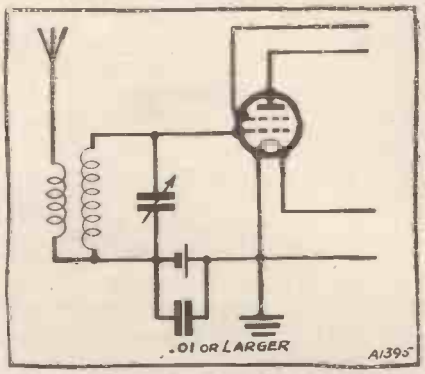
By KEITH D. ROGERS.

AT first glance this title may appear to be a rather terrifying one, but I do not intend to go deeply into the whys and wherefores of manufacturing costs, the calculations of percentages of profits for retailers, wholesalers and manufacturers. What I want to do is to view the screened-grid valve from a purely operative point of view, as it affects the user of an ordinary broadcast receiver.

Preliminary Cost

To start with, the screened-grid valve costs about 22s. 6d. That is well over twice as much as the ordinary type of H.F. valve. In return for this extra money the screened-grid valve will provide you with a higher magnification than the ordinary H.F. valve, and, in most cases, considerably more stability in operation. For unless an ordinary H.F. valve is thoroughly well neutralised one is liable to get trouble somewhere or other on the tuning scale, and even with a neutralised stage one really should re-neutralise for the long waves, and then again for the short waves, every time the wave-change switch is thrown over from one to the other.

TWO METHODS OF—



This is one method of adding grid bias to an H.F. stage and—

The screened-grid valve simplifies all this sort of thing, but it has its drawbacks. Tuning with a screened-grid valve circuit is often flatter than that obtained with a neutralised stage, and there is also liable to be a certain amount of background or "breathing" caused by the screened-grid valve in its operation. These two, of course, militate against the valve, and must be put upon the debit side.

Anode Wattage

In addition to this we must consider quite carefully anode wattage. An ordinary H.F. valve will work very well on 90 volts. The screened-grid valve, however, requires about 120 to 150 volts on the anode if it is to work at its normal maximum, and, moreover, at these figures it consumes an H.T. current far in excess of that consumed by the ordinary H.F. valve. A further debit on the side of the screened-grid valve.

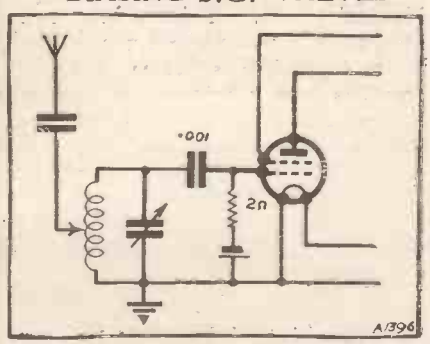
What one has to balance up, therefore, are the two credits—increased magnification and increased stability—against a series of debits—increased cost of purchase, increased anode wattage consumption, and a certain amount of background noise, which may or may not be troublesome. As a rule this is not particularly so on the local, but on distant stations it may be a little unpleasant.

Question of Selectivity

Finally, a debit which may or may not be important, according to your location from the local station, is the fact that the most efficient circuit, from the point of view of magnification, with a screened-grid valve, is inclined to be less selective than that employed with a neutralised stage.

These debits can, however, be greatly reduced if care is taken concerning the conditions under which the valve is operated. Obviously the first cost of the valve

—BIASING S.G. VALVES



—here is a second scheme which is useful in many cases. The leak and condenser can be inserted in any S.G. grid circuit.

The L.S.D. of S.G.'s—*continued*

cannot be reduced, but the operating expenses can be lessened considerably, although it is doubtful if you would ever get them down to the level of the ordinary neutralised valve, and yet still retain the maximum efficiency of the screened-grid amplifier.

Advantage of Grid Bias

There are occasions (which I shall discuss later) when it is not, in my opinion at any rate, always an advantage to use the S.G. all out, as it were. Occasions when a little loss of amplification is not particularly amiss if some other advantages accrue; but more of this later.

The first and easiest way of economising with the screened-grid valve is obviously in that which concerns the H.T. consumption—the ordinary screened-grid valve taking anything from three to six milliamps in H.T. current, while I have known cases which have exceeded thirteen milliamps.

But I think it can be taken as a general rule that we must be prepared to supply at least five milliamps if we use the valve in the ordinary way, and without grid bias. It is the application of negative grid bias that constitutes the first step towards economy, for by its use it is quite easy to cut down the anode current to a much more reasonable figure, say, two to two and a half milliamps per valve.

It will naturally depend upon the make of the valve, and to some extent on individual valves themselves, as to how much grid bias can be usefully employed, and what effect this grid bias will have. I have known a screened-grid valve which would take 4½ volts grid bias before it really gave its best amplification, and in such a case the H.T. consumption was cut down very considerably. Average 2-volt valves, however, usually give their best amplification with a grid bias of about ·9, though in general use I find 1·5 volts is not really detrimental to results.

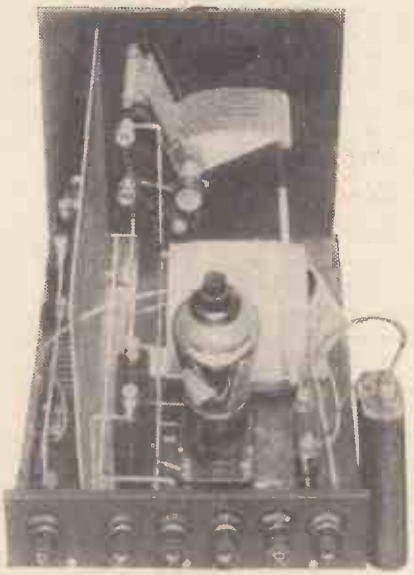
Making Adjustments

For those using mains eliminators the H.T. consumption is not a very vital point unless they are using the eliminators on the verge of their maximum output, when use of an S.G. valve going all out may easily cause the set to motor-boat owing to the fact that the eliminator is overloaded.

So if you are going to use a screened-grid valve the first thing to do is to make provision for grid bias, using 1½ or 3 volts, which is usually quite sufficient, and the bias should be placed in the H.F. stage itself. It is not advisable to use a common grid-bias battery for the H.F. and L.F. stages.

Used carefully, properly screened, and with suitable grid bias, the screened-grid valve becomes quite a suitable proposition for the average listener, and will give him very much greater amplification than the ordinary H.F. valve in a neutralised stage.

A POPULAR H.F. UNIT



This is a photograph of the "S.S." H.F. unit, which can be added to any set. It was described in last month's "Wireless Constructor." Note the grid bias!

But there is another way of using a screened-grid valve which you may not have tried, and which is particularly suitable for those listeners who want to carry out DX reception, and have to run their sets from H.T. batteries.

The screened-grid valve normally used gives very much greater amplification than a neutralised valve, while the neutralised stage naturally gives a quieter background than does the screened-grid. By judicious alteration of anode and screening grid voltages it is possible to make the screened-grid valve operate with the comparative silence of the neutralised stage and yet give quite good amplification.

We lose a certain amount of amplification, but we do gain in silence, so that even if the stations which were previously accompanied by a sort of breathing sound are not quite so strong as before they will at any rate come through much more clearly. It is obviously for the listener himself to decide which he prefers—plenty of strength with noise in the background, or slightly less strength with a quieter background.

Easily Arranged

All you have to do to obtain the latter is to alter the voltages on the anode and screening grid, at the same time bringing the voltages very much lower. I have found in experiments that the best voltages seem to be somewhere between 15 and 22 or so for the anode, and about 30 to 40 for the screening grid.

Exactly how the valve works under these conditions I am not prepared to say at the moment, but there is no doubt that you get very silent operation, extremely low H.T. current, and I have worked two stages of screened-grid amplification with a total anode current and screened-grid current of 2·9 milliamps (just over 1·4 milliamps per valve), while the amplification did not drop below 75 per cent of what it was before. In practice the two stages gave me all I wanted with a wonderfully clear background.

Anyone Can Try It

Many of my friends with only one stage of screened-grid amplification have also tried this scheme and have decided not to go back to their old method of using the valves, but to give up a slight amount of amplification to obtain the freedom from background noise, the economical running and the increased selectivity which accompanies this unconventional way of using the S.G. valve.

The best of this scheme is that anybody can try it with their own set without having to alter the wiring or anything inside the set. You have only to alter the H.T. tappings on the valves, reducing both to about the voltage stated. Then you listen-in in the same way.

(*Continued on page 55.*)

The "FEATHERWEIGHT" PORTABLE

Here are full details of one of the simplest wave-change portable receivers ever designed. You have only to look at the photograph at the foot of this page to see how absurdly easy the wiring is, and how very few parts are required. And the results! Well, just build the set and hear for yourself. You'll never regret it!

Designed and Described by A. S. CLARK.

The complete set. Full details of the loud speaker are given elsewhere in this issue.

HERE is a portable set which really is "portable," not merely "*transportable*." It is very specially designed throughout, and the receiver part is not merely that of an ordinary set whose size has been squeezed down and down until it would go into what is generally termed a "small case"!

Quite apart from its practical merits as one of the first truly portable sets ever to be brought within the scope of the constructor, the design is of great interest from a technical point of view. Perhaps the best way of bringing out its salient features is to describe the evolution of the set.

What the Set Does

The main idea in designing the receiver was to keep the size down without in any way impairing the efficiency. Incidentally, in keeping the size down the weight has also been reduced to a remarkably small amount.

The designing of a portable set for the home constructor is quite a different matter from designing one which is to be produced commercially. In the latter case special components can be made, and also a special case can be produced to "fit round the completed design."

In the case of the set for the home constructor, standard components must be employed, and, additionally, they must be arranged so that the constructional work is fairly simple.

First of all, the requirements of the set had to be decided upon, and these were fixed as follows: Loud-speaker results must be obtained from the local and the more powerful distant stations, the set must be small, and it must be so easy to make that anyone can undertake the construction with the assurance that when completed the set will give complete satisfaction.

The question of results is mainly dependent on the circuit, and we will consider this first. Probably the circuit is the most interesting part, for it is entirely new, nothing like it ever having been produced before.

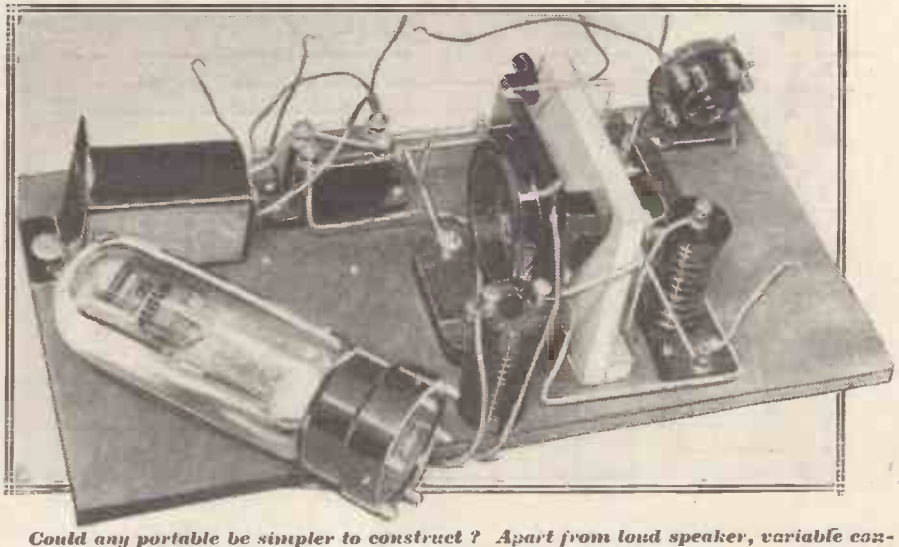
An "All-In" Valve

Naturally, to get the results which were laid down as necessary nothing less than an efficient three-valve circuit would be suitable. One good H.F. stage had to be provided because, due to the small case, a small frame only would be available. To keep the number of controls small the H.F. stage is aperiodic, and this part of the design did not necessitate much thinking about.

PARTS FOR THE PORTABLE

1 Portable cabinet (Cameo "Carrier").
1 Loewe valve type RNF7, and holder type F7.
1 Vertical-mounting ordinary valve holder (W.B., or Junit, etc.).
1 ·0005 variable condenser (Graham-Farish, or similar very compact type).
1 L.T. switch (Lissen, or Igranic, Benjamin, Lotus, Bulgin, Magnum, Utility, etc.).
1 ·0001 fixed condenser (T.C.C., or Lissen, Igranic, Dubilier, Mullard, etc.).
1 ·0003 fixed condenser (Lissen, or Igranic, Dubilier, Mullard, etc.).
2 ·002 fixed condensers (Dubilier and T.C.C., or Igranic, Mullard, Lissen, etc.).
1 ·001 fixed condenser (Lissen, etc.).
2 H.F. chokes (Keystone and Ready Radio, or other good make of moderate size).
1 Neutralising type condenser (Bulgin, or other type with handle at least 2 in. long).
1 1½-volt grid-bias battery (Ever Ready).
½ lb. 26 D.C.C. wire.
4 Sockets and 2 pins to fit (Clix, or Eelex, Burton, Belling & Lee, etc.).
Wire, screws, wood, wander plugs, etc.

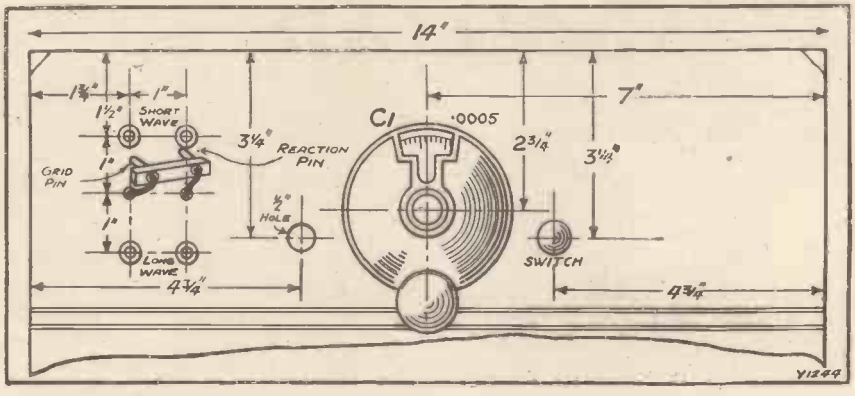
IT WON'T TAKE YOU LONG TO BUILD THIS!



Could any portable be simpler to construct? Apart from loud speaker, variable condenser and on-off switch this is "all there is to it." The frame aerial is easily wound round the whole outfit afterwards.

The "Featherweight" Portable—*continued*

THE WAVE-CHANGE SCHEME IS SIMPLICITY ITSELF



The trouble began when the components for the L.F. side were considered. What with output filter, coupling units, and stabilising devices, they presented a formidable array which was quite out of keeping with our ideas of compactness, although in the usual way they are needed in the modern set.

Eventually it was decided to use a Loewe multiple valve. It may be thought that this ended all the problems in regard to the circuit. Actually this was far from being the case, and in fact they were only just beginning!

Aperiodic H.F. Stage

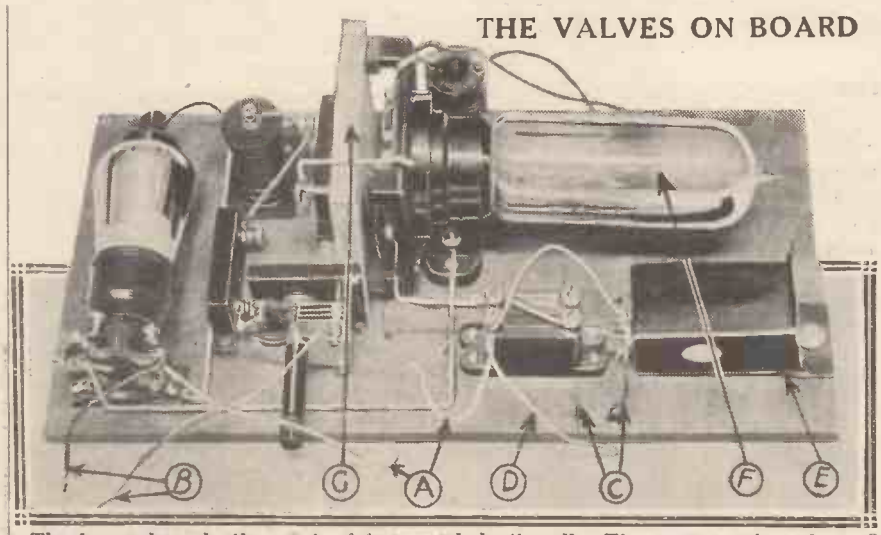
The 3N.F. Loewe multiple valve is, in effect, a complete detector and 2 L.F. R.C.-coupled L.F. amplifier. There are no difficulties to overcome when the device is used by itself, and an aperiodic screen-grid H.F. stage used in front of an ordinary set is a straightforward affair. But on attempting to combine the two all sorts of peculiar effects cropped up, and no little experimenting was necessary to get the *tout ensemble* working properly.

No Filter Necessary

The detector valve operates on the anode-bend principle, and it is an interesting point that the use of an H.F. choke in place of a grid leak for this valve made a most remarkable difference to volume and stability.

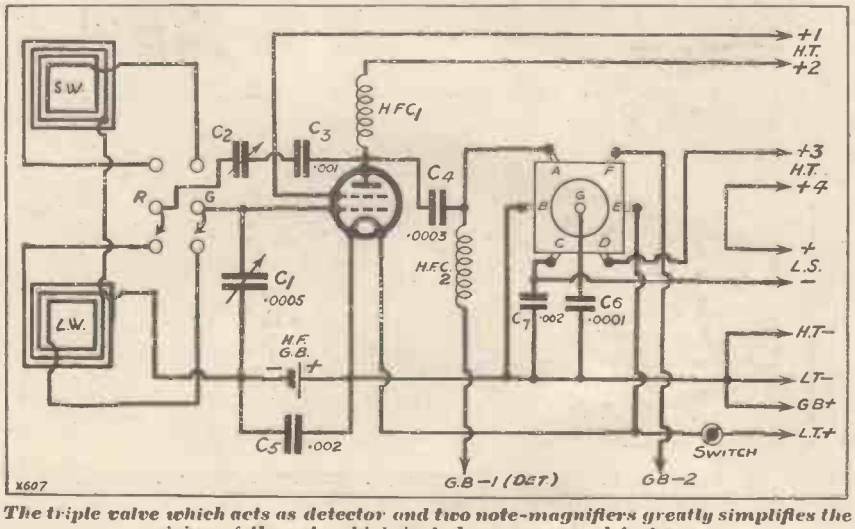
No output filter or decoupling devices are necessary and this fact

THE VALVES ON BOARD



The two valves do the work of four and do it well. The components and wires shown lettered are: (A) the connections for the variable condenser; (B) the leads to the wave-change pins; (C) the L.T. switch connections; (D) lead to common point on frame aerials; (E and F) the H.F. grid bias and multiple valve respectively, and (G) a vertical piece of wood to which three of the components are mounted.

HERE'S THE THEORETICAL CIRCUIT.—QUITE STRAIGHTFORWARD, ISN'T IT?



The triple valve which acts as detector and two note-magnifiers greatly simplifies the wiring of the set, which includes many novel features.

provided the first means of cutting down size.

Although the circuit was now working fine, more trouble was experienced as soon as an attempt was made to put it into the cabinet. After a lot more experimenting the trouble was cured by changing from a 3N.F. valve to an R.N.F.7. The difference between these valves is that the latter has an extra connection to the detector valve plate, which enables a by-pass condenser to be connected to the plate.

The Loud Speaker

This condenser lets any H.F. that is in the detector valve plate circuit go straight to earth instead of getting through to the L.F. side. This condenser, together with a by-pass condenser across the loud speaker, made the set quite stable and the results

The "Featherweight" Portable—*continued*

more than justified the time spent in perfecting it.

Having finished with the circuit, search was made for other means of reducing the size below that of most home-constructed portables. Almost immediately it was realised that the loud speaker needed careful consideration. But how to make a compact, efficient and yet easily constructed loud speaker was a question not readily answered.

The solution was eventually found in the design which is fully described in another article in this issue, and there is no doubt whatever that it is a wonderful combination of compactness, efficiency and ease of construction.

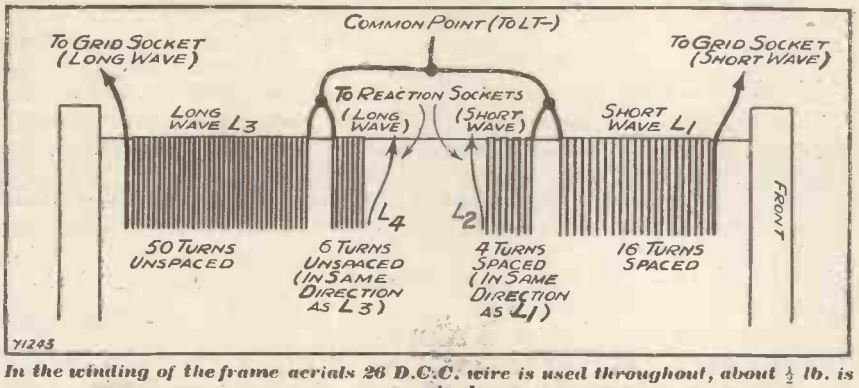
Really Easy to Make

No attempt was made to reduce size by cutting down batteries, as it would undoubtedly have led to poor quality, which is one of the chief drawbacks to many portable receivers. On the contrary, 120 volts are used, so that the reproduction is really good and is up to the standard of most ordinary receivers.

Our third requirement, that the set should be easy to make, had been automatically carried out by the circuit and loud speaker. It was carried a stage farther by the type of cabinet employed, which has an inner framework which is completely removable, so that the frame aerial can be put on it with the greatest of ease.

Before considering the construction we will take a look at the circuit diagram. You will note that reaction is obtained by means of the variable condenser C_2. This condenser is of the neutralising type and provides a slight feedback to the grid circuit. There are two frame aerials and the tuned parts are connected across the C_1 variable condenser.

HOW THE TWO FRAME AERIALS ARE CONNECTED



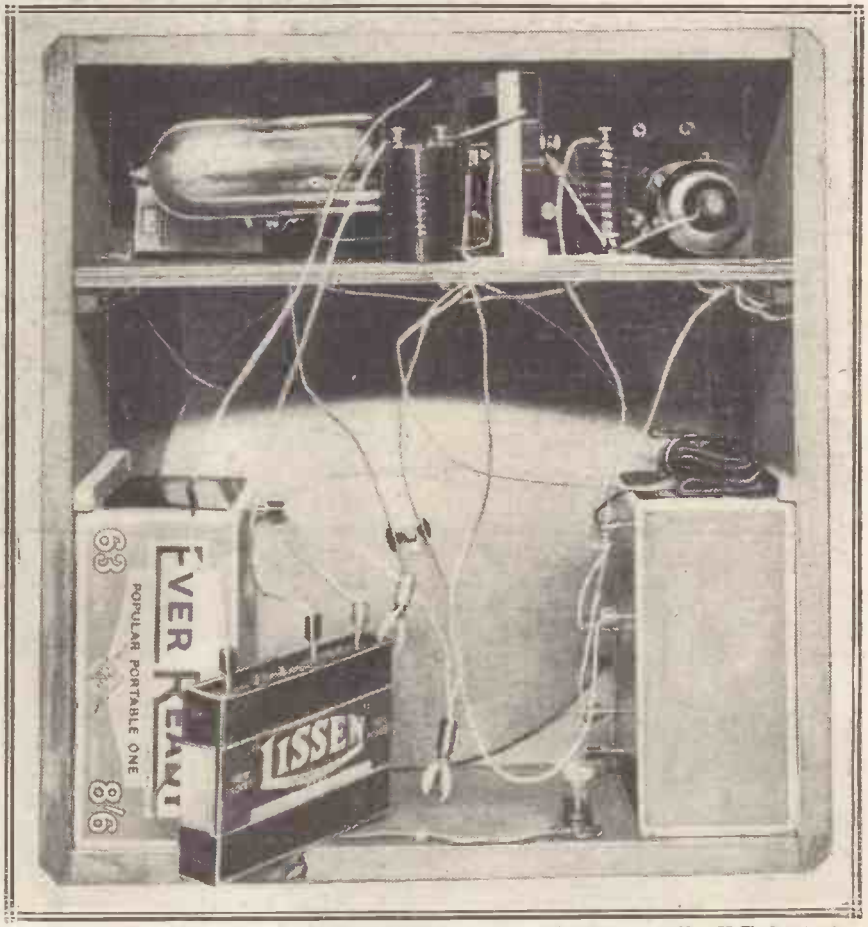
In the winding of the frame aerials 26 D.C.C. wire is used throughout, about ½ lb. is required.

The frame aerials are wound side by side, and have a common tap which goes to negative on the H.F. grid bias. The two ends, in both cases, are taken to sockets, and a change from long to medium waves is made by means of a small piece of ebonite with two pins on it. These pins engage with either one or the other pair of sockets, and can be seen on the front of the set at the top left-hand corner.

The grid-bias battery serves a dual purpose. It tends to improve the amplification of the S.G. valve, and to keep the H.T. consumption of this valve low. In some cases more than 1½ volts negative bias is found to be suitable, and there is plenty of room for a 4½-volt grid-bias battery in place of the 1½-volt one.

While on the question of H.T. consumption it may be mentioned that the consumption of the Loewe valve is only about 7 milliamps, so that the total consumption is quite moderate and will not run the H.T. batteries down very quickly. This is

INSIDE THE "FEATHERWEIGHT" PORTABLE



Here the wiring is finished. The L.T. battery can be fitted between the H.T. batteries. Two 60-volt H.T.s are used and a fuse can be inserted in the wire which joins the positive of one to the negative of the other.

The "Featherweight" Portable—*continued*

an important point, because in some portables the H.T. consumption is so high that the drain on ordinary batteries wears them out in no time!

And now for the construction. All the components and materials required are given in a separate list. Alternative makes are mentioned in most cases, but with regard to the Loewe valve and the cabinet there are no substitutes. Apart from these two, however, there is a very wide choice, and probably you will already have many of the parts.

The panel on which the controls are mounted does not come out with the baseboard, but this does not matter, as only the L.T. switch and tuning condenser are fixed to it, apart, of course, from the frame-aerial sockets, which are wired direct to the frames themselves.

It is as well to complete the panel and wind the aerials before starting work on the baseboard part of the set. First drill the panel in accordance with the dimensions given in the panel layout diagram.

The Reaction Condenser

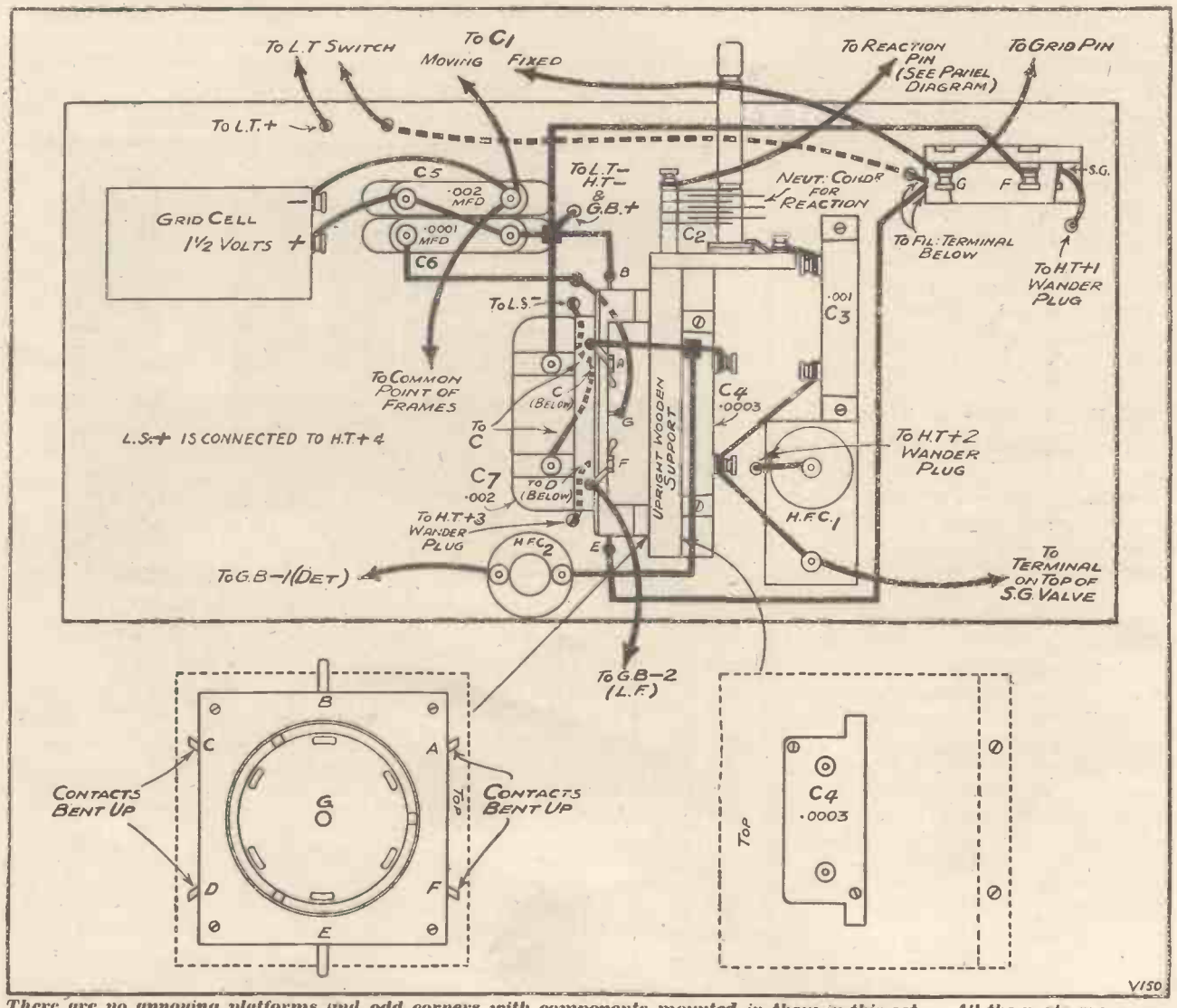
The N.C. condenser should be of the type which has a fairly long ebonite handle about ⅜ in. in diameter. This will then protrude a convenient amount through the ½-in. hole to the left of the slow-motion dial.

When you have drilled the panel and mounted the parts which go on it, wind the frame aerials. Gauge 24 D.C.C. wire is used throughout for these, and the number of turns is given in a special diagram. If you wind L_1, L_2, L_3, and L_4 in the same direction you will not have trouble with reversed reaction.

Join the four ends of the windings to the correct sockets on the panel, after bringing them through small holes to the inside of the wooden frame. These holes should naturally be as near to the sockets as possible.

The four wires which are joined together should be only just long enough to meet and should not be brought through to the inside of the wooden frame.

NOTE THE REMARKABLY FEW CONNECTING LEADS



There are no annoying platforms and odd corners with components mounted in them in this set. All the parts are on one baseboard and all the wiring is carried out as in the construction of an ordinary set.

The "Featherweight" Portable—*continued*

Before leaving the wooden frame screw two small fillets to the sides to support the baseboard. The upper sides of these should be 4 in. from the top of the wooden frame, measured from the inside.

The next step is to mount the components on the baseboard. It will be seen that the holder for the Loewe valve is first fixed to a piece of wood which is secured in a vertical position to the baseboard by means of another strip of wood along the bottom of it.

The Valve-Holders

The neutralising-type condenser is also screwed to this piece of wood, so that the final position of the vertical piece of wood must be decided by the N.C. and the distance the latter has to be from the panel for the handle to project a suitable amount.

It will be seen that eight holes are required in the baseboard for taking wires through, and these should be drilled before the components near to them are fixed in place.

The condenser C_4 is screwed to one side of the vertical piece of wood which supports the valve holder for the multiple valve. It is desirable to bend the contacts A, C, D, and F of this valve-holder over, to simplify wiring, which now has to be carried out.

Many of the vertical mounting valve holders that are now made are of a universal type, which means that they are also suitable for A.C. valves of the indirectly-heated type and have an extra socket in the centre of the usual four sockets.

If your holder for the S.G. valve (which must be a 4-volt one) is of this type, just trace out which terminal is connected to the centre socket and ignore it. The other four terminals are arranged in the usual manner.

Wiring of the Baseboard

Some of the wiring is of insulated stiff tinned-copper wire, and the remainder of flex.

The four leads which go to the L.T. switch and variable condenser C_1 should be arranged so that they are just long enough to be joined up before the baseboard is slid into position. The one which goes straight through the baseboard to L.T. can be pulled tight afterwards.

The connection from one side of the loud speaker to H.T.+4 is not shown on the wiring diagram because it is made direct below the baseboard. The flex lead to the common point of the frame should be taken through a hole directly above C_5, to the outside of the wooden frame and joined up to the common point of the frame aerials.

Fixing the Batteries

Having fitted the baseboard in position (with the valves in their sockets), all that remains to be done is to fix the loud speaker to the front of the cabinet by means of two nuts and bolts and put the batteries in.

The H.T. batteries are placed one on each side, the 4-volt accumulator and 9-volt grid-bias battery going between them. The batteries are kept away from the cone by means of small fillets screwed in suitable positions.

Since the size and shape of batteries will vary, no instructions can be given where to fit the fillets.

The set is now ready for connecting up, and you should have eight leads hanging down, two of which come round the back of the baseboard. All these leads are marked on the wiring diagram, so you will know where to connect them.

Grid bias —1 goes to 1½ volts negative, and G.B.—2 to 9 volts negative. You can try the latter in a lower tap, but the maximum is usually the best position for it.

H.T.+1 should go to the nearest tap to 80 volts, H.T.+2 and +4 to about 120 volts, and H.T.+3 to a tap between 90 and 120 volts, whichever gives the best results.

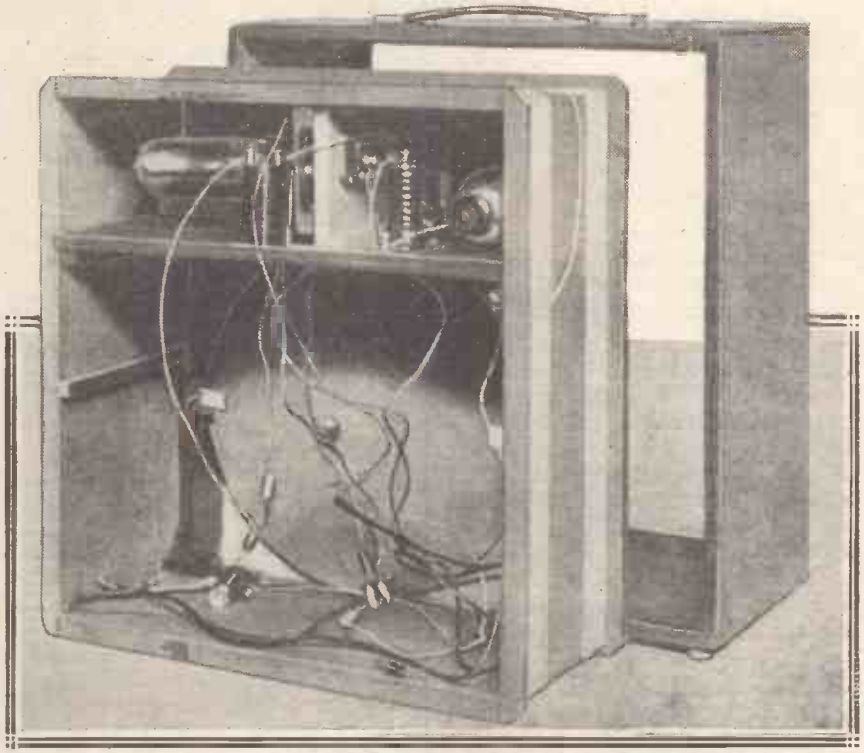
You will find that the operation of the set is just the same as any ordinary set with a single tuning control, but the tuning will be much more critical or sharp. The reaction condenser will naturally require altering as the tuning condenser is varied.

Some Final Hints

Do not try to use too much reaction or you will spoil the quality. Before trying to get stations which are a fair way off, get the "feel" of the set by tuning in the nearest and most powerful station. To change wave-bands all you have to do is to change over the wave-change pins.

Both the valves should have a piece of thick felt wrapped round them to avoid all possibility of "ponging" or of a build-up sound between them and the loud speaker. Elastic bands are very convenient for keeping the felt in position.

BUILT TO WITHSTAND ROUGH USAGE



The complete set is built in a wooden shell, as shown, which fits inside the main case when you want to carry it about.

HOW TO MAKE A BATTERY TESTER

Here are full constructional details of an efficient device that you can make for a few pence.

By a Correspondent.

USEFUL as it is in other ways, the voltmeter is of very little value as a means of testing the condition of accumulator cells used for either high- or low-tension current supply with the wireless set. The only really satisfactory method of doing this is to measure the specific gravity of the electrolyte.

When the accumulator is fully charged the gravity of the solution should be from 1·220 to 1·250, according to the make (the proper gravity will be found stated upon the label); the battery will be damaged if any cell is allowed to run down until the gravity is less than 1·170. Calibrated hydrometers can be purchased for a few shillings, but an instrument which will serve admirably for testing accumulator cells can be made at a cost that runs into only pence.

Preparing the Pellet

Obtain from a chemist a small pipette about 6 inches in length, like that shown in the accompanying drawing. Get him to make you up as well two small bottles of dilute brimstone sulphuric acid and distilled water, the specific gravity of the first bottle being of the figure given by the makers of your battery as correct when the accumulator is fully charged, and that of the second 1·170.

Take a small piece of paraffin wax and roll with it a little pellet which will fit easily into the top of the pipette. Into this pellet press lead filings until the pellet will float just touching the surface of the acid solution with the higher specific gravity. Make a scratch with a diamond about an inch below the bulb end of the pipette.

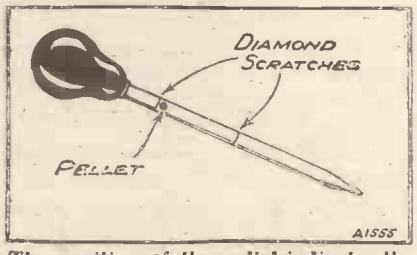
Making the Markings

Place the pellet in the tube, and draw up enough solution to reach the scratch made. If the pellet has been properly adjusted it will now float just on a level with the scratch. If not, a fresh pellet must be made and balanced until the desired end is achieved.

Empty the solution out of the pipette and draw up a supply from the bottle containing the solution with the weaker specific gravity. This again must just reach the diamond scratch. It will be found that the pellet is now floating some distance down from the top of the liquid. Make a second diamond scratch on a level with the top of the pellet.

The instrument is now ready for use. When one of your batteries returns from the charging station the pellet should just reach the top mark when the solution from one of the cells is level with this. If it does not, either the battery is not fully charged or the specific gravity is incorrect.

RAPID READINGS



The position of the pellet indicates the condition of your accumulator cell.

When the battery has been in use for some time test its cells again.

If the pellet sinks to the neighbourhood of the second scratch it is time to see about a re-charge. If you like, you can make a third scratch half-way between the others. When the pellet rises only to the level of this you know that the battery is about half-discharged.

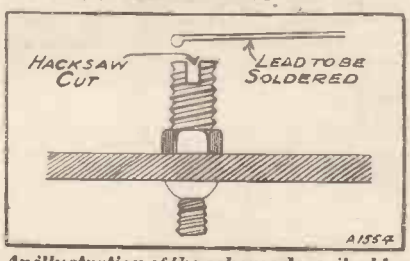
Don't forget that it is also most important to fill the tube of the pipette exactly to the level of the top scratch—and don't, by the way, use anything but lead filings for weighting your pellet; iron filings, for instance, would very soon be dissolved away by the action of the acid.

SOUND SOLDERING

How to solder terminal and other connections so that they will "stay put."

THOUGH soldering wires to terminals has rather gone out of fashion, there can be no doubt that connections of the lowest possible resistance are made in this way. For this reason, those who can use a soldering iron will certainly be well advised to make the majority of their connections with its help, especially in short-wave sets and others where it is of the utmost importance to keep down high-frequency resistance.

A TERMINAL TIP



An illustration of the scheme described for making sound connections to terminals.

One of the most difficult joints to make really soundly is that between a wire and the shank end of a terminal. The old hand may succeed every time, but the less-experienced solderer is more apt to make joints which, though they look good enough at first, eventually give trouble by coming adrift.

An Annoying Trouble

And the worst of it is that when the two parts of the joint do part company it is as often as not exceedingly difficult to see that anything of the kind has happened. The set either goes dead or becomes horribly noisy, and one may spend quite a long while in endeavouring to discover just what is the cause of the trouble.

Quite Simple

Here is a very simple method of making completely reliable soldered joints to terminals. Before fixing the terminal in position on the panel or the terminal strip, make a hacksaw cut about a quarter of an inch deep in its shank. Lay the wire to be joined to it in this cut, and then pinch it up tightly with the pliers. Apply a small amount of non-corrosive flux, and solder with a hot iron.

Half the soldered joints that come loose do so through the effects of vibration which cause the solder to come adrift. When the lead is firmly held in the pinched-up hacksaw-cut it cannot move. It does not, therefore, "work against" the solder, and the latter cannot fracture.

The "CONSTRUCTOR" CONE

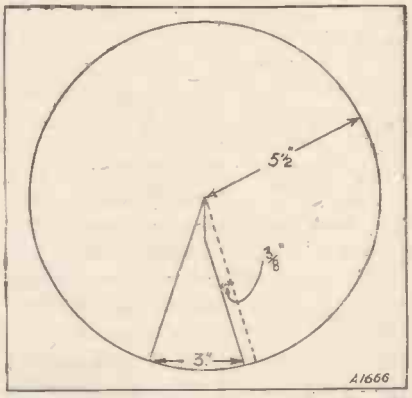
An easily made loud speaker for use either with portable sets or in a cabinet for home use. It is this speaker which is employed in the "Featherweight" Portable described elsewhere in this issue.

Designed and Described by The "Wireless Constructor" Research and Construction Dept.

ELSEWHERE in this issue details are given for the construction of a compact portable receiver, and a compact portable receiver obviously requires a compact loud speaker.

The speaker used in the above-mentioned set is not only compact but is of a very novel kind, and was specially designed for incorporation in portable sets. It is easy to make, but nevertheless is very efficient. As a matter of fact, it is also very effective as a loud speaker for normal use.

CUTTING THE CONE



Cut the paper neatly in accordance with these details.

With most home-made cone loud speakers it is usual to mount the unit at the back of the cone, and to support it by means of some wooden or metal cradle. There are two very patent drawbacks to this arrangement from the point of view of a portable set.

Cone Problems

First, the arrangement takes up a lot of room, and valuable space is wasted due to the straggly nature of the speaker, which makes it difficult to fit the batteries or other components very near to it. Secondly, the scheme adds weight, which is obviously unwanted, and involves extra work or expense by virtue of its cradle.

In finding the best method of overcoming these two points many schemes were tried or considered, including the use of some form of flat diaphragm in place of a cone.

The difficulty of obtaining a fairly large sheet of light but absolutely rigid material, as well as the fact that a flat surface does not set the air in motion so much for a given movement as a cone, put such a scheme out of the question.

Many Advantages

Eventually an arrangement was devised which overcame both the difficulties at once, and also made the constructional work absurdly simple. As you will have gathered from the photographs, this feat was accomplished by the expedient of arranging the unit at the front of the cone.

By using a fairly shallow cone the total depth of the loud speaker is only about 3 in., and only one piece of straight wood is required to support both the unit and the cone.

The cone itself remains rigid without a support right round its edge, and is secured in place by means of two small pieces of sticky tape diagonally opposite one another. The spindle of the unit is sufficiently strong to act as the main support.

Apart from the saving in constructional work, this method of mounting the cone has the advantage that the cone is very free, and is thus able to move exactly in accordance with the vibrations of the actuating spindle.

Both the definition and sensitivity of the loud speaker are remarkably good, and it is so easily made that the diagrams are almost self-explanatory.

The components and materials are few and it is not worth while putting them in a separate list. However, we will mention them all here so that they can be easily collected together.

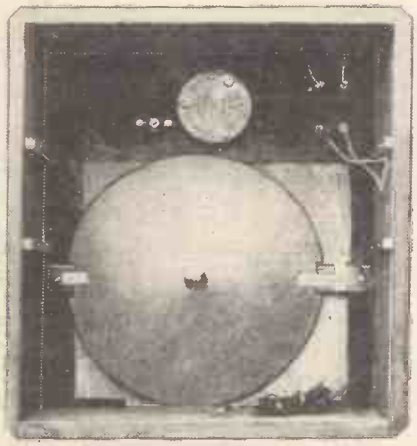
Simple Materials

First of all, you will require a sheet of Kraft paper. The size of the piece actually required is only 1 ft. square, so that you will be able to cut two or three cones out of one sheet, and it will not matter if you spoil one.

The paper should be of the usual thickness employed in making cone loud speakers, and the proper description is Kraft paper weighing 120 lb. to the ream.

A piece of ⅜-in. wood is required, 12¾ in. long by 1 in. wide. This should be well-seasoned, hard wood, otherwise it might warp and distort the cone.

THE "C.C." IN USE



The "Constructor" Cone in position in the "Featherweight" Portable.

You will also require about 1 ft. of sticky tape. Medical tape, usually known as sticking-plaster, about ⅜ in. wide, is very suitable.

The last item is the loud-speaker unit. The one actually employed is

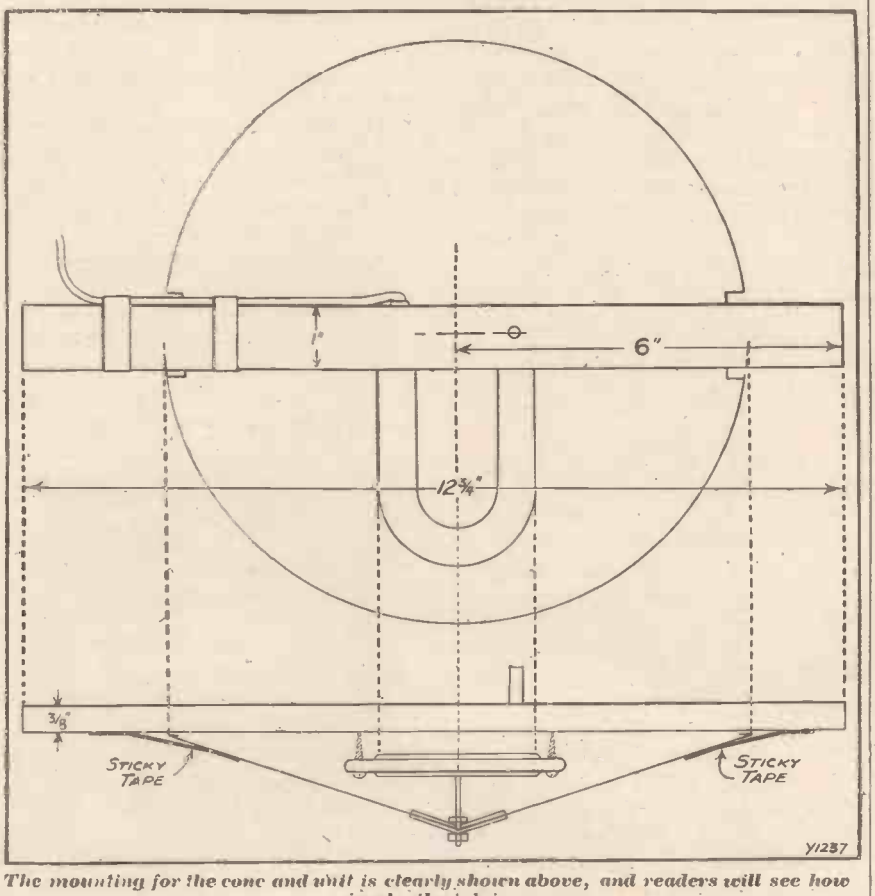
The "Constructor" Cone—*continued*

the well-known Blue Spot. This particular unit was chosen because it is fairly small and can be mounted on a flat piece of wood. Any other make of unit can be chosen providing it is possible to mount it in a suitable manner, and it is not so large that it would foul the cone at any point.

Fixing the Unit

First of all, describe on the paper a circle with a radius of 5½ in., and then mark out a piece to the dimensions given in the small diagram. When you have done this the cone should be cut out with a pair of sharp scissors.

SIMPLICITY AND EFFECTIVENESS ARE FEATURES OF THIS SPEAKER



The mounting for the cone and unit is clearly shown above, and readers will see how simple the job is.

Cut it out carefully so that it does not get crumpled or bent in any way. Also, don't cut along the dotted line by mistake, as the flap is required to join up the cone.

Stick the cone together with a glue adhesive of some sort, such as Seccotine or Croid, overlapping the paper as far as the dotted line. While the cone is drying the unit can be screwed to the wooden batten.

The position of the unit should be arranged so that the spindle is 6 in. from one end and over the centre of the piece of wood so far as its width is concerned. The Blue Spot unit can be held in place with ordinary wood screws, but when other units are used it may be necessary to employ other methods of mounting. A hole will be required in the wood for the adjusting spindle of the unit.

The flex leads to the unit should be tightly bound to the wood by two pieces of the sticky tape. Run them to the longer end of the wooden batten, where they may be joined to two small terminals if desired.

Final Details

All that remains now is to fix the cone in place. Before fitting it over the unit spindle cut two small pieces out of it at points opposite one another. These should be a little over 1 in. wide and about ¼ in. deep. You will see from the photographs and diagram how they are arranged so that the cone clears the piece of wood. Next stick two pieces of sticky tape to the cone at these points. Reference to the photographs will again be found helpful.

The cone should be clamped in such a position on the unit spindle that it just clears the wood by about ⅛ in. The pieces of sticky tape will help to keep this clearance just right when they are stuck down to the wooden support.

The cone is now complete, and it is mounted to the back of the loud-speaker grill in the portable set or the loud-speaker cabinet by means of screws or nuts and bolts passing through each end of the wooden batten.

The adjusting knob comes out in front of the grill and so is very accessible.

NEW HIGH-POWER ROME STATION

Sir,—You may be interested to learn that I receive this station at full L.S. strength, using no reaction whatever. My set is a screened-grid 3, built at home, with Mullard P.M.12, Osram L.210, and Marconi P.240, leaky-grid rectification (with alternative anode-bend rectification, if I wish, which, however, doesn't give noticeably better quality and is, of course, less sensitive on foreign stations), and A.F.5 transformer. Quality of Rome transmissions as *I* get them is exceedingly good, and if I have received any one foreign station at greater strength than any other it is this new Rome station.

As a purchaser of every number of WIRELESS CONSTRUCTOR since it was first published I would greatly appreciate an article in it in the near future giving full details on methods of using a milliammeter on a set to ensure getting best results in the shape of purity of reproduction and freedom from distortion. I get at least 20 foreign stations at good L.S. strength on a good, short, high, outside aerial, some with very fair quality, too.

Yours faithfully,
J. G. CHESHER.

Addiscombe, Surrey.

A PRACTICAL MAN'S CORNER

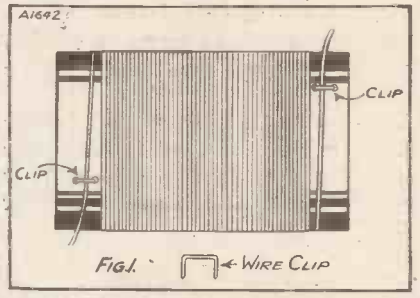
This is a special section for the set-builder in which he will find many valuable hints.

By R. W. HALLOWS, M.A.

THE usual method of anchoring the beginning and end of a solenoid coil is to pierce a couple of holes fairly close together, taking the wire down through the first, up through the second, down through the first again and then up through the second.

Personally I have never very much cared about this way of doing the job, at any rate, where cardboard

KEEPING THE TURNS TAUT



This diagram shows a very simple but efficient method of fastening the ends of a solenoid coil.

formers are used, for if the "anchorage" is pulled tight one is very apt to tear the tube between the small holes.

A much better way of anchoring end turns is that shown in Fig. 1, where two small clips are used. The clips are similar to those employed for fixing together the pages of the WIRELESS CONSTRUCTOR. They are obtainable from some stationers, or you can take them out of an old magazine.

Anchoring with Clips

Pierce two holes in the former where the anchorage is required, using a stout needle for the purpose, so as to make the holes as small as possible. Put in the clip, place the wire under it and then turn down the points that protrude into the interior of the former, either with the finger or with a handy piece of metal.

Place something hard inside the former to act as an anvil, give the outside of the clip one tap with a light hammer and the wire is anchored as well as one could wish. This tip is also particularly useful for securing to the leads running from tapping points on the coil. Such leads are apt to break if they are not secured, but when they are clipped down in the way suggested they are perfectly safe.

A month or two ago I mentioned the difficulty of making the turns on a plain solenoid coil remain taut, shipshape and in position under the more or less rough handling that comes the way of most coils.

A Very Useful Idea

I showed then that the important thing was to fix the first and last turns firmly, for if these could not move the rest were automatically held in position. The reader may remember the tip then given for winding these coils on ribbed formers; a shallow nick is made in each rib with a small hacksaw or a good file for the first and last turns. They sit firmly in these nicks and so long as they are there the other turns must remain where they are put.

Here is an equally useful hint for coil winding upon plain cylindrical formers without ribs. Remember in the first place to get your first and last turns as tight as possible. For some queer reason this is not too easy—no matter how tight the others are, the first and last always seem to be rather slacker. See, anyhow, that they are not *too* slack.

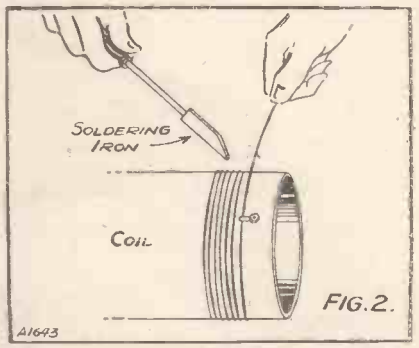
Having put on all the turns, take the next very important step before anything else is done with the coil. Sharpen the point of a match and on to it squeeze a very little Seccotine from a tube. Run round the first turn, working the Seccotine in between it and the former. Then deal with the last turn in the same way.

That Last Turn

You can make assurance doubly sure by working a very small amount of Seccotine in between the first and second turns and between the last and the last but one. This method is just as effective as dressing the whole coil with shellac, and it has the advantage that it does not bring about anything like so great an increase in the self-capacity.

Here is a way of ensuring that the last turn is tight, which I have never known to fail. My own preference in coil winding is for ebonite or paxolin formers, and with these terminals and tags are better than any kind of anchored fixings. Fig. 2 shows how the last turn is secured. The turn is first of all pulled tightly over the tag and then carefully bared of insulation at the right spot. One hand holds

ANOTHER SIMPLE METHOD



Here we see a second scheme for fixing that troublesome "end" turn.

the wire and keeps it under strong tension whilst the other wields the soldering iron, applying the necessary small "blob" that fixes it in position once and for all.

A Practical Man's Corner—*continued*

So long as the tension is not relaxed until the solder has set, the last turn put on in this way will always remain tight. When the clip anchorage already described is used with cardboard formers the same method can be adapted to meet the circumstances. The points of the clip having been given their preliminary turn over, the wire is held under tension whilst the final tap is administered with the hammer.

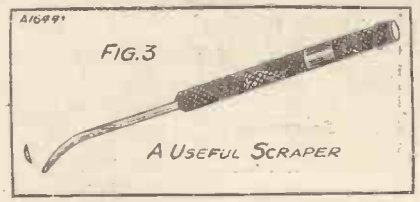
A good sound rule is always to give the first and last turns as strong a pull as the wire will stand. A little experience in coil winding soon enables the constructor to know instinctively just what tension he can safely put on wire of any particular gauge. If either first or last turn becomes loose in time it can be tightened up by slackening off the terminal nut and moving the tag so that the wire is tightened.

Concerning Tags

The success of the method described in the previous paragraph for tightening up the last turn secured to a tag depends to no small extent upon the kind of tag used. Some of those sold in wireless shops are flimsy little things punched from metal of very small gauge, and these are completely unsuitable for the constructor's purposes.

He should avoid light, thin tags, and never allow himself to be persuaded into buying them. In addition to their tendency to give way

KEEP YOUR TERMINALS CLEAN



A useful little scraper that is invaluable for cleaning corroded battery terminals, earth-pin connections, etc.

under any strain, and therefore to let the coil turn go slack, they are exceedingly liable to break. Another bad kind of tag is that cut from rather hard metal, for this very often breaks if it is bent with the pliers to a convenient shape.

Worse still, a complete break may not take place at first, the metal merely cracking during the process of bending. A little later on, when the set has been in use for some time, a breakdown occurs, and the cause is eventually traced—possibly at the expense of a good deal of time—to a broken tag. There is a third kind of evil tag—that which is made to look pretty by being given a plating of nickel. Why this is done by some makers I never could make out, for there is nothing to be said in favour of the nickelled tag. What constructor has not, at one time or another, spent a profane period in endeavouring to make solder run on to a tag that absolutely refused to receive it?

Using Nickelled Tags

By using far more than the due amount of flux, and heating his iron up to a temperature much higher than is good for it, he may eventually succeed in making a joint of some kind to a nickelled tag.

But more often than not any such joint turns out in course of time to be a gay deceiver, for there is nothing like nickel for producing that bugbear of the constructor—the dry joint.

Therefore obtain "tinned" tags if you possibly can, but if, as is quite likely, you are unable to do so, always remove the nickel plating from tags that look suspiciously bright before you start soldering operations. This may be done with an old file. Continue until the copper or brass is exposed, then tin with the soldering iron before you attempt to make a joint.

By far the best tool that I know for all-round use in cleaning up small metal surfaces is what is known as a curved toolmaker's scraper half-round in section. This is illustrated in Fig. 3. This tool costs only a matter of pence, and no constructor will regret adding it to his outfit. Besides the job mentioned there is nothing to beat it for scraping up accumulator and other terminals that have become corroded.

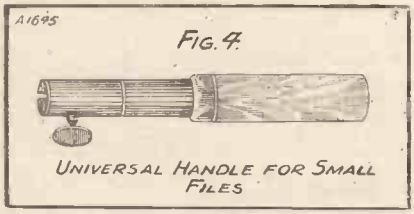
Making a Scraper

The blade of a knife never seems to be able to get right into the corner between the threaded stalk and the flat part of the terminal; the scraper, however, does the job easily and quickly. Anyone who possesses an emery wheel can make up a first-rate scraper for himself from an old half-round file about five or six inches in length.

Begin by grinding both the flat and the round surfaces of the file smooth for about an inch from the end. Then grind this part to a width of a quarter of an inch, and afterwards point it off rather sharply. The edge between the flat and the round faces must be straight and quite sharp.

Grinding is made easier if the file is first "let down" by bringing it to

A UNIVERSAL HANDLE



This is an adjustable handle which will fit almost any file and should be included in the constructor's kit.

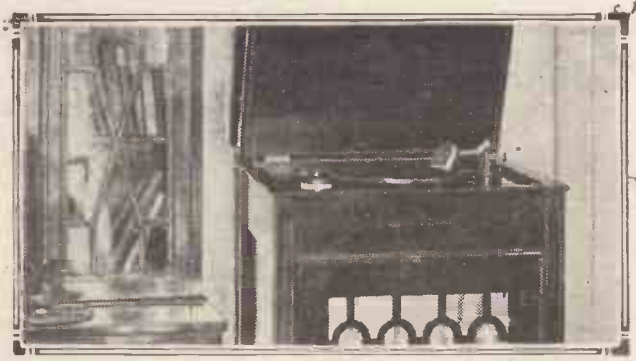
white heat and allowing it to cool slowly. It can be retempered subsequently by heating it up again and immersing it gradually in water or oil. Since you will never have to cut any very hard metal in wireless work, no very fine tempering is required.

Small files, if they are used just as they are purchased, have a very nasty knack of making the palm of their owner's hand pretty sore with their sharp tangs.

A Hand-Saver

Ideally, one should fit every file with a handle of its own, but not everyone wants to go to the trouble and expense of doing this. A further point is that handles take up a good deal of space. One can keep quite a number of handleless small files in an old cigarette tin of the hundred size but if they are provided with handles something a good deal bigger is needed.

A tip which saves both space and money is to provide a single handle, such as that seen in Fig. 4, into which any of the files can be fitted. These handles, which are quite cheap, consist of a wooden grip with a rather long metal ferrule furnished with a set-screw. The tang of the file is pushed into the ferrule and a turn of the set-screw makes it as tight as is necessary. The cigarette tin still remains big enough to house the equipment of files and the one handle which serves for all of them.



WITH PICK-UP AND SPEAKER

The Electric Motor—Timing the Gramophone—Long Leads —Pick-Up Chatter—A Curious Trouble—Needle Chucks.

Conducted by A. JOHNSON-RANDALL.

ONE of the only real drawbacks about "grinding your own programme" is the fact that attention is called for every few minutes. Needles and records must be changed and the motor rewound if it is a clockwork one, and the net result is a rather restless time for the operator.

A really good electric motor is a solution of the winding problem (although rather an expensive one), and there are semi-permanent needles which reduce this part of the nuisance, but the record-changing difficulty seems incurable in an inexpensive way. Magazine gramophones of wonderful ingenuity have already appeared, but it seems that the complicated and accurate mechanism called for by the multiplicity of operations involved in the changing of records must always be costly.

A Rosy Dream!

Possibly some day a solution of the problem will be provided by the arrival of a home form of the film-recording and light-ray reproduction method used in the talkies. When the record material is in the form of a strip it will obviously be a relatively simple matter to arrange for a number of items to be joined up in series, run off on to a single reel and then fed through the reproducer continuously. Having set the apparatus running, one could then go and sit in peace for quite a while. Truly, a rosy dream!

Long-playing Records?

There is one expedient which seems to be nearer at hand in its actual practical application, and that is the production of records of the ordinary type but with a slower spiral for the groove, so bringing the grooves closer together and increasing the total length of groove on the record.

The amplitude of modulation would have to be cut down correspondingly, and the record would therefore be useless for the mechanical type of gramophone, but for electrical reproduction it would still serve. After all, the present record, with its heavy modulation developed to suit the mechanical system, really gives too much volume for many outfits with a sensitive pick-up, and heavy volume-controlling must be done.

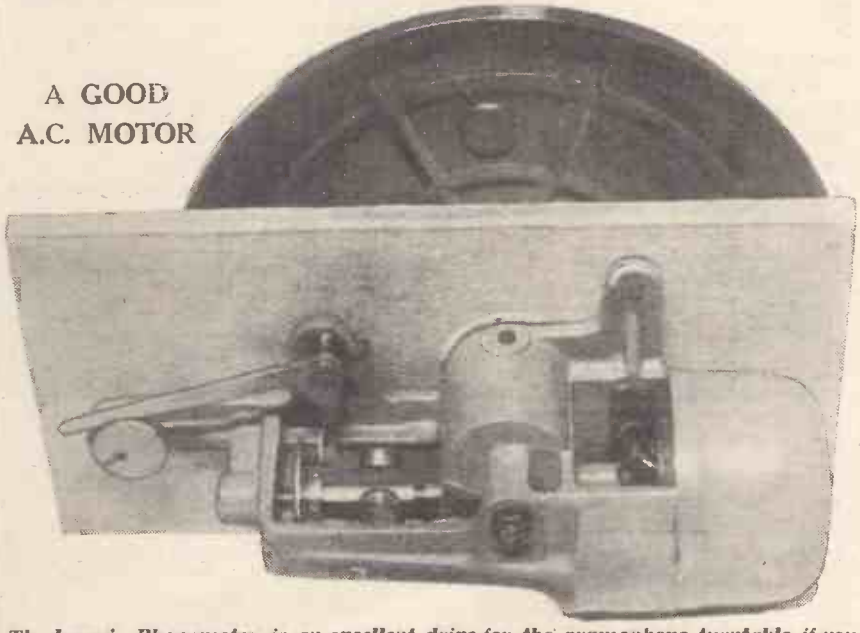
What We Should Need

On the face of it, therefore, it would seem feasible to employ considerably lower modulation and still obtain adequate volume, provided that we decided we must make a standard of three L.F. stages, and a fairly sensitive pick-up. This would merely mean in practice that we should have to decide to make it a rule to connect the pick-up in front of the detector valve and to see that there were two L.F. stages following that valve.

Given such a system of reduced amplitude recording and a much finer spiral, records of greatly increased playing time could be produced. Perhaps when users of electrical reproducing outfits become sufficiently numerous to create a substantial market of their own the gramophone companies will begin to give us such records.

Here is a hint about timing a gramophone which may prove of service to those readers who possess a considerable stock of records. In the usual method, of course, you make some sort of a mark on the turntable and watch this for a given period of time, say, one minute, counting the revolutions. This process is not too easy, for one is very apt to make a mistake in counting in glancing from the revolving turntable to the watch, and so it was suggested recently that an old record should be used on which a radial scratch has been made so as to produce a click every time it comes round.

A GOOD A.C. MOTOR



The Igranic Phonomotor is an excellent drive for the gramophone turntable if you have A.C. mains.

To save the reader from the possibly difficult task of deciding which of his records is to be sacrificed in this way, it may just be mentioned that one which has been accidentally cracked will serve the purpose just as well, provided that the crack runs more or less radially.

Readers sometimes complain that the system of change-over switching

With Pick-Up and Speaker—*continued*

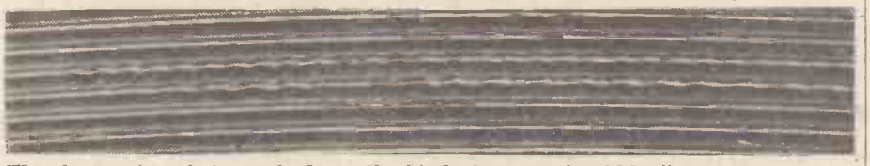
in their sets which gives the choice of radio or gramophone reproduction suffers from the defect that when on the gramophone side a faint background of the radio programme can be heard coming through all the while.

The trouble is most likely to occur when the change-over switch is of the simple, single-pole type, somewhere in the grid circuit of the first L.F. valve. In such cases the H.F. stage, or stages, and the detector valve are left running, and it is not really surprising that just a faint trace of the radio programme should sometimes get through into the amplifying circuit.

A Simple Cure

The remedy is usually fairly simple. Just fit an extra switch to turn out the filament of the detector and H.F. valve, or even the H.F. valve alone. You can fit this as an extra switch on the panel, but really a neater way of doing it is to replace your single-pole change-over switch which gives you radio or gramophone with a double-pole component, using the extra pole to break the filament circuits of those valves which are not required when the amplifier is being used alone for gramophone reproduction.

WHAT THE PICK-UP NEEDLE HAS TO FOLLOW



The above microphotograph shows the kind of groove "wobbles" that the pick-up needle has to follow, and it takes a good pick-up to do it properly.

Everybody knows that it is not really good practice to have a very long length of lead between the pick-up and the input terminals of a gramophone amplifier. Sometimes, however, circumstances compel one to have the pick-up working at some little distance from the amplifier, and so a rather lengthy lead becomes inevitable.

Granted, then, that cases do arise in practice where long pick-up leads cannot be avoided, a few hints may be welcome as to the best method of minimising possible ill-effects. Well, the main trouble to be feared is a tendency to instability or to actual howling. Such a tendency is quite a natural one when you remember that you have taken the grid lead of the first L.F. valve for a walk round the room, quite possibly even approaching the loud speaker in doing so.

Preventing Howling

An actual howl is almost certain to result if this lead does actually pass very near to the loud speaker, but it remains a possibility even when it runs away by itself without apparently coming within the sphere of influence of any other lead. By far the best preventive of trouble, in the writer's experience, is to use an input transformer, placed right up against the input terminals of the amplifier. In other words, the grid lead of the first L.F. valve is kept quite short, the long extension line to the pick-up being on the primary side of the input transformer. A good low ratio intervalve L.F. transformer usually serves quite well.

Pick-up "chatter" has often been mentioned in these columns, but possibly a little further explanation of one aspect of it may help some readers who are just making a start in radio-gramophone work. Let us put it in the form of a practical hint: if you appear to be getting discordant, shrieking or jarring sounds from the loud speaker, do not be too sure that it is anything wrong with the reproduction. It may be just mechanical noise made by the pick-up and heard direct.

Silencing the Pick-Up

It is much easier to be "had" this way than you would think. To make sure about it, just put your ear very close up against the loud speaker, and note whether you still hear the discordant sounds as loudly in proportion as ever.

Having decided that the false notes are not really coming out of the loud speaker at all (as you probably will), you will soon be able to trace the noise to the pick-up. What to do then depends on circumstances, but it is chiefly a matter of lining the lid of the gramophone cabinet with felt, making the lid fit well with the aid of strips of the same material seccotined in place, and so on.

A very curious and puzzling effect was noticed by the writer the other day which may not be so rare an experience as he was at first inclined to think it. A pick-up was being used into which the needle normally fits rather deeply, so that the body of the pick-up rests very close down over the surface of the record. The symptoms were that the pick-up was only reproducing a note or two here and there, and seemed to be jumping about from groove to groove in a quite erratic manner.

A Puzzling Fault

Examination of the pick-up itself revealed no defect whatever, and everything seemed to be in perfect order, until an effort was made to watch the behaviour of the pick-up with the eye on the same level as the record. It was then seen in a moment that the trouble was due to the very simple fault of a short needle, which had gone so far into the grip that the body of the pick-up was resting on the record itself. It sounds a very easy defect to spot, but as a matter of fact it is by no means so simple in practice, hence these lines of warning to the reader.

A random hint the writer would like to pass on before he forgets concerns the gripping of needles in the pick-up chuck. Some people are a little careless about this operation, and lack of attention to it is very apt to lead to most puzzling faults in the reproduction. A needle which is not properly clamped is very apt to go into subsidiary vibration on certain notes, and produce all sorts of buzzings and breaking up of notes. Always be careful to see that the needle is home to the correct position (generally right in as far as possible) and to tighten up the clamping screw thoroughly.

Something Better Wanted

Incidentally, it seems reasonable to hope that manufacturers will give us ere long something more satisfactory than the single grub screw with which we have had to be content in the past for this purpose.

Why not a split chuck similar to a drill and designed to grip the needle at several points?

"AS WE FIND THEM"
NEW APPARATUS TESTED

All apparatus reviewed in this section each month has been tested with the utmost care in the "Wireless Constructor" Laboratory.

A New Transformer

THE high permeability alloy core has evidently come to stay. It certainly has definite advantages from the point of view of transformer construction. In the first place, it enables the overall dimensions of the component to be cut down, and, secondly, it provides a considerable reduction in weight.

Messrs. Lissen, Ltd., have now entered the field with a new transformer having a ferro-nickel core and a step-up ratio of 4–1. This component is exceedingly well finished, the windings and core being encased in a handsome bakelite moulding. It measures at the base a little over 2 in. square and the height is approximately 2¾ in. Moreover, it is exceedingly light in weight.

The new Lissen transformer is a well-finished little component.

On test we found both the quality and amplification to be very good, and it is a component which should be highly suitable for use in portable designs and in sets where space is limited.

Wire-Wound Resistances

Messrs. Collinson Precision Screw Co. have recently brought out a new line of fixed resistances. The one sent us had a value of 68,000 ohms, and we are informed that a whole range of different values is obtainable.

The resistances consist of a layer of wire wound upon a glass tube, the wire being kept in position by a covering of insulating varnish. The glass tubular former is mounted upon a base which has two eyelet holes, one at each end, to enable it to be mounted upon the baseboard. The value of each resistance is clearly marked.

We measured the particular resistance sent and found that the value came within practical limits of the makers' marking. The resistances are designed to dissipate ten watts without overheating—a very valuable feature. For use in eliminator circuits or in other arrangements where a heavy anode current has to be passed they can be thoroughly recommended.

M.P.A. Loud Speaker

Listeners contemplating the purchase of a loud speaker of moderate price should not forget the M.P.A. Popular Cabinet model. It retails at 45s. in oak, or 47s. 6d. in mahogany. The speaker is attractive in appearance, and the unit, which is adjustable, is a good one. We tested this speaker for sensitivity and found it to be excellent.

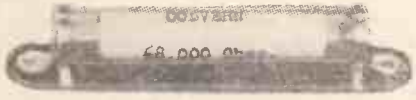
This is a good point and one which is of particular importance to the user of a small set or of a receiver in which it is not desired to use high anode voltages or a valve of the super-power type. Readers wishing to buy a speaker round about this price should certainly hear the M.P.A.

A Double-Duty Wave-Trap

Messrs. General Electric Company, Ltd., have sent us a sample of the Gecophone wave-trap and coupling unit. This unit is of very neat appearance and has a small horizontal tuning dial projecting through a slot at one side of the case. At one end of the unit there are five terminals, and at the other a single terminal for connection to the earth point on the set.

The device can be used either as a wave-trap for cutting out one station on the medium broadcast band or as an additional tuning arrangement for improving the selectivity of the receiver over the wave-band covered by the wave-trap circuit.

When used as a wave-trap the aerial lead-in is connected to one of the three terminals marked A, B and C. Terminal E is connected to the aerial terminal on the set and the single terminal at the other end of the unit to the earth terminal of the set.



A useful fixed resistance.

We connected this unit to a powerful three-valve receiver in the WIRELESS CONSTRUCTOR laboratory in Tallis House. Using terminal C we had no difficulty in completely eliminating the transmission from Brookmans Park.

Selling at a popular price, the M.P.A. loud speaker has a very pleasing appearance.

"As We Find Them"—*continued*

The makers point out that in the case of direct-coupled circuits it is best to connect up the unit as a selectivity device as distinct from a wave-trap. That is to say, to wire up the unit so that it becomes an additional tuning circuit in cascade with the aerial circuit of the set.

The Gecophone combined wave-trap and coupling unit.

We are in agreement with the makers on this point, since we have found that when using various types of rejectors in conjunction with the old-fashioned plain aerial-tuning receivers, it is not always possible to produce a satisfactory elimination of a powerful local station.

To obtain the maximum effect from the average wave-trap or rejector it is usually necessary for the aerial circuit of the receiver to be of the coupled or tapped coil type. The Gecophone wave-trap and coupling unit retails at 18s. 6d., and is a thoroughly well finished and workmanlike job.

Some Useful Components

Messrs. Graham Farish, Ltd., have submitted a number of their components for test and report. These include the "Megite" grid leaks and "Ohmite" anode resistances. The anode resistances consist of a special composition hermetically sealed in a bakelite tube. They are designed to carry ten milliamperes at their rated voltages.

We tested the resistance values of the various specimens sent us and found them to be very accurate. The "Megite" grid leaks are similar in appearance to the anode resistances and are really high-resistance counterparts of the "Ohmites," and as in the case of the anode resistances the particular samples measured were found to be accurately marked.

Then there is also the "Standard" grid leak, which is really a cheaper edition of the "Megite." These grid leaks are not designed for heavy duty, but are quite suitable for use in conjunction with leaky-grid rectifiers, etc.

They are substantially made and well finished. We found the values to be accurately marked within the usual limits of manufacture. Messrs. Graham Farish also manufacture fixed condensers of various capacities. These condensers can be obtained with or without grid-leak clips.

This Polar short-wave choke is especially designed for work down to the 10-metre wave-lengths.

The casings are of well-moulded brown bakelite, and it is interesting to note that these condensers can be mounted horizontally or vertically, since the holding-down lugs permit either method to be employed. In addition, the terminals, which incidentally have slotted heads, are supplied with soldering tags. This is a useful refinement.

The standard Polar H.F. choke is suitable for use on all ordinary broadcast wave-lengths.

Polar H.F. Chokes

Messrs. Wingrove and Rogers have also sent us two of their new H.F. chokes. One of them is designed for ordinary broadcast receivers and the makers state that it will function satisfactorily on wave-lengths from 20 to 5,000 metres.

The component is exceedingly compact and could be used in portable and other small sets where space is limited. It is, of course, equally suitable for any receiver, either large or small. On test the choke did not show any peaks on either the medium or long broadcast wave-bands; in fact, it was tested on wave-lengths well above any used by normal broadcast stations.

Tried as a plate circuit choke for reaction purposes on broadcast reception, it carried out its duties in a highly commendable manner.

The other choke, which is intended for short-wave sets, is specially designed to go down to 10 metres. Both components are nicely made and give one the impression of being thoroughly well designed.

This representative group of Graham Farish products shows the components referred to above, and others on which we hope to report next month.

IN LIGHTER VEIN

THE GOOPOSCOPE

By WIRELESS WAYFARER.

THE professor had just been explaining to me how wonderfully descriptive and how beautifully precise are the technical words used by scientists. "Micro," he pointed out, at the beginning of any word showed that it meant the millionth of a something.

"Thus," he said, "microampere is a millionth of an ampere, microvolt a millionth of a volt and microhm a millionth of an ohm."

"I see," I cried, "then a microbe is a millionth of an obe."

"I see," I cried, "then a microbe is a millionth of an obe. And a microphone is a millionth of a phone, and——"

"Shut up, you ass!" roared the professor. He then went on to tell me that "kilo" always signified a thousand, giving as examples kilogram and kilometre and all that kind of thing.

"And don't you think," I inquired, "that motor bikes might be known as killercycles since they lay out thousands?"

Those Scientific Terms

The professor became a little annoyed over this, and his wrath mounted when I told him that I thought scientific terms were tripe, tosh, bilge, and balderdash. He maintained that they make it so easy to explain anything, whilst *I* maintained that they make it so easy to get out of giving an explanation of anything when you aren't quite sure how to do it.

I mean, if you go up to one of these scientist johnnies and say: "Why is it that you get quick fading on the short waves?" he will first look at you as if you were the kind of thing that one expects to see in a cheese and will say: "This interesting phenomenon is generally believed to be due to the procatabinostic intergalbination of the asymphontic nodes," and so on and so on. You know the kind of thing.

As likely as not he will pull an old envelope out of his pocket and say: "If you want a clear proof of my argument here it is," and then he will write down something full of x's and square-root signs and brackets and fractions and decimals and indices and logarithms and the twirls and twiddly bits that they use in the calculus and suchlike high flights.

"Never Treats me Like This"

I will say this for Professor Goop. He never treats me in this way when I ask him for an explanation. He knows jolly well that if he did his path would very shortly be crossed by a dark handsome man wielding an earth tube.

And that, if you will believe me, is by far the best way of dealing with the chappies who wrap up their meaning in six-syllable words and then say "obviously then——," and follow it up with reams of disgusting mathematics.

They are pretty futile sort of blokes anyhow, for any one of them will prove to you, if you will listen (as, if you take my advice, you will not), that you cannot possibly hear anything of the bass with such and such a circuit. And then you just go and make up the circuit and find that you can.

I got the professor at length switched off from the topic of technical terms. After an absent-minded interlude, during which he flung the contents of his tobacco jar into the fire and loaded his favourite pipe with coal, he suddenly said, "What's wrong with the talkies?"

Too Much Noise

That seemed to need some thinking over.

"The noise," I said at length. "In the old days I used to find the seats at the movies very comfortable, and I have never had anywhere pleasanter little naps than I used to have at the cinema before the talkies came along. Now, if anybody will invent a silent talkie——"

"No, no," said the professor. "The public has shown that it now wants films to speak and sing and roar and so on; therefore, though Sir Scone Teeth maintains that it is utterly wrong ever to give the public what it wants, I maintain that the talkies must undoubtedly produce noises. Admitting this, I ask you once more what is wrong with them?"

"Well," I said, after a pause for further thought, "they do shatter love's young dream, don't they? I mean that when you hear some beautiful young thing who won your heart in the old silent days speaking with a voice that sounds like a bandsaw at work, and talking the poifect English of the Bowery tough, it does kind of tear things, if you see what I mean.

Lack of Synchronisation

"And then there's all that funny business about S's and F's and Th's and things. I mean that when the hero tries to say: 'My sweetheart, I simply worship those sweet eyes of yours,' what he actually produces is, 'My hweetheart I himply worhhip hose hweet eyes of yourth.'"

"No," said the professor with a smile. "It was not the quality of

He flung the contents of his tobacco jar into the fire and loaded his favourite pipe with coal.

the speech that I was thinking of, though I am very shortly about to improve that. What I really had in mind when I asked my question was the slight imperfection that you may have noticed in the matter of synchronisation.

"If, for example, you are sitting far back in the house, the villain has

The "Gooposcope"—*continued*

often brought his face to rest before you hear his teeth grit. And sometimes the second tear from the heroine's eyes reaches the floor before you hear the splash of the first, and all that kind of thing."

"My system," continued the professor, "completely does away with the old faults of synchronisation. No matter in what part of the house you may be sitting, the mother's cry of, 'Oh, my cheeild!' begins as she opens her lips and ends when she closes them.

The Demonstration

"The fatal shot rings out just as the villain presses the trigger; you hear the nice squashy sound of the hero's straight left just as it biffs the arch-criminal on the nose."

"It's all very well talking," I remarked; "but I have heard so many claims made lately that really you must give a demonstration if you want to convince me and everybody else."

"That," smiled the professor, "is easy. In point of fact, I have engaged the Mudbury Wallow Grand Opera House for to-morrow night, and I should be much obliged if you would kindly let all our friends know that there will be a demonstration of the super-talkies, or Goopies as I think they will shortly be called."

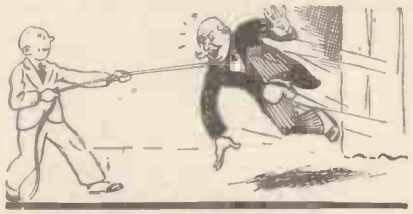
I rushed to the telephone, for if it was a matter of ringing up half Mudbury Wallow I thought that it might just as well be put down on the professor's 'phone bill as on mine. Sir K. N. Pepper would be delighted to preside; Captain Buckett would come; Miss Worple promised to put aside all her other engagements; Primpleson, Tootle, Goshburton-Crump and all the rest undertook not only to come but to bring friends, relations, and offspring.

Installing the Gooposcope

The professor and I spent the following morning in installing the Gooposcope at the Grand Opera House. As I had not time to gather exactly how it worked, I had better, I think, explain to the reader in the clear language of science that its operation is dependent upon the procatabinostic intergalbination of the asymphontic nodes. He will then know quite as much about it as I do.

Sir K. N. Pepper rose punctually on the stroke of eight o'clock to introduce the professor and his invention.

"Few words of mine," he said, "are needed to introduce to you Mudbury Wallow's world-famous genius, Professor Goop. I know that you are yearning to see and hear what he has to demonstrate to you. Therefore I will not detain you long."



I lassoed Sir K. N. Pepper from the wings, bringing his few words to a close.

At 8.30 p.m. I lassoed Sir K. N. Pepper from the wings, bringing his "few words" to a close. Professor Goop sprang to his feet, pulling an old envelope out of his pocket. I was just in time to remove the lasso from Sir K. N. Pepper's neck and to drop it neatly about that of the professor.

The lights went off, the great moment had arrived. Upon what is, I believe, known as the silver screen, there appeared the gigantic face of a beautiful lady. She smiled; her lips opened and shut several times. She disappeared. From somewhere in the hall a mighty loud speaker bellowed out: "Dear friends, I hope that you will like our film."

A Nasty Time-Lag

"Tut, tut!" said the professor, who by this time had freed himself from the rope. "A nasty time-lag there."

Some beautiful young thing speaking the poifect English of the Bowery tough.

With me hard upon his heels, he fled to the operating chamber, and proceeded to twiddle things. I think he must have turned the knobs a bit too far, for we heard the hero's little speech introducing himself several seconds before his face appeared upon the screen.

Then the real film began. The professor was still turning the knobs like anything, and didn't seem quite able to hit the tuning point. The hooves of the horses of a galloping mass of Red Indians were accompanied by the sound that little waves make when they break upon the beach. Then when the heroine was seen tripping lightly across the sunny lawn the galloping hoof noises came in in a most entertaining way.

Worse and Worse

When the villain pulled the trigger of his pistol it produced the toot of a motor-horn; the load of bricks dropped by the villain upon the hero reached the ground with a gentle sigh; the sound of the pistol shot occurred when the heroine closed her eyes during a close-up; when the hero slapped his manly chest and appeared to be telling the heroine that he loved her, he bleated like a goat, and when the goat suddenly butted the funny man it remarked, "Darling, I love you."

The audience laughed as I have never seen an audience laugh. At first they roared, then they could only just manage to squeak at intervals, and finally they were reduced to such a state that they were completely helpless.

The professor did not at first see what a triumph he had scored. Then a large man in evening dress was ushered into the operating-room.

"Thay," he said, "I'm Motheth Ithaacovitth, the talkie film magnate. I'll offer you right now a million dahlerth for thith invention. Gueth I haven't laffed so much in yearth."

Then it dawned on the professor that he really had done something. In a neat little speech he told the audience how pleased he was that they had enjoyed his poor efforts. He said he hadn't warned them that it was going to be a comic film for he wanted them to be taken completely by surprise.

Fifty-Fifty

"This," he said, "is the greatest day of my life."

"Of our lives," I corrected.

"What do you mean?" he asked.

"Fifty-fifty," I smiled, "or I'll give the show away."

"That means that you are going to get—let me see." Here the professor produced an old envelope, and I produced the earth tube.

"Halves in that megadollar," said I.

"Halves it is," agreed the professor,

HOW TO GET SINCERITY OF TONE

"Music whispering words of love—of Southern skies and scented nights—a flash of feeling in every bar of it, a thrill for the heart in every beat of it."

There is this and more to hear in Rio Rita when pure Lissen power is pulsing through your set. Feel the intoxication of its rhythm, urging you to dance, hear its caressing melody. Every note a cameo borne upon the silent power of Lissen, every word of vocal refrain full of emotion because of the sincerity of tone that Lissen current influences your loud speaker to yield.

The Secret Process of the Lissen Battery gives your set the power to interpret perfectly every note of music, every word of song and speech. The current it yields flows smoothly, silently; there is never any ripple in it never any hum. It is the one source of power that keeps radio reproduction pure, loud and clear always. Ask any radio dealer firmly for Lissen New Process Battery; there are 10,000 dealers to choose from.

MADE IN ENGLAND.

PRICES.

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120 volt .. 15/10
36 volt .. 4/6
60 volt (Super power) 13/6
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9 volt Grid Bias 1/6
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WORPLE ROAD, ISLEWORTH, MIDDLESEX.
Factories also at Richmond (Surrey) and Edmonton.
(*Managing Director*: T. N. COLE.)

IS YOUR SET STABLE?

Nothing is more annoying than trying to tune in a distant transmission on a set that is unstable. You almost get your desired reception and then—"plop" the set goes into oscillation, or into a howl. If you are troubled by this sort of thing you should carefully read this practical article.

By T. B. SANDERS.

IN the past year or so very great improvements have been made with regard to the performance of valves, and these improvements created a demand for better coupling to do justice to them.

No engineers responded more nobly in their efforts to satisfy this demand than the designers of L.F. transformers, with the result that the combination of a modern valve and a modern transformer provides a degree of distortionless amplification which, a very little while back, would have been regarded as impossible.

L.F. Instability

This, of course, is all to the good of the constructor, but trouble from L.F. instability has increased with the greater efficiency. The effects of this instability in a receiver is often so marked as to produce actual high-pitched howling and "motor-boating." Quite frequently, however, the effect merely shows itself as a form of distortion unaccompanied by actual howling.

Such instability is generally due to resistance in the source of H.T., either batteries or mains unit. If this resistance is common to the anodes of two or more valves it acts as a coupling device between the valves, in somewhat the same way as the resistance we use for coupling valves in an R.C. stage.

In modern receivers precautions are now usually taken to prevent L.F. instability by including in the design of the receiver devices which deflect the fluctuating currents away from the common H.T. resistance.

Positive Proof

These devices have proved to be so successful that it has become very much the "fashion" for the "friend who knows a good bit about wireless" to ascribe distortion and general bad behaviour in an older type of set to L.F. instability, and to be rather free with advice about the use of wire-wound resistances and large fixed condensers, which he asserts are a positive cure for all types of poor reproduction.

Positive proof as to whether or not distortion is caused by low-frequency reaction due to battery resistance would, therefore, be very welcome.

This can very easily be done with quite simple apparatus. All that is required is a variable resistance of some 400 or 500 ohms. An ordinary potentiometer will do, the slider terminal and one of the other terminals being employed.

If the suspected receiver has only one positive H.T. lead, this resistance should be inserted in series with it, and the value of the resistance gradually increased while receiving a strong signal from the local.

If the distortion in the receiver *is* being caused by resistance in the H.T. supply source it is obvious that an increase of resistance in the common H.T. lead will produce an increase of distortion. In fact, there will be very little doubt about it, since if the set is giving bad reproduction because it is on the verge of L.F. oscillation, as soon as a little extra resistance is added the set will begin to howl.

Stopping the Trouble

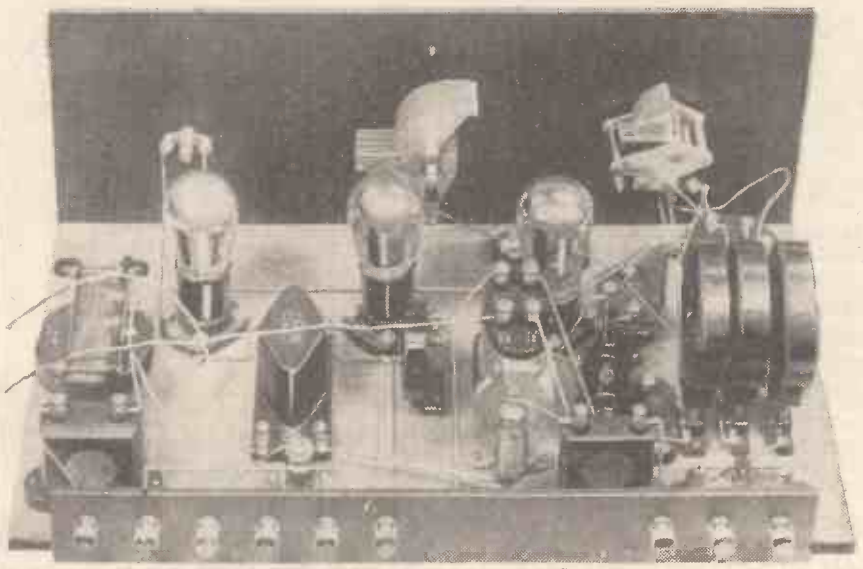
If this occurs, all doubts as to the cause of the distortion will be removed and a cure can be effected by feeding the detector valve and possibly one of the L.F. valves through a resistance of not less than 20,000 ohms, the plate side of which is connected to earth via a condenser of about 2 mfds.

On the other hand, if the value of the resistance which has been artificially introduced into the positive H.T. lead can be increased to its maximum without either extra distortion or actual howling, it can be safely concluded that L.F. instability is not present.

That being so, little benefit is likely to follow the indiscriminate use of anode resistances and condensers.

Where the L.F. stages are fed by more than one H.T. positive lead the artificial resistance should be inserted in each lead in turn.

STOP THAT HOWLING!



A three-valve transformer-coupled receiver which incorporates special "anti-howl" devices so that completely stable results can be obtained.

WHAT OF THE PRAGUE PLAN?

From a Special Correspondent

Here is a trenchant article on the present wave-length situation in Europe. Every listener to the Continental stations will find it of absorbing interest, for our correspondent hits out forcibly and freely, but we would remind readers that we do not necessarily associate ourselves with the views expressed by our contributors.

THE Prague Plan for the allocation of wave-lengths for the use of broadcasting on both the medium and upper bands came into being in June, 1929. It replaced the Brussels Scheme, which had itself succeeded the original Geneva Plan. Each of these schemes has been an attempt to put European broadcasting upon a thoroughly sound basis.

The difficulties are admittedly enormous, and they are increasing rather than decreasing. When the Geneva Plan came into operation on November 14th, 1926, there were far fewer European stations than there are now, though still too many for all those working upon wave-lengths between 250 and 550 metres to be fitted comfortably into the limits of the medium broadcast band. Hardly any country in those days would accept wave-lengths below 250 metres, so that the very bottom of the band was almost uninhabited except by a few small Swedish relays.

The Geneva Scheme

The basis of this scheme was a 10-kilocycle separation, for experiments had shown that this was just sufficient to prevent heterodynes, and that a receiving set of reasonable selectivity should then have no difficulty in bringing in stations clear of one another. The Geneva Plan was doomed to failure from the very outset.

In the first place, comparatively few countries subscribed to it; secondly, accurate wave-meters were not available for some considerable time; thirdly, the design of many transmitting plants was such that with the best will in the world they could not keep their wave-lengths constant; fourthly, quite a number of stations made no attempt whatever to fall in with the Plan. As soon as it started these delinquents began to wander up and down the scale from night to night in an endeavour to find a wave-length which would give freedom from interference in their own service areas, without any regard whatever for the interference that they might cause.

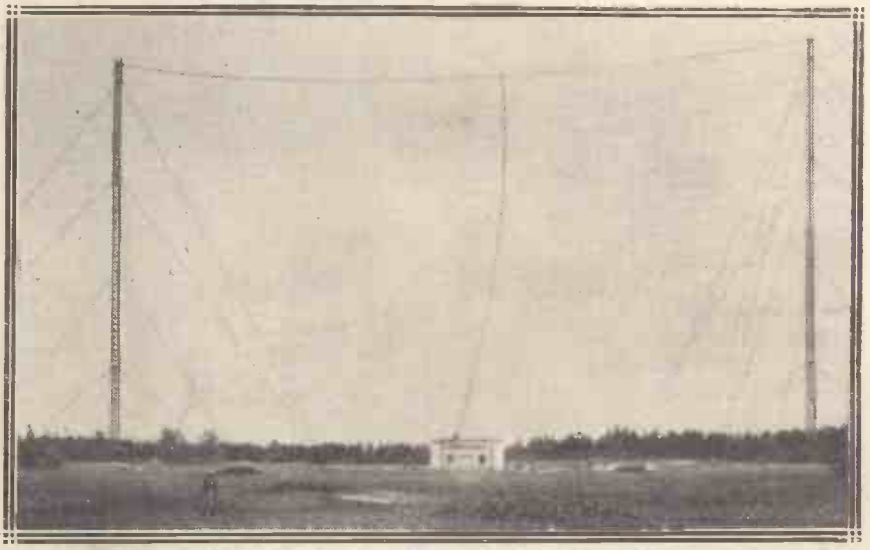
The Spanish stations were the worst offenders; in fact, there was probably hardly a station in Europe which was not at one time or another heterodyned by one of them! Some countries, such as Great Britain and Germany, tried to abide loyally by the provisions of the scheme.

"Squatting and Shouting"

They found that they were simply punishing themselves by so doing owing to the way in which some of the more powerful foreign stations behaved. Many of these obtained exclusive wave-lengths by "squatting and shouting!"

Here is an example of the kind of thing that happened. A station, which shall remain nameless, decided

WHERE THE WHISTLES COME FROM!



Those irritating continuous whistles which so often come in with continental stations are due to powerful broadcasters wandering off their correct wave-lengths and trespassing on those of other transmitters.

What of the Prague Plan?—*continued*

that it would like to have a certain wave-length between 300 and 400 metres. The wave-length selected was fairly close to that of a law-abiding station.

The squatter appeared one night in the "Naboth's vineyard" that he coveted. He heterodyned the law-abiding station and was heterodyned himself, but he was quite prepared for that!

A Battle Royal

Upon the next evening, with his transmitter running all out and over-modulating for all he was worth, the squatter played havoc with his rival. In self-defence, the law-abiding station appealed to the International Bureau at Geneva, and, having obtained no satisfaction there, took the only possible course of increasing or reducing its wave-length, as the case might be.

In a week or so the squatter was in full possession of the desired wave-length, and any rival that appeared later was promptly frightened away by a fresh use of the tactics already described.

Sometimes, of course, two or more squatters met in a battle royal, and for a space quite a considerable portion of the broadcast band was thrown into complete confusion. It became plain that the Geneva Plan could never work, since the number of stations whose transmissions were free from interference even in their own service areas became smaller and smaller.

Matters were made worse and worse as month by month the number of stations grew. Newcomers which had had no wave-length assigned to them under the scheme came into operation, and each had to elbow its way into the band by shouting and squatting. The only alternative was to go under. A new factor, too, was making its appearance.

Broadcasting Bullies

Four or five kilowatts had been the general maximum output rating of European stations. A few of the German stations were shown in the lists as having somewhat greater power, but these figures were probably misleading, being based upon input, which is a very different thing.

Since over-modulation of a moderately-powered station had a certain amount of success in enabling squatters to seize wave-lengths, it seemed reasonable to suppose that even greater success would attend new stations of much greater power. Even without over-modulating, the high-power station can drown interference over a pretty useful service area; hence numbers of countries decided to erect giant transmitters.

By the time that the Geneva Plan came to an end the position was a very curious one. A certain number of stations had obtained freedom from interference by sheer good luck; a greater number had got it by the forceful use of metaphorical elbows; a still greater number were being heterodyned out of existence both within their own service areas and outside them.

A Startling Plan

To meet the new conditions an entirely new system was clearly called for. The Brussels Plan was startlingly original in that it proposed nothing greater than a nine-kilocycle separation and that it grouped many of the smaller stations upon common wave-lengths. It was not long-lived, since again several countries refused to have anything to do with it.

Now, if it is important that everyone should carry out the provisions of an agreement based on a ten-kilocycle separation, it is fifty times as important that there should be no "outlaws" in a scheme which has a separation of only nine kilocycles. Preliminary experiments showed that good reception was possible from stations working as close together as this; the necessary wave-meters were available; and transmitters were far better able to keep their wave-lengths constant.

Meeting an Emergency

But the scheme did not work. Where there was one heterodyne prior to its coming there were ten after it had been in being for a short time.

Meantime more and more stations were appearing on the Continent of Europe; more and more were increasing their power. It was perfectly clear that unless something could be done and done quickly, not merely long-distance reception, but also the reception of home stations at a range of a few miles would very shortly become impossible.

To meet the emergency a devoted band settled down to devise an entirely new scheme. It was essential that all countries should subscribe to it, and at an historic meeting held at Prague it appeared that all were willing to do so and to carry out the provisions of it.

The Prague Conference went much farther than any previous conference had done, for it was attended not merely by the representatives of various broadcasting concerns. Its terms were agreed to and signed by the official representatives of practically every European Government.

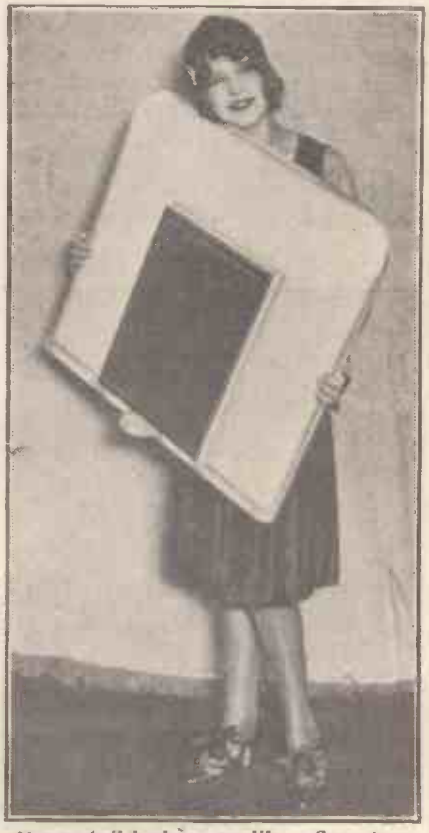
The New Scheme

The Plan came into operation on Sunday, June 30th, 1929. An enormous amount of care and labour had been expended in drawing up this wave-length scheme.

So far as was possible wave-length neighbours were geographically distant. Countries with stations upon or near sea coasts, and therefore

(*Continued on page 56.*)

A NEW NOTE



Although it looks more like a fire-place, the instrument this girl is holding is a new American loud speaker of really unusual design.

TIPS for TRANSMITTERS

Some interesting practical details of a new short-wave transmitter.

Designed and Described
by L. H. THOMAS (G6QB).

ABOUT a year ago, under the title of "The Fly-Power Transmitter," I described a low-power outfit with which quite a lot of useful work had been done. It looked more like a simple short-wave receiver than a transmitter, and had, in fact, been built along the lines of a receiver, since it was proposed to use it only with powers of the order of 1 watt or less. In my opinion, its simplicity and the lack of non-essentials was one of the main reasons for the successful results obtained.

Since that time various transmitters have been in use at this station, the normal "stand-by" transmitter being a low-power crystal-controlled outfit, which has been always ready for use in comparative tests while the "test" space on the bench has been occupied by other rigs of all shapes and sizes.

The "Fly-Power" Grows Up

Recently the idea was developed of constructing a transmitter for use with input powers up to 50 watts, and on lines as simple as humanly possible. The ultimate result of much experimenting on these lines was a transmitter occupying hardly any more space than the original "Fly-Power," and, while being quite suitable for inputs even as high as 60 watts, capable of giving abnormally good and consistent results with powers as low as one cared to employ.

The two photographs, while not really doing justice to the extreme simplicity of the arrangement, do give some idea of its straightforwardness.

The circuit employed is virtually the same as that of the "Fly-Power" arrangement: a straight tuned-plate, tuned-grid circuit. It is shown in Fig. 1, and the reader will realise from this how symmetrical and neat a layout it is possible to obtain when the circuit is used with the particular modifications shown. Really it is probably no more efficient than any other transmitting circuit, but I have used it now for about four years and am a firm believer in the principle that "the circuit you know is better than the circuit you don't"!

Simplicity

Naturally, a certain amount of external apparatus is necessary in conjunction with the transmitter, such as a filament voltmeter and a plate milliammeter, but it is thought better to include these with the power supply than to complicate the transmitter itself by their inclusion. Thus if the wiring of the transmitter is traced out in the photograph, which shows it without the valve in position, it will be seen that it corresponds almost exactly to the theoretical circuit in the layout adopted. The grid leak, by the way, is a Climax potential divider, and is mounted under the baseboard.

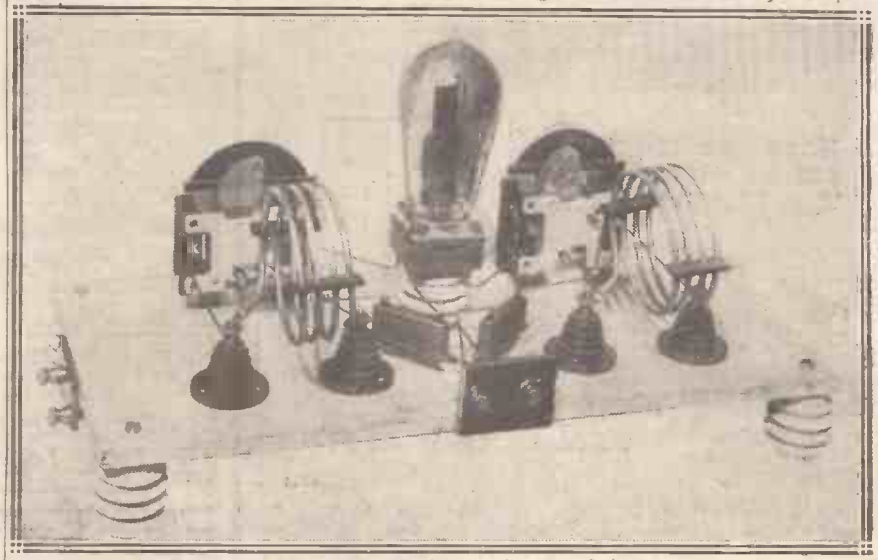
Naturally, with a transmitter employing fairly high powers, the currents flowing in the tuned circuits (the anode circuit in particular) will reach very high values, and it is therefore essential to keep the resistance of the circuits down to the very lowest possible figure. The coils must be wound with heavy wire and, above all, the connections between the coils and their associated condensers must be good.

In this case the coils are of No. 6 copper, silver-plated, and two very small ebonite spacers are used to prevent "concertina" action of the coils under vibration. They are mounted on small "stand-off" insulators by means of copper lugs soldered on to their ends, and heavy wire connections are made from the tops of the insulators to the variable condensers.

Trouble with Ebonite

The latter are standard receiving condensers of a type with reasonably low losses, the vanes being double-spaced to eliminate the risk of sparking across, and also placed in pairs to give the effect of vanes of double thickness. Altogether these "doctored" condensers are very satisfactory.

They are mounted on two separate small panels, chiefly because of an unpleasant experience of mine some time ago, when an ebonite panel was



The simple 50-watt transmitter described in this article.

Tips for Transmitters—*continued*

found to have "gone bad" through constant exposure to strong sunlight, and about 500 volts of D.C. was leaking profusely over a surface of nearly five inches! Naturally, one set of moving plates is connected to positive H.T. and the other to negative L.T. (through the grid leak). With both sets of moving vanes connected to the low-potential points in this way there are no troublesome hand-capacity effects when adjusting.

The valve ordinarily used is an Osram D.E.T.1, with an anode voltage of about 550 volts, derived from full-wave rectified A.C. The rectifiers are two B.T.H. R.H.1 valves, and smoothing is achieved entirely by a large bank of condensers, the total capacity being about 14 mfd.

Coil Details

No chokes are necessary to give a pure D.C. wave with a transmitter of this type carefully operated, and chokes designed to carry high currents, such as would be necessary in this case, and also to have a high enough inductance to be of any value for smoothing, are rather expensive and bulky, and too frequently of so high a D.C. resistance that a considerable voltage drop results.

It will be seen that the valve itself, and also the baseboard, are mounted on "stand-off" insulators. These form a cheap and convenient method of support and certainly enhance the appearance.

With the 4-turn coils in use the 20-metre amateur band is covered easily by the condensers, which have a capacity of about ·00008 mfd. The size of coil was chosen so that the condensers would be nearly set at their maximum capacity in order to work on the usual wave-length.

For the 40-metre band two 9-turn coils are used. A better note and a more stable signal altogether result from using coils that are on the small side, rather than attempting to use large inductance and small capacity.

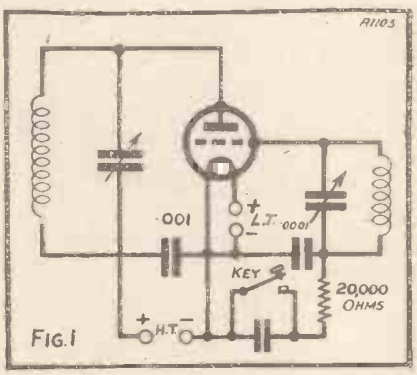
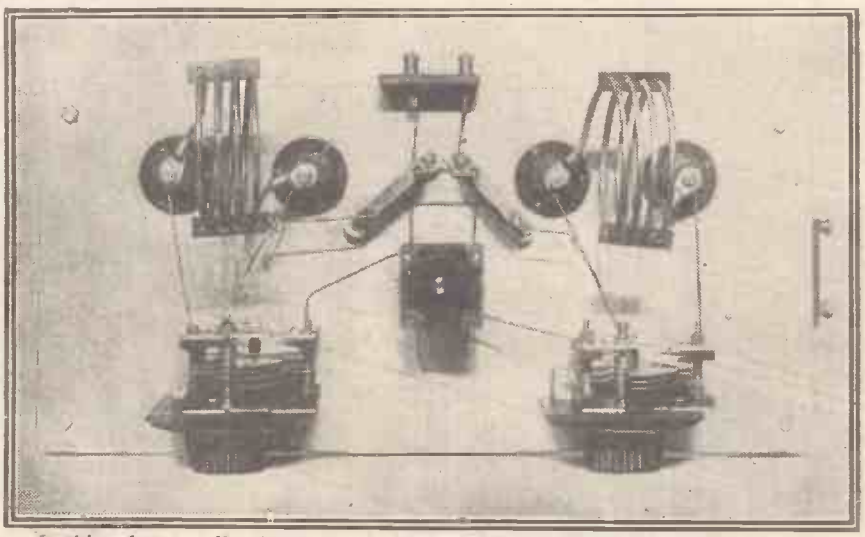


FIG. 1

Keying, it will be seen from the circuit diagram, is effected in the grid-leak circuit. If the key is shunted with a suitable size of condenser (the size must be determined experimentally to suit the particular set of conditions under which the transmitter is operating) there is no chirp and no "grid howl" or "grid tick." For very high powers this method would probably be of little value.


Looking down on the simple layout employed in the transmitter discussed here.

Results Given

The results obtained with this transmitter have been particularly good, possibly because an unusually efficient aerial system appears to have been found. It consists of a Hertz-type aerial, one wave-length long (for 20 metres, and half-wave for 40 metres), fed right at the *end*. No feeders whatever are used, the total length of the aerial from the far end to the anode coil itself being 21·2 metres (about 65 feet). The end is tapped on the anode coil 1½ turns up from the low-potential end, after the transmitter has been adjusted to resonance on the correct wave-length.

Antipodes Worked

In resonance without the aerial the input is of the order of 4 m.a. at 500 volts. Clipping on the aerial (provided that it is of exactly the right length) effects no change in wave-length, but merely increases the plate current from 4 m.a. to anything up to 50 m.a., according to the point at which it is tapped on. It takes a considerable amount of time and patience to get the aerial cut to exactly the right length, but one is apparently well rewarded.

With a 3-watt input, signals have been reported R.5 in Australia and R.6 in three parts of the United States. With the more usual 10-watt input all continents have been worked successfully, the best reports always being received from the Pacific Coast of America and from South America. Some thirty stations in the Antipodes have been worked and another twenty or so have reported reception of signals.

Ultra-Short Waves

Most of the work has been carried out on the 20-metre band, but quite consistent results have always been obtained on 40 metres, which will probably be used throughout the summer for European work when the really long-distance signals have faded out on the shorter wave-length.

For work on the "ultra-short" waves of 10 and 5 metres the same circuit is quite suitable without modification. Two-turn coils are required for the former band and one, or one and a half, for the latter.

It is not safe, however, to use more than about 10 watts with the valve mentioned on these wave-lengths, as loss of emission and cracking at the "pinch" often results.

There seems to be no limit to the wave-length range of a transmitter of this type, since it also works quite well on the 150-metre band!

Our News Bulletin

Big Broadcasting Business

THE National Broadcasting Company of America seems to be doing good business, for last year it received a revenue of £3,000,000 from 199 advertisers who used the broadcasting facilities of the company to advertise their goods.

The President's Speeches

It is also interesting to note that President Hoover broadcast speeches thirteen times over the company's system, his speeches being relayed all over the United States. The company now has in operation 73 relay stations, with 32,500 miles of leased telephone wires.

Propaganda Programmes

Have any of our readers heard anything of the mysterious broadcasting station which has been interfering lately with Riga? The mystery has now been solved, and it is found that the station was that of a Soviet broadcaster near the Latvian frontier. (It was probably Minsk or Smolensk.) This station has been broadcasting Communist propaganda, and the Latvian authorities have started investigations.

Microphone "Puffs"

Incidentally, it is worth noting that the broadcasting station at Moscow sends out propaganda lectures in German twice a week, puffing the advantages of the Soviet system of government.

A Television Fusion

It is announced by the Baird International Television Company and the Baird Television Development Company that they have agreed upon a scheme of amalgamation. Our readers will remember that the Baird International Television Company was formed in 1928 to acquire rights and interests in the Baird inventions and patents, including shares in Baird Television Development.

The issued capital comprised £262,500 in "A" shares of 5s. each, and £350,000 in "B" shares, also of 5s. each.

Alpine Regionals

It is understood that Switzerland is to have a regional broadcasting system somewhat on the lines of the B.B.C.'s system. There will probably be three high-power stations, and some smaller relay stations near the principal towns. The most powerful of the new stations will have 60 kilowatts, and has already been ordered from Marconi's. It will be erected at Munster, which is about twelve miles north-west of Lucerne.

Still More Licences

The estimates of revenue departments for last year have been published, and show increases in salaries and wages of £1,166,455. An interesting feature of the Post Office estimates is that the grant to the B.B.C. is put

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OUR NEWS BULLETIN

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down at £1,060,000, representing an increase of £97,000.

So the B.B.C. will have a little more money to play with again this year, and can, incidentally, answer its adverse critics by showing that it has secured another big extension in the number of wireless licences.

How the Dutch Do It

The Postmaster-General recently stated in the House of Commons that he was having an inquiry made into the advisability of a plan now in operation in Holland for utilising the telephone system for the reception of broadcasts.

According to the Postmaster-General, experts in this country have hitherto considered that the disadvantages would outweigh the advantages. Nevertheless, we understand that recent developments in Holland have made further inquiries desirable, and that something may come of the system yet.

Russian Radio

According to the "Daily Worker," the following Russian stations should be received at loud-speaker strength under good conditions, employing a receiver with at least one stage of high-frequency:

Station	*Wave-length*	*Power*
Moscow	938 metres	50 kw.
Leningrad	1,000 ,,	20 ,,
Moscow Popoff	1,103 ,,	40 ,,
Kharkov	1,304 ,,	25 ,,
Moscow Komintern	1,481 ,,	40 ,,

Three times a week, at the end of the evening programmes, either Popoff or Kharkov transmits pictures by a new Russian system.

Three More Stations

It is also understood that three new high-power stations, probably of 100 kw. each, are being erected at Kolpino (near Leningrad), Bogordsk (near Moscow), and Novosibirsk (in Western Siberia.

Good-Bye B.B.C.?

The article in the "Daily Worker," from which we have quoted above, must be thanked for giving this interesting information, and we cannot help quoting the concluding paragraph:

"We workers who are interested in radio must realise the immense value due to Russia from the educational and propaganda viewpoints. Hasten the day when our B.B.C. is smashed, along with capitalism, and radio control passes into the hands of the British workers."

Attaboy! Sir John Reith must be trembling!

The New Chairman

Rumours are now current that Lord Lee of Fareham will succeed the Earl of Clarendon as Chairman of the B.B.C. Anyhow, this is the view put forward by the "Daily Chronicle."

As a matter of fact, the position with regard to the successor of Lord Clarendon is still very obscure, but

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OUR NEWS BULLETIN

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from information we have acquired it seems that in well-informed circles it is considered that Mrs. Philip Snowden or Sir John Reith are the people who stand the best chance of succeeding Lord Clarendon.

The A.C. Power Unit

By the way, with reference to the A.C. power unit described on page 307 of the March issue, in the list of components Climax Autobat transformer type H.L.G.1 should have been "type H.L.G.4."

Also, Westinghouse metal rectifier type H.L.4 should read "type H.T.4."

Marconi's Latest

Marquis Marconi's experiments, carried out on board his yacht, the "Elettra," when he tested his new system of transmitting sufficient energy to operate relays at a distance which would, in turn, operate switches controlling electric light supplies, have been curiously misunderstood by certain sections of the press. Some of the newspapers seem to have the idea that Marconi has devised a method of sending sufficient energy by radio actually to light the lamps with that energy. This, of course, is all wrong.

Radio Power

The operation of relays by radio signals is well known experimentally, but it has never been regarded as a very practical proposition. Marconi, however, seems to have discovered a new method and, according to the Marquis Solari, it will be possible not only to light and switch off all the lights of a city, but to stop and restart trams, railways, trains, etc., by radio.

Some Paris Changes

Changes are likely at Radio Paris, Poste Parisien and the P T T station in France. Radio Paris is probably the best-known among listeners in this country, and a new transmitter may be set up near Moulin de Bicherel, about twenty miles from the city. The power will be raised to 60 kw. instead of the present power of 12 kw.

Poste Parisien, which is well known on 329 metres, may also be moved, to about fifteen miles outside Paris.

Radio Newcomers

Listeners can now hear broadcasts from Almeria, Spain, on 251 metres. Picture transmissions can be picked up on 1,200 metres from the Belin private station just outside Paris; the call-sign is F 8 B O.

A new 10-kw. transmitter situated near Helsingfors, can be now heard testing on 221·4 metres.

Relay From Downing Street.

Our readers will hear an interesting broadcast on April 27th, when the B.B.C. will relay from Mrs. Snowden's drawing-room at 11, Downing Street a reception which she is giving in honour of the artistes engaged for the Royal Opera House season at Covent Garden.

By the way, we understand that the B.B.C. has made definite arrangements for broadcasting some of these operas this year.

New Empire Station?

There is a rumour going about that discussions are taking place at the Colonial Office concerning a new Empire broadcasting station. As we have said before, this is a matter entirely for the Governments of the Dominions and Colonies, in consultation with our own Government, and we hope that whatever scheme is proposed nothing will be done which will mean any further absorption of the licence fees paid by listeners in this country.

THE BAIRD TELEVISOR

—continued from page 4

experimenters and constructors to go very carefully into the question of buying a televisor. If they feel they have the money to spend—we estimate a complete outfit to cost between fifty and sixty guineas, including, of course, the necessary amplifying apparatus—and if they can provide 400 or so volts high-tension, we feel that the money would be well invested, and that a series of extremely interesting experiments could no doubt be carried out, probably with very far-reaching results.

New Discovery Wanted

But the main consideration about the televisor is its potential value in the home of the ordinary listener, and whether the B.B.C. will be justified in continuing to grant the Baird Company facilities for two wavelengths for regular television and speech transmission.

Quite frankly, we have come to the conclusion that such a broadcast television service will not prove popular at the present stage of development of television. We consider that television is in a state of development similar to that of wireless some thirty-five years ago, i.e. from the utility point of view, and we still feel that possibly the only thing which will put television on its feet as a legitimate companion for broadcasting is a new discovery similar in importance to the Fleming valve.

At present, from the entertainment point of view, results are distinctly crude; but as we have pointed out, from the laboratory point of view, interesting. As for seeing a boat race, a football match, or any other such event by television, readers can dismiss the possibility from their minds at once.

Powerful Apparatus Wanted

In short, apart from the extreme interest of the televisor from the experimental point of view, we cannot see that it has at the moment any general appeal to the public. Technically, it requires apparatus which only a technician should handle. The grade of amplifier required, to begin with, is very much out of the ordinary, for the output valve should be capable of handling at least ten times the power of the type usually utilised in ordinary wireless receivers.

Furthermore, the very high H.T. necessary is another point which will weigh to the disadvantage of television in the home.

It has been pointed out that television is just out of the egg, that its mouth is wide open for sustenance, both financial and mental. But we emphatically agree with the critic who said that the way to help it to grow its wings is not to attempt to sell it all unfledged to the man-in-the-street.

First-Class Pioneer Work

We feel we cannot do any better than quote from an article on one of these televisors written by Captain Robinson, the well-known experimenter (G-5 Y M), who recently expressed his views in the "Observer."

"It is easy to moralise on the unwisdom," wrote Captain Robinson, "of allowing dividend-seeking finance to be associated with the early days of scientific research. It is easy to say that children and fools should not be shown unfinished work. In this case (i.e. television) the thing has been done.

"The ultimate triumph and general availability of television will not be affected by the public apathy; but it is a pity that Mr. Baird's work could not have been backed up by some organisation less concerned with immediate returns. We should have expected less at the present, and might have had more."

We feel that the above remarks succinctly sum up the average expert's opinion of television to-day. We feel, as we have always felt, that Mr. Baird has done first-class experimental pioneer work in devising his system of television; we feel that the first televisor he has put on the market is, from the laboratory point of view, a credit to all concerned with its production; we feel that the results which can be achieved with this televisor are, from the technical point of view, meritorious and of considerable interest.

But we feel definitely that television in its present state is quite unworthy of the attention of the ordinary home listener.

THE 1930 "STRAIGHT-LINE" FOUR

—continued from page 11

wire is used, as vibration will sometimes cause the insulation to be chafed through.

A single length of Systoflex tubing of a size sufficient to slip over your wire can be obtained from the dealer from whom you obtain the parts for the set.

After the various parts are wired up, connect the battery cords as shown. You will be able to identify the leads very easily as they are distinctively coloured, and the colours at the free ends will, of course, correspond with those at the wander-plug end, each plug being distinctly marked.

After all the leads are in position, check up all the wiring carefully. In the case of those wires which make direct contact with the screens, this contact is best established by placing 4 B.A. or 6 B.A. metal screws through holes in the screens, locking them in position, after soldering lugs have been slipped under the screws on each side of the screen. You may not be able to solder to aluminium, but you can easily do so to the soldering lugs.

Adjusting the Bias

As previously stated, provision is made in each screened-grid stage for the use of grid bias. In most cases 1½ volts negative will suit, but some screened-grid valves will stand more than this without loss of efficiency, and with corresponding reduction in the high-tension current consumption.

When the set is run from the mains unit, and economy of high-tension consumption is not a matter of great moment, these cells can be dispensed with and excellent results still obtained. When, however, the receiver is to be run from H.T. batteries, a very distinct economy is brought about by the use of these cells.

Put 1½ volts therefore on each of the first two stages, and for grid bias on the detector begin by placing G.B.—1 in the positive socket of the main grid-bias battery. Put the G.B.+ in 1½ negative and G.B.—2 into a negative socket giving a value recommended by the makers of the output valve you use, according to the high-tension voltage in use.

The figure on the grid-bias battery will give you a reading of 1½ volts less than the marking, due to the abstraction of 1½ volts in order to give the necessary positive bias to the detector.

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THE 1930 "STRAIGHT-LINE" FOUR

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For L.T. you can use two, four, or six volts, according to the valves you choose, and for high tension 70 or 80 volts on H.T. + 1, 120 to 150 volts on H.T. + 2, and the highest value you have for H.T. + 3. This will, of course, depend on your supply and the particular output valve.

Choosing Valves

With regard to the choice of valves, where filament current economy is requisite use the 2-volt type, but if you do not mind the larger low-tension battery I would recommend either 4- or 6-volt valves, preferably the latter. The first two, of course, will be of the screened-grid type of standard make, the detector valve can be either an H. or H.L. type, or what is called by some makers the R.C. type, while for the output valve wherever possible use a super-power valve.

Wonderful results can be obtained with a valve of the P.625 type with 150 to 200 volts on the plate, with considerable bias, but excellent results are also obtained with 120 volts as the maximum using super-power valves of the 256 type. Many readers will already have valves they desire to use, and it is very satisfactory to know that all the leading makes of 2-, 4-, or 6-volt valves will work very satisfactorily with this set.

Before commencing to listen, turn to the reaction condenser and place it as far as it will go in an anti-clockwise direction and the volume control full on (as far as it will go in a clockwise direction). For the lower wave-band the wave-change switches should all three be pulled out, and for the long wave-band all three pushed in.

Tuning-In

The thumb of the right hand can be used to operate the two middle condensers simultaneously, while that of the left hand will operate the first condenser. By keeping all three in step you will soon pick up several stations, and a little fine adjustment of all three will bring them in at maximum strength.

Only occasionally will you desire to use reaction, when a little extra selectivity is required. If you have a particularly long aerial you may need to insert a fixed condenser of ·0002 or ·0003 mfd. in the aerial lead.

If on any station strength is too great for comfort, reduce it by turning the volume control in an anti-clockwise direction until the volume is brought down to the level desired.

This will not in any way alter the tuning, and, as previously explained, when used in conjunction with the reaction control enables good results to be obtained very close to a powerful local transmission.

Very Sensitive

The set is so sensitive that it will work on a very small indoor aerial, and even a dozen feet of wire will bring in some twenty stations or more on a good evening. Daylight reception, too—usually so bad—has a new fascination, for on the long-wave adjustment a wide choice of daylight programmes will be found, while on the short waves several Continentals can also be heard.

After dark additional stations will roll in with a volume and purity which will astonish you, giving a number of genuine alternative programmes with a quality strictly comparable with that we generally associate only with the local.

With so many stations to be heard I would strongly recommend you to make up two calibration charts. These are made by taking two large sheets of squared paper, marking on one side vertically condenser degrees from 0 to 100, while on the horizontal line wave-lengths can be marked from, say, 200 to 600 on on chart and 1,000 to 2,000 on the other.

A Handy Chart

You will not find it necessary to record all three settings for each station, and it will be convenient to mark only the second dial readings. Whenever you pick up a station note the second drum reading and mark it on your chart, and before long you will find that a number of stations fall on a straight line.

By ruling a line through them you can predict the positions for others you have not yet heard, but which with the tuning chart will be quite easily found. Subsequently, when you want to find a station, set the middle condenser first to the marking indicated by the chart, and adjust the others round about the same figure until the station can be heard.

This is better than recording the readings for the first dial, which is somewhat influenced by the aerial, or the third, which is apt to be slightly altered by the amount of reaction employed.

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THE 1930 "STRAIGHT-LINE" FOUR

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The 1930 "Straight-Line" Four will thus be found to provide a receiver of the highest grade and sensitivity, giving a reception which will appeal to the most fastidious when used on the local station, but providing in addition a wealth of alternative foreign programmes when desired.

Many readers no doubt will like to fit this set to the more elaborate type of cabinet such as have provision for batteries and loud speaker in the base, and indeed I have done this myself. Where economy must rule, the ordinary standard "American type" cabinet will be found quite satisfactory.

One final word—use a good loud speaker with this set, a moving coil if you have it, for it deserves a good speaker and only such can do it true justice.

THE L.S.D. OF S.G.'s

—continued from page 20

I have found that a reduction of grid bias, if you happen to be employing this, is sometimes beneficial, but as a rule the adjustment is not at all critical. You could try the scheme with the 1930 "Straight-Line" Four if you provide a separate H.T. tapping for the detector—as described, the detector H.T. also goes to the anodes of the S.G. valves.

Cheap to Run

I have come across one or two valves, just individual valves and not any particular types, that do not work well with this scheme, but the majority of S.G. valves seem to work perfectly satisfactorily with this inverted voltage method. It is *advisable* to have a separate H.T. tapping for each anode, and a separate H.T. tapping for each screening grid voltage, but in my own set at home I am using the scheme with a common H.T. for both anodes and a common lead for the screening grids, the results being perfectly satisfactory.

The beauty of the method is not in any particularly wonderful amplification results, but rather in the purity which can be obtained.

Also in the economy of running in H.T. wattage, for about 36 volts maximum is usually all you require, with a total current per valve of about

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THE L.S.D. OF S.G.'s

—continued from page 55

1·4 milliamps, which is somewhat different from the 120-volt battery with about 3 to 5 or even more milliamps consumption.

This means you can use a screened-grid valve with a small set, using only a 60-volt H.T. battery. Many constructors doubtless would like to use H.F. amplification, and screened-grid valves at that, if only they had not to increase their H.T. to 120 volts; 120-volt H.T. batteries are not a cheap proposition, a 60-volt battery (especially of the smaller type) can be purchased for a few shillings.

If you try this method of using a screened-grid valve you will find that you can usually employ cheap batteries with really good effect, and I should be glad if readers would write to me and let me know how they get on.

They may or may not notice a falling off in amplification, dependent upon the particular valves used. If they notice a falling off it will not be very great if the valves are working properly. They will not get *more* amplification, but they *will* get a silence of background (which is a great advantage) and an economy of running which is obviously very welcome.

Incidentally, they will also probably find that the selectivity of the receiver has increased, enabling them to listen to distant stations with much more pleasant results than before.

WHAT OF THE PRAGUE PLAN?

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likely to suffer from spark interference, were assigned wave-lengths as far as possible from the 300- and 450-metre wave-lengths used for shipping and coastal work. The group partners of common wave-lengths were very carefully chosen, and some countries, such as our own, made a very real attempt to ensure success of good working by installing elaborate and costly control devices in their transmitting plants.

To the joy of all, the International Laboratory at Brussels was appointed to be a kind of policeman of the ether, The Laboratory was empowered to measure the wave-lengths of as many European stations as possible on every evening and to report to the International Bureau any that showed deviations of more than a few hundred cycles.

Those Mystery Stations

Under the scheme such offenders were to be reported by the Bureau to their Governments, who were bound to take immediate steps to prevent a recurrence of the trouble.

There is no question that had those who signed the Prague agreement carried out the provisions wholeheartedly, not only in the letter but also in the spirit, the Plan would have been, if not a complete success, at all events something very like it. Unfortunately there have been far too many ifs and buts.

One of the most disquieting features of the monthly reports from Brussels is the number of mystery stations which appear. In a recent report more than a dozen stations which were shown to have been working regularly proved to be unidentifiable.

The one thing certain is that they were *not* the stations to whom the wave-lengths that they used were assigned. And besides these "regulars," on almost any night of the week there is a considerable crop of nameless stations butting in upon the medium wave-band.

The present position, then, seems to be that Germany, Austria, Poland, Czecho-Slovakia and Great Britain are about the only countries which are making any serious attempt to abide by the agreement. It was understood when the Prague Plan was signed by official representatives that the Governments of the countries concerned would take drastic steps to prevent wave-length wandering.

Nothing, however, will be accomplished until Governments are ready to do their bit by punishing stations which transgress. So long as wave-length wandering can be indulged in with impunity stations will change their wave-lengths as they list, no matter how widespread may be the interference that they bring about in the process.

It is proposed now to limit the output of stations to a maximum of 100 kilowatts.

The main object of every European station will therefore probably be to increase its rating to 100 kilowatts.

A "Shouting" Match

At the root of the whole matter really lies the desire for every country to have something more than the minimum number of stations that will provide an effective broadcast service. Paris, for example, can scarcely need the Eiffel Tower, Radio-Paris, the Petit Parisien, Paris P T T, Radio L L and Radio Vitus. But she will probably continue to use those six stations, just because she now has them and cannot bring herself to reduce the number.

Sweden could probably do with considerably fewer stations. Germany might close down one or two without feeling the loss, and, to come nearer home, we might ourselves at a pinch sacrifice one of our exclusive wave-lengths. Unless the principle of give-and-take replaces that of grab and shout I am afraid that European broadcasting will provide some very difficult problems in the next few years.

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