ANTHONY ASQUITH ON BROADCASTING FILMS

MODERN WIRELESS

1/- MONTHLY

Edited by
NORMAN EDWARDS

Vol. XI. No. 26. FEBRUARY, 1929.

The "TRANSPORTABLE" FOUR

The IDEAL SELF-CONTAINED SET

Full Details Inside!

SPECIAL CONTENTS

ENDURANCE

In a recent Cape to Cairo and London car endurance test Mullard Valves were unhesitatingly chosen for the radio installation in the car.

A seven months' journey — over mountains, through rivers, across some of the roughest country in the world—and not a single valve breakage or replacement during the whole journey.

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Use Mullard Valves in your receiver. Use them for reliability, for strength, for tone, volume and distance.

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THE · MASTER · VALVE

CONTENTS

VOL. XI. No. 26. MODERN WIRELESS. FEBRUARY, 1929.

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

Edited by NORMAN EDWARDS.

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

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

MODERN WIRELESS

Vol. XI. No. 26. February, 1929.

Sets in this Issue—The B.B.C. Publications—"The Listener"—Cost of Programmes—The "Ideas Department."

By The EDITOR.

Four New Sets

THE four sets which we describe in this February issue of MODERN WIRELESS have been selected from over a dozen receivers which the Research Department has been experimenting with for some time past. The "M.W." "Transportable" Four has been designed by the Research and Construction Deapartment with a view to producing a completely self-contained receiver which can be moved from room to room with the minimum of difficulty.

The "M.W." "Transportable" Four will bring in many programmes, and the home-made loud speaker will be found to be extremely efficient. We should like to point out that a striking feature of this set is that it has one-dial tuning, although there are no ganged condensers or other complications. It is a remarkably simple and inexpensive set and we feel sure that it is undoubtedly one of the most practical portables ever designed.

The "Neutro-Screen" Three is a powerful set specially designed for short-wave work. It employs a neutralised screened-grid valve, giving maximum stability and amplification. This receiver has been specially designed and described by our well-known contributor, Mr. C. P. Allinson, A.M.I.E.E.

The "Instanto" Two incorporates two simple switches with which you may turn from any one to any other of three stations without referring to the tuning controls of this efficient little alternative-programme receiver. It is an easy and cheap-to-build set, and the simplicity of its operation needs no stressing. It has been designed and described by Mr. L. H. Thomas.

The "M.W." Tapped Crystal Set is another production of the Research Department. Its outstanding features are high selectivity and a gain in volume instead of the more usual loss in sensitivity.

The B.B.C. Publications

As the result of a suggestion from Lord Crawfurd's Committee in 1925, inquiries into the possibilities of broadcasting in relation to Adult Education were recently carried out under the joint auspices of the British Institution of Adult Education and the B.B.C. In the report of the deliberations and findings of the Committee, it was recommended that the B.B.C. should publish a weekly journal, both supplementary and complementary to its talks and educational broadcasts. This recommendation of the Committee has been acted on by the B.B.C., with the result that announcements were recently made concerning "The Listener."

The first issue was published on January 16th. Although it was stated by the B.B.C. that "The Listener" concerned itself almost entirely with personalities, subjects and matter associated with the microphone, and that it would not be in competition with other weekly journals, and that, further, it would make broadcast talks more effective, inasmuch as it would tend to strengthen and widen the market of the printed word, a considerable amount of opposition has been created.

"The Listener"

ALTHOUGH it is quite true that under the terms of the B.B.C.'s charter there is nothing to restrict its publishing activities, it is undoubtedly unfair that the B.B.C. should further supplement its activities by the production of this journal. It must be remembered that the B.B.C. is a Government department and, on moral grounds, it is unwise that such a journal should be published, in view of its official "origin."

Furthermore, it has been alleged that the B.B.C. pays no Income Tax, and its primary object in life should be to provide broadcasting entertainment. Criticism has already been levelled at the B.B.C.'s efforts to take upon itself the task of educating the public, and it is not surprising that all those vested interests connected with publishing and printing should have condemned, in no uncertain words, a state of affairs which allows the B.B.C. to produce these publications *ad libitum*.

As a result of the deputation which conferred with the Prime Minister, the B.B.C. has agreed not to publish any more journals, and, furthermore, to restrict "The Listener" in certain definite ways. The improvement of actual broadcast programmes, rather than the production of journals which are outside their legitimate scope of activities, will now, it is hoped, occupy the B.B.C.'s attention.

* * *

THE "Daily Mail" has been taking a close interest in B.B.C. finance, and although certain facts which the public were not aware of before have come to light, a good deal of the full story has not yet been told—until our readers turn to the article in this issue entitled "B.B.C. Finance," which is based upon the statements of a most reliable authority.

The "Daily Mail," however, points out that the Chairman of the B.B.C., the Earl of Clarendon, receives a salary of £3,000 a year; Lord Gainford, as Vice-Chairman,

(*Continued on page* 223.)

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

By W. L. S.

WE short-wave enthusiasts have by now, I suppose, just had sufficient time to form some opinion of what the "1929 conditions" are to be like, and how they will affect us. The short-wave enthusiasts who simply listen to broadcast (and these are probably in the majority) will have noted that their lot appears to have been altered in no way whatever. The same stations come and go, and—at the time of writing, at all events—no radical changes appear to have been made at all.

With the "DX-hound," who has to depend chiefly upon amateur transmissions for his excitement, things are vastly different. Practically all the amateur stations in the world have blossomed forth into new call-signs, the A.R.R.L. system of "intermediates" having been scrapped and the old "de" brought back into use again.

Fair Play Wanted

One point is annoying me very much. As an amateur transmitter myself, I may be accused of speaking from selfish motives; such, however, is not the case. I remember that when the new amateur bands were decided upon at Washington in 1927, certain gentlemen spoke half-apologetically to the effect that the bands were *narrow*, but they were to be *exclusive*. We were, therefore, looking forward to a reasonably clear field free from the attentions of high-powered commercial stations.

Have we got it? No, by no means! We have got the narrow bands, surely enough, but up to the present they are infested with commercial stations turning out signals that would lose any amateur his licence on the spot. Organised protests are to be made, and it is to be hoped, simply for the sake of fair play, that these will result in some benefit.

For the benefit of the DX listeners, I am giving a list of the new prefixes which are already in use. These become actually part of the call-sign, and must be sent every time the call-sign is sent. Doubtless others will be in use by the time these notes appear, but these are at present either actually in use or officially sanctioned:

The New Prefixes

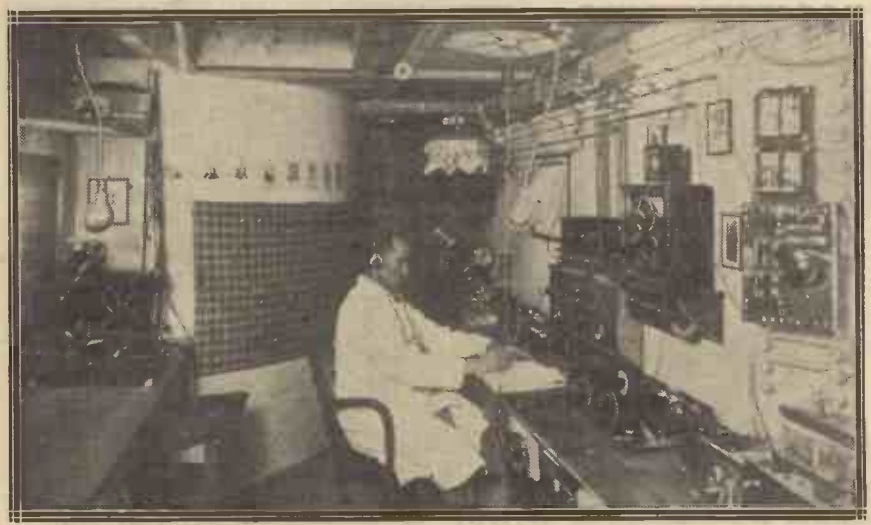
C M, Cuba. C N, Morocco. C P, Bolivia. C R, Azores. C S, Portugal. C V, Roumania. C Z, Monaco. D, Germany. E A, Spain. E I, Irish Free State. E S, Esthonia. F, France. G, Great Britain. H A, Hungary. H B, Switzerland. I, Italy. J, Japan. K, U.S.A. (outlying possessions). O H, Finland. O K, Czecho-Slovakia. O Z, Denmark. P Y, Brazil. R Y, Lithuania. S M, Sweden. S P, Poland. S U, Egypt. T F, Iceland. U L, Luxemburg. U O, Austria. V E, Canada. V O, Newfoundland. W, U.S.A. Y I, Iraq. Y L, Latvia. Z L, New Zealand. Z S, Union of South Africa.

In addition to the changes in the prefix letters, the form of call-sign has been altered also. Thus Danish stations have been changed from E D-7 C G to O Z 4 C, while the old South African station F O-A 3 Y now becomes Z S 6 D. In the Irish Free State, G W-18 B has become E I 8 B, while G W-17 C has become E 17 C.

That Threshold Howl

I have recently been experimenting with all kinds of anti-motor-boating devices, and have been delighted to find that, with one exception, every case of threshold howl that I have struck has been cured simply by an anti-motor-boating scheme in series with the H.T. lead to the detector. A 15,000- or 20,000-ohm resistance in the H.T. lead, with a 4-mfd. condenser from the anode side of it to earth, has proved a practically certain cure, although it seems that the more conventional 2 mfd. is of very little use!

As you must know though, there are several different kinds of threshold howl—the causes are various, but the effect the same—and there appears to be one of them which does not succumb to this treatment. I should have been a far happier man if I had not discovered this, but I suppose I am wrong to expect so much from such a simple remedy.



Claimed to be one of the most complete school wireless installations in the world, this amateur station is situated high in the Swiss mountains at Zuoz, Engadine

BROADCASTING FILMS—Will it come to that?

By ANTHONY ASQUITH

The brilliant son of the Countess of Oxford, who produced "Shooting Stars" and "Underground," gives an intriguing survey of the future of wireless and the films in this exclusive interview with OSCAR M. SHERIDAN.

ANTHONY ASQUITH and I sat in the comfortable stalls of the New Empire Theatre, once the home of famous musical comedy, and to-day the shop window for the modern American film. The launching of a ship, or the laying of a foundation stone, familiar events in the modern film entertainment, were the inducement to conversation which proved Mr. Asquith's versatility in his knowledge of things scientific. It was not unnatural, then, that we spoke about wireless, television, and the medium whereby the kinema would be allied to broadcasting.

An Entertainment Revolution

"I think I was interested in wireless before I became enamoured of the possibilities of the film," said Mr. Asquith. "I realised, as everyone else must have done, that it would be years and years before one could even vaguely gauge the uses, advantages, and even the necessity of wireless.

"As a science, and as a hobby, its novelty stimulated my interest, until I was aware that wireless would become, sooner than one imagined, a predominant factor in the growth of civilisation. And to-day, as I review my interest in wireless, one important fact stands out. It is the idea I have always cherished, that in the future—the near future, perhaps—there would be a synchronisation of ideas in wireless and films that would mean a revolution in the entertainment world.

"Let me paint the picture that I imagine. Of television, I know very little. I do know, though, both from what you tell me and what I have already heard, that television at present is the very reverse of perfection. For one thing, I am not of the opinion that owners of wireless television sets will stay for three hours watching an almost vague image that is confined to space even smaller than an ordinary cigarette card.

"I see the possibility of television only when the necessary perfections have been made that will allow the wireless picture to be projected, or shown on a space equal to the screen of a home cinema.

A recent portrait of Mr. Anthony Asquith.

The Home Cinema

"There are still to-day people who complain that the cinema, even with its present lavish luxury, is tiring to the eyes, and sometimes a strain on the nervous system," went on Mr. Asquith. "Therefore, it seems doubtful that a whole entertainment viewed in the confines of an aperture less than a postcard size will ever be a genuine and popular family entertainment."

Mr. Asquith went on to explain that if ever television were exploited to its eventual success, he would be one of the first to praise its utility and necessity. The success of the cinema in the home, he told me, was that the real spirit of the silent stage was presented, as the same films can be purchased, and the only loss,

apparently, is the musical accompaniment as provided in the legitimate cinema theatre.

"I suppose the day will eventually arrive when, by means of broadcasting and television, the actual cinema entertainment will be part of the equipment of every modern home, just as the gramophone and the wireless set is to-day. If, as I think, it may soon be possible to show a full-size screen or stage, and hear the same accompaniment that goes with the show in the theatre, then I think we shall have a revolutionary move in the art of entertainment, the beneficial extent of which (or otherwise) it is at present impossible to gather.

"Its value in the provinces and in uncivilised countries will be tremendous. There will, of course, always be the difficulties that are at present encountered in the broadcasting of ordinary wireless entertainments. If in the perfection of television the theatres and musical halls are to suffer, then every manager will be up in arms against having their particular entertainments televised.

Radio and Gramophones

"The gramophone has only become popular," he continued, "because it has become a really perfected thing. The absence of 'scratch' on records, and the high quality of the actual gramophone—made possible, it must be admitted with the help of radio valves and other wireless advantages—has almost totally done away with the idea that it provides mechanical music only.

"With Kreisler, Paderewski, the Philadelphia Symphony Orchestra—to mention just a few as contributors to this entertainment—what was once a novelty has become a real thing, the loss of which would be a disastrous affair.

Concrete Atmosphere

"Wireless, also, taken as a purely scientific affair (and not worrying about the quality of the things broadcast), is perfect. The next step, and that, of course, is the most important step of all, is for the concrete atmosphere—by that I mean the action, the players, the scenery, the whole theatre, in fact—to be brought into the home.

"But it will have to be brought lock, stock, and barrel, and not devoid of any of the things that make theatre and kinema-going a pleasure.

"If one is able, in the near future, by means of an apparatus that costs only a few pounds, to switch on the choice of a dozen British and Continental kinema or theatre programmes, with a clarity of sound and strength of picture that loses nothing by its transposition to the wall of one's drawing-room, then the future of wireless television is something to look forward to."

And, in those few words, are expressed the sentiments of a young man who is well in the vanguard of the clever modern young men of to-day. Mr. Anthony Asquith has given the British film industry renewed hope; when television comes to stay, I would not be surprised if we do not hear more of him in that direction.

TWO TECHNICAL TIPS

A Hydrometer Hint—Drill Points

A Hydrometer Hint

NEARLY every reader will have had practical experience of the fact that after a hydrometer has been in use for some time for the purpose of taking the gravity of the accumulator acid the inner walls of the instrument tend to become cloudy, this cloudiness being due to the deposition of very fine particles contained in the electrolyte.

THE RADIO-CINEMA.

The interview with Mr. Anthony Asquith was given before details of our Technical Editor's Radio-Cinema invention were disclosed. It is, therefore, all the more interesting to note the significance of some of Mr. Asquith's remarks: "It is the idea I have always cherished that . . . there would be a synchronisation of ideas in wireless and films that would mean a revolution in the entertainment world," etc. He was alluding to Television, but Mr. Dowding's combination of Radio and Films is eminently practical and is ready for putting into operation, simply, inexpensively and without troublesome complications. The result will be high-class Film Talkies in your own drawing-room. Mr. Dowding is contributing a special article on his Radio-Talkie invention to next month's "M.W."

THE EDITOR.

In such circumstances it becomes difficult to take an accurate reading with the hydrometer. Of course, the true remedy for the trouble lies in the taking of the hydrometer to pieces and washing it out with warm soap and water, and, in fact, this procedure should be carried out in bad cases.

In slight cases of hydrometer cloudiness, however, and as a means of precaution against the trouble occurring in the case of a clean or new hydrometer, one cannot advise anything more suitable than having at hand a small bottle of methylated spirits.

After the hydrometer has been used for taking the gravity of the accumulator acid, dip the nozzle of the instrument into the methylated spirits bottle and allow the barrel to fill up with the spirits. Subsequently, when the spirits are squirted back again into the bottle, any slight cloudiness formerly present on the inner walls of the hydrometer will be found to have vanished.

The methylated spirits can, of course, be used over and over again for the same purpose, and if the above procedure is adopted every time the hydrometer is used, it will remain indefinitely in a perfectly clean condition.

Drill Points

It is not every amateur—especially during busy constructional periods—who takes the trouble of keeping the points of his drills in a perfectly sharp condition. An attempt, however, should always be made to keep drill points sharp, for the power required to drive a dull drill is considerably greater than that which will operate a sharp one. Careful rubbing of the point over the surface of a fine oilstone from time to time will keep the drill point in a good sharp condition.

When working with small drills, do not use too great a degree of pressure. Even if they do not actually snap under excessive pressure, they will be liable to become distorted, and their rotation will be uneven. In using fine drills, therefore, make up for the lessened pressure by an increase in speed.

Hard Patches

If, during the course of drilling a piece of metal or other hard material, you suddenly meet a spot which is harder than the rest, do not force the drill. Rather withdraw it, and rub over it a little turpentine. Then continue the drilling, decreasing the speed of the drill, and lessening its pressure. In this way the hard patch of material will be drilled cleanly and effectively, and the drill itself will not suffer any harm.

Finally, when putting your drills away for any length of time, do not forget to rub a little oil or grease over them.

J. F. C.

THE NEUTRO-SCREEN 3

A very interesting receiver specially designed for short-wave work. It employs a screened-grid valve which is neutralised, in order to get maximum amplification.

By C. P. ALLINSON, A.M.I.E.E., F.Inst.P. Inc.

In a recent article I expressed the opinion that the real future of the screen-grid valve, especially for short-wave work, was to use it in a neutralised circuit.

As you know, the trouble with the very high frequencies is that coils will couple together at unbelievable distances, while mutual capacities which are almost below measuring range will also give unwanted coupling; while if coils are wound astatically their efficiency is reduced and signal strength is lost.

Simple Screening

At the same time, it must be born in mind that the residual capacity of the screen-grid valve is by no means negligible at these very high frequencies, and I have found that a short-wave H.F. amplifier using a screen-grid valve would oscillate when both circuits were in tune, even with the greatest precaution being taken to avoid coupling extraneous to the valve itself.

The receiver I am going to describe has been developed especially for short-wave work, and so as to allow of straightforward inductances being used, and also to simplify the construction of the receiver as far as possible by eliminating the necessity for extensive screening. It is an exact copy of the set I use myself for short-

COMPONENTS REQUIRED

- 2 ·0003 S.L.F. or square-law variable condensers (G.E.C. in set). (Any good make, either slow-motion or plain type with vernier dials. For short-wave work it is advisable to choose a type with a particularly good connection to the moving vanes.)
- 1 ·0002 reaction condenser (Bowyer-Lowe, Cyldon, Burton, J.B., Igranic, Peto-Scott, etc.).
- 1 Base-mounting neutralising condenser (Gambrell, J.B., Bowyer-Lowe, Burne-Jones, Peto-Scott, etc.).
- 1 L.F. transformer (Ferranti, Mullard, Igranic, Philips, Lissen, Marconiphone, R.I.-Varley, Brown, etc.).
- 1 H.F. choke suitable for shunt feed.
- 1 H.F. choke for reaction control. (Both these chokes should be suitable for use on the short waves, and should preferably be of different makes. A few suitable specimens are the Bowyer-Lowe "Long Range," Wright and Wearite, Burne-Jones, Lewcos, etc.)
- 1 Six-pin coil base (Peto-Scott, Lewcos, Burne-Jones, Colvern, etc.).
- 1 Four-pin straight-line coil base (Colvern).
- 1 Fixed resistor (Cyldon, Peto-Scott, Dubilier, etc.).
- 1 ·004 fixed condenser (Dubilier, Mullard, Lissen, T.C.C., Clarke, Igranic, etc.).
- 1 ·01 fixed condenser (Dubilier, Mullard, Lissen, T.C.C., Clarke, Igranic, etc.).
- 1 ·0003 fixed condenser (Dubilier, Mullard, Lissen, T.C.C., Clarke, Igranic, etc.).
- 1 30-ohm variable filament resistance (Igranic, Lissen, etc.).
- 1 5-megohm grid leak and clip or holder (Lissen, Dubilier, Igranic, Ediswan, Mullard, Pye, etc.).
- 1 2-mfd. reservoir condenser (Dubilier, Lissen, Ferranti, Mullard, T.C.C., Hydra, etc.).
- 1 1-mfd. reservoir condenser (Dubilier, Lissen, Ferranti, Mullard, T.C.C., Hydra, etc.).
- 1 ·25-mfd. reservoir condenser (Dubilier, Lissen, Ferranti, Mullard, T.C.C., Hydra, etc.).
- 1 On-off switch (Lissen, Lotus, Igranic, Benjamin, Burne-Jones, etc.).
- 11 Indicating terminals (Belling-Lee, Igranic, Eelex, etc.).
- 1 Set of Neutro-Screen short-wave coils (Colvern).
- 1 Aluminium panel, 20 in. × 7 in. (Burne-Jones).
- 1 Copper sheet, 9½ in. × 6½ in., for inter-stage screen (Paroussi).
- 1 5-ply baseboard, 20 in. × 10 in.

Ebonite for terminal strips and a coil of Glazite for connecting up.

wave reception, except that I use two L.F. stages instead of one, as I like to have a set with an unusually high factor of safety.

As it is intended for short-wave work, I have considered it essential to use a metal panel for mounting the components. A photograph taken from the front of the receiver shows that it presents an extremely distinctive appearance, while other views taken from the back of the panel show the simplicity of the screening arrangements employed, an inter-stage screen merely being used between the H.F. and detector valves, and circuits.

The theoretical circuit diagram of the receiver is shown in Fig. 1, and it will be seen that the use of the metal panel has introduced one or two slight peculiarities into the circuit which I think I ought to explain in case they should cause any confusion in the constructor's mind when considering building this set.

Varying Volume

In view of the fact that I wanted to be able to incorporate some form of volume control without having to introduce extra complications in the way of making special ebonite bushes and so on, it seemed to me that the simplest way of achieving the desired result was to employ a filament resistance to turn down the H.F. valve.

By connecting this in the negative filament lead, the spindles of the condensers and the negative filament of the H.F. valve would all be at earth potential, for the spindle of the filament rheostat, being in direct contact with the bush which fixes this component to the panel, would complete the L.T. negative circuit. This arrangement also avoids unnecessary long leads to the L.F. valve, which otherwise would have to be taken right across the set.

The arrangement employed does not apply negative bias to the grid of the H.F. valve as well as turning down the filament, as the more usual arrangement of inserting the filament in the negative lead does, so that no fear need be entertained that distortion owing to rectification will be introduced when the H.F. valve is used to control volume.

In order to allow any voltage valve to be used in the H.F. position, I have also included a fixed resistor R_3, which merely requires the correct value of resistance to be clipped into it to ensure that the H.F. valve shall be run at the correct potential when the other resistance is at its minimum setting.

Notes on Neutralising

The neutralising method employed might almost be said to be a form of split-secondary, in that a continuation of the secondary winding is used to give the necessary phase reversal, the voltage therefrom being applied to the plate of the H.F. valve through the small neutralising capacity C_2.

Loose coupling with the aerial has been used, the aerial coil being L_1, tuned grid coil is L_2, and L_3 is the neutralising winding, to which I have just referred.

The output circuit of the H.F. valve is, in effect, ordinary tuned anode, and here I have made use of an unusual expedient in order to simplify the question of mounting the anode tuning condenser.

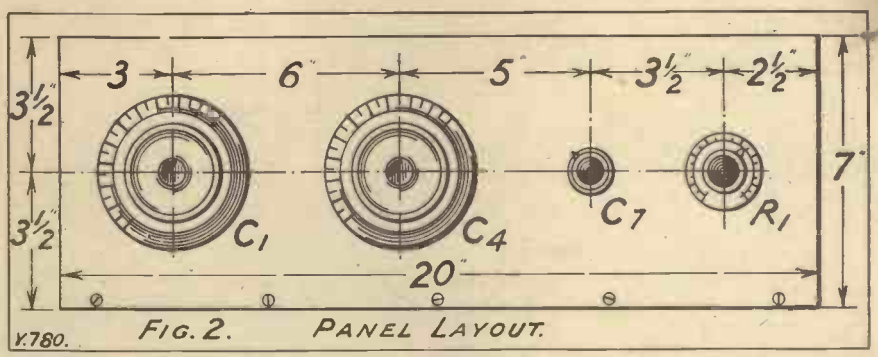


FIG. 2. PANEL LAYOUT.

With the conventional tuned-anode circuit it would be necessary to insulate the tuning condenser entirely from the panel, since this condenser would be connected straight across the anode coil and would therefore have the high-tension voltage of the battery on it.

Now it is desirable to eliminate battery coupling if possible by isolating the tuned-anode circuit. If I had used ordinary shunt-feed this would, of course, have made it a simple matter to mount the anode tuning condenser C_4 on the panel, but in this case the damping of the H.F. choke would be across the tuned circuit and would therefore introduce losses, so reducing the efficiency of the amplifier.

By using the scheme shown, however, not only can we mount the condenser directly on to the panel, but also the H.F. choke L_6, which is used to isolate the H.F. circuit, has both its ends at earth potential, so that damping across the tuned circuit will in no way be introduced.

No "Noisiness"

Further to ensure the elimination of any possibility of a short-circuit of H.T. occurring owing to the short-circuiting of the tuning condenser C_4, a fixed condenser C_3 has been connected in series with C_4 as shown. This also has the further advantage that should the tuning condenser collect dust between the vanes, no noisiness will result as would otherwise be the case.

Since the receiver employs one stage of L.F. amplification only, I have used leaky-grid-condenser

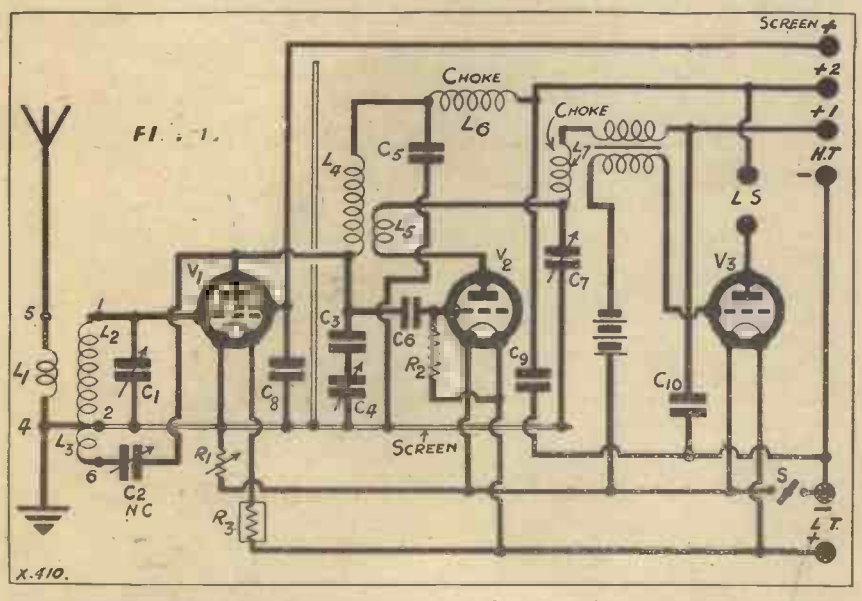


FIG. 1.

rectification followed by a transformer, as this is the most sensitive arrangement, and will give the greatest signal strength.

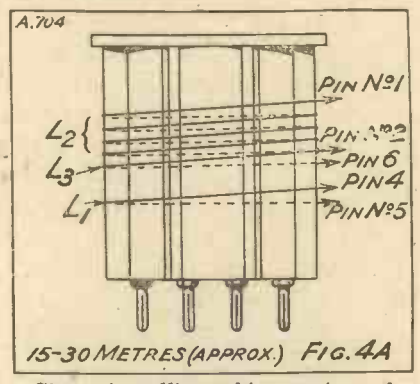
For the reaction circuit I have used throttle control, the reaction coil L_5 being connected directly in series in the anode circuit of the detector valve, after which the H.F. choke L_7, and the reaction condenser C_7, enable control of reaction to be obtained.

Not only does this method give the smoothest and most satisfactory control of reaction on the very short wave-lengths, but in my experience it will frequently enable oscillation to be obtained where a straightforward Reinartz circuit will not.

Avoiding Hand-Capacity

At the same time, the spindle of the reaction condenser is earthed, thus avoiding hand-capacity effects, and also simplifying the construction of the receiver, especially in this case where the metal panel is itself earthed.

I may say here that this is not the first receiver that I have built on these lines. Six months ago I built a similar model for experimental purposes, and the present set is therefore the outcome of considerable experience, and introduces the results of much experimental work undertaken in order that the maximum efficiency might be obtained.



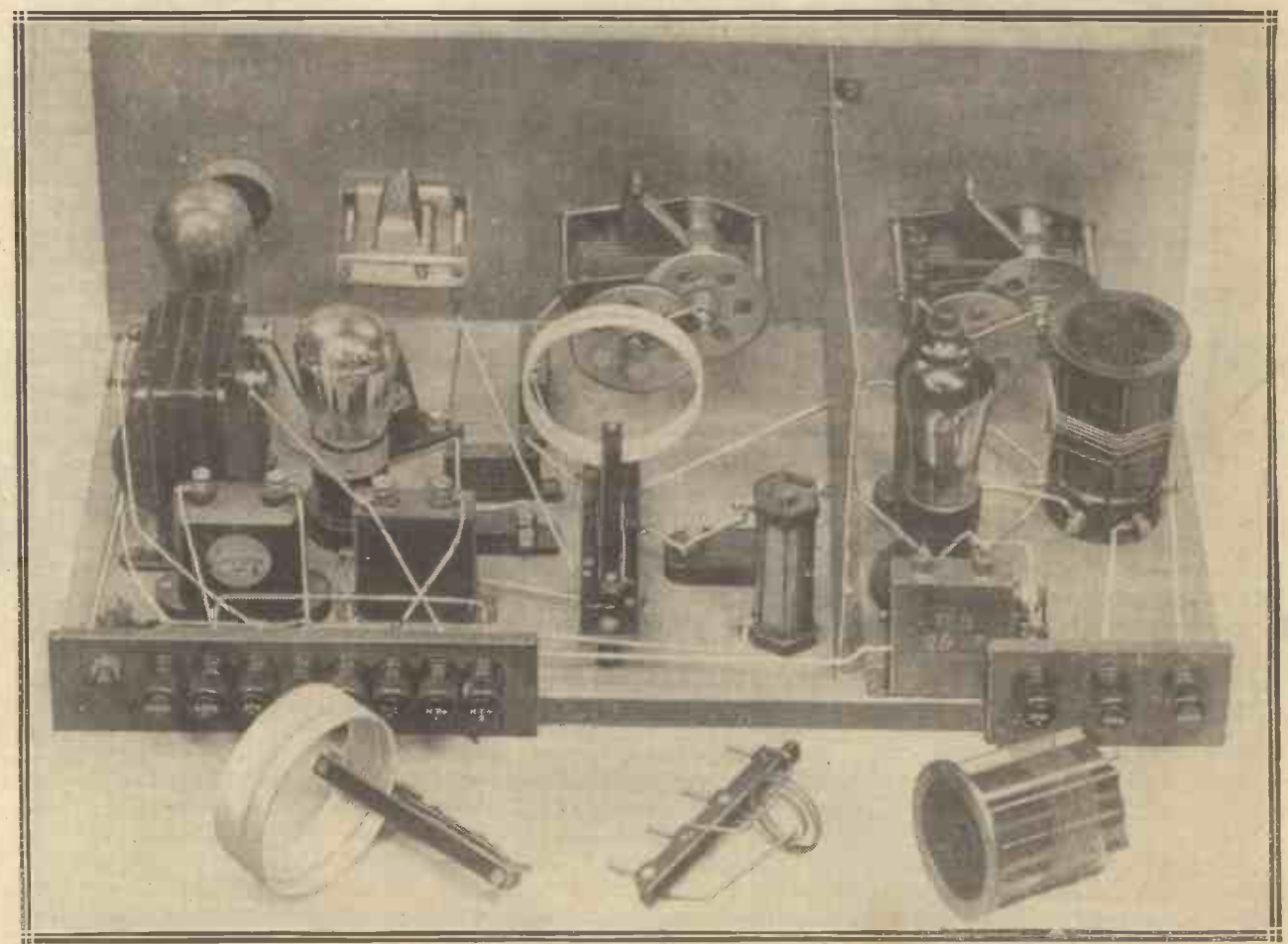
Since installing this receiver for my own short-wave work, I may say, incidentally, that I have only worn the headphones on two or three occasions, and then only when extremely weak signals had to be copied. For most communications the loud speaker can be used on 99 stations out of 100, and amateurs from all over the world come wandering in at amazing strength. One of the great advantages of this circuit will be found when reading a Morse station. This is owing to the fact that the H.F. stage is neutralised so that with the detector oscillating no energy is radiated from the aerial, and some nearby short-waver does not mistake your oscillating receiver for a transmitter, and in his efforts to find out what you are doing make it impossible for you to read the station to which you are listening.

High Amplification

It might be thought that the extra tuning control would somewhat complicate the operation of the receiver. This, however, is in no way the case, for the tuning of the H.F. circuit (owing to the heavy aerial damping) is decidedly on the flat side.

This induced me to think that it might be possible to do away with this tuning control, and instead of an ordinary aerial coil just connect an H.F. choke or high resistance between grid and filament of the H.F. valve.

I tried this out, and found that the drop in amplification was so marked that I determined to retain the extra control, for the extra amplification obtained would be more than worth the slight trouble involved in adjusting it.



Here is a view of the set which shows the exact spacing of the components and disposition of the wiring.

Another advantage of this circuit (and this happens to be one of its greatest advantages) is owing to the fact that the detector circuit is damped only by the output impedance of the H.F. valve. The result of this, of course, is that no dead spots are ever found with this receiver except those which may possibly be introduced by an H.F. choke (a thing which should not occur with a good H.F. choke, incidentally).

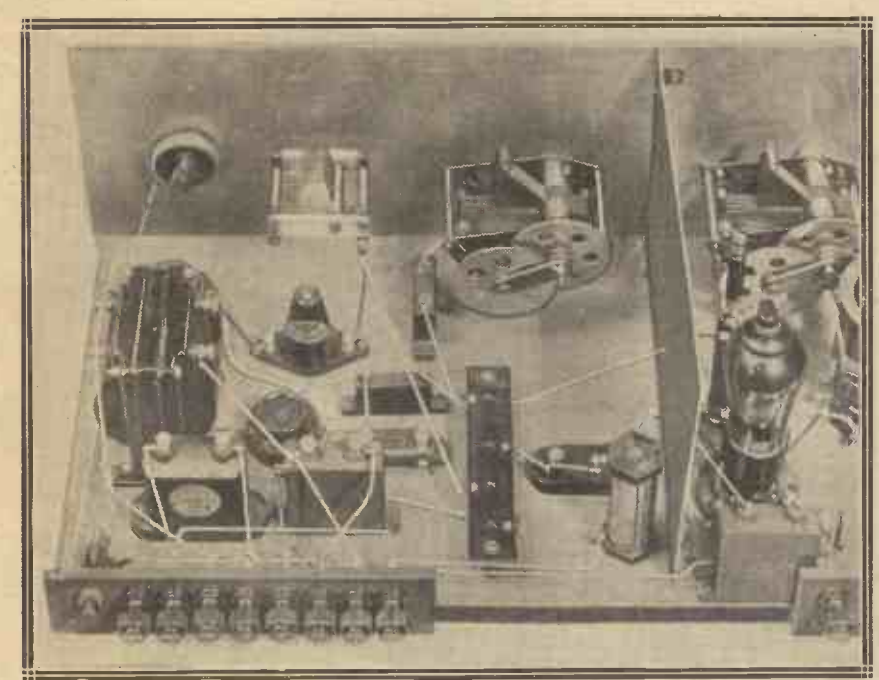
No "Dead" Spots

Under these circumstances it doesn't matter whether the station you are receiving happens to come in tune with the fundamental of your aerial or on one of its harmonics, whether your aerial is a big or a small one, highly damped or lightly damped, whether your earth is efficient or inefficient, etc.

extra trouble in making insulating bushes is required.

The inter-stage screen is another quite simple piece of work, since all that is necessary is to bend over ½ in. along the long side of it so as to mount it on the baseboard; two screws, one at each end, sufficing for this. The panel is fixed to the front edge of the baseboard by means of five or six small screws, and the only other constructional work involved is in making up the terminal strips.

It should be noted that the on-off switch is placed on the battery terminal strip, where it is most conveniently located. In this position it considerably simplifies the wiring and also prevents meddlesome fingers from switching the set on during your absence, since the switch is concealed from view.



The low-frequency wiring is shown in clear detail in this illustration of a portion of the receiver. Note the connections to the "straight-line" coil-holder.

Reaction demand will be found to be consistent with the load on the circuit without dead or half-dead spots where the reaction demand suddenly increases to the maximum available.

Choose your components with care as regards their mechanical construction, in the case of any component having moving parts, if you wish to be able to operate the receiver with ease and certainty and unvarying satisfaction.

The constructional work involved in making this receiver is extremely simple, since all the components which are mounted on the panel have to be in electrical contact with it, so that no

I have taken particular care to see that everything is well spaced out, thus not only simplifying the actual wiring-up, but making the layout considerably less critical than would be the case if a more compact form of construction had been employed.

Coil Construction

Beyond the usual precautions of spacing out grid and anode leads as far as possible, there is no need for me to deal with the wiring of the receiver. It is not as if it were at all complicated and certain leads had to go into position before others.

Before we come to the question of operating the receiver, I will deal with the coils, since there are many experimenters who will no doubt want to make their own coils up, rather than purchase them ready-made.

The aerial coils I have wound on 2¼ in. diameter ribbed formers. The 15- to 30-metre coil has one turn for the aerial coupling coil which is connected between terminals 4 and 5, four turns for the grid coil connected between pins 1 and 2, and a little less than one turn for the neutralising winding connected between pins 2 and 6.

The Pin Connections

The full details of the connections are given in Fig. 4 at A. For the 30- to 80-metre band I have used auto-coupling, so the connections are a trifle different. The grid coil consists of 10 turns with the aerial tapped on one turn from the earth end.

The neutralising winding in this case consists of 1½ turns connected between the same pins as before. The details for this coil are shown in Fig. 4 at B, which makes the matter quite clear. The turns of wire are well spaced, and I am of the opinion that this is a precaution well worth taking.

Ample overlap is obtained on the two coils. If you want to go to the next higher range a suitable number of turns will lie between 20 and 30, according to the gauge of wire and method of winding employed. It is extremely difficult to get coils to allow the condensers to match as regards their readings, for the aerial and detector loading are so different and the capacity in a short-wave circuit preponderates in effect so heavily as to make tuning condenser matching almost impossible. If the condensers match at the top they won't at the bottom, and vice versa.

For the H.F. coils the tuned-anode coil L_4, 3 in. in diameter, consists of three turns and the reaction coil L_5 two or three turns of the same diameter closely coupled to it for the 20- to 40-metre band. For the 40- to 80-metre band the anode coil has eight turns, the reaction coil five turns, and the next biggest coil has sixteen turns for the anode winding and eight turns for the reaction winding.

Rigid Reaction

If you decide to make these coils for yourself, care must be taken, of course, to see that a rigid and solid job is made of it, and that the coupling between reaction and anode windings cannot vary while the coil is in use. At the same time it is

preferable that it should not be able to vary when the coil is not in use, for if it does, then the calibration of your receiver will be upset.

The set can now be connected up, after the usual tests have been made, to ascertain that L.T. and H.T. circuits are correctly wired, and the first thing to do is to get the H.F. valve stabilised.

The Valves to Use

I don't intend to use the word neutralised at all as regards this set, because, strictly speaking, it is not necessary to neutralise the H.F. valve at all, but merely to stabilise it by means of the small adjustable condenser C_2.

For the H.F. valve any good screen-grid valve will do. I myself have actually tried the Cossor, Marconi, Osram, Mullard and Ediswan, and found them to give the most satisfactory results. For the detector a high-mu valve of the resistance-capacity coupling type should be used, while for the L.F. valve a medium impedance valve such as the D.E.L. type should be employed, unless headphones are going to be used, in which case I prefer an H.F. valve having an impedance in the neighbourhood of 20,000 to 30,000 ohms.

With reaction set to zero and the correct voltages applied to the various valves, two coils covering approximately the same wave-band range should be plugged into their respective holders.

Screw the stabilising condenser right out and rotate the two dials backwards and forwards to see if the set oscillates at any position. It will probably be found that at certain positions on the two condensers the set will oscillate.

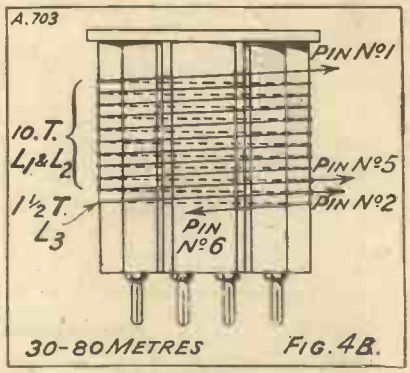
All that is necessary to stabilise the set is to increase the stabilising condenser until the set has stopped oscillating.

H.F. Tuning

It is quite possible, however, that no point will be found at which the set oscillates because the mere presence of the small condenser gives sufficient feed-back to prevent oscillation occurring, owing to the fact that the residual capacity within the valve is exceedingly small.

When reaction is used it will be found that the set behaves in a perfectly normal manner. For instance, reaction is increased until the detector valve is just *not* oscillating, when the H.F. circuit is out of tune Now when the H.F. circuit is brought into tune it will be found that the set begins to oscillate.

The result is that with reaction correctly set it is a simple matter to



keep the circuits tuned to each other within a couple of degrees on the dials by keeping the reaction so adjusted that the set will just oscillate when they are both in tune.

Now stations can be searched for and tuned-in and it will be found that the H.F. tuning condenser is by no means critical in its setting.

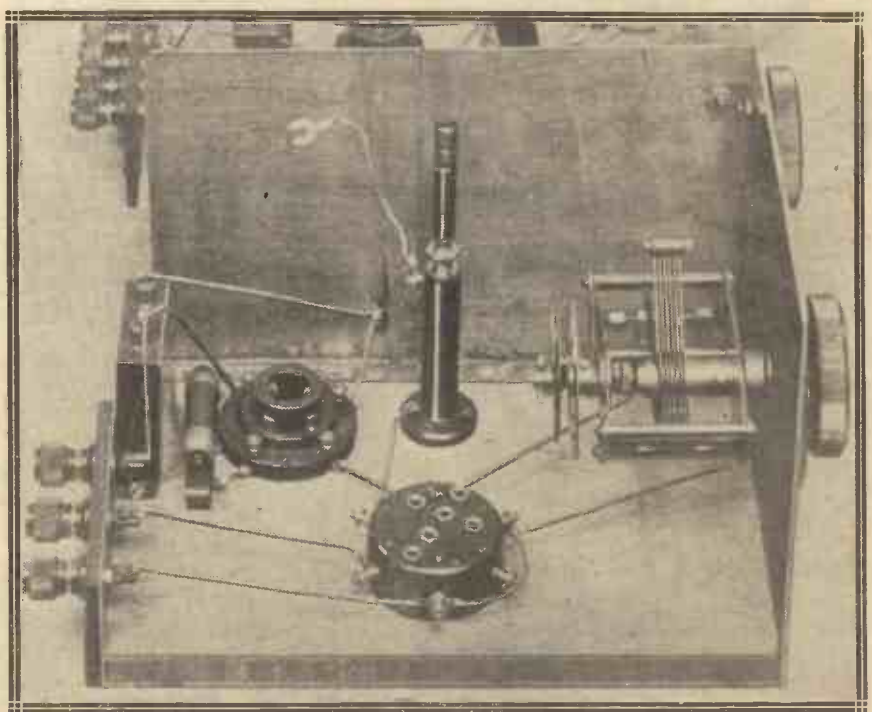
Now, most amateurs will have found the foregoing information sufficient to get going with the set, but for the benefit of less-experienced experimenters some further details will no doubt be useful.

First of all, if he follows my instructions exactly in making up the coils he probably will like to know more exactly what the wave-length ranges are. Here are figures that I have checked up on a wave-meter: Coil No. 1, i.e. the 4-turn coil, 17·5 to 42·5 metres (rather a greater wave-length range than one might at first expect); Coil No. 2 (the 10-turn coil), 32·5 to 85 metres.

Now, the smaller of the coils used to couple the H.F. valve to the detector consists of 3 turns 3 in. in diameter, and will not tune much below 20 metres. If you reduce the number of turns you will find it difficult to get control of reaction, so if you want to go down farther it is advisable to reduce the diameter of the coil. The coil I have just referred to is the smallest coil in the Collinson kit, and is all that is needed for usual purposes, but if you are keen to get down farther you should make up a 2-turn coil having a diameter of 1¼ in., in every respect like the one I described for use in the three-valve short-waver called "3 S.W." described in MODERN WIRELESS last April. This article also gives you details as to the wave-length range of the other coils, which are the same as those used in the "3 S.W."

Operating Notes

This coil will, in the "Neutro-Screen" Three, go down to about 12 metres, or perhaps a little lower. This is lower than the bottom limit of the smaller of the two aerial coils of which I have given you details. If, therefore, you want to get right down to 12 metres on that coil, too, you will have to make up a third coil for the purpose.



As in all short-wave sets, the high-frequency wiring has to be carefully and efficiently arranged.

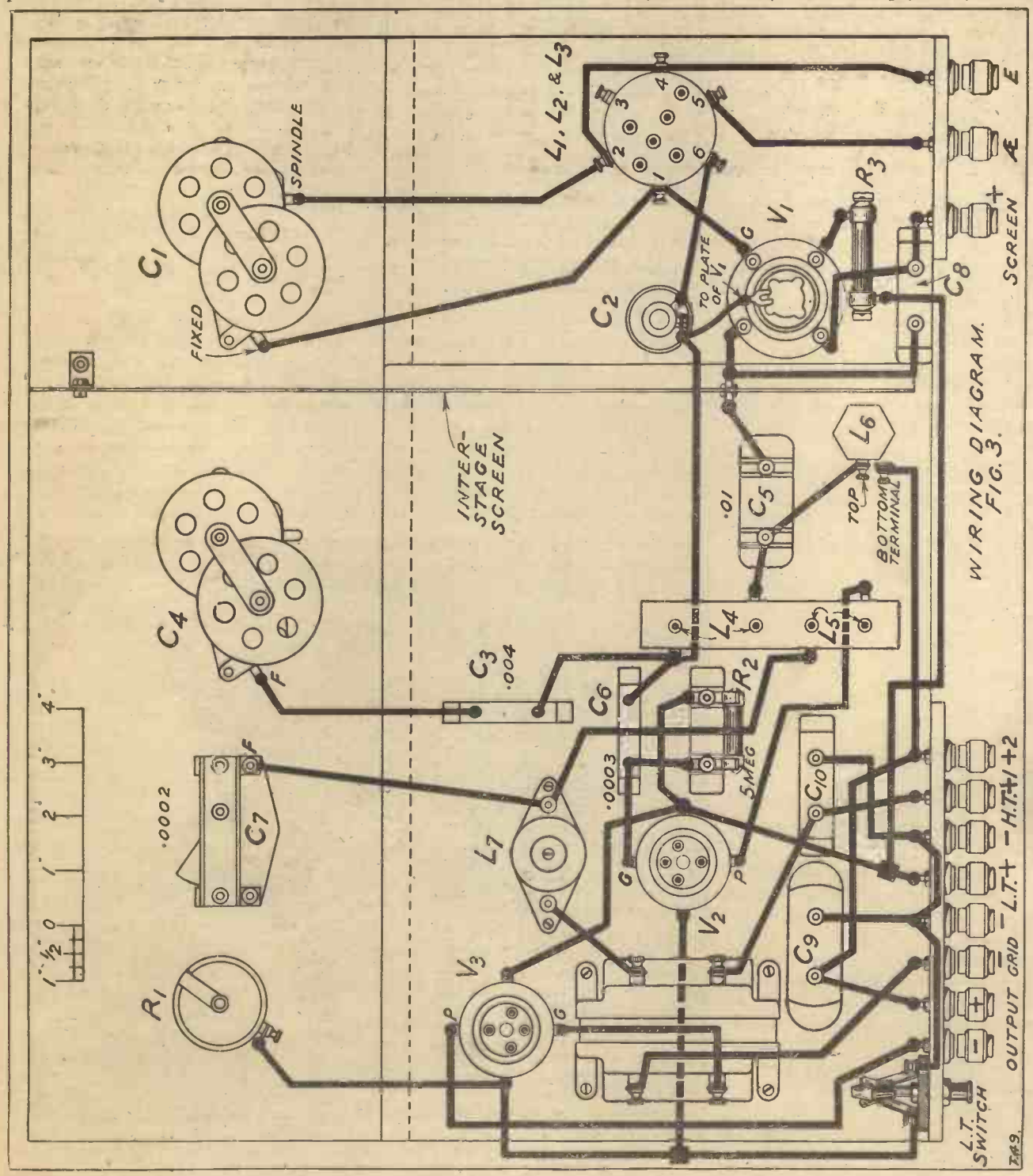
This should be wound on a small former, a 1½-in. former such as is used in some binocular coils is suitable. This should have two or three turns put on it with about half a turn for neutralising, the aerial being coupled to it by a single turn spaced about 1 in. away. The method of winding and connecting is exactly the same as coil No. 1, details of which are given in Fig. 4a, so no further illustration is required, the former being fixed to a standard six-pin base.

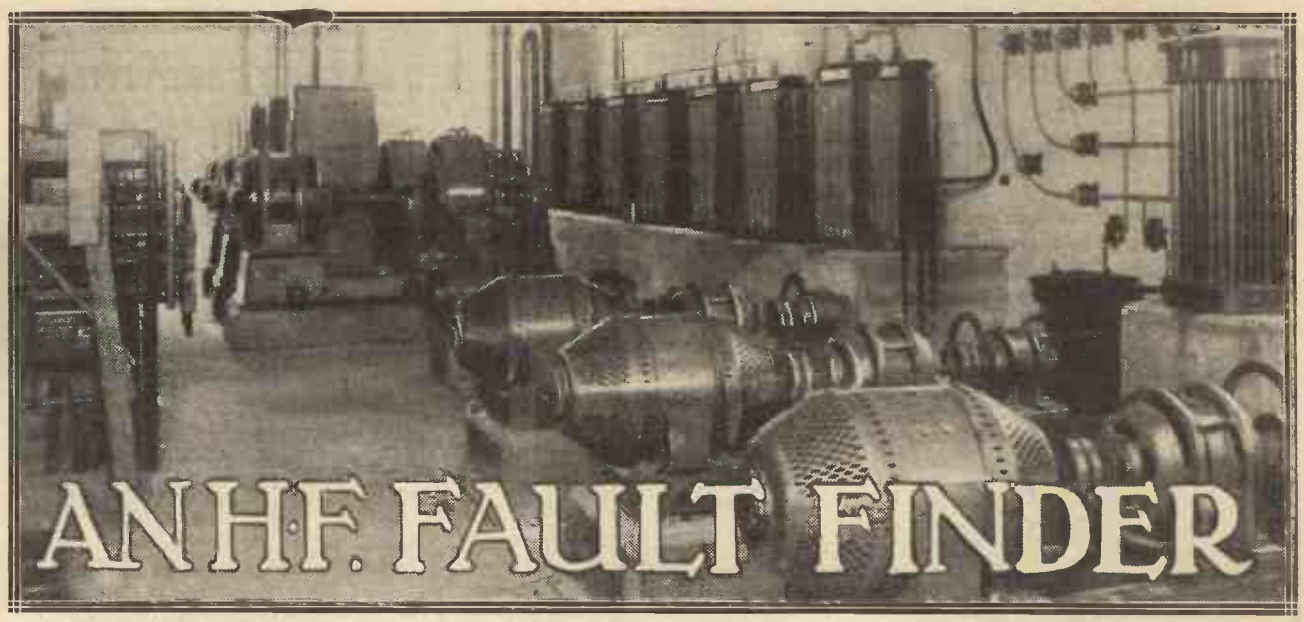
Now, in getting the best out of this set there are one or two points to watch. For instance, the screen-grid potential should be very accurately adjusted in order to give the maximum amplification. This may differ from the maker's figures by 10 or 12 volts in some cases, owing to the fact that with a stabilised circuit you can afford to work on a slightly different part of the valve characteristic. Try the effect of varying it, therefore, in small steps up to 10 or 12 volts above or below the maker's rating.

You will probably find that the best results are obtained with a *lower* voltage than that recommended.

Next try out different valves as detector. A short-waver is inclined to be rather fussy about detector valves. It will refuse to oscillate with some, or with others it will produce unpleasant noises "off" that make the copying of a weak signal a difficult matter. For the L.F. valve, too, be sure to choose one that gives a completely silent background.

(*Continued on page* 222.)





AN H.F. FAULT FINDER

The use of high-voltage high-frequency as a method of testing alternators and large electrical plant current is a new idea which is proving very satisfactory in America

By a Special Correspondent

LESS than a year ago the world was astonished by the news that a judge, sitting comfortably at his desk in New York City, started the machinery of a great steel mill by merely passing his hand over a small crystal ball placed on his desk.

Incredible almost, but not more so than talking half-way round the world, or sitting in one's home and listening to a concert hundreds or thousands of miles away.

Indeed, the radio wave is a quick and industrious little messenger, so quick and industrious and reliable that it becomes the busiest messenger of the world. It has gone on a variety of missions, but the most unusual service it has been called upon to perform is that of detective. Mr. J. L. Rylander, a Westinghouse engineer, is now employing the radio-frequency wave to detect insulation faults in the coils of motors, generators, induction regulators, and many other electrical machines. This has proved such an efficient and vigilant detective that since enlisting its services for commercial testing of coils, insulation failures have been almost eliminated.

Two Tests Necessary

In describing this new method of testing coils, Mr. Rylander says: "To be sure that the insulation of a finished electrical machine will meet the demands of service, two insulation tests are necessary; first, a test proving that a reasonable overload will not cause a short-circuit between any part of the windings and the frame of the machine, and, second, a test proving that a reasonable overload will not cause a short-circuit between turns of the coil winding.

"The first test is relatively simple. The second test is more difficult, because impressing a high test voltage of ordinary frequency across the terminals of a coil will cause a heavy current to flow. The current flowing under these conditions may be sufficient to burn the copper and damage the insulation.

Very High Voltages Used

"A high voltage, however, may be used, provided a high-frequency current is used. With a 60-cycle current of 10 amperes flowing through the coil under test, the voltage drop across the coil may be 4 volts. If the frequency is increased to 60,000 cycles, 4,000 volts are required to produce the same current. Hence, by increasing the frequency practically any voltage may be applied across the

Mr. Rylander (left) believes that high-frequency testing of electric machinery will soon become universal practice. Part of the apparatus used can be seen above.

H.F. FAULT FINDER
—continued

terminals of the coil without causing an excessive current in the winding.

" For coil testing, the spark system of obtaining high-frequency current, familiar in radio circles, is employed.

" Power is supplied to the apparatus by a standard transformer. By adjusting the length of the rotary spark gap the point on the voltage curve at which a spark will occur is determined.

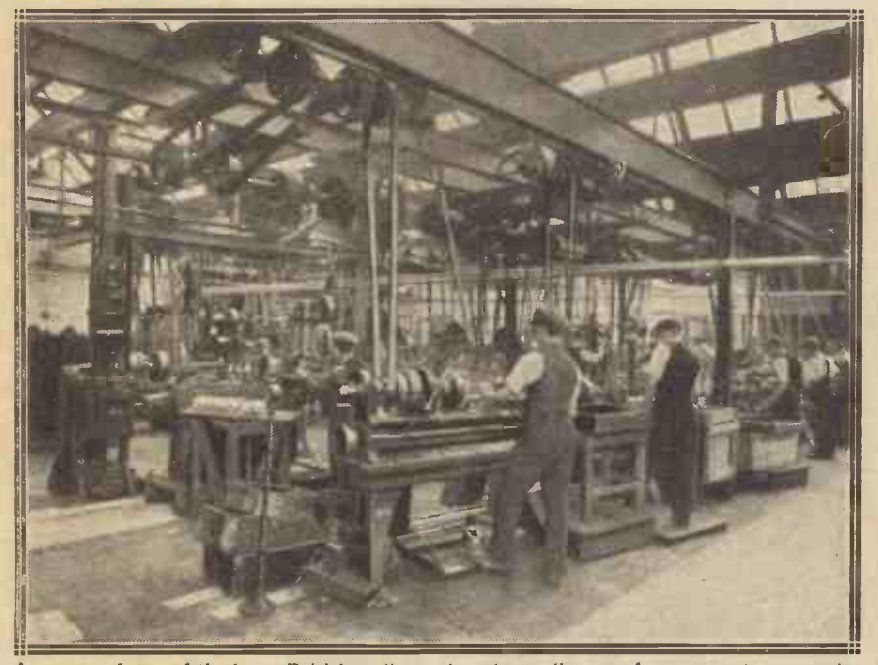
Fault Immediately Found

" When this spark occurs the condenser discharges through the coil under test, resulting in a frequency of oscillation depending on the capacity of the condenser and the characteristics of the coil under test. This testing device, which provides high voltages with comparatively low current, is a simple type of radio transmitter.

" Any fault which may be present in the insulation of the coil under test may be detected immediately by means of a special radio receiving set having a sensitive milliammeter in the circuit. By adjusting its variable condenser the receiving set is tuned to the wave sent out by the transmitter. The milliammeter will then indicate the maximum reading, but if a faulty coil is put into the circuit of the transmitter the wave-length will be altered, the receiving set will be out of tune, and the milliammeter reading will drop. What does this test mean in terms of field failures ?

Invaluable Guide

" The ratio of field failures of machines per year since the high-frequency method of testing was adopted by the Westinghouse Company to the number of field failures per year before this method was adopted is approximately one to twenty. High-frequency testing shows up poor workmanship, checks the insulation design and the processes of manufacture. It ensures that proper and adequate insulating materials are in their proper places and not missing or damaged, and that no harmful foreign materials are present. One of its chief merits is that it invariably shows the cause of the failure, as the arc is of only such intensity as to burn out the weak insulation without burning the adjacent insulation or the copper."



A corner of one of the large British radio works where all sorts of components are made. (Benjamin Electric.)

When crackling noises are troublesome, and it is uncertain whether these are due to the set itself or to some outside cause, there is much to be said for the old-fashioned plan of disconnecting the aerial and earth leads to see whether this stops the trouble.

* * *

When crocodile clips are used for taps, etc., do not forget that if the springs of these are allowed to get dirty there will be unnecessary resistance at the point of contact.

BATTERY BREVITIES

Never shake an L.T. battery unnecessarily, as if sediment from the bottom of the cell settles on any of the plates, " local action " sets in and the battery may be ruined.

* * *

If distilled water is absolutely unobtainable and it is essential to replenish the electrolyte, as a temporary measure it is better to use clean rain water, thoroughly strained, for this purpose, than ordinary tap water.

* * *

After a battery is discharged, it should never be stood aside for a few days, as in this condition the plates start to sulphate quickly, which is not the case if the battery is promptly recharged.

* * *

Topping Up

If the level of an L.T. battery falls, do not on any account add acid to make up for this, but use distilled water for the purpose (the acid would make the electrolyte too strong).

* * *

Be sure not to lose the little vent plugs on the top of an accumulator, as these play an important part in the maintenance of a cell in its correct condition.

* * *

When connecting up an accumulator to a charger, it should be remembered that positive should be connected to the positive side, and the negative to the negative part of the charging apparatus.

* * *

Although the separators in an accumulator may last longer than twelve months, it is often advisable to replenish them after they have been in use for about that period.

* * *

L.T. battery terminals should not only be kept clean, but they should be covered occasionally with a good coating of petroleum jelly in order to protect them against the action of the acid.

* * *

Noisy Reception

Irregular and noisy reception can sometimes be caused by impurities inside the accumulator, and if this is suspected it is a good plan to connect a pair of telephones across the terminals. (Very little current will flow because of the high resistance of the 'phones, but if there is an irregularity in the supply this will be indicated by clicking noises.)

FINDING FOREIGNERS

How many times have you heard a station and have been unable to identify it? Here is a novel scheme to make the finding of foreign stations an easy matter.

By A. G. ALLAN.

RECENTLY I was able to read a large number of different people's opinions on the kind of identifying signals broadcasting stations should possess. Listeners to foreign stations will all have experienced the trouble of not being able to identify some station or other.

As long as broadcasting stations have not got a permanent wave-length, not heterodyned by other stations, and with no new stations cropping up wanting a wave-length, and as long as every station has not got one single distinctive wave-length for itself alone—well, as long as these and other innumerable conditions prevail, which will no doubt be for many years, every broadcasting station requires some characteristic signal or call, by means of which every civilised human being throughout the entire world will be able to identify the station.

Definite Characteristics Wanted

We all have names, we all have hundreds of characteristic features which make us totally different from other people, but so has every broadcasting station, only that up to the present moment either you must be intimately acquainted with the station to recognise it, or you must understand the language, or one of the languages, used by the given station.

What we require is a call or signal understood by everybody without the necessity of special knowledge, such as knowing Morse, Esperanto, etc.

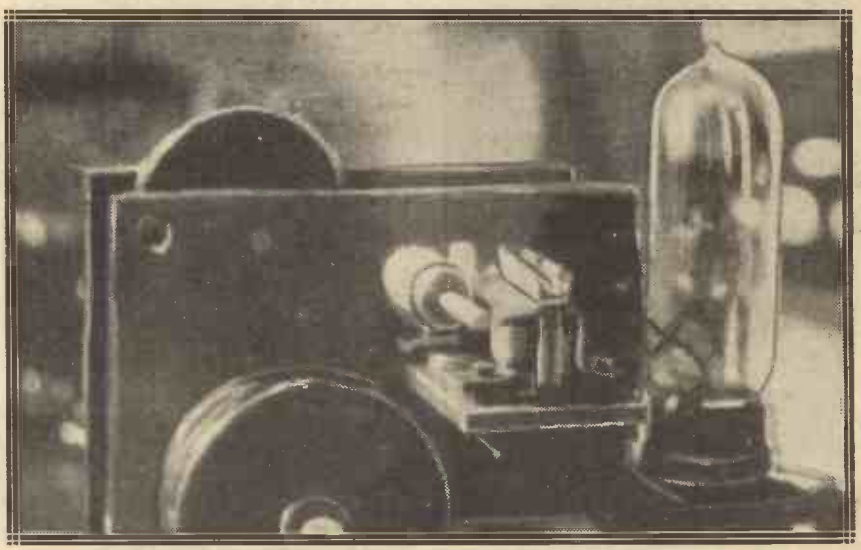
The stations themselves have seen this need with the growing scope of broadcasting over more than one country, and have attempted to solve the problem in different ways. One thing must always be remembered: the identification signal dare not be so monotonous as to drive the local listener to distraction.

The stations, especially on the Continent, have rendered, or are attempting to render, their interval signals so distinctive that they can serve as identification signals, for it is quite clear than an internationally understood identification signal must be some kind of sound, either musical or otherwise.

We have a score or so of metronomes ticking away at different speeds, we have two cuckoos calling us from Ljubljana and Wilna respectively, we have Morse signals from Hamburg, several chimes, gongs, musical notes (Stuttgart), and about every kind of sound we can think of. I had nearly forgotten the best interval signal as yet, the type employed by Budapest—a pleasing melody, not tiring to the local listener.

Ideal Interval Signal

No doubt about it, the Budapest signal seems to be the ideal. One usually is of different opinion about intervals; some stations (thank



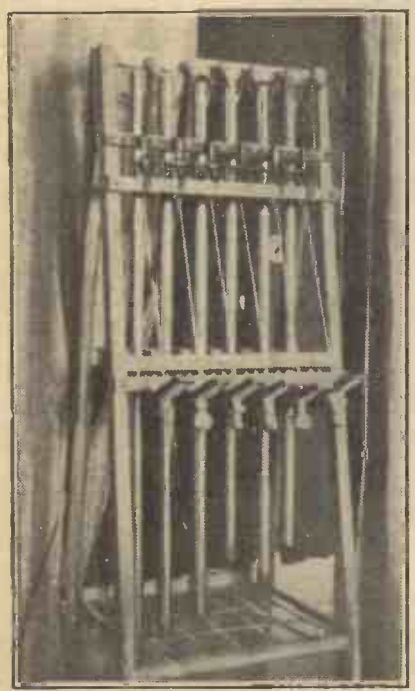
A musical-box interval signal is used by the Budapest broadcasting station.

goodness) are slowly abolishing them but the need for an identification signal remains. Let it be sounded before or after every item before the announcer has his say. Local listeners will not have to tear out their hair because of half a minute's ticking metronome, but will like the simple little melody typical to their own station. And the foreign listener in whatever country he may be, whether musical or unmusical, will recognise the signal as typical to this or that station, even if the wave-length is not that which was advertised.

Alternative Suggestions

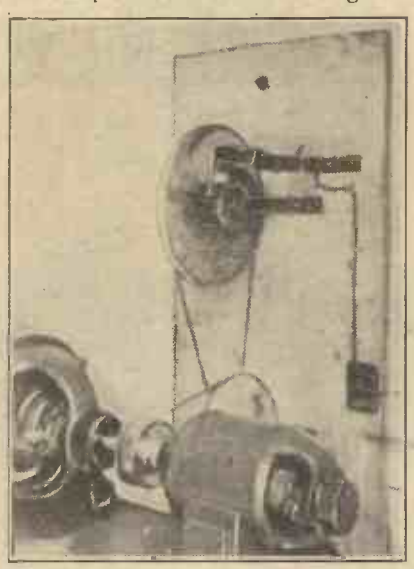
Surely there are sufficient simple tunes to go round the stations. The main station will have some fundamental tune, the relays will have some slight variation. Stations in one country will have deep melodies, other countries will adopt high-pitched tones. Thus we will always be able to tell what station, what relay, and from which country the sounds are coming.

Morse is bad because it is monotonous and not understood by everybody. Esperanto would be all right if a mechanical signal were not far better and if really everybody could understand Esperanto as pronounced in different countries. Cuckoos are monotonous to the local listener, and we really cannot have the whole animal world represented by the different stations. Fancy one station using the " Bah-bah " of the sheep, or the " He-haw " of the donkey next to the lion's roar and the fish's silence.



Milan's musical chimes form a well-known interval signal.

Now a tune—simple, pleasing and short—meets all requirements, with one exception—how are we to register



A " cuckoo " signifies that you have tuned-in Ljubljana or Wilna. Above is the mechanism employed.

or publish it for those people who know nothing of notes or pianos or, in fact, anything musical? Once every station has its distinctive tune, some enterprising firm will surely construct a kind of tiny, cheap, automatic gramophone which will permanently reproduce the tunes of all the stations according to the alphabet or according to countries.

Then another thing, why publish the notes at all? For the first year or so the change will go gradually, and wave-lengths are pretty constant nowadays, which means that distant listeners will soon get used and acquainted with every station's distinctive tune.

A " Station Medley "?

Just imagine the pleasure to hear our friends in the morning train, or meeting them in the street, humming a tune and asking what station that could have been. Perhaps even somebody will compose a " Station Medley," and then we might dance to a mixture of Hamburg, Vienna, Prague, Berlin, Warsaw, Madrid, Rome, Munich, Cologne, with the London signal, perhaps, as a finishing flourish.

Interval signals are things of the past; what we need are identification signals. And whether these are tunes or not, or if somebody else finds a better solution or not, every station needs some kind of earmark, or in this case some kind of " earsound," by which everybody, regardless of nationality and knowledge, general or otherwise, can recognise a given station.

BELOW SIXTEEN METRES

The Editor

MODERN WIRELESS.

SIR,—In your December issue of the MODERN WIRELESS, W. L. S. wishes to know if any reader has heard any telephony below 16 metres. Well, I should like to mention that some few weeks ago I heard an American accent calling " Hallo, Bridgewater " several times, following up with American news and gramophone records; and also I have heard, well below that — on, I should think, about 10 or 12 metres —two Morse stations. (Being unable to read Morse I cannot say who they are, but I should very much like to know.)

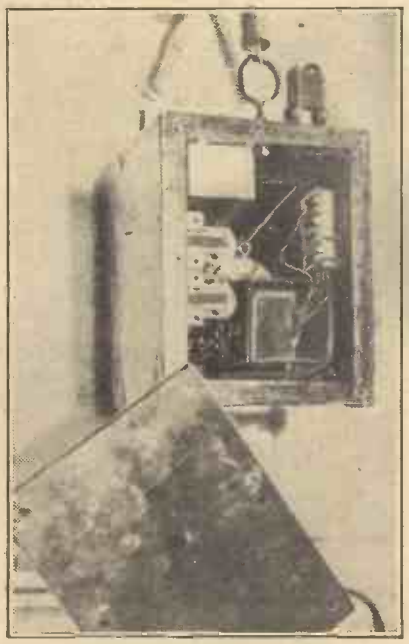
I should also like to say I can get almost any station with perfect ease on the short waves, with very little reaction.

My set is called the " Handyman " Two, with an amplifier added, and it's a gem, and I can assure you I have tried every short-wave circuit that has been published (both in " M.W. " and " P.W."), but the " Handyman " Two is the master.

Yours faithfully,

C. ANDREWS.

Middlesex.



Munich favours an electrical metronome placed in a box with a microphone.

THE "M.W." TAPPED CRYSTAL SET

In this remarkable little set it has been found possible to obtain high selectivity, together with a distinct gain in volume, when compared with tapped circuits of the usual type.

Designed by the "M.W." RESEARCH DEPT. and described by A. JOHNSON RANDALL.

To design a crystal set which gives loud signals as well as sharp tuning is no easy matter. Many schemes have been tried, but, in most cases, in order to get the required sharpness of tuning it has hitherto been necessary to sacrifice a little signal strength.

COMPONENTS REQUIRED.

- 1 Panel 7 in. × 8 in. × ¼ in. or ⅜ in. (Ebonart, "Kay Ray," Resiston, Red Seal, Ripault, Trelleborg, Becol, etc.).
- 1 Cabinet, 7 in. × 8 in. × 7 in. deep approx. (Raymond, Bond, Artcraft, Caxton, Raymond, Pickett, Cameo, Makerimport, Gilbert, Lock, etc.).
- 1 Coil former, 3 in. diameter × 3½ in. long (Pirtoid, Radion, Paxolin, etc.).
- 1 Single coil holder (Lotus, Peto-Scott, etc.).
- 1 ·0005 mfd. variable condenser with plain dial (J.B., Lissen, Lotus, Cyldon, Utility, G.E.C., Raymond, Igranic, Formo, Colvern, Pye, Dubilier, Ormond, Marconiphone, Ripault, Bowyer-Lowe, etc.).
- 1 Crystal detector.
- Wire for coil (see text). ¼ lb. of each size will be sufficient.
- 4 Terminals, markings according to diagram (Belling-Lee, Igranic, Eelex, etc.).
- 1 Piece of ebonite for terminal strip, 5½ in. × 1 in. × ¼ in.
- 8 Panel-mounting sockets (Clix or similar type).
- 2 Plugs to fit sockets (see above).
- Quantity of No. 18 or 20 S.W.G. tinned copper wire and Systoflex or, alternatively, Glazite.
- 1 Shorting bar for loading-coil holder.

It has been the usual thing in these sets to employ one of the well-known methods of tuning, such as the tapped "aperiodic" aerial schemes, with a tuned secondary coil.

The "M.W." Research and Construction Dept., realising the need for selectivity without any loss of volume, has for some time past been conducting a series of experiments with various arrangements in an effort to overcome the usual troubles associated with crystal circuits. However efficient the tuning coil, there is always one point to be considered, and that is, the effect of the crystal itself. Unfortunately a crystal is not like a valve. A valve exercises very little "damping" effect across a tuned circuit. That is to say, it does not "flatten" the tuning very greatly and thereby make it impossible to separate stations from one another.

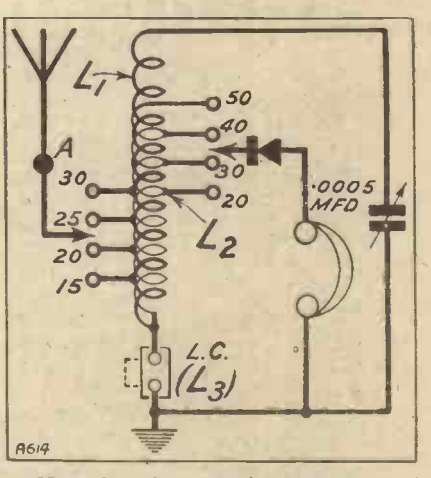
Obtaining Selectivity

A crystal, on the other hand, does "flatten" the tuning because of its low "resistance" and of the fact that it is joined directly across the tuning circuit.

Now in the "M.W." Tapped Crystal Set a special principle has been adopted. Instead of connecting the crystal across the tuning circuit it is joined to a separate tapped coil inductively and closely coupled to the tuned circuit. This tuned circuit is simply a semi-aperiodic arrangement with tappings to which the aerial can be taken. There is also a loading coil socket which is short-circuited on the medium waves and in which a No. 150 coil can be inserted for the reception of Daventry (5 X X).

The Tappings

The method of tuning the set is very simple. There are four aerial tappings, and the aerial lead should be joined to all of them in turn in order to find out which gives the best results. Also there are four crystal tappings and the same procedure is adopted, i.e. the crystal tap is tried on each of the tappings until the best combination of aerial and crystal tap is found for the particular station being received



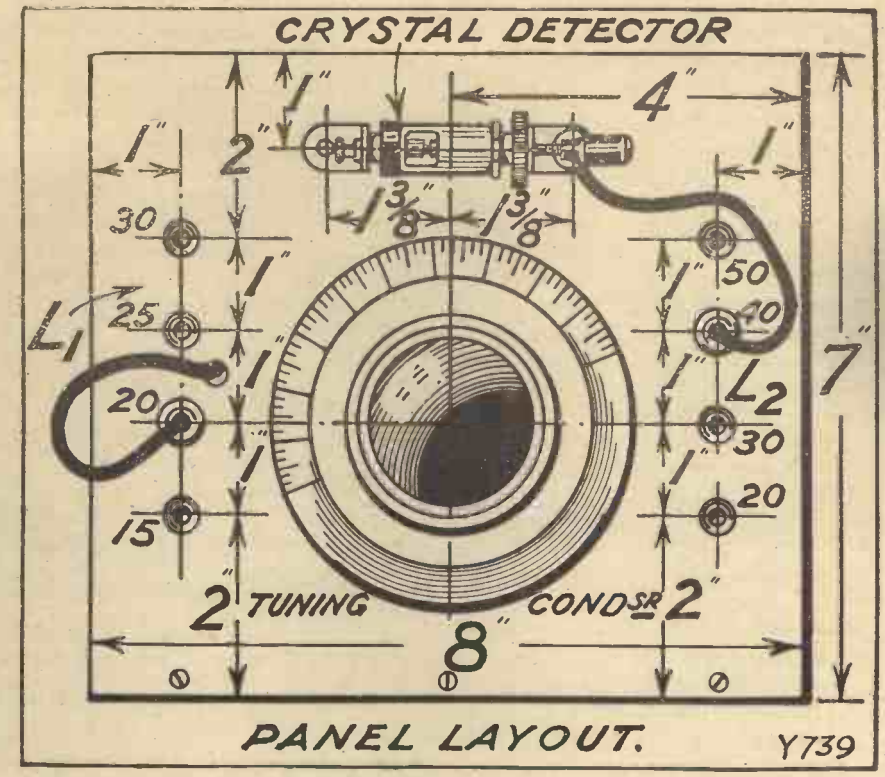
Now for the actual constructional part of the set. There is practically nothing easier to build than a crystal receiver. If you look at the photographs you will see that the home-wound and loading coils are mounted on a wooden baseboard, while the

remainder of the components are secured to the vertical panel. This procedure of using the vertical panel scheme is very valuable in cases where the listener desires to add an amplifying unit at some future date. The majority of modern amplifiers are built on this principle. Commence the construction by marking off and drilling the panel in readiness for the components.

Making a Start

The necessary dimensions are given in the panel drilling diagram. Take a straight-edge and a scriber, or a sharp-pointed nail, and mark off lines across the panel, measuring along these lines the various drilling points. Then take a centre-punch and give it a tap with a hammer at the centre points so that you will have a mark at each drilling centre deep enough to prevent the drill from wandering. The ·0005 tuning condenser will probably require a $\frac{3}{8}$-in. bit and it is advisable to use this in conjunction with an ordinary carpenter's brace rather than one of the American hand-drills.

Then there are eight sockets—four on each side of the panel—for the tappings from the coil. On the right-hand side (looking at the back) of the panel a small hole will be needed near these sockets for the flexible from the aerial to the plug to pass through.



Here we see the four crystal tappings which are taken at 20, 30, 40, and 50 turns along the winding L_2. These taps are joined to sockets on the right-hand side of the panel (looking at the front) and are marked L_2 in the panel layout diagram shown above.

Above the tuning condenser are the two holes for the crystal detector mounting, and you will see that one of these screws has a flexible which terminates in a second plug for the L_2 or crystal tap sockets.

Along the bottom edge of the panel, about $\frac{3}{16}$ in. up, you will require three holes to take the wood screws which secure the panel to the baseboard.

At the back of the baseboard is a strip of ebonite about $5\frac{1}{8}$ in. long and 1 in. or $1\frac{1}{2}$ in. in width for the four terminals. The terminal strip can be mounted horizontally on two wood blocks, but this is not very important, and if the constructor wishes it may be secured vertically directly to the edge of the baseboard.

Winding the Coil

After you have mounted the components on the panel and secured it firmly to the baseboard you will be ready to turn your attention to the construction of the broadcast band coil. This is made as follows:

The basis for the coil is a former of any good material 3 in. diameter and $3\frac{1}{2}$ in. long. Upon this there are two windings, one consisting of 60 turns of No. 24 gauge D.S.C. with four tappings, and another of 50 turns of No. 32 D.S.C. with four tappings, which has to be interwoven, turn by turn, with the thicker winding.

This is how you proceed to wind the coil. Arrange your two bobbins on the table and take the two ends and twist them together. Secure these by

passing them through two small holes in the tube placed about three-quarters of an inch from one end. Proceed to wind on the two wires, side by side, pushing them up close together with the thumbnail as you proceed. When you have wound on 15 turns of the thicker wire, twist up a small loop, in the thick wire only, to form a tapping point. At the twentieth turn take a second tapping along the thick wire winding and the first tapping along the thin wire winding. Take tappings along the thick wire winding at 25 and 30 turns, and along the thin wire winding at 30, 40 and 50 turns, taking care to keep the two sets of tappings well separated.

Wiring Up

When you have finished winding the coil, mount it vertically on the baseboard with the aid of a strip of wood inserted in the coil former and screwed down to the baseboard.

The strip should have the ends rounded so that it fits tightly inside the former. Then place the loading coil socket in position.

Now you are ready for wiring up. There is little to be said about this. The various leads—which can be Systoflex-covered 16- or 18-gauge tinned copper wire—can be soldered to the tapping loops on the coil, but in many cases you will be able to use the terminal connections on the components, thereby obviating soldering.

When you have completed the wiring the set will then be ready for testing. Join the aerial and earth leads to the terminals so marked and a pair of high-resistance (2,000 ohms) telephones to the 'phone terminals on the strip. Insert the L_1 tapping plug in the 30-turn socket and the L_2 wander plug in the 50-turn socket. Short-circuit the loading coil socket with one of the plugs sold for the purpose and adjust the tuning condenser until you hear your local station. Then try various positions for the L_1 and L_2 plugs to see which gives the best results.

Receiving 5 X X

To tune in 5 X X insert a No. 150 coil in the L_3 socket and re-tune on the tuning condenser.

This set should receive 5 X X up to distances of 80–100 miles, and an ordinary main B.B.C. station up to 12–15 miles. For a relay the range would be about 5 miles. Use, if possible, a good outdoor aerial, because the strength of signals depends upon the efficiency of the aerial and earth systems, and it is useless to expect good volume if you have a poor aerial.

Many listeners frequently wish to increase the volume they are obtaining in order to work a loud speaker. The easiest way to do this is to add a separate low-frequency amplifying unit to the set.

To obtain decent loud speaking it is advisable to construct a two-valve amplifier, because a single-valve amplifier is really only suitable for use within a few miles (three or four) from the local station. A two-valve amplifier, on the other hand, will operate a sensitive speaker up to distances of ten miles or so from a main B.B.C. station.

Such a unit is quite easy to make, and its operation is simple and does not add complications to the existing set.

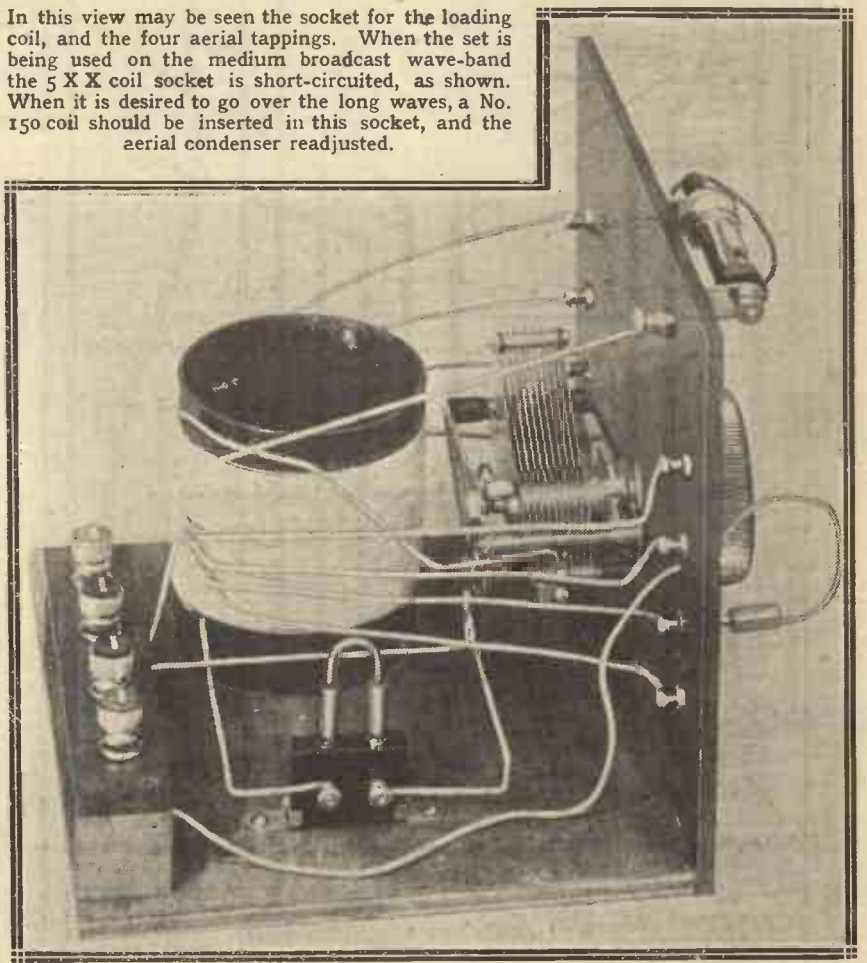
There is a two-valve amplifier blue print which is very suitable for use with crystal sets. Its number is 38, and the price 7½d. post free from the publishers of this journal.

Sometimes readers desire to increase the range of their crystal receivers. This is not an easy matter, and the use of an H.F. unit is not to be advised. It is difficult to design a really efficient circuit that will function satisfactorily with the average crystal set, and in addition listeners who have had no previous experience of two-dial tuning would find such a unit rather beyond them.

Obtaining More Volume

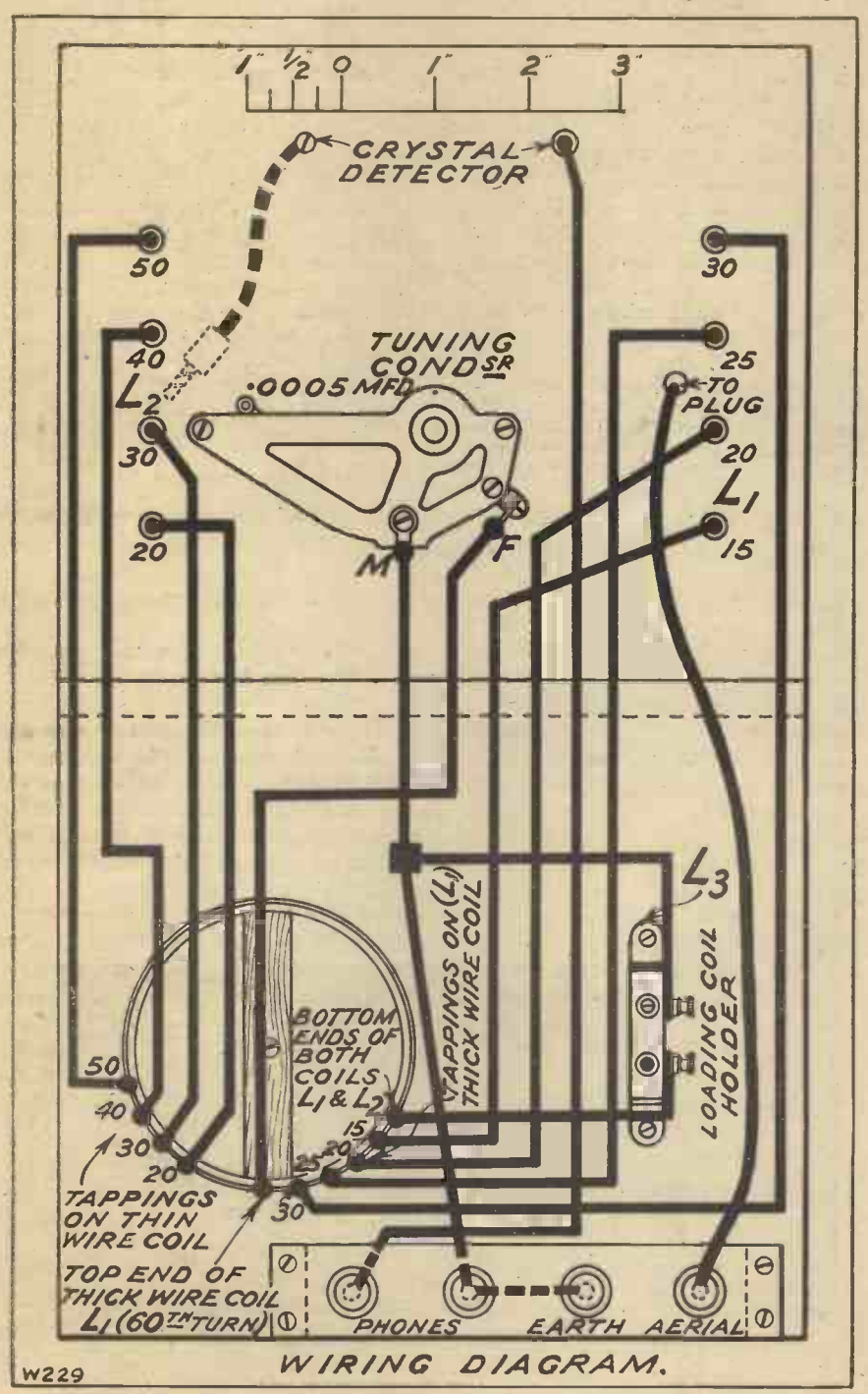
If you want louder signals, by all means build an L.F. amplifier, but do not try to add one of the H.F. units intended for use with valve receivers. It is a vastly different matter to design a high-frequency amplifier for a crystal set. It is not suggested that it is impossible to use high-frequency amplification in conjunction with a crystal. The use of H.F. valves with a crystal set has, however, dropped out, except in the case of special circuits such as, for instance, the reflex type.

Constructors who are unable to erect a good outdoor aerial are very badly handicapped when the question of getting the best from a crystal receiver arises. A crystal possesses no amplifying properties and in consequence it relies solely upon the energy picked up by the aerial. Now, if the aerial is poor and badly screened the total amount of energy picked up will



In this view may be seen the socket for the loading coil, and the four aerial tappings. When the set is being used on the medium broadcast wave-band the 5 X X coil socket is short-circuited, as shown. When it is desired to go over the long waves, a No. 150 coil should be inserted in this socket, and the aerial condenser readjusted.

be small and signal strength will suffer. If you are situated very near your local station, say, within a mile or so, an indoor aerial may be quite O.K., but otherwise it will pay you to build a single-valve set, if you cannot erect a decent outdoor aerial.



WIRING DIAGRAM.

Here is another tip. Never touch a crystal with your fingers. If you do, you will probably leave a coating of grease on the surface and destroy the sensitivity of the detector. If you require maximum signal strength, a good cat's-whisker crystal detector is best, but if you want reliability at the expense of a slight loss of sensitivity, the permanent type is to be recommended.

Here is a final hint. Do not paraffin-wax or shellac the coil with the idea of waterproofing or making it more robust. This used to be the usual procedure with coils a year or two ago. Modern development proved that it did not pay to cover the coil with a coating of varnish or wax, since the "dope" increased the self-capacity of the winding and reduced its efficiency very considerably.

In the ordinary course of events there is very little danger of the windings getting damp.

5SW IN INDIA

SIR,—I am now going to give this information regarding the transmission of 5SW (Chelmsford, England), of The British Broadcasting Corporation.

I receive their transmission at good loud-speaker strength on using one detector and two low-stage. Their transmission was very clear, like a local station (7CA, Calcutta station, 12 kw.); speech was as clear as possible, very steady; the evening transmission from London comes here as good as possible. It seems to me that 5SW is one of the most powerful stations in the short-wave telephony. I received their test transmission with the station 2XAD (U.S.A.).

I am now regularly going to hear the following short-wave telephony stations: 5SW, 2XAD (U.S.A.), 2XAF (U.S.A.), 2XG (U.S.A.) (the American stations come here on good headphone strength), 3LO (Melbourne), 2ME (Sydney), 6AG (Perth, West Australia) (the Australian stations come here good loud-speaker strength). The Dutch stations, PCJJ and PCLL, come here good headphone strength. The 7LO station comes here like a local station. The Java short-wave stations, ANE and ANH, come here like a local station. I have heard sometimes the ANH station going to test with the station 2ME (Sydney, Australia).

This is the report of my short-wave work. I am now using the straight short-wave circuit. I hope that you will be glad to get this information.

Yours faithfully,

M. MOZOOMDER.

Calcutta, India.

THREE USEFUL TIPS

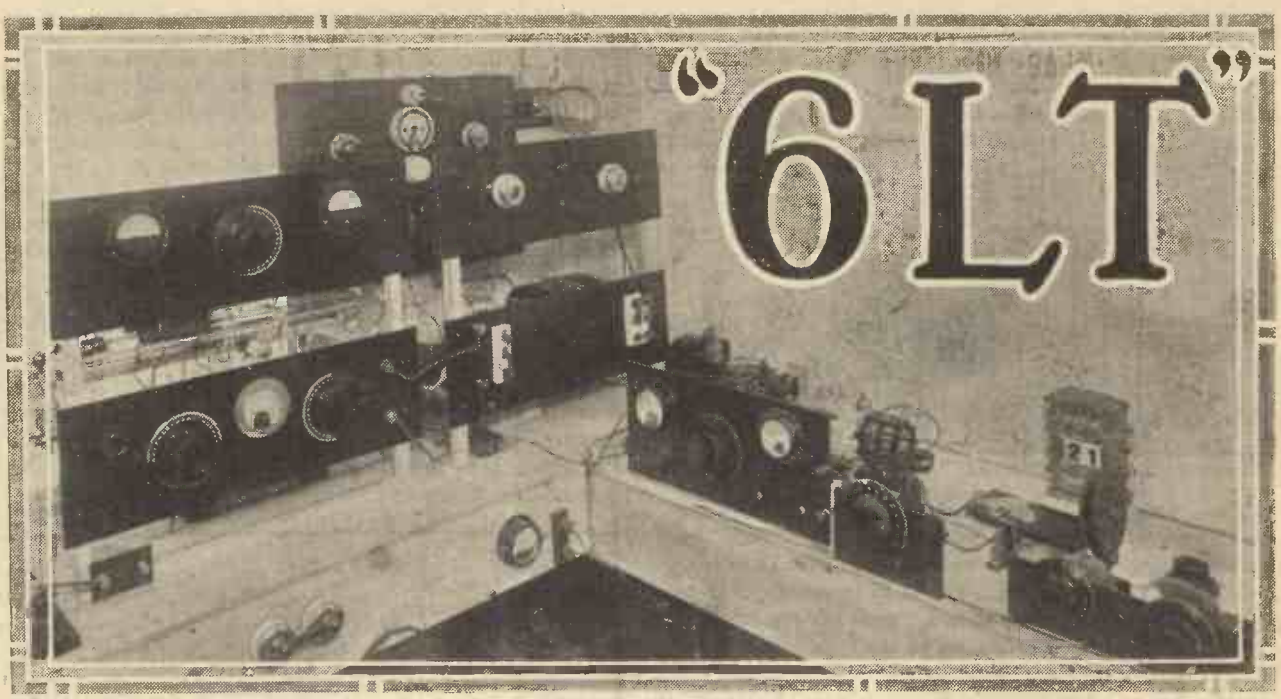
A fact which is often overlooked is that wires running too close to one another in a crystal set will often give rise to a serious loss of strength.

* * *

Continuous scratching noises in a set, accompanied by a great loss in signal strength, generally indicate a burnt-out transformer winding.

* * *

Although a little sag is advisable in the aerial, it is important that it should not be allowed to swing too much, or one or more of the strands may be broken, which will give rise to unpleasant crackling noises in the set.



Details of a "baby" short-wave transmitter which is being used for tests where a portable station is essential.

By L. H. THOMAS (6 Q B).

"6 L T" is the pet name of a portable transmitter which was built in the spring of 1927. Owing, however, to the almost entire absence of any summer during that year, operations with the portable did not commence in real earnest until this last summer, when the weather was very much more in keeping with such pursuits.

The transmitter was really made in the first place with the object of touring round the neighbourhood in a small car, camping out at various points, and getting into touch with the "home" station, 6 Q B, for the purpose of checking the directional effects of the "home" aerial, and the screening effects of various large buildings and steep hills in the neighbourhood.

This year, however, the home station was moved to a better locality, where there is considerably less screening, and there was, consequently, rather less work to be done on these lines than was anticipated. 6 L T, therefore, degenerated into a mere transmitter which was taken for a ride out into the country on occasions and used in conjunction with small aerials slung up convenient trees.

A Complete Low-Power Station

As yet no serious work has been done between the two stations, as there seems to be no real reason for carrying out such tests unless over a fairly long distance.

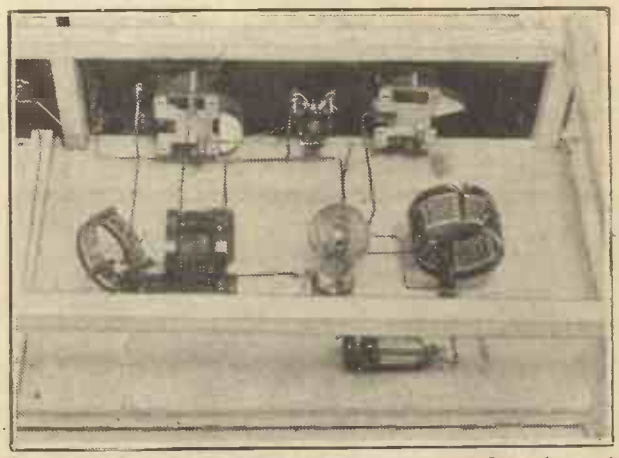
"6 L T," of course, comprises a receiver as well as a transmitter, in compliance with the conditions of the licence. It must also carry with it a licensed operator who has satisfied the G.P.O. of his ability to send and receive Morse signals at a given speed.

One of the photographs gives a good idea of the layout of the transmitter, which is kept separate from the receiver, although the two are mounted on the same frame and baseboard. Although the very lowest powers were always used, the transmitter was constructed somewhat solidly, and all wiring was carried out with No. 12 gauge copper wire, for the sake of rigidity.

The actual circuit used was the favourite Armstrong or "tuned-plate tuned-grid" arrangement, chiefly because this lends itself to a compact layout and is noted for the steady signal that it will put out when properly operated.

The valve in the socket is an L.S.5, which was used throughout the tests. The complete circuit is shown in Fig. 1.

The receiver is a perfectly straight detector and one stage of L.F. It is somewhat remarkable to note that as soon as one gets well out into the country this receiver will often give far stronger short-wave signals on the smallest aerial, perhaps not more than 10 ft. high, than it will on the main aerial at home, although that is believed to be in a fairly good location.



The interior of the transmitter, showing the L.S.5 valve and the short-wave coils.

As will be seen from the photograph of the front of the set, the two tuning controls of the receiver have been placed on a small panel mounted at the *top* of the frame to facilitate tuning. Only the rheostat is mounted on the front panel, which houses also all the transmitter controls, the change-over switch, and the H.T. and L.T. terminals.

The frame has been made to fit snugly into the rear seat of the car. The seat itself is fairly well sprung, and for this reason it was not thought necessary to indulge in

the usual fancy mounting of rubber bands, inner tubes, or anything of the kind, for the apparatus. No breakages have yet been experienced, although some very rough roads have been traversed in the search for a good location.

From the L.T. terminals two thick leads are taken

Changing over from " transmit " to " receive " on 6 L T.

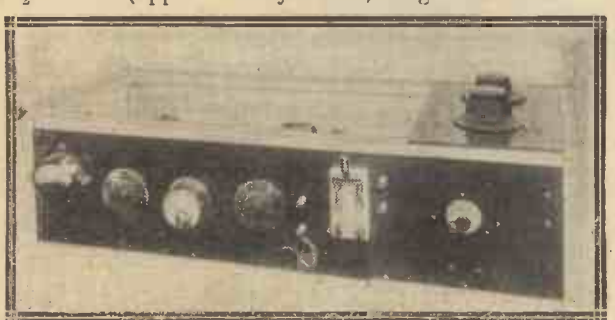
straight down to the car battery, which is normally housed under the near-side front seat; these leads are, therefore, quite short and do not interfere with the wiring of the car in the least. From the H.T. terminals, also on the front panel of the transmitter, two leads are taken to the H.T. supply which is housed on the floor immediately beneath the transmitter, behind the front seats.

The H.T. supply has been changed from time to time. An M.L. anode converter, delivering 550 volts, has been the standard supply for 10-watt tests, but when much lower powers have been employed for various reasons, one or two 99-volt H.T. batteries of a standard receiving type have been used, and stood up to their rough treatment quite well.

A " Mobile " Aerial!

The meter at the left-hand end of the main panel is a Telefunken hot-wire meter with a shorting switch incorporated. Although the actual value of aerial current obtained with the transmitter means nothing at all, it is always useful to have a ready means of *comparing* aerial currents with one or more aerials and with different transmitter adjustments, and for this reason the meter was incorporated. The other meter is a Weston milliammeter in series with the H.T. supply.

Two of the other photographs show the set in its natural surroundings, one in particular showing the method of erecting the aerial. For work on 45 metres, which was the wave-length used for most of the tests, an aerial exactly 22½ metres (approximately 73 ft.) long was used, and



The transmitter is to the left of the change-over switch, the section to the right is the receiver.

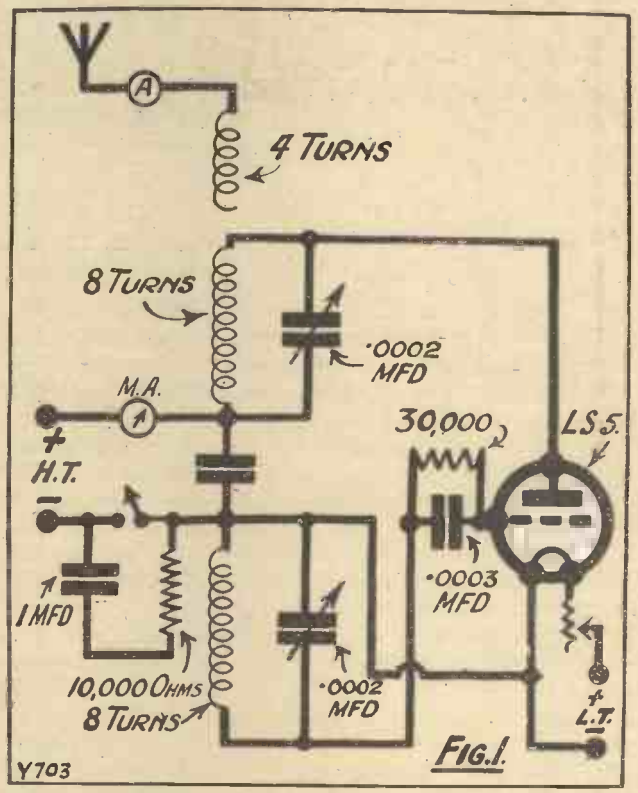
for the sake of convenience this was carried in the form of a 73-ft. length of rubber-covered flex, with two insulators permanently fixed at either end.

The usual procedure was simply to fix one end of this to the top of a convenient tree, attaching the other end to the back of the car and driving the car slowly away from the tree until it was fairly tight.

This was very convenient for studying directional effects also, since the car could be driven round the tree without disturbing the transmitter at all! Naturally, the amount of swing possible was usually limited by the presence of other trees, not to mention ponds, fences, and other obstructions! The spare two feet or so " beyond " the insulators at the lead-in end was simply taken to the aerial terminal on the transmitter; thus it was possible to make the aerial quite reasonably tight without hauling the whole apparatus out of the car.

The Most Startling Result

The aerial was supposedly working as a " half-wave voltage-fed Hertz," to give it the full title, being fed directly at the end. As will be seen from the circuit diagram, one side of the aerial coupling coil (that nearest the anode coil, in practice) was left " dead," the other being taken to the aerial.



Probably the most startling result obtained with the transmitter was on the very first test which was carried out. The location was between Chipstead and Reigate.

An Immediate Reply

The aerial was a makeshift affair slung to a dead tree lying in a field, the topmost parts of which were no more than 14 ft. high. Since the " home " end of the aerial, attached to the car, was but 3 ft. from the ground, the average height of the whole affair was just over 8 ft.!

With an input of exactly 1 watt (10 milliamperes at 100 volts) a short test call was transmitted, and a reply received immediately from GW-11D, at Naas, Co. Kildare, a distance of about 250 miles. He reported the C.W. signals as " R.5, very clear and dead steady."

At none of the locations tried since has it been possible to obtain another report as good as this with a similar input. Strangely enough, this particular location was apparently far from good from the receiving point of view, since all the stations heard were extremely weak.

B.B.C. PROGRESS IN 1928

A review of some of the outstanding broadcasting events of the year.

By THE EDITOR.

THE B.B.C. has circulated some notes concerning the progress of the Corporation during 1928. These notes certainly make interesting reading, and the compiler of them is of the opinion that one of the most outstanding events of the year 1928 was the start made in May on the new Regional Transmitter at Brookman's Park.

As every reader knows, this is the new twin wave-length high-power station for London, and when it is completed it will be the first of its kind to be erected in the world. It is anticipated that this first Regional station will be in operation some time this summer, and that when completed it will cover a much larger and wider area than the present 2 L O. Furthermore, there will be less interruption, and eventually it is anticipated that the station will give all South-East England an alternative programme, first in an experimental form and, later, when technical progress has been made, on a permanent basis.

Further Regionals

Other sites in other parts of Great Britain are also now being investigated by the B.B.C. engineers with a view to the erection of other Regional stations similar to the one now in course of construction at Brookman's Park.

Listeners who keep a diary will remember that last January a new aerial was erected at Daventry experimental station with the result that the quality of reception of 5 G B's programmes in the North-East and South of England showed a very great improvement.

Our photo above shows Earl Jellicoe before the microphone.

Some of the chief outside broadcasts of the year included the relay of the nightingale's song from Pangbourne last May, when reception reports were sent in from as far away as New Zealand. There was also the relay of a running commentary on the University Boat Race last March, the relay of a descriptive narrative of the

These illustrations recall two of the B.B.C.'s successful "outside" broadcasts, viz., the Oxford and Cambridge Boat Race and the debate between Mr. G. B. Shaw and Mr. G. K. Chesterton.

Derby on June 6th, and other well-known races in June and September.

Another important and successful outside broadcast was the relay of the Armistice Day Service from the Cenotaph, last November 11th, and listeners will also probably remember the relay last March from Liege, which included a choral programme given by the famous Liege Choir. On March 12th, the B.B.C. gave the first simultaneous broadcast from British and German stations, the Second Act of the "Marriage of Figaro," performed in the studio of the Cologne station, being relayed to London.

A Famous Relay

Then, in August, was the relay of the service which terminated the British National Pilgrimage to the battlefields. This was broadcast from the Menin Gate to all stations of the B.B.C. except 5 G B, and was also broadcast by the short-wave station, 5 S W.

Other relays of the year included one of the first matches in the F.A. Cup competition, the Cup Final at Wembley, the Wimbledon Lawn Tennis Tournament, the final shoot for the King's Cup at Bisley, etc., etc. A running commentary of the Tunney v. Heeney fight at the Yankee Stadium, New York, was also relayed from 2 L O and 5 X X in July, and from Lakehurst, in October, was given a descriptive narrative of the arrival of the Graf Zeppelin.

Outstanding Plays

Some of the outstanding radio plays of the year included: "Pursuit" (given last January), "Speed," "Rampa," "Through the Looking Glass," "Caravan," "Montezuma." The B.B.C.'s new series of plays selected from classics of British, Belgian, Norwegian, Spanish and other authors was started in September under the title of "The World's Great Plays." This series is now continuing, and is proving extremely popular.

Plays by Ibsen, Strindberg, Sheridan, Oscar Wilde, Temple Thurston, John Drinkwater, Maeterlinck, Yeats, Synge and Bernard Shaw were also included in the dramatic programmes for 1928, and among the famous artistes who appeared before the microphone may be mentioned Lady Forbes-Robertson, Phyllis Neilson-Terry, Matheson Lang, Granville-Barker, Fay Compton, Mabel Terry Lewis, Wilkie Bard, Clarice Mayne, Arthur Prince, Muriel George and Ernest Butcher, Violet Lorraine, Harry Lauder and many others.

1928 also saw the inauguration of variety turns relayed from the stage and broadcast to listeners. These relays from the Palladium, London, are still continuing, and among other stage relays of the year must be mentioned: Excerpts from "So this is Love," from the Winter Garden Theatre; and "Virginia," from the Palace Theatre, London. An outstanding new feature commenced in 1928 was the surprise item. The first surprise item was given in July and has been continued weekly ever since.

The broadcasting of the song of the nightingale—one of the most popular of all the broadcast events—has been greatly assisted by Miss Beatrice Harrison. She is here shown in the studio playing the 'cello that is used to encourage the nightingales to sing for the microphone. Last year's nightingale broadcast was from the woods near Pangbourne.

Probably the most interesting was on August 10th, when the broadcast took place from a Signal Box at King's Cross, and also on September 14th when Jack Hobbs and other members of the M.C.C. team broadcast a good-bye on the eve of their departure for Australia.

A musical relay of great importance occurred on January 5th, when the Royal Philharmonic Orchestra's programme was broadcast from the Queen's Hall via 2 L O. Symphony Concerts in London and the provinces have been broadcast under the direction of the world's most distinguished conductors, including Dame Ethel Smyth, Eugene Goossens, Stravinsky, Scherchen, Talisch, Schneevoigt, von Hoesslin, Fried, Barbirolli, Sargent, Ronald, Hamilton Harty, Henry Wood and Percy Pitt.

Promenade Concerts were also broadcast this year from the Queen's Hall, and a series of B.B.C. Symphony Concerts began in October, the first conductor being Sir Thomas Beecham. At a later concert, a special work entitled "The Pilgrim's Progress," by Professor Granville Bantock, was given, with the full newly constituted National Chorus.

Operatic Broadcasts

Some of the great musicians of the day have broadcast during 1928, and although they cannot all be mentioned, they included such stars as Olczewska, Elizabeth Schumann, Eugene d'Albert, Suggia, Miriam Licette, Solomon, Medtner, Moiseiwitsch, Gretchaninov, Myra Hess, Albert Sammons, Pampanini.

Some of the Operas broadcast in 1928 included: "Maritana," "Pelleas and Melisande," "Samson and Delilah," "The Blue Forest," "The Girl of the Golden West," "The Return of Ulysses," "Merry Wives of Windsor," "Armida," "Cosi Fan Tutte," "Manon Lescaut," "Oedipus Rex," and among the Light Operas may be mentioned the first performance of "Charming Chloe" and "A Sea Change"; also must be mentioned the first broadcast performance of "Merry England" and "Tom Jones," by Sir Edward German, and "The Rebel Maid," by Montague Phillips.

Last February was formed the National Orchestra of Wales, in co-operation with the B.B.C., when the latter undertook to support the scheme financially.

Well-Known Speakers

In March, 1928, following a statement made by the Prime Minister in the House of Commons, the B.B.C. announced that authority had been conceded to them to include controversial matter in the programmes—a satisfactory conclusion to a five years' endeavour to secure this privilege. Although it has been very difficult since to get suitable controversial programmes, readers will remember that some very interesting discussions have been given in 1928, among which may be mentioned the debates between Sir Ernest Benn and Mr. James Maxton, M.P., on "Riches and Poverty"; Mr. Pat Hendren and Colonel Philip Trevor on "Cricket"; the Rt. Hon. J. H. Thomas, M.P., and Col. J. C. T. Moore-Brabazon, and, later,

Mr. Thomas's "gloves off" debate with the Editor of the "Daily Express."

There was also the debate between Miss Ellen Wilkinson, M.P., and Mr. W. H. Thoday on the question of "Should women be paid as much as men?" and Miss Marjorie Fry and Captain Arthur Evans, M.P., on "Capital Punishment."

Royalty Before the "Mike"

It would be impossible to give a list of all the talks given in 1928, but among the distinguished speakers may be mentioned: Sir Nigel Playfair, Sir Barry Jackson, Miss V. Sackville-West, the Rt. Hon. Arthur Ponsonby, Mr. George Grossmith, Sir James Jeans, the Rt. Hon. L. S. Amery, Rt. Hon. W. Ormsby-Gore, Rt. Hon. Philip Snowden, Sir Valentine Chirol, Lord Jellicoe, Lord Cavan, Sir Sefton Brancker, Sir Alan Cobham, Lady Heath, Major Malcolm Campbell, Emil Ludwig, Ian Hay, E. F. Benson, John Buchan, Lord Dunsany, John Drinkwater, Compton Mackenzie and many others.

Among the Royal broadcasts of the year was that of the Queen, when Her Majesty was heard for the first time by listeners on December 12th on the occasion of the Unveiling of the Memorial to the Merchant Navy, the ceremony being relayed from Tower Hill.

His Majesty the King was heard in July, when he opened the new University Building in Nottingham, and again in October he performed the opening ceremony of the new Tyne Bridge.

The Prince of Wales' first broadcast in 1928 took place in March, when he spoke at the Annual Banquet of the Master Mariners at the Mansion House.

In May the Prince was again heard when his opening speech of the Royal Tweed Bridge was broadcast from Newcastle, when the B.B.C. relayed to London and broadcast from other stations.

The Prince was again heard in June at the Unveiling of the Welsh National War Memorial, and, lastly, on Christmas Day, when His Royal Highness appealed from the studio at 2 L O on behalf of the Miners' Distress Fund.

Fultograph Tests

The final outstanding event of 1928 was the first transmission of still-pictures in October, the experimental broadcasts being so successful that it is now understood that the Fultograph system will be continued for another twelve months.

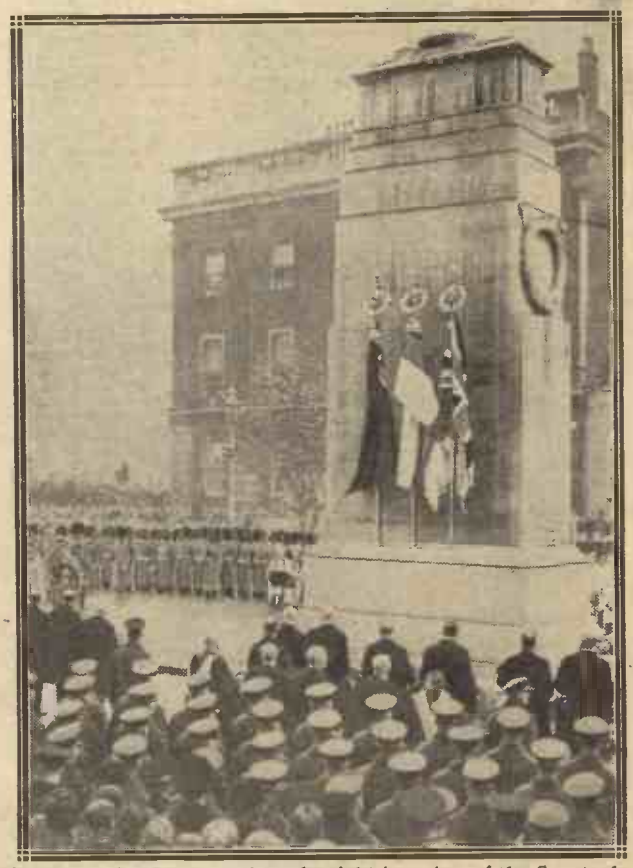
At the end of 1928, the B.B.C. announced that following the introduction of the Regional Scheme, rather than withdraw the relay stations an attempt was to be made to overcome interference and revive their usefulness by adopting the arrangement of single-wave working.

The Nottingham transmitter was taken out of action in November, and Nottingham listeners have since taken their place among the Birmingham listeners in the service area of the Daventry Experimental station, 5 G B.

Few Breakdowns

During the year the B.B.C. broadcast programmes occupied 68,000 hours, this including all transmissions from twenty-one stations of the B.B.C.

The total period of breakdown was less than twenty hours; and, finally, as a proof of the steadily growing popularity of broadcasting and the success of the B.B.C., it may be mentioned that the licences in force on November 30th, 1928, numbered 2,580,342. This figure includes 13,826 free licences issued to the blind.



The left-hand picture shows the equipment on the launch which followed the boat-race, and on the right is a view of the Cenotaph service in Whitehall.

Screening-Grid Voltage

G. K. (Sidcup) has an H.T. eliminator and finds that he is unable to adjust the voltage on the screening grid of his H.F. valve (one of the vertical type) to his liking. His mains unit has three tappings, none of which gives the required 80 volts.

Your best plan, G.K., is to procure a variable resistance of the Centralab or Bradleyohm type, having a value not exceeding 250,000 ohms. Place this in series with the H.T. lead to your screened-grid valve, and adjust its value until you obtain the desired results.

You may have to use one of the higher H.T. tappings on your eliminator, but the resistance will give you all the control needed. Do not attempt to measure the H.T. voltage on the screening grid when the resistance is in circuit, because if you do you will find it practically impossible to obtain an accurate reading with a voltmeter of the ordinary type. Your adjustments should all be carried out by experiment, and when you get the best signal strength you will know that you have obtained the optimum value of H.T. for the particular valve you are using. One of the advantages of this resistance in the H.T. lead is that it helps to prevent battery coupling, because in very nearly every set there is a fairly large by-pass condenser from the screening grid to L.T. —. This in conjunction with the resistance forms to some extent an "anti-mobo" device, and is a help in preventing instability.

Volume Control

D. T. A. (Chiswick) asks whether a volume control is an advantage when a stage of L.F. incorporating a pentode valve is used.

Yes, a volume control is beneficial with any set except perhaps two-valvers such as a det. and L.F. In the case of the pentode, one might say that a strength control of some sort is almost essential.

The pentode has a steep curve, since it has a very high amplification factor. In consequence, the permissible grid swing is about equal to that of a small power valve, although, of course, the actual volume obtained for this small grid charge is much greater than that which one would get with an ordinary 3-electrode valve. It is, therefore, essential to adjust the signal strength so that the pentode is not overloaded, and to do this a volume control is very necessary. De-tuning is one method, but perhaps the most convenient scheme is a potentiometer of about 500,000 ohms (or more), connected across the secondary terminals of the L.F. transformer. The connections are as follow: One terminal of the transformer secondary is taken to one side of the potentiometer. The other secondary terminal goes to the other end of the potentiometer resistance strip. The lead from the secondary terminal to the grid of the valve is disconnected and taken to the moving arm of the potentiometer.

An Efficient Two-Valver

O. A. K. (Glasgow).—"I am a comparative novice in constructional work, and I should like to make up a two-valve set for all-round work. I am rather keen on making up a set from a blue print, since I find these easy to follow, owing to the large scale to which they are drawn.

"Can you tell me where I can obtain a suitable blue print?"

Blue prints of a large number of receivers of standard type are obtainable from the Radio Queries Dept., Fleetway House, Farringdon Street, London, E.C.4.

The price is sixpence each, and all applications should be accompanied with a stamped addressed envelope. A list of blue prints in stock will be forwarded upon request. In your particular case we recommend blue print No. 31, a "Standard" Two-Valver, which is a most efficient detector and one L.F., incorporating plug-in coils and Reinartz reaction.

Selectivity and Crystal Sets

W. W. (London).—"I have a crystal set which gives me all I desire in the way of volume from the London station. My trouble is to receive 5 X X and 5 G B without interference from 2 L O, from which station I am only three miles distant. Can I improve the selectivity in a manner which will enable me to do this?"

You are situated in what one may term the "swamp" area, and we are afraid that it will be very difficult for you to cut out the powerful local transmission and receive the two Daventry stations. Your best plan is to build a two-valve set, with a selective H.F. stage, and to use this in conjunction with a wave-trap if necessary.

By doing this you will stand a much better chance of eliminating this local interference. Such cases as yours are fairly common, and it is always a troublesome matter to tune out the nearby station when endeavouring to receive another weaker transmission.

With a valve set it is easier to obtain selectivity, and there is a bigger reserve of signal strength.

The "M.W." "TRANSPORTABLE" FOUR

This is a set that contains its own aerial, batteries, loud-speaker—in fact, everything. A set that can be picked up and carried from room to room as desired. A set that gives really good reproduction of your local station, with 5 G B and many foreigners as alternatives. In fact, just the set you have been looking for.

Designed and described by the "M.W." RESEARCH DEPT.

THE great and still growing popularity of the more powerful type of semi-portable receiver has been quite a remarkable feature of the current wireless season. That such sets should be taken up so widely during the winter months may seem odd to anyone who has always thought of them as holiday or picnic outfits, but the fact is that many people have been discovering that they have really a far wider sphere of usefulness.

Modern types of self-contained sets have so improved in performance that they now make very serious claims upon the attention of everyone who wants the programmes in different parts of the house, does not want to erect an outside aerial, or objects to the untidiness of the ordinary set, with its exposed batteries and separate loud speaker.

Growing Vogue of Portables

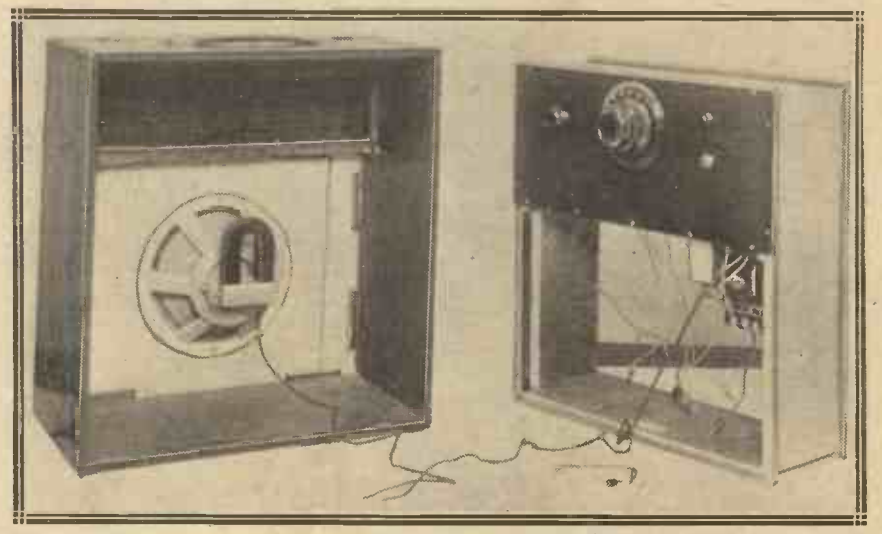
They can now be produced in forms giving really good reproduction, and the larger versions can be depended on to receive the local, 5 G B, and quite a number of foreigners on the loud speaker without the use of an outside aerial. Taken all round, such a set is a very attractive proposition, bearing in mind its neatness and freedom from external connection, and it is evident that it will make an increasingly strong appeal to the home constructor as time goes on.

The whole question is a very interesting one, and its importance has been considered such as to warrant the expenditure of a great deal of time in experimental work in the "M.W." Research Dept. We have investigated the whole problem with some thoroughness, and in the course of the practical work undertaken we have arrived at some general conclusions which may interest the reader who is considering such a set for his own purposes.

First of all, there is the question of the amount of amplification necessary to get really adequate results, i.e. the number of valves required. It seems that we must assume that a built-in frame-aerial winding must be used, since most people apparently object to a separate one, however it may be arranged. This in itself is a handicap, since such a frame cannot be as efficient as a separate one, and this means that greater sensitivity will be required.

The Enclosed Aerial

Basing our experiments on such a moderate size of frame as can be fitted inside a normal type of "transportable" cabinet, and allowing for



The containing case with loud speaker is shown to the left, whilst beside it is the frame aerial assembly containing the set, which fits inside the case.

the reduced efficiency resulting from its being placed round the set, speaker and batteries, we have found a single normal three-electrode H.F. valve is scarcely sufficient.

Moreover, to get high amplification from such a valve it is generally necessary to use fully-tuned intervalve circuits, and that means two tuning dials. This, in turn, means a rather difficult set to operate, since tuning becomes exceedingly sharp and critical on a frame aerial. Ganging we do not find a satisfactory solution of the problem under home construction conditions: it complicates matters greatly and introduces risks of trouble.

One or Two Stages?

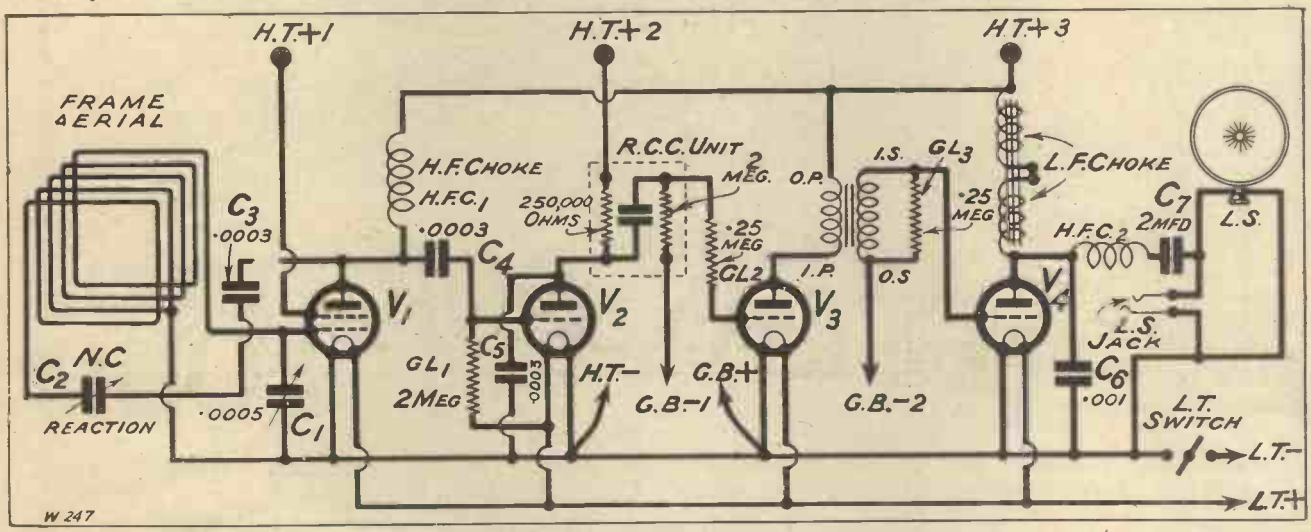
To ensure simple handling and make the set suitable for general domestic use it is evident that a single tuning dial is essential, and to this limitation we have conformed. It was then found that two semi-aperiodic H.F. stages with ordinary valves would be needed to give the desired results, and it was decided that the resulting increase in the size and complication of the set was undesirable.

Accordingly, we turned to the screened-grid valve in hopes that it might be found that a single stage on these lines would be adequate. A normal fully-tuned stage was first tried, and this, as might be expected, did actually give quite sufficient amplification for the standard of reception we had in mind (more as to this later).

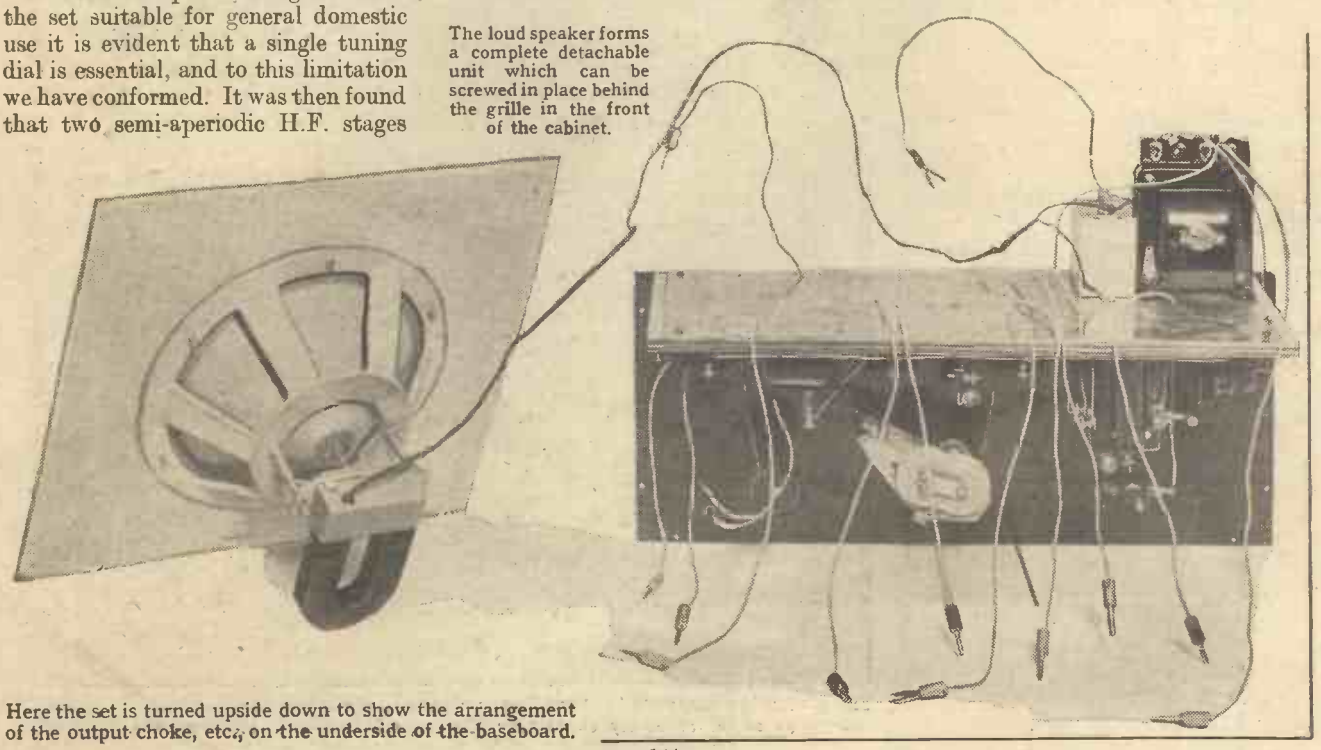
A stage of H.F. on these lines, however, was found to present a very difficult problem from the stability point of view, and in any case the extra tuning dial was not in accordance with the plan originally laid down. We next proceeded, therefore, to try out some aperiodic H.F. couplings for the S.G. valve, and some very remarkable results were obtained.

We at first expected that there would be an inevitable heavy sacrifice of sensitivity on using an S.G. valve in this way, i.e. with an aperiodic H.F. coupling, and it was a very gratifying surprise to find that this is by no means the case. As a matter of fact, with the best of these aperiodic couplings the amplification under certain conditions is fully equal to that obtained with one of the popular fully-tuned S.G. circuits, i.e. the one known as "parallel feed."

That this should be so may seem at first sight a little hard to credit, but if we look at the elementary



The loud speaker forms a complete detachable unit which can be screwed in place behind the grille in the front of the cabinet.



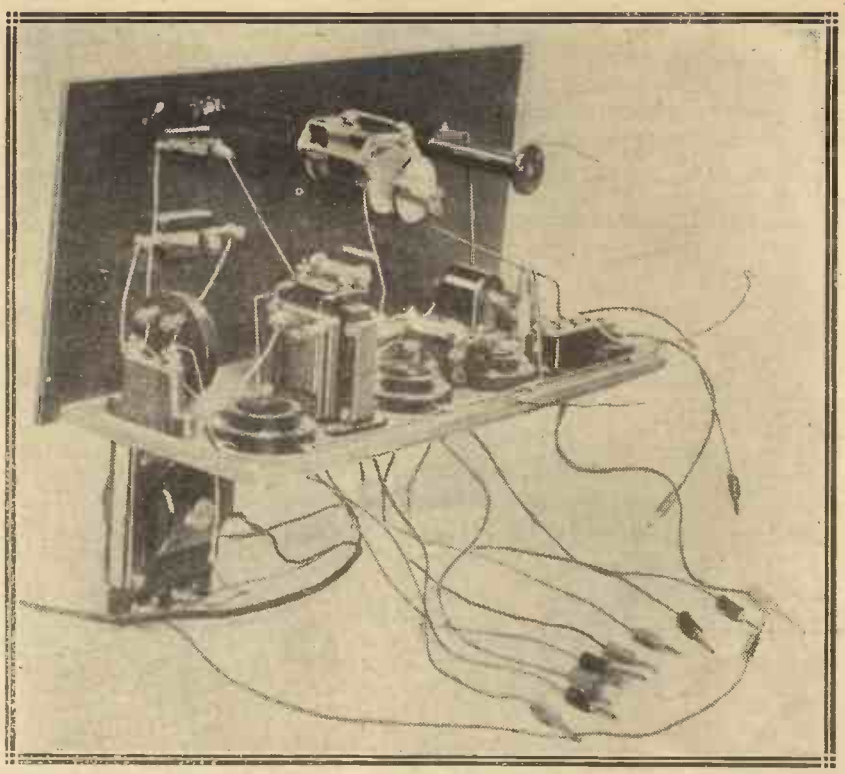
Here the set is turned upside down to show the arrangement of the output choke, etc., on the underside of the baseboard.

theory of the "parallel feed" type of circuit we shall soon see how it is. Remember that the essential factor in getting good amplification with this valve is to provide a high output impedance, that is, a high-impedance intervalve coupling.

COMPONENTS AND MATERIALS

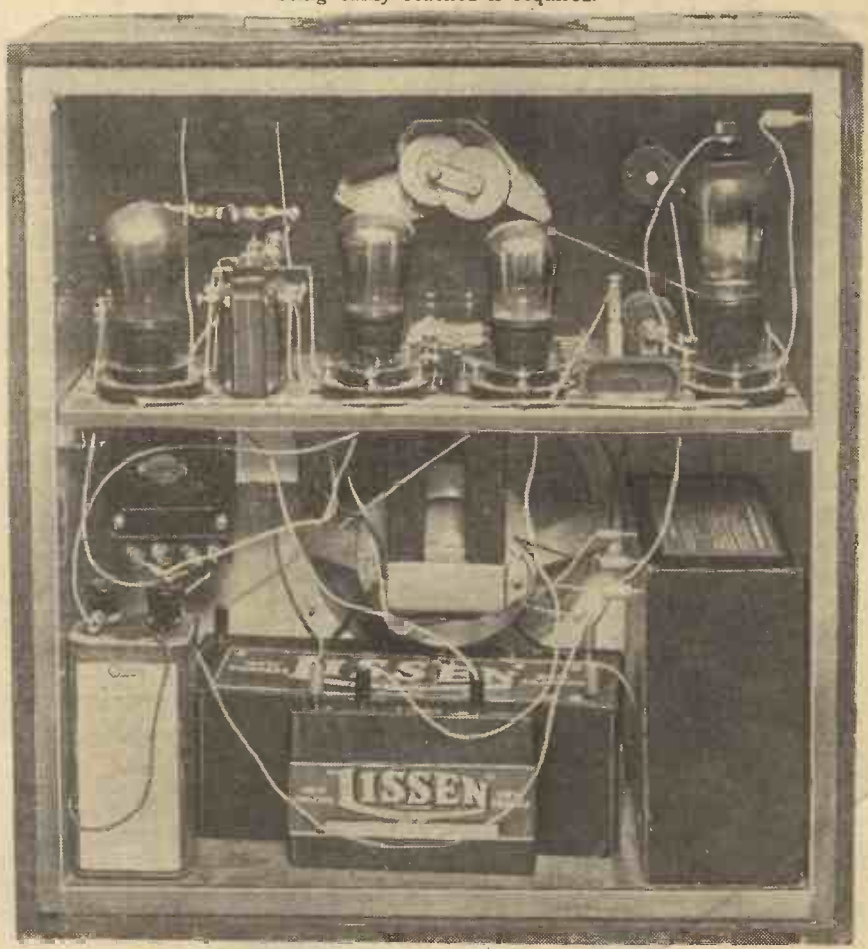
1 Cabinet, type known as "Birthday Four" (Camco).
1 Panel, 16 in. × 7 in × $\frac{3}{16}$ in. or $\frac{1}{4}$ in. (Resiston, Trolite, Becol, "Kay Ray," Trelleborg, Ripault, etc.).
1 ·0005-mfd. variable condenser (slow-motion, or with vernier dial). (Any good make of a rather compact type will suit. Very large or heavy instruments are not desirable. A few examples are the J.B., Dubilier, Ormond, Lissen, Lotus, Utility, etc.)
1 L.T. switch (Lotus, Benjamin, Burne-Jones, Burton, Wearite, etc.).
1 "Single-circuit" jack (Lotus No. 1 or similar type in the Ashley, Bowyer-Lowe, Ormond, or Igranic ranges).
1 Panel-mounting neutrodyne condenser (Used as reaction condenser. See note in text re handle). (Any good make, but preferably with very gradual adjustment, such as the Gambrell.)
4 Sprung valve holders (W.B., Benjamin, Lotus, Igranic, B.T.H., Wearite, Burton, Pye, Marconiphone, Burndept, Ashley, Formo, Burne-Jones, Bowyer-Lowe, etc.).
2 H.F. chokes (Bowyer-Lowe and Igranic in original. Any good makes of a small and compact type).
1 R.C.C. unit, flat type with interchangeable resistances, or similar compact form (Lissen, Dubilier, Carborundum, etc.).
1 L.F. transformer of low ratio (Must be one of the smaller types—e.g. Marconiphone "Universal," Philips, Igranic type "J," Mullard, R.I.-Varley "G.P.," etc.).
1 2-meg. and two ·25-meg. grid leaks with holders (Dubilier, Lissen, Ediswan, Pye, Mullard, Igranic, etc.).
3 Fixed condensers of ·0003 mfd. and one of ·001 mfd. (Lissen, Clarke, T.C.C., Dubilier, Mullard, Goltone, Burne-Jones, Igranic, etc.).
1 Output filter choke of moderate size (Igranic type "F," Pye, Burne-Jones, etc.).
1 2-mfd. condenser (Hydra, Mullard, T.C.C., Lissen, Ferranti, Dubilier, Marconiphone, etc.).
Set of copper-foil sheets for screening (See text for dimensions). (Ready Radio, etc.)
Set of parts for loud speaker (Type known as "The Connoisseur's Cone"). (F. Squire, Raymond, Pearl, etc.)
Materials for frame aerial and reaction windings (see text).
Flex, wire, H.T. and G.B. plugs, etc.

In the parallel-feed circuit we have in the anode circuit of the valve an H.F. choke, and from the anode end of this a feed lead goes off through a blocking condenser to the tuned-grid circuit of the valve which follows. Now, the output impedance of this



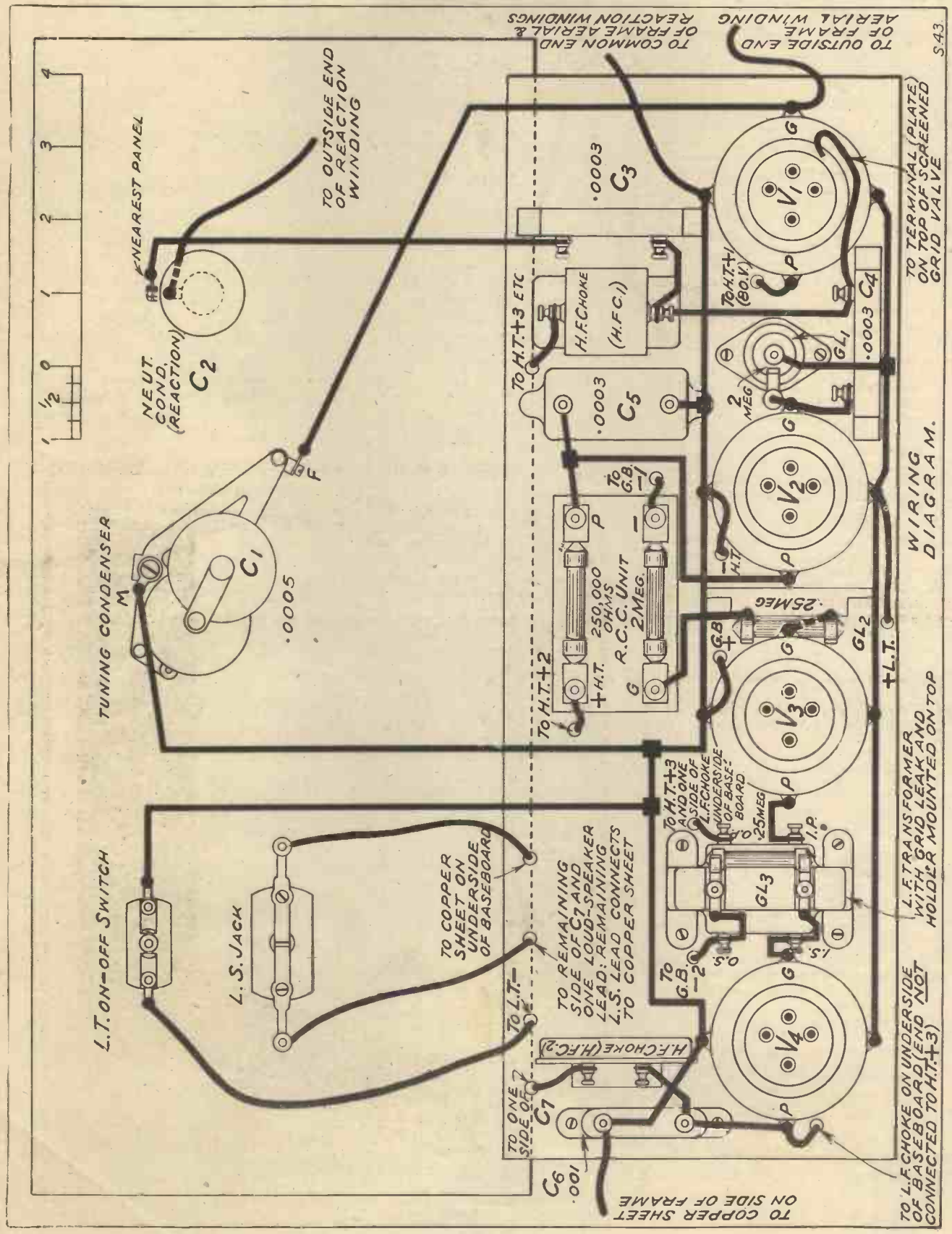
Although so much is packed into a small space, it will be seen that the wiring is not unduly complicated, either on the panel or baseboard. All the battery leads terminate in plugs or spade terminals (L.T.). Note how the output filter choke is mounted on the under side of the baseboard, immediately under the last L.F. stage.

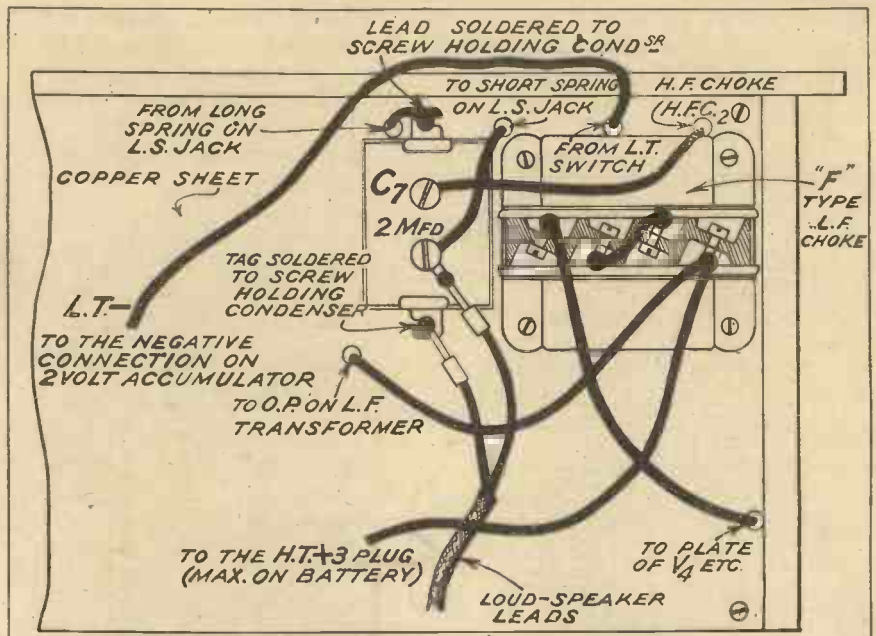
Below is the complete set seen from the rear, with valves and batteries in place. Note that in spite of the necessary flexible leads the set is remarkably accessible, all leads being easily reached if required.



arrangement is simply that of the tuned-grid circuit, shunted by the H.F. choke, which is to all intents and purposes in parallel therewith. Obviously, if we omit the tuned-grid circuit we shall affect the output impedance very slightly indeed. Actually, under some conditions we may even *increase* it!

Evidently, then, if we depend upon the H.F. choke alone for inte valve coupling we shall not, upon the average, lose sensitivity at all seriously, provided that the choke is really good. All that we shall lose will be the





X 425. WIRING DIAGRAM OF THE CHOKE FILTER CIRCUIT AND SURROUNDING CONNECTIONS.

extra selectivity provided by an additional tuned circuit, and this is a matter of little or no importance when working on a frame aerial.

This arrangement is the one finally adopted for the set, and in the particular details of the reaction arrangement, etc., it is due to Mr. Percy W. Harris, who first pointed out its potentialities. Getting reaction, by the way, is rather a difficult matter with this method of coupling, since it obviously cannot be applied to the grid circuit of the detector valve in the usual way.

Special Reaction Circuit

In the final version of the circuit it is done by providing a form of the so-called Reinartz circuit for the H.F. valve, with a special reaction winding on the frame aerial and a very small reaction condenser from the plate of the S.G. valve.

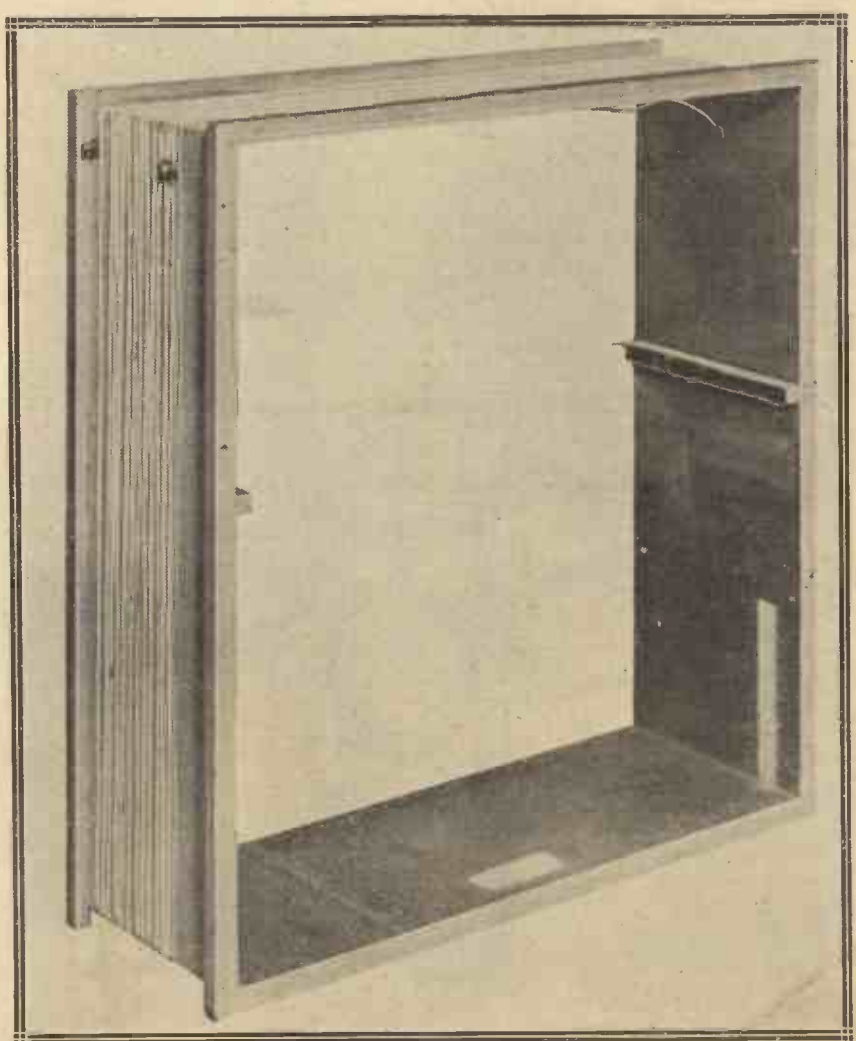
So much for the circuits affecting general sensitivity. That they are extremely effective you may gather from the fact that the sensitivity of the set is such that it is capable of tuning-in quite a creditable string of foreign stations at pleasant loud-speaker strength, and the ease of handling is all that can be desired.

The detector valve works on the leaky-grid principle, since the greatest possible sensitivity is obviously necessary for frame-aerial work. Following upon this comes a low-frequency amplifying circuit, upon which a great deal of work has been expended. The L.F. side of such a set is obviously of very great importance, since a considerable amount of amplification is needed, yet the circuit must be of such rock-like stability that it will work satisfactorily without the holding-down effect of the earth connection provided on the normal receiver.

The possibilities of the pentode valve were explored in the course of this work, and it was found that there were several serious objections to its use for this particular purpose. In the first place, there is the question of H.T. consumption, and this is a serious one, for in such a set the amount of battery space which it is practicable to provide is limited, and the pentode necessarily takes a considerable current.

For and Against the Pentode

Again, we did not find a single pentode stage any simpler from the stability point of view than two ordinary stages, so that there was no apparent gain here. The final deciding point was that of amplification, since, in our experience, the pentode does not give quite as much magnification as two normal stages of L.F.



This is the detachable framework inside which the set is placed. The frame aerial is wound outside it. Note the ledges on which the baseboard of the receiver proper rests.

The final choice, then, was for two normal fairly high-magnification L.F. stages using ordinary valves. The first stage is resistance coupled, with a medium value anode resistance (¼ meg.). The next stage is transformer coupled, and it is important that a component of fairly low ratio be used here.

Important Stabilisers

The various provisions made to ensure stability and correct working on the L.F. side are absolutely vital, and no changes whatever should be made here. First, there is the question of excluding H.F. currents. This is attended to at two points. First, a fixed condenser of ·0003 mfd. is connected from plate to filament of the detector valve, and, secondly, a ¼-megohm resistance is connected (in series in the lead to the grid of the first L.F. valve) as an "H.F. stopper."

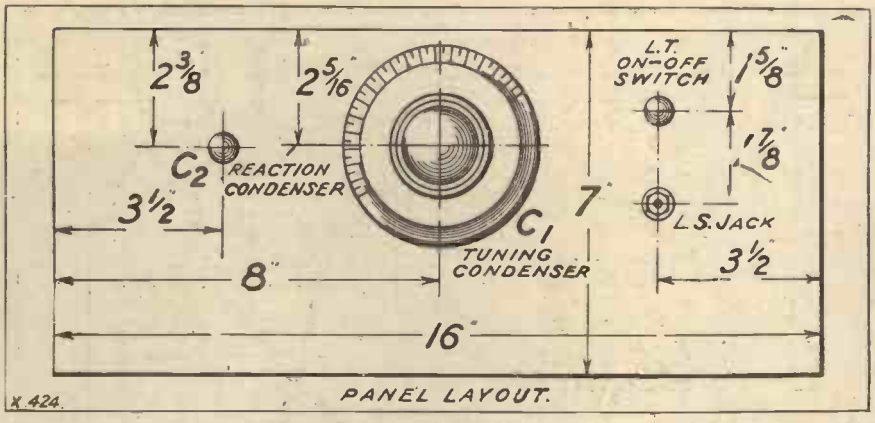
On the last stage precautions are taken on a very thorough scale indeed. First, to suppress tendencies to L.F. oscillation, i.e. howling, a resistance (grid-leak type) of ¼ megohm is shunted directly across the secondary terminals of the L.F. transformer. Next, to reduce risks of trouble from battery coupling an output filter is used for the loud speaker, which also helps to prevent trouble due to the loud speaker being right inside the frame aerial. This last is a most vital point, and has received far too little attention in the past.

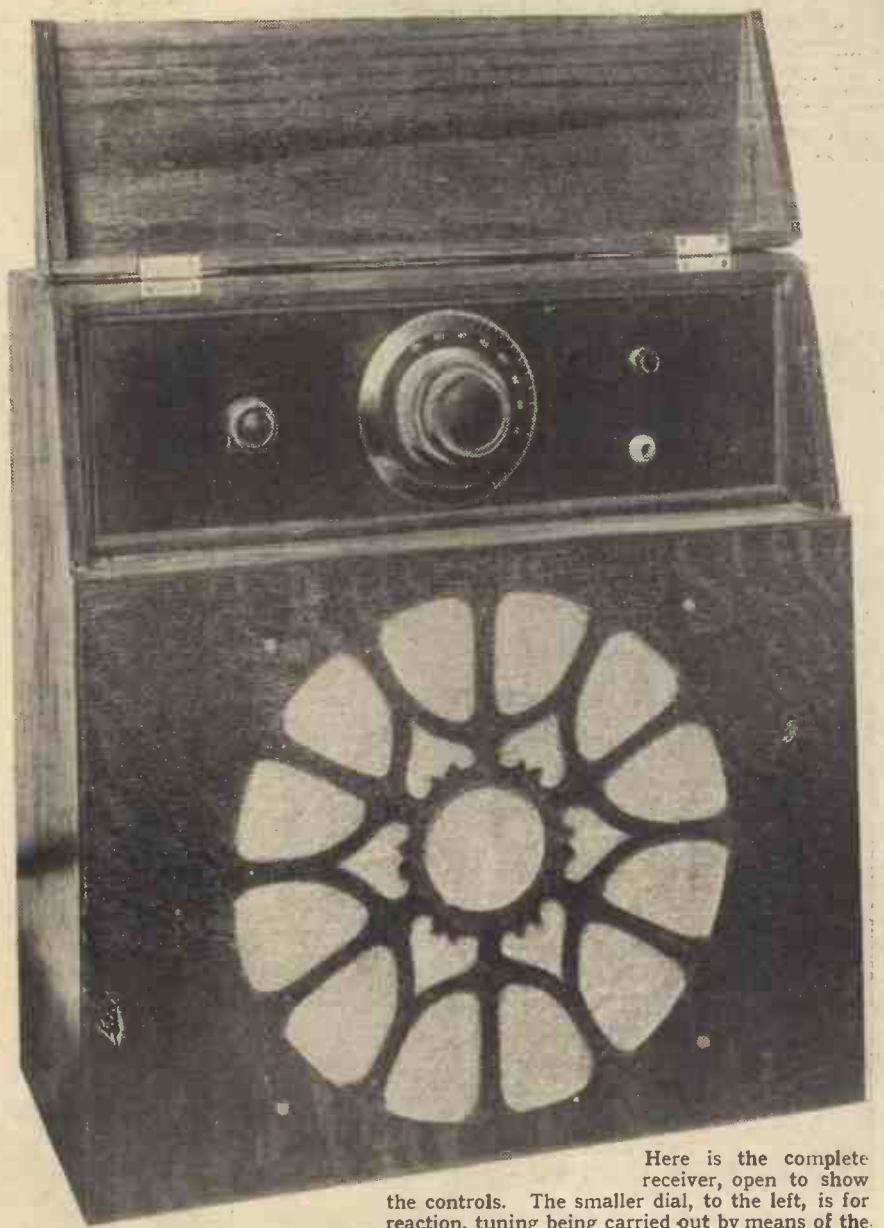
Unwanted reaction may operate at either L.F. or H.F. (or both!) and gave us lots of trouble with the first model of this set. It was finally cured by introducing a stopping and by-passing system of H.F. choke and ·001 mfd. fixed condenser. This alone, however, was not sufficient, since there was still interaction between the L.F. circuits themselves and the frame winding.

To stop this we found it necessary to introduce a limited amount of copper foil, partly to provide actual screening and partly to provide a floor of metal at filament potential to act as an "anchor" for the set in the absence of an earth connection.

Full constructional and operating details we must leave for a further article in next month's issue (we have already over-run our space allowance), but a few brief summarised points will enable you to make a start. The copper foil for screening consists of one piece 14 by 5½ in. (screwed to underside of baseboard), one piece 5½ by 5 in., and one 5½ by 13 in. (the uses of these will be given next month.)

The aerial is wound round the main frame and consists of 14 turns of No. 22 D.C.C, spaced about 3/16 in. apart with the ends taken to Clix sockets mounted directly through the wood. The reaction winding has foue turns (same wire, in same directioh, unspaced) against the "filament" end of the main winding, and terminates in another socket.





Here is the complete receiver, open to show the controls. The smaller dial, to the left, is for reaction, tuning being carried out by means of the central dial. To the right is the on-off switch, and below it a socket by means of which an extra loud speaker can be plugged in.

A DETECTOR FOR DETECTIVES

In this interesting article the valve is depicted in a new role—that of Sherlock Holmes! The various ways in which it watches against wrongdoers make absorbing reading.

From a Special Correspondent.

A BACK-COUPLED valve when on the threshold of oscillation is known to be extraordinarily sensitive to outside influences. A valve so adjusted is commonly said to be "triggered"—a word which well describes its tendency to "spill over" suddenly into sustained oscillation.

The slightest impulse applied to the grid circuit is sufficient to start self-oscillation. This causes a sudden change in the value of the current flowing through the valve, which in turn can be used to energise a local relay, and so ring a bell or operate some other form of indicator.

Burglar Alarm

A triggered valve can be made to serve as a burglar-alarm. The capacity effect of the burglar's hand on a hidden coil of wire as he fumbles with a safe, or of his body as he passes through a door, is sufficient to throw the valve over into definite oscillation.

Here the effect is due to an increase of capacity in the grid circuit. This brings the latter into tune with the plate circuit, and so starts the system oscillating. Once oscillation has commenced a local hold-down relay is energised and continues to ring the alarm, even after the original stimulus has been removed.

A similar effect can, of course, be secured by inductive action. For instance, a small wire solenoid surrounding the keyhole of a door, and forming part of a tuned circuit, will have its inductive value reduced by the insertion of a key. The principle is the same as that used in so-called spade or "shadow" tuning, where a metal plate is moved over the face of an inductance coil to alter the latter's wave-length.

Here, again, the alteration of the inductance sets the valve oscillating and so gives warning of any unauthorised attempt to enter the premises at night or during forbidden hours. Normally the guard circuit would be rendered inoperative by means of a switch.

French sleuths listening-in to headquarters whilst rushing after criminals in a police van.

In these cases the valve acts as a "watchdog" owing to the capacitative or inductive effect of the intruding body, as a whole, upon the tuning of one of the valve circuits. The action does not depend upon the particular composition of the body, except that it distinguishes between conductors and non-conductors.

A Radio Doctor

It has recently been asserted, however, by two American inventors, Dr. Simon and J. A. O'Connor, both of California, that the sensitivity of a triggered valve oscillator can be used to distinguish between substances of different chemical composition, and even between different biological organisms, such as bacteria.

They claim that their apparatus will not only discover the presence of certain germs, but will also identify the type of bacillus and so permit a radiological, or high-frequency, diagnosis, of particular diseases. Further, the oscillator distinguishes between germs that are alive and those that

are dead, so that the progress of the patient can be duly recorded day by day.

Amongst other substances the oscillator will give a definite response to such poisons as arsenic, strychnine, etc. By making a comparative test, the suspected presence of these substances in the human body can therefore be tested for and the particular poison identified.

The circuit arrangement of the apparatus used is shown in the figure. It consists essentially of a back-coupled valve V, with means for adjusting the degree of reaction so as to set it on the threshold of self-oscillation. This is termed the response circuit.

The Circuits Employed

Tapped off from the plate of the valve is a second circuit to which the substance to be tested is applied. This is called the control circuit.

The plate circuit of the valve contains an untuned coil L, to which a coil L_1 forming part of the tuned-grid circuit is coupled. The plate circuit is completed through a pair of 'phones and the usual H.T. battery to an adjustable tapping on a potentiometer P shunted across the filament battery.

One side of the tuned-grid circuit L_1, C_1 is connected through a variable high-resistance R to the plate circuit, whilst the other side is coupled to the grid electrode through a variable condenser C_1. A separate flywheel circuit L_2, C_2 is coupled both to the grid and plate circuits as shown.

forms a shunt to earth through a second variometer N_2.

The valve is first set on the threshold of oscillation by adjusting the coupling between the coils L, L_1, L_2, the variable grid condenser C, the resistance R, and the tapping point P. The vial is then inserted in position,

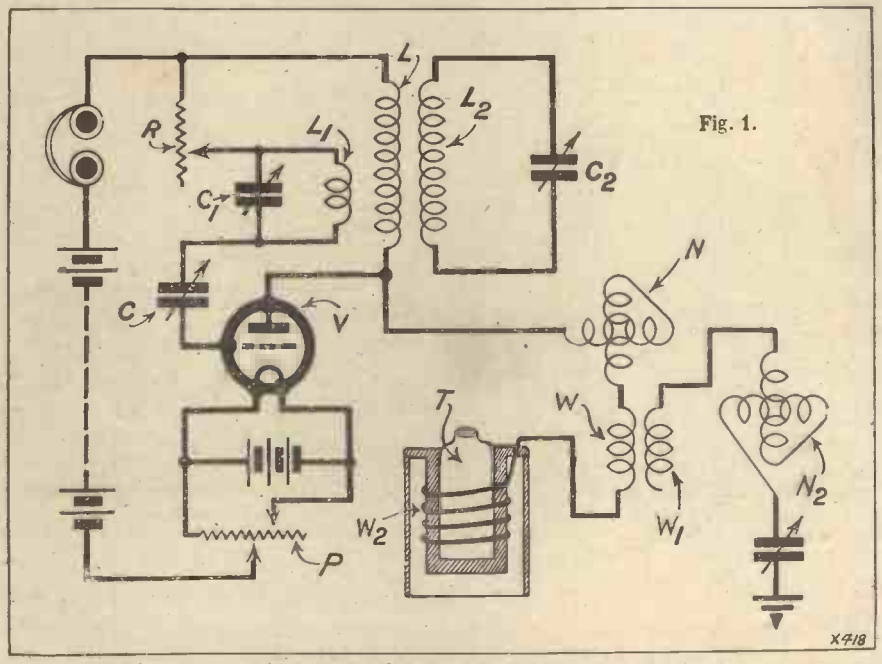
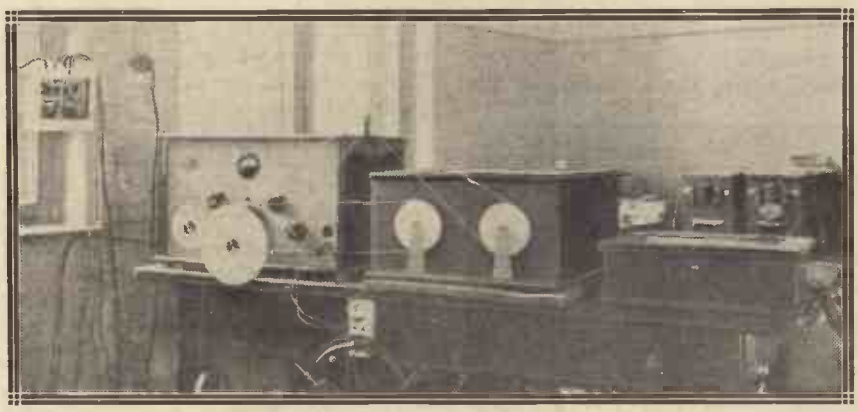


Fig. 1.

The circuit employed for detecting the presence of poison.

containing, say, a solution of a definite poison, such as strychnine.

When this has been done, the variometers N, N_2 are adjusted until a characteristic note is heard in the 'phones, indicating that the system is barely oscillating. The apparatus is then ready for test.



This receiving set of the Berlin police is installed on the outskirts of the city, and controlled from police headquarters.

The control circuit is tapped off from the plate winding L, and comprises a variometer N, a free-ended transformer winding W, and a second open-ended winding W_2, which surrounds a casing containing a vial in which the substance under test is placed. The secondary winding W_1

If the vial T is now replaced by a similar vial containing the suspected substance, the inventors claim that the characteristic telephone note will not be heard unless the substance for which the apparatus has been set (in this case strychnine) is present in the substituted vial.

If the telephone note is identical with that previously obtained, then strychnine is present in the suspected solution. Otherwise it is absent.

A similar procedure is adopted when testing for the presence of disease germs. A solution is first made from the blood of the patient and is then compared by the "detective" valve with a standard culture of the particular bacillus suspected.

Action Not Understood

The inventors admit that the underlying causes of the reaction of the oscillator to specific elements or chemical compositions is not fully understood. It may lie in the particular atomic or molecular formation, or possibly in electronic emanations or radiations thrown out by the body under test. They do, however, claim to have detected in this way the presence of matter not discoverable by means of a microscope.

Whether these claims can be substantiated or not, the device certainly offers an interesting field for further speculation and research.

THEORY AND PRACTICE

Although there is no absolute dividing line between high or radio frequency and low or audio frequency, it is usual to call a current a high-frequency current if the alternations are of the order of 15,000 cycles or more.

* * *

Telephones which are in constant use are often rendered insensitive by the forming of rust inside the diaphragms. (This can be removed by a soft oiled cloth.)

MY PROGRAMME

By Rosita Forbes

We all have our own ideas about the ideal Wireless Programme. Rosita Forbes, who is known to millions as an explorer of courage and resource, has written this exclusive article for "Modern Wireless" on a theme which will always be interesting—for the simple reason that we shall seldom, if ever, agree as to what constitutes an "ideal" programme. But other people's views are interesting, and certainly Rosita Forbes has some ideas on the subject which the B.B.C. might adopt with considerable advantage.—THE EDITOR.

DURING the General Strike—why should these two words, which represented a stinging-nettle rather than the Sword of Damocles, always be written with capital letters? Well, then, during the general strike, a voice of velvet stroked with gold announced from Savoy Hill that a certain East End district was quiet "with the exception of sporadic ebullitions." Next day a gardener remarked to me that "it was bad luck some sort of infectious disease—he didn't rightly know what—had broken out in East London on top of the strike an' all."

So the first thing about my programme would be its expression in the simplest possible English that no one could misunderstand.

This country is possibly the least musical in the world, so I would keep a wary eye on the length and quality of concert programmes. I confess that I should have to leave the selection to others, because my own tastes would run to undiluted grand opera when I felt lazy and the latest jazz when the day hadn't provided me with enough exercise.

Rosita Forbes—the famous woman explorer.

Talks Are Enjoyed

In every country-house I've ever known the wireless is always turned off when the news bulletin is finished, unless, of course, some ingenuous experimenter tries to pick up the Antipodes or U.S.A., or a political speech is expected. Yet country-house mentality is not particularly highbrow.

A lecturer can appeal to every quality of intelligence in his necessarily mixed audience, though he has only one subject at his disposal. A broadcasting programme, with every topic to choose from, ought to be able to do the same.

The fare must be as varied in quality as in quantity. It is an age of labels and I'm sure most broadcasting officials try to docket their different audiences — "this will appeal to women, this to clerks, this to football fans," and so on. But in 1929 it's impossible to do this. There isn't one general mentality for flappers, for chartered accountants, or for husbands!

Ensuring General Appeal

The only way you can possibly be certain of a general appeal is to gauge the amount of commonsense distributed through what is a particularly practical race, and play up to that.

There are a few common denominators. The love of travel and adventure is deep embedded in the kinsmen of Drake, Sir Richard Burton, and Cecil Rhodes. We are a discontented race, suffering from lack of industrial and agricultural opportunity, from under-employment and all the ills of over-population. Broadcasting might be a panacea for all these sores, if it were fully conscious of its possibilities.

The main object of my programme would be to familiarise England with the colonies and the opportunities they

represent; to interpret one country to another. Savoy Hill could people the fallow lands of the Empire, and ease the burden on the rates of every British manufacturing town if it would teach its thousand thousands of listeners-in what the world really is!

A few years ago I broadcast an appeal for the housing of refugees. A farmer's wife wrote to me that she would be delighted to take in a Greek family, but would they be black or white?

My programme would be the greatest factor for preventing wars, because when governments disagreed, the ether, which belongs to no political party, should inform the people of any potential enemy land what the English public was thinking and feeling. If the peoples of the world could get together and understand each other, there would obviously be fewer opportunities for those tragedies of political ambition which end in war.

Information and Advice Wanted

Every normal human being is an egotist. He is naturally most interested in things which have or may have some relation to himself—hence the popularity of politics, sport (which is an opportunity for gambling), and romance! I would appeal to that personal egotism in my programme.

We are a serious people. We want to know about things. We have inflated the standard of living beyond the average man's earning power. Obstinately, doggedly, we want to improve our conditions. I should say the main object of every boy and girl to-day is "to better themselves" in one way or another. My programme would show them how they could do it. I would have weekly talks on "opportunity," showing what the actual practical openings were for youth when it left school.

Broadcasting the ceremony of the opening of the New South Wales Parliament, which was carried out by 2 F C, the Sydney station. The arrow points to the microphone in the top left corner of the picture.

Parents would thus be taught what trades would be most profitable to their children, and the young people would know the difficulties and possibilities of the careers they contemplate.

A Welsh miner wrote to me a few months ago: "Instead of the old-time sturdy Welsh, we are breeding a race of C3 men, who from the time they leave school have no chance of getting work. I don't know where to send my sons, or what to do with them." Why shouldn't the wireless help with information and advice?

My programme would include a practical travel talk showing what sort of holidays can be taken on what sort

A broadcast bridge party in progress. On the right is Lady Oxford and Asquith, who was one of the party.

of means. I would familiarise the most adventurous and, I believe, the pluckiest race in the world with the possibilities of travel.

There are worlds still uncultivated, if not unexplored. The unemployed of England might be the makers of a new Africa, a new Australia, or a new Brazil. Every week I receive an average of a hundred letters from adventurous youth wanting to work or to holiday abroad. My wireless programme would tell them how to do it.

We are too insular in England. Everything across the Channel is "foreign." A century of wireless ought so to connect the world's workers, their interests and their objects, that there would be no "foreigners" at all.

My programme would deal with that horrible domestic problem that confronts us all at the moment—how to make a great deal out of very little! I would have a house and home expert whose descriptions would rouse the imagination of householders and housekeepers and whose explanations would enable them to put their ideas into practical form.

Solving Domestic Problems

In our houses, our clothes, and our pursuits, we lack imagination. We're not as comfortable, as interested, or interesting, as pretty or as happy as we might be, if we employed a little more brains in the disposal of our ordinary means.

My house and home expert would tell women what they really want to know, not all the short skirt and lipstick stuff they learned years ago and now consider as much part of their natural equipment as a tooth brush and artificial silk hose!

Modern women—and women have always been the modern element in whatever century they were born, because it was they who had to adapt primeval needs to changing standards—modern women, I repeat, are interested in just the same things as men, their comfort, their work, their "rights" and their wrongs.

Beauty in all forms appeals to them, of course, so I would have practical dress talks. Women famous for their knowledge of clothes should analyse the possibilities

of the dress allowance, showing how to obtain the best results for the least expenditure.

Every new wife and most old ones want to make the most of their houses and themselves, but they don't know how to do it. My house and home expert would tell them. Most women are obliged to work in order to run the home according to the elastic standard of 1928.

The pin-money girl works for experience, latitude and opportunity, but she looks forward to a home at the end. My programme would appeal to all women who are trying to combine domestic and office life.

A Real Problem

This is the real problem that besets the youth of 1929. Every girl wants to make a success of marriage and of her job. I would get the famous women who have succeeded in both spheres to broadcast their ideas on subjects of vital, not superficial, interest to women.

A programme should be as "varied in quality as in quantity." This picture shows how a recent broadcast of reptile noises was carried out by an American station.

It is odd that though the average woman nowadays lives the same sort of life as a man, the majority of those who cater for her amusement and interest imagine her outlook limited to fashion, make-up, and make-believe!

The modern woman has got two problems to man's one. She has not only to supplement her husband's earnings with her own, but has to dispose of those earnings for the benefit of the family in a manner as elastic as possible.

My wireless programme would interest her because it would give her new ideas and the ideas of people she's read about for the solution of such familiar puzzles!

"The World in Pictures"

Wireless, on the whole, is better adapted to interest than to amuse. In any literate country, where lending libraries abound, it is much easier to read a book or a paper than to listen-in, if sheer amusement is all that is required.

It is up to my wireless programme, therefore, to provide what is not to be found on a bookshelf or in a newspaper. I would try to do it by combining music, sport and news with up-to-date topical lectures in tabloid form.

In fact, instead of presenting "the world in pictures," I would put the whole world on the wireless and show every listener-in what it is and what it might contain for him or her!

WHO WAS CHATTERTON?

From a Correspondent

WHO exactly is (or was) this Mr. Chatterton in whose honour the well-known adhesive compound of rubber and tarry materials has been named? That, indeed, is an interesting question which has often been asked. Had this celebrated Mr. Chatterton anything to do with radio in its earlier days? Was he the inventor of any remarkable component or piece of apparatus, or did he effect some great advancement in the technique of the early science? At any rate, how did his insulating and adhesive composition originate?

Well, after many moons, I have at last succeeded in tracking the elusive Mr. Chatterton to earth. The fact of the matter is that this renowned gentleman, whose name is, among radio amateurs, of greater fame than that of many a greater man, had nothing to do with radio; living, as he did, before the science of wireless communication was thought of.

Curiously enough, however, Chatterton was an early pioneer of the telegraph, particularly of the submarine telegraph. He was associated with the firm of Messrs. Glass, Elliot and Co., cable manufacturers, of London.

This firm made a speciality of supplying heavily insulated long-distance cable about the middle of the last century, and Chatterton, being employed in the capacity of chemist, found it necessary to devise special insulative and damp-proof compositions in order to render these early cables efficient.

Here, therefore, lies the originating source of the famous "Chatterton's Compound." It is noteworthy that the compound was employed in the insulation of the first Atlantic cable laid in the years 1857–8. Since that time, the rubber compound has been employed extensively for all types of electrical work, its radio-constructional uses constituting, of course, merely additional applications of the well-known commodity.

"My programme would deal with that horrible domestic problem that confronts us all . . . how to make a great deal out of very little," says Rosita Forbes, in the article concluding on this page.

RADIO ABROAD

Eindhoven

A NEW station (which is intended only for communicating with amateur receivers throughout the world, and not for the broadcasting of musical programmes) is the Eindhoven short-wave transmitter erected recently, and working on 41·3 metres. The call-sign is P B F 5.

Unique Event

An American business man, Mr. Firestone, of Akron, Ohio, U.S.A., had the unique experience recently of listening by wireless to the speeches made at the opening of a factory belonging to one of his subsidiary companies in England. The occasion was the opening of the Firestone Tyre factory at Heston, when a speech was made by the Home Secretary, Sir William Joynson-Hicks. Mr. Firestone sat in his office in Ohio and heard the whole proceedings.

The Australian Way

In Australia, radio set owners pay licences which are used to support "Class A" stations; while "Class B" stations, owned in most cases by organisations which desire a mouthpiece for their views, are not so favoured.

Since the Commonwealth's postal authorities have undertaken a co-ordination of the programmes and activities of the "Class A" stations, a request has been presented on behalf of the "B" stations for either a share of the licence revenue or the exclusive right to accept paid advertising.

In the latter case, the virtue of the sponsored programmes might be fairly tried out—were it not that the Australian listener must pay the bills of the preferred stations, whether or not he prefers other programmes!

Short or Long Waves?

In view of the great expectations of short-wave transmission, it is interesting to note that international discussions are now taking place as to the limitations of short-wave transmission and the introduction of long-wave ditto for the periods when short waves are not properly effective.

One well-known expert, after relating in some detail his experience with various frequencies and expressing the hope that "the reliability of short-wave channels may be made such as some day to eliminate altogether the necessity for the long-wave channel with its much more expensive plant," goes on to say that the information available regarding short waves does not suggest that they will ever give a reliability of service comparable with that over similar distances by land-line circuits.

Anglo-American Channels

It is expected, therefore, according to the present views, that suitable service between America and Europe will require the continuation of the long-wave channels, notwithstanding the fact that much more extensive and complicated plant is required than for short waves.

The technical, control, administration and advertising office of the WHO broadcasting station of U.S.A. An article fully describing this broadcaster appeared last month in "M.W."

Although short-wave transmitters perform with extraordinary efficiency under ideal conditions, the total percentage of the twenty-four hours during which any short-wave channel serves between two given points is at present distinctly limited.

An Important Demonstration

The simultaneous transmission of two high-speed telegraphic services and one telephone service over the same wave-length was recently demonstrated at the English beam station at Bridgwater. This demonstration, which was made in the presence of David Sarnoff, the Vice-President of the Radio Corporation of America, was conducted between the stations at Bridgwater, England (receiving), and Montreal, Canada (transmitting).

It is claimed that this apparatus, which has been produced by Senatore Marconi and Mr. G. A. Mathieu, diminishes fading to a great extent and thus gives a constant volume of speech and signals.

The Growth of Listeners

According to figures given by Mr. Thomas F. Logan when recently addressing the International Advertising Association in Detroit, Michigan, radio receiving sets are now to be found in 35 per cent of the homes in the United States, these sets serving a total audience of some 40,000,000 people.

In discussing the advertising phase of radio, the lecturer said that first-night audiences of popular musical programmes by national advertisers numbered from 10 to 15 million listeners.

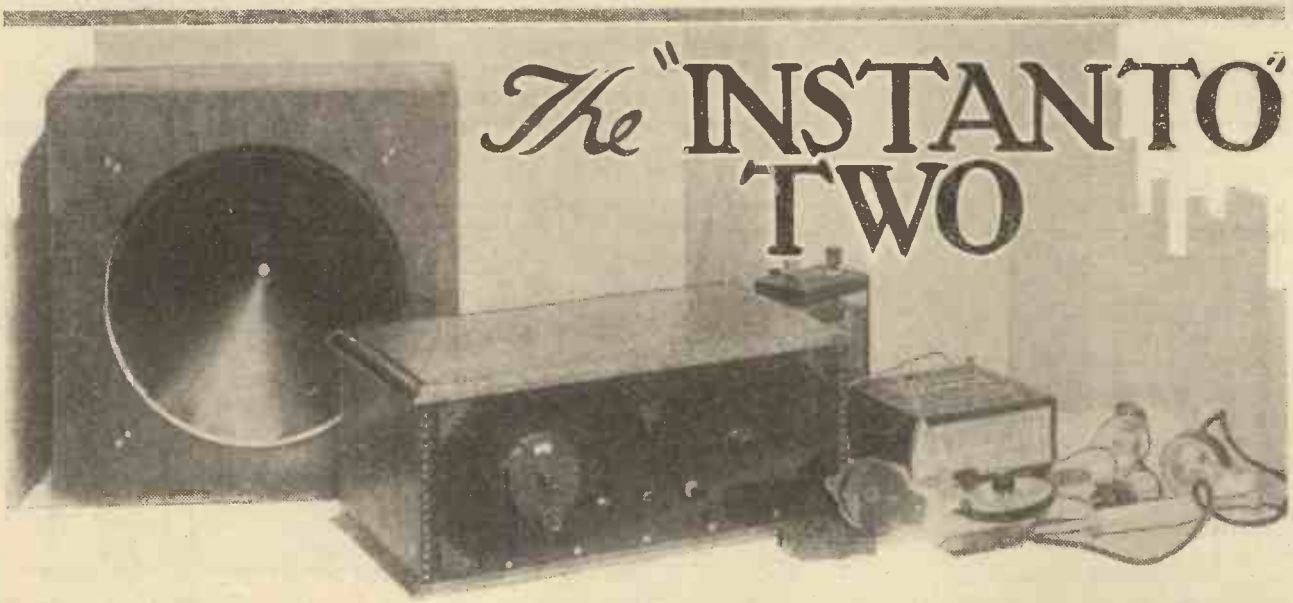
Taking No Chances

Commander Byrd is taking no chances on the radio side of his expedition, for in addition to the special precautions taken with batteries (already mentioned) he is having 25 operators who are being given an intensive preliminary training.

Whose Island?

Antarctic meteorological information is to be distributed from a new Norwegian radio station at the remote island of Bouvet in the Southern Ocean. It is uncertain whether this island belongs to Great Britain or to Norway and both countries have claimed ownership.

The "INSTANTO" TWO



An efficient "alternative" three-programme receiver for the listener-constructor. The operation of two simple switches changes the set from one station to another, no tuning adjustments being necessary.

By L. H. THOMAS.

THERE is still, in this age of complicated receivers with practically unlimited range, a class of listeners who consider that all the extra "bother" introduced into a set to give it a long-distance performance is not worth while. They prefer a set which will receive the local station, 5 X X, and perhaps one other station, such as 5 G B, on occasions, and they want a set which will do this for them with the absolute minimum of trouble and expense.

"Three-Station" Set

Just as there have always been, and will always be, motorists whose chief joy in driving is the use of the gearbox in such a way as to extract the last ounce of performance from their car, so there are radio enthusiasts who are enthusiastic enough to build themselves sets which are real hard work to handle, and the wonderful results that are *sometimes* obtained with such sets often justify the trouble. On the other hand, we have those who simply want to move themselves from one station to another without even having to think, and this receiver is designed for their express benefit.

It is essentially a "three-station" receiver, the change-over being arranged entirely by means of two switches. With the set in use as it is at my own home, an instantaneous change-over from 2 L O to 5 G B and 5 X X may be made by the use of the two left-hand switches on the panel.

With the right-hand switch pulled out and the left-hand pushed in, we tune in 2 L O. Pulling out the right-hand switch, we tune the "Formo-densor" behind it until 5 X X is heard. Then, pushing it in again and pulling out the left-hand switch we adjust the other "Formo-densor" until 5 G B is received. We then need not know the first thing about radio or electricity to "tune in" these three stations for ever after. (A "local expert" may, if desired, be engaged to tune the set in the first place, and afterwards nothing but the switches need be touched.)

The Circuit Employed

Fig. 1 shows the full theoretical diagram, and it will be seen that the circuit employed is perfectly straight fundamentally. We have three coils with fixed coupling, one in the aerial circuit, one for the secondary and a reaction coil. Across the secondary, in series with a switch, is a "Formo-denser" which can be brought into circuit when desired.

COMPONENTS AND MATERIAL REQUIRED

- 1 Ebonite panel, 18 in. × 7 in. (Trelleborg, "Kay-Ray," Red Seal, Resiston, Becol, Trolite, Ebonart, etc.).
- Cabinet for above with loose baseboard 10 in. deep (Raymond, Pickett, Cameo, Artcraft, Makerimport, Caxton, Lock, Gilbert, etc.).
- 1 ·0005 variable condenser (Cyldon, Lotus, J.B., Igranic, Dubilier, Lissen, Bowyer-Lowe, Raymond, Colvern, Ormond, Ripault, Gecophone, Utility, Burton, Brandes, etc.).
- 1 Miniature type reaction condenser (Bowyer-Lowe, Igranic, Peto-Scott, Lissen, J.B., Dubilier, Ormond, etc.).
- 3 On-off switches, one of suitable type for S_3 (see text) (Lotus, Lissen, Benjamin, Burne-Jones, etc.).
- 2 Non-microphonic valve holders (Benjamin, Lotus, Pye, Marconiphone, W.B., Burndept, Wearite, Ashley, Burne-Jones, Redfern, B.T.H., Bowyer-Lowe, Burton, etc.).
- 1 L.F. transformer (Ediswan, Brown, Lissen, Igranic, Ferranti, R.I.-Varley, Philips, Marconiphone, Mullard, etc.).
- 3 Baseboard-mounting coil sockets (Burne-Jones, Peto-Scott, Lotus, etc.).
- 1 Standard loading coil (Burne-Jones, Ready Radio, Wearite, Paroussi, etc.).
- 1 ·0003 fixed condenser (T.C.C., Lissen, Dubilier, Clarke, Goltone, Mullard, Burne-Jones, Igranic, Marconiphone, etc.).
- 1 2-megohm grid leak (Ediswan, Lissen, Mullard, Dubilier, Igranic, Pye, etc.).
- 1 H.F. choke (Burne-Jones, Lissen, Colvern, Lewcos, R.I.-Varley, Climax, Igranic, Cosmos, Bowyer-Lowe, Peto-Scott, etc.).
- 1 Volume control (high-resistance potentiometer type) (Burne-Jones, R.I.-Varley, Igranic, Gambrell, etc.).
- 1 Formo-densor, type F, and 1 type G (Arthur Preen & Co., Ltd.).
- 1 Seven-terminal strip and 1 two-terminal strip.
- Tinned copper wire, screws, flex, etc.

Then we also have a loading coil, wired in the usual manner, for long-wave reception, and across part of this is another Formo-denser, enabling us to tune the new value of inductance to the wave-length of 5 X X or, for that matter, any other long-wave station that we particularly want to listen to. Apart from this, there is nothing peculiar about the set.

The whole receiver is, it will be noticed, rather on the large size for a two-valver, but it was thought more advisable to "spread" the components slightly, and be reasonably certain of good results, than to take the usual risks attendant on cramping the layout, simply for the purpose of producing a small, neat-looking receiver.

Volume Control

One other point is the use of a volume control, arranged potentiometer-fashion across the secondary of the L.F. transformer. It was thought that in several cases this set might be made up for the benefit of someone with absolutely no radio knowledge at all, and left to their mercy.

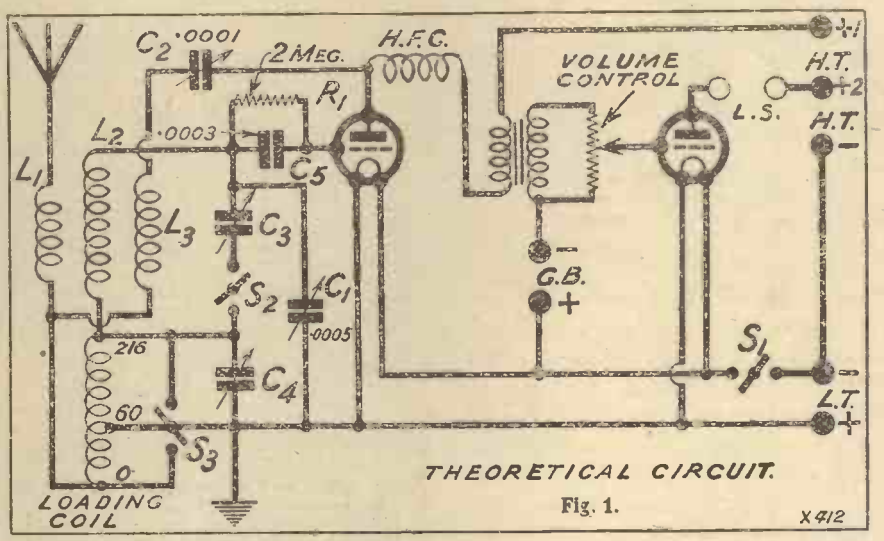
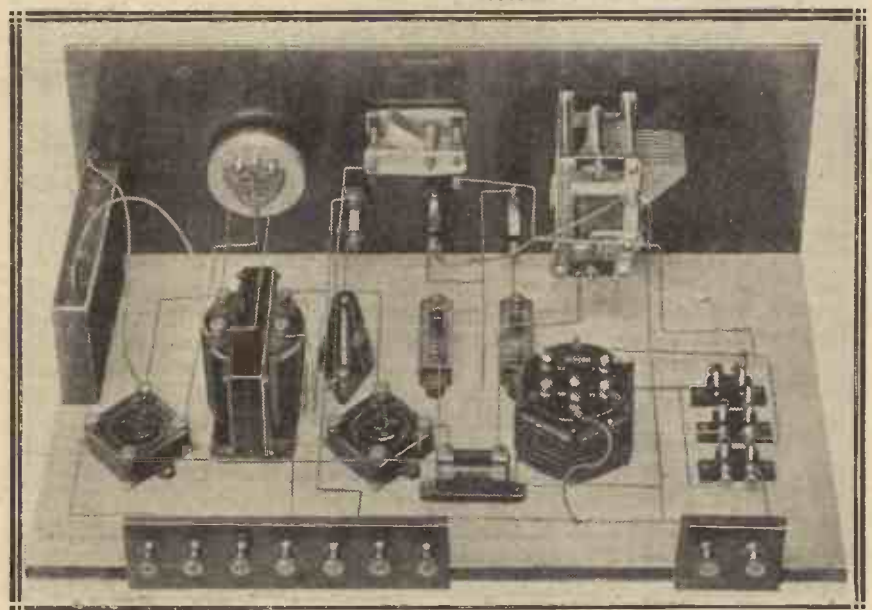


Fig. 1.



Could anything be more simple than the wiring of this receiver, which can be constructed in a few hours.

In this case, if the volume were at any time too great for them and they were to attempt to reduce it by the usual process (for receivers of this type) of detuning, all the adjustments for the three stations to be received would promptly be upset, and it would probably result in an S.O.S. for the maker of the set. There is now no excuse for this, since the volume should be controlled only by means of the component provided for that express purpose, which is a high-resistance potentiometer.

The reader should have no trouble at all in following the baseboard layout from the photographs and the back-of-panel diagram. Of the three coils on the right (looking from the rear), that nearest to the aerial terminal strip is the aerial coil L_1, the centre coil the secondary, and the third the reaction coil L_3.

C_1, with a capacity of ·0005, is, of course, the main tuning control, while a small condenser with a maximum of about ·0001 serves for reaction control. The volume control, on-off switch, and the two wave-change switches complete the list of components mounted on the front panel.

The baseboard layout shown should be adhered to as closely as possible. For one thing, there are present very few awkward corners in the wiring, and most of the leads are of the minimum length possible. It is preferable to drill the panel first of all, after which it is fixed to the baseboard by five or six screws along the bottom edge.

No brackets are necessary if a reasonably thick panel is used. Then mount the components in their correct positions on the panel, following them up with the baseboard components, and wire up the whole set as it stands. With many receivers it is preferable to wire up the baseboard components first of all, but with this there seems to be so little "interference" between panel and baseboard that the whole thing may be done at one sitting, so to speak.

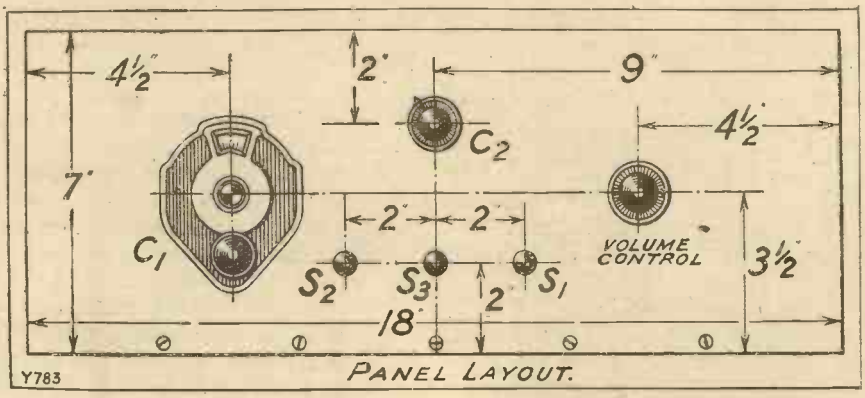
Wave-Change Switches

A word as to the sizes of the Formo-densers. That connected across the loading coil must, of course, be fairly large, while it is essential that the other one, connected across the small portion of the secondary, should *not* be too large. If your local station is one whose wave-length is very close to 5 G B, the "short-wave" Formo-denser must have a very small minimum capacity, or switching it into circuit will make the set jump right over the wave-length.

The value I used for this condenser (C_3) was ·00002–·00015. The value of the larger condenser C_4 was ·0001–·0005. More will be said about these and their use under the operating notes, at a later stage.

With regard to the wave-change switches, it must be noted that the centre switch S_3, which arranges the change-over from short to long waves, must have three separate contacts

all insulated from each other. The type used, an "L. & P," has an insulated centre-piece which makes contact with *both* the outside "brushes" together. Thus we have three contacts which are all independent when the switch is in and all connected together when the switch is out.



PANEL LAYOUT.

In the diagram of the circuit it will be seen that the two "brushes" of the switch are connected to the extremities of the loading coil, while the centre-piece is connected to the "60" point on the coil and to earth.

Actually a flex lead is soldered to the centre (moving) part of the switch, and this can be seen in the back-of-panel diagram.

Parallel H.T. Feed

It will be noticed that "parallel feed" has been employed for the H.T. supply, to make possible the scheme for using the loading coil both for the aerial circuit and for reaction. This being the case, it is essential that the H.F. choke in the H.T. positive lead should be a really good one.

This is mentioned because it is the fashion nowadays to use "series feed" and some form of throttle control for the reaction, in which case a choke is often not necessary at all, and when one is used there is no need to be particular about its efficiency. This case, however, is quite different.

There is really nothing more to be said about the layout and construction of the set. The wiring is not complicated, and should be completed within an hour or so.

Suitable Anode Voltages

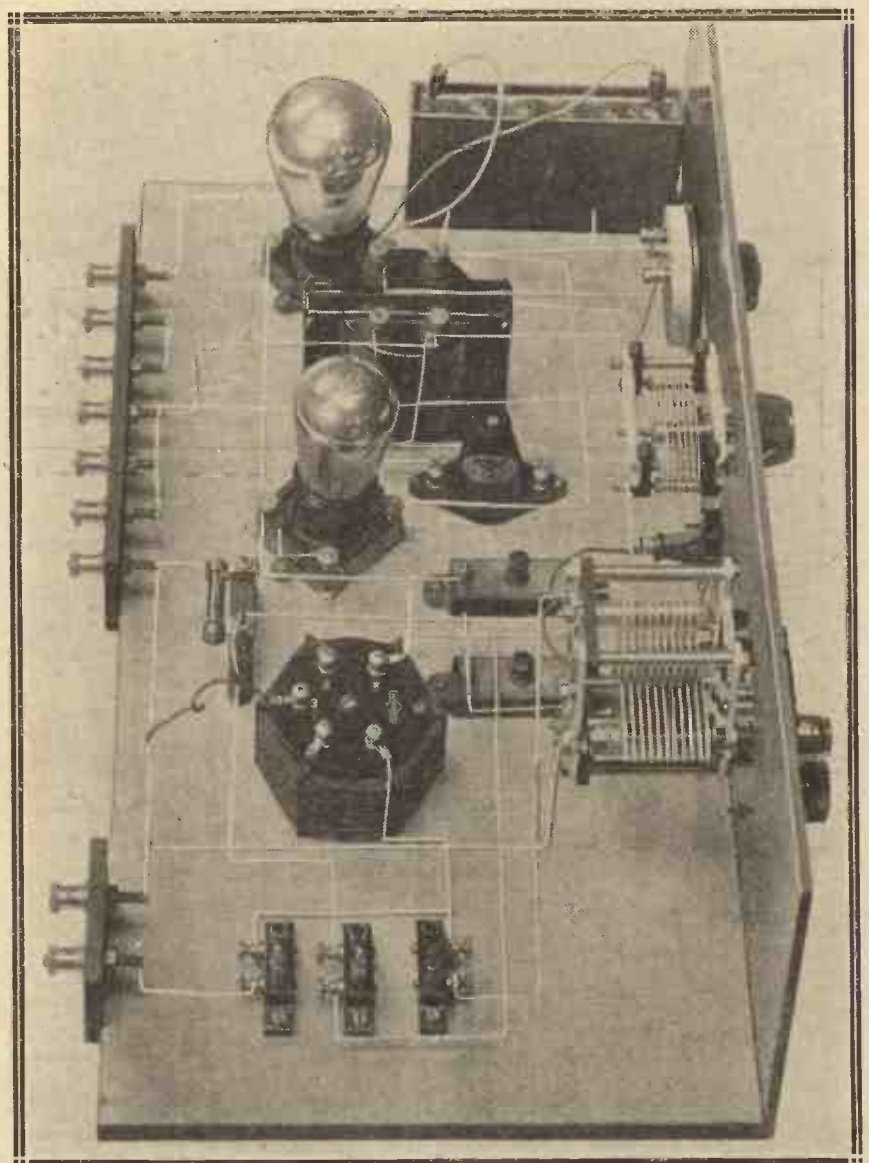
Having finished the set, the wiring should as usual be carefully checked over with the diagrams, and then the first tests may be proceeded with.

For the detector almost any general-purpose or H.F. type valve will be suitable, and for the note-magnifier any small power valve may be used. Regarding values of H.T., about 60 to 70 volts on the detector and 105 to 120 on the note-mag. will probably be about the most suitable voltages for average use, and the grid-bias on the last valve will be in the region of 7½ volts, generally speaking with plate voltages of the order of that mentioned.

Plug-in Coil Values

Connect the aerial and earth to their terminals, and insert coils as follows: Aerial coil L_1 (nearest back of baseboard), No. 30 or 35. Secondary, in centre, L_2, No. 50 or 60. Reaction, L_3, No. 30 or 35. In general, these sizes will always be found quite satisfactory, although for extremely long aerials a smaller size for L_1 may be advantageous. The tap on the loading coil will always be connected to the "60" terminal.

Now, with the centre switch pulled out (i.e. shorting out the loading coil) and the left-hand switch in (the Formo-denser thus being out of circuit), switch on the L.T. and listen.



An end view of the set, showing the valves in position. Of the three coil holders in the foreground the left is the aerial coil, the centre is the medium-wave coil, and the right-hand for reaction. Behind these the standard loading coil can be seen.

If all is in order the set will be behaving just as a straight detector-and-note-mag. should.

The local station should be found at very great strength somewhere on the main condenser, and reaction control by the small condenser C_2 should be smooth and even. For the sake of simplicity I am henceforth going to refer to the local station as "2 L O" and provincial listeners must substitute their own call-sign.

Tune-in 2 L O now, and leave the condenser setting at the optimum point. If the volume is too great for comfort, alter it by means of the volume control and *not* by de-tuning. Now pull out the switch on the left, thus bringing the small Formo-denser into circuit, and by means of a screw-driver carefully adjust this until 5 G B is heard at maximum strength. There should be no difficulty about this unless you are in one of the regions where 5 G B is never audible at good strength, in which case you should substitute your favourite foreign station, or anything you please.

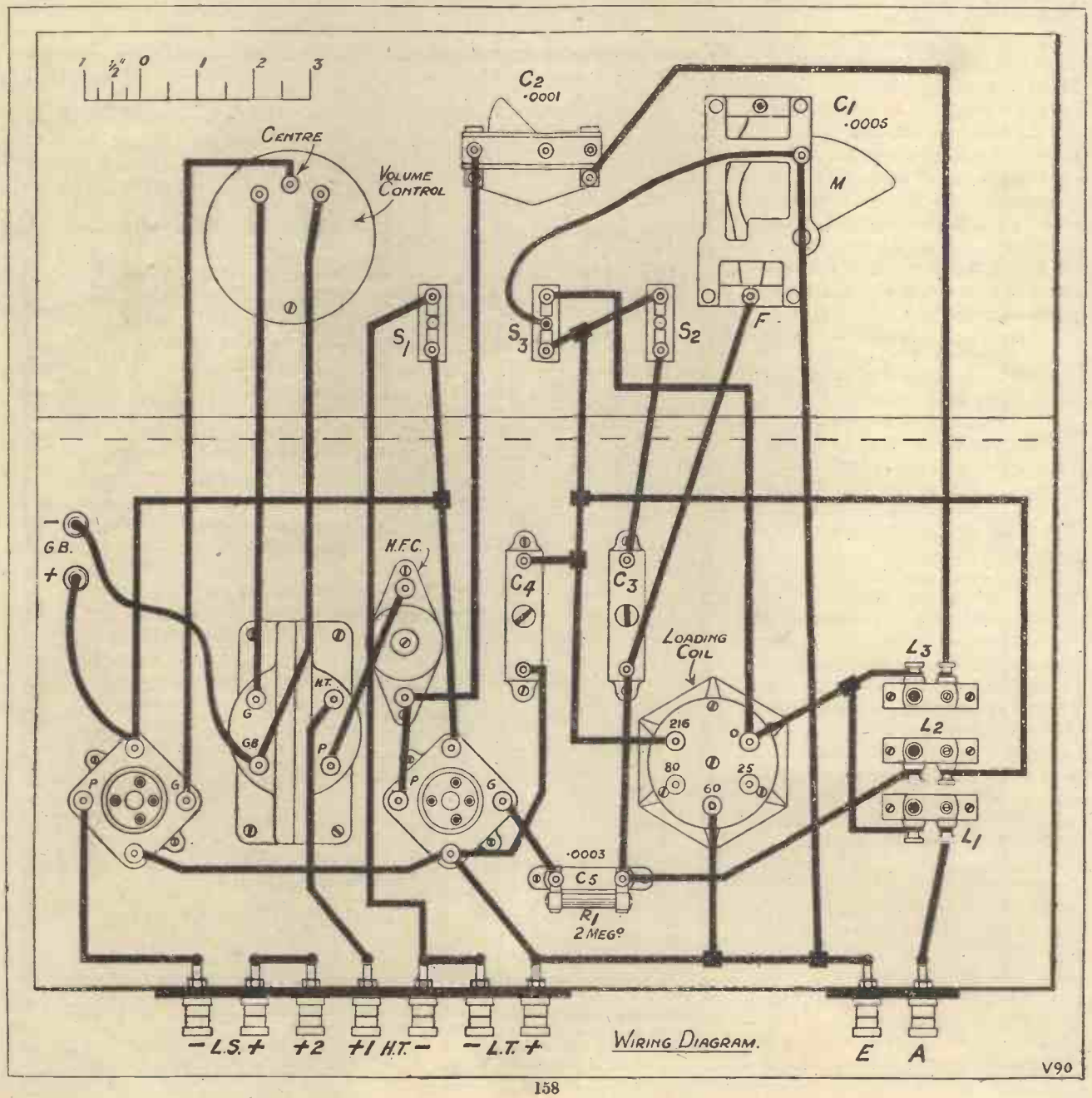
Completing the Tuning

Remember that the entire process of tuning-in this station must be performed on the Formo-denser and that the main control C_1 must be left absolutely alone.

Now there is another point to be mentioned. For London listeners 2 L O is naturally the station to be tuned in first, as 5 G B's wave-length is considerably above his. If your best station has a wave-length greater than that of 5 G B, or of your other favourite station, this station must be tuned-in first, and the higher-wave station found afterwards with the Formo-denser.

The lowest station that you wish to receive with the set must be the first one tuned in, and the others follow. Now, having found and settled the positions of two stations, push in the knob of the centre switch, thus changing over to the long wave-length range. Still the setting of the main condenser must not be altered.

By means of the second Formo-denser, immediately behind the centre switch, 5 X X may now be tuned in. If 5 X X is not wanted, there is no reason why the set should not be "pre-adjusted" to Radio Paris or any other station that is heard on the



long-wave range. In London, Radio Paris was received at sufficient strength to be quite comfortably understood on the loud speaker, and would have made quite a good substitute for 5 X X.

One point must now be mentioned. It may possibly be found that if the set is originally tuned to 2 L O with just the right degree of reaction, it begins to oscillate when switched over to the long wave-length.

Setting the Reaction

Now the whole purpose of the set is done away with if we have to alter the reaction control when the station we listen to is changed, so that the remedy in this case is to reduce the reaction on the short-wave side to just such a point that the set does *not* oscillate when switched over to long waves. In general, hardly any reaction at all will be needed for 2 L O and 5 G B, so that the difficulty will not often arise, but it is possible that some cases will be more stubborn than others, and it is on this account that the matter is mentioned here.

At my home it is difficult to believe that a movement of the switch has really changed the set over from 2 L O to 5 X X, when they are transmitting the same programme, since the two stations come in on this set with absolutely identical volume and quality. Both are received well on the loud speaker, as is 5 G B, with no trouble whatever.

The set has been left for over a week without being touched at all, and after this time the settings were found to be perfectly correct for the three stations, showing that changes in temperature and humidity do not have a very great effect upon the constants of the receiver.

As a "DX" Receiver

When operated in this way it makes an admirable receiver, as I suggested, for "non-radio" folk, but it may also be used for long-distance reception by anyone fairly skilled in the art, since if we ignore the switches it becomes a perfectly straight and normal receiver. On the short-wave side it is sufficiently selective to receive a C.W. station working in between Langenberg and 5 G B without the slightest interference from either, a test which all receivers should pass before they are certified "O.K."

Quite a large number of German stations were logged on the first night, many of them on the loud speaker, and on the long-wave side innumerable C.W. stations were logged. Of course, by merely setting the centre-switch at the long-wave position and using the main dial as tuning control quite a wide wave-range is covered, and when the maximum position is reached there is the Formo-denser in addition.

I do not recommend tuning in distant stations with a screwdriver, but it can be done when necessary!

As a final word of advice, let me say this: Do not look on the receiver as a freak circuit, or you will be pretty certain to manufacture difficulties that are really non-existent. If you regard it as a perfectly straight set and treat it as such you will have no trouble with it, and will find the switching scheme a great convenience even if you are bitten by the "DX" craze.

REPRODUCTION WRINKLES

In order to reproduce the lower musical frequencies the horn of the loud speaker should be as long as possible.

* * *

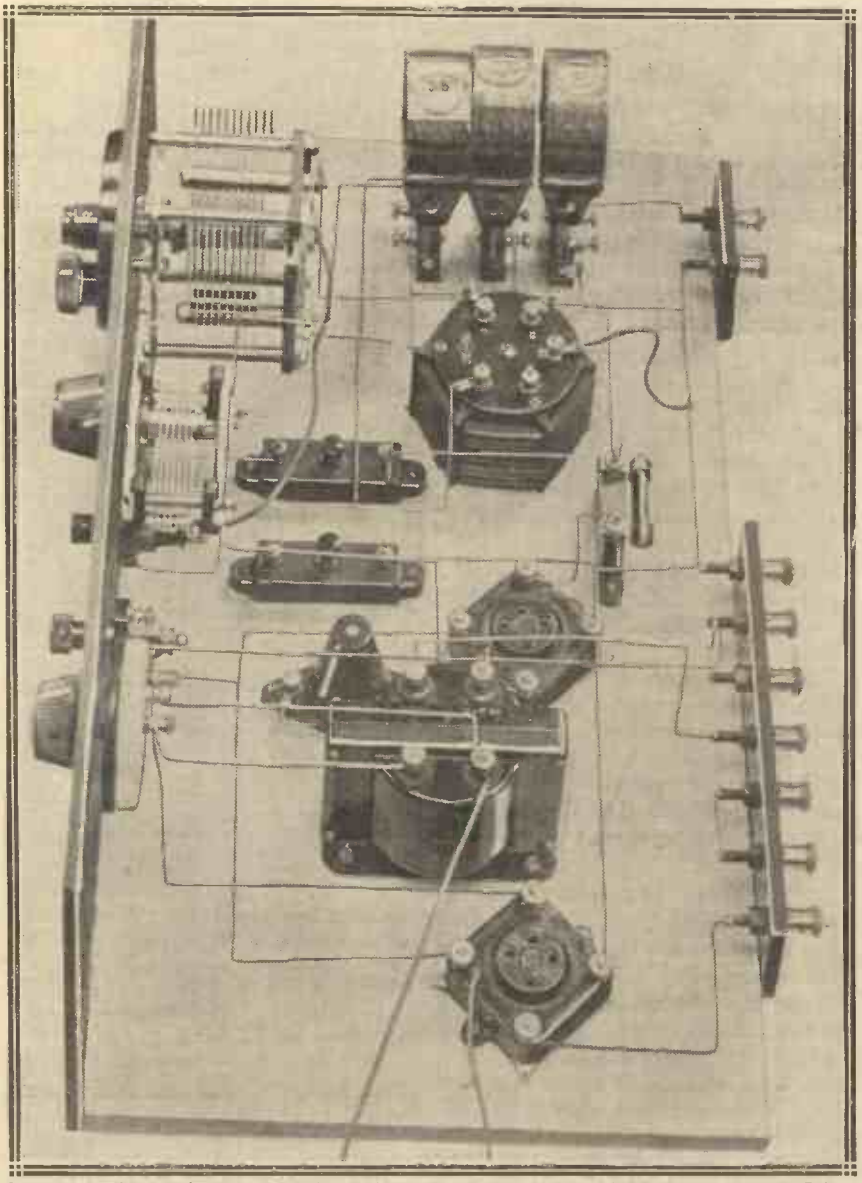
Instead of connecting the loud speaker directly in the plate circuit of the last valve, it is a great advantage to use an output filter which excludes all the ordinary plate current and utilises only the currents representing music, speech, etc.

* * *

One advantage of an output circuit as compared with the connection of the loud speaker direct to the plate circuit is that with the former the loud speaker overloads less easily than when the direct current is flowing through the winding.

* * *

Although in many cases distortion troubles are due to the H.T. battery, it should not be forgotten that a faulty grid-bias battery can cause distortion, and the voltage of this should be checked occasionally.



The two leads coming right out of the picture in the foreground in this photo are the G.B.+ and G.B.= leads, the G.B. battery having been removed from its usual position in the foreground near the panel.

Coils for the 'World-Wide' Five

Constructional details of the long-wave coils for the five-valver described in last month's "M.W.", together with further operating notes.

By C. P. ALLINSON, A.M.I.E.E., A.M.I.R.E., F.Inst.P.Inc.

ALTHOUGH wireless is becoming more and more a precise science, there are still many things that puzzle us in the behaviour of a wireless set. For instance, as you have probably found out yourself, it is often found that two wireless sets built exactly alike will not always behave the same.

Why this is so one can very seldom say. Even assuming that the components are exactly the same they may not behave the same in different sets.

For Long Wave-Lengths

I once built a short-waver that would insist in giving a threshold "growl"; I tried substituting every component in it with others which were working in another short-wave receiver that gave no trouble of this description without curing the trouble. To this day I don't know what the cause of the trouble really was.

It is possible, therefore, that when you have built the "World-Wide" Five it may not behave exactly like mine does in some respects. There are one or two points, therefore, I should like to deal with so as to assist you in any difficulties that may arise.

First of all, though, I must give you the details of the long-wave coils for this set. These are practically identical with a well-known type and are to all intents and purposes standard. A fair amount of work is involved in making them, so if you prefer to buy them ready-made you will have no difficulty in obtaining them (I understand that Wright and Weaire are making them.)

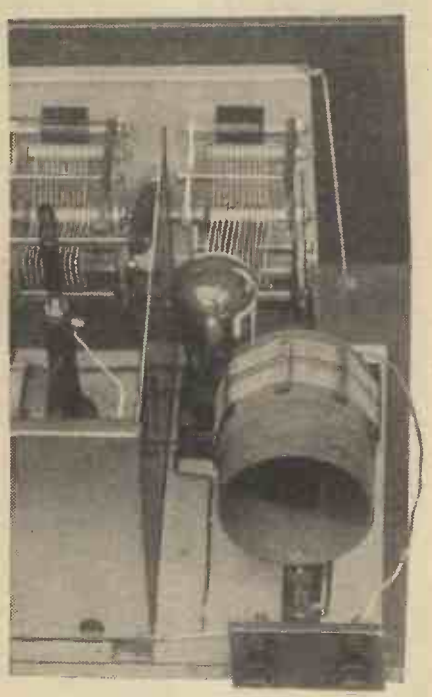
Aerial Tappings

However, for the keen home constructor here are the details: The aerial is tapped on to the long-wave grid coil L_2; this winding consists of 280 turns of 38 D.S.C. wound in 10 slots 3/32 in. wide and $\frac{1}{8}$ in. apart on a 3-in. ebonite former; the slots may be about 3/32 in. deep, and 28 turns are put in per slot.

The aerial is tapped on in two places so as to provide alternate tappings at the beginning of the 3rd and 4th slots. If a very high degree of selectivity is required, an additional tap might be taken at the beginning of the 2nd slot.

For the H.F. transformer windings, the secondaries L_4 and L_6 will have the same windings exactly as L_2, while the primaries will be wound over the L.T. end of the secondary on top of ebonite spacers. These spacers are made of $\frac{3}{8}$-in. ebonite tubing, each piece being a little less than a half-section of the tube. Eight of these spacers will be needed for each primary winding. (They can be obtained from most wireless dealers.)

The primary consists of 50 turns of 38 D.S.C. wound with the turns touching, after which the neutralising winding is put on top of the primary winding with the same ebonite spacers as used before.



The aerial input end of the "World-Wide" Five, showing the aerial coil in position.

The connections are as for the broadcast coils. The 2nd H.F. transformer has a continuation of the secondary winding which forms the reaction winding (L_7), consisting of a further 56 turns, i.e. two more slots with 28 turns in each.

The above figures for primary windings are given for the average H.F. valve of 25,000 to 30,000 ohms impedance. With a lower impedance valve it will be desirable to remove a few turns equally from primary and neutralising windings, though this is not really necessary unless stabilisation becomes difficult owing to having too big a primary winding.

In some cases it may be found with this set, whether on long or broadcast waves, that easier stabilisation may be obtained by reversing the connections to the primary windings, i.e. to pins 3 and 4. In any case, it will be found that only the one neutralising condenser C_2 is at all critical in its adjustment, C_4 will only be found to have any very definite influence either at the top or bottom of the condenser scale.

Uniform Stability

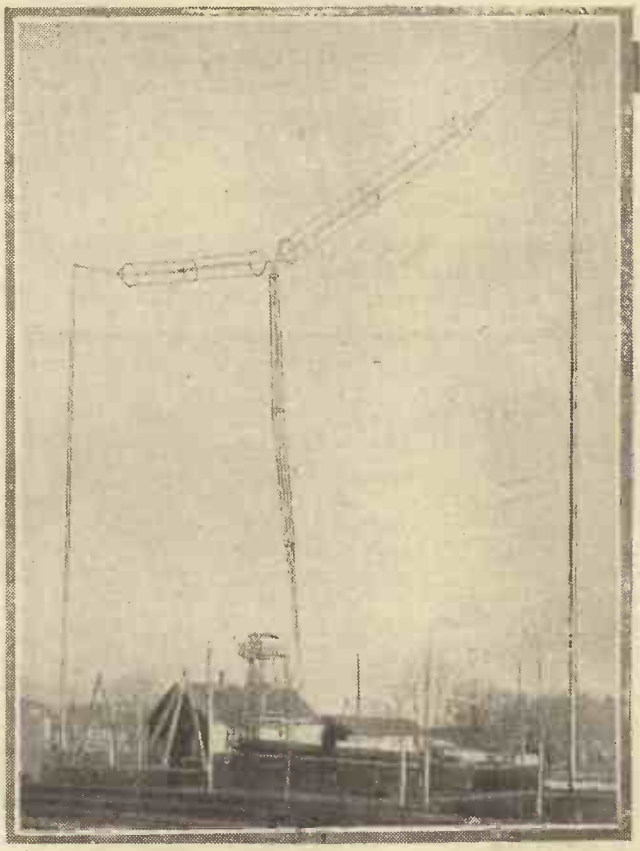
I would like to repeat here the importance of having the right size primary winding for the valves you are using. On medium wave-lengths, with the 20-turn primaries (which are intended for use with valves of 30,000 ohms impedance), using valves of the P.M.5X type, which have an impedance of only 20,000 ohms or thereabouts, I found that it was a little more difficult to stabilise over the whole scale than if I used the correct primary winding for this type of valve, or alternatively the H.T. had to be cut down.

It is also important to have the values of the two variable resistances R_8 and R_9 correctly set, otherwise you may find difficulty in getting the set to stabilise properly over the whole band of wave-lengths covered by the tuned circuits.

With these resistances correctly set you will find you can use a much higher value of H.T. than would otherwise be the case, with stability at all points.

Bias for the Detector

Now there is a little question about the detector valve. You will have noticed that I have connected the grid leak to a separate terminal, so as to allow of either positive or negative bias being applied. This is obviously a compromise, though a useful one, but I prefer to use about $1\frac{1}{2}$ volts positive, as this gives greater signal strength on weak stations, and easier control of reaction, than the use of negative bias. Zero bias is, to my mind, utterly useless, for it is neither one thing nor the other. And as regards quality, frankly I can detect no difference between $1\frac{1}{2}$ volts positive and $1\frac{1}{2}$ volts or 3 volts negative.



KALUNDBORG'S COMPANION

Some interesting details of the Danish Broadcasting Company's island station at Sorö.

From a Special Correspondent.

VERY few "station getters" in this country are unaware of the existence of the Danish radio station at Kalundborg. It is a station which comes in frequently with good strength, and, as its musical programmes are of interest, it has been received very often in this country.

But few seem to have heard of Kalundborg's companion station at Sorö, a station which is almost of equal importance in Denmark. Like the transmitting station at Kalundborg, the Sorö radio station is owned and operated by the Danish Broadcasting Company, and it is equipped with the most up-to-date apparatus.

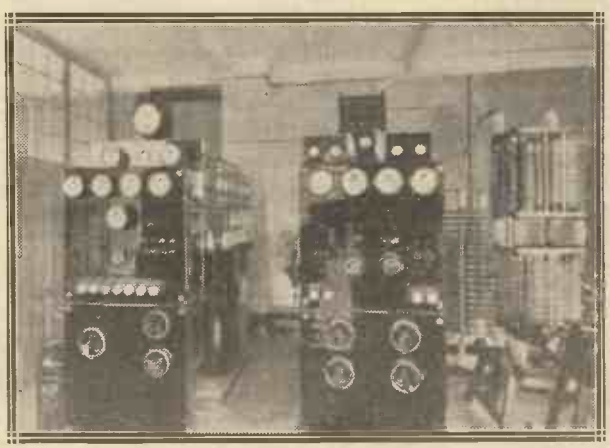
Probably, however, the reason why the Sorö station has not been picked up very often in England lies in the fact that its wave-length is an undoubtedly high one, being of the order of 1,153·8 metres, and that its transmitting power is not in keeping with its high wave-length, the aerial power of the station being 2 kilowatts.

Still, however, the Sorö station is of interest to the keen amateur, because, unlike the more popular European stations, it is not "overworked" in the respect of its being received here at any old time, so to speak.

Where is Sorö?

But where is this Sorö, you may ask? Get down your atlas, and glance at the map of Denmark. Among the almost innumerable small islands to the south of Copenhagen you will come to an "Isle of Sjælland," upon which will probably be marked the name "Sorö." Here, then, lies the radio station which we have under description at the present moment. It lies in a direction south-west of Copenhagen, the Danish capital, and approximately 80 miles from that city.

Sorö constitutes one of the several Danish relay stations, and, perhaps, it is the most up-to-date equipped of them



Figs. 1 and 2. These two pictures show different parts of the transmitting apparatus at the Soro station. To the left are the rectifier and modulator panels, with an air condenser and inductance in the background. In the right-hand picture are the tuned circuits Note the large tuning condensers mounted on stands.

all. True, there is some type of studio at Sorö, but most of the programmes come from Copenhagen, to which latter station the Sorö transmitter is permanently connected by land- and sea-line.

The heading photo will enable the reader to form some idea of the exterior appearance of the station and of its aerial. The latter comprises a cage aerial having an electrical length of approximately 150 ft. It is suspended between two 180-ft. masts, the latter being of interest on account of the fact that they are not of the steel tubular type ordinarily employed, but consist of nothing more or less than tall telegraph poles which have been impregnated with special preservative material.

Into this aerial, as we have said, the station's transmitter sends up a power of 2 kilowatts.

The Generating Plant

The Island of Sjælland being in a somewhat isolated position, the Sorö station has to rely on the generation of its own electrical power. It does this by means of the single motor generator shown in Fig. 3. This supplies an alternating current of 500 cycles which, by means of a transformer, is subsequently stepped-up to a voltage of 10,000. This voltage is then rectified by the usual series of rectifying valves, and then conveyed to the anodes of the oscillating and modulating valves.

The three smaller generators seen in the background of the illustration, Fig. 3, supply the filament current to each of the valves.

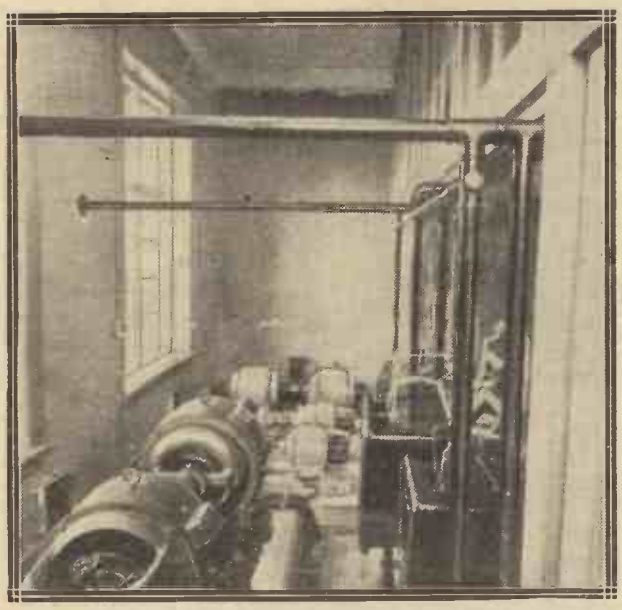


Fig. 3. In the foreground are the motor generators from which the 10,000 volts H.T. is obtained. The generators supplying filament current are shown in the background.

Coming now to the transmitter proper, which is of some interest in that it shows the type of transmitter employed at most of the Danish stations associated with popular broadcasting activities in that country, two general aspects of the transmitting gear will be seen at Figs. 1 and 2.

In Fig. 1 we have on the left the rectifier panel of the station. This contains six valves, and its function is, of course, to rectify and smooth out the H.T. currents derived from the motor-generator of the station. On the right of the rectifier panel is seen the oscillator and modulator portion of the transmitter. This panel contains four oscillating and four modulating valves. On both panels every possible control is mounted in a convenient position in order that rapid adjustments may be made.

The oscillating circuit of the transmitter, which exists between the rectifier and the oscillator-modulator valves, is seen on the right of the photograph, Fig. 2. This comprises two vertical coils of copper strip, and a large air-spaced condenser which is placed immediately behind it.

Turning now to the illustration, Fig. 2, the reader will be able to obtain a good view of the aerial tuning inductance of the transmitter, this portion of the apparatus

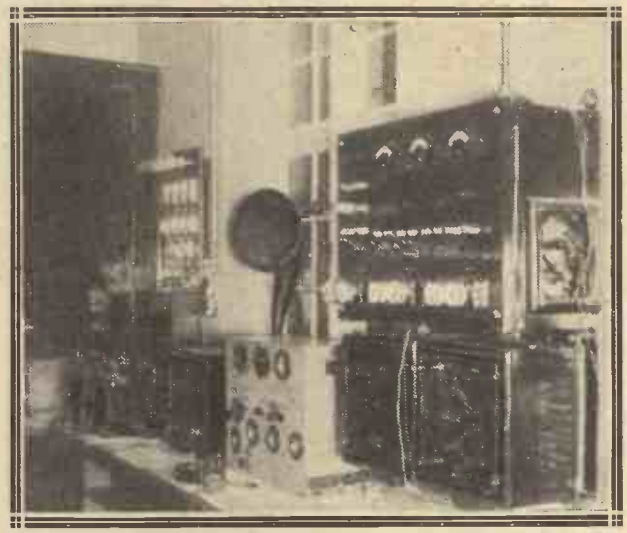


Fig. 4. This photograph shows the control panel of the Sorö transmitter, and also the relay panel connecting the Copenhagen station, 75 miles away. Transmissions from Copenhagen are frequently relayed from Sorö.

being seen on the right of the photograph, and consisting of two horizontal copper strip coils mounted with a smaller condenser at their base. All the tuning circuits are, of course, provided with the usual fine controls, these latter being seen mounted upon small wooden trestles in the foreground of the picture.

The heavy porcelain insulation of the various circuits should be noticed, this high efficiency in insulation seemingly being a special consideration of all Danish stations.

Relaying Copenhagen's Programmes

The speech currents received at Sorö over the lines from the Danish Broadcasting Company's main studio, some 80 miles away at Copenhagen, are amplified before being applied to the grids of the modulating valves. The Copenhagen relay board of the station to which is connected the speech amplifier will be seen at Fig. 4. On the left of the photograph, also, will be seen the control panel by means of which the quantity and quality of the current sent up into the aerial is governed.

A small control panel leading to the miniature studio which the station maintains is also included amongst the control apparatus seen in the photograph, Fig. 4.

However, the studio broadcasts of the Sorö station are seldom heard, for not only is the entire station somewhat difficult to get at by would-be broadcasters, but there is hardly more room in Sorö's little studio for more than a few individuals at a time.

The station, however, functions excellently as a relay station, transmitting the admirable programmes from Copenhagen to the islands around that of Sjælland, many of which, for the use of simple types of receivers, are quite out of reach of Sorö's companion station at Kalundborg.

GRID-CIRCUIT COUPLING

In this article the author follows up his remarks on L.T. switching contained in "Switch Off!" which was published in "M.W." last month. He shows that this apparently very simple business deserves greater consideration than is usually given it and brings forward some practical and novel viewpoints for the guidance of amateurs.

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

IN an article published in MODERN WIRELESS last month I discussed the subject of L.T. switching. Passing from one problem to another in connection with this apparently simple subject I eventually outlined a scheme which is shown theoretically in the accompanying diagram.

This diagram shows a three-point switch and a fuse used in such a way as to provide what I consider to be maximum safety. When the switch is in the "off" position both the H.T. negative and L.T. negative leads are broken, and there is then no danger of H.T. short-circuits occurring inside the set and burning out the valves, or ruining the battery, providing the switch itself is properly and correctly wired.

The valves are also fairly well protected against the grid-bias battery, which, as I have shown, can provide quite enough current to burn-out valves if it is of the 18 or more volts order. The "pealamp" fuse is there to guard against any other H.T. shorts that are liable to occur.

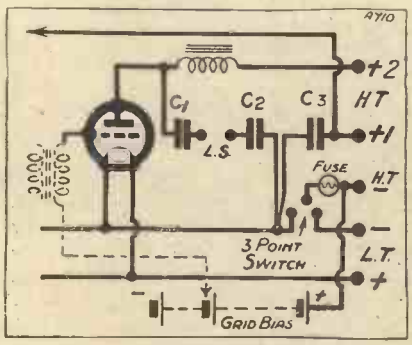
High Voltage G.B.

Personally, I feel rather inclined to advocate four-point on-off switches so that the G.B. battery can be as cleanly cut off as the H.T. and L.T. when the set is switched off, more especially in view of the high G.B. voltages modern sets demand. The grid-bias battery used in some receivers is as large as that required for the H.T. in more modest sets. I am myself using a 108-volt H.T. battery for providing the G.B. in my home set at this very moment!

More Care Needed

There is no doubt about it that some of our sets are becoming high-power electrical installations and need to be treated as such. It is quite all right so long as the outfit is handled only by a skilled amateur, but when it is a household affair, then precautions must be taken.

I have always deprecated the light-hearted way many manufacturers case up mains units, as though they



were low-tension devices, and I have said so a number of times in various articles. But there is now a tendency to make such devices conform to standard power practice, and we have to thank the I.E.E. for laying down regulations for the guidance of designers. Even so, peculiar and dangerous mistakes are made by some of the less prominent firms, such as connecting protecting cases of A.C. units to one of the input leads. Why these people do such things will no doubt be as much a source of wonder to MODERN WIRELESS readers as it is to myself.

However, I am rather straying away from the subject I set out to deal with. Referring to the accompanying diagram (it is reproduced from my article in the January MODERN WIRELESS), you may remember I said: "There is one snag, and I am wondering how many of you are going to spot it."

At the time of writing I have not received a single letter from a "successful solutionist," but probably this is due more to the fact that most of you spotted the snag right away, and consider it almost too obvious to need pointing out.

An Interesting Letter

I have had one letter of interest concerning the diagram from a reader who signs himself "Sherlock." He wrote primarily in connection with my Radio Cinema Scheme (I have had enough letters and to spare about that!), which is being dealt with in "Popular Wireless." But he adds a P.S. in reference to my "Switch Off!" article in which he says:

"The snag is that if the bypass condensers are good ones they will retain their charges for *long* periods of time.

"The poor listener will operate your oh-so-perfect L.T. switch and then think he can do what he likes with the inside of the set. A bypass condenser discharging through his fingers will swiftly make him realise that static electricity can be

dynamic in causing galvanic action!" Rather clever that!

But I said in my article, referring to the bypass condensers: "For a time they will retain their charges if they are in good condition, but they will not be under strain for twenty-four hours in every day."

And even if the condensers were connected in the usual way directly across the H.T. battery terminals, no switching bar external battery switching could affect them. The alternative would be to leave them connected as shown in my diagram and deliberately make them inefficient regarding their charge-holding capacities by joining grid leaks across their terminals. Not an expedient light-heartedly to be practised, owing to its possible effects on the operation of some circuits.

A further scheme would be to employ a multi-contact switch which automatically short-circuited all the H.T. by-pass condensers as well as performing the other duties assigned to the "on-off" switch.

An Efficient Condenser!

Actually, I do not think any of these schemes are worth while. Nevertheless, my correspondent rubs home a good point, and that is, always beware of the bypass. Particularly in A.C. mains units, condensers are to be encountered which can hold truly stunning charges. I once received a mains unit by post and got a shock from one of its condensers which had held its charge only too well. How long it had held it, I never found out; but it must have been a good condenser. Anyway, it was a good shock!

The Circuit "Snag"

But reverting once more to the subject in hand, the "snag" in my diagram does not concern the storing capacities of condensers; at least, not directly. The "snag" is this: Every grid circuit which derives grid bias from the grid-bias battery shown will be coupled by the common resistance represented by the fuse lamp.

You might consider that this could hardly do any harm, because, anyway, they are already coupled by the resistance of the G.B. battery itself; and, in any case, they are merely grid circuits. Dealing with the last question first, don't forget that every grid circuit, except that of the first valve, may be virtually a plate circuit; there will be couplings —some very tight, indeed—between these and the anodes of the preceding valves.

But whereas the resistance of a grid-bias battery in good condition should be but a few ohms, that of the "flash-lamp" fuse may be forty. Even so, it is not certain that serious coupling effects would occur; but a by-pass condenser of the order of at least 1 microfarads would be needed to eliminate all risks of such.

Should my circuit be incorporated in a set and coupling effects actually are troublesome, I would say do away with the fuse. With such carefully-planned switching its value is not very great unless pentodes or S.G. valves be used, when the whole subject of protective fuses needs to be completely revised. The closeness of the electrodes in these new valves makes valve short-circuits a danger, instead of, as in the case of ordinary valves, a very rare event deserving of chronicling as a "curious incident."

By the way, in view of some of the above remarks, it occurs to me that the subject of "grid coupling" through common sources of G.B. supply has failed to receive as much attention as it may deserve. I wonder how much apparently very obscure distortion effects which have puzzled amateurs have been due to this?

Useful Information

But if your G.B. supply is in the form of a dry battery, you can safeguard yourself against such trouble by seeing that the battery is discarded the moment it shows signs of deterioration. To keep the G.B. as well-maintained as the H.T. and L.T. is yet another good rule to observe.

I had intended to deal with other points in switching, but find that I now have not the space to do so, and must reserve my other ideas regarding switching for some future occasion. Nevertheless, I do not feel that I have wasted space on irrelevancies, because re-reading this article and the article in the January "M.W." I note that some really useful information has been forthcoming as a result of my research into one of the most humble, but most important, of radio components —the "on-off" switch. At least, that is my belief, and I trust my readers will endorse it.

FILMING THE FIRST RADIO-TALKIE

"Shooting" a "close-up" scene in "A Dash for Liberty," a play written by the Editor especially for the Radio-Cinema. This film was the first complete drama to be produced for this purpose. Mr. G. V. Dowding, inventor of the system, can be seen (second from left) watching the Kodak camera-man at work. The object of the Radio-Cinema is to combine a broadcast play with a home-projector film and to produce a perfect "talkie" while leaving the broadcast as a normal programme item for those listeners not having projectors.

ABOUT AERIALS

It is possible for a crystal set to receive a programme from a foreign station through the medium of a nearby aerial attached to a powerful valve set, which is not only picking up the distant station's programme, but is re-radiating this with sufficient strength for the neighbouring aerial to pick up the impulses.

* * *

The maximum amount of interference between neighbours' aerials occurs when they are parallel to one another, and at about the same height.

THE NEW PENTODES

Some details of a few of the 5-electrode valves recently placed on the market.

By KEITH D. ROGERS.

As I write these notes the new five-electrode or pentode valve is gradually making itself more widely known on the British market, and the valves are now not nearly so difficult to obtain as they were some weeks ago, when the supply appeared to be very limited indeed.

The Cossor Pentode valve. Note the terminal on the base, this terminal being for the connection to the priming grid.

Up to the present I have had opportunities of testing four types of pentodes, the 2-volter and 4-volter made by the Mullard Valve Company, the Ediswan 2-volter and the Dario Bi-volt. Most have come up to my expectations as regards amplification and general behaviour.

Let us take as example the Ediswan pentode, the 5E.225, first. This valve has a filament voltage of 2, and takes quarter of an amp., while the anode volts are 150 maximum and the priming grid volts 100 to 150 maximum. The amplification factor is given as 80, while the impedance is only 66,000, thus giving a slope of 1·2 milliamp per volt.

Grid-Swing Problem

Thus it will be seen that the valve has a fairly steep curve, and it will not, unfortunately, carry any very great grid swing. But this disadvantage is off-set by the fact that tremendous magnification is obtained, compared with that of the ordinary valve, for any given input, and so it is not necessary to feed the valve with as much signal strength as would be the case with the ordinary valve, for a given output strength.

The long and short of it is that the pentode valve can be placed in the last stage of a small receiver and can be expected to fulfil the magnification powers usually associated with a couple of low-frequency stages. Care has to be taken, of course, to see that the valve is not overloaded, and, furthermore, care must be taken with the circuit in which it is used.

This does not mean that the circuit must be tricky or that any particular type of circuit has to be employed, but merely that the output circuit impedance should be of such a value as to suit the impedance of the pentode valve itself. This, of course, holds good with all the pentodes, and it is essential for really good results that an output transformer suited to the pentode, which is now on the market in several makes, should be used.

The Output Circuit

The method of taking the loud speaker direct to the plate of the valve is to be deprecated, and if pure results are to be obtained, with a fair amount of bass and not too much preponderance of the high notes, it is essential that a properly designed output transformer should be used.

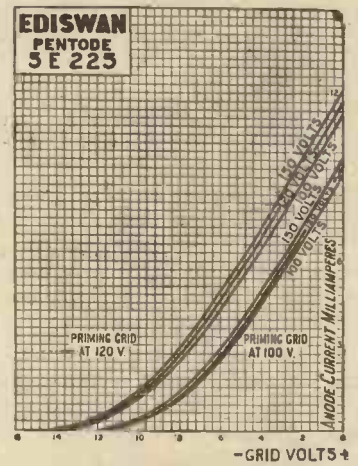
The Ediswan 5E.225 works best on 150 volts H.T., and a grid bias of 6–7½ volts. The H.T. consumption, of course, is not a low figure, but it must be remembered that the pentode is taking the place of two valves and, moreover, is taking the place of one power or super-power valve. It should also be remembered that when using a pentode with the high-pitched type of loud speaker, that is, one which will give a preponderance of high notes, one is liable to increase the prominence of the high notes, and thus get a rising characteristic when using this type of loud speaker.

As regards the other pentodes, the Mullard P.M.22 and the P.M.24 are both excellent valves, for 2- or 4-volt accumulators respectively, and having very high magnification factors. In exchange for a somewhat high plate current they will stand a useful input, and so considerable punch can be got out of the valve in the way of signal strength.

Plate Current Required

The P.M.22 takes about 12 to 14 milliamps plate current for 150 volts with proper bias, and the P.M.24 a little more. It should therefore be remembered by all who are desirous of using pentodes that they will have to get H.T. batteries or mains units capable of supplying the milliamps required at the voltages required if the best results are to be obtained. These pentodes are priced at 25s. each.

I must also mention a French pentode which has come into my possession, marketed by the Dario Company, and which is sold for a guinea. This is quite a good little valve, and although I have not had time fully to test it, it seems by just a rough try-out that it is quite a promising proposition.



This is the static characteristic curve of the Ediswan Pentode valve.

The construction can be seen from the photograph, and it will be noticed that in this specimen the connection of the outer grid to the filament does not go to the centre of this latter, but a little to one side, and thus the characteristics of the valve are inclined to vary according to whether any one filament pin is made positive or negative.

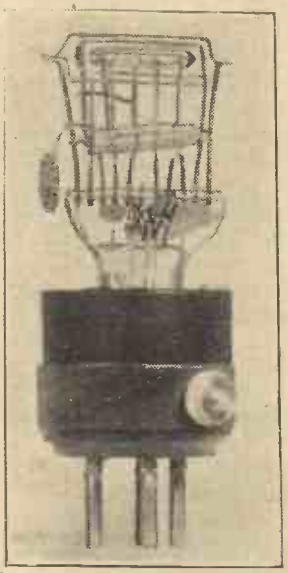
In the case of the Dario valve the plate is of the horizontal variety, and is not to any really great extent hidden by the gettering, and so one can see quite clearly how the valve is constructed and how the various electrodes are spaced.

Keep H.T. Down

This valve is also of the 2-volt variety with the usual high-impedance and high-magnification factors associated with all pentodes, and capable of carrying quite an average pentode grid swing. Care should be taken to run it at the specified H.T. voltage, or a little under, as increasing the H.T. above the maker's figures causes serious loss of emission.

Incidentally, I have also been trying the Dario Bi-volt power valve (7s. 6d.), which has an impedance of 4,500 ohms, and magnification factor of 9—very good characteristics.

In practice this valve is certainly good value for money, and makes a useful 2-volt output valve.



The interior of the Dario Pentode valve showing the construction and assembly of the electrodes. The disc at the side carries the "gettering" compound which is volatilised on heating the valve after the bulb has been exhausted.

The problem of using pentodes to the best advantage is not such a difficult one as is sometimes thought, provided that care is taken in the H.T. supply.

Where a pentode is taking the place of an ordinary L.F. valve following a plain detector, no trouble is likely to occur, but when it is preceded by an L.F. stage then, unless the H.T. supply be above suspicion, motor-boating is likely to occur.

Especially is trouble likely to be encountered if the anode current is being provided by a mains unit, more especially if separate tappings for the various stages are not available or if the tappings are not properly arranged.

The Mullard 2-volt Pentone. Note the centre insulator which is used as a support and connector for the various electrodes. The connection to the centre of the filament cannot be seen.

When a potential divider is used, and tappings for various voltages are taken, the resistance between the various tappings is liable to cause coupling between the various stages in the set and so cause motor-boating.

In such cases an anti-motor-boating device should be placed in the detector plate circuit, but if this does not stop the trouble it may be found to be due to coupling between the anode and priming grid circuits of the pentode valve.

Therefore an output circuit of the correct impedance should be used for the pentode, and the grid connection taken to the H.T. terminal via a choke and condenser, the latter being of the 2–4 mfd. variety.

The Output Circuit

The output choke or transformer is an important feature owing to the high impedance of the pentode itself. It is obviously bad practice to run the valve so that the loud speaker comes into the plate circuit.

Finally, it must be remembered that if H.T. mains units are not employed when pentodes are used, the H.T. battery must be of the large capacity type.

As amplifiers following short-wave detectors pentodes are excellent, and especially when they are inserted in place of L.F. valves in sets consisting of two valves—detector and 1 L.F. stage.

THE "INVINCIBLE" FIVE

SIR,—Having just completed the "Invincible" Five, as described in the November issue of "M.W.," I thought you might be interested to know how it behaved.

I must congratulate you on such a successful design as the "Invincible" Five, and I have handled quite a few, including your "Solodyne." Your claims are not in the least exaggerated, and the set behaves exactly as you describe it to all its controls, and it is the finest "five-valver" I have yet met. Using two-volt valves, and only a mile from the local broadcasting station, I picked up about fifteen stations all at full loud-speaker strength.

Further Details

I did not make a log as I have not got the set properly neutralised yet.

You stated in your November issue of "M.W." that further notes would follow next month, and I was disappointed when I went for my usual copy to find it made no reference to it.

If you could give me any further wrinkles on the neutralising, etc., of this set I would be greatly obliged.

Again thanking you for placing such a fine set through "M.W." at my disposal and wishing your valued paper every success.

I remain,

Yours faithfully,

A. O'LEARY.

Ballyhooly Road, Cork.

[Ed. Note.—The further details referred to by Mr. O'Leary were published in MODERN WIRELESS for January.]

CONCERNING LICENCES

Your receiving set and your licence are open to inspection at all reasonable times by duly authorised persons from the Post Office, who will produce cards of identity upon request.

* * *

It is a condition of your receiving licence that when an aerial is crossing above, or liable to fall upon, any overhead power wires (including electric light and tramway wires) it must be guarded to the reasonable satisfaction of the owner of the power wires.

* * *

Any permanent change of address on the part of a B.B.C. licence holder should immediately be communicated to the postmaster of the district in which the station is now situated.

HOW TIME FLIES IN RADIO

This article, written for the listener who is interested in the working of his receiver, deals with the time taken by the programmes to travel through space from lecturer to listener.

By P. R. BIRD.

RADIO is not really instantaneous. When the announcer says: "Here is the second news bulletin," it might be thought that every working loud speaker in the British Isles utters those words at the same instant. Actually this is not so. There is a time lag—in fact, there are several—and as they are not generally considered it will be interesting to see when and how they occur.

Looking first at the purely wireless part of the transmission, we will imagine a wave leaving the local broadcasting station's aerial, being flung out into all directions, and arriving practically simultaneously upon your own aerial. Although the transfer of energy from that distant aerial to your own was *practically* simultaneous, there is a certain amount of time lost between aerial and aerial.

This does not mean to say, of course, that the B.B.C.'s time-signal is wrong by the time it reaches your aerial! From a practical point of view the time-signal can be regarded as arriving at the very instant of its dispatch. From a scientific point of view, however, there is a pause—an almost infinitesimal fraction of time lost in travelling. You can easily calculate how much time is lost, for the electro-magnetic waves of wireless travel at the same speed as light itself. Long before wireless was invented the speed of light had been ascertained pretty accurately by independent investigators and found to be about 186,000 miles per second.

Nature's Own Quick-Step

There is something fascinating about this speed and something fundamental. For those things which man commonly regards as instantaneous, i.e. light itself, the electric telegraph, and wireless, are all tuned up to this particular pitch, and no other. Whatever the reason for it, this speed of 186,000 miles per second is Nature's own quick-step, and is used by her for wireless, for light, and for certain other phenomena.

Applying this to your own case you can soon find out how much delay there is upon the time-signal or other transmission between the transmitting aerial and your own. If you divide the number of miles separating the two aerials into 186,000, your answer will give the fraction of a second it takes to travel that distance. In the case of a listener living, for instance, at twenty miles from his nearest station, the local programme always arrives about 1/9,300th of a second late.

Even if you are listening to a foreign station and the distance between the aerials runs into hundreds of miles, you will soon see that the time lost is so infinitely small as to be inconsiderable, and consequently we can regard wireless communication, even between stations thousands of miles apart, as being practically instantaneous But before we leave this part of the subject it will be interesting to notice how time flies in radio over the Atlantic.

The Transatlantic Time Lag

If you have managed to pick up a programme from one of the American stations direct, such as K D K A, 2 X A D or 2 X A F, the distance between aerials would be a matter of just under 3,000 miles, and over such a tremendous distance the time lag is really worth noticing. By dividing 3,000 into 186,000 we see that the signals coming the shortest distance between these points would be about 1/62nd of a second late! This means that if the world were wide enough to hold sixty-two Atlantics, placed side by side, a wireless signal could cover the distance from one end right across to the other and still arrive within one second of dispatch! No wonder then that signals from the local station (generally only a few miles away) appear to be absolutely instantaneous.

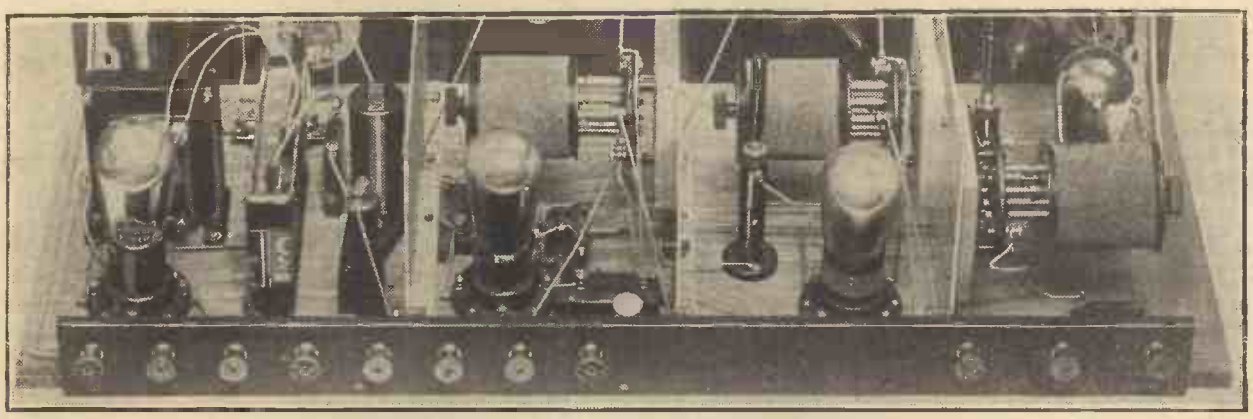
As this universal speed of 186,000 miles per second applies to electric currents running along wires as well as to wireless, the simultaneous broadcasting of programmes is, to all intents and purposes, really simultaneous. Because

if any station taking the London programme is situated even 300 miles away from London, we find on dividing our 300 into the universal speed that the journey only takes 1/620th of a second. The extra mile or two to a listener's aerial makes a negligible difference to the time taken, so that the wire and wireless part of the programme pays very little toll to Father Time.

But that wily old gentleman sets another trap for the transmission. Either by wire or wireless one second of time represents many thousands of miles, but we must remember the programme exists before it reaches the microphone, and after it leaves the loud speaker, and this is where Father Time gets his chance!

Let us take, for instance, the case of a speaker in the studio who is just going to give a talk. Mr. What's-His-Name starts by drawing a breath, moistening his lips, and saying to the unsmiling mike, "Hello, Everybody." A fraction of a split-second later, people all over the British Isles have heard their loud speakers say to them, in life-like imitation, "Hello, Everybody."

Coming from the speaker's mouth, these sound waves travel outwards, across the studio, and reach that super-electric-ear, the microphone. Here a sensitive diaphragm is shaken by the sound wave, and that movement is translated into electricity. From that point the words exist not as words, but as corresponding electric currents.



Despite the great distances covered, and the complexity of wiring in the modern transmitter and receiver, no time is lost in the really radio part of the transmission. What lag there is between the original sound and the duplicate of it heard by the listener occurs before the sound reaches the microphone or after it leaves the loud speaker.

They are hurried along to the aerial, flung out into the ether in the form of electro-magnetic disturbances and eventually reach the listener's aerial, where they are transformed back into high-frequency electric currents. After operating the various valves, they are fed, now in the form of low-frequency electric currents, through the windings of 'phones or a loud speaker.

Here their magnetic effects are utilised to move the receiving diaphragm backwards and forwards in the air, thus transforming electro-magnetic energy into sound energy. As they were originally controlled by the distant speaker's voice, so they now control the diaphragm of the loud speaker, giving it the necessary pulls in order to make it set up a similar air commotion.

Where the Time-Lag Lies

It is these waves, travelling across the room through the air, that reach the ear of the listener and reproduce the "Hello, Everybody."

Notice particularly that those words have existed *twice* in the form of sound waves. Once they were sound waves travelling from the speaker's lips to the microphone. Then after the necessary voyage by wire and wireless, they were sound waves again, travelling this time from the diaphragm of the loud speaker to the ear of the listener. In any wireless programme it is chiefly in these sound waves that the time lag lies. For compared with wire or wireless, sound is sluggish and slow.

Sound waves move in the air not at thousands of miles a second, but only at the rate of about 377 yards per second. Although it has to cross only two small rooms, the sound impulses take more time to do that than the wire and wireless take to link up the transmitter and the distant receiver.

The Slowness of Sound

The comparative slowness of sound cannot be appreciated from figures, but it will be apparent if we try to follow out this journey of the particular "Hello, Everybody" uttered by Mr. What's-His-Name, giving average distances to show the comparative times of transit.

Suppose, for instance, in the case to which we have reverted, Mr. What's-His-Name stands six feet from the microphone. By this latter the "Hello, Everybody" is translated into electric currents, and after an adventurous journey of, say, 100 miles by wireless, currents representing those two words arrive at the diaphragm of John Listener's loud speaker. This perhaps is in a corner of a room, so that John Listener himself is ten feet away from it.

The total journey *through the air* in the form of air waves in such a case would be six feet from the speaker to the microphone plus ten feet from the loud speaker to the listener, a total of sixteen feet through the air. The *electrical* distance is 100 miles (that is to say, the electro-magnetic impulses have to travel 100 miles between the diaphragm that receives the speech and the other diaphragm [loud speaker] which will give it out). The *electrical* journey of 100 miles took these two words only 1/1,860th of a second to do. The *air* journey, although only sixteen feet, took about 1/70th of a second!

In other words, the time taken by sound to get across the two ordinary rooms is about 27 times as great as the time occupied in "wirelessing" that sound over a distance of 100 miles! The whole transaction is so rapid that it appears to be instantaneous, but if we investigate the delay we find, as shown, that practically none of this delay can be laid at the door of radio. Nearly all the time lost is lost by *sound*, either before radio began the transmission, or after it had finished.

A Versatile METER

An easily constructed and comparatively inexpensive instrument, with which practically all the electrical measurements the amateur radio experimenter desires to make can be carried out. By a simple system a very high degree of accuracy is achieved.

Designed and Described by

R. W. HALLOWS, M.A.

THE milliammeter is the handiest of all wireless instruments. As we shall see, it can be made to read not only the *milliamperes* of plate current, but also the *voltages* of filament, plate, and grid batteries, and the *amperes* consumed by the valve filaments. First of all we had perhaps better see just what the milliammeter is. It was discovered many years ago that if a magnetised needle is suspended in a coil of wire a deflection occurs when current is passed through the wire The degree

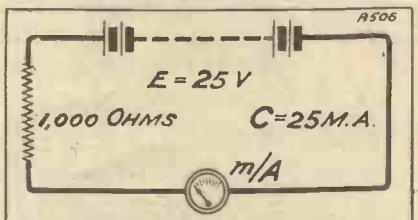


FIG. 2. BY OHM'S LAW AN E.M.F. OF 25 VOLTS DRIVES 25 MILLIAMPERES THROUGH A RESISTANCE OF 1,000 OHMS.

of the deflection depends upon the amount of the current flowing, whilst its direction is governed by the direction of the current flow.

Moving-Coil Meters

This principle forms the basis of the majority of current and voltage measuring instruments, and it is still used in its original form in the moving-iron voltmeter and ammeter. The moving-coil principle is a development of the same idea. Here we have a fixed permanent magnet and a coil, carrying a pointer, which is free to rotate within certain limits between its poles. Moving-coil instruments are preferable for radio work, since they are more sensitive and enable dead-beat readings to be obtained.

The principle of the moving-coil galvanometer is seen in Fig. 1. Between the pole pieces of a permanent magnet is fixed a cylinder of iron whose purpose is to intensify the magnetic flux. In the small space between the poles and the cylinder is a rectangular coil, so mounted that it is free to move.

It is wound generally upon an aluminium frame mounted in jewelled bearings. The coil carries the pointer, which is made as thin and as light as possible.

Two spiral springs, one at either end of the coil, return the pointer to the zero position when current is not passing. These springs also form the contacts between the terminals of the instrument and the windings of the coil. When current is flowing through the coil it tries to set itself so that its flux is parallel to that of the magnets.

The coil thus moves when current is passing, the amount of the movement depending upon the flow of

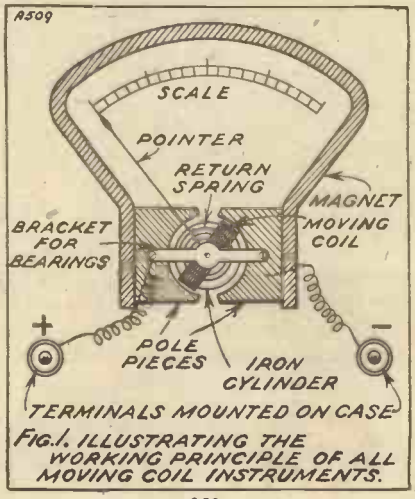


FIG. 1. ILLUSTRATING THE WORKING PRINCIPLE OF ALL MOVING COIL INSTRUMENTS.

current. In the central-zero instrument the coil can move either clockwise or anti-clockwise and thus indicate the direction of the current. For the purpose to be indicated the best form of moving-coil milliammeter is that which has a left-hand zero and reads from 0 to 25 milliamperes.

This wireless milliammeter is, then, nothing more nor less than a calibrated moving-coil galvanometer, so

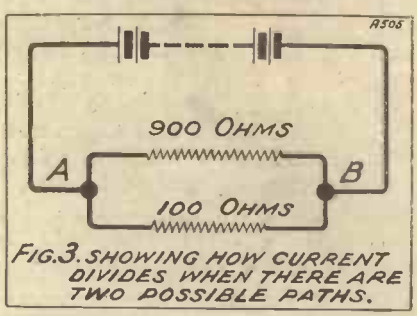


FIG. 3. SHOWING HOW CURRENT DIVIDES WHEN THERE ARE TWO POSSIBLE PATHS.

adjusted that a current of 25 milliamperes suffices to make the coil carry out its maximum movement; if this current is flowing the needle passes from zero to the top end of the scale. To convert the instrument into a voltmeter is quite a simple business, bearing in mind the facts already stated.

Milliamps to Volts

Let us take a milliammeter reading from 0 to 25 milliamps. Suppose that we desire to read from 0 to 25 volts, the problem is simply this. We must so arrange the instrument that an E.M.F. of 25 volts will drive a current of 25 milliamperes through it. Ohm's law shows us that if we connect in series with a source of direct current supplying an E.M.F. of 25 volts a resistance of 1,000 ohms, the current flowing in the circuit will be 25 milliamperes. This is made plain in Fig. 2.

All that we have to do then in order to make the 0 to 25 milliammeter read accurately from 0 to 25 volts is to arrange in series with it a resistance whose value *plus* that of the windings of the instrument is exactly one thousand ohms. Voltages less than 25 will then give proportionately lower readings, and each division of the scale will represent 1 volt.

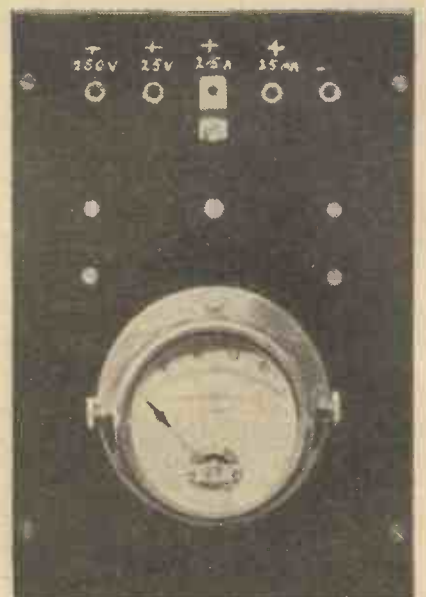
"Constructors who wish to get a little more accuracy can obtain resistances accurate to within 1 per cent. With these the greatest possible errors are so small that they are negligible."

Similarly, it is easy to make the milliammeter read from 0 to 250 volts. In this case a simple calculation will show that the total resistance required is 10,000 ohms. This range is exceedingly useful for keeping a check on the H.T. battery. For the filament and grid batteries the 0 to 25-volt range may be used. So much for the moment for the milliammeter as a voltmeter. Now let us see how it can be made to read amperes as well as milliamperes.

Useful Ammeter

A very useful range for the wireless receiving set is from 0 to 2·5 amperes. We have already seen that a full-scale deflection of the instrument is secured when a current of 25 milliamperes is passing. Now 2·5 amperes represent 2,500 milliamperes.

Ohm's law of resistances shows us that if there are two possible paths for current it will divide,



The various ranges are always immediately available and can be read directly from the one scale.

the flow along each branch of the circuit being proportional to the resistance in that branch. Look at Fig. 3, which shows such a condition of affairs diagrammatically. Between the points A and B there are two paths for current, the one containing a resistance of 900 ohms, and the other a resistance of 100 ohms. Nine-tenths of the current will flow through the smaller resistance and one-tenth through the larger.

In making the milliammeter read from 0 to 2·5 amperes the problem is to bypass 99 per cent of the current and to allow only 1 per cent of the current to pass through the windings of the instrument.

Fig. 4 shows diagrammatically how this is accomplished by means of a shunt. The resistance of the shunt is so arranged that when a current of, say, 1 ampere is being measured, 990 milliamps pass through the shunt

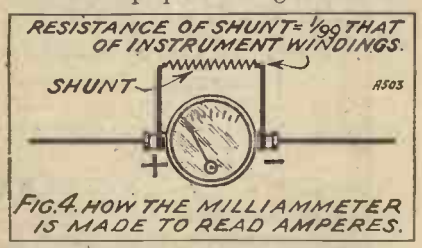


FIG. 4. HOW THE MILLIAMMETER IS MADE TO READ AMPERES.

and only 10 through the milliammeter. Any other range within reason is equally possible.

It goes without saying that if a multi-range instrument of reasonable accuracy is desired there are two essentials. In the first place the milliammeter itself must be a thoroughly good instrument. The more accurate it is the more precise will be the readings obtained on all ranges, and vice versa.

Secondly, the resistances and shunts must be made with every possible care. It is by no means a difficult business to make them dead accurate, but for general wireless work, where laboratory precision is not required, a great deal of trouble can be saved by using ready-made resistances for the voltage scales.

Standard Resistances

The standard resistances made by the R.I. & Varley Company have a maximum error of + or − 5 per cent. The actual resistance of the windings of the average moving-coil milliammeter of reasonably good quality, reading from 0 to 25 milliamperes, does not usually exceed 25 ohms, and it is often a great deal less.

Let us see what is the maximum error in voltage readings that will occur if a "1,000-ohm" resistance is actually 1,050 ohms, and the resist-

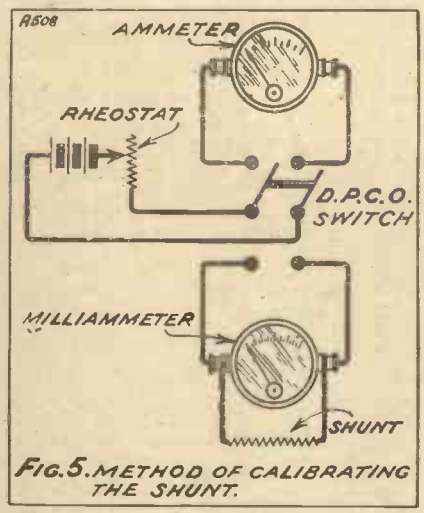


FIG. 5. METHOD OF CALIBRATING THE SHUNT.

ance of the milliammeter as much as 25 ohms.

We now have a total of 1,075 ohms, and a simple calculation shows that 25 volts will drive 23·25 milliamperes through this. The instrument, therefore, under-reads by 1·75 volt on 25 volts, and by ·7 volt on 10 volts. This is the greatest possible error that can occur, and it is not serious, since the finished instrument can afterwards be compared with an accurate one belonging to a friend and a note made of the amount by which it over-reads or under-reads.

If the resistance is actually 5 per cent low, that is 950 ohms instead of 1,000 ohms, the milliammeter whose windings have a resistance of 25 ohms will show only 2·5 per cent over the true voltage at all readings up to 25 volts.

Negligible Errors

Actually the errors are likely to be much less, since the resistance of the instrument may be well under 25 ohms, whilst the degree of inaccuracy in the resistance is seldom so great as 5 per cent. For the 250-volt range a

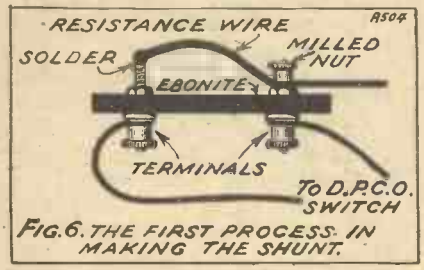


FIG. 6. THE FIRST PROCESS IN MAKING THE SHUNT.

10,000-ohm resistance is required, and here the error is smaller, even if the actual value is as much as 5 per cent out.

Constructors who wish to get a little more accuracy still can obtain resistances from the same firm guaranteed accurate to 1 per cent. With these the greatest possible errors are

so small that they are negligible ; in fact, if the milliammeter is a good one the accuracy of the instrument on either range will be quite equal to that obtainable in a moving-coil voltmeter costing twenty-five shillings or more.

"The instrument is most convenient to use since direct readings are always obtainable from the existing scale."

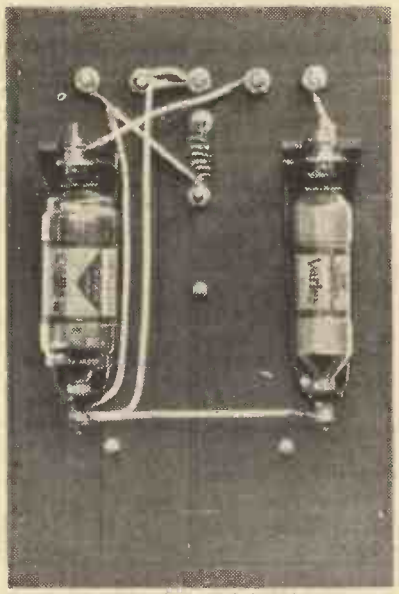
The components required for making the multi-range instrument under description are : Sloping-front cabinet with panel 7½ by 5 in. (Peto-Scott, from whom the panel can be obtained ready drilled and engraved); 1,000-ohm resistance with holder (R.I. & Varley) ; 10,000-ohm resistance with holder (R.I. & Varley) ; 0–25 milliammeter (any good make) ; 5 sockets (Eastick, or similar type) ; small piece of springy metal; short length of No. 22 Eureka resistance wire (or a piece taken from an old 4- or 5-ohm rheostat) ; Glazite for wiring.

Easily Made Shunt

It is a fairly simple business to make the shunt which will enable the instrument to read from 0 to 2·5 amperes. To enable one to do so an ammeter must be borrowed. The other components needed are a D.P.C.O. switch and a rheostat, by means of which we can regulate the flow of current to, say, exactly 1 ampere. Fig. 5 shows the circuit used. The battery used for calibration is preferably an accumulator wth an E.M.F. of 6 volts.

The switch is turned over so that the borrowed ammeter is thrown into circuit and the rheostat is adjusted until the current flow is just 1 ampere. The shunt is made to begin with on the lines indicated in Fig. 6. In a small strip of ebonite two terminals are mounted one inch apart. To the tip of one of these is soldered the end of a piece of No. 22 Eureka or other resistance wire. On to the shank of the other is turned a nut, preferably of the milled-headed type, so as to make it into a double terminal.

The wire is drawn under this nut and clamped down so that to begin with there is only a very short length between the two terminals. This



This is a photo of the original instrument, and you can compare it with the wiring diagram which also appears on this page.

having been done, connect the shunt to the milliammeter as shown in Fig. 5, and the milliammeter to the switch. Turn the switch over and note the reading. Very possibly the needle will hardly move at all ; at any rate, the reading will be very low. This is just what we want. Place the switch in the open position, slacken off the nut of the terminal in the shunt and pull a little more wire through so as to obtain a rather greater length between the two screws.

Testing the Resistance

Close the switch and try again. Continue until the milliamperes reading is about 10 per cent low, i.e. the needle is recording 9 milliamperes when 1 ampere is passing. Then cut the wire, remove it from the screws and make it into a spiral, taking care, though, that the turns do not touch.

What is the use of a stunt like that ? The milliammeter is reading only about ·9 ampere, whilst the ammeter shows that a current of a full ampere is passing. Wait a minute. We have not quite finished yet. We shall come presently to the final process of calibration.

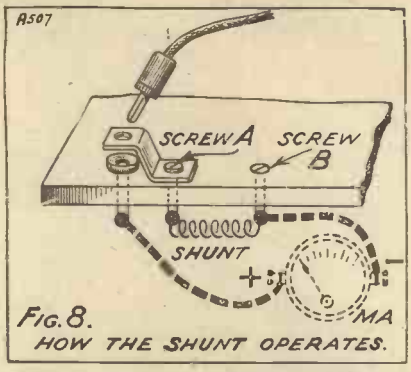


FIG. 8. HOW THE SHUNT OPERATES.

We are now ready to proceed with the simple drilling required for the panel. The layout is shown in Fig. 7. This is for a panel-mounting milliammeter ; if a flush-mounting instrument is used the resistances may be placed a half an inch nearer the top of the panel and the position of the milliammeter will be a little lower than that shown by the dotted circle, so as to give ample clearance.

Completing Construction

Mount the resistances and the sockets and insert the countersunk 4 B.A. screw marked B in Fig. 7. Now cut out a small piece of sheet metal so as to make the springy second contact for the ammeter shunt which is seen over the middle socket in the photographs which show the upper side of the panel.

Fig. 8 will explain the way in which the shunt contacts operate. As the plug is inserted into the ampere socket it makes contact first of all with the springy strip, which is connected to the top end of the shunt.

(*Continued on page* 220.)

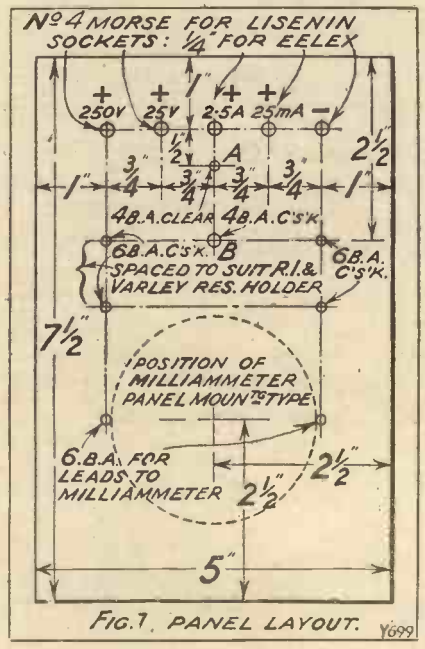


FIG. 7. PANEL LAYOUT.

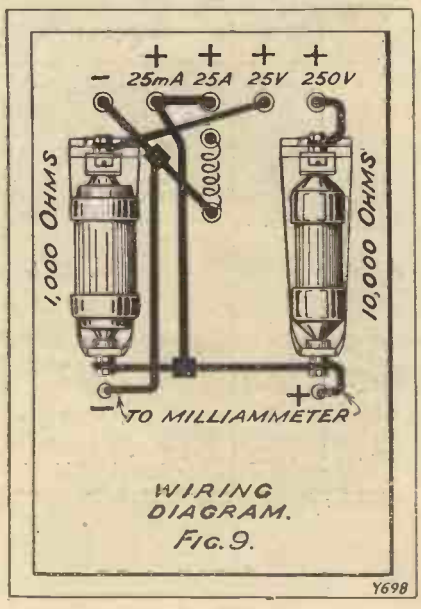


FIG. 9.

SHORT-WAVE SCHEDULES

A list showing the more important of the world's short-wave stations, together with notes on reception and the usual times of transmission.

PRINCIPAL STATIONS WORKING ON WAVE-LENGTHS BELOW 31 METRES.

Wave-length in Metres.	Frequency in Kilo-cycles.	Name of Station.	Remarks.	Wave-length in Metres.	Frequency in Kilo-cycles.	Name of Station.	Remarks.
15·74	19,059	Bandoeng (Java) ..	Call-sign, A N E. Weds., 12.40 p.m. to 2.40 p.m.	21·96	13,661	**SCHENECTADY, NEW YORK**	Call-sign, 2 X A D. Sun., 10.30 p.m. to 3.30 a.m. Mon., 7 p.m. to 9 p.m. Wed., 11 p.m. to 4.30 a.m. Fri., 11 p.m. to 4 a.m. On Wed. and Fri. 2 X A D relays the programmes from W G Y.
16·02	18,726	Rocky Point (Long Island), New York	Call-sign, 2 X G. Mon. and Fri. from 7 p.m. onwards.				
16·88	17,772	**HUIZEN, Holland** ..	New station, wave-length subject to alteration.	22·99	13,049	Houlton Maine	Call-sign, 2 X A A. Transmits after 11 p.m.
				24·5	12,244	St. Assize, France ..	Call-sign, F W.
17	17,647	**BANDOENG, JAVA** (Radio Malabar)	Call-sign, A N H. Weds. 12.40 p.m. to 2.40 p.m. Power of 30 kilowatts.	25·6	11,750	**CHELMSFORD**	5 S W. Maximum power 15 kw. Mon. to Fri., 12.30 p.m to 1.30 p.m. and 7 p.m. to midnight.
				28·5	10,526	**SYDNEY, AUSTRALIA**	2 F C.
18	16,666	**KOOTWIJK, HOLLAND**	P C L L. Weds. 2 p.m. to 4 p.m.	30	10,000	Bergen, Norway ..	L G N.

NOTES.—To cover this wave-band a 2-turn coil is generally used for aerial, a 4-turn for the grid circuit, and a 5-turn in the reaction coil holder. Where there is no separate aerial coil the aerial lead is usually clipped on to the grid coil at a point about one or two turns from the "earth" end of this.

The new station at Huizen, Holland, will doubtless be watched with great interest, and it is probable that there will be regular transmissions with full orchestra on Wednesdays from this station. This section is the most prolific part of the short wave-bands, special favourites in this country being Radio Malabar (17 metres), 2 X A D (21·96 metres), Chelmsford, and Sydney 2 F C (28·5 metres).

PRINCIPAL SHORT-WAVE STATIONS WORKING ON WAVE-LENGTHS ABOVE 31 METRES.

Wave-length in Metres.	Frequency in Kilo-cycles.	Name of Station.	Remarks.	Wave-length in Metres.	Frequency in Kilo-cycles.	Name of Station.	Remarks.
31·4	9,554	**SCHENECTADY, NEW YORK**	Call-sign, 2 X A F. Aerial power of 10 kw. Mon., 11 p.m. to 5 a.m. Tues., 11 p.m. to 4.30 a.m. Thurs., 11 p.m. to 5.30 a.m. Sat., 11 p.m. to 5 a.m. Silent on Sun., Wed., and Fri.	33·5	8,955	**NAIROBI (KENYA COLONY)**	Call-sign, 7 L O. Daily 4 to 7 p.m. Sunday, 7 to 8 p.m.
				37	8,108	**PARIS, RADIO VITUS**	Wed., Fri., and Sun., 9 to 10 p.m.
				37·65	7,968	**DOBERITZ**	Call-sign, A F K Mon., Wed., and Fri., 6 to 7 p.m.
				43·5	6,896	Rome	Call-sign, I M A. Sun., 4 to 6.30 p.m.
31·4	9,554	**HILVERSUM, HOLLAND**	Call-sign, P C J. Tues., 4 p.m. to 8 p.m. and 11 p.m. to 2 a.m. Thurs., 4 p.m. to 8 p.m. and 11 p.m. to 3 a.m. Fri., 4 a.m. to 7 a.m.	58·5	5,128	**NEW YORK CITY** ..	Call-sign, 2 X E. Relays W A B C's programme. Weekdays, 11 p.m. to 5 a.m. Sun., 3.50 p.m. to 5.30 p.m.
				59·96	5,003	Boundbrook, N.J. ..	Call-sign, 3 X L. Power of 30 kw.
32	9,375	Melbourne, Australia	Call-sign, 3 L O. Sun., 7 to 8 p.m.	62·5	4,800	**PITTSBURG, EAST** ..	Call-sign, W 8 X K. Power of 40 kw. Daily, from 10 p.m.
32·5	9,231	Copenhagen	Call-sign, 7 M K. Tues. and Thurs.				

NOTES.—For stations on this wave-band the usual coil sizes are: aerial 2 turns, grid coil 4 or 6 turns, reaction 4 or 6 turns.

The most consistent foreign station is Hilversum (P C J, formerly P C J J), and of the distant stations that firm favourite 2 X A F (31·4 metres). For a long-distance station using comparatively low power, Nairobi (Kenya Colony, East Africa) has been remarkably well received in this country, whilst the Paris stations and Doberitz are worthy of special mention.

AERIALS ABROAD

Some observations of interest on the different types of wireless masts and towers employed in other lands.

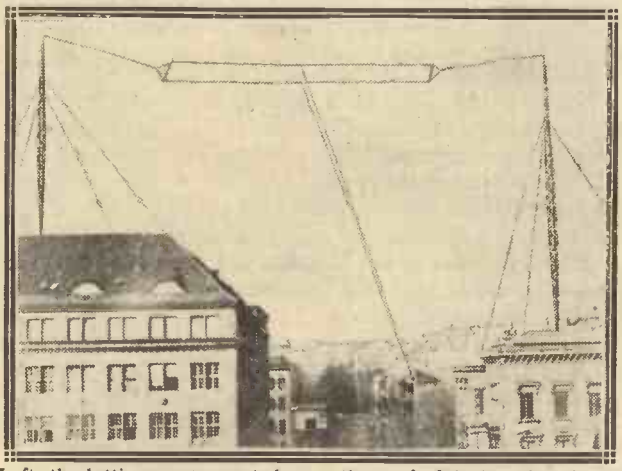
From a Special Correspondent.

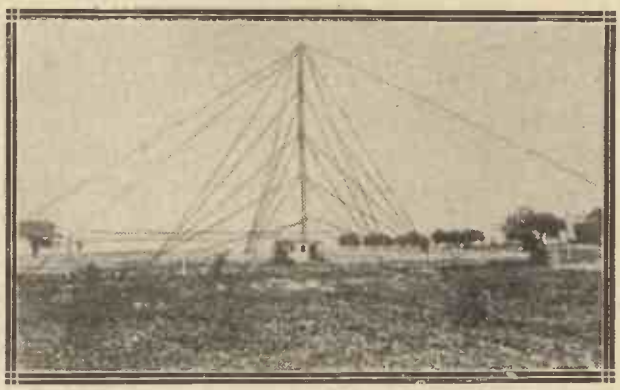
IT has been said with a certain amount of truth that wireless is a science connected with the placing of landmarks up and down a country. Certainly it is that the oncoming of radio has resulted in the erection of aerial masts and towers which possess all the characteristics of landmarks.

After all has been said and done, there is something ennobling in the sight of an aerial mast or tower which has been properly erected. It is symbolical of a new power, and of a means of friendly communication between nations. And in another respect a wireless mast constitutes a landmark in the progress of mankind.

Not Very Beautiful!

There are, of course, aerials *and* aerials. There is obviously nothing very beautiful in the slinging up of a wire or a series of wires between two adjacent buildings. Yet that type of aerial construction is one which our own B.B.C. seems to be rather fond of. Take, for example, the aerial of the Manchester station, 2 Z Y, slung between chimneys.





Left, the lattice masts erected upon the roof of the broadcasting station in the Magdeburger Platz, Berlin. The down-lead is in the background on the right. On the right is the "umbrella" type of aerial used at the U.S. Air Corps' Beacon station at Wright Field, Ohio.

Naturally, this type of aerial construction may serve its own purpose quite efficiently, but for high-power broadcasting and transmitting stations some better type of aerial support is necessary, and is, indeed, in the majority of cases forthcoming.

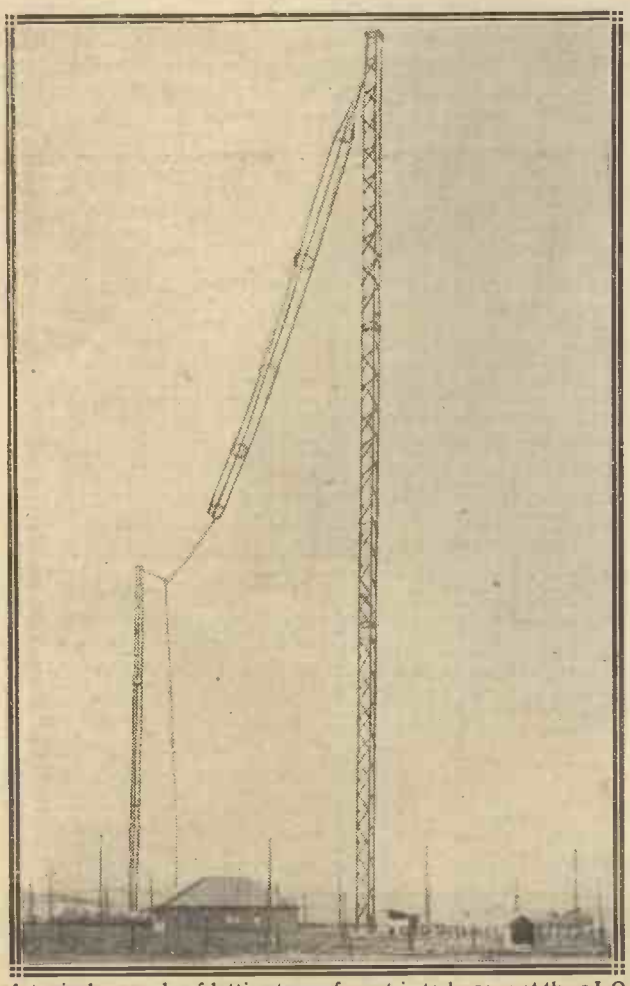
In general, all aerial supports may be classed under two heads, viz., aerial *masts* and aerial *towers*. The term "mast" is properly applied to an aerial-supporting structure which must of necessity be itself supported by a series of ropes or wires. On the other hand, a "tower" is the term applied to an aerial erection which is of itself self-supporting and for which no stay-wires or ropes are necessary.

Difference Between "Masts" and "Towers"

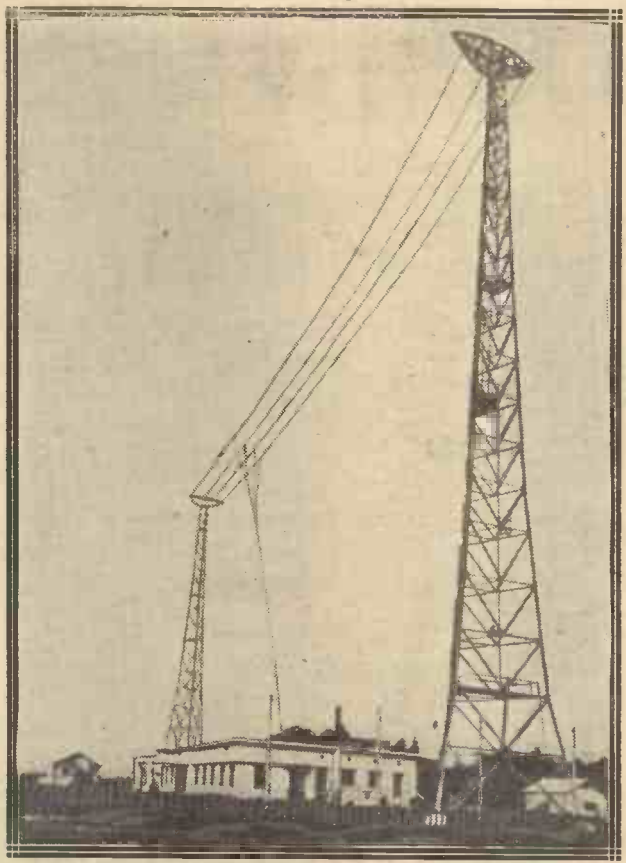
The terms "mast" and "tower" are often confused in meaning by the amateur, and therefore it would be well to bear the above facts in mind.

What we may term a classic example of a simple type of wireless mast is that by the aerial system of the Prague broadcasting station. Here, it will be observed, the masts are stayed by means of steel guy ropes, and that the masts themselves are of the steel tubular type, a type which combines reasonable lightness with stability.

Some stations, however, rely upon the lattice type of mast, as witness the Melbourne station, Australia, whose aerial we see below. In such instances, also, some system of stay-wires must be employed in order to protect the mast against the force of the wind.



A typical example of lattice type of mast is to be seen at the 3 L O station in Melbourne, Australia.



A recent example of a "tower" aerial support. The new 350-ft. aerial towers at the recently erected J O A K station (Tokyo) of the Japanese Central Broadcasting Company

The Melbourne masts are noteworthy it only in view of the remarkable means of raising them bodily which has been adopted by the station engineers. One of the photos opposite shows a "close-up" of the base of one of the 200-ft. masts used by the Melbourne station.

This base converges to an apex which rests upon a series of glass insulators, the latter being let into a concrete bed. When occasion demands, the entire mast can be jacked up and the insulators renewed, the mast itself not being directly embedded in the ground.

Dealing, now, with the second class of aerial-supporting structures, we come to the towers, of which there are many well-known examples all over the world. One of the most recent examples of this class of aerial structure is to be seen in the aerial towers of station J O A K, the Japanese broadcasting station in Tokyo, which were erected during the summer of 1928.

Resisting Enormous Wind Pressures

These towers are nearly 350 ft. high, and they rest upon widespread concrete bases. They are constructed to resist an enormous wind pressure, and it is estimated that they will remain in good condition without requiring any attention whatever, except, of course, in the way of painting.

It will be more or less obvious, of course, that the main source of strain or "load" to which a wireless tower or mast is subjected is that of the pressure of the wind upon its surface. This pressure is proportional to a certain constant (K), the latter depending upon the proportions of the surface of the mast or tower which is exposed. The wind pressure of the mast is also proportional to the square of the velocity of the wind, and to the area of the mast or tower exposed to the wind.

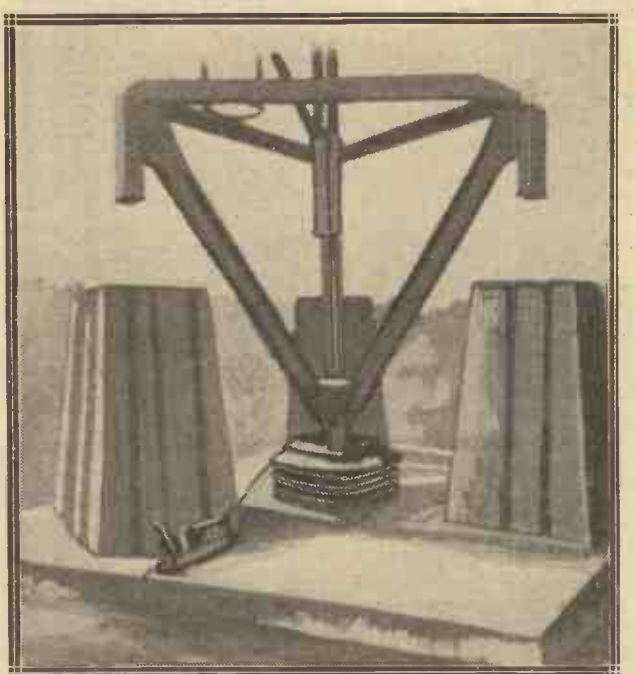
Mathematically expressed, therefore, we have:

$$P \text{ (Wind Pressure)} = KV^2A.$$

For these reasons, therefore, a wireless tower must be erected upon outstretched feet, and a mast must be well stayed with stout wires or ropes, otherwise the entire structure would quickly blow over.

Germans Fond of Roofs

Provided the foundations are firm enough, a radio mast or tower may be erected upon the roof of an already existing building, and, indeed, in many countries this type of construction is popular. The German broadcasters, for instance, are fond of erecting lattice masts upon the roofs of their buildings, as witness the aerial at the Magdeburger Platz station, Berlin. On the other hand, some stations erect squat towers upon the roofs of buildings; the aerial towers of the Madrid station being a typical example of this type of construction.



The base of a modern aerial mast, showing the glass insulators and the concrete pillars for jacking-up the mast.

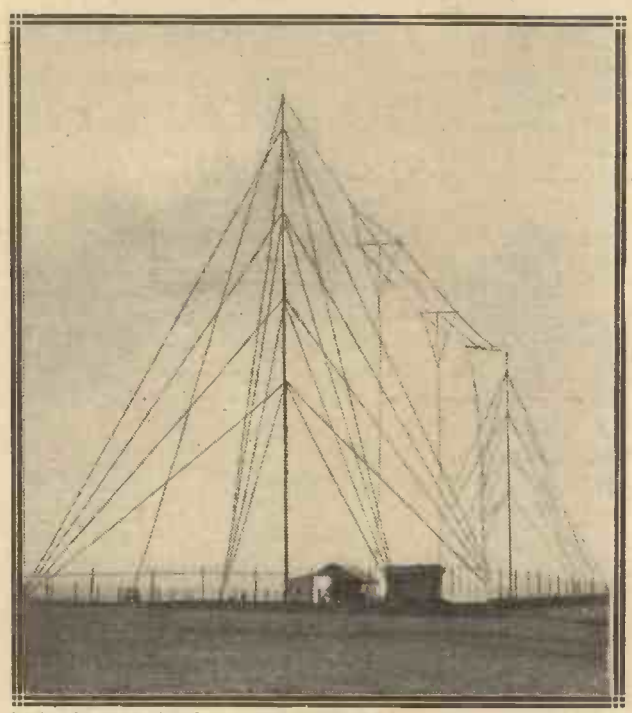
Then, of course, there exist a certain number of freak aerials in different parts of the world. Perhaps one of the most interesting of this miscellaneous class is the aerial shown opposite. This is the aerial support of station W L B W, of Oil City, Pennsylvania, U.S.A.

It comprises a light wooden tower which is, in reality, the framework of an old oil well, and the stay "ropes" seen in the picture are, in actual fact, long wooden poles which have long been impregnated with oil and which are thus permanently rot-proof. Two of these wooden towers support W L B W's aerial, sufficient stability being afforded by the wooden supporting rods.

A Very Peculiar Aerial

As a final illustration of a peculiar type of aerial which is sometimes seen abroad I give as an example the peculiar "umbrella" aerial employed by the United States Air Corps' Beacon station, situated at Wright Field, Ohio. This aerial erection comprises nothing more than a stayed steel pole, some 90 ft. high.

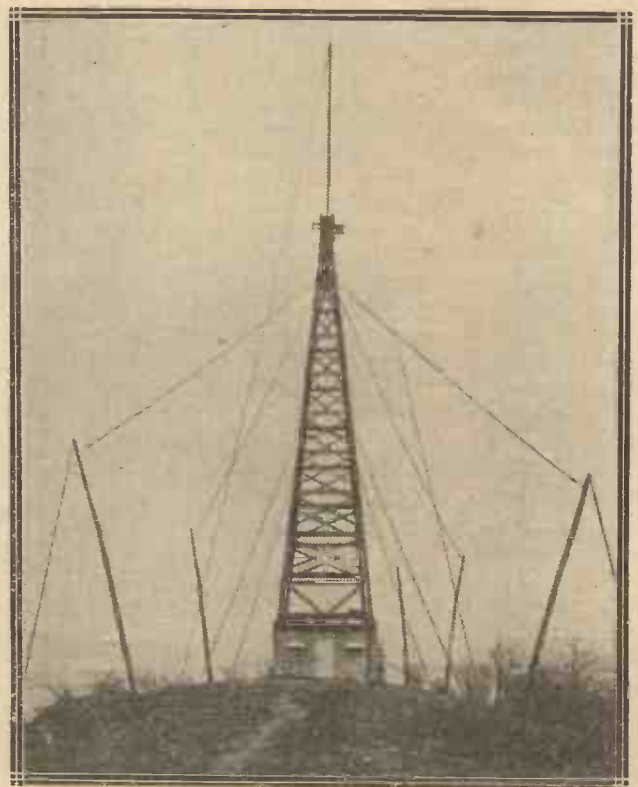
The actual aerial wires spread out from the top of the pole, alternating in this respect with the stay wires; thus forming a sort of gigantic umbrella framework. Such a



A classic example of an aerial mast of steel; the tubular type a Prague. The aerial is of the three-wire flat-top variety.

type of aerial is, indeed, a very peculiar one, but it serves its purpose, being in certain respects specially directional.

Let us not imagine, therefore, that aerial-supporting structures are put up by station engineers more or less as fancy takes them. There is a vast science inherent in the construction of such erections, and much observation is necessary before their construction can be undertaken.



A curious aerial support comprising the tower of an old oil well. The supporting "ropes" are wooden masts, impregnated with oil. Appropriately enough, the tower is to be seen at Oil City, Pennsylvania.

MIXING BATTERY ACID

Some valuable hints on a subject of interest to all practical amateurs.

By C. P. A.

THE question of the correct mixing of acid for an accumulator is a very important one, for the wrong strength of acid, or the use of tap water instead of distilled water, may result in the battery being ruined, or else in its life being seriously reduced.

If you have in your neighbourhood, at a handy distance, a distributor of one of the special brands of accumulator acid, the problem is solved for you, for this acid is ready mixed for pouring into your battery.

The Right Materials

Otherwise you will have to mix up your own acid, and there are certain precautions to be observed in carrying out this process.

Firstly, you must have the right materials to begin with. These are pure concentrated sulphuric acid, obtainable from a chemist at about 3d. an ounce (the price, I find, varies with the district and how well-dressed you look) and ordinary distilled water.

Under no circumstances, except those of extreme urgency, should tap water be used in an accumulator, for it contains impurities which will give rise to trouble sooner or later.

Secondly, the vessel used to mix the acid in must be acid-resisting. A tin, obviously, must not be used. Either glass, china or enamel may be used, but if an enamel vessel is employed be sure that it is not chipped.

A Word of Warning

Thirdly—and this is most important—always add the acid to the water, *never* do the reverse, or there may be serious consequences.

Sulphuric acid does not just mix with water or dissolve in water as would methylated spirits or salt respectively. Actually, it combines with it chemically, and in doing so a considerable amount of heat is generated. Sulphuric acid, as a matter of fact, has a very great affinity for water, and combines with it rather violently, especially if there is only a small amount of water and a lot of acid. So if water is added to acid the heat generated may be sufficient to make the acid boil violently, and hot acid may be projected on to hands or face.

Deciding Density

If, however, the acid is poured slowly into the water, the large bulk of water (on account of the proportions used), and the fact that the acid is added to the water, does not give rise to a sudden increase in temperature. At the same time, the water will get quite hot—hotter, indeed, than the hand can bear—so the mixing, under any circumstances, should be done slowly.

It is important that the acid and water be mixed in the correct proportions in order to produce the desired density "electrolyte," as the dilute acid is known. This value varies with different types and makes of battery, and the label on an accumulator should always be consulted before starting to mix your acid.

If you have a hydrometer it is a simple matter to read off the density of the acid after you have mixed it. Make sure, however, that you take your readings after the acid has been allowed to cool down, for just after mixing, when the electrolyte is still very hot, the density reading you obtain will be much lower than it should be. An approximate correction is given by reckoning a decrease of ·001 in density for every 3 degrees rise in temperature, the normal temperature at which the density should be read being 15 degrees Centigrade. Without a hydrometer, you will have to mix acid and water by measurement, and the following proportions give you the densities tabulated against them.

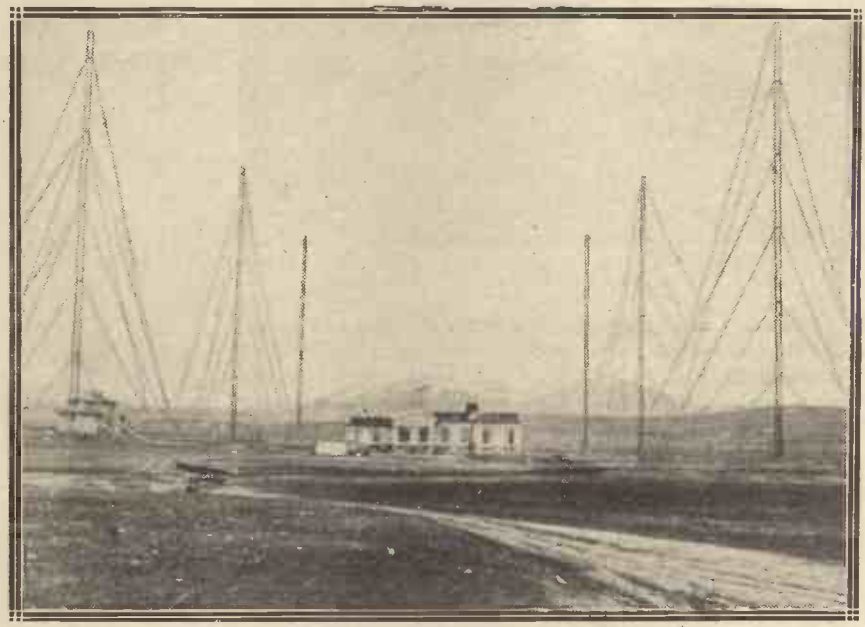
The Proportions

Parts Water.	Parts Acid.	S.G. of Elec.
4¾	1	1·200
3¾	1	1·230
3¼	1	1·260

From these figures it will be seen that density of concentrated brimstone sulphuric acid is taken as being approximately 2·375, and this will enable you to work out your own proportions.

Remember that the more acid you have the denser the solution, and vice versa. When making the final adjustments to the electrolyte to get it exactly the right density, add acid or water (as may be required) very gradually, and stir it well with a glass rod after each addition before taking a reading, so as to make sure that the solution is uniform.

WORLD'S LARGEST RADIO STATION



Now that the building of the new wireless station has been completed, Angora, the Turkish capital, will possess the largest radio station in the world. The above photo shows the station buildings together with the transmission towers.

CRYSTAL AMPLIFIERS

The valve amplifier has so much to recommend it that other means of strengthening the programme are often overlooked. Here is a practical talk on the subject of microphone amplifiers for crystal set use.

By J. FRANCIS.

IN past years, quite a number of varying types of microphone amplifiers for use with crystal receivers have been marketed. Most of them were more or less efficient in action, although, perhaps, some of them may have proved rather troublesome in use.

However, at the present time I think we may safely divide up the crystal-set microphone amplifiers which are now in use into three varieties, to wit, the so-called "box type" amplifier, in which a vibrating reed actuated by headphone magnets impinges upon a sensitive microphone; amplifiers which are contained in the base of a loud speaker, and which operate on a similar principle; and finally the "bar" type of amplifier, an illustration of which will be seen at Fig. 1.

Easily Operated

Probably, at the present day, this latter type of crystal-set amplifier has retained the greatest amount of popularity on account of its simplicity of operation, and I propose mainly to confine my remarks to amplifiers of this type more than to the older and now almost obsolete types.

Fig. 1. A crystal-set microphone amplifier of the adjustable bar type.

Of course, I know that many amateurs regard the use of an amplifier to boost up the signals from a crystal set as a rather childish proceeding. "Why not," those good "fans" remark, "get a valve set, and have done with it?"

You have got to remember, however, that there are still a lot of elderly and infirm people to whom even the simplest valve set, with its usual accompaniment of batteries and accumulators, appears to be an awfully complicated device, and it is in the main, I think, for such people that the microphone amplifier caters.

After all, the microphone amplifier of any type is a very simple piece of apparatus, despite the fact that its best use requires a certain amount of skill in affecting its most sensitive adjustment. Consider, however, the principle of the apparatus.

What It Is

In the latest types you have a carbon granule microphone fitted into a rectangular metal casing, as shown at Fig. 2. The microphone is made to slide into what is nothing more or less than a single headphone, suitably mounted in an upright position. A detail of this latter, with the microphone casing removed, will be apparent from a glance at Fig. 3. Here the magnets are clearly seen.

Current from the crystal set is led to the headphone magnets. These cause the diaphragm of the microphone to vibrate, and, the microphone being connected in series with a battery, the strength of the current flowing from the latter is varied in accordance with the vibrations. Consequently a pulsating current flows across the microphone. This passes down into a suitable transformer, and from thence is led to a pair of 'phones or to a loud speaker which is connected to the instrument.

Don't Expect Too Much

Used with reasonable care, any type of microphone amplifier for crystal set use will give satisfactory, although, of course, limited, results. I say "limited" because I have known some keen radio amateurs to have appeared to expect amplifiers of this type to give results something equal to that of a three-valver! The truth of the matter is, however, that a crystal-set amplifier of any of the above types is intended solely to boost

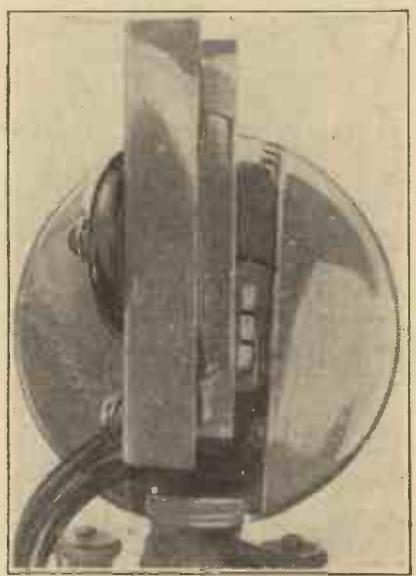


Fig. 2. A close-up of the amplifier, showing the microphone and diaphragm.

up the signals which have already been obtained by means of a crystal set.

If, therefore, a crystal receiver refuses to give you a required station, you may be pretty sure that the employment of a microphone amplifier will not be likely to bring about much better results. If, however, your crystal set receives your local station clearly and distinctly, although the signals received may be uncomfortably weak, well, then, an amplifier of the microphone type will give you the results you want. That is to say, it will bring in the signals loud enough for any headphone reception, and probably it may allow some loud-speaker reception to be carried on as well.

Adjusting the "Mike"

The vital portion of any microphone amplifier is, of course, the microphone adjustment, and it is in the operation of this adjustment that many people go wrong. If, for instance, the adjusting knob is not screwed down far enough, the signals will be weaker even than they would appear with the crystal receiver alone, and, in fact, in such an instance they may even be conspicuous by their complete absence.

At the other extreme, if one attempts to attain too sensitive an

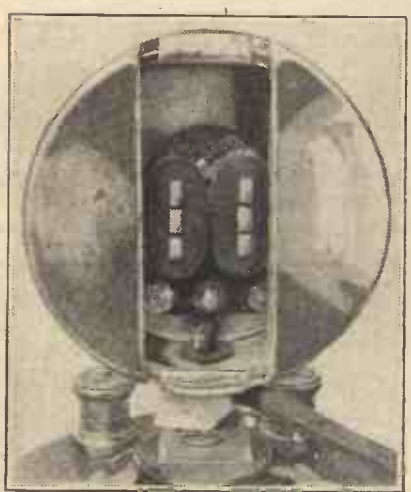


Fig. 3. A close-up of a bar-microphone amplifier, showing the magnets and windings.

adjustment, matters will be made almost as bad. For under these circumstances every little movement of the leads to and from the amplifier, every little inequality in the flow of current from the battery, and any maladjustment of the crystal contact on the receiving set, will give rise to a series of scrapings, clickings, and hissings in the headphones, and these will naturally get the listener into a most exasperated frame of mind.

Current Consumption

The easiest method of adjusting an amplifier of this nature satisfactorily is to screw down the microphone knob until scrapings and cracklings are heard, and then to unscrew it very slightly so as to make the latter just disappear. The instrument will then be working at its most sensitive adjustment for practical use.

And as regards the current consumption of these amplifiers. This naturally depends to some extent upon the size of the microphone and the area of carbon-granule surface exposed to the action of the current. In average cases, however, a crystal-set microphone amplifier, used two hours or so nightly, will exhaust a flashlamp battery in a month. It will, however, work satisfactorily off two large bell-batteries (in series) for nine or ten months, and sometimes even more.

Everything, therefore, is to be gained by the use of large batteries in conjunction with microphone amplifiers. Their current-giving capacity is far greater than that of any flashlamp battery. Furthermore, the current derived from a new flashlamp battery is rather too strong for use with the average amplifier. Such batteries tend to produce distortion, and they certainly create a good deal of noise at times, owing to the erratic nature of their current flow.

Two large batteries, on the other hand, give a rather lower voltage than does a flashlamp battery, a voltage, however, which is amply sufficient for the operation of any amplifier of this type. The current flow from these batteries is more even. Thus their use brings about freedom from distortion in the signals, ease of adjustment of the microphone, a freedom from extraneous noise in the headphones, as well as, of course, a far greater working life.

Need for Battery Switch

One word more. Should you be fitting up any type of crystal-set amplifier for the use of an invalid or an old person, don't forget to include a small switch somewhere in the battery circuit. This will help enormously in economising batteries; and also, as under these conditions the current can be switched off without handling the amplifier itself, the chance of the instrument getting out of adjustment will be lessened.

SIMPLE TESTS FOR FIXED CONDENSERS

ANY present-day fixed condenser of the receiving set type will hardly ever give trouble, provided that excessive voltages are not applied across it, but, nevertheless, it is sometimes the case that a radio worker may suspect one or more older condensers of the small "fixed" type to be the cause of bad and noisy reception.

Naturally enough, the simplest method of "testing" a suspected fixed condenser is by taking it out of the circuit and by substituting a new condenser of the same type and capacity value for it.

However, it is not everybody who possesses a varied assortment of new condensers at his disposal. In nearly every case, therefore, a suspected fixed condenser is best tested according to the following scheme:

Test for Direct Electrical Contact Within the Condenser

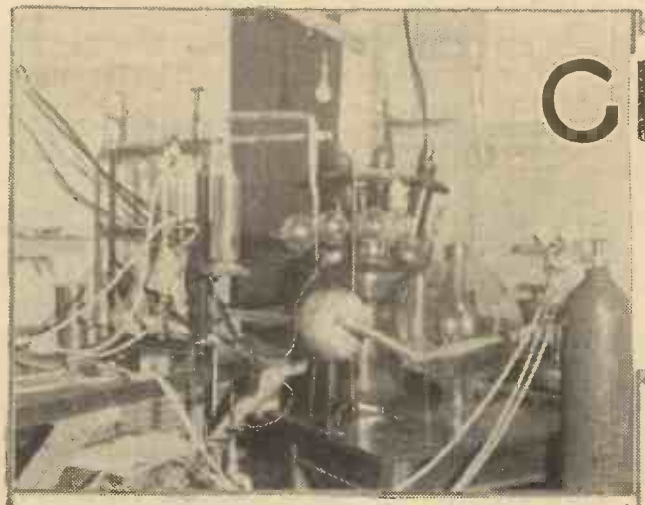
Connect up in series with the condenser a flashlamp battery and a suitable bulb. If, on making the contact to the lamp, the latter does not light up, the condenser is more or less O.K., in the respect that it does not permit direct electrical leakage.

Test for Dielectric Quality

The dielectric, that is to say, the insulating medium of the condenser, will hold a charge for some time, provided that the material is of good quality. A good way to test out the capabilities of a condenser in this direction is momentarily to bring leads from it into contact with the poles of a 2-volt accumulator. Immediately after this, connect the condenser in series with a pair of headphones. On completing the circuit to the condenser, a distinct click should be heard in the 'phones, this representing the giving up of the electrical charge acquired by the condenser from the battery.

Further Test for Dielectric Quality

Touch the condenser with the poles of a small battery, as before; but this time allow about an hour to elapse before conducting the 'phone test. If the click is heard this time it will prove the condenser to have a good charge-retaining quality.



Some of the apparatus used for the developing of hundreds of thousands of volts.

GENERATING GIGANTIC H.T.

An interesting description of the methods and apparatus used to produce electrical pressures of the order of millions of volts.

By W. K. CASTLETON.

THE news of the employment of stupendous electrical pressures like that of over 5,200,000 volts, described in a recent issue of "M.W.," for the purpose of a more complete and thorough investigation of the internal structure of atoms, has been received with enthusiasm by atomic physicists everywhere. To them it opens up a new vista; the possibility of coming very close to the fundamental laws of matter.

They foresee not only the exquisite beauty of atomic structures revealed on an incredibly minute scale, but they can get impressions of the universe reached even to the farthest star. That is their poetry. On the practical side there yet remains to be told something of the methods which are employed in order to provide them with these instruments requisite for their researches and investigations.

Spectacular Demonstrations

A laboratory source of high electrical pressures like that of the Carnegie Institution, which, as we showed, developed 5,200,000 volts, is usually based on an adaptation of high-frequency resonance coils.

That was the case here. There is nothing new in this, of course, for it will be remembered that coils operating on the same principle were constructed 38 or 40 years ago by Nikola Tesla and Elihu Thompson, whilst certainly for thirty years similar things have been used as spectacular demonstration toys for amateurs and schoolboys.

That is the marvel—that in these little coils should have been the genesis of such enormous far-reaching results. Every student in an elementary or high school has seen a coil of the nature in operation. He has marvelled at the sparks up to one foot long which his instructor informed him represented pressures of 100,000 volts and which might be taken into the body without danger, because of the high-frequency of the alternating current from the coil.

A Familiar Principle

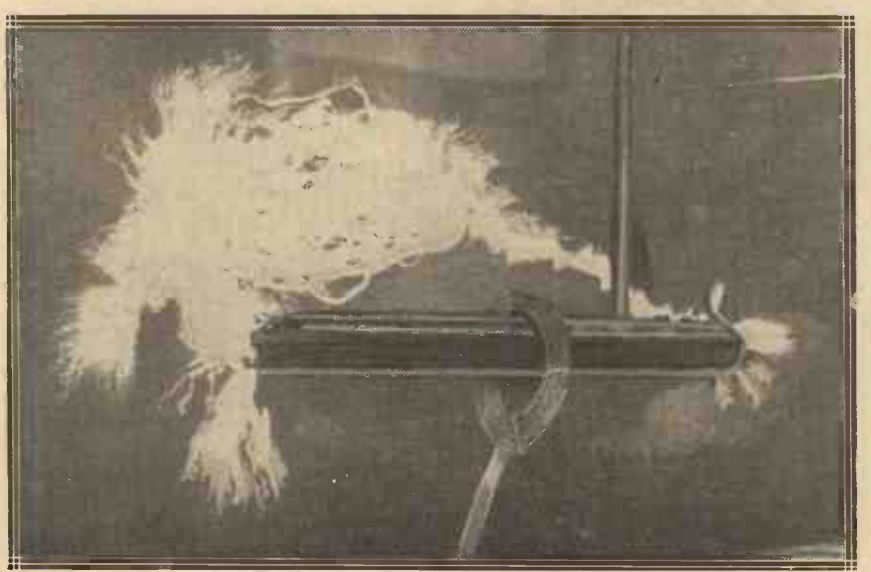
The principle employed is the same as that operating in the familiar acoustical example of a violin string vibrating "sympathetically" when the string, tuned to the same note, is struck on an adjacent piano. The same principle of "resonance" or "tuning" is also familiar to all radio enthusiasts.

The high-voltage coil itself consists of 8,000 turns of silk-insulated copper wire, wound on a single layer on a Pyrex glass tube 3 in. in diameter and 36 in. long. This coil is immersed in an insulating oil, such as is used in all electrical transformers, and the ends of the coil are fitted with metal caps 8 in. in diameter, whose rounded surfaces prevent spark-discharges out into the oil when the caps are raised to such high voltages by the action of the coil.

The coil is excited to the high voltage by means of a primary circuit consisting of a large glass-plate condenser, a spark-gap, and a primary coil of two turns of copper tubing wound about the middle of the high-voltage coils and spaced some distance from it in the oil. The condenser and primary coil are adjusted to be electrically "in tune" with the high-voltage coil.

When the Condenser Discharges

The condenser is charged to 50,000 or 100,000 volts by means of an ordinary high-voltage X-ray machine, and when it discharges through the



A Tesla coil sparking in air at about 300,000 volts.

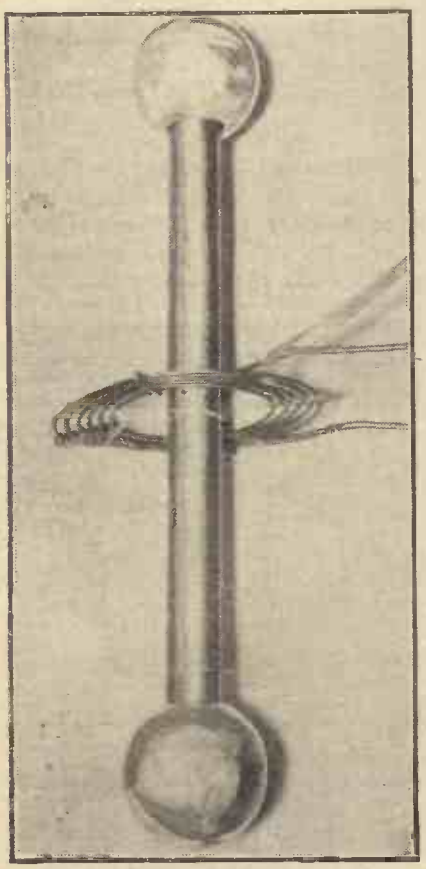
spark-gap the surges of current in this primary circuit by "resonance" set the high-voltage coil into oscillation and build up the very high voltages (of the order of millions of volts) between the two balls on its ends.

Surrounding the high-voltage coil by oil is an important feature of the method. An ordinary Tesla coil operating in air will not go to voltages higher than 300,000 to 400,000, because of the large sparks and streamers and "corona discharges" which occur from all parts of the coil, but when this spectacular display is prevented by immersing the coil in oil, the energy which would ordinarily be used up by sparks goes into raising the coil to a very much higher voltage.

Five Million Volts!

In the case of the Carnegie Institution's equipment, it was found that voltages up to about 3,000,000 were readily obtainable by using a coil of this type in an ordinary open tank, but above this voltage, sparks from the caps on the ends of the coil would flash out into the oil.

By placing the high-voltage coil inside a large steel tank fitted with oil under a pressure of 500 pounds to the square inch, we were able to obtain over 5,000,000 volts.



A typical Tesla coil such as is used in developing high voltages.

A BLACK ENAMEL FOR METALWORK

THE many varieties of quick-drying black enamels which are sold in bottles or tins are not usually inexpensive commodities, and for some trifling local enamelling of a loud-speaker horn, a transformer case, or some similar component which has acquired a somewhat shabby appearance, the expense incurred in purchasing an entire tin or bottle of enamel is quite out of proportion with its usefulness.

Many constructional amateurs, however, have by them a quantity of ordinary clear varnish, and, in such instances, a black enamel suitable for the above-mentioned uses can very easily be made.

Dissolve two parts by weight of finely-powdered *ivory black* in twenty parts by weight of the clear varnish, and stir the mixture very thoroughly.

This composition will make an excellent black varnish. It is slow drying, but it possesses a good "body" and, next to a stove enamel, it is very resistant to rough handling. Moreover, the black varnish can be made up in very small quantities at a time, thus eliminating any possible waste.

AN AERIAL LEAKAGE PREVENTER

IN summer and in autumn, as well as in winter, the aerial system of a house is, at times, apt to undergo electrical leakage in inclement weather owing to rain-water trickling down the aerial lead-in, and thus providing a low-resistance circuit to earth for the feeble aerial currents.

The writer has seen many schemes for avoiding this often very considerable trouble, but to his mind there is nothing simpler or more effective in providing a cure for the trouble than the use of the little home-made gadget described below.

All That Is Needed

The "raw material" for this little aerial-leakage preventer consists of nothing more complicated than a circular tin lid which may be obtained either from a cigarette tin or from one of the innumerable containers of domestic commodities.

Make a radial slit to the centre of the tin lid, and cut away a small piece of the rim in order to facilitate the dripping of water away from the lid.

In rainy weather this article (a "close-up" of which is seen in the photograph) is slipped over the aerial down-lead at some convenient position, such as, for instance, the one depicted in the diagram.

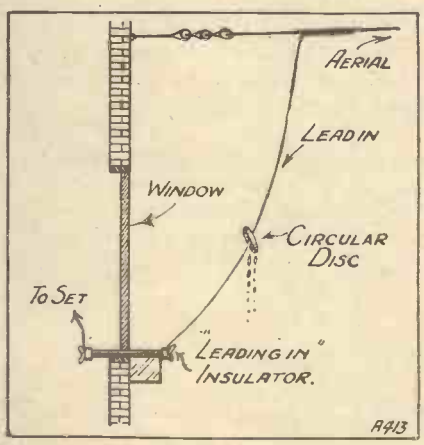
The lid will then act as a sort of water-trap. It will not only allow the water running down the lead-in wire to drip off harmlessly, but it will also, to a certain extent, keep a portion of the lead-in wire dry, owing to the sheltering effect of the rim of the lid.

A photo of the actual device in use.

In fine weather, of course, the lid is easily removed, and it can be slipped on again at a moment's notice.

Works "Most Satisfactorily"

Of course, a more artistic-looking gadget of this nature could be constructed out of a piece of plain sheet metal or wood, but not being blessed (or cursed) with the artistic temperament, the writer pins his faith to the yellow lid of the celebrated Messrs. Gold and Flake for the above radio purpose, and he has still to experience an occasion upon which the article refuses to carry out its required function to a most satisfactory degree.

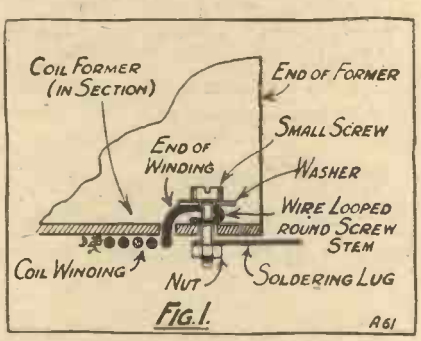


SOUND CONNECTIONS

Faulty contacts and connections are one of the most frequent causes of troubles in modern radio sets. Here is a practical article which tells you how you can take precautions against them when building your set.

By C. A. OLDROYD.

"To solder or not to solder," is a question home constructors must face sooner or later. Do you remember some experimental sets hurriedly thrown together on the hook-up board? Any old bits of wire were used for the connections, components were placed anyhow, leads straggled all over the baseboard. And yet the set worked splendidly, and when rebuilt in a more permanent form as a finished



receiver it appeared to be no better as far as performance goes. Why solder then?

On the surface, it looks as if the soldering iron would speedily become obsolete and end its days in a dim corner of the workroom. There is another side to it, however. The rough-and-ready experimental set was used a short time only; if it had been in use for months insteads of days some of the connections might have worked loose and caused those mysterious crackling noises which are most difficult to trace.

Must be "Airtight"

A clamped joint cannot be perfectly air-tight over the entire surface, and when the contact surfaces become oxidised the resistance of the joint may rise appreciably. One poor joint might not greatly affect the efficiency of a set, but a number of them will ultimately make a difference in both volume and range.

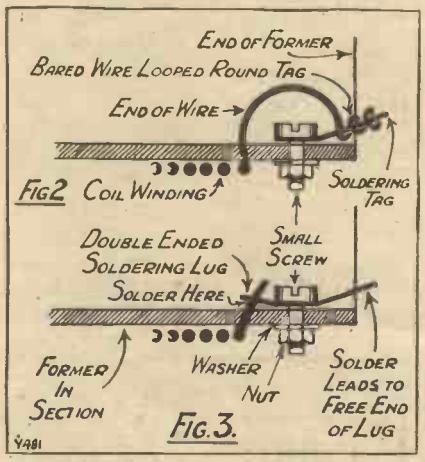
Comparative tests of the contact resistance of soldered and clamped joints have been made by American radio engineers and they maintain that "ten unsoldered joints increase the resistance in the conductors four times in less than three months." A well-soldered joint, on the other hand, "will lower the resistance in the joints to approximately sixty per cent of the resistance offered by the conductor itself."

Good and Bad Joints

A soldered joint cannot deteriorate since the air is excluded from the contact surfaces. For a similar reason, a flat soldering lug appears to be better than a round wire when clamped under a terminal nut. The nut bears evenly on practically the whole contact surface of the lug and keeps the air from the bright contact surfaces for a considerable time.

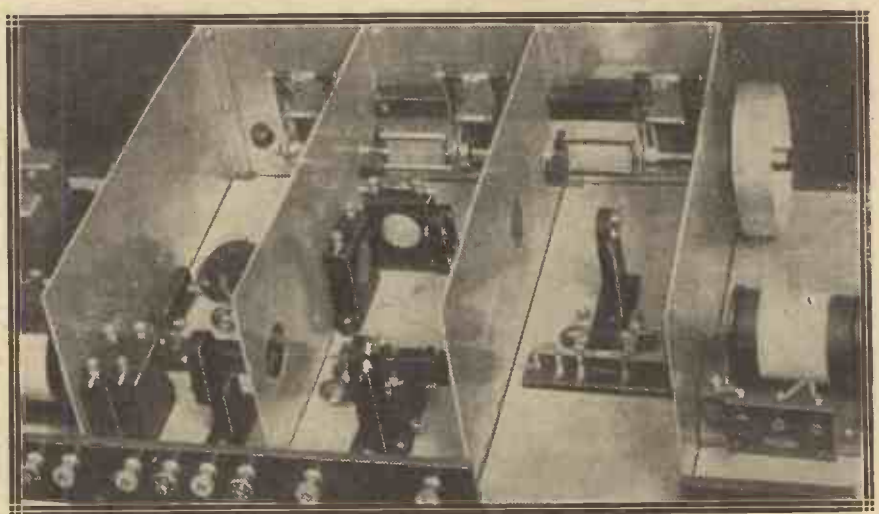
A connection cannot be too direct; often two joints are made where one would be better. A typical example may be a home-made solenoid coil wound on a cardboard or Paxolin former (Fig. 1).

At first sight, the joint illustrated in Fig. 1 looks excellent; the end of the winding has been clamped under a washer inside the former shell.



The soldering lug is fixed under a nut on the outside of the former. Now let us regard this joint from the point of view of a feeble radio impulse passing through it.

First of all, the current must pass from the bared wire end through the washer into the screw stem, after



The use of screens gives the added advantage that "earth" leads can be shortened and reduced in number. But connections to screens should be soundly soldered and not haphazardly bolted.

travelling down the latter it reaches the underside of the nut, and from here it finally reaches the soldering lug. Unless all contact surfaces have been very carefully cleaned the resistance of this joint may be considerable; a better way is shown in Fig. 2.

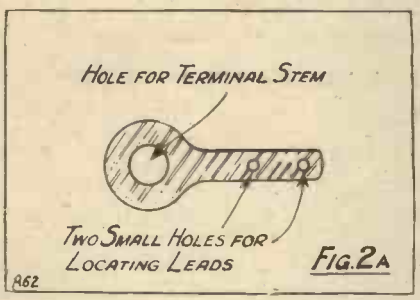


FIG. 2A.

Here the bared end of the winding is taken several times around the tongue of the soldering lug and soldered to it. The small hole in the extreme tip of the tongue is left free for outside connections. Such a joint is easily made and a perfect connection is guaranteed even if the screw holding the lug should be slack.

An Ideal Method

Ideal would be soldering lugs with two small holes in them, as illustrated in Fig. 2A; one for the end of the winding and the other for the outside lead. The writer has not succeeded in tracing a commercial lug of this type, perhaps some manufacturer will oblige us with an improved design in the near future.

On the other hand, a double-ended lug could be used (see Fig. 3), unfortunately the inner joint is sometimes hard to get at with the soldering iron.

Speaking of manufacturers brings me to another bone I have to pick with them. I wonder if they ever find time to build a set themselves? If they do, how do they connect the leads to the stems of the terminals mounted on a terminal strip?

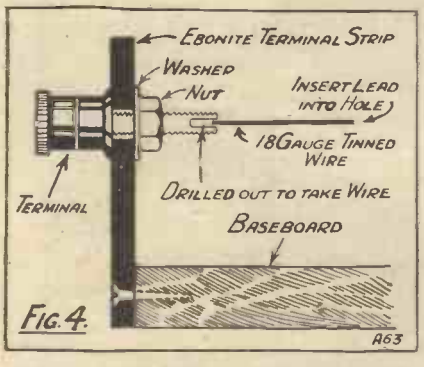


FIG. 4.

Assuming that the joint is to be soldered, we may spot the lead to the end of the stem, but a far better method would be the one shown in Fig. 4. The end of the terminal stem is drilled out to take round tinned wire for a depth of about ⅛ in. or so.

Automatically the hole registers the lead at the exact centre of the stem and the solder has a large surface to "bite" on (see Fig. 5). If the terminal strip is tilted to bring the terminals into a vertical position flux and solder will not tend to run off the joint and the resulting connection will be both neat and efficient. At the end a shoulder of solder will form which adds to the strength of the joint.

Question of Terminals

Some constructors prefer to mount their terminals upright on a narrow strip of ebonite held clear of the baseboard by distance pieces (Fig. 6). In this case the method suggested above fails since the tips of the terminal stems are no longer accessible with the soldering iron.

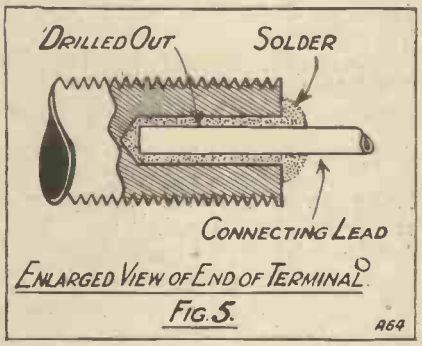


FIG. 5.

Still, the former method can be adapted even to this case. A small hole might be provided in the shoulder of the terminal, just above the ebonite strip (see Fig. 6), to allow the end of the lead being inserted.

The mouth of the recess could be slightly countersunk to prevent spreading of flux and solder; the completed joint will look neat and the connection is bound to be above reproach.

Final Advice

Gradually, personal experience has converted the writer from clamped to soldered joints, and my parting advice can be summed up in a few words. Make a friend of your soldering iron, keep it clean and treat it well, and you will find soldering a pleasure.

Carefully follow the numerous hints that have been published from time to time in these pages, and with some experience and a little care your soldering efforts will not have to fear comparison with professional work!

And, finally, don't forget to wipe the soldering flux from the soldered joint while the latter is warm. Surplus flux will eventually cause corrosion and its subsequent troubles.

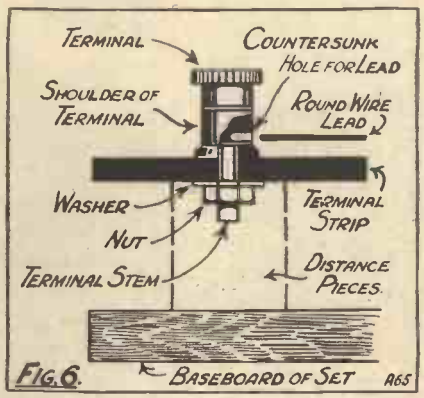


FIG. 6.

RADIO ODDS AND ENDS

Listeners who are also amateur gardeners should remember that this is the best time of the year to inspect or re-arrange a buried earth system. (If left till later in the season there is likely to be interference with gardening.)

* * *

Grid resistances inserted to keep H.F. out of the L.F. side of the receiver are less effective for that purpose on the long waves than on the shorter ones.

* * *

A Useful Tip

A rubber band placed round the top of a grid-bias battery will steady the flexible leads to the plugs and prevent them from coming loose.

* * *

The standard split-secondary transformer was designed for use with a fairly small tuning condenser, say, ·00025 mfd., and consequently it may not tune down properly if shunted by a tuning condenser of ·0005 mfd.

* * *

A good indicator for condenser dials can be made from an ordinary tapping stud, filed down to a point.

* * *

Rattling on loud speakers or 'phones can often be cured by tightening up loose screws on the base.

* * *

A decided softening of the loud-speaker reproduction can sometimes be obtained by standing the instrument near a heavy curtain.

MY BROADCASTING DIARY

Under this heading month by month our Broadcasting Correspondent will record the news of the progress of the British Broadcasting Corporation, and will comment on the policies in force at B.B.C. headquarters.

A Muddle and a Blessing

LISTENERS are still mercifully saved from the threatened flood of political oratory which menaced the programmes last autumn. But the professional politicians do not like being excluded from the microphone.

I heard the other day from a member of the Abingdon Street staff that the Liberals had sent a special committee of inquiry to examine and report upon the use of broadcasting in politics in the United States. The report speaks in the most enthusiastic terms of the splendid opportunity given the American politician to educate his public over the microphone.

The Liberals are so impressed that they make no secret of their intention to attack the monopoly of the B.B.C. at the General Election if, meanwhile, they fail to obtain satisfaction in their demand for microphone time. They would like about an hour a night, between 8 and 10 p.m. Fortunately for the entertainment of listeners, there is no sign as yet that any agreed scheme of political broadcasting will come into force this side of the General Election.

There may be discussions of one or two exceptionally important matters, in addition to the election pronouncements of the Party leaders, but beyond this listeners are unlikely to be disturbed. Nor need the B.B.C. fear any attack on its monopoly on this account.

Realism in Drama

There is a revival of criticism of the B.B.C. for allowing "objectionable" passages to be included in its dramatic broadcasts. A case in point is "Montezuma," the history play by Cecil Lewis, which was given early in the year, and which the dramatic critics praised.

But some correspondents to newspapers developed a real white-heat of fury over some of the things said in this play. Taking into account the advance descriptions, I found nothing wrong with the play at all.

There is much more ground for criticising the B.B.C. for silly censorship than for passing "immoral or objectionable" broadcasts. "Montezuma" was a play set in the fifteenth century in Mexico. It was a reasonably faithful representation of those rugged times. The only thing I had to find fault with was the introduction of modern slang such as "rumpus." So far as relaxing censorship of impropriety in literature, I say to Savoy Hill, "go to it," and leave Shakespeare alone when you broadcast him.

Those Publications' Announcements

No doubt many other listeners share my vexation at the weary and seemingly endless repetition of advertisements of B.B.C. publications on the microphone. More recently I thought I noted a contraction both in the number of such announcements and in their length.

On enquiry at Savoy Hill, I am told that this is the case, and that the policy is to reduce still further the use of the microphone for this purpose. Apparently it has been realised at long last that even on elementary commercial considerations it is not good selling policy to irritate your market.

B.B.C. Publishing

The recent press campaign against the B.B.C.'s new publication would come as no surprise to readers of this page, where I anticipated developments over a year ago.

SCOTLAND'S RADIO BEACON

This wireless beacon station, built at Fraserburgh, was the first to be built on the mainland of Scotland. Note the fog siren in the foreground.

The B.B.C. probably wishes it had never set up that "Hadow Committee" on education.

Everything that has happened as a result of the activities of that Committee has got the B.B.C. into trouble.

The suggested extension of educational talks before the Regional Scheme had been finished was met with strong opposition. And now the publication of an educational "follow-up" paper has united the whole of the newspaper and publication industry against the B.B.C.

But the campaign does not seem to have been very well managed. Apparently no protests or representations were made to the B.B.C. itself. The idea was to tackle the P.M.G. direct, and get him to order the B.B.C. to desist. Even if he had been willing to do this, he has no status in the matter unless it could have been proved that the B.B.C. had declined to receive a deputation first.

Another thing, too, was that the paper was announced last summer, when the Hadow Committee's report was published by the B.B.C., in a book entitled "New Ventures in Broadcasting." There the recommendation is much more objectionable from the press standpoint than what the B.B.C. actually contemplated.

THE MADRID BROADCASTER

The aerial of the Madrid broadcasting station is erected on the roof of the building. The call-sign of this station, which is often heard in this country, is E A J 7.

From what I am able to gather, the result of the campaign will be that "The Listener" will go on in a chastened restricted way, and that, after a decent interval, the B.B.C. will quietly draw in its horns in publishing.

Anyway, there will be no new series of educational publications such as Mr. Stobart was supposed to have announced. It is curious to note that once again Mr. Stobart, the most peaceful and amicable of men, finds himself in the centre of a tumultuous campaign. He has had to bear the brunt of several attacks on talks and broadcast education.

Smaller Provincial Orchestras

I am told that plans are now complete for the reduction of all B.B.C. provincial orchestras, except those of Birmingham and Belfast, by fifty per cent, in about six months time. This sweeping change is supposed to be rendered necessary by the financial requirements of the new permanent orchestra under Sir Thomas Beecham.

It is purely a matter of money; but nevertheless it will bring in its trail a lot of trouble for the B.B.C. at a time when it can ill afford unnecessary difficulties. Savoy Hill would have been much better advised to carry its existing orchestras a little longer. As things stand it will probably be forced by fierce local campaign to make some compromises which will satisfy no one.

No sooner has the B.B.C. established a National Orchestra of Wales, and a Northern Wireless Orchestra, than it washes them out. Incidentally, why spend money on studio accommodation in Manchester, Glasgow and Cardiff if there is to be no programme work done there? This is a matter which needs investigation.

Broadcast Opera Decline

I hear that there has been a big decline in the number of copies of opera libretti which the B.B.C. has disposed of this season in connection with its monthly opera scheme. The reason for this is that the selection of the operas is not above criticism. There has been a growing tendency at Savoy Hill to neglect the "popular classics" in favour of obscure works with an exotic flavour.

Broadcast Drama at Last?

I believe the appointment of Val Gielgud to take over all the B.B.C. dramatic work means a great improvement in that part of the programme organisation. Mr. Gielgud has a sound journalistic background, is not handicapped by stage or music-hall prejudices, and has a mind at once receptive and resilient and original.

A B.B.C. Black-List

It was mentioned the other day at a dinner party where I was a guest that the B.B.C. kept a black-list of people who had offended it. It was suggested that the last name to be added to this list was that of Lord Melchett.

The same night in the news from 5 G B was given a glowing account of the progress of Lord Melchett's rationalisation scheme. So the black-listing, if it exists, does not extend to the news bulletins.

The Studio is velvet draped!

TO SECURE SILENCE IN THE BACKGROUND

and the way a Lissen Transformer amplifies, keeps that background just as silent as it was in the Studio.

The acoustic experts of the broadcast studios use every effort to obtain a background of absolute silence for each item of the programme. To obtain the same effect from your receiver, use Lissen Transformers for each stage of amplification. Then you get a silence upon which the broadcast instrument or voice can paint a living picture, building up the melody without a trace of extraneous sound to interfere with it, every word and every note standing out in stereoscopic relief.

Lissen Transformers can be used in every receiver and in every published circuit—use them whatever receiver you are building and you will always get the true effect of every broadcast item.

The famous 8/6 Lissen Transformer has won for itself the reputation of "The Transformer that will never break down." Suitable for all ordinary purposes. Turns ratio 3 to 1. Resistance ratio 4 to 1 . . **8/6**

THE LISSEN SUPER TRANSFORMER

This Super LISSEN Transformer is made in two ratios, 3½ to 1 and also 2.½ to 1. The 3½ to 1 is suitable for use in either the first or the second stage of an L.F. amplifier, or can be used in cascade for both stages, and with practically any valve. The 2.½ to 1 transformer is suitable for use after a high impedance rectifier valve without fear of distortion or loss of high notes and overtones. The price is the same for both ratios **19/-**

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TRANSFORMERS

LISSEN LIMITED

20-24, FRIARS LANE

RICHMOND, Surrey.

(Managing Director—Thos. N. Cole)

In Our Test Room

A Philips Amplifier—British General Components—Loewe Receiver—Ferranti Safety Box—Brown Cubist Loud Speaker—Lewcos Loading Coil.

A Philips Amplifier

THE power-compactness ratio of the Philips gramophone amplifier must surely reach record heights. The accompanying photographs will give a good idea of the small size of this instrument, more particularly when it is mentioned that the valves shown are of quite normal dimensions.

Note the compactness of the Philips amplifier.

The amplifier is provided with a removable metal cover, and so is, in fact, practically a totally enclosed device. It has a multi-flex cable for the batteries, the robust terminals on the end of this being very clearly marked. There is an efficient potentiometer type of volume control at the input end, and a Philips L.F. transformer, noted both for its efficiency and small size, is incorporated in the amplifier. A pentode valve is used in the last stage.

With a high amplification type of valve in the first position, great amplification can be obtained. Altogether, this Philips gramophone amplifier is a notable achievement.

British General Components

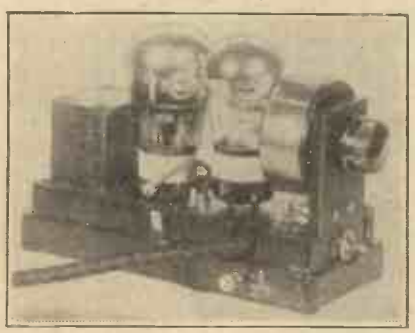
The British General Manufacturing Co., Ltd., recently sent us two of their components, the price of each of which is the same, i.e. 18s. 6d. The one is an aerial tuning unit designed for covering the range of 250 to 2,000 metres simply by operating a switch control.

The device fixes to a panel (two holes only are needed), and of the two front knobs the one is the above-mentioned wave-length switch control, and the other the reaction control. It is a robustly and soundly constructed component and operates well.

Manufacturers and Traders are invited to submit for test purposes radio sets, components and accessories to the "Modern Wireless" Test Room at Tallis House, Tallis Street, London, E.C.4. Under the personal supervision of the Technical Editor all tests and examinations are carried out with the strictest of impartiality.

Readers can accept the Test Room reports published monthly under the above heading as reliable guides as to the merits and demerits of the various modern productions of the radio industry.

The other British General item is an L.F. transformer, the particular one sent us having a ratio of 5 to 1. It is styled a Super Shrouded Transformer, and it is worth noting that it carries a twelve months' guarantee. This, too, is a component that can hold its own.



Internal view of the Philips amplifier.

Loewe Receiver

We recently had the opportunity of testing a Loewe triple-valve receiver. This remarkable little set has the appearance of a one-valver, although, in effect, it is a det.-2 L.F. set.

Referring to the accompanying photograph, it will be seen that the instrument comprises a small flat panel on the side of which is fixed a coil holder. The panel also carries the tuning condenser dial and an on-off switch. The flexible cable which can be seen embodies the battery connection.

This is the Loewe triple-valve set, a feature of which is its extraordinary small size in comparison with the results given.

When it is stated that the valve is not much larger than an ordinary valve and smaller than some power valves, the compactness of the arrangement will be apparent. The valve is a most complex assembly of elements. It incorporates in the one bulb the elements and coupling devices of three valves.

The set is quite a simple one to handle. While the reaction effects do not seem to be quite normal, the set, in general, operates like an ordinary one. The makers claim little more for this receiver than loud-speaker reception of the local station, but we found no difficulty in getting some of the more powerful continental stations during our tests. Bearing in mind the price of the little outfit, we can only consider it a most successful application of a unique principle.

Ferranti Safety Box

"The safety problem in connection with the use of supply mains for radio purposes has not in our opinion previously been given the attention which it merits," say Messrs. Ferranti, Ltd., in a covering letter when sending a sample of their new Ferranti Safety Box. And undoubtedly, to a certain extent, this is the case, although we think that we can claim that we have done our share to impress upon users of mains the desirability for observing certain precautions.

But this Ferranti Safety Box is going to make things somewhat easier. It is made of steel and is fireproof, and is provided with a three-core flexible cable, one arm of which is for earthing purposes and should normally be connected to the earthing pin of the power plug in order to comply with regulations.

If there is no power plug available this lead needs no connection.

The object of the Safety Box is, of course, completely to enclose an H.T. unit, but the novel feature is that a double-pole switch and fuse are provided and arranged so that on the lid being lifted all the apparatus inside is disconnected from the mains.

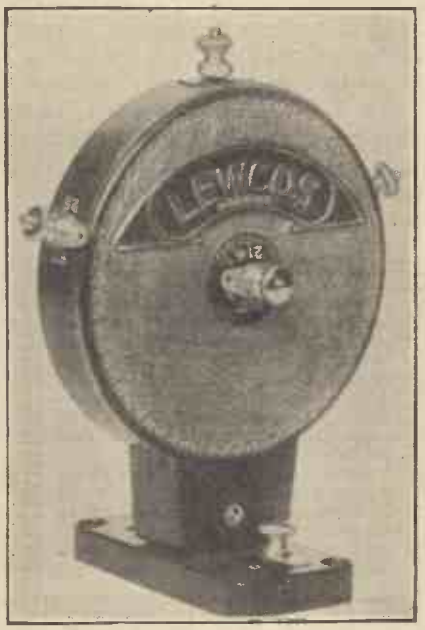
Messrs. Ferranti have also produced five designs of satisfactory supply units which can be enclosed in the Safety Box. Any one of the five appropriate charts, which are fully explanatory from a constructional point of view, are available to anyone free of charge on request. The price of the Safety Box is 13s. 6d., and we consider it as good value for money as anything we have seen.

The Ferranti safety box.

Brown Cubist Loud Speaker

The design of moving-coil loud speakers seems in general to have settled down to very hard and fast lines. But there is one very notable exception. This is the Brown Cubist loud speaker. One of these (it is of the permanent magnet variety) was recently sent us for test.

The most outstanding feature of this most interesting speaker is that instead of the usual straightforward cabinet or baffle, it has fixed to it a large metal "flare" mounted in a handsome cabinet. Setting the diaphragm back behind this structure seems to have the effect of brightening the response.



The Lewcos loading coil.

There is another novel feature in this Cubist, and that is that the moving coil is of octagonal or eight-sided shape, instead of being round, and the eight magnet bars are bent round and lined up closely in the same form, providing a very strong field.

The assembly and the finish of all the parts concerned are up to the highest of the Brown standard. The handsome mahogany case is a first-class piece of work.

The impressions that we received whilst the instrument was undergoing its test were distinctly favourable. Keyed up to criticise everything that we could, we had to admit that we liked the reproduction as much as anything we had heard. This Brown Cubist decidedly lines up with the best, and all those interested in moving-coil results should make an early opportunity of hearing one in action.

A view of the Brown "Cubist" after the back of the cabinet had been removed.

Lewcos Loading Coil

The "M.W." standard loading coil, which has figured in so many well-known receivers during the past year or so, has no doubt become a familiar object to most "M.W." readers. The Lewcos version of this coil, therefore, will probably cause considerable surprise.

Although it follows the electrical specification of the standard model, its physical dimensions are totally different In fact, it very closely resembles an ordinary Lewcos plug-in coil, except that instead of having the usual plug-in socket it is mounted directly on a flat base suitable for baseboard mounting.

Three of the terminals are disposed around the periphery of the coil, the

(*Continued on page* 220.)

Front view of the Brown "Cubist" loud speaker.

T.C.C. Electrolytic Condenser. Capacity 2,000 mfds. In a case 5 inches high. Price 15/-.

T.C.C. Flat Type Mica Condenser. Capacities from ·001 mfd., 1/10 to ·01 mfd., 3/6.

MR. WEDGWOOD DID NOT MAKE KNIVES & FORKS!

JOSIAH WEDGWOOD was a specialist. He devoted his whole life to one thing— the making of pottery. Again and again he failed, but, undaunted, he persevered until ultimately his pottery became the fashion of the period and is still to-day in great demand.

Like the Burslem potter, we are specialists. For nearly a quarter of a century we have made nothing but condensers. And because we have never deviated from our task —never expended our energy in the making of other components—the name T.C.C. on a condenser is accepted throughout the world as the undisputed hall-mark of accuracy and dependability. For this reason, the Admiralty, the G.P.O., and the Cable Companies of the World consistently use T.C.C. Condensers. For this same reason, too, it will pay you to use T.C.C. Condensers in your next Set.

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ACCORDING to my calendar—presented by the grocer at Christmas as a delicate reminder that his bacon is not so tough as the Co-op's—we are now entering upon the month of February. This month is devoted to tossing pancakes, filling dykes and generally preparing for the Ides of March.

About this calendar! Its main feature is a coloured picture—a sailor with a plum-coloured face, sky-blue trousers and a green parrot enters the garden gate of a cottage covered with green roses. The cottage chimney emits smoke of crimson lake.

"Drat It!"

At the door stands a nut-brown maid. She is buxom. She has weak eyes, too, because although she is looking *away* from the sun, which is either setting or rising in the north—judging by the weather-cock thing on the church in the distance—she is forced to shade them with her hand. Underneath the picture is the legend, "Jack's Return, printed in Germany, with the compliments of A. J. Bulkhorn. Grocer."

Young Bill piped out that it was a sound notion and that he would help me.

It is a "tear off" calendar, and each day's sheet bears a beautiful text, sacred or profane. To-day's is:

No good ever came of saying "Drat it."—(Mrs. Aphra Twobley).

Last Sunday's was:

I do not subscribe to the doctrine of ruining the vessel for lack of a guinea's-worth of bituminous caulking material, demmit.—(Lord Drage of Chesterfield).

Now, then! It was the text for January 16th which finally convinced me that I must clear out my wireless den. It runs:

Make ready thy house against the coming of the Dark Angel. Lo, he stealeth upon thee with a wallop in both mitts! Bo, you are sure for it.—(Fra Pongelico).

I tell you that this Ethelred the Unready business was fairly preying on my mind. Only the week before, Chiggles, the stockbroker at No. 17 our road, had died, *two days after renewing his dog-licence.* His widow said that Edward always lacked foresight.

I had no wish for my executors to go fooling about with my layouts, short-circuiting batteries, buckling-up condensers, and what not, and so I suggested at breakfast on January 17th that I had better clear up the wireless room, a gesture which brought my better three-quarters' batteries of sarcasm into action on the instant.

"Shall you—do you think?" she cooed.

Now how's that for rotten grammar, I ask you?

"I remember," she continued, "that you were supposed to have tidied the place up four years ago, before grandma came to stay. And for months afterwards everybody in the house was being accused of stealing wire and things."

The Perfect Pickle

A flagrant exaggeration. As a matter of fact, young Bill—that's my son—*did* sneak a pet bit of rubber-covered; and the maid had the long-handled screwdriver to open a tin of sardines with.

"I should let sleeping dogs lie, if I were you," added my wife.

That made me feel very bitter, because I was always being told that the room was in "a perfect pickle." And then when a man suggested—— But there, they are all alike! As Tennyson sings, "Women and walnuts and little green peases, are like to like as a row of Dutch cheeses."

At this stage of the campaign I received an unexpected reinforcement in the shape of young Bill, who piped out that it was a sound notion and that he would help me. This made me thoughtful. Bill likes to help me clear out drawers and cupboards; in fact, he frequently proposes some such operation. He is like the jackal; for when the tiger has finished, the jackal finds plenty of bits and pieces. On the day after I tidy my desk Bill's pockets bulge with chunks of brass, small coils of wire, screws, etc. And then his ma blames me!

Demon Drink

However, on this occasion I felt the need of support, be it ever so self-interested, and I took Bill over un-

The lads who travel to town with me daily.

conditionally, with the rank of sergeant-major.

This move so rattled the enemy that she promptly told Bill to look at his hands. I'm sure they've not been washed to-day, leave the table and don't wipe the dirt off on the towel. Bill had to execute *that* evolution unsupported and "at the double."

Well, they say that strange news is like a prairie fire. It spreads and then some. When I reached the platform on the following morning a faint cheer, redolent of irony, greeted my ears. This emanated from Glapp and Co., the lads who travel to town with me daily. I suppose that there had been some intensive communication work amongst the wives. Anyhow, Glapp and Co. were very witty; Glapp offering to lend me a baize apron and a feather broom, and old Pa Tippins promising to give me a free boost in the miserable rag he edits. Colby's theory was that I had joined the Salvation Army, while Dingham, a low brute who has no interests beyond bowls and Halma, asserted his belief that all I was going to do was to search for a lost ha'penny.

Driven to bay, I ticked them off—I wish you could have heard my shafts of satire—and ended by inviting Glapp to assist me. He accepted. Papa Tippins wanted to send a

reporter, but I shut him up by asking him why he had the gall to read a paper before the local literary society, entitled "The Demon Drink," and accept the ads. of four wine and spirit merchants.

Crump Crumples

Mention of the demon "drink" reminds me of poor old Crump. Now, Crump decided to have a thorough clearance of his wireless den. On the great night he ascended to the sacred room and by dint of herculean labour got all his gear shifted from one side of the room to the other. Then he thought he deserved a drink. Which done, he said to himself, "All this clutter had better be carefully shifted to the other side of the room and sorted out." So he did it and had a drink to keep himself going.

After that he thought he ought to move to the other side of the room all the stuff that was any good, leaving the rubbish where it was. So he moved the whole lot over, including a No. 6 Meccano set of his son's, and parts of the mangle and of his wife's sewing machine, which somehow or other had got there. This labour obviously called for a little refreshment.

Glapp and I entered upon our labours.

After sluicing down the inner man, Crump manfully tackled the job. "All this junk must be sorted out," he said. So he carried over to the opposite side all he wanted. He wanted it all, apparently.

By this time the fourth bottle was half empty, but he carried on till cock-crow. Result—a hole in the lino and four empty bottles. Next evening he found everything wrong, and on interrogating his wife, she said, "Well, you always had that rubbish on *that* side of the room—so I've put it there."

Now behold Glapp, Bill and I entering upon our labours.

"Mind you leave yourself a few bits to play with," called out my wife as we went upstairs. "And don't forget how the dustman growled when you crammed Ethel's old bicycle into the dustbin."

We took off our coats and looked around, young Bill's eyes bright with the fever of the hunt.

"First of all we'll de-wire everything and make a wire dump. Then Bill can sort the wire into kinds and lengths." In fifteen minutes it was done and Bill began to sort the heap, whilst Glapp and I undertook next to collect loose bits of brass and ebonite, terminals, small tools and so forth. Presently Glapp said, "Wassis? Something come adrift?" He was shaking a one-stage "note mag." (or L.F. amplifier) and the sound indicated that a large heavy object was loose inside. We opened the case.

"So *that's* where the key of the garage was," I exclaimed, in amazement. "And I nearly sacked Barton, too, for lying."

Bill turned greenish.

Ma's Vase

"Oh," I said, "do *you* know how the key managed to get inside and screw itself down?"

"Yes, dad," exclaimed young Washington. "Y-you see, me and Fatty Bowyer were playing hiding things, and I hid that there and then we broke Ma's blue vase and hopped it, and when I came home I forgot all about the key and——"

"Wassis?" said Glapp, with sudden interest in his voice.

I turned. "Tha—that's only an old bottle," I replied.

He inverted it. "Nothing in it," he said, pensively. "Wassit doing behind this seven-valver, Jones?" Just then my wife popped her head in the room. Glapp, with a ready wit, exclaimed. "Shall I get you some more varnish, old man? I see you've run out." And that deep woman answered for me, "Don't bother, Mr. Glapp! It's gone up—since the war, and is very weak as well!" What did she mean?

Presently we had separated all the sets from their accessories, and the accessories from the dust, fag-ends and burnt matches. Bill had been very silent and hard-working, and the room looked like a ruined rope-walk. Just then Glapp said:

"Hullo, Jones! Is this a 'Vie Parisienne'?"

"Yes, I believe it is," I retorted. "I must speak to the housemaid. Leaving her fashion books all over the place. Bedtime, Bill." Bill went off, with pockets bulging, and we sat down for a pipe and a rest.

"Yes," remarked Glapp, after a few minutes with his latest find, "very healthy-looking lot but not my idea of Art. That reminds me—did you hear——"

"So I said to Jinkins, 'Of course, if you insist on that clause I'll do my best to persuade the Board, but I'm afraid they'll buck at sixty per cent. However'—mm—mm——"

That last speech represents me guarding the position till I heard my wife's footfalls receding.

The poor chap had been winding sticky insulating tape round himself.

Well, next we started in to re-wire the sets. Whether Bill had snipped bits off the wires or what he had done I cannot imagine, but I do know that all the lengths seemed either inadequate or redundant. We pawed around the floor and got as black as sweeps. Glapp upset a box of two million terminals, which spread themselves in an even layer, and I had the misfortune to knock over Bill's white mice, two of which dived into an open tin of soldering flux.

Presently Glapp, who was determinedly trying to make six inches of "flex" stretch a foot, remarked that his limbs felt sluggish.

Touch of Trench Fever

"It's a touch of trench fever, I believe," he added. In a few minutes he said that he was afraid he had creeping paralysis and that the skin of his legs felt tight.

"Great heavens!" he muttered. "It's magnetic. I'm being sorter pulled. Lemme get a light."

My wireless garret boasts but an anaemic oil-lamp, so we struck matches and peered at his legs. The poor chap had been winding sticky insulating tape round himself from a huge roll of the stuff which had been set aside by Bill and had finally got wedged between the table and the wall. I cut him off from the main spool and unravelled his cocoon, but the crease in his trousers will never be the same again. After that he retired and Maisie and the housemaid hacked their way in and cleared up. After all, it's a woman's job, this clearing-up business!

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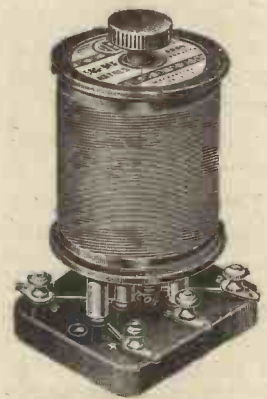

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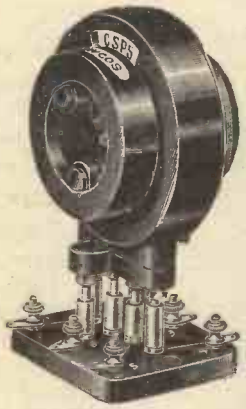

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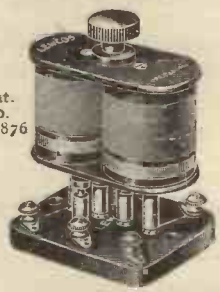

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Radio and the Gramophone

In this section of MODERN WIRELESS each month will be discussed both technical and other data of interest to the set owner who is also interested in gramophones.

Besides articles of a practical nature, a brief survey and critique of the latest gramophone records is included, making the section of vital interest to all music-lovers.

Conducted By KEITH D. ROGERS

CONTENTS

That Tracking Trouble

THE problem of correcting needle tracking when pick-ups are being used is still vexing a great many, both listeners and traders. Many firms are beginning to realise the advantages of offset carriers, while others are designing "straight tracking" devices which allow the needle to run straight across the record, remaining tangential to the grooves over the whole of its path.

In addition to descriptions of new pick-up carriers based on these two methods of obtaining tracking we publish an interesting letter from a radiogram enthusiast which expresses what must be the thoughts of large numbers of listeners.

No Noticeable Difference

Is there any noticeable difference in the tone of the reproduction or in the life of a record when it is used with a perfectly tracked needle and when used with a needle that is approximately tracked?

There certainly does not seem to be any visible increase in wear when a pick-up needle is several degrees out of track over that which is caused by a needle that is perfectly aligned. As regards tonal quality, this does not seem to suffer even when the tracking is badly out—though there are limits to the error possible before roughness of reproduction and increased wear are made noticeable.

A Valuable Article

The ideal should always be our goal, but experiments have shown that there need be no heart-burning if the tracking of any particular pick-up is not exact.

Readers about to purchase pick-ups will find the article, "Pick-up Points," by E. H. Turle, M.I.E.E., of value, while operating notes on the pentode valve, and details of a super-amplifier for demonstration purposes, are given in other pages.

Finally, listeners' experiences with pick-ups of various types and with different methods of carrier construction would be welcomed and would be of value to many readers

SOME NEW CARRIERS

Details of three new pick-up carriers that have recently been placed on the market.

WE have just had an opportunity of testing the new Gecophone pick-up and the pick-up carrier (illustrated elsewhere). The former is an improved model of the old Gecophone pick-up which was placed on the market some time ago, and it can be obtained in several types to fit various tone-arms and in a special type to fit the Gecophone pick-up carrier.

This latter has a slotted holder so that the pick-up itself fits on to the carrier in much the same way as it does on to a gramophone tone-arm, the adaptor of the pick-up being provided with a little pin which slides up the slot on the arm. This automatically gives you some idea of the correct angle at which the pick-up should be used, and provides a locking device which makes the pick-up quite secure.

A very commendable feature of the pick-up is the provision of leads of ample length for use with any reasonable apparatus. In fact, we do not know of any pick-up with which such long leads are provided.

Ingenious Component

In operation the pick-up acts quite well, being extremely brilliant on the high notes, though not lacking in the bass. It is, however, rather heavy and really requires to be used with an adjustable carrier such as the one provided by the makers themselves, or one of similar type. It is quite sensitive and requires a volume control in order that the best shall be got out of it.

In regard to the pick-up carrier, this is a very ingenious little contrivance, and is extremely well made. Constructed of aluminium it is well over eight inches in length, and is provided with a spring adjustment at the pillar end, while the long arm is slotted to take the wires from the pick-up, and at the pick-up end the holder is off-set at an angle which can be varied to suit the particular pick-up in use.

It is extremely easy to centre a pick-up with this arm, and with a little care it is possible to get the alignment practically correct over the whole of the track of the needle. The movement is easy, and the radius of swing is extremely large.

The only drawback that can reasonably be taken to be a drawback, in the case of this arm, is that on completing the record no provision is made for the pick-up to be swung back, as is the case with many pick-up carriers and with tone-arms.

Good Value

The pick-up and carrier arm have to be lifted, swung clear of the record, and then either rested on the side of the gramophone or on some suitable support, or else held in the hand while the new needle is placed in, and a fresh record placed on the turntable. If the makers could have seen their way to provide a little swivel joint at the end whereby the pick-up itself could be lifted and swung back, with

The cheapest model "Beamu" drive and offset carrier is covered with "Rexine" cloth.

the needle faced upwards, it would have greatly increased the facility of needle changing and provided an automatic rest for the pick-up.

But one cannot expect every refinement in a carrier which is placed on the market at the small sum of 12s. 6d., and at this price the Gecophone pick-up is certainly very good value for money.

Straight Tracking

Another carrier which has come to our notice recently is the "Ray-trak" carrier based on the mono-rail principle. It consists of a stout pillar and an adjustable swivel and a long, straight arm so constructed that a little carrier having two wheels on it runs along a single rail, which is of aluminium rod, and on this carrier is placed the pick-up holder.

The pick-up, therefore, is enabled to run straight across the record and can be so arranged that it runs dead in line all the way across. The construction of the carrier is such that the pick-up may be swung clear of the record at any time, and though there is no weight adjustment or counter-balance on the present model to take up the weight of the pick-up should an exceptionally heavy one be used, we understand this is to be fitted in future.

In action the carrier is quite satisfactory as regards the tracking. It runs freely and enables the pick-up to go straight across the record, but it is apt to be noisy in operation itself, while the question of the disposition of the pick-up leads in a satisfactory manner is a tricky one. The carrier running along the single rail is not too well designed, the wheels and the general movement being rather loose, and so upon heavy organ passages or particularly loud notes the whole instrument is inclined to rattle.

Vibration and Chatter

The extent of the chatter can be well judged from the fact that it is extremely violent on some passages, and in intensity quite twice as loud as the ordinary chatter produced by the average pick-up, which, as readers will know, is by no means negligible. The pick-up carrier is made by the Robinson & Hands Electric Co., Ltd., of Birmingham, and is being placed on the market for 35s., rather a large sum when one considers that only if correct off-setting in an arm is obtained one would seem to be able to get perfect tracking without the need for elaborate design.

And reverting to swivelling arm carriers, it is interesting to note that Messrs. Beagley and Musto, whose "Beamu" carrier was reviewed in a recent issue of "M.W.," are now altering the design to give correct tracking all the way across by means of offsetting. This, in addition to the weight adjustment, small size, swivelled end-piece, and invisible leads will make the "Beamu" carrier one of the most popular on the market. The old price of 10s. 6d. is being retained, and the firm is replacing all the old models free with new offset models free of charge—a truly commendable and generous action.

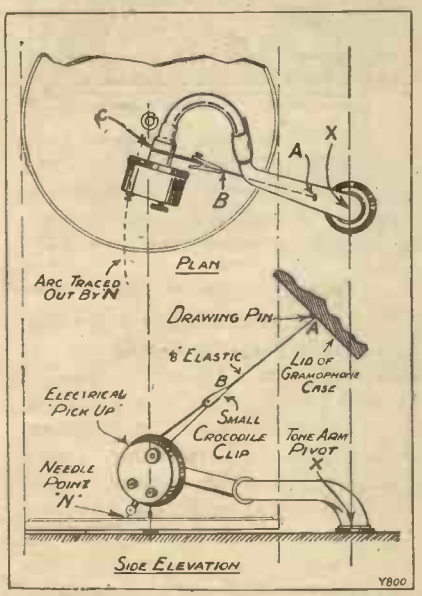
Balancing the Pick-Up

Does your pick-up come under the "heavy" class, weighing more than 5 ozs. ? If so, try the simple scheme outlined below.

By a Correspondent.

IN view of the widespread popularity of the electrical pick-up, the method detailed below of balancing the tone-arm should prove of interest to many.

This arrangement has been found by the writer to minimise greatly wear of records due to the weight of the pick-up or sound-box. Wear due to damping, etc., is not, of course, considered here.



How the counter-balancing scheme operates.

In the accompanying diagram the device is shown in use on a portable gramophone; however, modifications of the principle will, no doubt, occur to the reader to enable him to apply it to any particular type of machine.

The pressure which is exerted on the record by the needle is reduced by means of a narrow piece of elastic, one end of which is fixed to the lid of the gramophone case at A, the other end, after passing round the tone-arm immediately behind the pick-up, being clamped at some point, B, of the elastic by means of a small "crocodile" clip, as shown.

An Important Point

It is important that the supporting system should possess just the right degree of elasticity. After trial of several different kinds of elastic, the writer has found the ordinary cotton-covered variety, $\frac{1}{8}$ in. in width, perfectly satisfactory for any sound-box or pick-up, even the heaviest available.

Should any pick-up come to hand so light that it is found that the $\frac{1}{8}$-in. elastic is too wide to give the required degree of elasticity, it would indicate simply that this pick-up does not need to be balanced.

The tension of the elastic should be adjusted by altering the position of the crocodile clip until the pick-up bears on the record with a weight of about three ounces or so. If the pick-up is permitted to bear on the record with less weight than this the tone will become distinctly "fuzzy." Thus the procedure to be followed in adjusting the clip becomes obvious.

One more point of great importance: When fixing the drawing-pin at A, care should be exercised to see that the latter, the pivot (X) of the tone-arm and the point C remain in approximately a straight line (when looked at in plan) throughout the travel of the pick-up, in order that the tension in the elastic may remain practically constant.

I say "practically" because as the point A is not *at* the pivot (nor does it coincide with X when looked at in plan), and since the point C is in motion in the arc of a circle, with X as centre, it is impossible for A, X, and C to remain *exactly* in a straight line.

For this reason a slight allowance must be made for a variation in tension. In other words, the adjustment of the crocodile clip to a position beyond which any further increase in tension causes a falling off in the tonal quality should be carried out with the tone-arm in that position which causes the tension in the elastic to be a maximum.

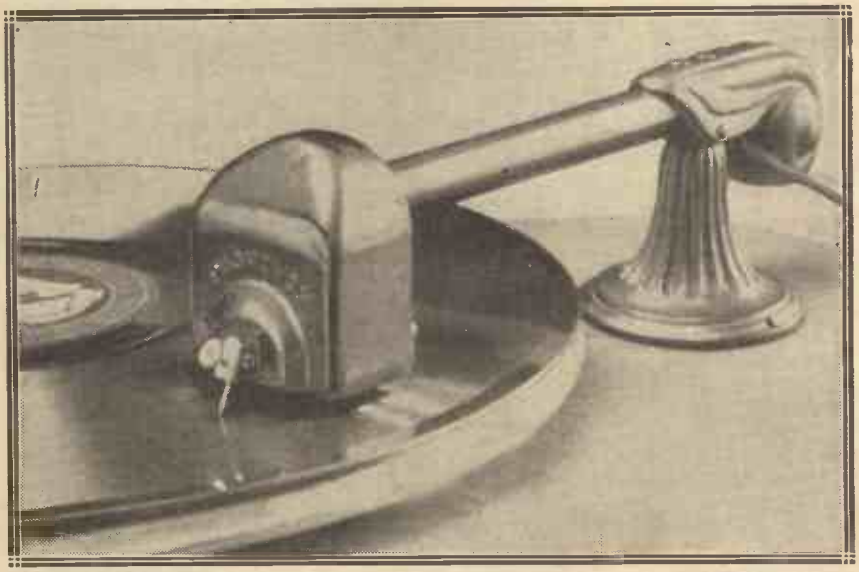
At all other positions the pressure exerted by the needle on the record will, of course, be just a very little more than it would be required to exert if it were possible for A to move in an arc about the same centre as C.

Slight Pressure Variation

However, the writer has found that this small variation in pressure is insufficient to warrant the slight extra trouble of attaching the end of the elastic to the top of a column mounted on the tone-arm (thus allowing A to move, and thereby remain in exact alignment with X and C), instead of to a drawing-pin on the inside of the lid, as shown.

In the case of the gramophone used by the writer, the needle-point N travels in an arc of 9 in. radius. Using the $\frac{1}{8}$-in. elastic, it has been found inadvisable to increase the distance A X (again when looked at in plan) beyond about 2 in.; $1\frac{1}{2}$ in. gives every satisfaction and a large margin of safety.

In conclusion, the total cost of the materials required is about twopence-halfpenny.



The new Igranic-Pacent pick-up and arm. The fibre needle model of the Phonovox was reviewed last month.

PICK-UP "POINTS"

How to make sure that your choice and method of using a pick-up is the "best." What to look out for, and what to avoid.

By E. H. TURLE, M.I.E.E., M.I.R.E., M.I.W.T.

THE advantages to be gained by utilising an electrical pick-up, wireless amplifier and cone loud speaker in place of the gramophone amplifier and horn are now so great that to the owners of reasonably good wireless receivers this method of reproduction from gramophone records is now the only one that can satisfy them, and any appreciative and discriminating hearers.

The steadily growing demand for gramophone electrical pick-ups is being met by the considerable number of makes of differing design now available, and for the most part all capable of good, or at least very fair, results, so that a wise choice between them is not a simple matter to the inexperienced.

Many Advantages

As compared with a mechanical gramophone, and providing that it is used under suitable conditions, an efficient pick-up can effect the following advantages:

(1) Needle scratch noise so much reduced as to be unnoticed and barely audible.
(2) Volume under smooth control from a whisper to the fullest loud-speaker strength.
(3) Reproduction clearer, particularly in lighter passages, while the loudest remain rich and full, that is to say, undamped.
(4) Record wear reduced very considerably.
(5) The broadcast voice can be given a pleasing background of soft music.

To obtain these advantages to the fullest practicable extent, however, requires not only discrimination in the choice of pick-up, but correct application in using it, and as very many people will be adopting the above method once they have heard for themselves the vastly improved reproduction obtained, the following important points of note may be opportune.

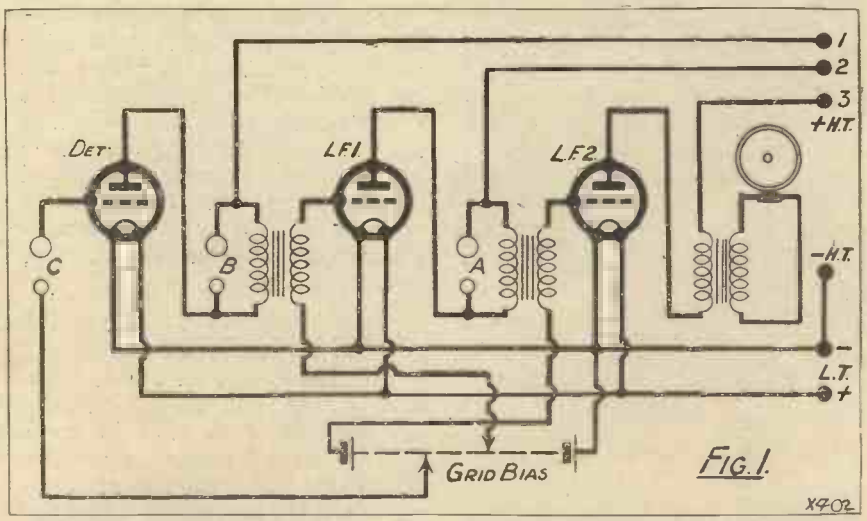


FIG. 1.

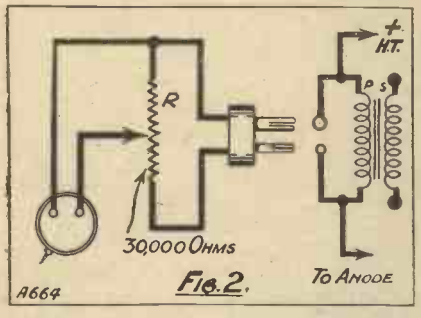
The first consideration should be given to the weight of the electrical pick-up, because if this is too light it will jump the deeper passages, and, if too heavy, tone will deteriorate and wear of records be excessive, while the needle may break through the walls of the grooves on the record.

Question of Weight

The weight of an efficient sound-box on a gramophone is usually of the order of 5¼ ozs., as in the case of the H.M.V. No. 4, but as a weight of four ounces is sufficient to maintain contact with the normal undulations on a record, and the resultant loss in volume can be readily compensated in the valve amplifier, the pick-up should weigh, say, 4¼ ounces, thus markedly reducing wear of the records, while at the same time needle-scratch noise is reduced in volume, and this is rather more than are the impulses from the sound waves recorded on the wax.

Needle-scratch noise is largely caused and is accentuated by unnecessary play of the needle, and it is therefore important to choose a pick-up in which the needle is properly mounted.

The electrical pick-up is either exchanged for the mechanical sound-box on the tone-arm of a gramophone,



where it must be a really good tight fit, or it can with advantage be fitted on an entirely separate arm free to give the same range of travel, but in either case the needle must be at an angle of 65 degrees with the record for the most satisfactory results, while the flexible connections must be so supported as not to impede the pick-up in its travel across the record or to give increased weight to it.

Attaching the Amplifier

The pick-up must be connected to the valve receiver in such a manner that the tiny electrical impulses set up by the armature (to which the needle is attached) vibrating in a magnetic field are impressed upon the grid of the detector or a low-frequency valve.

This is best done through a step-up transformer, the ratio of which can

The Burndept "Electrical Soundbox."

be as high as 70–1 if a low-resistance pick-up and separate transformer be used but where the low-frequency valves of the wireless receiver are transformer-coupled, then those transformers can be satisfactorily utilised, and this need involve little or no alteration to the set if the pick-up be of the high-resistance type, which is preferable. The diagram, Fig. 1, shows the detector and two low-frequency transformer-coupled stages of a wireless receiver, where sockets either already are, or can be, provided at "A" and "B" for the ready connection of headphones for tuning purposes.

Plug-in Connections

The sockets serve admirably for the ready connection of the pick-up. "A" being used where the record employed for reproduction is moderately loud and the room is not large, for in these circumstances one valve will usually suffice. When greater volume is required the pick-up is connected to sockets "B"; and in exceptional cases, and for still greater volume, connection can be made between the grid of the detector valve and a negative terminal of a grid-bias battery.

The positive terminal of this is connected to the negative end of the detector-valve filament, when the volume is still further increased by raising the value of the positive H.T. to the anode of this valve by 40–60 volts and adjusting the value of the grid bias to avoid distortion, thus utilising the amplification properties of the detector valve also.

In either of the above cases the volume is controlled by a potentiometer of about 30,000 ohms of the graphite track type, which it is important should be connected exactly as shown in Fig. 2, and which gives such complete control that with the pick-up connected to sockets "A" (Fig. 1) while the set is reproducing wireless transmission at comfortable loud-speaker strength (the somewhat dull news bulletin, for example) can be brightened by super-imposing music as a subdued background by the aid of a suitable record such as a violin or 'cello solo, or perhaps the more dreamy Hawaiian music may be considered a match.

The Needle Problem

The choice of needle has considerable bearing upon the results. The best practice is therefore to use a "half-tone" (moderately stout) needle for all string instrumental music and the like, and "tungstyle" (ordinary loud) needle for singing, brass bands, organ and similar loud music having heavy crescendos.

To meet the case of records that give rise to an unusually high ratio of needle scratch noise, such as the older records (acoustically recorded), the ratio can be usefully reduced by

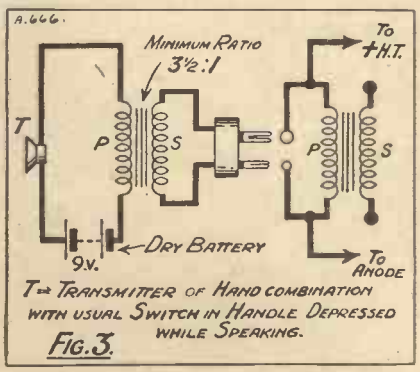
A light and efficient instrument—the R.I.-Varley pick-up is well-designed.

connecting a condenser of the order of ·5 to 1 mfd. across the terminals of the pick-up and, if necessary, increasing the volume by the control provided for this purpose.

Electrical reproduction from gramophone records can provide most excellent musical effects for local dances, socials, whist drives and dinner or card parties, where someone can be deputed to put on the records in a predetermined order from a position unseen and even remote from the places occupied by the audience.

Increasing the Effect

The effect can be heightened by oral announcements of the items, also through the loud speaker, by utilising an ordinary domestic telephone type of hand combination transmitter mouthpiece connected with a



9-volt grid battery through a 3½ to 1 ratio low-frequency transformer to sockets "B" as Fig. 3.

The adoption of the above procedure adds so large a measure to the enjoyment of gramophone music that it has only to be put into effect to be so much appreciated by its hearers that they will never willingly go back to the mechanical sound-box and gramophone amplifying horn.

USING THE PENTODE

The popularity of the Pentode valve as a gramophone amplifier is rapidly increasing, and the following notes will be found useful to many constructors.

By G. W. EVANS

FOR those who want a neat little valve set and do not want to go to the trouble of building a big set, but who yet can supply an adequate amount of H.T. current, and want gramophone reproduction as well as broadcasting, the ordinary two-valve wave-change set, using a detector and a pentode valve, forms perhaps an ideal combination.

The H.T. Supply

From the point of view of reproduction, using the average cone loud speaker, it can be strongly recommended, but it is essential that it be designed properly, and that sufficient H.T. voltage as well as H.T. current should be available to operate the pentode in an efficient manner.

Unfortunately, together with the advantages of increased magnification—for the pentode takes the place of two ordinary low-frequency stages—we have the disadvantage that it requires a heavy plate current and also a special output transformer if best results are to be obtained.

The plate current of the usual two-volt pentode varies between 12 and 16 milliamps, and the four-volter requires somewhat more, so that it is obvious that one requires the largest size of dry batteries, or else one must use an accumulator or H.T. mains unit for high-tension, if successful operation is to be obtained.

Improved Reproduction

Offsetting these disadvantages, the man who can supply the high-tension without any trouble has an added advantage that often better reproduction can be obtained from a detector and pentode than from the popular detector and two L.F. stages. Especially is this the case with loud speakers which tend to emphasise the bass rather too freely at the expense of the higher notes.

With such speakers as the average cones, which are usually rather on the deep side in tone, the use of a pentode will rectify this fault and give a wonderfully clear and straight-line reproduction, which it is practically impossible to obtain with the ordinary super-power output valve.

After all, the high-tension current required is not greater than that needed by an ordinary det.-2 L.F. set with a super-power in the last stage, whereas the space occupied by the set itself is less than that in the case of the three-valver.

For the man who wants to build his set in a compact cabinet, perhaps together with the gramophone, a detector-L.F. pentode combination is very suitable, if he is within reasonable range of any local station.

It is essential in such a receiver to employ a volume control for pick-up work, as overloading of the first stage would cause horrible distortion by the time the pentode has amplified it, and, of course, one has to be careful not to overload the pentode valve, which is rather critical as regards the maximum grid swing it will carry.

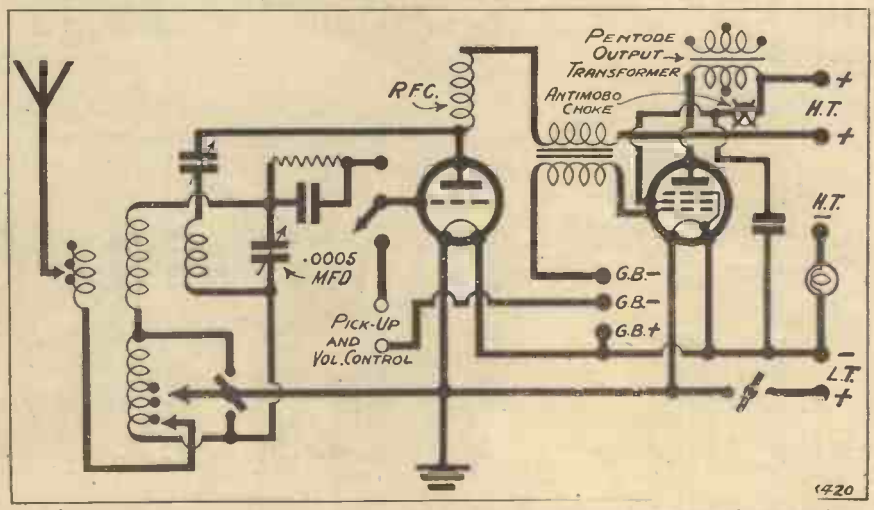
Unfortunately this grid swing is not very great, but the valve makes up for that by amplifying everything to a tremendous extent.

The circuit shown on this page gives some idea of an average pentode receiver which can be used with great success, and which incorporates a wave-change switch if it is wished to use the set for the long and short waves without the trouble of changing coils.

On the other hand, if ordinary plug-in coils are used and care is taken in the construction of the set, then it would be quite suitable for short-wave reception down among the twenty- and thirty-metre bands, as well as for the ordinary and long-wave programmes forming an ideal receiver.

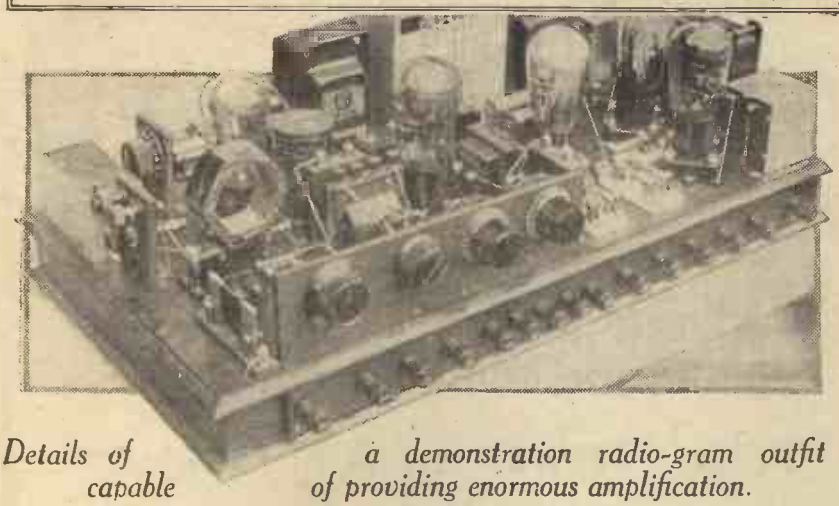
Volume Control

With the usual types of pick-up a detector and pentode is quite sufficient for all household work on the average loud speaker, while the volume control allows one to have complete control over the strength obtained from the gramophone, so that it can be brought up from a whisper to full strength in a perfectly smooth and regular manner.



A useful two-valver capable of being used for broadcasting or for gramophone work.

A SUPER-AMPLIFIER



Details of a demonstration radio-gram outfit capable of providing enormous amplification.

By G. V. COLLE.

WHEN one speaks of a public radio demonstration there immediately leaps to the listener's mind a picture of bellowing loud speakers, giving forth large volumes of sound without a semblance of quality, or memories of the raucous tones of a speaker whose voice has been amplified out of all recognition.

This, therefore, represents a fair view of how most people regard a demonstration of this sort, and in many cases adverse criticisms are not wholly unjustified.

Like in every new science, however, rapid strides have been made in perfecting the radio amplifier, while equal attention has been given to the loud speaker. In addition, with the introduction of the gramophone pick-up we now possess a means of amplifying "canned" music without the attendant disadvantage of what are usually termed "gramophone" noises.

Perfect Reproduction

Naturally enough, the cost of making an amplifier and maintaining it so as to give the desired results is an expensive business, but it is gratifying to balance against this the fact that it takes a person with a keen musical ear to differentiate between the output from a good gramophone amplifier and a good radio set.

A number of experiments have been conducted on the writer's large six-valve set, as described in a past issue of "M.W.," and it was in consequence of the results obtained with some of the latest types of pick-ups that the construction of a super-amplifier, suitable for giving an output for a large hall from a gramophone pick-up, was commenced.

Special amplifiers require special attention, and in this respect it is very interesting to see what has been done in the one under discussion. In the first place, it has to give an output suitable for operating three or four moving-coil loud speakers at a volume equivalent to the original transmission.

Tremendous Volume

Thus if, say, the Philadelphia Symphony Orchestra record of the Hungarian Rhapsody No. 2 is played, the output from the bank of loud speakers should approximate in volume somewhat to that when the disc was recorded—not an easy job.

Secondly, to enable the last power valves to handle the grid swing given them, valves having very long "straight curve" characteristics had to be employed. For this purpose 480 volts had to be used.

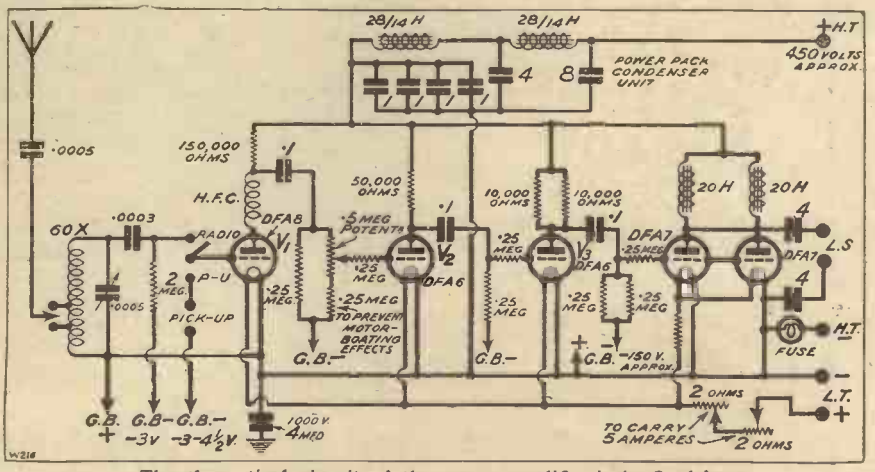
The voltage (from the mains) is cut down to about 410–420 volts, and it will be seen from the photographs that special Mullard valves of the D.F.A.8, D.F.A.6 and D.F.A.7 types were chosen so as to stand up to the high plate potential supply. Current is drawn through four L.F. chokes, two on a separate D.C. unit and two on the amplifier, while condenser by-passes total about 30 mfd., 16 mfd. of which is also included on the amplifier.

Smooth H.T. Supply

In consequence of the large smoothing system the output is remarkably free from hum, although it must be admitted the D.C. mains are in the first place very silent—a tribute to the efficiency of the electricity service.

Since the 480-volt supply is on a three-wire system, it will be appreciated that even with a choke filter output, which the amplifier includes, the earth is 240 volts below earth potential, so that a 4-mfd. 1,000-volt condenser is place each side of the loud speaker, to isolate it and to prevent shocks.

Even so, the writer must record that during adjustments at one of the meetings he nearly had the misfortune to electrocute himself in front of the audience through coming into accidental contact with the anode of one of the power valves. One cannot be too careful with high voltages.



The theoretical circuit of the super-amplifier in its final form.

An interesting part of this amplifier is the involved system of scratch filters and frequency corrector incorporated. After much experiment the writer would add a few words on his results—on the whole they are not worth it. The filters always appear to do their work too effectively and

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Radio Editor of a well-known Northern Newspaper.
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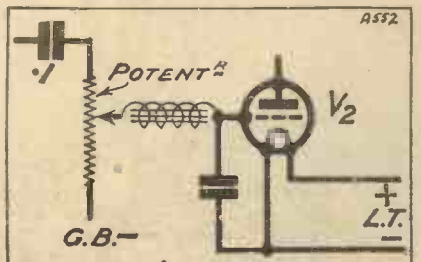
cut off the higher frequencies, a state which is to be expected if one understands over what band of frequencies discs are recorded.

Good records are recorded up to about 10,000 cycles, but owing to



CAPT. ROUND'S METHOD OF FREQUENCY CORRECTION ON THE MAGNETIC LEAKAGE PRINCIPLE

channel wear and the wax affecting the needle, the effective frequency is about 6,000 cycles, while scratch can be heard down to 5,000 cycles, using, of course, a good pick-up. It will, therefore, be seen that a filter circuit would cut off these frequencies and so defeat our object. However, fortunately the problem is not an acute one, so the writer's advice to those interested is " leave well alone " where filters are concerned.

Scratch Filters

Correction filters appear to offer possibilities for experiment, the writer having tried various types and values on the magnetic leakage principle, as advocated by Capt. Round, with various degrees of success.

Up to the present, however, no filter has been tried that has not reduced to some extent the brilliance of the rendering, and this is a very important point when one is reproducing orchestral and other string instrument items.

The writer does not advise the construction of this amplifier unless ample H.T., from either A.C. or D.C. mains, is forthcoming; and the description and circuit are reproduced here for the benefit of the more advanced radio-gram enthusiast. All the values are given in the diagram, which shows that the set is not difficult to build, but requires a certain amount of knowledge to operate and maintain in its maximum efficiency.

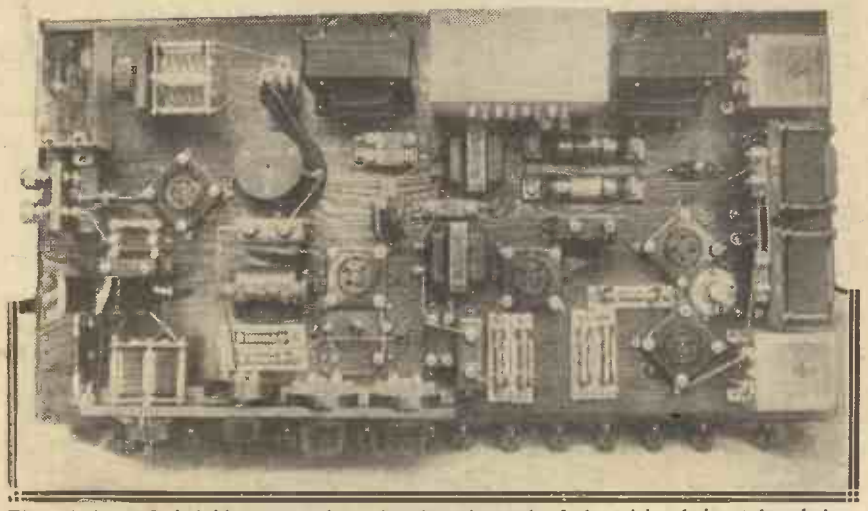
Referring to the theoretical circuit, it will be seen that no provision has been made for anti-motor-boating devices, although it will be appreciated how four L.F. stages tend to oscillate under the best conditions.

Inter-Circuit Coupling

Actually, there never was the slightest sign of unwanted coupling between the valves in the original amplifier, due no doubt to the efficiency of the H.T. supply, which appeared equivalent to a low-resistance H.T. accumulator. Whether the amplifier behaves normally on a rectified A.C. supply is a matter for test; but, in any case, the remedy is obvious.

Operating an outfit of this description often brings to light things of interest. For instance, the writer well remembers installing the amplifier in big demonstration showrooms and, having arranged everything, the outfit operating as expected, it was switched off for the night.

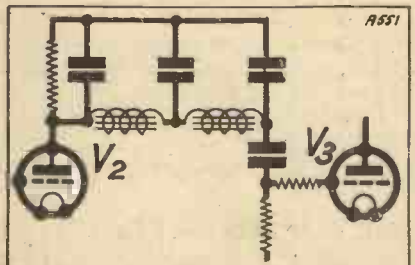
On switching on the following day, a violent howl was produced which no amount of juggling with the controls stopped, until it was realised that the gramophone had been moved some inches nearer the amplifier, bringing the pick-up leads nearer the loud-speaker output, and producing feedback effects.


The whole outfit is laid out on a large baseboard, much of the wiring being taken below the board. The scratch and frequency filters shown were afterwards omitted.

A SIMPLE TONE CONTROL

An important factor in the tone quality of a gramophone outfit is the question of " tuning " the loud speaker by filtering the output from the set. In the first place, it is taken for granted that a power valve is being employed at this late stage, so as to have the necessary volume available for reproducing a wide range of signals.

The output from the power valve should be transferred to the loud speaker by means of a suitable output filter, such as an output transformer or a condenser-choke combination. The next step is to filter out as much of the higher frequencies, including scratch, as seems necessary to obtain the necessary mellowness.



METHOD OF FILTERING NEEDLE SCRATCH WHICH WAS TRIED AND SUBSEQUENTLY ABANDONED.

It is a fact that in some instances the crisp, sharp, penetrating tone resulting from the higher frequencies is most desirable. This crispness may not always be required, and may even be undesirable; it depends on the speaker used.

Removing Shrillness

There is little we can do to add the higher frequencies to our gramophone reproduction, but most good L.F. amplifiers and most loud speakers have the necessary higher frequencies to begin with.

The problem is therefore one of controlling those higher frequencies, and this can be accomplished through the use of by-pass condensers.

A ·01 mfd. mica condenser will take off the sharp edge or disagreeable shriek in any loud-speaker rendition when shunted across the loud-speaker terminals.

A good idea is to have a variable tone control. For the purpose, a combination of a ·25 mfd. condenser and a volume control is shunted across the loud-speaker terminals. It now becomes possible to obtain any degree of mellowness in keeping with the selection and the taste.

ROUND THE TURNTABLE

by "TONEARM"

A page of odds and ends of interest and value to all radio or gramophone enthusiasts.

The Tracking Problem

A Reader's Views

SIR,—I think rather too much stress has been made of late on the subject of correct tracking of pick-ups and carriers.

In the first place, it is rare to find a record which is perfectly flat; it is far commoner to find them considerably warped, even when purchased new. In the second place, it is still rarer to find a perfectly true turntable. Both these factors will account for quite a large error in a correctly-tracked arm and pick-up.

The method I have myself adopted is to use quite a heavy pick-up in conjunction with a spring counterbalance, giving an effective weight on the record of only two ounces. The reed is heavily damped to prevent chatter, and the needles used are the soft, thin variety of about $\frac{5}{8}$ in. length, and alleged on all sides (quite wrongly, in my judgment) to be "record destroyers" on account of their "whippiness."

Played 200 Times

The amplifier is adequate, and consists of four valves with push-pull output; and the volume is such as to be unbearable in a room without the least distortion or chatter from the pick-up. The lid of the cabinet being mostly left open while playing.

A certain record (12 in.) has been played two hundred times with the above arrangement, and there is no *visible* sign of wear. This, I think, would satisfy most people.

It seems to me that there are two sides to the matter, and they may be summed up as follow:

(1) Pick-up weight on record in region of 4 oz.; (2) about 2–2½ oz.

(1) Pick-up lightly damped; (2) heavily damped.

(1) Stylus or reed very free; (2) fairly rigid.

(1) Tracking very important owing to weight: (2) not so important.

(1) Little needed in the way of amplification; (2) a good amplifier reed.

(1) The disadvantages are: Chatter, thick needles essential, wear much greater, and blasting and resonance in the record much more apparent. To my mind, the advantages of the second method are many with practically no disadvantages.

It would be interesting to know the method used by the B.B.C., though even this would not form a complete guide, owing to the fact that they play mostly new and unworn records.

Scratch Eliminators

Scratch eliminators have several times been mentioned, but I have so far seen no details concerning these. I should imagine, from my own experiments, that the volume would be reduced in proportion to the scratch, in which case the advantage would be nil.

The ideal, to my mind, is to take as little energy as possible from the record, and then make up with amplification to the desired volume, thus dispensing with volume controls and getting the greatest amount of life from the record. Otherwise why go to the trouble of electrifying the reproduction at all?

Yours faithfully,

FRANK B. THOMAS.

E.15.

THIS MONTH'S PICK-UP PROGRAMME.

ORCHESTRAL.

Ballet Egyptien—Luigini .. Col. 9566/7
Orchestre Symphonique de Paris.
Overture—Light Cavalry— H.M.V. B2856
Suppe
New Light Symphony Orchestra.
Le Rouet d'Omphale— Parlo. E10789/90
Saint Saens
Opera Comique Orchestra.

INSTRUMENTAL

Nocturne in E Major— .. H.M.V. DB1106
Chopin
Vladimir de Pachmann.
Organ Fantasie in G Minor—Bach Col. 9552
Eduard Commette on Lyon's Cathedral Organ.

LIGHT ORCHESTRAL.

Friend o' Mine—Sanderson H.M.V. B2857
De Groot and the Piccadilly Orchestra.
The Londonderry Air .. .. Ccl. 5158
J. H. Squire Celeste Octet.
Leslie Stuart Melodies .. .. Parlo. R241
Orchestra of the London Coliseum.
The Carmen Selection .. .. Regal G1050
Classic Symphony Orchestra.

VOCAL.

Abide With Me—Liddle .. Bruns. 20073
Master Frederick Firth.
Solveig's Song—Greig .. .. Col. 9577
Dora Labbette.
Sea Shanties .. .. .. H.M.V. B2831
John Goss and Cathedral Male Voice Quartet.

SYNCOPATED VOCAL.

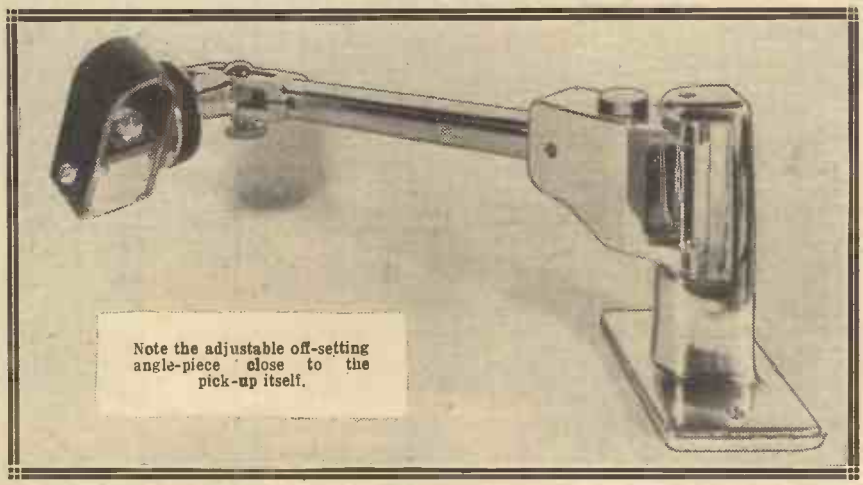
Crazy Rhythm .. .. .. Col. 5146
Layton and Johnstone.
You're In My Heart .. .. Zonophone
Maurice Elwin.
When I Set Eyes on You .. Parlo. R239
Red Anders.

DANCE.

Dakota .. .. Parlo. R237
Roof Garden Orchestra.
Little Dream Nest .. H.M.V. B5560
Ambrose and his Orchestra.

HUMOROUS.

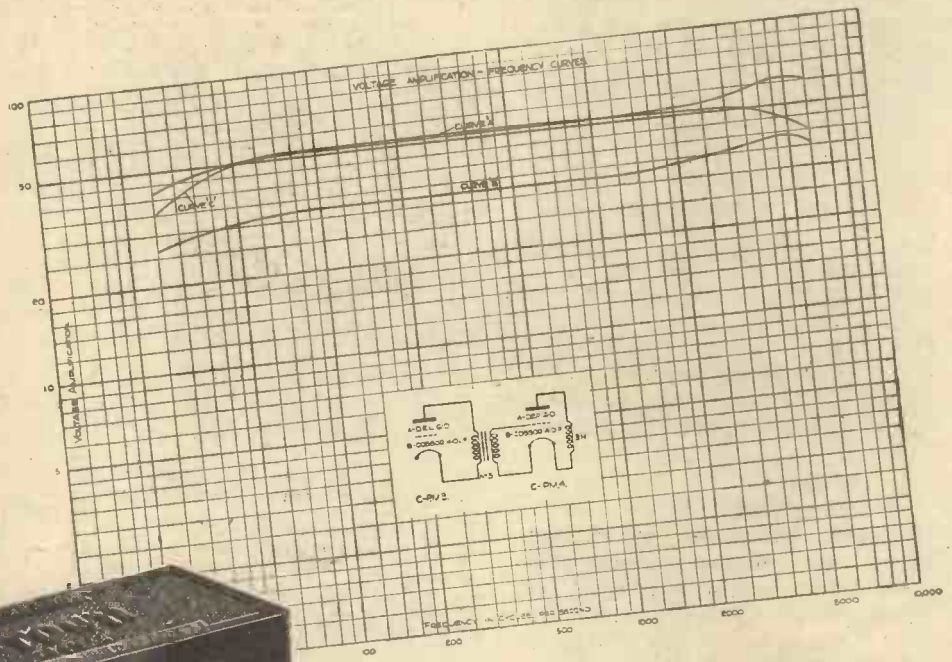
Ee, by Gum! .. .. H.M.V. B2880
Gracie Fields.
McGinty on Marriage .. Parlo. R248
A. C. Astor (Ventriloquist).
Gardening .. .. .. Winner 4869
Tommy Handley.

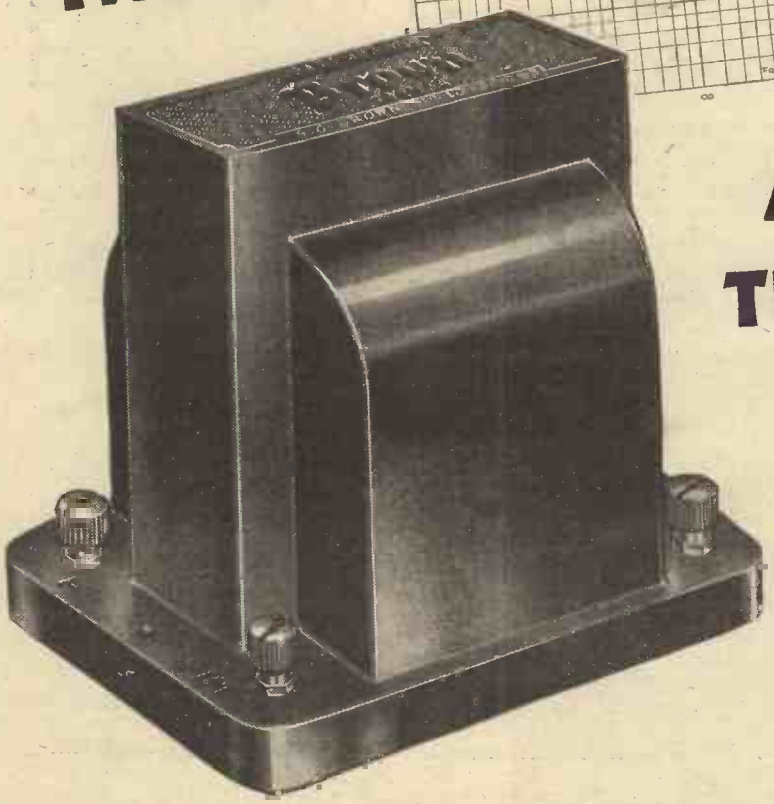


Note the adjustable off-setting angle-piece close to the pick-up itself.

The Gecophone pick-up and new balanced carrier reviewed in another page in this section.

THIS CURVE TELLS THE TRUTH





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RECENT RECORD RELEASES

Broadcast

IN our opinion, the outstanding success of the Broadcast "Twelve" this month is the disc by Arthur Vivian (baritone) with orchestral accompaniment (5038), ***When the Sergeant-Major's on Parade*** and ***If Ever I Meet the Sergeant.***

Both are excellently rendered and excellently recorded.

Chanson Indoue (Rimsky-Korsakov) and ***Concerto in E Minor*** (Mendelssohn), violin solos by Peggy Cochrane, with organ acc., on 5042, are not so good; the organ seemed out of tune at times, as is sometimes the case with organ records. Other Broadcast "Twelves" were good, but the one above mentioned seemed to us to be the best.

The fifteen-penny Broadcasts are mostly so good that it is practically impossible to pick out even a few from the rest and to assert that those are the best.

One that particularly attracted our attention was the comedy fox-trot, ***This is the Way the Puff-Puff Goes,*** by Fred Gibson, with Bidgood and his Broadcasters, on 333. This record is one of the brightest and catchiest tunes we have heard for some time, and is far in advance of the more notorious ***Why is the Bacon so Tough,*** which forms the subject for the other side of this disc.

Homing and ***My Prayer,*** by Gwen Lewis (contralto), on 336, are two well-known favourites recorded for the first time on this style of record. Unless kept down by means of the volume control the voice is inclined to "blast" on the top notes—as so many contraltos do, even in the higher-priced records.

Of the dance numbers, ***Gems from "Lucky Girl"*** form a double-sided disc of special interest. It is played by members of the Symphonic Dance Band, assisted by vocalists (326). Other well-recorded numbers are ***Jeannine*** (W.) and ***Nothing But You*** (F.T.), by Bidgood's Broadcasters (with the Stoll Organ in the latter case), 331; and also ***I Can't Give You Anything But Love*** (F.T.) and ***Minnetonka*** (F.T.), by the same band, on 330.

Parlophone

Two red-label items, marches, are among the best of the Parlophone releases this month: ***Nibelungen*** (Wagner) and ***Our Marines,*** played by massed military bands. Well played and excellently recorded (E.6112).

Raie da Costa figures prominently in the list, providing ***Laughing Marionette*** and ***Rag Doll,*** assisted by "Her Orchestra" (R238). Electrically reproduced this record did not come up to our expectations, the piano sounding rather harsh at times.

A recording that is sure to be a "best seller" is ***Sonny Boy,*** from the "Singing Fool," sung for Parlophones by Warren Carson (tenor), with orchestral accompaniment. This is an excellent record from every point of view. The reverse side, ***Mother of Mine,*** by Frank Braidwood, is also good, but is overshadowed by the former (R255).

On R247 is ***In the Pit*** (two parts), a character monologue by Mona Grey. An excellent record which should appeal to those favouring this type of entertainment.

The Three Australian Boys, who have toured the London Music Halls so successfully, have recorded ***Coo-ee*** and ***From Monday On*** (R249), but we must say we prefer them on the stage, they seem to lose a great deal by recording.

Excellent dance numbers in the Parlophone list are ***Sometimes*** (W.) and ***For Old Times' Sake*** (W.), by the Roof Garden Orchestra, on R254, but we find Herman Darewski and his Covent Garden Dance Band far below the usual Parlophone band standards in ***Sing-Song Girl of Old Shanghai*** and ***Minnetonka*** (F.T.), on R243. Two good numbers spoiled.

Zonophone

Another of the Vocal Gems series from the Gilbert and Sullivan operas is issued in the form of parts 3 and 4 of the ***Gondoliers,*** by the Zonophone Light Opera Co. (A350). This does not seem quite so well done as previous recordings of these operas. The result is a little "hard" as reproduced by electrical reproducers.

Clarkson Rose gives us ***Dada, Dada*** and ***All by Yourself in the Moonlight,*** on 5248. The latter is excellent, but the former, although well recorded, is neither amusing nor particularly suitable, in our opinion, for recording purposes.

The best of the syncopated vocal items is provided by Maurice Elwin with ***You're in My Heart,*** while ***To-day, To-morrow, For Ever*** runs a good second. The former is excellently done. All lovers of light vocal items should get this disc (5242).

FOR YOUR NOTEBOOK

One of the golden rules of radio is that the receiving set should be placed as close as possible to the point of entry of the aerial lead-in wire.

* * *

The swinging of an aerial or lead-in wire too near to an iron gutter pipe will often give rise to mysterious fading effects.

* * *

One of the most puzzling causes of distortion and weak signal strength is a faulty fixed condenser.

* * *

The use of anti-motor-boating devices should not be allowed to hide the fact that a high-tension battery which is getting old is prone to introduce distortion into the receiver.

* * *

A frequent cause of distortion in multi-valve receivers is H.F. leakage, and this can frequently be traced to long grid-bias battery leads.

* * *

When a large multi-valver requires a small negative bias on the H.F. valves or for anode-bend detector, it is generally better to have a separate cell for this rather than to take a long lead to the main grid-bias battery.

RADIO NOTES AND NEWS OF THE MONTH

A feature in which our Contributor brings to your notice some of the more interesting and important Radio news items.

Conducted by "G.B."

Straight Talks

RECENT experiments conducted by Marconi hold out the prospect that in the near future the leading Dominions of the Empire will all be linked together by wireless telephony. The next step is likely to be the experiment of establishing two-way communication so that London can speak to Canada and Canada to London. Later on, it is held that communication between South Africa, India and Australia will be made possible.

The Year's Forecasts

1929 seems to give promise of considerable advance in broadcasting technique, and some of the developments forecast are:

1. Big advances in short-wave transmission technique.
2. Definite progress with the Regional Scheme, giving listeners choice of programmes.
3. Commencement of work on the new Broadcasting House at Portland Place.
4. Establishment of a permanent B.B.C. Symphony Orchestra in conjunction with Sir Thomas Beecham.
5. Progress with educational broadcasting.

Radio Finger-Prints

Experiments are being carried out at New Scotland Yard in connection with the transmission by wireless of photographs and finger-prints of criminals. It is said that great success has already attended these experiments, and Viscount Byng of Vimy, the new Commissioner, who has seen the results, has expressed his approval.

It is forecast that in the near future there will be a string of Police wireless stations in England, and that wireless will be used more and more for the prevention of crime.

Party Palavers

The B.B.C. has invited the three political parties to take part in a debate on the Government's De-Rating Scheme and the Local Government Bill. It is probable by the time this issue of MODERN WIRELESS is on sale the broadcast debate will have taken place, but as the matter is under consideration it is not by any means yet certain.

The B.B.C. has suggested that a representative of the Conservative Party should speak for about twenty minutes, followed by spokesmen of the Labour and Liberal parties, who would speak for the same length of time, and that then the Conservative representative should be allowed a final ten minutes in which to reply to his critics.

The Liberals have announced that they will accept the invitation, and it is understood that the Conservative

(*Continued on page* 214.)

RADIO NOTES AND NEWS OF THE MONTH

—*continued from page* 212

Party are disposed to consider it favourably. As we go to press, the Labour Party has not yet come to a decision.

Royalty and Radio

Owing to ill-health, the King's uncle—the Duke of Connaught—spent Christmas abroad, and heard news of the King's progress by wireless. His chauffeur erected a wireless set at the Duke's villa, and it is understood the Duke listens-in regularly to all the bulletins. The Duke is seventy-eight.

Bright Ideas

As reported exclusively in our contemporary, "Popular Wireless," the B.B.C. has founded a "Bright Ideas Department." It is officially called the Programme Research Department, and Mr. R. E. Jeffrey, late Director of Dramatic Productions, will be the head. Mr. Jeffrey's new department's duties will be to put sparkle into the programmes and to find fresh talent and brain-waves generally.

Ballan Beam Burnt

The expensive Beam station at Ballan, about fifty miles from Melbourne, Australia, narrowly escaped complete destruction on the 28th December last owing to an outbreak of fire. It destroyed the roof and damaged the generator, and it is understood that the transmitting gear was also damaged by fire and water.

B.B.C. Best

It is stated that foreign members of the Commission of the International Radiophone Bureau have been very much struck by the way in which the B.B.C. transmits plays from its studios. Especially were they interested in the Dramatic Control Panel which enables the producer of a radio play to control effects without seeing the artistes, and to merge voices, music or any other sounds from as many as twelve different studios. It appears that members of the Commission were unanimous in their opinion that this dramatic control-panel arrangement is an advance on any other device known to broadcasting in other countries.

Eiffel Tower and 5 X X

Owing to the new wave-length changes, the Eiffel Tower may now be heard on a wave-length of 1,485 metres, which should bring it within the scope of any ordinary wireless set. Radio Paris (Radiola) remains unchanged at 1,750 metres. The power of the Eiffel Tower station is 5 kilowatts

There have been complaints, however, that the Eiffel Tower station now interferes with Daventry. We should be glad to hear from any readers who find their reception is being spoilt by the Eiffel Tower.

A Long Way Round

The radio operator in the "New York Times" wanted to send a message to a colleague living in a suburb of New York. Failing to reach him

(*Continued on page* 216.)

RADIO NOTES AND NEWS OF THE MONTH

—continued from page 214

on the city telephone, and knowing that his colleague was at home listening to a message from the Byrd Antarctic expedition 10,000 miles away, he wirelessed Byrd's operator on board the "Eleanor Bolling," the vessel in the Antarctic which does Byrd's radio broadcasting. The "Eleanor Bolling's" operator relayed the message to the "City of New York," the converted sealing vessel which is Commander Byrd's advanced post, and carried the aeroplanes with which his Antarctic flight is to be attempted. Here the operator inserted it into a Press despatch he was sending to New York, and it was promptly delivered after its Polar adventures.

Byrd Broadcasts

So far there has been no break in the wireless communication linking New York with Commander Byrd's expedition, and apparently none is expected. A reporter on board the "City of New York," which is now alongside the ice packs, sits at a typewriter and describes how Byrd "rediscovered" Scott Island, with its two peculiar-looking peaks rising 300 feet above the sea, the home of thousands of sea birds.

As the expedition continues the wireless will bring news daily to America from the ship, from the ice packs, and even from the exploring aeroplanes.

The B.B.C. Contradicts

In the middle of January reports were current that the B.B.C. was willing to grant broadcasting facilities to the Baird Television Company. Very promptly these reports were denied, in no uncertain terms, by the B.B.C.

An Official Statement

The B.B.C. has sent round another memorandum concerning television, asking for it to be repeated, as there still seems to be some misapprehension about broadcasting, so here it is:

"On October 17th we stated that a demonstration of the Baird Television Development Company on October 9th had failed to fulfil the conditions which would justify trial through a B.B.C. station, but that any claim of improvement would be examined."

"No Improvement"

The statement continues as follows: "The Baird Television Company has not yet intimated to the B.B.C. any claim to improvement. Any such improvement would be examined by the B.B.C. with a view to determining whether the above decision should be modified."

Why Not?

The Managing Director of the Baird Television Company stated in an

(Continued on page 218.)

MAINLY ABOUT AERIALS

The great disadvantage of a frame-aerial is that it is capable of picking up only a fraction of the energy which is receivable upon a good outdoor aerial.

* * *

Generally speaking, a frame aerial is more suitable for short wave-lengths than for long.

* * *

Amongst the advantages of frame aerial reception are the greater selectivity due to its directional properties, and its portability.

* * *

Where interference from neighbouring power stations or electrical plant is extremely bad, a frame aerial is sometimes the only satisfactory method of tapping the ether for broadcasting programmes.

* * *

Although a great many experiments have been made and many variations tried, the favourite grid leak and condenser arrangement is a capacity of ·0002 mfd. and a resistance of 2 megohms, the latter being connected to the positive lead to the filament battery.

* * *

Although 100 ft. of wire is the maximum length allowed for a listener's aerial it is not necessarily the best length, especially for an indoor aerial.

* * *

Generally speaking, whilst indoor aerials are satisfactory for the reception of the local station when this is situated only four or five miles away, they are not suitable for long-distance reception.

RADIO NOTES AND NEWS OF THE MONTH

—continued from page 216

interview in connection with this communication from the B.B.C. that it was hardly borne out by the facts. He recalled that application for broadcast was made by Mr. Baird in September last. Post Office engineers witnessed experiments with the system some time later, and the Managing Director claims that the G.P.O. sent him a written statement in which he said that the engineers were delighted with the system and considered it commercially practicable.

If this is so, why doesn't Captain Hutchinson, the Managing Director, issue a copy of this letter for publication in the Press?

Radio Drama

Mr. Val Gielgud, who has succeeded Mr. R. E. Jeffrey as Play Producer of the B.B.C., has some pretty concise views as to the direction of radio drama. He has made it clear that he is not going to attempt to produce plays to please everybody. His policy will be to cater for all tastes in turn. He seems to want it emphasised that he is not highbrow, but all the same he would like to improve the standard of the plays produced.

Microphone Plays

Mr. Gielgud said, in a recent interview: "I want to induce dramatists to write plays specially for us, but there is the difficulty of our not being able to offer them very substantial inducements, because our plays run for one night only. We may overcome this difficulty by running plays for three consecutive nights. Mr. Ashley Dukes, who wrote 'The Man with a Load of Mischief,' is writing a radio play for us now."

A Jazz Studio

The B.B.C. is introducing a Jazz Studio—its latest novelty for making brighter broadcasting. It appears that artistes have complained of the drab atmosphere of the old 2LO studio, so Number Three Studio has now been converted into a jazz one. In other words, it is decorated with much of the night-club touch, and it has a night-club atmosphere. The ceiling is silver-grey, the carpet has a cheerful pattern, and the lighting is subdued but radiates in a cheerful way.

This studio will be used in future for chamber music (and it is sincerely hoped the new decoration will make chamber music a little more cheerful!), military bands, dance music, and light broadcasts of other kinds.

The Indian B.C.

Mr. Eric Dunstan, the popular announcer who left Savoy Hill early in 1927 to take up the post of General Manager of the Indian Broadcasting Company, has now returned to the B.B.C. headquarters. Mr. Dunstan spent twenty months in India, but many difficulties arose, and it was more than once suggested that broadcasting would have to cease. Piracy and the small number of licences that were issued combined adversely to affect the Company's finances, and in October of last year the whole staff resigned.

IN OUR TEST ROOM

—continued from page 188

216-turn terminal being in the centre and "zero" on the base.

May Facilitate Wiring

Although, of course, it is in some respects an advantage for standard objects to remain standardised in every respect, it must be pointed out that this Lewcos loading coil fulfils the "M.W." technical requirements. We asked for a certain total inductance and certain tappings. Providing these are all in order, that is all that matters so far as the operation of the set in which the coil is to be used is concerned.

And on test we find the Lewcos version of the "M.W." standard loading coil to be quite satisfactory and fully up to standard. Constructors need have no hesitation in including them in sets in which such a device is specified, and, indeed, in some cases the Lewcos form may facilitate wiring.

Useful Books

Two useful books have been produced by the Standard Wet Battery Co. The one is a handbook of instructions for assembling and using the standard Sac Leclanché wet H.T. batteries, while the other also deals interestingly with the products of the firm. Anyone interested can obtain free copies of these booklets.

A Pocket Soldering Outfit

Elmesan (London), Ltd., are the sole distributors in Great Britain of that well-known solid fuel "Meta." They have now produced the "Soldometa," a pocket soldering outfit which retails at 2s. 6d. In a handy size tin are a small soldering iron, a tin of "Fluxite," a tin of "Soldo" (this is a soldering compound in powder form which dispenses with the need for flux or resin, etc., possessing in itself all the solder needed for tinning and soldering).

There is also, of course, a small packet of Meta and a stick of solder. Finally, there is a small holder for the fuel.

With all these excellent things one could hardly fail to make a good soldering joint. Despite its small size the outfit is quite a practical one, and small jobs such as wiring a radio receiver can be carried out with it. "Meta" is a clean and a safe fuel, and it gives out a hot flame. The small iron soon loses its heat, and a little skill is needed to avoid "dry" joints.

A VERSATILE METER

—continued from page 171

The other end of the shunt is connected directly to the negative terminal of the milliammeter. The ampere socket is connected to the positive terminal of the instrument. As, therefore, the plug is pushed home it connects the shunt between the positive and negative terminals of the instrument. The strip should be shaped so that it lies normally about $\frac{1}{8}$ in. clear of the top of the ampere socket.

The Final Process

The hole in it over the socket should be a close fit for the plug (A in the diagram). The strip is fixed in place by means of a round-head or cheese-head $\frac{3}{4}$-in. screw. To the tip of this screw, and to that of the countersunk screw 1 in. below it, the ends of the shunt are now soldered. The wiring of the instrument is then carried out in accordance with Fig. 9.

The only remaining process is the final calibration of the ampere shunt. Use is again made of the borrowed ammeter and of the D.P.C.O. switch. One lead from the ammeter is plugged into the negative socket of the multi-range instrument and the other end into the 3·5-ampere socket. We left the shunt with rather too high a resistance in order to allow for contingencies. It will probably be found that owing to soldering its ends the resistance is not now very much too high.

A Resistance Adjustment

The final adjustment is made by taking a very little solder on the point of a small iron and applying it carefully to one of the turns of the shunt. The resistance of the solder is much

(*Continued on page 221.*)

A VERSATILE METER

—*continued from page 220.*

lower than that of the wire, and by its use small portions of the latter can be short-circuited until the total resistance is exactly right.

The instrument is most convenient to use since direct readings are always obtainable from the existing scale. On the 25-volt and 25-milliampere ranges each full division equals 1-volt or milliampere, as the case may be. On the 250-volt range each division is 10 volts, and on the 2·5-ampere range it is ·1 ampere.

By making up the multi-range instrument one obtains what amounts practically to four high-class moving-coil instruments. The resistance of the voltage ranges is of the high order desirable and no damage can be done to batteries, since for a full-scale deflection the maximum current taken from them is but 25 milliamperes, and, of course, at the voltages commonly measured it is very much less (1 milliampere at 120 volts).

THE "NEUTRO-SCREEN" THREE

—continued from page 128

Next remember that grid leaks also give rise to noises very often, and try out a good selection before you decide which you are going to use. See that all valve pins are clean and making good contact in the holder. This also applies to coil-mount pins.

See that all connections are tight, especially if you have just begun to use a soldering iron. As a matter of fact, I know some amateurs who have soldered their joints for years, and even then a careful examination of one of their sets will often reveal a couple of "dud" joints.

You will find that the setting of the stabilising condenser C_2 is not at all critical with the small coils. It will only actually need adjusting with the larger coils. This is preferably done with a long ebonite rod filed to a chisel edge at one end, and cutting a slot in the top of the ebonite adjusting handle of C_2.

Try the effect of reversing primary and secondary windings of your L.F. transformer if you get any signs of threshold growl. A reversal of connections will often cure it.

On the wave-lengths below 20 metres you may find it an advantage to use a small series condenser in the aerial lead, or else to use a special small aerial. On several occasions I have tried changing over in this manner with a marked improvement in results.

On Broadcast Wave-lengths

I now want to touch on a very interesting application of this set, and that is to broadcast reception. By using suitable coils this set can be used for broadcast work, and, it will be found, will give a degree of amplification that I think will be a revelation to you.

There is one point you want to watch, and that is the H.F. choke L_7. If this is a special short-wave choke it will not be suitable for broadcast work; it will result in the detector valve going into continuous oscillation. But if you are using a universal choke you have no alteration whatever to make to the set so as to make it suitable for broadcast work.

For the coils you will want inductances wound with Litz for secondary and anode coils if you are to get the full benefits that this set will bring you in the way of H.F. amplification. The aerial coil L_1 may be a 7- or 10-turn coil placed inside the secondary, while L_3 will be 6 or 7 turns wound on as a continuation of the secondary with a fairly fine gauge of wire, say, 28 D.S.C. As the actual number of turns for L_3 may be slightly influenced by the layout, if you have departed much from the layout I have used, it will be advisable to put on about 10 turns and then strip them off, a turn at a time, till you find the correct number. This winding will be found to be critical within 1 turn, and as you take the turns off you should explore the full range of the stabilising condenser.

L_2 should be 65 to 70 turns of 27/42 Litzendraht wound on a 3-in. former, the aerial coil being coupled to the end of the secondary that is connected to L.T.

Matched Tuning

For L_4 the same winding will be correct, so that the two tuning condensers keep pretty well in step. L_5 will be 10 to 15 turns of 24 D.S.C. wound in the same direction as L_4, the outer ends of the two windings being connected to grid and anode respectively. This gives the correct connections for reaction to be obtained.

On plugging these two coils in you will find that the H.F. amplification given, after the H.F. stage has been correctly neutralised, is simply enormous. I have a set built on these lines only with another L.F. stage, first built about a year ago, that brings in stations from all over Europe at terrific strength. Even in daylight it will bring transmissions like Münster, Frankfurt, Langenberg, etc., at far too great strength for comfort, while on the long waves it is equally efficient.

At night there are few of the stations that one usually receives free of interference that can be borne fully tuned in, and drastic use of the volume control has to be made.

If you try out this set on broadcast waves it will be a revelation what can be done with three valves.

EDITORIAL

—continued from page 119

receives £1,000; Sir Gordon Nairne, Dr. Montague Rendall and Mrs. Philip Snowden each receiving £700 a year. The salary of the Director-General, Sir John Reith, is not definitely known.

Other interesting results of the "Daily Mail" inquiry show that, in 1927, £487,728 8s. 6d. was expended upon programmes; there were 68,296 hours of broadcasting; which means, according to the above figure, that programmes were sent out at an average cost of £7 2s. 8½d. an hour.

But, as the "Daily Mail" rightly points out, that is an illusory figure, for there are many hundreds of hours when one programme served many stations, while much of the £487,000 was spent on persons and things having no relation to the microphone.

However, perhaps some of the mystery of the B.B.C. will be cleared up when our readers have read the article on that subject in this issue.

The Ideas Department

THE formation of the B.B.C. Ideas Department has long been forecast. As a matter of fact, five years ago Mr. Cecil Lewis put this suggestion before the B.B.C. chiefs, and at various other periods we understand that he has made such proposals. However, slow but sure seems to be the B.B.C.'s motto in this respect, and we are glad to note that at last the formation of this essential department has been decided upon, and that Mr. R. E. Jeffrey, the popular Chief of the B.B.C. Dramatic Department, has taken over his duties with a full knowledge of their significance and importance.

"SAFETY FIRST" RADIO

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

I NEARLY had an accident the other day which would have resulted in the loss of one of my favourite accumulators, much spilled sulphuric acid, and probably much ruined apparatus, to say nothing of my suit.

As my lighting supply is D.C. and I have a separate power point off which I run an electric heater, taking approximately 4 amperes, I usually charge my L.T. accumulators by putting them in series with this heater. The accumulators are of large capacity, so that this current gives just about the correct charging rate.

Up till now I have had a couple of heavy flex leads permanently connected so that I can put the battery on charge. When no battery is being charged the ends of the leads are twisted together.

A few days ago I had put a big accumulator on charge, and when it had come well up and was gassing freely I went to take it off. The heater was on, and I just loosened off one terminal and pulled the lead away.

Fire Just Avoided

Unfortunately, the lead was frayed and one strand was left behind, and as the circuit was broken a 4-amp. arc was started that burnt up this strand. The resulting flame ignited the celluloid case of the accumulator, and had it not been that the top was wet from sprayed acid I am afraid the accumulator, and many other things too,

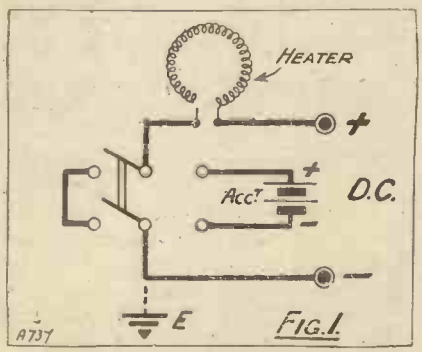

FIG. 1.

would have been a complete "write-off."

Now I have installed a heavy copper double-pole double-throw switch connected as shown in the sketch. With the switch on the left the heater circuit is closed and the accumulator is "dead," i.e. it is not connected to the mains on either side.

By throwing the switch over to the right the accumulator is connected in series with it, so that it is on charge. Care must, of course, be taken to see that the polarity is correct, so as not to run the accumulator down instead of charging it. The usual salt-water test will tell you which lead is positive and which negative.

It is also advisable when installing a switch of this description, especially if it is an unprotected switch not of the "quick break" kind, to have it mounted well away from the battery on charge.

Explosive Gases

This is owing to the fact that a battery which is being charged, when it begins to gas freely in the last stages, gives off oxygen and hydrogen. The mixture of these two gases, as you know, is highly inflammable, and if present in sufficient quantities may even be explosive.

The arc from the switch, if mounted close to the battery, may ignite the mixture, and with celluloid-cased accumulators the results would be unpleasant. It is also inadvisable therefore to bring a naked light close to a charging accumulator when this is gassing freely, and a case was reported in the papers where a serious fire occurred at an electrician's owing to the gases from the batteries being ignited.

Where you have electricity in the workshop it is usually found that one point is not sufficient to supply all your needs, and a flex lead is frequently taken from the ceiling rose, or from a double lamp holder, to give you a handy point on the work bench.

It is advisable, however, to take a little care over the provision of an extra point. When experimenting, short-circuits occur from time to time,

(*Continued on page* 225.)

"SAFETY FIRST" RADIO

—continued from page 224

and if ordinary lighting flex is used it may gradually cause the insulation to break down at some point. This may result in a partial short, not enough to blow a fuse, but enough to give rise to a fairly heavy arc.

If the wire is strung along a wooden back to the bench, or along a piece of batten, or under a wooden shelf used for storing wireless components, a fire may easily be started.

To be on the safe side, therefore, you should carry out such wiring with lead-covered cable, or else run it in iron conduit tubing, if you have the skill for it. The former method is, of course, far the easier to handle. The lead covering should be earthed, and this is of especial importance when the mains supply is A.C., for troublesome interference may result with reception from a length of unshielded flex carrying alternating current.

Safeguarding the Leads

When a set is run entirely from mains, or even where the H.T. supply is provided from mains, especially in the case of D.C., and the loud speaker is installed in a living-room, both loud-speaker leads should be condensered

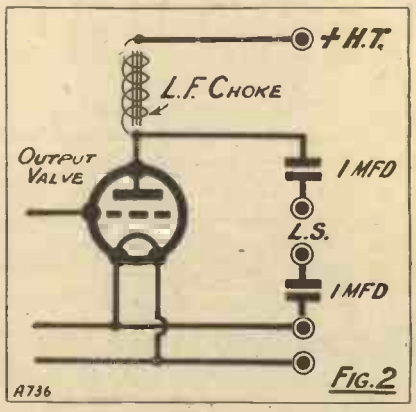

FIG. 2

and a filter circuit should be used as shown in Fig. 2. There is always the possibility that someone may catch hold of a loud-speaker terminal and place the other hand on something connected to earth, and get a nasty shock if this precaution is not taken.

Even where the negative main of a D.C. supply is earthed there is nevertheless a difference of potential between this main and a direct earth in the house, owing to the voltage drop across the main lead. This may in some cases amount to as much as 40 volts; enough to give one of your kiddies, and they are the meddlers, an exceedingly unpleasant shock.

SHORT-WAVE CONDENSERS

By J. ENGLISH.

CHOOSING and using the right type of tuning condenser in a short-wave receiver is a matter of more importance than some amateurs realise. Often mediocre results can be traced to the use of variable condensers which, although good enough for tuning on medium and

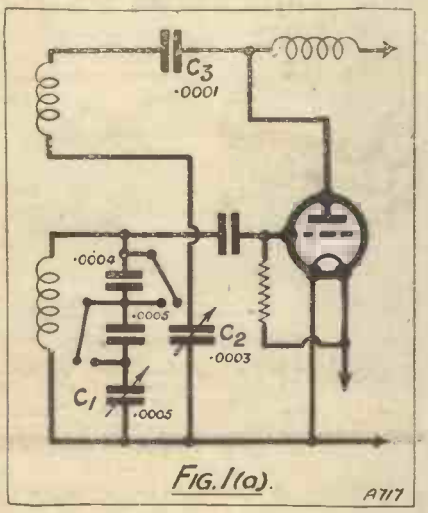

FIG. 1(a). A717

long wave-lengths, are quite unsuitable for a short-wave receiver, by which I mean a receiver tuning below 50 metres or so.

The shorter the wave-length the greater the need for a really good condenser, because such small variations of capacity are then required for accurate tuning that any small electrical or mechanical defects are magnified into quite serious faults. A most desirable feature in a receiver intended for short-wave reception is a perfectly silent background. You do not want loud signals so much as clear, readable signals, which are difficult to obtain if the set is at all noisy.

Ensuring Quietness

If the receiver is perfectly quiet in operation, then even a weak carrier-wave can be resolved into readable signals, so that the range of reception is dependent to a very large extent on the amount of background noise. Often breathing and scratching noises are traceable to the tuning condenser, if this is of the type where the contact to the moving vanes is a rubbing contact of small area. I have often noticed that the substitution of a variable condenser with a "pigtail" connection to the moving vanes produced a very definite improvement in reducing background noise. The friction contact type of condenser, however, appears to be quite satisfactory as a reaction control on short waves, and it is only in the grid circuit that a variable condenser with a sound electrical connection to both sets of vanes is really necessary.

Another cause of faint noises is dust on the condenser vanes. This may even cause partial short-circuits between the fixed and moving vanes, which makes the condenser very noisy in operation. Even in a totally-enclosed receiver the condensers accumulate dust in a surprisingly short period, and it is about time some enterprising manufacturer brought out a totally-enclosed variable condenser for short-wave work.

Meanwhile, it is a good plan to remove the dust periodically with one of those fluffy pipe-cleaners, which are just the right size for inserting between the vanes. A better way of cleaning them is to pass a bunsen flame between the

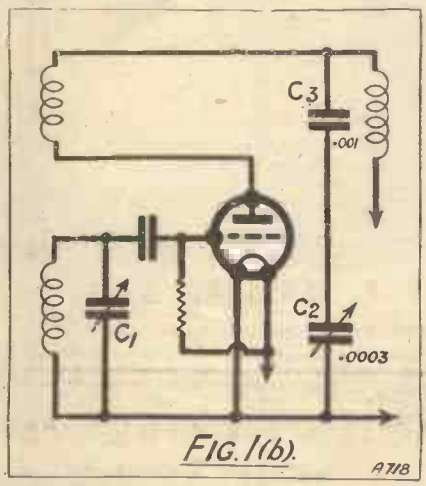

FIG. 1(b). A718

vanes, but not every amateur possesses a bunsen burner, while the operation requires care.

When making up a short-wave set you may be tempted to use a spare variable condenser to save the cost

(*Continued on page* 227.)

SHORT-WAVE CONDENSERS

—*continued from page 226*

of a new one. This may be of too large a capacity, for even with a slow-motion dial a capacity exceeding ·0005 mfd. is too big. There are other reasons why you should use a tuning condenser of small capacity. Not only is tuning easier but the ratio between coil inductance and tuning capacity is higher, which gives you better signal strength.

It is now generally accepted that a tuning condenser of ·0003, or, better still, ·00025 mfd. capacity, is the right size for short-wave tuning, while for reception below 20 metres I prefer a variable condenser of ·00015 mfd. capacity. If you want your set to tune over the most interesting wave-band of, say, 15 to 50 metres, then a compromise must be made, using a condenser of ·0002 mfd. capacity.

A Useful Scheme

Some receivers are designed to receive on both medium and short waves, in which case the ideal variable condenser for the short-wave range is too small for the medium-wave range. A condenser of ·0005 mfd. capacity is about right for wave-lengths between 250 and 550 metres, and a recognised expedient for reducing its capacity for short-wave work is to arrange for a small fixed condenser to be switched in series with it when changing over to the short waves.

This is quite a good way of getting over the difficulty, because, although the tuning condenser has a nominal value of ·0005 mfd., the fixed condenser in series makes its effective maximum capacity smaller, according to the size of the fixed condenser. If this is ·0005 mfd.. then the variable condenser becomes one of ·00025 mfd. capacity, which is just right for short-wave work. A good idea is to arrange for a second fixed condenser to be inserted in series for wave-lengths below 20 metres or so, its capacity being ·0004 mfd., which will bring the main tuning condenser down to a fraction over ·00015 mfd., the capacity mentioned above for this wave-band. These fixed condensers should be connected as shown in Fig. 1(a), which illustrates several other points about short-wave condensers.

(*Continued on page 228.*)

SHORT-WAVE CONDENSERS

—continued from page 227

When choosing a condenser for short-wave work preference should be given to the condenser in which the vanes are specially shaped for straight-line tuning, either straight-line frequency or straight-line wavelength. Low-loss construction is highly desirable and a small, compact condenser is useful, as its smaller external field gives less trouble due to stray capacity couplings.

The Reaction Control

For your reaction control condenser you can use any of the standard types, and, as mentioned before, there is no need for a special low-loss component, although one with a pig-

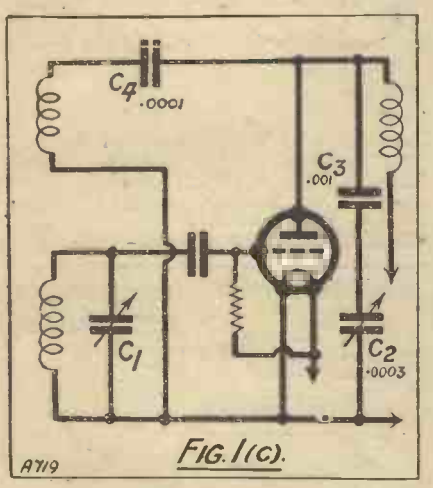

FIG. 1(c).

tail connection is to be preferred; even a condenser with the old-fashioned circular vanes can be pressed into service, as there is no advantage in using an S.L.F. or any other "straight-line" type for reaction control. The capacity of the reaction condenser depends upon the circuit of the receiver, and in the diagram of Fig. 1 you will find recommended

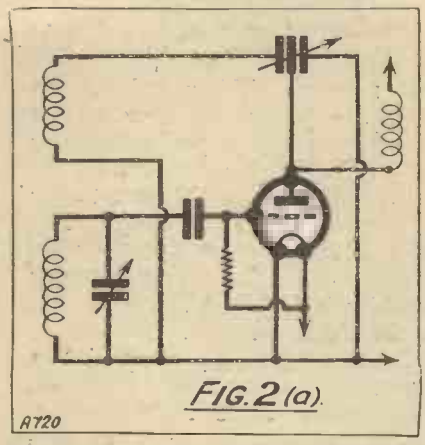

FIG. 2(a).

capacities for the various well-known circuits.

In each case you will see that a small fixed condenser is inserted in series with the reaction condenser chiefly as a safeguard against shorting the H.T. supply. This fixed series condenser should always be used, but do not insert any condenser regardless of its capacity.

Double Condensers

In the by-pass control system of Fig. 1(c), for example, the series condenser C_4 is virtually connected across the transformer or 'phones so that if it exceeds ·0005 mfd. capacity the total capacity, with C_2 C_3 in parallel, will be too much for good quality. This is a point to be watched when making up a set to receive on both short and medium wave-lengths.

A particularly useful condenser for throttle control in short-wave sets is the double condenser, such as the Pye differential condenser and the Igranic screened double condenser. This is used as shown in Fig. 2(a), one-half being the series feed condenser and the other half the throttle control. As the moving vanes are rotated the capacity of one condenser is increased as the capacity of the other is decreased.

This provides a very efficient reaction control and, at the same time, the capacity across the transformer primary is always the same, which is better for quality than the usual throttle-control arrangement. A constant shunt capacity of this nature also has less effect on tuning when making reaction adjustments. The circuit of Fig. 2(a) can be somewhat troublesome as regards hand-capacity effects, but the modification in Fig. 2(b) is free from such troubles.

A Curious Feature

An interesting feature arising out of connecting a fixed condenser in series with a variable one is that the characteristics of the variable are considerably altered. The S.L.F. and S.L.W. type, for example, becomes very much like condensers with

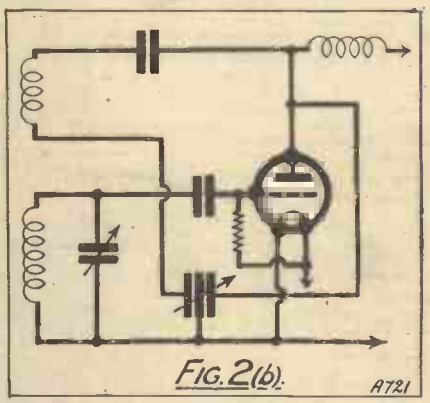

FIG. 2(b).

circular vanes, and this changed capacity-characteristic produces a crowding of wave-lengths over the lower readings of the condenser.

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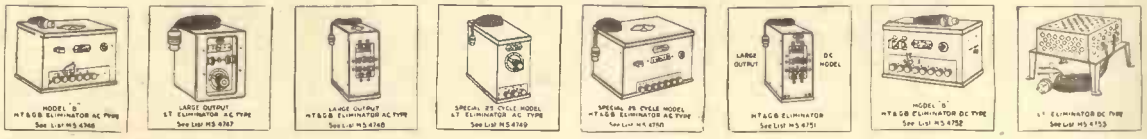

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