SPECIAL CHRISTMAS NUMBER

Modern Wireless

1/6d

Vol. XIV.
No. 48.
DECEMBER
1930

FULL SIZE BLUE PRINT FREE!

Special Articles in this Issue by—

SIR JOHN REITH, EDGAR WALLACE, CAPTAIN P. P. ECKERSLEY, COMMANDER KENWORTHY, etc., etc.

FULL DETAILS OF FIVE FINE SETS

PAGES 561-608 ARE MISSING

CONTENTS

VOL. XIV. No. 48. MODERN WIRELESS. DECEMBER, 1930.

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

Edited by NORMAN EDWARDS.
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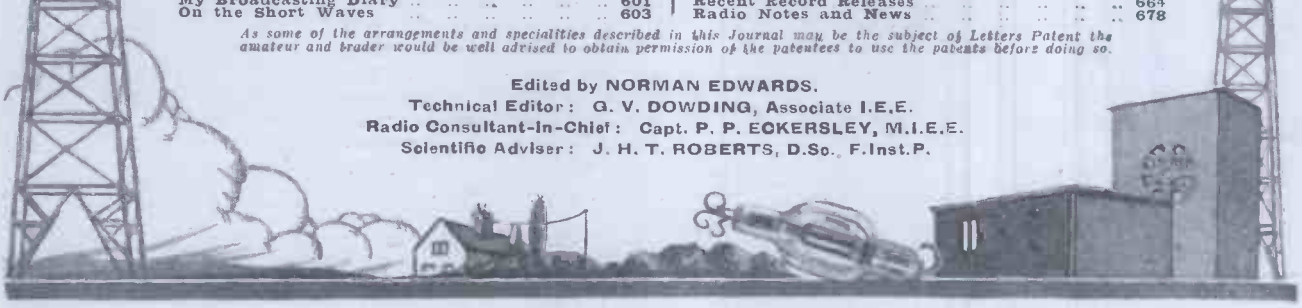

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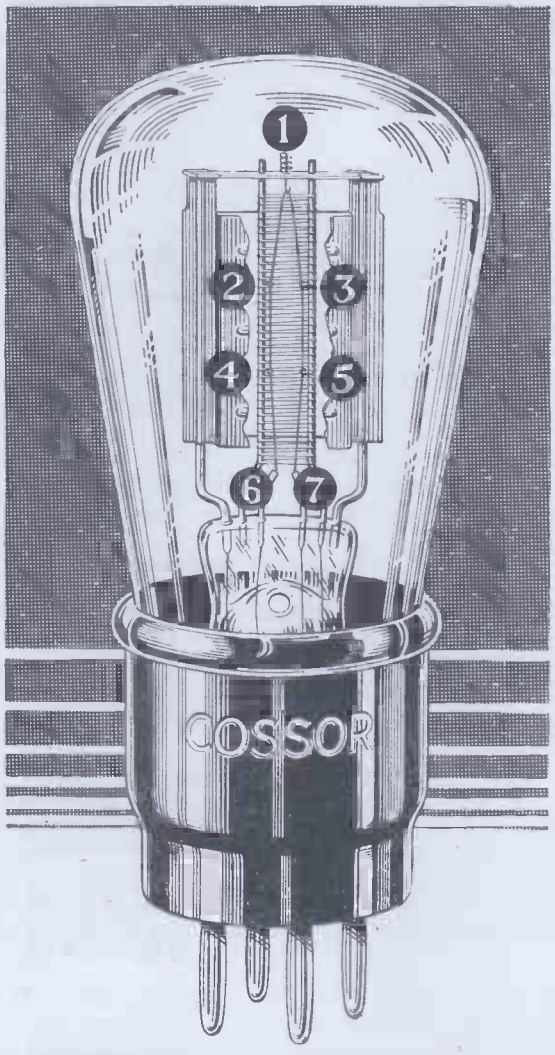
Seven point suspension *definitely prevents* microphonic noises



—by eliminating filament vibration

Microphonic noises in a Receiving Set are usually traceable to the Detector Valve. Nine times out of ten the cause is filament vibration. Look at the illustration alongside. This shows the internal construction of the new Cossor Detector Valve. See how the filament is held—not only top and bottom—but also by four insulated hooks spaced at intervals throughout its length. The purpose of these hooks is to damp out any tendency for filament vibration. Therefore by using this "steep slope" Cossor Detector Valve in your Receiver the possibility of microphonic noises is definitely eliminated and you are assured of greater volume with absolute tonal purity.

We have just issued a novel circular Station Chart which gives identification details of nearly 50 stations, and space is provided for entering your own dial readings. Price 2d. each, they are obtainable from any Wireless Shop. In case of difficulty write us, enclose 2d. stamp and head your letter "Station Chart M.W."

Cossor 210 DET., 2 volts, .1 amp. Impedance 13,000. Amplification Factor 15. Mutual Conductance 1.15 m.a./v. Normal working Anode Voltage 90-150. *Price* 8/6

THE NEW COSSOR DETECTOR VALVE

DEFINITELY FREE FROM MICROPHONIC NOISES

C614

MODERN WIRELESS

Vol. XIV. No. 48. DECEMBER, 1930.

A Merry Christmas to You—"M.W.'s" Wonderful Programme—Very Special Sets—Our Famous Contributors—The Idea of It!

A Merry Christmas to You

A MERRY Christmas to all "M.W." readers! True, it *is* a little early in the month to offer such wishes; but as we shall not be before you again until the New Year, we must take the only available opportunity. And because we wish you the season's greetings rather early in the month, they are none the less hearty and sincere.

* * *

You will probably notice some rather striking changes in the general "get-up" of this issue of "M.W." And we hope you like the changes. We feel they are worth while, for this reason: During the past year—thanks to the support of our readers—"M.W." has progressed remarkably well, and, as is usual, with ever-growing success we are encouraged to do even better than before in giving you the tip-top best in radio magazine literature.

"M.W.'s" Wonderful Programme

THE trials and troubles of editing a radio magazine are many, but we should like to take this opportunity of telling readers how those trials and troubles are well worth while when encouragement and help are given in the way so many readers have given to "M.W." There is an old saying that nothing succeeds like success. It is true enough, but "M.W.'s" success depends to a very great extent on the host of "M.W." correspondents—old readers who, from their frequent and friendly and critical letters, are now old friends and valuable supporters. Their numbers have grown exceedingly during the last year, hence the steady growth of "M.W." and the many innovations we are enabled to introduce.

This month we present you with a full-size blue print of the "Plus-X" Four, a star of star sets, which you will read about in detail on another page. Next month we are presenting to every reader a magnificent gift book. Its title is self-explanatory—"50 Guaranteed Circuits." And when we say "guaranteed" we mean guaranteed! *And* the month after, in the February "M.W.," you will find *another* gift booklet—"50 *More* Guaranteed Circuits"! Well, we have other plans in view, but perhaps that's enough to go on with just now! Enough, anyway, to make you realise the importance of keeping a close watch on succeeding issues of "M.W."

Very Special Sets

A WORD or so about this issue of "M.W."—our special Double Christmas Number.

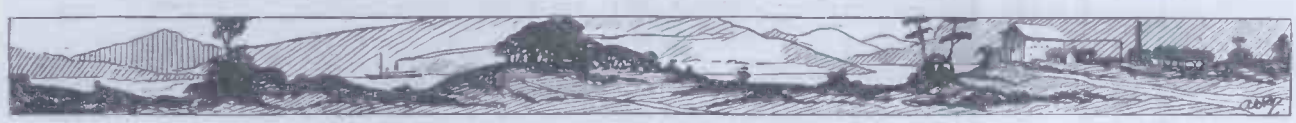
The "Plus-X" Four we have referred to, the blue print and full working details you will find elsewhere in this issue, but mind you have a careful look at the other constructional articles. The "M.W." Three and the "Tri-Coil" Two are both of considerable technical interest; while the "Super-Simple" Mains Unit and the "Mains-Power" Three are also extra-specials from the "M.W." Research Department.

Our Famous Contributors

A CHRISTMAS number of a widely circulated magazine like "M.W." should not be *wholly* technical, and that is why we invited Mr. Edgar Wallace, the famous author and playwright, to contribute to our columns. Mr. Wallace's article has a radio flavour and is written in his own inimitable style; while Sir John Reith's article is one which old listeners, who remember the early days of broadcasting, will read with special interest. Captain Eckersley, Commander Kenworthy, and Albert Sammons are other famous people who contribute to this issue, and we hope that you will read them, one and all, and thoroughly enjoy the fare we offer you in this our Christmas number of MODERN WIRELESS.

The Idea of It!

THE radio news sensation of the month was provided by Mr. Granville-Barker, the dramatist. He wants the Government to sanction the transference of some of the B.B.C.'s "profits" to a fund for backing a National Theatre! What a hope! Listeners' licence money—there are no B.B.C. "profits"—to be diverted from the cost of running and improving the B.B.C. to assist in building a theatre which would not pay its way and would probably produce plays nobody wants to see! Well, Mr. Barker is certainly an optimist if he thinks listeners would sit quietly by and see their licence money spent in such a way.



Edgar Wallace — NEARLY SAYS MARVELLOUS!

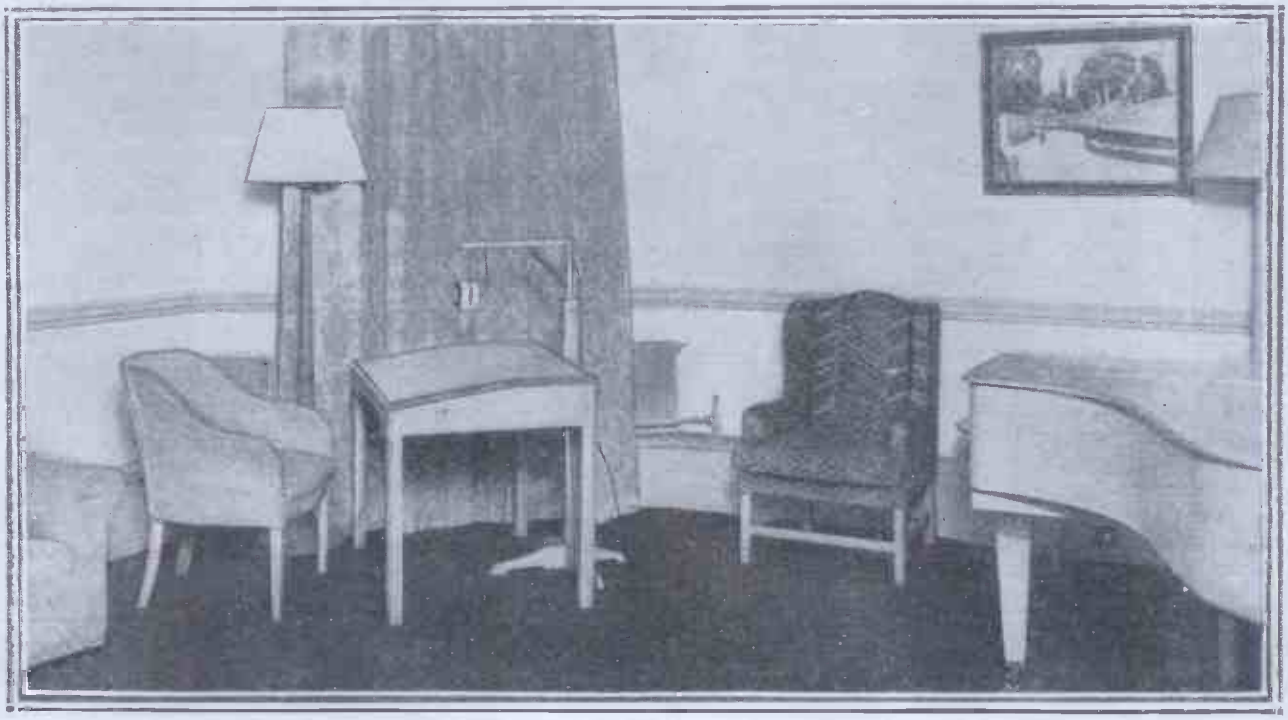
"MARVELLOUS" and "miraculous" are two words that I have refused to employ when speaking of wireless. They are the clichés of the new science. And yet I nearly fell from grace when I walked into a room at Savoy Hill, and there was explained to me the mechanics of the little talk I was to give.

The room was dimly lit. There was in its decoration something of the style of Byzantium. It was entirely untenanted; it was almost entirely unfurnished.

There was a grand piano; there was a desk with a sloping, felt-covered top, and suspended over this was a ridiculously small, octagonal microphone, about the size of half a grape-fruit. Near one of the doors were two lights.

Then the Red Light Glowed!

The two men who had taken me up explained the procedure. One was an official of the B.B.C., the other a famous American journalist who acts for a great American news agency in London.



The "Number Six" Studio at Savoy Hill, London, from whence Edgar Wallace "told the world" via 5 S W.

" We get through at a quarter to ten," he said, " and I will introduce you to some twenty million people who are looking at their watches and saying, ' London hooks up in five minutes.' New York will hear you at about a quarter to five ; Chicago will hear you at a quarter to four ; people will be listening to you in Los Angeles in their lunch hour.

" Florida will hear you, and so will Winnipeg and Vancouver, and, of course, the eastern states of Canada. In a few minutes you will be talking to people who are sitting in old colonial houses in Virginia and Maryland—odd, isn't it ? "

I nearly said " Marvellous," but restrained myself.

And then the red light glowed, and he began to talk. The silence of the room was oppressive ; not even a clock ticked. He spoke in a very ordinary, conversational tone of voice.

" The room was dimly lit . . . the red lamp glowed . . . not even a clock ticked."
Be sure to read this account of the famous author's visit to the London broadcasting station, his feelings when he told Chicago, New York and Los Angeles all about his work, and of the cabled " come-back " from Hollywood.

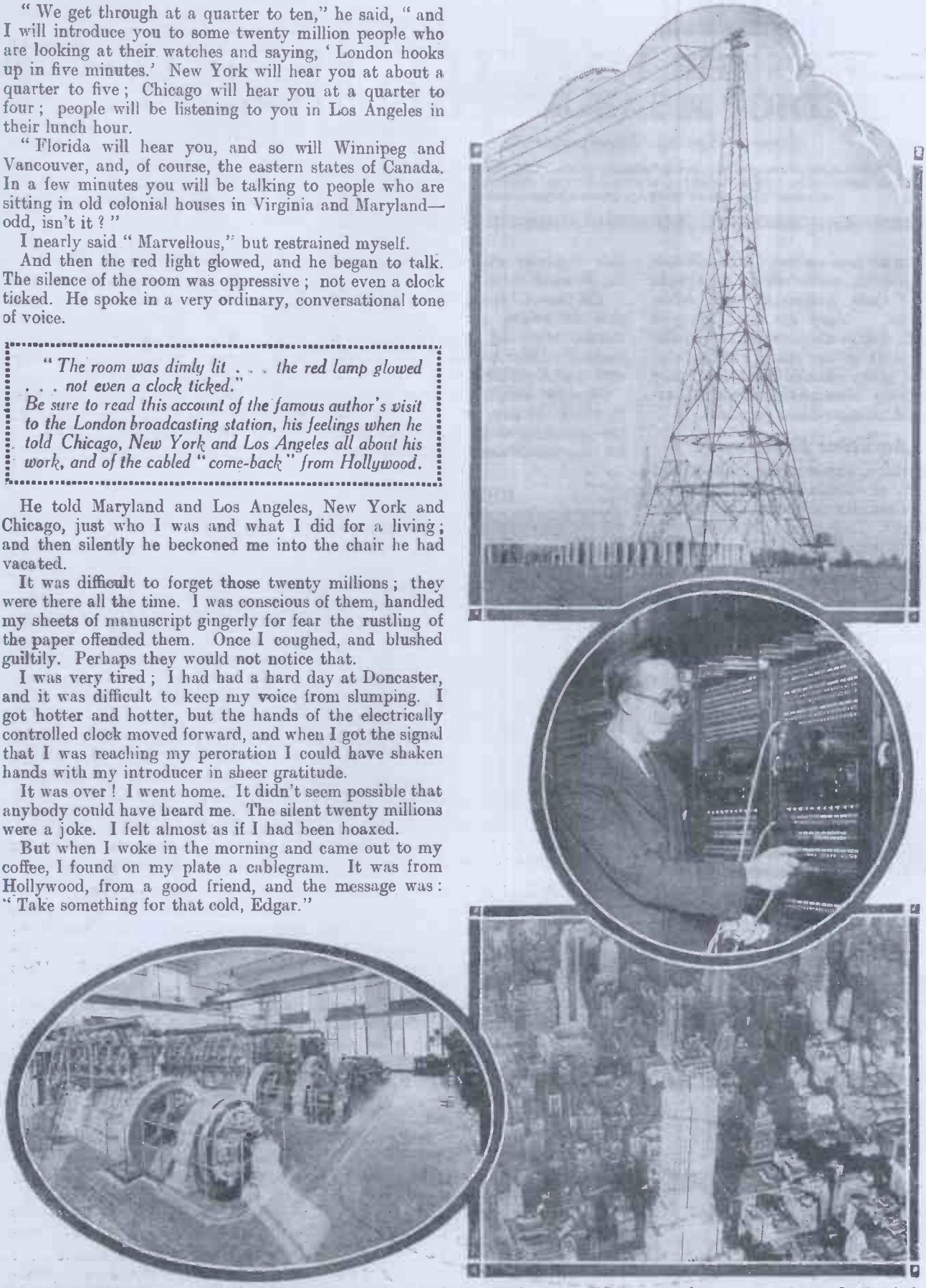
He told Maryland and Los Angeles, New York and Chicago, just who I was and what I did for a living ; and then silently he beckoned me into the chair he had vacated.

It was difficult to forget those twenty millions ; they were there all the time. I was conscious of them, handled my sheets of manuscript gingerly for fear the rustling of the paper offended them. Once I coughed, and blushed guiltily. Perhaps they would not notice that.

I was very tired ; I had had a hard day at Doncaster, and it was difficult to keep my voice from slumping. I got hotter and hotter, but the hands of the electrically controlled clock moved forward, and when I got the signal that I was reaching my peroration I could have shaken hands with my introducer in sheer gratitude.

It was over ! I went home. It didn't seem possible that anybody could have heard me. The silent twenty millions were a joke. I felt almost as if I had been hoaxed.

But when I woke in the morning and came out to my coffee, I found on my plate a cablegram. It was from Hollywood, from a good friend, and the message was : " Take something for that cold, Edgar."



Above are shown some of the generators at the London station, and (right) New York as seen from an aeroplane. In the circle above is the control room for an all-America hook-up. The top photograph shows the Brookmans Park station, London.

THE FIRST "RADIO" MEASUREMENT

From a Special Correspondent.

There is a fundamental similarity between radio and light waves, and in this interesting article details are given of some historic experiments in measuring the velocity of electro-magnetic waves.

LIGHT rays are very little different from radio waves, except in their frequencies and wave-lengths. They are both, as you know, electro-magnetic wave-like disturbances in the ether, and both of them, given suitable conditions, may be freely transmitted, absorbed, reflected, refracted and polarised.

An Ether Experiment

Perhaps, however, the fundamental point of similarity which exists between radio waves and light is their velocity. Radio and light waves both travel through the ether with approximately the same speed, to wit, with a velocity of 186,000 miles per second.

Now, although by means of our knowledge of the electro-magnetic nature of light it has been a matter of comparative ease to calculate the velocity of radio waves through the ether of space, such was not the case at the period during which the speed of light waves was first determined.

Indeed, the first determination of the speed of light was the result of much tedious observation and experiment. However, the scientist who first discovered this physical constant may certainly be said to have made the first radio measurement; for, after all, light, as we have already seen, is in nature identical with wireless radiations.

The Moons of Jupiter

Olaus Roemer, a Danish astronomer, was the first to measure the velocity of light. He published his results in the year 1676—more than two and a half centuries ago—and this is how he obtained them:

The planet Jupiter has, as no doubt you are aware, several satellites or moons revolving around it in a manner similar to that in which our own moon revolves round the earth.

Consider, now, the diagram herewith in which the sun, earth, Jupiter, and the particular moon of Jupiter chosen for the observations of Roemer are lettered *S*, *E*, *J* and *M* respectively.

Owing to the fact that Jupiter's moon revolves around the planet in a plane very nearly coincident with that of Jupiter's orbit round the sun, the moon frequently passes into the shadow of the planet and so becomes invisible to astronomers on the earth.

Now, when the earth is in the position E^1 the time of disappearance of Jupiter's moon into the shadow of the planet is carefully observed. The time at which the same phenomenon should take place after the elapse of six months is then worked out mathematically. This is easily possible owing to certain astronomical laws concerning the revolutions of planets and their satellites which are well known.

1,000 Seconds Too Late!

Exactly six months after the first observation has been made the time of the eclipse of Jupiter's satellite is again determined astronomically and it is compared with the theoretically calculated result.

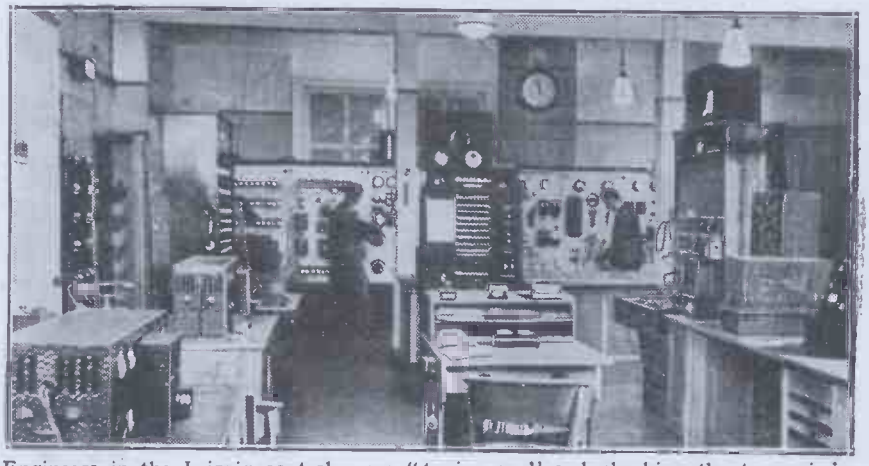
The comparison shows, however, that the eclipse takes place the second time about 1,000 seconds too late.

Here, however, we have the crux of the observational experiment. During the six months between the first and second observations the earth has moved round the sun from the position E^1 to the position E^2. That is to say, it has moved half-way round its orbit. Light rays from Jupiter's satellite have, therefore, to travel the extra distance represented by the diameter of the earth's orbit before they can be observed.

The additional journey of the light rays from Jupiter and its moon takes 1,000 seconds. Hence, as the diameter of the earth's orbit is known to be 186,000,000 miles, the velocity of light is 186,000 miles per second.

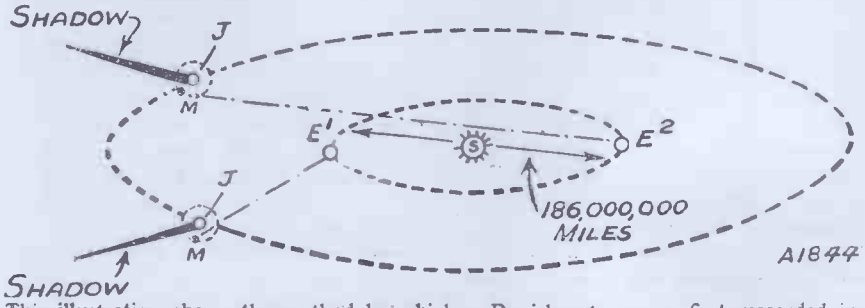
This is the method by means of which the astronomer Roemer first measured the speed of light. (Of course, he only obtained an approximation to the correct result, and more refined methods of measurement have been discovered since his day.)

BEFORE THE BROADCAST BEGINS



Engineers in the Leipzig control room "tuning up" and checking the transmission before it goes "on the air." Leipzig works on 253 metres, with a power of 2·3 kw.

MEASURING THE VELOCITY OF LIGHT—BY JUPITER!



This illustration shows the method by which a Danish astronomer first succeeded in actually measuring the speed of light.

THE "PLUS-X" FOUR

Is there any real progress in wireless nowadays. Are they the same old circuits over and over again, with different components and a different panel layout? No! Though absence of any such revolutionary development as the screened-grid valve this season has led some superficial observers to ask queries something like this.

Very Real Progress

Such questions are not likely to come from regular readers of "M.W.," for they have only to compare the series of designs we are presenting this season with those of last year and the one before to see what very real and noteworthy progress has been made.

It's not just a matter of different methods of construction either, but real fundamental improvements in circuits to remove old defects and meet new conditions.

Such developments as the "Star Turn" circuit, "Interwave" coupling, and our new dual-range coil unit, with its high standard of efficiency in wave-change switching, should go far to prove our point.

Our series of simplified mains devices and all-mains receivers, too, represent a really substantial advance. This new development, however, is not yet fully disclosed, and we cannot at present say very much about it. If you are interested in mains working, keep a look-out for future issues.

Important Step Forward

Now we come to a receiver which marks an even more important step forward. In the "Plus-X" Four we have definitely achieved something for which designers have striven in vain for years.

That is a sweeping statement, but we make it after due consideration.

"X" EQUALS:

1. ARM-CHAIR CONTROL
2. COLOSSAL POWER
3. UNIFIED TUNING
4. NO GANGING
5. SIMPLE SCREENING
6. RAZOR-EDGE SELECTIVITY
7. INEXPENSIVENESS IN ASSEMBLY AND OPERATION
8. EASY TO BUILD
9. EXTREMELY EASY TO OPERATE
10. STABILITY WITH VIRILITY
11. FIRST-CLASS QUALITY OUTPUT
12. EXTREMELY EFFECTIVE PANEL WAVE-CHANGE
13. LOUD SPEAKER RESULTS FROM SCORES OF STATIONS
14. NO COIL-CHANGING
15. NO "SNAGS," NO COMPROMISES
16. NO PECULIARITIES
17. A CONSISTENT PERFORMANCE THAT SETS AN ENTIRELY NEW STANDARD FOR FOUR-VALVE SETS
18. NO REASON AT ALL WHY *YOU* SHOULDN'T GET PERFECT RESULTS

We know that our readers have come to expect a restrained and careful estimate of the merits of each of our new designs, for that is our invariable rule, and so we believe they will realise that we are not seeking for cheap journalistic effect when we say that this receiver is definitely in a class by itself.

Perfect Control

It sets an absolutely new standard of perfect simplicity of handling, achieved without the slightest complication of design, and truly exceptional sensitivity and selectivity. It is exactly as simple to operate as a modern detector and L.F. receiver of the "Star Turn" type (the actual controls are identical), yet it contains a screened-grid H.F. stage giving a really substantial amount of amplification.

Nevertheless, this simplicity of operation is *not* obtained by the use of ganging, with its consequent expense and complication. There is only *one* ordinary condenser-tuned circuit in the set, yet its selectivity is right up to the exacting requirements of modern conditions. It may seem impossible, but wait and see how it is done.

The secret, of course, is to be found in that outstanding "M.W." development, the "Star Turn" circuit. The regular reader will probably be familiar with this remarkable tuning system, which has in sober fact revolutionised our ideas of the selectivity which can be got from relatively simple circuits.

The "Star-Turn" System

MODERN WIRELESS has gained a large body of new readers of late, however, and for their benefit we must explain a little. Well, the essence of the wonderful "Star Turn" system is this: In the ordinary types of single-tuned-circuit receivers you depend entirely for selectivity upon just the tuned secondary circuit.

The aerial is coupled fairly tightly to this in some simple way and functions more or less aperiodically, i.e. it gives little or no help in the direction of selectivity.

In a "Star Turn" circuit the aerial is *tuned*, and this means a big step towards the high selectivity we want nowadays. Further, since it is tuned the incoming signals build up much larger currents in it, and for this reason (and others with which we need not trouble you) it becomes possible to work with much weaker coupling between the aerial and the secondary circuit.

This again gives a great increase in selectivity, and it does it, moreover, without loss of strength. The increase

A Powerful Set with Arm-Chair Control

in efficiency obtained by tuning the aerial circuit is so marked that in spite of this weak coupling the actual volume given by a "Star Turn" set is definitely better than that of one of the older and simpler circuits.

This is one of the most remarkable features of the new system, for it means better range and strength of signals in addition to the amazing selectivity which is its other main characteristic. In this it presents a welcome contrast to other high-selectivity devices, which involve a loss of volume to some extent, however good they may be in other ways.

One Dial—No Ganging!

By now the reader who does not know the "Star Turn" circuit must be wondering how we can possibly justify our claim of ultra-simple operation for the set. It must surely look to him as though we had put an extra tuned circuit of the ordinary type into the receiver, and that it would therefore have two dials to tune.

But look at the photos: only one condenser dial outside, and no gang condenser inside! How is it done? That is just the special virtue of the "Star Turn" system, for the explanation is that the extra circuit is *not* tuned with a condenser at all.

The Selector Coil

You see, a separate aerial circuit does not normally tune very critically even when the adjustment is done with a variable condenser, and by making the adjustment one of inductance instead of capacity it becomes less critical still.

We have taken advantage of this fact in the "Star Turn" circuit. The tuning of the aerial is done with a variable inductance, and since only a comparatively coarse control is needed it takes the form of a tapped coil and a rotary stud switch.

This unit is known as a "Star Turn" Selector coil, and the tapping switch is actually built into it, so that a compact single-hole mounting component results. The unit can be obtained ready-made from the various firms who specialise in coils for "M.W." sets, or if you wish you can make it up for yourself from the description given in the issue of "M.W." for May last.

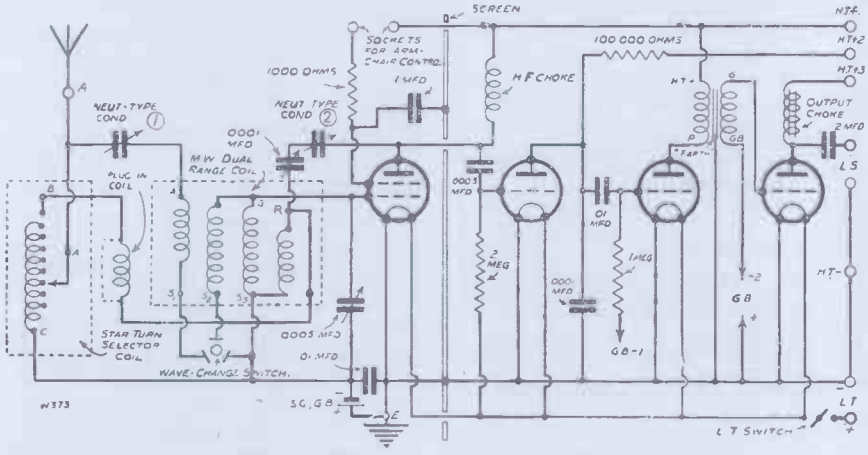
A FULL-SIZE 1/- BLUE-PRINT of this magnificent set is presented free with this issue of "Modern Wireless."

The tapping switch varies the amount of the coil in circuit in steps of four turns at a time, which is found to give an adjustment quite sufficiently close for all normal purposes. The beauty of the "Star Turn" scheme is to be found in this lack of critical tuning in its extra circuit, for it is this which gives it the perfect simplicity of handling which is lacking in all other high-selectivity citrcuits unless they are ganged.

Simple Searching

You see, when you are "searching" you can do it almost entirely on the single condenser dial, and only bring the aerial into tune with the aid of the "Selector" when you have picked up your station. So long as the Selector is anywhere near the right stud you will be able to find your station, and then by setting it correctly you will get the enhanced selectivity and increased volume which naturally follow from the aerial circuit being properly tuned.

FULL OF ENTIRELY NOVEL FEATURES

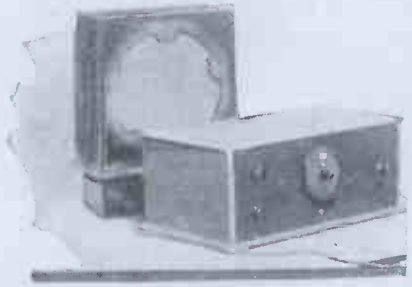


One of the very special features of this magnificent set is its novel and effective arm-chair control. You can adjust the volume smoothly from wherever you are in the room.

The circuit employs an effective combination of the "Star Turn" principle and the new "M.W." dual-range coil.

In this way it achieves a marvellously high degree of selectivity without any of those sacrifices frequently made to obtain it.

Also, the circuit assumes a simplicity out of all proportion to its remarkable advantages and potentialities.

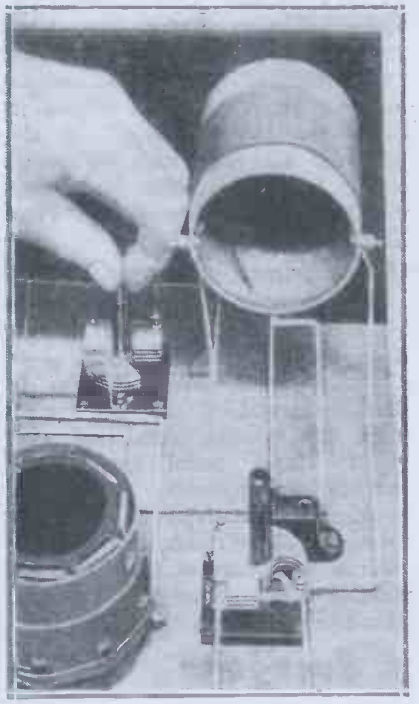


Concerts in Comfort

"M.W.'s" LATEST AND GREATEST RECEIVER DESIGN

Just what this means in delightful ease of handling is a little difficult to realise for anyone who has not actually operated a "Star Turn" set.

PERFECT REACTION



Adjusting the "master" reaction adjustment which ensures that whatever make of S.G. valve you use your reaction adjustment will be properly under control.

Try to imagine, however, a receiver with which you can change from one station to another on just one dial, adding a spot of reaction to find it if the station is a weak one, and then bring your second circuit into tune as a quite separate operation with the "Selector."

When you do this last, of course, volume will come up, and you will generally be able to slack back the reaction again. Isn't that a refreshing change from the ordinary kind of two-circuit receiver, in which *both* circuits must be brought into tune before the station will be heard? (Unless it is an extremely powerful transmission, of course.)

Really "Charming"

That will give you some idea of the charm of a "Star Turn" receiver, but you can only appreciate it to the full by trying such an instrument under actual working conditions. When you do so you will discover that it gives you something really new in radio, however hardened and experienced a constructor you may be.

This really rather wonderful new system of enhancing volume and selectivity, and yet maintaining single-dial simplicity, is an exclusive "M.W." feature, and it is forming a strong part of our programme for the season. It has already made its mark, and it is now pretty evident that it is setting a standard by which discriminating constructors are judging the merits of all sets which claim simplicity of operation as well as range and selectivity.

It has certainly removed once and for all the fears of many people who thought that the coming of "regional" conditions meant the end of the comparatively simple receiver. No longer need it be thought that the only solution of the problem is to be found in elaborate gang-tuned multiple band-pass filters and such-like expensive and awkward devices.

The "M.W." Research Dept. never admits that these complicated and conventional methods are the only solutions of a difficult problem until it has first tried whether it cannot be solved by the application of hard work and original ideas. That has been our rule for years, and it is one of the main reasons why we have achieved a reputation for turning out sets with really worth-while new features without ever losing the essential simplicity and straightforwardness demanded by the practical constructor.

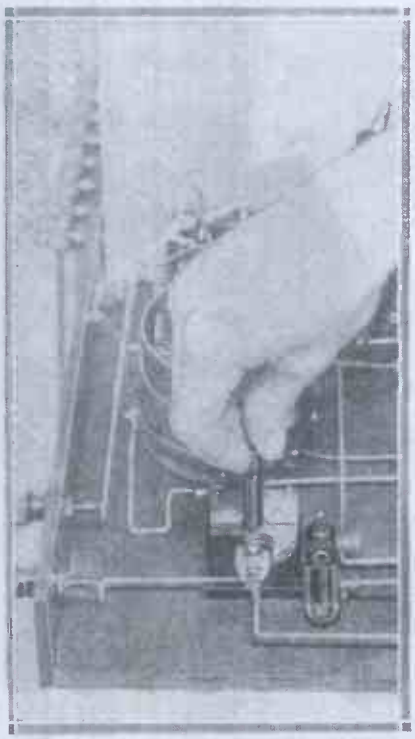
Definitely "Plus"

So far so good, you may say, that is all very well, but we have had "Star Turn" sets before. Wherein does the "Plus-X" Four represent an advance on the previous receivers of the series?

Just here: it is something very much more than an ordinary "Star Turn" set. It is "plus" a lot of things which have never before been combined into one set—hence its rather mystifying name.

The main new feature is that although it has only the normal

NO LIMITATIONS



By setting this "neut."-type variable you can control the aerial coupling so that you completely suit the set to your own local conditions, even if they are most unusual.

THE COMPONENTS YOU WILL REQUIRE

PANEL
18 × 7 in. (Lissen, or Red Seal, Goltone, Paxolin, etc.).

CABINET
18 × 7 in. panel space, with baseboard 10 in. deep (Camco, or Pickett, etc.).

VARIABLE CONDENSERS
One ·0005-mfd. (Lissen, or J.B., Lotus, Ready Radio, Formo, Polar, Dubilier, Igranic, Ormond, etc.).
One ·0001-, ·00013- or ·00015-mfd. plain reaction (Lotus, or Dubilier, Lissen, Keystone, Igranic, Polar, Ormond, J.B., etc.).
Two baseboard-mounting neutralising type (Bulgin, or Magnum, etc.).

SWITCHES
1 L.T. (Lotus, or Igranic, Lissen, Benjamin, Bulgin, Ready Radio, Junit, Goltone, Wearite, Magnum, Red Diamond, etc.).
1 three-point on-off wave-change (Wearite, or Ready Radio, Bulgin, Magnum, Ormond, Red Diamond, etc.).

VALVE HOLDERS
4 sprung-type (Lotus, or Telsen, W.B., Lissen, Igranic, Benjamin, Magnum, Dario, Formo, Wearite, Bulgin, Junit, Burton, etc.).

COILS
1 "Star Turn" selector (Ready Radio, or Wearite, Magnum, Parex, etc.).
1 "M.W." dual-range (Wearite, or Magnum, Ready Radio, Goltone, Keystone, Parex, etc.).

CHOKES
1 H.F. (Varley, or Lewcos, Ready Radio, R.I., Dubilier, Keystone, Lissen, Magnum, Wearite, Lotus, Igranic, etc.).
1 output filter (Ferranti, or Igranic, Lissen, Varley, Wearite, R.I., Magnum, etc.).

L.F. TRANSFORMER
(Telsen, or Lissen, Varley, Ferranti, R.I., Igranic, Mullard, Lewcos, Lotus, etc.).

FIXED CONDENSERS
1 2-mfd. (Dubilier, or Lissen, T.C.C., Igranic, Hydra, Mullard, Ferranti, etc.).
1 1-mfd. (Lissen, etc.).
2 ·01-mfd. (T.C.C., or Ediswan, Lissen, Dubilier, Igranic, etc.).
1 ·0003-mfd. (Mullard, or Lissen, Telsen, Ready Radio, Ediswan, Formo, Ferranti, Dubilier, Igranic, Goltone, etc.).
1 ·0001-mfd. (Lissen, etc.).

RESISTANCES
1 100,000-ohm anode, with holder (Igranic, or Lissen, Dubilier, Varley, Mullard, etc.).
1 1,000-ohm Spaghetti type (Magnum, or Bulgin, etc.).
1 1-meg. and 1 2-meg. grid leak and holder (Lissen and Dubilier, or Igranic, Ediswan, Ferranti, Mullard, etc.).
1 variable resistance for use as distant volume control (Atlas "Rheograd," or similar type—e.g. Rotorohm, etc.). (See text.)

MISCELLANEOUS
1 standard "M.W." screen, 10 × 6 in. (Magnum, or Ready Radio, Parex, Wearite, Keystone, etc.).
1 vernier dial (Igranic, etc.).
10 terminals (Belling & Lee, or Igranic, Eelex, etc.).
2 small sockets (Eelex, or Clix, etc.).
Terminal strip, 18 × 2 in.
Single coil holder.
Wire, screws, flex, G.B. plugs, etc.

Sets an Entirely New Standard in Performance

" Star Turn " controls it incorporates a useful stage of screened-grid H.F. amplification, without an extra dial, and without a gang condenser. And how is it done? Just by using a very valuable but much neglected method of H.F. amplification, which has never been used extensively, simply because by itself it does not give enough selectivity for modern conditions.

A Good Scheme

This is the " aperiodic " system, in which a high-frequency choke forms the coupling between the H.F. valve and the detector which follows, without any tuned circuit. A substantial amount of amplification can be obtained in this way, considerably more, in fact, than is indicated by a simple consideration of the impedance of the choke and the nominal impedance of the valve.

It is true that more amplification still can be got with a really good tuned coupling, but it does not follow that this is necessary in a set as large as a four-valver. So long as the overall magnification of the set is sufficient, on an average aerial, to bring up to satisfactory loudspeaker volume all those stations which are worth listening to, is there any point in providing still more power? It would only mean that the set would require to be constantly volume-controlled to avoid overloading and keep down the general " noise-level " to bearable limits.

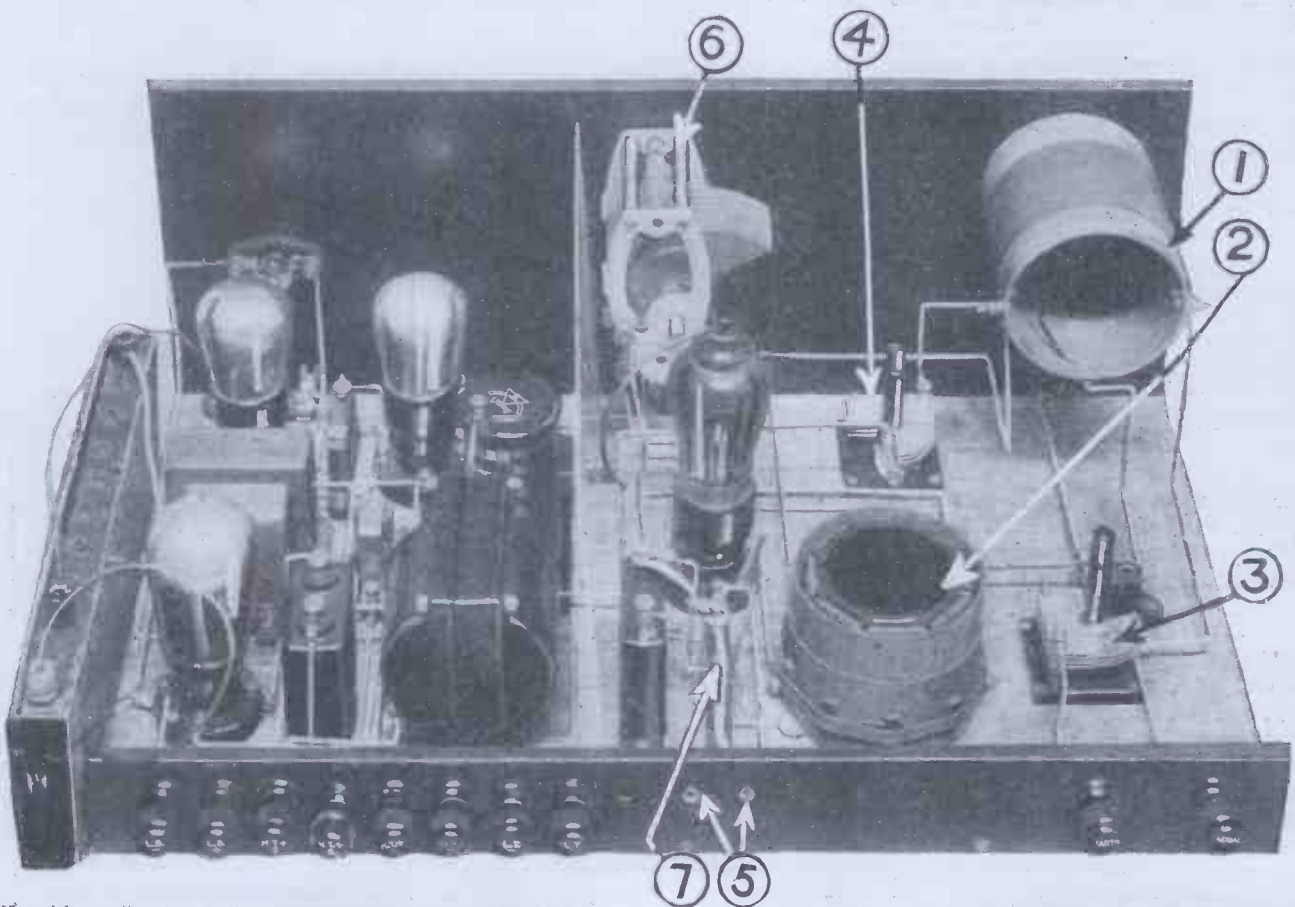
You can build an " M.W." set with confidence. All " M.W." sets are scientifically tested with extreme thoroughness before being passed " O.K." There are many stages in the evolution of an " M.W." receiver between the initial experimental hook-ups and the final finished and perfected model from which the published specification is taken.

The neglect of aperiodic H.F. coupling has been far more a matter of selectivity than amplification, and for that we now have the remedy, as you have seen. Not merely can we get the selectivity we want by " star turning " the circuit, but we also get an increase in volume to offset the lower " mag." of the aperiodic coupling, and the result is the very remarkable instrument which has been christened the " Plus-X " Four.

Fine Features

This, then, is the general idea on which the " Plus-X " is based: Aperiodic H.F. coupling, which gives a really worth-while boost-up to the signals without the need for an extra tuning dial, combined with " Star Turn " aerial tuning and coupling arrangements. These give us the high selectivity called for by present-day conditions, and improve volume still further, yet the set remains much simpler to operate than one of the two-dial type.

Super Results within the Reach of Everyone

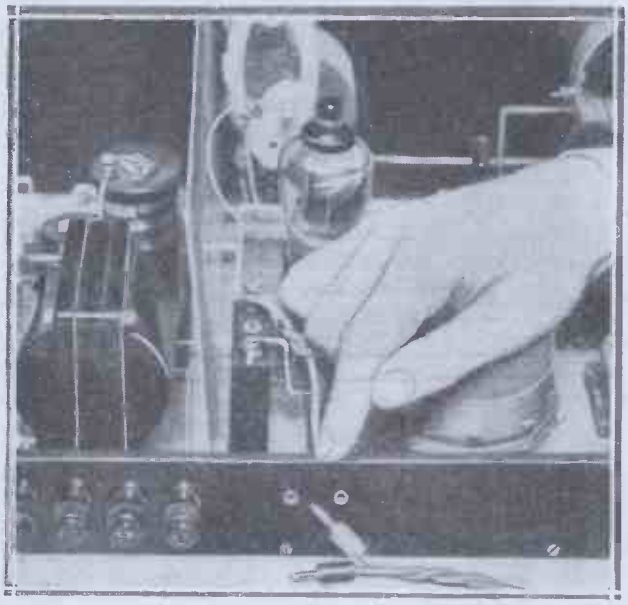


Notwithstanding its really outstanding all-round efficiency (it compares very favourably with many five-valvers), the layout of the " Plus-X " has been so scientifically planned that its construction is no more complicated than that of the average three-valver. (1) is the " M.W." " Star Turn " Selector; (2) " M.W." dual-range coil; (3) coupling adjustment; (4) master reaction control; (5) sockets for arm-chair control; (6) the single tuning condenser, and (7) an H.F. de-coupling resistance.

Now you will probably be getting an idea of our reasons for saying this receiver stands in a class by itself, for you have already learned enough to show you that it represents a real break-away from current methods.

We have not come to the end of its novelties yet, however. There remains a feature to which we attach a great deal of importance, simple as it may be. Simple it certainly is; so much so, in fact, that you may be inclined to wonder why we are making such a fuss about so obvious an idea, until you stop to consider what it means in practice.

THE ARM-CHAIR CONTROL



Indicating the sockets into which the extension leads for the distant volume control are plugged.

Very Valuable Idea

When you do stop and think, though, you will most assuredly join us in believing that it is a really stout notion. And what is it? We will prepare to answer that question by asking another. What is the irritating feature, common to even the finest of sets, which causes the best-tempered operator to get peevish at times? Isn't it the fact that they cannot be controlled from a distance?

Doesn't it constantly happen that you switch on, adjust the volume to suit some orchestral item, and then go and sit down, only to find that a talk follows shortly and is far too loud? That means you have to get up and go over to the set, reduce the volume suitably, and return to your armchair.

When the talk is over you have to pay another visit to the set to bring it to music level again, and a few trips like that every evening must make even the energetic sigh for some sort of distant control.

Smooth Variation

That is just what you get with the "Plus-X" Four. It has a volume control unit of an extremely simple type which you can place anywhere in the room, with just a twin-flex lead connecting it to the receiver.

You can run this flex under the carpet, round skirting boards, and so on, to any desired position in the room, and from there control the volume of the set to a nicety. You can adjust it to any desired level for different items, and if something comes along that you don't want, you can soften it right down until there only just enough left tell you when the item finishes.

This scheme is one which several members of the "M.W." staff have been using for quite a while, and having once tried it they would never be without it any more. The solid satisfaction of sitting in one's armchair and adjusting the volume of a distant set to the exact needs of each part of the programme must be experienced to be believed!

Now it is time we got down to details and told you something about the way these special features of the "Plus-X" are actually arranged. Let us start with the volume control which we have just been discussing in its general aspects.

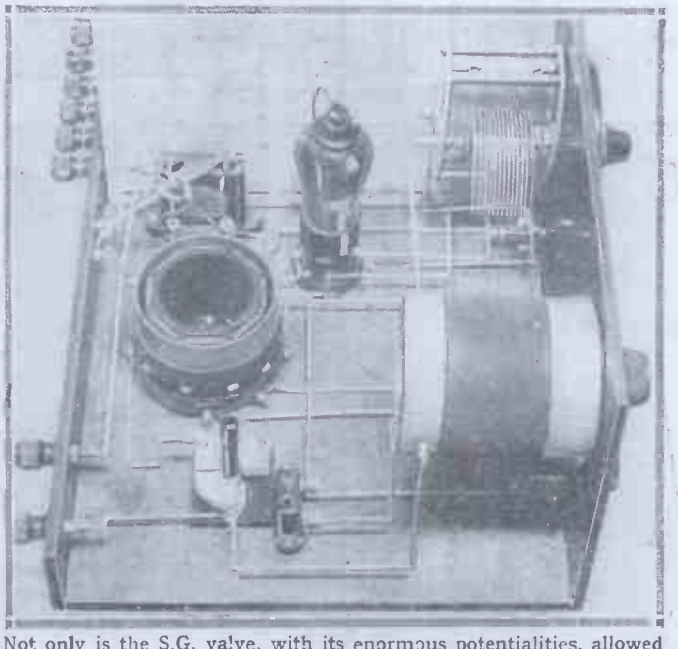
It takes the form of a variable high-resistance of the compression type and operates as a control of the voltage on the screening electrode of the S.G. valve. This is normally set for the best volume on a weak station, of course, but by adjusting it to give suitably lowered voltages you can vary the volume as desired.

Searching for Foreigners

In practice the resistance can be of such a type as the Atlas "Rheograd" (universal model), and it should be mounted in the lid of a small wooden box. It will then form a neat little unit which can be tucked away in some convenient but inconspicuous position.

In use, it should be noted, there is a slight time-lag in the operation of a volume control of this type, so it should always be manipulated rather slowly. Another point: when you are about to search for foreign stations you should first turn up the volume to maximum before you go over to the set.

WHY USE MORE VALVES?

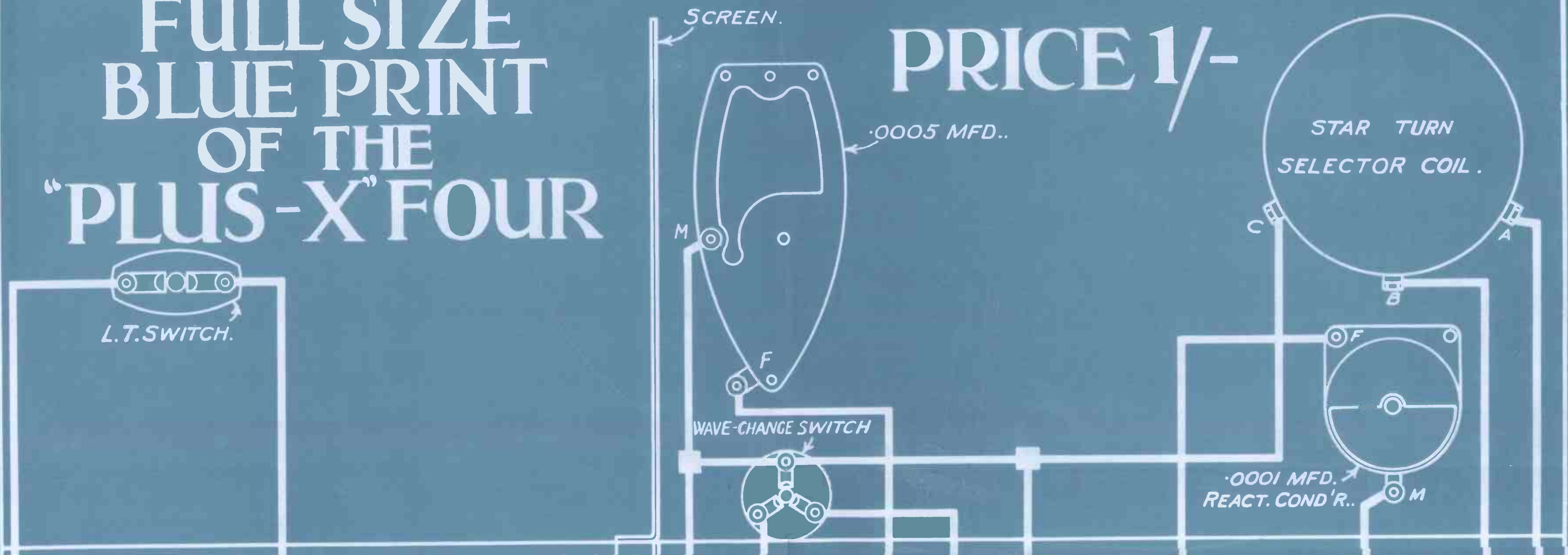


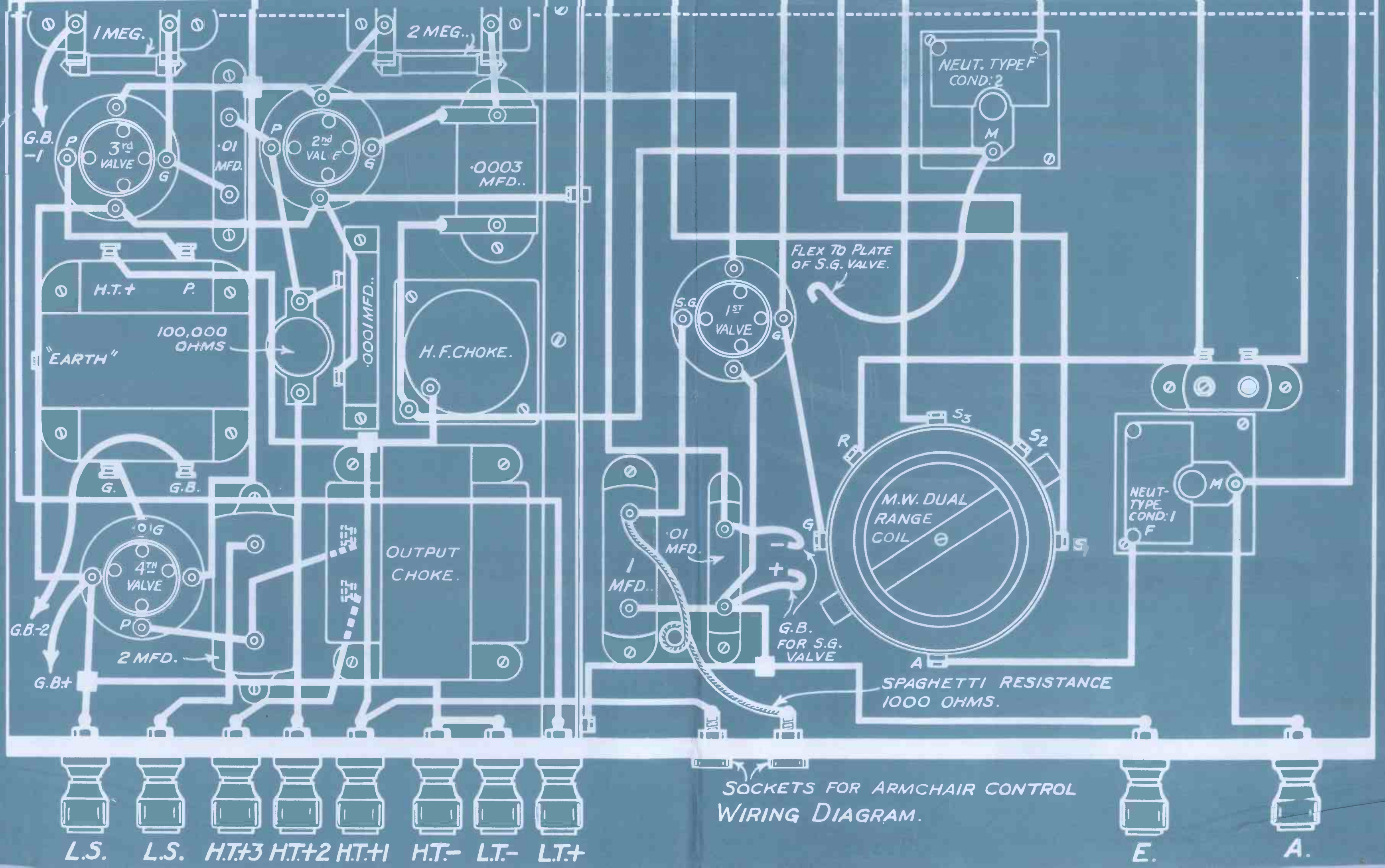
Not only is the S.G. valve, with its enormous potentialities, allowed to contribute a full measure of its amplifying properties, but an incidental advantage of using the "Star Turn" principle to get knife-edge selectivity is that the energy in the aerial circuit is built up to unusually high dimensions.

If your local station is fairly near-by this might mean that everything would overload and produce a tremendous volume of distorted noise, unless steps are taken to prevent it. The remedy is fortunately very simple.

FULL SIZE BLUE PRINT OF THE "PLUS-X" FOUR

PRICE 1/-





SOCKETS FOR ARMCHAIR CONTROL

WIRING DIAGRAM.

From Oslo to Rome in a Flash

In the set there is a neutrodyne-type condenser which adjusts the degree of coupling between the aerial circuit and the H.F. tuned grid circuit. If this is set to a very small value it will be found that the volume is cut down heavily, and this should be used as a supplementary control under the conditions we have mentioned.

Ever So Easy

When working on the local transmissions it should be set so that when the distant control is adjusted for maximum volume the strength comes just up to the highest level the power valve can handle without overloading.

Then when you want to search for other stations you just set the distant control for maximum volume and then proceed to the set. The first step on arriving there, of course, is to detune and then to increase the capacity of the "neut." coupling condenser to the normal value found by previous experience, and then you search as usual.

While we are referring to this coupling question we may perhaps as well cover it completely. Reference to the circuit diagram will show you that it is connected so that it forms a small capacity "feed" between the tuned aerial circuit and the tuned grid circuit.

Selectivity and Sensitivity

Variations of its capacity will thus naturally give you a control of coupling and hence of selectivity. Under most conditions adequate selectivity will be obtained at maximum (moving vanes fully engaged with fixed).

Where exceptionally severe local interference is experienced, however, the necessary higher degree of selectivity can be obtained by a suitable reduction in the coupling capacity. Probably about half-way from maximum to minimum, or a little farther, will be sufficient.

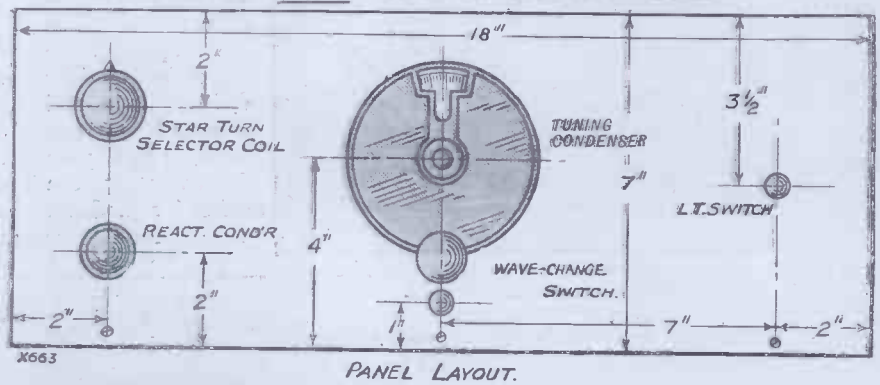
To identify this coupling condenser, by the way, refer to the third page of this article. There you will see a photograph at the bottom right-hand corner showing the adjustment being made.

There is another "neutrodyne" type of condenser in the set, and this is seen in the other photo on the page to which we have just referred. The function of this component is to adjust the reaction circuit to the characteristics of the particular screened-grid valve employed.

Controlling Reaction

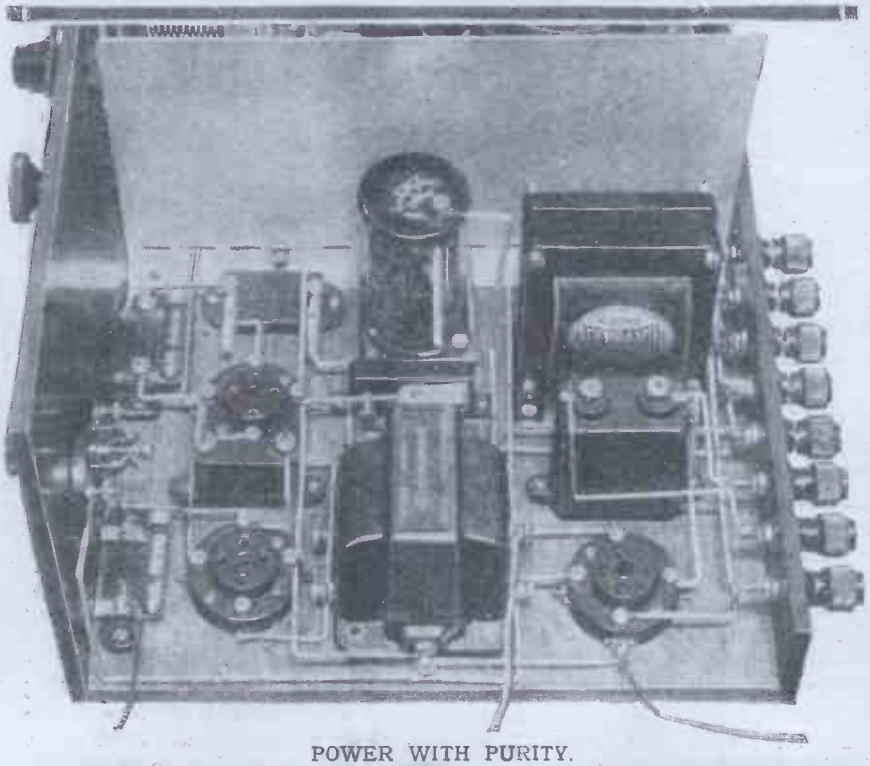
You see, reaction is obtained from the anode circuit of the S.G., and these valves differ considerably in their behaviour in this respect. Accordingly the second "neut." is placed in series in the reaction circuit, and when the set is first put into operation it is adjusted to bring the control properly on to the scale of the reaction condenser on the panel.

ONLY ONE TUNING CONDENSER



PANEL LAYOUT.

The only tuning condenser figuring in this fine four-valver is of the ordinary simple type—a fact of such vital significance that it deserves particular stress.



POWER WITH PURITY.

A carefully balanced L.F. end enables every available "ounce of power" to be developed without sacrificing that high standard of quality aimed at in all "M.W." sets.

No "Breaking Through"

The general theoretical arrangement of the receiver we think you will be able to follow out quite easily from the circuit diagram on these pages, noting the "Star Turn" aerial tuning and coupling arrangements and the aperiodic H.F. intervalve circuit.

Observe, too, that the "Star Turn" system is only used on the medium wave-band; on long waves we do not require it.

All you want there is normal good general selectivity, and some device to prevent the local (low-wave) station from "breaking through" if it is only a few miles away.

A Scientifically Unified Tuning System

We usually do this by means of "Interwave" aerial coupling on long waves, but we found another method suited the special needs of this rather unusual circuit somewhat better.

You will see this special device in the circuit diagram in the form of something marked "Plug-in coil." The socket for this is placed beside the first "neut."-type condenser, and it is so wired that it comes in series in the aerial circuit on long waves.

The Interference-Stopper

If you are so located as to get trouble from your local on long waves, keep in this socket a coil of size 50, 75 or 100, the actual size being that which is just large enough to stop the trouble. Incidentally, it is worth trying this scheme in other situations as well, because it usually produces a slight increase in the volume of the long-wave stations, and this may be helpful where only a poor aerial is available.

In places where this interference-stopper is not needed, just put a shorting plug in the coil socket in question or join its terminals together with a bit of wire. (The device will not be required in most situations.)

The rest of the circuit explains itself, we think. You will see that the detector is of the usual leaky-grid condenser form, followed by a low-frequency side of modern high-quality type with an output filter for the loud speaker.

Wonderfully Easy to Build

Turning to the constructional side, the first thing you will discover on inspecting the blue print is that it is amazingly simple for so large a receiver. So far as actual instructions are concerned, it seems only necessary for us to deal with certain matters of detail, for all general questions of assembly and wiring are made amply clear by the blue print and the photos and diagrams on these pages.

First, just a hint that it is as well to place your dual-range coil unit so that its terminals correspond roughly to those on the blue print; this makes for good and easy wiring.

Note, too, that some makes of "Selector" coils may have their terminals placed slightly differently. Wire up, therefore, by the *marking* of these rather than by their positions.

In fixing your screen in place be careful that it does not make contact with any point on the tuning condenser. Allow just a little clear space between them.

In the wiring operation the main points are to see that the leads constituting the reaction circuit are spaced out a little from all others, to remember to use insulated wire for all leads passing through the screen, and

G.B. FOR THE S.G.

One of the methods adopted for the reduction of running costs, and the increasing of efficiency, is in the provision of properly placed grid bias for the S.G. valve. The hand is pointing to the leads that go to the little bias battery, for which space is allowed on the baseboard.

to note very carefully any connections to the metal of the screen itself. All the rest of the work you will find quite obvious and straightforward.

The Valves You Want

The working data for the finished receiver are as follow: A screened-grid valve in the first socket, one of the H.F. or "special detector" type in the second (detector), an L.F. in the third, and a power or super-power in the fourth.

Grid bias on the L.F. valves will be according to the maker's instructions, and that on the H.F. valve will be provided by a single dry cell (the 1½-volt type will serve, but the special ·9-volt variety is to be preferred).

The H.T. voltages are very simple: 120 to 150 volts on both H.T.+ 1 and H.T.+ 3 (only separated in case mains H.T. units are used by some readers), and about 80 or 90 volts on H.T.+ 2.

Using the Switches

The general procedure in operating the set you will already have grasped, and it just remains to explain the wave-change switching. For long waves push the knob of the wave-change switch inwards, turn the "Selector" coil knob right round as far as it will go to the right and leave it there.

For the medium wave-band, pull wave-change switch knob outwards, and place "Selector" knob for best volume. Reaction, of course, is used when required, and will be found to give an excellent build-up on the weaker stations without working on the edge of oscillation.

We have reached the end of the operating matters, but we see we have still got nearly half a column left, so we shall be able to deal with a certain little matter concerning volume control which we feared we should have to omit.

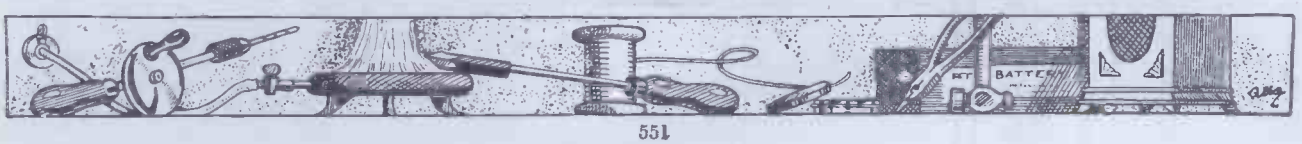
As we have described the outfit it consists of a receiver in one position and a volume control somewhere else.

Moving the Volume Control

We have suggested a scheme which enables you to turn up the volume to maximum before you go over to the set to search for foreign stations. This method will be found adequate in practically all cases, but it is conceivable that in some circumstances you may want to adjust the volume control while operating the receiver.

It is easy enough to arrange for this. Instead of taking the extension straight to the volume control, let it terminate in a small block of ebonite with two sockets like those on the terminal strip of the set.

Furnish your volume control with a yard or so of flex ending in plugs to fit the sockets. Then you can plug into the set itself or into the sockets at the distant point.



Sir Henry Wood says:—

A Tonic Talk with the Famous Conductor of "The Proms" and "Symphony" Concerts.

By CLIFFORD B. REES.

Editorial Note:— Readers of "Modern Wireless" will learn with great interest that this is the first exclusive and authoritative interview given by Sir Henry Wood on matters affecting Wireless and Music.

So much is being said and written in praise and in condemnation of broadcasting, especially of its effect on our musical culture, that the editor of MODERN WIRELESS suggested that it would be a service to music, to wireless and to music-lovers generally to seek out the views of the man who has done more than any other in our time to mould and raise the musical tastes of the masses.

Accordingly, I asked Sir Henry Wood to spare me a little of his time—time which is as essential to his extraordinary day as it is to his conducting—to discuss the new phenomenon of an unseen audience of millions to his concerts where before the capacity of Queen's Hall was the determining factor in the number of his listeners.

Passive, Inert Listeners

He had just finished his morning's rehearsal when I met him, and fresh, indefatigable and disarmingly genial he took me into his room and talked to me as if he had no other work to do than give interviews to persistent journalists.

"Do you think, Sir Henry," I asked him, "that wireless is likely to produce a race of passive, inert, indiscriminating listeners, people who prefer to listen to performances rather than perform for themselves?"

"Bellowing" Conductors

"Every new invention," he answered, swiftly and pointedly, "has been condemned at one time or another—machinery, cotton, scientific instruments. Broadcasting is no exception. No, it is not reducing the standard of musical culture; it is, on the contrary, raising it.

"Take the *vibrato* singer. No teacher in the world, no school of music is really tackling this evil at the source. They let it grow, and then it is too late to do anything about it. *Vibrato* should be nipped in the bud. Wireless is helping more than anything else to do that. Remember, a *vibrato* on the loud speaker sounds much worse than in the concert hall.

"The standard of singing is, consequently, improving. There is an all-round raising of the efficiency of artistes. It affects even conducting."

Sir Henry smiled.

I nearly asked him if he thought his art wanted improving, but before I could descend into facetiousness, he went on:

"You do not hear the bellowing conductor to-day. You do not get conductors who tap the desk with their baton, or conductors who stamp their feet. These noises would be transmitted, and that would never do! Even the standard of conducting is improved by broadcasting."

"What about the effect on the amateur?" I asked. "Some are saying that the B.B.C. is killing the amateur."

"I love the amateur," was the immediate reply. "Without the amateur there would be no professionals, and I have always had the warmest admiration for what the amateur is doing."

Two Kinds of Amateurs!

"You yourself," I interposed, "have done a good deal for the amateur."

But the great conductor waved that aside. Sir Henry is too busy, too

"Wireless is Raising our Musical Standard"

full of his work to turn aside to receive bouquets.

"What is happening," he continued, "is that the bad amateur, the inefficient amateur, the amateur who doesn't care, who is slip-shod, who ought not to be making music at all, is being eliminated. The B.B.C. is having the effect of reducing sheer inefficiency. That is for the general good of music. But the good amateur, the amateur with enterprise, who cares for music—broadcasting helps him."

Only the Beginning—

Sir Henry intimated that we were only at the beginning of wireless developments, and that just as a one-time anathematised means of locomotion had become the veriest convention of transport, so the critics of broadcasting were really only keeping up the tradition of temporary hostility which assails all new media, men and works.

Private Enterprise Beaten

"But for wireless," Sir Henry reminded me, "there would have been no performance of the gigantic Eighth Symphony of Mahler, of Schonberg's 'Gurrelieder'—works which were costly to produce, demanded large orchestral and choral forces and more rehearsal than private enterprise could afford."

To the left is **ARTHUR BLISS** in thoughtful mood.

CONSTANT LAMBERT.

Sir Henry Wood pays magnificent tributes to the galaxy of living British composers, some of whom are depicted on this page.

The portrait at the top is of **DAME ETHEL SMYTH**.

In circle : **G. HOLST**. Above : **ARNOLD BAX.**

"The Standard of Conducting is Improved by Broadcasting"

"What effect do you think wireless is having on the standard of the Promenade audience?"

"A very good one. There is a readiness to listen to new works, which is a healthy sign. We cannot afford to stagnate in art. We must hear the modern works. I like them myself, and the public likes them.

"These new compositions, some of which are exceedingly interesting, help us to appreciate the classics. There must be progress, development, experiment. We must hear the new men, the young men who are experimenting in a new idiom. It is the same in painting, literature, sculpture. Wagner did good on top of Beethoven, and Brahms on top of Wagner, and even out of the conflict between the schools of Wagner and Brahms progress came.

British Music

And how good it was to hear from this man whose whole life is a concentrated devotion to the best in music, a fine, spontaneous tribute to British music and musicians.

"Look at our British nights at the Proms," he said with unmistakable enthusiasm. "What other country could provide such programmes of their contemporary music as we do of ours? There is no other country. When I have played the noble Cesar Franck Symphony, and one or two other smaller works by Debussy, Ravel, Saint-Saëns and Berlioz, there is not much left in France.

Strong Array of Genius

"In modern Germany they have the great Richard Strauss, but no young composers of the first rank, and in Italy only Resphigi. But if you turn to the living composers of Great Britain, we have indeed a strong array of genius and talent. Elgar with his two great symphonies, Vaughan Williams with two magnificent symphonies, Bax with three, and Holst and Bliss, and the younger men like William Walton and Constant Lambert."

"The B.B.C. is having the effect of reducing sheer inefficiency. That is for the general good of music," says Sir Henry Wood.

"Are the British nights successful?" I queried.

"Very much so. The people are getting to like the music of their own composers. There is the keenest enthusiasm and, remember, it is not confined to the Hall. Listeners-in all over the country are hearing these works and are getting to like them. Another instance of the way in which wireless is educating the masses to appreciate our own home-made music."

I asked Sir Henry why there was only one Mozart symphony in the Promenade programmes this year.

"There has been a good deal of criticism about this omission," he answered, "but the reason is simply that this new orchestra does not know Mozart well enough yet. You cannot play Mozart without perfection, so rather than give inadequate performances I decided not to put in any symphony except the 'Haffner.'"

New Orchestra's Enthusiasm

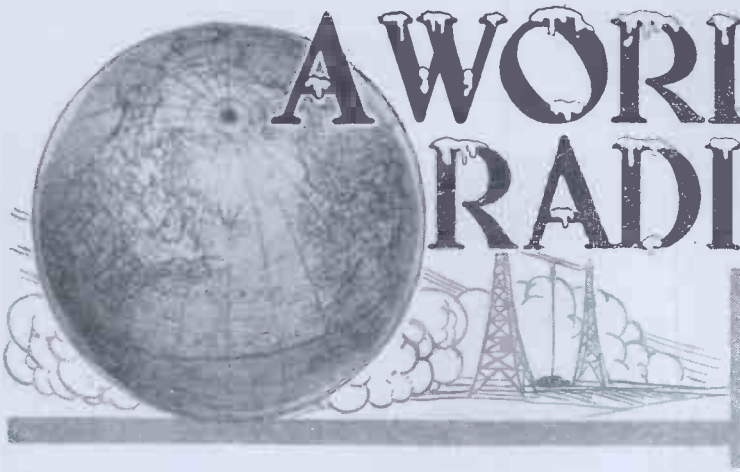
This reference led him to a warm tribute to the orchestra.

"The band took forty-two parts of Strauss's 'Ein Heldenleben' out for private practice on the afternoon before the performance. That's excellent!" he added.

He told me, too, that he thought Cyril Smith's playing in the Brahms Piano Concerto, a most difficult work, was as good as any performance he had heard by some of the great pianists, and he told the young pianist so. He praised the "wonderful music staff of the B.B.C." and the work of the new music director, Dr. Adrian Boult.

And as I came away from this exhilarating experience with a man whose art is his life and whose life is his art, I thought how far removed from the alleged pettinesses of musicians was the spirit of Sir Henry Wood.

OLD FAVOURITES—"THE WIRELESS ORCHESTRA, Conducted by JOHN ANSELL"



A WORLD-WIDE RADIO XMAS

In this section of "M.W." will be found news of interest to all long-distance listeners, with helpful hints on reception, and kindred topics connected with

THE WORLD'S PROGRAMMES.

THAT YULE LOG!

THERE is a wonderful charm about this Christmas fire business, isn't there? The glowing, red coals; the nip out of doors and the warmth within; the sparkle and the crackle.

Radio, with its cheery greetings and cosmopolitan way, fits snugly

The tropics—where the weather is beautiful, but "X's" are simply awful!

into the picture and does its part towards the yearly house-warming of the world. *But what does that warming do to radio?*

It must be confessed that too much warmth is undesirable. At least, it is bad for radio batteries. And the wise set owner who wants to make the most of his radio Christmas will see that neither his set nor his batteries get too warm.

A sure way of shortening the life of the ordinary H.T. battery is to store it in a chimney cupboard, over hot-water pipes, or some similar warm situation. And even an L.T. battery resents this kind of treatment.

Every home can be linked with other lands by an aerial.

In most cases evaporation is unduly hastened. And although the L.T. battery may be topped-up with clean water, and apparently suffer no damage, the makers nearly always recommend that it should be kept in a *cool* situation.

The H.T. battery suffers more severely from evaporation, for if the paste inside the battery dries there is no means of replenishing the moisture, and the life of the battery is shortened. So, however much you yourself may appreciate a good fire, remember that the radio battery's right motto is—"Keep cool."

BORN ON CHRISTMAS DAY!

If all goes well Europe is to have a station born on Christmas Day. For December 25th is the provisional date fixed for the appearance of Warsaw's new station, on 1,411 metres. Erected for the Polish government, this station will be the most powerful in Europe, using an aerial power of 160 kilowatts. Listen for the big "Little Stranger" on Xmas Day.

CHRISTMAS DAY IN THE ETHER

WE listeners are sometimes apt to forget that our programmes are only one side of the activities of the ether. Long after we have all switched off for the night and gone to bed, and long before the earliest broadcasting programme begins, the wireless work of the world goes on, on all the wavelength bands.

On Every Band

On the very low waves there are the short- and the long-distance telegraphic links, the beam services that bind the Empire from main to main. And a whole network of other services operating from stations on land, on the sea, or in the air.

Near the broadcasting wave-lengths are the bands allotted to the never-silent shipping, to the radio "lighthouses" and beacons associated with it. Also the air services, with telegraphy and telephony, direction finding, and what not, on wave-lengths round about 900 metres. And on the high wave-lengths lie the world's high-power stations—naval, military, and commercial—interlinking every point of the earth's surface.

Broadcasting is quite a recent development, and at first wireless was valued for its use at sea.

Multifarious and multitudinous as all these services are, Christmas Day affects nearly every one of them. From ships sweltering in tropical waters come cheery Christmas greetings to home.

All the World Over

The North-West Mounted Police outposts on the shores of Hudson Bay feel the touch of festivity when they tune in a cheery Canadian radio programme.

The lonely settler of the backwoods, or wireless telegraphist in the island outpost, the radio man on the small ship of the iceberg patrol, the naval telegraphist in the Red Sea—each one of them in his own sphere notices the Christmas touch in the ether.

If you live near the coast use stranded enamelled wire for your aerial—it withstands the atmospheric conditions better than bare wire.

HOW THEY SAY IT

Some Pronunciation Puzzlers!

This identifying of stations would be very much easier if only the foreign announcer pronounced the name of his station like we spell it. But he does not!

* * *

Vienna, for instance, calls itself "Veen," and just to make it as difficult as possible they spell it Wien.

* * *

Belgrade is another one. They put in an O, knock the L and the final E out, and spell it as "Beograd." But they pronounce it Baograd, as though it were a combination of Bay-o'-Biscay and Petrograd!

* * *

D'y'know a Genoa call-sign when you hear it? They put in a V and pronounce it in that mellifluent Italian manner, "Genova."

* * *

Prague is another one. The announcer there calls it "Pra-ha."

* * *

Another queer one is Berne, the Swiss station. The announcer there calls it "Bairn," as if it were a wee Scot!

GETTING BETTER SELECTIVITY

There are several ways of doing it; the simplest and sometimes the best method being to decrease the length of your aerial. But do not cut a big lump off or you may go too far and regret it.

* * *

Rig up a temporary aerial instead, of 24 D.C.C. wire, find out what length you need to give you the required selectivity, and cut your main aerial accordingly.

Another simple method is the small series condenser. But it must be small (·0001 or so), or there will be no improvement.

* * *

Sometimes even a neutralising condenser will do. The smaller the condenser the sharper the effect it gives.

* * *

If your set uses a separate aerial coil, a smaller one will often sharpen selectivity. If it does not use a separate aerial coil, you can provide it with one by winding 15, 20 or 25 turns of insulated wire round your grid coil.

Tuning is easy with a "drum-drive" condenser. And another invaluable aid is a chart, as described in last month's "M.W."

One end of this added coil goes to earth and the other to the aerial lead, which is removed for the purpose from its usual terminal.

* * *

Yet another method is to add a tuned aerial circuit, consisting of a coil with tuning condenser across it. One end of this combination is joined to the earth terminal, the other end takes the aerial lead, and the aerial terminal on your set goes via a neutralising condenser to the non-earthed side of the new tuned circuit.

The extra circuit will need tuning and the strength of the input to the set can be adjusted by varying the neutralising condenser.

* * *

Usually an "X" coil is much more selective than a centre-tapped coil, but if it is not selective enough make sure that the coil-holder connections do not need reversal. (It is easy to connect an "X" coil the wrong way, which will spoil selectivity.)

INDIA CALLING!

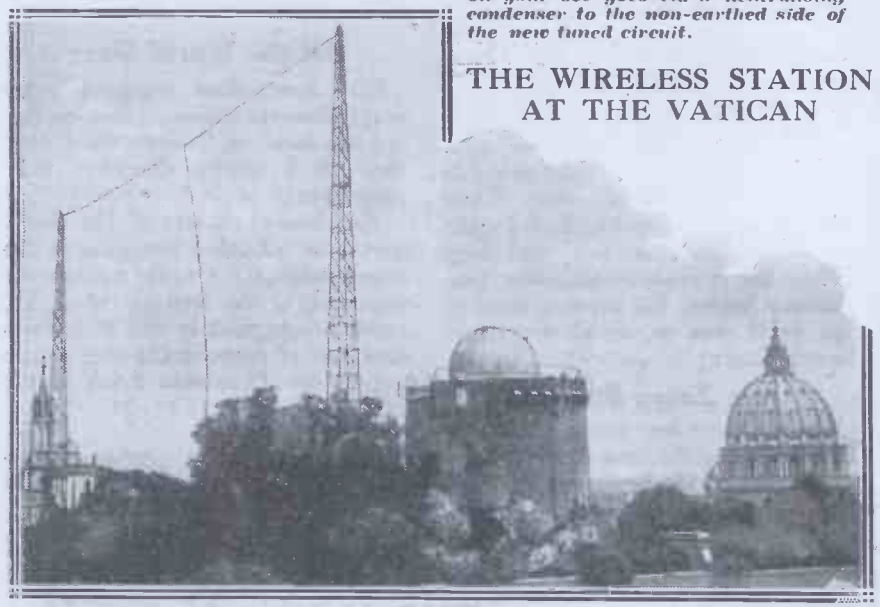
India now has two short-wave stations, in addition to those on ordinary wave-lengths. The latter are:

Calcutta: 320·4 metres. Call V U C. Hours, 8.30-9.15 a.m.: 1.15-3.45 p.m., and 5-10 p.m. (Indian Time.)

Bombay: 357·1 metres. Call V U B. Hours: 8-8.30 a.m.; 12-1.30 p.m., and 7-11 p.m.

The new short-wavers are:
Bombay, 49·1 metres, power 1 kw.
Calcutta is testing on 25·27 metres.

THE WIRELESS STATION AT THE VATICAN



This is the new wireless station erected under the direct supervision of Marchese Marconi in the Vatican. By means of it the voice of the Pope can be sent on short waves to every continent.

STATIONS ABOVE 600 METRES

Wave-length Metres.	Name of Station.
1961	Ankara (Turkey).
1935	Kaunas (Lithuania).
1875	Huizen (Holland), 8·5 kw.
1796	Lahti (Finland), 54 kw.
1725	Radio Paris, 17 kw.
1635	Konigswusterhausen (Germany), 35 kw.
1554	Daventry National, 35 kw.
1481	Moscow (Old Komintern).
1445·7	Eiffel Tower (FL), France, 15 kw.
1411	Warsaw (Poland), 14 kw.
1350	Kasbah (Tunis).
1348	Motala (Sweden), 40 kw.
1304	Moscow (Trades Unions).
1200	Kharkov (Russia). Istanbul (or Stamboul) (Turkey). Boden (Sweden), 0·75 kw.
1153	Kalundborg (Denmark), 10 kw.
1116	Novosibirsk (Russia).
1103	Moscow, Popoff (Russia).
1073	Rostov-Don (Russia).
1071	Oslo (Norway), 75 kw.
1000	Leningrad (Russia).
937·5	Kharkov (Russia).
870	Tiflis (Russia).
840	Nijni Novgorod (Russia).
800	Kiev (Russia).
778	Petrozavodsk (Russia).
770	Östersund (Sweden), 0·75 kw.
760	Geneva (Switzerland), 1·5 kw.
720	Moscow (Experimental).
700	Minsk (Russia).
680	Lausanne (Switzerland), HB 3.

Round the Short-Wave Stations

The aerial of Wellington, N.Z.

A scene inside the Toronto station.

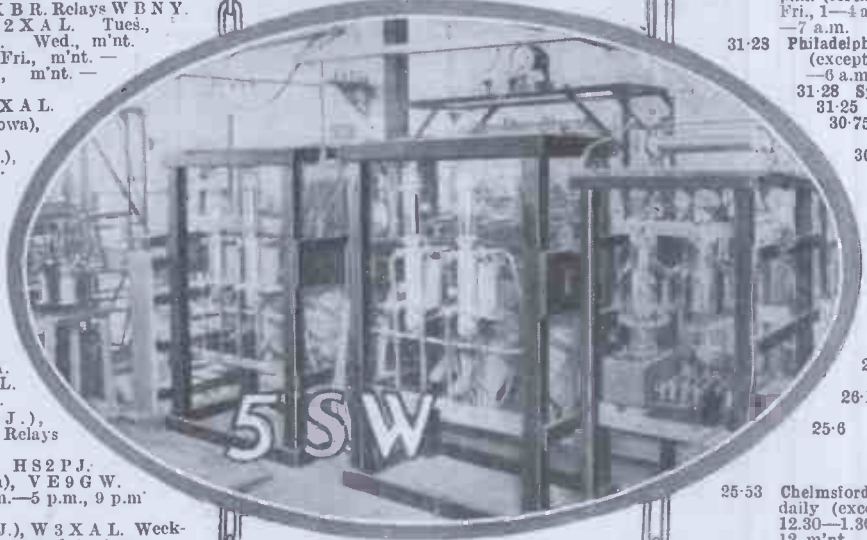
Wave-length (metres)	Name of Station
80	Rome (Italy), 3 R O.
80	Constantine (Algeria), 8 K R, Mon. and Fri.
70·1	Khabarovsk (U.S.S.R.), 9 a.m. to 12 noon.
61	Radio L L (France).
58	Prague, Tues. and Fri., 7.30—9.30 p.m.
54·02	New York City, W 2 X B H.
52	Bergedorf (Germany), A F L.
50	Moscow, Tues., Thurs. and Sat., 12 noon —1 p.m.
50	Barcelona. E A J 25. Sat., 8—9 p.m. News and gram. rec.
49·83	Chicago (Ill.), W 9 X F. Relays W E N R. Sun., 2—6.30 p.m.; 9.30 p.m.—12 m'nt. 2—7 a.m. Weekdays, 4—5.45 p.m.; 9.30 p.m.—1 a.m., and (ex. Sat.) 2.30—7 a.m.
49·83	New York, W 2 X B R. Relays W B N Y.
49·67	New York, W 2 X A L. Tues., m'nt. — 5 a.m. Wed., m'nt. — 2 a.m.. Fri., m'nt. — 4 a.m. Sat., m'nt. — 3 a.m.
49·5	Cincinnati, W 8 X A L.
49·5	Council Bluffs (Iowa), W 9 X U.
49·5	Philadelphia (Pa.), W 3 X A U. Relays W C A U. Daily 2—9 p.m. Thurs., and Fri., 2 p.m.—6 a.m.
49·4	Vienna, Tues., 10 a.m.—12 noon. Thurs. 2—3 p.m. Sat., 10 p.m. —m'nt.
49·34	Chicago, W 9 X A A. Relays W C F L. Daily 2—5 a.m.
49·34	Newark (N.J.), W 2 X C X. Relays W S O R.
49·3	Bangkok (Siam), H S 2 P J.
49·22	Toronto (Canada), V E 9 G W. Daily 11.45 a.m.—5 p.m., 9 p.m' —5 a.m.
49·18	Bound Brook (N.J.), W 3 X A L. Weekdays, 10—11 p.m. and 4—6 a.m.
49·02	Richmond Hill (N.Y.), W 2 X E. Relays W A B C, 1 p.m.—5 a.m. next day.

Kenya Colony

49	Nairobi (Kenya), 7 L O. Daily, 4—7 p.m. Relays G 5 S W occasionally, 7—8 p.m.
48·86	Pittsburgh East, W 8 X K. Relays K D K A. Wed. and Sat., 10 p.m.—5 a.m.
48·8	Manila (Philippine Islands), K Z R M. Daily (except Mon.), 8 a.m.—3 p.m.
48·62	Tegucigalpa (Honduras), H R B. Daily (except Mon.), 1.30—5 a.m.
48·35	Bogota (Colombia), H K C. Daily, 3 p.m.
47	Funchal (Madeira), C T 3 A G. Thurs. and Sat., 10 p.m.—1 a.m.
44	San Lazaro (Mexico), X D A.

Wave-length (metres)	Name of Station
42·86	Georgetown (British Guiana), V R Y. Sun., 10.45 p.m.—2.15 a.m. Thurs., 12.15 a.m.—2.15 a.m.
43	Madrid, E A R 110. Tues. and Sat., 10.30 p.m.—m'nt.
41·7	Canary Islands. Testing nightly at 10.30 p.m.
41	Radio Vitus. Testing.
40·2	Lyons (Rhone), Y R. Daily (except Sun.), 4.30—5.30 p.m.
39·7	Bogota (Colombia), H K F.
37·02	Bangkok (Siam), H S 4 P J. Tues., 1—4 p.m., and 7—9 p.m. Fri., 1—4 p.m.
34·68	Long Island (N.Y.), W 2 X V. Experimental. Fri., 11 p.m.—1.30 a.m.

EMPIRE LINKS



Gt. Britain is linked with the Empire by the Chelmsford short-wave station, 5 S W. The service is at present experimental, but in all probability a powerful and permanent station will be erected shortly.

Wave-length (metres)	Name of Station
32·5	Paris (Eiffel Tower), F L. Time signal 8.56 a.m. and 8.56 p.m.
32	Berne (Switzerland), E H 90 C.
32	San Lazaro (Mexico), X D A, 9 p.m.
31·51	Lyngby (Denmark), O X Y. Relays Copenhagen. Daily from 7 p.m.
31·48	Schenectady (N.Y.), W 2 X A F. Relays W G Y. Daily from 10.30 p.m. to 4 a.m.
31·33	Zeesen (Germany). Relays Konigswusterhausen, generally 1 p.m.—12.30 a.m.
31·35	Springfield (Mass.), W 1 X A Z. 8—10 p.m.
31·4	Manila, K A 1 X R. Relays K Z R M.
31·28	Eindhoven (Holland), P C J. Wed., 5—9 p.m. Thurs., 7—9 p.m., 11—12 p.m. (fortnightly). 12 m'nt.—1 a.m. Fri., 1—4 a.m., 7—9 p.m. Sat., 1 a.m. —7 a.m.
31·28	Philadelphia (Pa.), W 3 X A U. Daily (except Thurs. and Fri.), 9 p.m. —6 a.m.
31·28	Sydney, V K 2 M E.
31·25	Bergen, L G N.
30·75	Agen, Tues. and Fri., 9 —10.15 p.m.
30·88	Heredia (Costa Rica), N R H. Daily 10—11 p.m. and 2—3 a.m.
30·5	Poznan (Poland). Tues., 6.45—9.45 p.m. Thurs., 6.30 —1 a.m.
30	Belgrade. Mon. only, 8—9 p.m.
29·5	Bangkok (Siam), H S 2 P J. Mon., Wed. and Sat., 1 —4 a.m.
28·98	Buenos Aires, L S X. (Testing.)
26·1	Manila, K 1 X R. Relays K Z R M.
25·6	Winnipeg (Canada), C J R X. Daily (except Sun.) from 11.30 p.m. —1.30 a.m.
25·53	Chelmsford, G 5 S W. Relays 5 X X daily (except Sat. and Sun.) from 12.30—1.30 p.m., and from 7 p.m.—12 m'nt. Except News Bulletin.

Favourite Americans

25·25	Pittsburgh East, W 8 X K. 5 p.m.—3 a.m.
24·5	Manila (Philippine Islands), K 1 X R. Relays K Z R M. Weekdays, 10 a.m. —2 p.m.
21·3	San Lazaro (Mexico). Daily at 4 p.m.
21	Radio Maroc.
19·72	Pittsburgh East, W 8 X K. Relays K D K A, Wed. and Sat., 1—5 p.m.
19·56	Schenectady, W 2 X A D. Daily 6—8 p.m. (ex. Sat.),
16·8	Bandoeng (Java), P L F.
16·3	Kootwyk (Holland), P C K. From 7 a.m.
15·94	Bandoeng, P L E. Tues., 1.40—3.40 p.m.
15·02	Buenos Aires (Monte Grande). L S G.

THAT THRESHOLD HOWL

They say it's called Threshold Howl because it drives you to the Threshold of Insanity. . . . It certainly can be annoying! But here are some cures to try:—

Variable filament rheostat for the detector.

* * *

Different values for the grid leak and for the grid condenser.

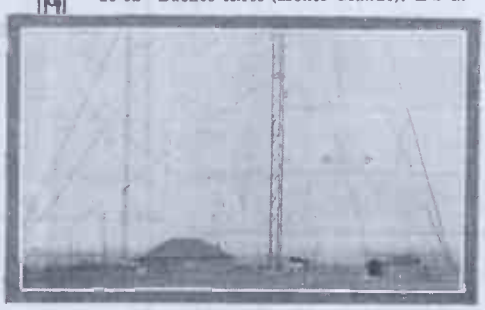
* * *

A ·0005 across the 'phones.

* * *

A 2-meg. leak across the primary or secondary of the L.F.T.

In the studio at Cape Town.



London's opposite number, Melbourne 3 L O.

Below 600 Metres

(Where aerial-power, under the new rating scheme, is known the figures are given.)

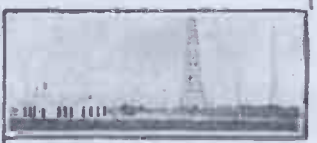
Wave-length in metres	Name of Station	Power in kilo-watts
574·7	Ljubljana (Yugoslavia)	2·8
570	Freiburg-im-Breisgau (Germany)	0·3
566	Hanover (Germany)	0·3
565	Smolensk (Russia)	
560	Augsburg (Germany)	0·3
550	Budapest (Hungary)	23
542	Sundsvall (Sweden)	15
533	Munich (Germany)	1·7
525	Riga (Latvia)	
517	Vienna (Rosenhügel) (Austria)	20
511	Archangel (Russia)	
509	Brussels No. 1 (Belgium)	1·2
501	Milan (Italy)	8·5
497	Moscow (Russia)	
487	Prague (Czechoslovakia)	5·5
479	Midland Regional Station (Gt. Britain)	38
476	Simferopol (Russia)	
473	Langenberg (Germany)	17
466	Lyons (La Doua) (France)	2·3
459	San Sebastian (Spain) / Zürich (Switzerland)	0·75
453·2	Porsgrund (Norway) / Aalesund (Norway) / Sala manca (Spain) / Bolzano (Italy) / Danzig / Klagenfurt (Austria) / Tromsö (Norway) / Uppsala (Sweden) / Tampere (Tammerfors) (Finland)	1·5 / 0·2 / 0·6 / 0·2 / 1
450	Moscow (Russia)	
447	Paris (PTT) (Ecole Supèricur)	1
445	Notodden (Norway) / Rjukan (Norway)	0·1 / 0·15
441	Rome (1RO) (Italy)	75
436	Stockholm (Sweden) / Malmberget (Sweden)	75 / 0·25
432·3	Belgrade (Yugoslavia)	3
424	Madrid (Union Radio) (Spain)	
418	Berlin (Witzleben) (Germany)	1·7
416	Rabat (Morocco)	
413	Dublin (2RN) (Ireland)	1·5
408	Katowice (Poland)	
403	Berne (Switzerland)	
398·9	Glasgow (5SC) (Gt. Britain)	1·2
394	Bucharest (Rumanja)	16
390	Frankfurt (Germany)	1·7

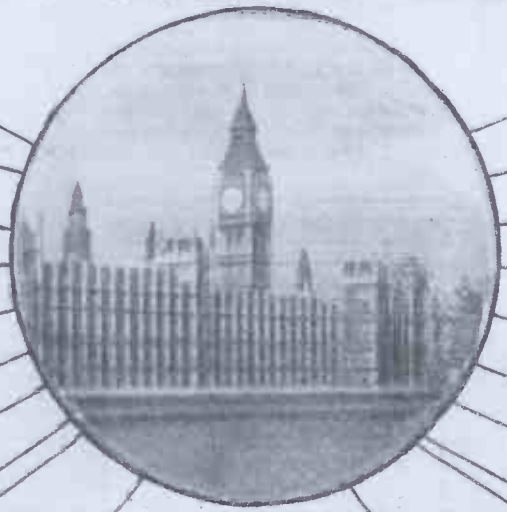
A Street Scene in Madeira.

The Station at Funchal works on 47 metres.

Wave-length in metres	Name of Station	Power in kilo-watts
385	Toulouse (France)	
381	Lwow (experimental) (Poland)	2·2
381	Genoa (Italy)	1·5
376.4	Manchester (2ZY)	1·2
372	Hamburg (Germany)	1·7
370·4	Radio LL (France)	—
368	Seville (Union Radio) (Spain)	
364	Bergen (Norway)	
363·5	Algiers (N. Africa)	
360	Stuttgart (Germany)	1·7
356·3	London Regional Station	45
352	Graz (Austria)	9·5
351	Leningrad (Russia)	
349	Barcelona (Radio Barcelona) (Spain)	
342	Brno (Czechoslovakia)	3
338·2	Brussels No. 2 (Belgium)	12
335	Cadiz (Spain) / Poznan (Poland)	1·9
332	Naples (Italy)	1·7
328·2	Paris (Poste Parisien) (France)	1·2
325	Breslau (Germany)	1·7
322	Göteborg (Sweden)	15
319	Dresden (Germany)	0·3
316	Bremen (Germany) / Marseilles (France)	0·3 / 1·5
314	Oviedo (Spain)	
309·9	Cardiff	1·2
304	Bordeaux-Lafayette (France)	35
301	Aberdeen	1·2
298·8	Hilversum (Holland) / Falun (Sweden)	8·5 / ·65
293	Kosice (Czechoslovakia) / Limoges (PTT) (France)	2·5 / ·08
291	Viipuri (Viborg) (Finland)	15
288·5	Bournemouth / Bradford / Dundee / Edinburgh / Hull / Liverpool	1·2 / 0·16 / 0·16 / 0·4 / 0·16 / 0·16
288·5	Newcastle / Plymouth / Sheffield / Stoke-on-Trent / Swansea	1·2 / 0·16 / 0·16 / 0·16 / 0·16
287·2	Lyons (Radio) (France)	
286	Montpelier (France)	1·2
283	Berlin Relay (Germany) / Magdeburg (Germany) / Stettin (Germany) / Innsbruck (Austria)	0·6 / 0·6 / 0·6 / 0·6
281	Copenhagen (Denmark)	1
280	Radio Liege (Belgium)	—
279	Bratislava (Czechoslovakia)	14
276	Königsberg (Germany)	1·7
273·2	Turin (Italy)	8·5
272	Rennes (France)	1·2
268	Barcelona (Radio Catalana) (Spain)	
265·4	Lille (PTT) (France)	1
263	Morovska-Ostrava (Czechoslovakia)	11
261·3	London National Station	68
259	Gleiwitz (Germany)	5·6
257	Hörby (Sweden)	15
255	Toulouse (France)	1
253	Leipzig (Germany)	2·3
251	Almeria (Spain)	1
246·2	Schaerbeek (Brussels) (Belgium)	—
242	Belfast	1·2
239	Nimes (France) / Nürnburg (Germany)	2·3
237	Örebrö (Sweden)	0·25
232·2	Kiel (Germany)	0·3
227	Cologne (Germany)	1·7
224·4	Cork (6CK) (Ireland)	1·5
222·9	Fecamp (France)	—
200	Leeds	·16

HOW MANY MILES?





	Miles
BERGEN	647
BRATISLAVA	801
BRUSSELS	199
CADIZ	1076
CORK	358
FRANKFURT	396
GENOA	640
HELSINGFORS	1131
KATOWICE	835
LAUSANNE	462
LEIPZIG	537

Miles	
598	MILAN
728	POSEN
248	RENNES
774	SALAMANCA
569	SAN SEBASTIAN
1018	SEVILLE
1553	STAMBOUL
1070	WILNO
830	ZAGREB

Station Information

OSLO, now employing high power (75 kw.), on 1,071 metres, daily sends a Time Signal in the half minute preceding 7 p.m. G.M.T.

* *

BRUSSELS No. 2 has recently been transmitting Sunday morning gramophone concerts, on 338 m.

* * *

VIENNA is arranging to exchange programmes (by cable) with Munich this winter.

* * *

PENTOISE is to be the "Chelmsford" of France when the short-wave Empire station now under construction is completed.

* * *

BORDEAUX AND STRASBOURG are each to have an increase of power, according to a statement by the French Minister of Posts, Telegraphs and Telephones.

* * *

TORONTO recently opened a new station controlled by the Canadian Pacific Railway, and the call-sign C P R is being used by arrangement with Bolivia, to whom those letters were allocated.

* * *

BRUMATH-STRASBOURG, the new French station, should be on the air regularly by the time these words are in print (wave-length, 346 metres).

* * *

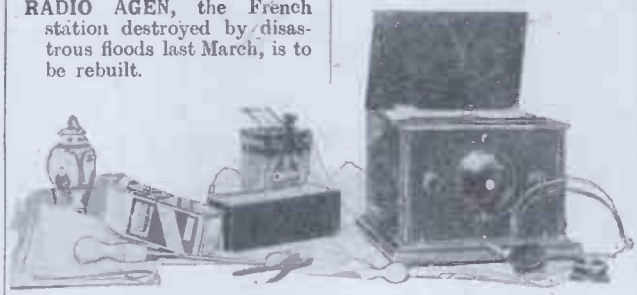
TOULOUSE (France) has been experimenting with picture transmissions on 385 metres.

* * *

ATHLONE is still named as the probable site for the Irish Free State high-power station, which is to work with a power of 60 kw.

* * *

RADIO AGEN, the French station destroyed by disastrous floods last March, is to be rebuilt.



RADIO BEZIERS (France) is to come "on the air" with 10 kw. instead of the 6 kw. which has been used by this station.

* * *

RADIO - VITUS, Paris, is shortly to be moved to the suburbs (Romainville), and will then use greater power.

* * *

PRATO SMERALDO is the name given to the Turin short-wave relay, now working on 25·4 metres.

AUCKLAND, and the other important New Zealand broadcasting stations, each observe one night per week as a "silent night."

* * *

SYDNEY 2 B L and SYDNEY 2 F C have ceased working on short waves.

* * *

SAIGON (French Indo-China) has been testing with gramophone records on 49 metres. (This station works commercially with Paris, St. Assize, during the day.)

* * *

WELLINGTON, N.Z., has been testing a new short-wave station on 27·3 metres. Call-sign Z L W.

* * *

HEREDIA, the Costa Rican short-wave station, announces in Spanish and English on 30·88 metres.

* * *

BUENOS AIRES has a new short-waver testing on 28·98 metres. Call-sign L S X.

* * *

TURIN, which has changed its wave-length to 273 m., has been in trouble for "wobbling" into the wave-lengths assigned to other stations.

* * *

KONIGSWUSTERHAUSEN (1,635 metres) used a metronome, ticking 40 beats in 10 seconds, as an interval signal.

* * *

NAPLES is now working regularly in conjunction with Rome, the usual announcement being "Roma-Napoli."

* * *

BARCELONA has been in trouble for causing interference with test transmissions from Brumath - Strasbourg, the new French station.

* * *

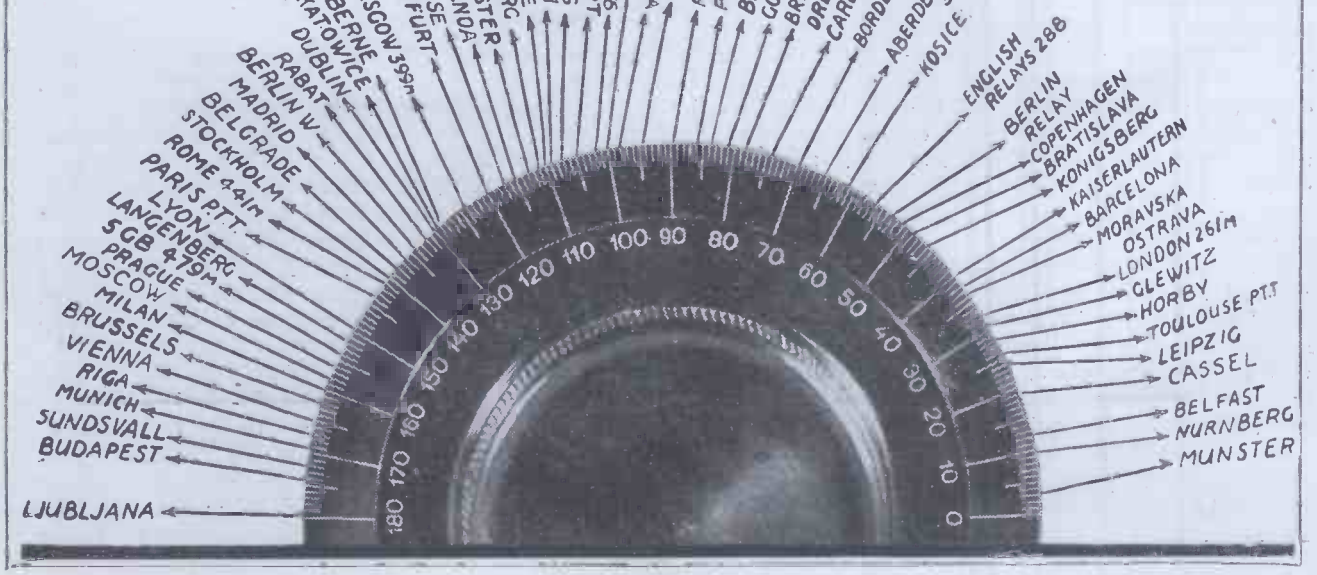
LANGENBERG is to increase its power to 75 kw. next summer.

* * *

RADIO LYON now arranges a programme of foreign relays every other week.

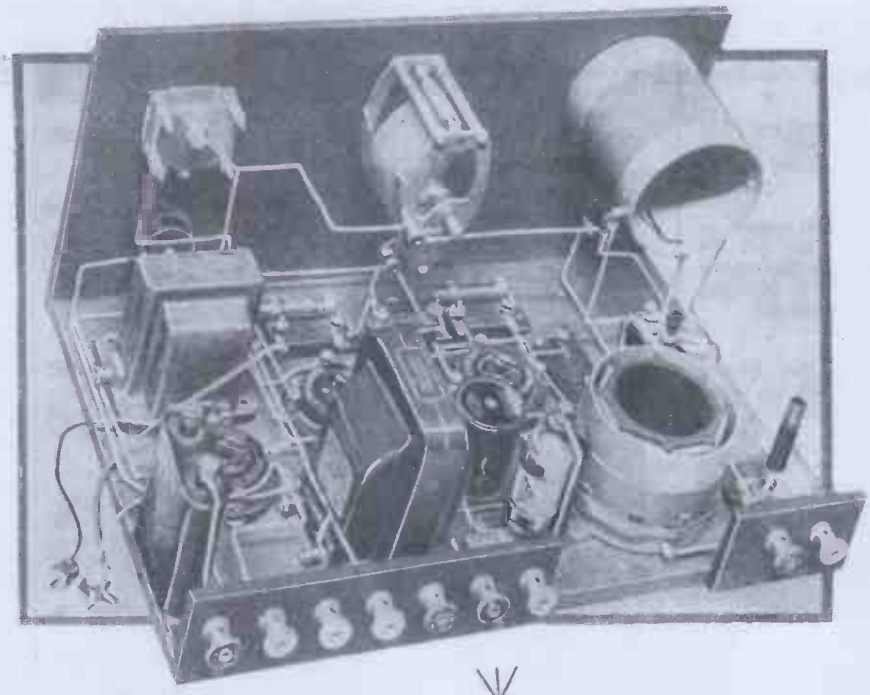
The representative tuning dial, showing order of stations, that was given in "M.W." some months ago met with so much appreciation that another is given below for the benefit of our many new readers.

THE ORDER OF THE STATIONS — BETWEEN 600 AND 220 METRES



THE "M.W." RESEARCH DEPARTMENT
this month presents to our readers—

The "M.W." Three



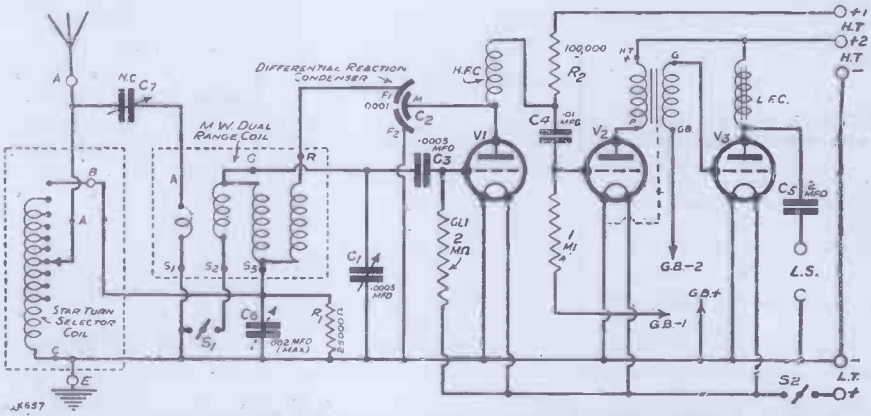
As recently as six months ago the results given by this set would have been regarded as "impossible."

VOLUME: Enormous, even on foreign stations.

QUALITY: Superlative, satisfying even the fastidious.

SELECTIVITY: "Positively remarkable."

And yet the set is
EASY TO BUILD AND TO OPERATE!



Here is a circuit that not only repays, but compels attention. Amazing selectivity is attained by the "Star Turn" Selector system, which is coupled through a neutralising condenser to the already famous "M.W." dual-range coil. The result is super-het sharpness if required. And on the long waves—available at the flick of a switch—the Interwave system of coupling keeps out the undesired local and brings in the Continental long-wavers with astonishing ease.

WHEN we got our first taste of regional broadcasting in the London area it really looked as though the difficult conditions which it brought would be a serious blow to the home construction of wireless receivers.

Modern Progress

It may be getting something of an old story by now, but it as well to remind ourselves occasionally of the troublous times through which we have passed and the lessons we have learned therefrom, in order to appreciate at their proper value our present-day set designs.

Hence our opening remark, because many of us are already beginning to forget that not so long ago people were quite seriously suggesting that regional conditions meant the end of all the simpler types of sets, on account of their comparatively low standard of selectivity.

Selectivity Without H.F.

It was quickly apparent that under regional conditions a really exceptional degree of selectivity was needed and it was equally quickly discovered that the current types of "detector and low frequency" sets did not provide it.

It was therefore prophesied that receivers of these previously very popular types would become obsolete in all "regional" areas, where it would be found necessary to use sets with at least one H.F. stage, simply and solely in order to get the necessary degree of selectivity.

If this had proved to be true it would indeed have administered a severe setback to the home-construction movement, for the set containing a detector and one or two low-frequency stages has always been one of the most deservedly popular of all types. Its simplicity in construction and operation, economy in first-cost and maintenance, robust independence of correct choice of valves, adjustment of voltages, and so on, have endeared it to the home constructor in a way unapproached by any other type.

If it had indeed become incapable of giving satisfactory service in such large areas of dense population as those affected by the regional scheme, it is quite possible that a very large number of would-be home constructors would have decided that they did not feel equal to the job of building one of the larger and more elaborate types, and so would have been driven to the purchase of a ready-made instrument.

Results of Research

What has actually happened, of course, is that the simpler type of set has been subjected to intensive research and development work, and has quickly been brought up to the

Test Bench

An impartial and critical review of "Lewcos," Standard Battery Co., "Pifco," Varley and Exide radio components and accessories.

The Varley impedance matching output transformer.

Varley L.F. auto-transformer, and the Varley impedance matching output transformer.

Moving-coil enthusiasts will be particularly interested in this last. It provides secondary ratios of 8–1, 10–1, 12–1, 15–1, 20–1, and 25–1, with a primary resistance of only 162 ohms and an adequate, well chosen inductance at 25 milliamperes—it can handle up to 50 milliamperes.

So you see that you are able to match the impedance of a carefully chosen valve to that of the moving coil to within very close limits. This is a vital necessity if you want to get the greatest undistorted output. The Varley instruction book that accompanies this component gives full details as to its use.

Two very useful and efficient devices—the Varley 3-henry tapped L.F. choke (left), and the Varley 1–7 auto-transformer.

The 3-henry choke is tapped at ·5, 1, 1·5, 2 and 3 henries, and has a maximum resistance of 47 ohms.

Its primary use is in tone-control units, but it has other useful applications, as amateurs will appreciate. It is the sort of thing that every experimenter should include in his kit as a matter of course.

The auto-choke has a ratio of 1–7, and in conjunction with a shunt H.F. feed it gives excellent results. You really do get the power promised by the high ratio, together with good quality due to a scientific design. The high "primary" impedance and a low overall self-capacity give a response that in no way lowers the usefulness of the best of moving-coil loud speakers.

Varleys are indeed producing some excellent gear these days, and we feel sure they are receiving the support they deserve from discriminating constructors.

New Exide Accumulators

Many of the so-called unspillable accumulators marketed a year or two ago were, in fact, far from being unspillable, and people who placed too much faith in them often had cause to regret it.

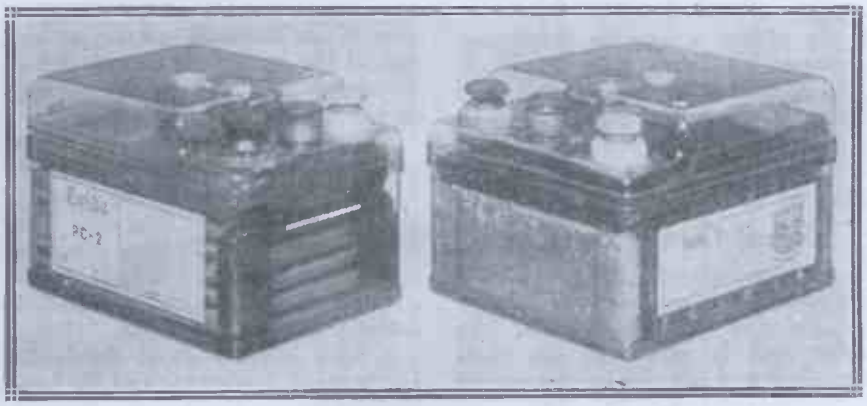
The new "Exide" unspillables are absolutely dependable. You can turn them completely upside down and push them about in that position without the slightest trace of moisture escaping. And this applies even to that one using ordinary fluid acid as its electrolyte; there are two types, the other being the "Gel-Cel," which employs a jelly acid.

A very special feature of these new Exides is the new and improved design of the cases they are built into. The tops of the cases are just as strong as the bottoms or sides, and are not, as in many types of accumulators, a weak point in the structure.

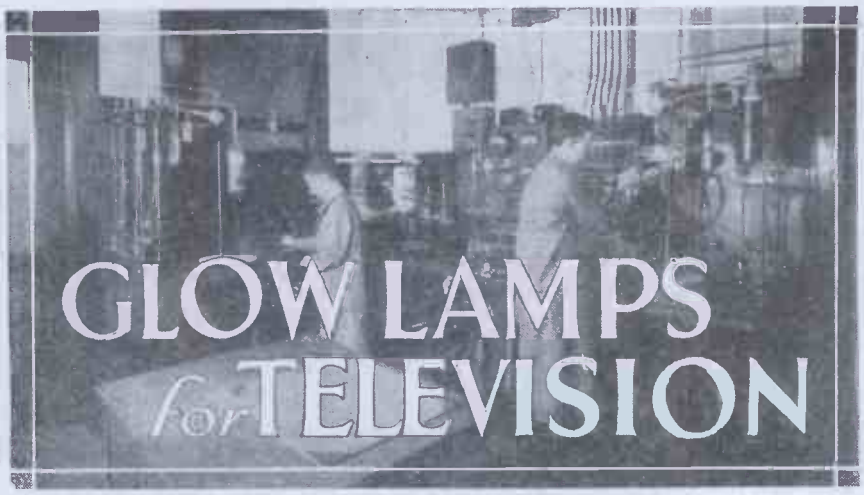
Special coloured, non-interchangeable terminals are another feature. Readers may be wondering why we are so long getting to what they may consider to be the most important point of all, the construction of the plates and their electrical efficiency; but the name Exide—the trade-mark of the Chloride Electrical Storage Battery Co., Ltd.—stamped on an accumulator definitely marks it as a 100 per cent production.

In all our long experience of Exide batteries, which reaches back for many years, we have found them always to reach a high standard; and these latest non-spillables, which are made available for all types of portables, and which we recommend as clean and safe for any set, are as good as anything the Chloride people have yet produced.

It would be a great pity if their use *were* restricted to portables for they deserve a much wider recognition.



Two of the new Exide unspillable accumulator cells.



GLOW LAMPS for TELEVISION

From a Correspondent.

How the latest lamps for television are made.

SINCE the historic television demonstration by Bell Telephone Laboratories in America, in April, 1927, many advances in the efficiency of the equipment have been made.

Notable among them are the changes made in the glow discharge lamps used at the receiving end. The lamps used with the present equipment permit much greater power input than those of the earlier demonstrations and their structure has been changed quite radically.

Getting Brighter Glows

Lamps as used for the early television demonstrations had flat plates for electrodes. These are separated by only about 3/32nds of an inch, and this small separation maintains effective insulation and forces the glow discharge to develop only on the outer surface of the cathode.

Radiation is depended upon entirely for cooling, which limits the operating current to about fifty milliamperes. The brightness of the glow is a function of the anode current and is thus limited by the cooling arrangement.

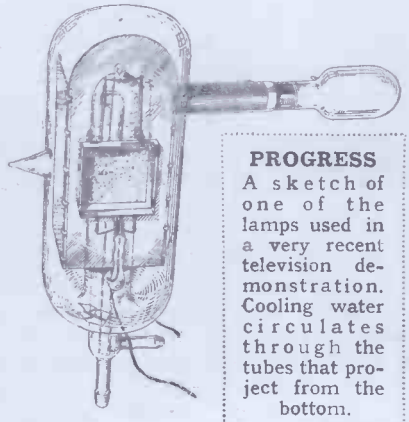
To obtain a greater brightness, water-cooled tubes were employed. The cooling of the cathodes of such tubes is not a limiting factor, and currents as high as 500 milliamperes may be used, giving a very bright glow on the cathode surface.

Colour Demonstrations

A nickel-plated hollow copper cylinder is employed for the cathode and the glow occurs on one end. The other end is sealed to the glass container and has two tubes entering it for water circulation.

Surrounding the cathode is a glass shield which restricts the area of glow to the end, and also serves as insulation between anode and cathode.

For the early demonstrations of television in colour a neon tube was used, of which a single piece of tubular nickel-plated copper, closed at one end and flattened along one side, forms the cathode. Its open end is sealed to a glass tube through which water is passed for cooling.



PROGRESS A sketch of one of the lamps used in a very recent television demonstration. Cooling water circulates through the tubes that project from the bottom.

The glow forms over a rectangular area of the flattened surface; on the rest of the surface glow formation is prevented by a protecting coating of lavite and insulating cement.

This early lamp possessed many objectionable structural features which have been eliminated in the tube for television in colour now in use. The cooling water for this tube is not in direct contact with the cathode, but is confined to a glass tube to which the cathode is tightly clamped.

A mica shield replaces the lavite and cement insulation, and by providing a long insulating path prevents the glow from forming anywhere but on the flat rectangular area. The anode is similar to that of the earlier tube, but supported in a slightly different manner.

The bulb attached to both of these tubes is used for supplying small quantities of hydrogen, which has been found essential for the efficient operation of all television lamps.

A New Type

After the lamp has been in operation over a period of time, the glow discharge develops a sluggishness, which causes fuzziness or poor definition of the image produced.

If a small amount of hydrogen is allowed to mix with the gas in the tube at this time, the sluggishness immediately disappears and good definition is again obtained. Such hydrogen admission is required periodically during the life of the tube.

For the more recent work on monochromatic television a new type of lamp has been devised. As with the latest lamp for colour television, the cathode is clamped in good contact with a glass tube through which the cooling water circulates.

The glow discharge is confined to a flat square surface by mica shielding, and the anode is a metal strip fencing off this active area. The uniformity of the glow of neon tubes and the "sputtering" from the active surface depends very much on the preparation of the cathode surface.

Sputtering is the dislodging of material from the surface by impact of ions from the glowing gas. The matter released leaves the surface with high velocity and deposits on the inside of the bulb directly in front of the glow.

Preparing the Cathode

This soon renders the lamp useless by reducing the intensity of the light as viewed through the bulb. It has been found that beryllium sputters far less than other materials and so is used for the final plating of the surface.

In preparation the cathode is first baked at 800 deg. centigrade in a vacuum for an hour, which anneals the copper without oxidation. The flat surface is then sand-blasted and nickel-plated, but not polished.

The rough surface allows the final plating to adhere tightly. Beryllium is not easily worked. It can neither be electro-plated nor readily deposited by cathode sputtering, so it is necessary to deposit it by the method of vaporisation and condensation. This is done in a high vacuum to prevent oxidation and to leave the surface as free from gas as possible.

A REMARKABLE RADIO DEVELOPMENT

IN this present issue of "M.W." full details of the "Plus-X" Four are given. And everyone who knows anything at all about the design of radio sets will agree that it constitutes a triumph for the "M.W." Research Department.

It is not a "standard" circuit lifted from some moth-eaten text-book and built up with modern components. On the contrary, it embodies a new circuit—one developed in the "M.W." Research Department as the result of months of experimenting on scientific lines.

"Plus-X" Proof

We do not proffer such statements merely as journalistic boosting—they are statements of fact.

Anyway, the doors of our Research Department are wide open to the trade, and representatives (often the managing directors themselves) of every big radio concern in the country continually visit us, and are shown everything of interest that is going on. Sir Oliver Lodge, Capt. Eckersley, and other scientific authorities, have witnessed tests and demonstrations of new "M.W." circuits in the "M.W." Research Department.

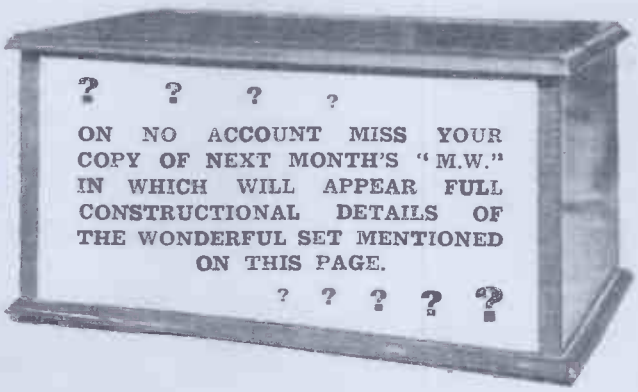
But no laboratory can be successful in its work unless it is equipped with the keenest of brains as well as with the most up to date of instruments. We feel we are fully justified in claiming to have in our staff, and in those other technicians at our ready disposal, unequalled resources in this respect.

The "Plus-X" Four surely proves that. Nevertheless, a four-valve set, however easy to construct, and however relatively inexpensive it may be, is beyond the reach of a large number of amateurs. Bearing this in mind, the Research Department has been busy on the development of somewhat smaller receivers having just as many comparative advantages, and, in their way, just as effective.

SOME IMPORTANT NEWS FOR HOME CONSTRUCTORS

Full constructional details of one of the most powerful, most selective, and most inexpensive sets in this smaller class will be published in "M.W." next month. It is not a junior edition of the "Plus-X" Four. It would be a very simple matter merely to reduce the valve stages of this wonderful set and dish up the result under another name. But that is not our way of doing things.

Each new set is tackled as a new problem. As much thought is devoted to it as upon any previous design. And it must be remembered that the evolution of a promising circuit is but half the battle. Just as important—indeed, more important at times—is the layout.



A Vital Factor

Perhaps it is not appreciated by many readers how much this part of our work has a vital bearing upon the distinctively successful results achieved by our productions. But it is a fact that you can take identically the same circuit, and identically the same kinds of components, and build up three or more different sets having as many different degrees of effectiveness. The results can range from complete hopelessness to a startling perfection.

Challenges the World!

Another very important point to note is that no "M.W." set is released for publication until it has passed the most exacting tests; tests carried out on scientific lines and not tests rendered negative on account of the presence of multifarious varying factors. We generate our own measured radio energy and apply congestion in varying degrees so that we can positively index every quality of our sets.

Thus the new set that will be introduced to the world in next month's "M.W." has passed through all the painful processes of evolution, and now rests on one of the test benches in its final form marked "O.K.," and awaiting collection by the Art Department, who will prepare the necessary diagrams and photographs.

We are not going to say much about it now—you will find its full description in our next issue. Nevertheless, we will give away this much of the secret. It will be available for every possible power supply. If you have A.C. mains, O.K.; if you have D.C. mains, O.K.; if you have no mains at all, O.K.; in any such circumstances you will be able to build it and add your quota to the general praise that undoubtedly will ensue.

We confidently challenge the world with our latest production, and if there are anywhere sets of similar pattern that can equal, let alone beat it, we should be very pleased to receive information as to their whereabouts!

At the "STATION with a LONG NAME"

An account of a trip around the German station Koenigswusterhausen, which is a colossal collection of great transmitters for broadcasting as well as for commercial communications.

From OUR OWN CORRESPONDENT.

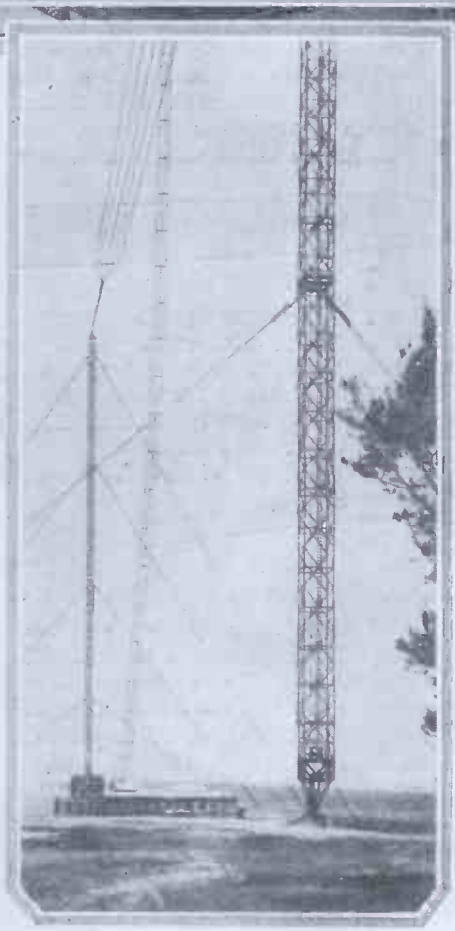
To anybody with a smattering of German, the name of our old friend Koenigswusterhausen doesn't present a mild form of terror, but no doubt the average DX enthusiast, who forgets the *ich bin's* he learned at school, has some excuse for writing just "German Station" down in his log!

Anyway, by the time one has seen —as I have done—over several other German stations and discussed radio technicalities in pidgeon-English and a modified deaf-and-dumb code, the Koenigswusterhausen name seems like child's play.

What It Means

It isn't so difficult, really. At the place itself, on railway stations and theatre bills, they don't run all the words into one. There are three words in the name—*Koenigs*, *wuster*, and *hausen*, and the local way is Koenigs Wusterhausen, meaning, literally, King's westhouse: but please don't ask me why!

Koenigs isn't primarily a broadcasting station, but is one of the centres of German commercial radio telegraphy, equivalent to Chelmsford or Rugby, but much bigger than either. The place reminds me of a huge Welwyn Garden City; very spacious, with broad roads and a number of big buildings like factories or Government offices.



How would you like to climb one of these masts? No lifts are available!

These are the transmitter halls and the living quarters of the engineers. It is all on a very vast scale.

The war had something to do with the prosperity of Koenigs. It became one of the centres of radio direction, together with Nauen, and many *verboten* messages in code flashed from its aerials during the Great Unpleasantness. And at the "cessation of hostilities," as the papers say, Koenigs rapidly turned its activities to commercial work again, and later to broadcasting.

"All Interesting"

I wonder how many old hands at radio remember when Koenigs made its debut as a broadcaster by some jolly good Sunday morning concerts. When the amateur transmitters grew wearisome with their "Hullo, old man. Over!" we often used to switch over to the long waves for music from "LP."

Now the broadcasting activities of Koenigs are in the relaying of Berlin on 1,635 metres, with the big power of 35 kilowatts. That means that he is jammed between 5XX on 1,554 metres and Radio Paris on 1,725 metres.

One of the engineers took me round the station (in a car, incidentally, for there are long walks from building to building), but I confess even now I was not able to grasp which of the many transmitters is for broadcasting only, and which are for commercial work. Anyhow, it's all interesting.

There are aerials all over the place at Koenigs. Two big lattice-work fellows, *à la* Eiffel Tower, I learned are for the long-wave work. One gets to the tops of these by a steel ladder (about 300 ft., in a stiff breeze which nearly always blows around the open country at Koenigs) and, horror of horrors, a spiral staircase up from the base to a height of 40 ft. or so.

I can't stand heights or spiral staircases, so, much as I should have liked to get a bird's-eye view of the surrounding country, I had to decline.

Extraordinary Earths

The ball-pivot method of support is used for some of the masts holding up the broadcasting aerials. It always seems incredible that these huge masts can stand on so frail-looking a support, and you can positively see them swaying in the wind.

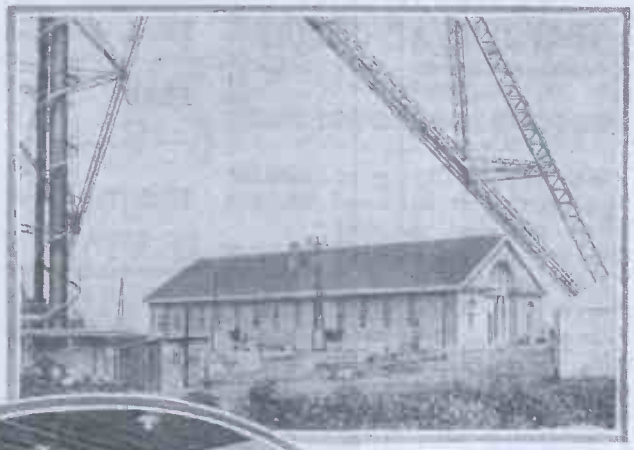
Heavy guy cables hold the masts up, and big counterbalance weights keep the guys in tension. In winter extra weights are added to the counterbalances.

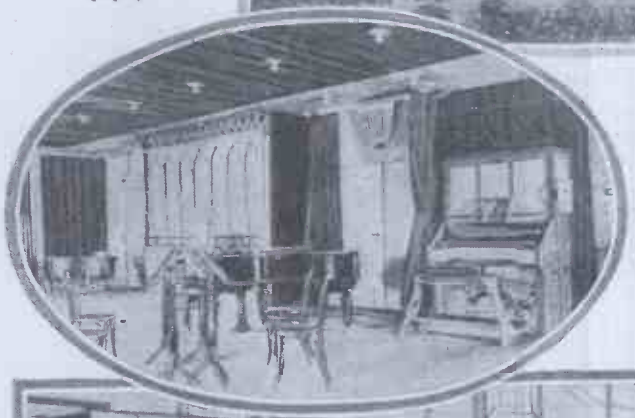
Apart from the masts there is a real forest of earth-wire poles. I had a chat with the engineers about this, and it appears that the subsoil in the neighbourhood is not very kind to earth connections, and so counterpoise earths are used for practically every transmitter. Some of these counterpoise poles are 20 ft. from the ground, and honestly it is difficult to distinguish some of the aerials from some of the earths!

There is also another group of poles holding up a special short-wave aerial. Koenigs is developing its short-wavers. Most

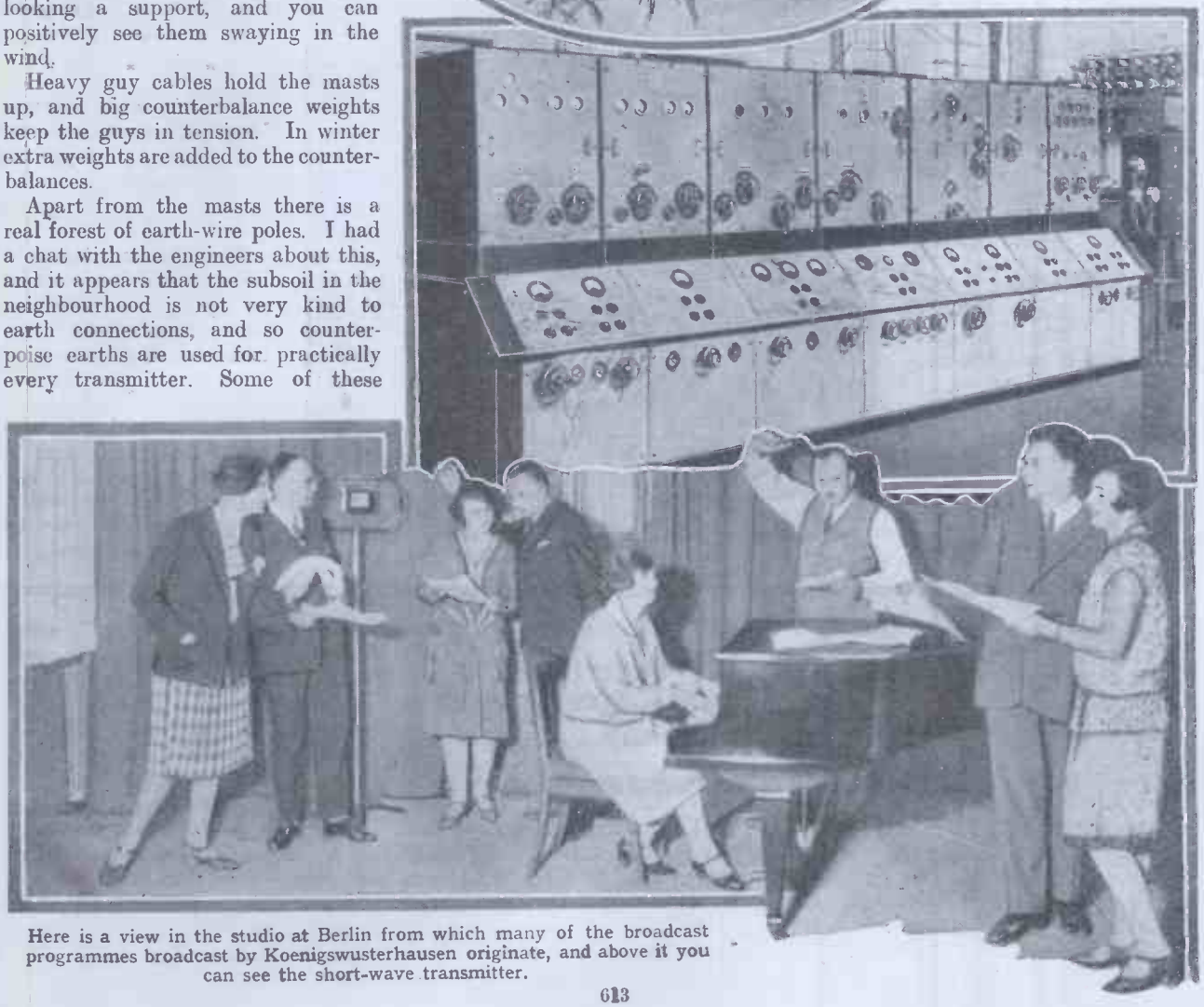
(*Continued on next page.*)

A HUGE RADIO CENTRE





One of the buildings (above) and one of the studios (left) at Koenigswusterhausen—Germany's great commercial and broadcasting centre.



Here is a view in the studio at Berlin from which many of the broadcast programmes broadcast by Koenigswusterhausen originate, and above it you can see the short-wave transmitter.

THAT "JAVA" CIRCUIT

Condenser Capacity—More Station Details.

Sir,—Might I draw your attention to an error that has crept into my letter, published in your October number, named "Java and Japan"? I observe that a condenser C_2 is stated to be of ·0001 mfd. capacity, when, in reality, it is of a much larger capacity, ·001 mfd. I point out this error, apparently made by a compositor, because I have found that a ·0001-mfd. condenser has little or no effect on the set, whilst the larger capacity has.

I am enclosing a short list of stations which will probably interest your "DX hounds."

Yours faithfully,

LESLIE W. ORTON.

Uxbridge.

HAVANA, CUBA.

CMW	1 kw.	500 m.
CMCF	·25 kw.	466 m.
CMBS	·05 kw.	441 m.
CMK	2 kw.	410 m.
CMI	·5 kw.	368 m.
CMC	·5 kw.	357 m.

MEXICO.

XFI	1 kw.	509 m.
XFG	2 kw.	450 m.
XES	·5 kw.	338 m.

URUGUAY.

CWOA (Montevideo) 1 kw. 700 kc.

CHILI.

CMAB (Santiago) 1 kw. 625 kc.

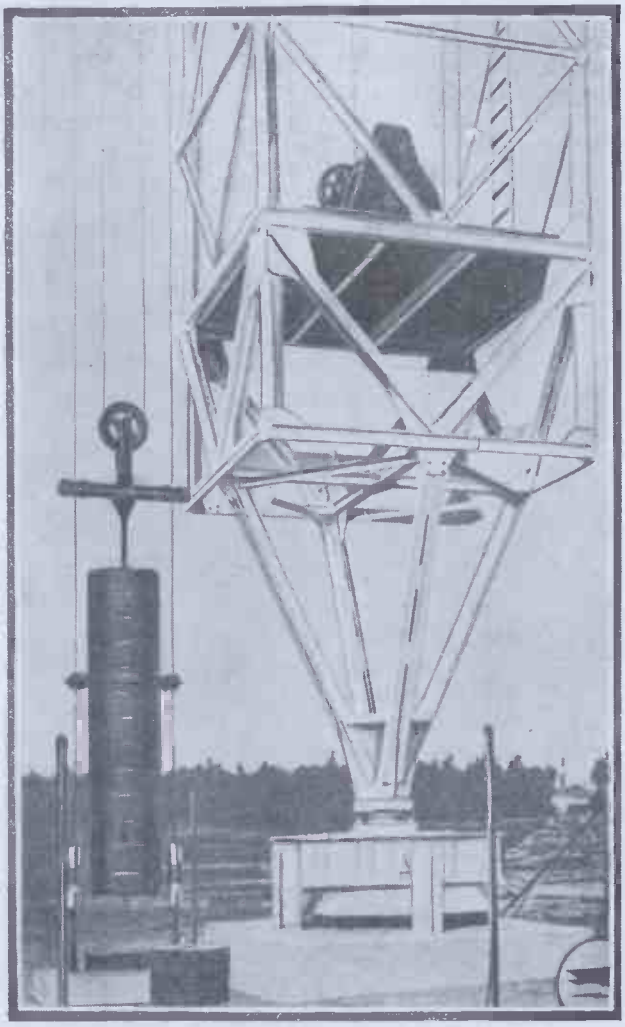
BRAZIL.

PRAA (Rio de Janeiro)—	1 kw.	750 kc.
PRAO „	1 kw.	1,330 kc.

HONDURAS.

HRB (Teguicigalpa) 2·5 kw. 6,170 kc.

IT SWAYS IN THE WIND!



A view of one of Koenigswusterhausen's masts, showing the ball and socket joint that permits the mast to "give" a little when strong winds blow.

RADIO WRINKLES

An H.F. Choke—Testing Mains, etc.

A good H.F. choke can be made by winding about 100 turns of fine wire on a glass test tube, the ends being secured to the tube by Chatterton's compound, or a similar adhesive.

* * *

Quite a good rough-and-ready galvo. can be improvised from a pocket compass placed inside a large hank-wound coil through which the test current is made to flow.

* * *

If the two leads from the D.C. mains are held in a glass of water, bubbles collect on one wire more than the other when the current is switched on, and the wire with the excess of bubbles is the negative.

* * *

Nearly all American broadcasting sets use several high-frequency stages and ganged tuning.

* * *

The Italian station at Turin, which uses a carillon as a preliminary signal, has been experimenting with new interval signals.

* * *

The Italian broadcasting authorities have just installed two special laboratories for checking transmission efficiency and minimising breakdown.

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of the work at present is done on the long waves.

You cannot learn much from looking at the transmitters, although it certainly is impressive to realise the thousands of volts on the plates of the big oscillator and power valves, and to see tuning coils higher than a man.

They tell me that Koenigs is a bad place for watches, for the amount of high-frequency in the air upsets delicate movements. When I went in to see the new short-wave transmitter I was warned to take off my watch for this reason.

AT THE "STATION WITH A LONG NAME"

—continued from previous page

The 1,635-metre broadcaster does not use crystal control, and I asked the engineer what precautions were taken to avoid interference with 5 X X and Paris. I was assured that the frequency of the station, 183·5 kilocycles, was tested every day.

Master-oscillator and not crystal control is used to keep the wavelength constant. As in all Telefunken gear—and all the plant at Koenigs is made by Telefunken—there are meters in practically every circuit, even in the filament circuits.

There are no actual studios at Koenigs, although there are two or three emergency and test microphones. The real studio for the 1,635-metre transmitter is the Voxhaus one in Berlin, and on occasions the Deutsche-Wellen studio also is used.

IS AUTOMATIC BIAS SATISFACTORY?

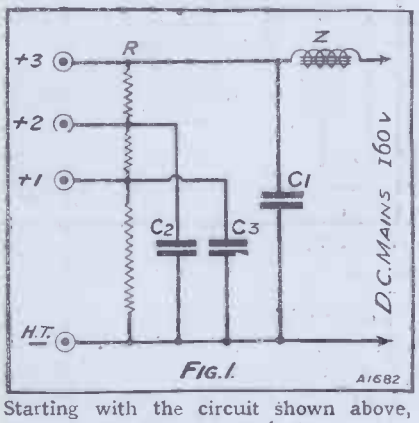
By J. W. HEREWARD

As our contributor remarks, "It all depends," and you must read this article before you form any decisive opinion on the merits and demerits of this form of grid-potential supply.

As is usually the case, a straightforward answer cannot be given to a straightforward question such as: "Is automatic grid bias always satisfactory." For the answer depends on a number of different factors, all of which must be considered.

The answer will depend on whether the valves are indirectly heated or not, whether the set is run from A.C.

THIS MAINS UNIT—



Starting with the circuit shown above, we can proceed—

or D.C. mains, whether in the case of A.C. mains differently functioning valves have separate heater windings, or whether a separate rectifier and potential divider system is provided for giving grid bias.

Where D.C. is concerned the only way we can get automatic bias from the mains is by reducing the amount of H.T. available.

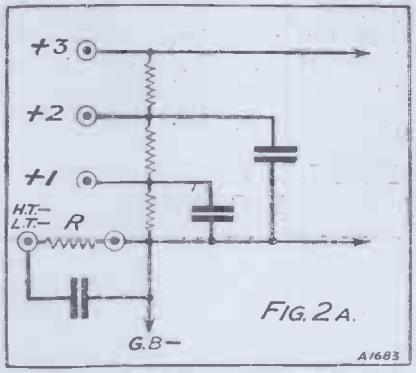
Let's take the simplest case first of a set being worked from D.C. mains as far as the H.T. supply is concerned. We probably have an H.T. eliminator somewhat on the lines of the circuit shown in Fig. 1.

Obtaining the Voltage

The voltage available is 160 and a fairly big valve is being used in the output stage of the set, say, a valve similar to the 220A., which has a magnification of 6·5. Then, dividing the H.T. voltage by twice the magnification we get the value of grid bias required to be 12 volts.

But the only way we can get this bias from the mains is to reduce the H.T. voltage by this amount. If we can spare it, well and good.

CAN BE CONVERTED—



—to add a bias resistance as at R in this diagram—

First, we can connect a resistance in the H.T.— return so as to give us a voltage drop of the necessary 12 volts, or else we can connect a potential divider so that the H.T.— and L.T.— connection is at a point 12 volts up from the negative mains end.

A Great Advantage

Either of these methods will work well, though I myself would prefer to use the first of these arrangements shown in Fig. 2A, rather than the latter (shown in 2B), for the reason that it will automatically compensate for overloading in the output stage.

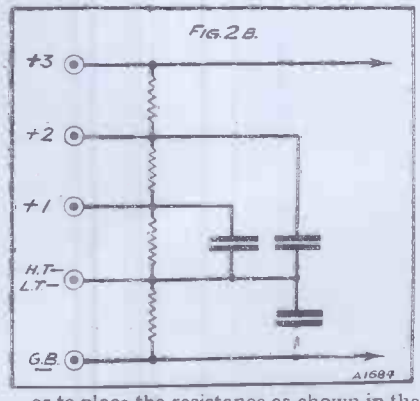
As you know, the voltage across the bias resistance R is the product of its resistance and the current flowing through it—usually known as the IR drop. So that if we are passing 12 milliamps, then 1,000 ohms will give us the required drop of 12 volts.

It is quite easy to arrange a resistance so that the bias automatically compensates for overloading in the last stage.

Now, supposing the output valve has to deal with a very heavy signal that sends it off the straight-line portion of its characteristic, what happens? Firstly, it makes the grid too negative, so that the plate current is unduly cut down. When this occurs the IR drop across R becomes less, and therefore the grid bias is reduced. This allows more plate current to flow and so counteracts the overload on the valve.

At the other end of the swing the grid of the valve becomes too positive.

IN TWO WAYS



—or to place the resistance as shown in the above illustration.

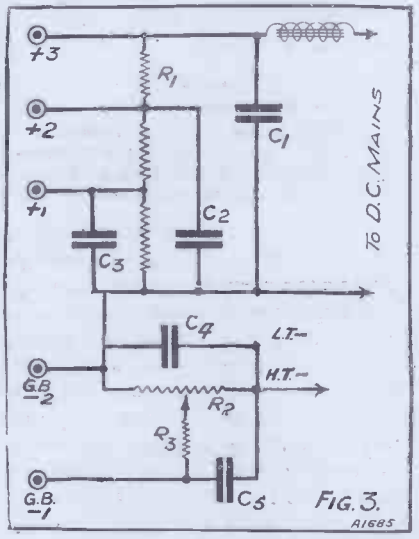
thus causing too much plate current to flow. Now the IR drop rises with the rise in plate current and the grid bias therefore rises also, thus cutting down the plate current.

Bias for Two Valves

This resistance can also be used for biasing previous valves by taking tappings at suitable points. In this case it may be necessary to de-couple these tappings to prevent interaction, and sometimes hum, from resulting. A complete circuit is shown in Fig. 3 of a D.C. mains eliminator providing one fixed and one variable G.B. tap and showing the correct point at which to connect the L.T. battery.

Now let's take an A.C.-operated set using indirectly-heated valves.

FIXED AND VARIABLE



A complete mains unit for D.C., providing one variable and one fixed automatic grid-bias tapping.

The receiver is a four-valver—H.F., detector, and 2 L.F.

First of all, the H.F. valve—a screened-grid valve—needs a small amount of G.B. The average S.G. valve takes about 4 milliamps, with another 2 on the screening grid. Say, a total of 6–7 milliamps, and we want to get about ½ a volt negative. I find this value is quite high enough, though I know that ¾ volt is usually recommended.

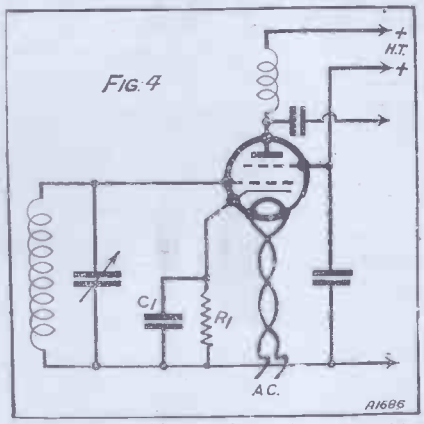
Calculating the Resistance

To get this drop we must connect a resistance in the H.T. return for this valve, i.e. in the kathode lead, which will give the required IR drop. Then, if IR=·5 volt, and I=6 m.a.,

$$R = \frac{\cdot 5 \times 1{,}000}{6} = 83{\cdot}3 \text{ ohms.}$$

Since this resistance has to carry only 6 m.a. it can be wound with extremely fine wire. This resistance is shown at

HALF A VOLT



Arranging a bias resistance to provide ·5 volt for an indirectly-heated-kathode A.C. S.G. valve.

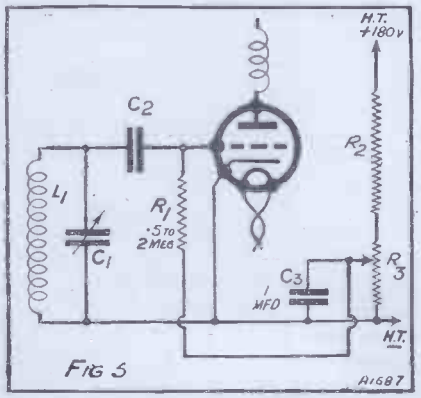
R_1 in the circuit diagram in Fig. 4, and is shunted by a fixed condenser C_1, which should have a value of about ·01 to ·1 mfd. This arrangement can nearly always be relied on to work satisfactorily in practice.

Now comes the detector. I have

"I have never yet found automatic bias for anode-bend detection to operate without some kind of trouble."

seen a number of circuits which give the same method as the one I have just described for giving the necessary bias for anode-bend rectification, but—I have NEVER yet found them to work without giving some kind of trouble. Every time I have tried

FOR LEAKY-GRID RECTIFICATION



One method of adjusting the positive bias on a leaky-grid A.C. detector.

them, and that has been many times in different receivers, all that has resulted has been a fearsome howl.

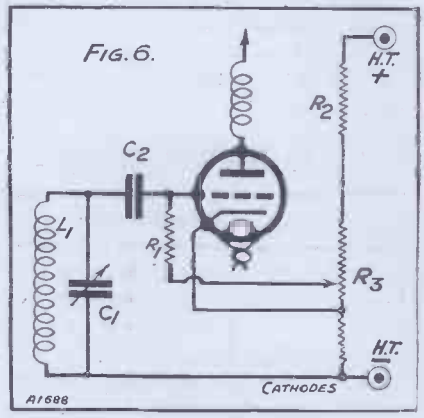
Therefore, I say—here is a case where automatic bias is not satisfactory. I have always used a battery for this purpose.

Use of Battery

The value of this battery will, of course, depend on the detector valve, the amount of H.T. and the value of the coupling resistance if R.C. coupling is being used, but in the ordinary way a 4½-volt battery will be found to be ample. As these batteries can now be purchased with tappings I also prefer to use one for the bias for the first L.F. valve.

Here again I have not found automatic bias entirely satisfactory, neither when it was obtained by means of a resistance in the kathode lead, nor when a resistance in the common H.T. return was used for the purpose, which was common to both L.F. stages. Although this is quite satis-

NEGATIVE OR POSITIVE ?



Where negative or positive bias can be obtained at will.

factory with D.C. mains, its use with an A.C. eliminator frequently leads to hum being introduced, though the use of automatic bias obtained in this manner is quite all right for the last valve.

With H.T. derived from A.C. mains, particular care must be paid to shunting the bias resistance, especially if efficient valves are being used, otherwise trouble will certainly be caused in the form of bad humming or else actual low-frequency howling will be set up, especially if this resistance is common to more than one H.T. return lead.

A Positive Bias

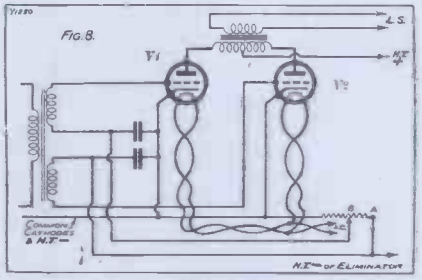
Before we leave the question of the A.C. set, suppose we wanted to use leaky-grid condenser rectification—how would we get our positive bias without the use of a battery? Obviously the only way we could do so

Avoiding Interaction Between Grid Circuits

would be by means of a suitable potential divider across the H.T., with a tapping so adjusted to give us a bias of $1\frac{1}{2}$ to 3 volts positive.

Now, it would be an advantage if we could make this tapping adjustable,

IN PUSH-PULL



Separate bias control of push-pull valves is an important aid to successful operation.

and as the positive voltage for the detector is to be derived from a fairly high voltage, probably 180 to 200 volts, the resistance across which it is obtained must, of course, be a small one.

Resistance Values

In fact, a 400-ohm resistance would serve very nicely for one part of the potential divider, and for the other part—assuming that the H.T. voltage is 180—we would need a resistance 60 times as big (59 times to be really accurate). Sixty times 400 is 24,000, and resistances of 25,000 ohms are easily procurable and this value would do very nicely.

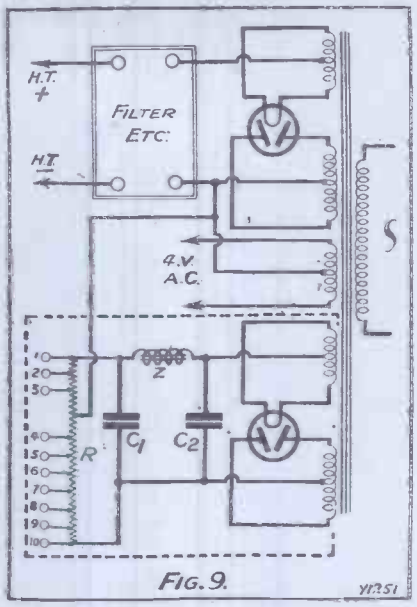
The arrangement of the whole scheme would be as shown in Fig. 5. L_1 C_1 is the detector tuned circuit, while C_2 is the grid condenser. R_1, the grid leak, is connected to the slider on R_3, which has a resistance of 400 ohms, while R_2 is a fixed resistance of 25,000 ohms; this gives us a variable + bias of from 0 to 3 volts.

For C_2, the grid condenser, I would advise a lower value than usual, not more than ·0002, and even ·0001, if this does not occasion too great a drop in signal strength, while R_2 will probably be about ·5 megohm.

The Grid Condenser

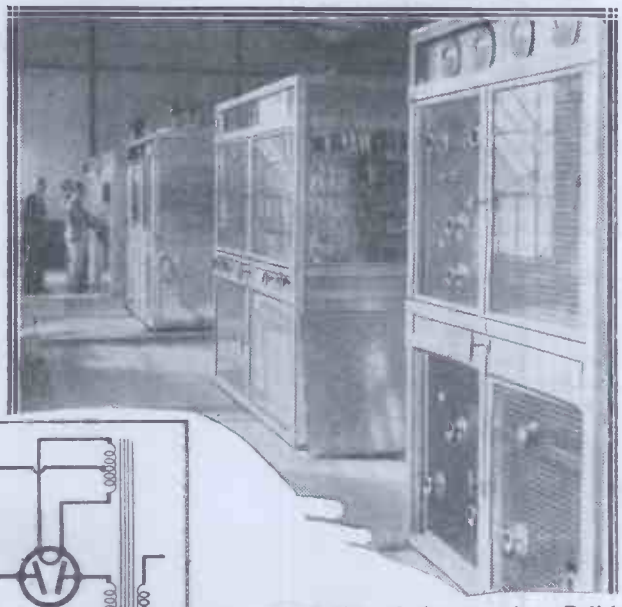
This is a point that you must find out for yourself, however, for though the makers of I.H.C. valves generally recommend that a value higher than this should not be used, I have come across sets where the use of a leak lower than 2 megohms resulted in a terrible hum. R_3, the 400-ohm resistance, can be an ordinary potentiometer, and by moving the slider from one end to the other any value of positive bias can be obtained between zero and the maximum, which will be just a small fraction under 3 volts with the value of resistance given.

ALL-POWER A.C. UNIT



The above diagram is a complete circuit for an A.C. mains unit and automatic bias regulator. Note the extra windings of the mains transformer.

WHERE BIAS IS A REAL PROBLEM



A general view of the new giant Polish station constructed at Chelmsford. Grid bias in such transmitters is a matter of thousands of volts.

It might be that for experimental purposes you want to be able to vary the bias on the detector grid between a certain maximum negative as well as positive value, say, between 3 volts negative and 3 volts positive. The way this could be done is shown in Fig. 6.

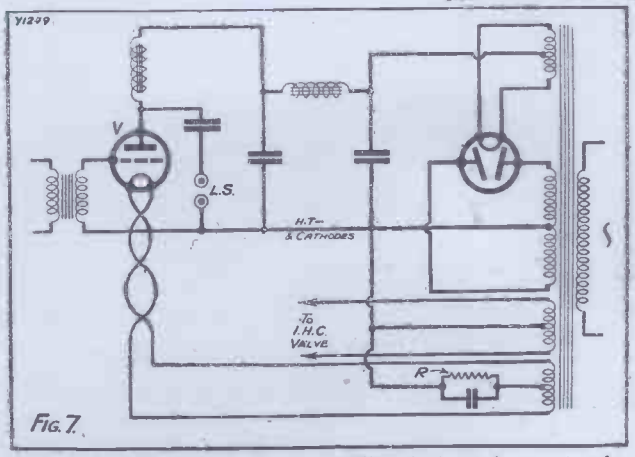
A Useful Scheme

One special component would be needed for this, though I expect that it could quite easily be obtained, and this would be a centre-tapped potentiometer having a total resistance of about 1,000 ohms, i.e. 500 volts either side of the centre-tap.

The method of connecting it is clearly shown in the diagram and you must note particularly that the

(*Continued on page* 676.)

THE LAST STAGE



A separate filament winding for a directly-heated output valve is very advisable, as pointed out in this article.

B.B.C. PROGRAMMES AND THE PUBLIC

By Lt. Commander the Hon. J. M. Kenworthy *RN. MP.*

WHENEVER people interested in wireless—and who isn't to-day?—meet together, the talk turns on one of two topics, either receiving sets or programmes. A minority—large, but still a minority—are wireless amateurs and can discuss the technicalities, the building of sets, etc. But *everyone* is interested in programmes.

There are 3,000,000 wireless licences sold in a year now, which means at least 6,000,000 people listening, more or less regularly. They represent the great national listening public. Are they satisfied with the programmes, is there room for improvement, are the complaints—which are inevitable with such a catholic audience—justified?

The Box Office Test

I have taken some pains to find out the views of the ordinary listener in many parts of the country and of all types and classes, and I believe I can express the general view. Remember that the B.B.C. programme directors have no certain means of gauging the public taste.

Broadcasting itself is still in the adventurous, experimental stage. The proprietor of a cinema-theatre or playhouse has one sure test of whether he is giving the public what it wants. It is the Box Office test. The editor and manager of a newspaper can tell at once by sales whether his readers are satisfied.

THE AUTHOR

Commander Kenworthy has the welfare of the listener very much at heart, and he has made a thorough study of our broadcasting system in all its aspects.

Many hundreds of letters about programmes go to the B.B.C. headquarters every week; but the people who write letters complaining of, or praising, our wireless programmes are not always representative of the main body of listeners. People who write letters of that kind are a special class by themselves.

The last thing the average man or woman wants to do is to put pen to paper! The Corporation is a national service and must try to cater for all tastes.

Educational Policy

It is easy enough for the listener with a good set and expert knowledge to take his pick of the European stations; but the lonely farmer and his family, the country-dweller, the invalid, are usually only provided with a comparatively primitive, inexpensive set, and have to take what is given them by our own British Corporation or go without. We may divide the programmes broadly into two sections—educating and entertaining. Let me say at once that with regard to the educational policy of the B.B.C. nothing but the highest praise can be given.

There is an advantage here, for the directors of study groups have means of making their needs known direct to the Corporation, and it is accordingly much easier to cater for the students.

Lt.-Commander Kenworthy is the Chairman of the Radio Association of Great Britain and Ireland.

The scientific talks, for those who are interested, have been, I have reason to know, extraordinarily successful. The new experiment of linking up these talks with the work of the museums is particularly interesting, and should prove of the greatest service to students. We have not been pioneers in this section of education by wireless, for it is already firmly established on the Continent.

But our British University Extension movement as linked up with broadcasting is admitted by foreign educationalists to be excellent. Nevertheless, here again the students and learners are in a minority of the listening public.

The Dividing Line

The programme directors must visualise the ordinary families of the country on a wet evening, of various ages and tastes, some of them tired after the day's work. They definitely want entertainment and pleasant amusement. Often the dividing line between instruction and entertainment is fine. But the public will only get irritated if an attempt is made to instruct it against its will under the guise of amusement. This is a trap which, I think, on the whole, has been avoided.

Trained Specially?

With regard to the talks, sermons and the like, I think more care should be taken in future to have these given by speakers with two special attributes. They must have good microphone voices. Some of our most eminent political leaders, for example, are definitely bad on the microphone.

They can sway great audiences and hypnotise them with their eloquence; but their voices do not come well over the ether. Others are very good. So it is with the men of learning who give the scientific talks, and the men of God who preach the sermons. The other necessary attribute is that mysterious quality called personality. Some people can get their personality definitely to the listener by means of the microphone.

This applies even more to the entertainers. Indeed, I have for long thought that to get the best value from entertainers it is necessary to train them specially for broadcasting.

". . . It is easy to grumble, though I have reason to know that our programmes are easily the best in the world of broadcasting. But continual improvement is necessary, and I believe the secret of success is . . . to give the public what it WANTS, and not try to force into its ears what the Powers-that-be think it ought to have"
—Lieut.-Cmmdr. Kenworthy.

Variety in Variety

And that brings me to the question of variety entertainment, which I believe to be by far the most popular part of the B.B.C. programmes. Here again we must have "variety in variety," that is to say, the listening public will soon tire of hearing the same entertainment too often. So we are in a dilemma.

If we specially train artistes for broadcasting, our area of choice will

A Band that is always welcome

Here we see the B.B.C. military band taking a breather between items. The studio they are in is the new No. 10, a warehouse on the Thames side near Westminster. Many of the large orchestral and choral concerts are broadcast from here.

The Talks are Badly Presented

be limited. It is one of the difficult problems that will have to be solved if general satisfaction is to be given. One mistake which should never be made, though it sometimes is, is to have similar programmes on the same evening from each British station. There should always be a choice of fare.

Now as to music. In the present stage of development of the science of broadcasting it is a fact that something is lost in the reception of music on the average set.

The Absence of "Presence"

It may be got over in time; but this mutilation of muting of certain sounds accounts, I believe, for the unpopularity of "Chamber" music. Some of the loss of effect is due to the impossibility of seeing the conductor. Television may solve this in time.

But we are dealing with the present. Again, in listening to an orchestra in a hall or concert-room the trained musical ear can hear the different instruments separately. This is often lost in broadcasting in its present stage of development.

The average set, in any case, "thins" music, and most of the Old Masters wrote music which is "thin." Wagner wrote perhaps the richest and most colourful orchestral music; but Mozart, Handel, Bach were definitely "thin."

This is "highbrow" music; and I state my first general conclusion that "highbrow" music, and, in fact, Chamber music generally, is not popular. The middlebrows and lowbrows don't like it; and the highbrows complain of it being distorted. Accordingly, I would have it cut down considerably.

What *are* popular, besides the "variety" referred to above, are the old, well-known tunes and popular light opera. The immortal Gilbert and Sullivan, the light Italian and French operas, such as Puccini's "Madame Butterfly," Leoncavallo's "Pagliacci," Gounod's "Faust," and Bizet's "Carmen"—all these are certain of warm appreciation from the great majority of listeners. So with the moderns—Strauss and Lehar.

The same applies to singing. Popular, well-known songs are always favourites; but something is bound to be lost of the great classical singers, which annoys the highbrows; and lowbrows don't like them in any case.

Now as to plays. Just as we are coming to the special play written for the cinematograph screen, so I believe we should have special plays written for broadcasting. I have just heard an old favourite of mine—Galsworthy's "Strife"—on the wireless. Frankly, it was disappointing.

It would have conveyed even less to a person who hadn't seen it on the stage. Here again great care is needed in the selection of the actors—they must be chosen principally for their voices, not for their appearance, gestures, or powers of mimicry. And the voices must contrast.

Titles of Talks

A man with a deep bass voice should play opposite a woman with a high-pitched voice, and vice versa. The trouble with the ordinary theatre play is that the whole of it must be heard and the plot understood. I consider that the time has come when a panel of professional entertainers or entrepreneurs should be set up to advise the directors of programmes.

Where the talks are concerned the B.B.C. should draw on the great profession of journalism.

A great deal depends, when it is a question of attracting the attention of the public, on the *titles* of the talks. Recently, for example, a series of Sunday Talks began with a wonderful discourse by Professor Julian Huxley, announced in advance as being on "Science and Religion."

The Secret of Success

The ordinary listener looking up the programmes of the week, and seeing this Talk, would probably decide to go for a walk or read a novel that evening. Yet a capable sub-editor could have given a title to that talk which would have attracted thousands who would have then been delighted with it.

In this article I have attempted constructive criticism. It is easy to grumble, though I have reason to know that our programmes are easily the best in the world of broadcasting. But continual improvement is necessary, and I believe the secret of success is the same as that of Lord Northcliffe in journalism—to give the public what it WANTS, and not try to force into its ears what the Powers that-be think it ought to have

PLAYING FOR THE PICTURES

Mark Hambourg, who has broadcast several times, recording for a talkie.

SHORT-WAVE SUPER-HETS

Some suggestions and new circuit arrangements of particular interest to the short-wave enthusiast. A two-valve adaptor you can apply to an ordinary set is described also.

By J. ENGLISH.

WHAT with new valves and new circuits the modern broadcast receiver is a long way ahead of its predecessor of even two years ago. I am afraid we cannot say the same of the short-wave receiver, which has remained very much as before—a regenerative detector backed up by one or two L.F. stages.

This well-tried arrangement has the advantages of simplicity and easy construction, but I am sure it is by no means your ideal of what a short-wave receiver should be. Usually reaction has to be pushed to the limit for D.X. results, so that quality can never be good, while tuning the best of short-wavers is certainly not as comfortable as tuning a broadcast set.

As for the delightful pranks some short-wavers play, such as hand-capacity threshold howling, and similar items, the least said the better.

It is not therefore to be wondered at that short-wave enthusiasts sigh for new ideas in design which will get over the drawbacks of the usual short-waver and give them more powerful, docile and easier-to-tune receivers.

A Return

Consequently you will find that experienced amateurs are now beginning to reconsider the use of short-wave super-heterodyne receivers.

Especially is this so in America, where some excellent designs are being produced. These up-to-date super-hets. are not much like the old-time multi-valve sets which some of you may remember.

Tremendous Range

New ideas in circuit arrangement and methods of operation have brought about a vastly improved performance on more economical lines. In fact, the tremendous range and volume obtainable is a revelation to anyone accustomed only to the usual short-wave set.

Now building a super-het. is an expensive business which does not increase its popularity, in spite of its being the short-wave receiver par excellence. If you possess a good broadcast receiver with at least one H.F. stage, as so many of you do nowadays, there is a very attractive and economical alternative.

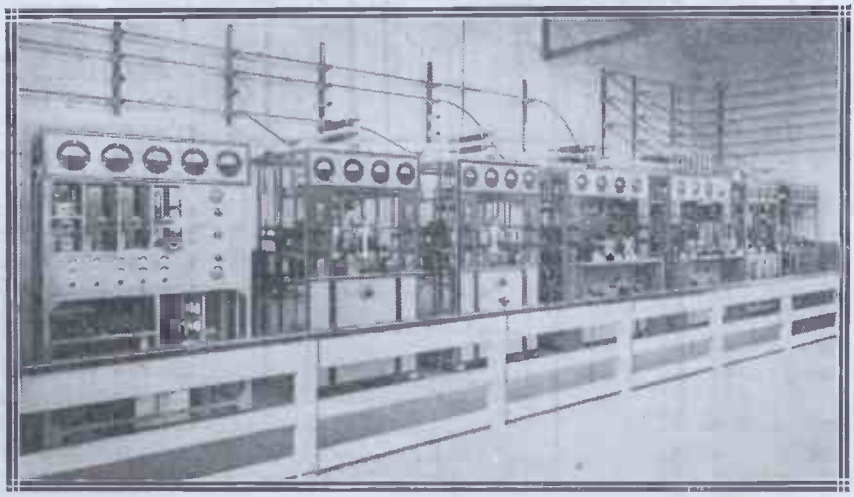
This is the supersonic convertor, a two-valve unit which, placed ahead of your receiver, forms a complete super-het. I propose to tell you something about the design and operation of this new type of short-wave adaptor, which, as you will see later, is vastly superior to the adaptors we have had so far, giving exceptional results with much easier operation.

Before I go any farther you may like to have your memory refreshed on the theory of the super-heterodyne, as it is necessary to have a working knowledge of this before you can understand and appreciate the converter.

Quite Simple

The principle of the super-het. is by no means so complicated as some people would have you believe.

HAVE YOU HEARD THE SHORT-WAVE HUIZEN?



Normally Huizen transmits on a long wave and is heard very clearly in this country. But he also sends out short waves for the benefit of very distant listeners.

First we have a simple detector for picking up signals and, coupled to this detector, another valve arranged to oscillate continuously on a slightly different wave-length. The two radio frequencies, signal and oscillator, are mixed and rectified by the detector and appear in the anode circuit of the latter as a radio-frequency signal of a much longer wave-length. This is amplified by one or two long-wave H.F. stages (known as the intermediate frequency or I.F. stages), then rectified by a second detector and amplified in the normal way.

The Beat Frequency

Thinking in frequencies instead of in wave lengths gives you a clearer idea of the super-het. principle. For example, the detector tunes in a signal frequency of 1,000,000 (300 metres) and also receives an oscillator frequency of 1,300,000.

In the detector anode circuit we then get a beat frequency of 300,000 (1,000 metres), equal to the difference between the two input frequencies. When writing down frequencies we save ourselves labour by dropping the last three noughts and calling this 300 kilocycles (k.c.).

The I.F. stages are fixed tuned to 300 k.c. and, as the detector tuning is changed, the tuning of the oscillator is correspondingly altered to produce the same beat frequency. The pictorial diagram of the super-het. which I have drawn in Fig. 1 will help to clear up any remaining difficulties you may have.

For the new type short-wave adaptor all we require is a two-valve unit comprising the first detector and oscillator, both with short-wave coils, to convert the incoming signals to a higher wave-length. The latter is here within the wave-range of the broadcast receiver, the H.F. stages of which act as the I.F. amplifier.

Ease of Operation

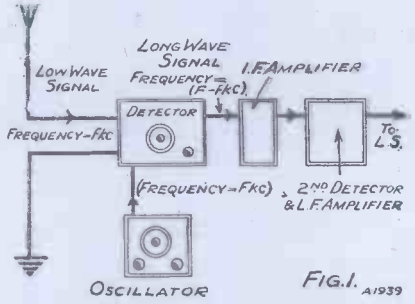
Since the H.F. section of a modern broadcast set is designed to give high amplification with stability and full transference of sideband energy, it is far superior as an I.F. amplifier to the very long-wave stages which we used to use in the old-time super-hets. Moreover, if the H.F. stage or stages are completely screened we avoid another of the earlier snags, external pick-up.

You will now, I think, appreciate the superiority of the short-wave supersonic convertor, as it uses all the amplification of your receiver, with all the advantages of high quality, immense sensitivity, and greater ease of operation, especially if the tuning of the broadcast set approximates to one dial control. In tuning there is none of that ticklish resolving of weak carrier-waves.

Independent Tuning

We can now concentrate on the design of the convertor, which must be simple and easy to tune. The chief problem when dealing with short waves is so to arrange the coupling between detector and oscillator that the tuning of both is independent, which is not easy to obtain with orthodox methods.

AT A GLANCE

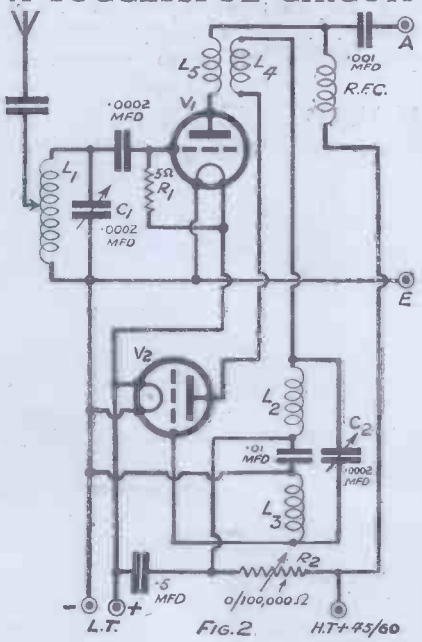


Here you can see at a glance exactly how super-hets. operate.

A Suitable Scheme

Unusual methods are necessary, as you will see from Fig. 2, a particularly successful circuit. In this case the Hartley oscillator V_2 is coupled to the *anode* circuit of the short-wave detector.

A SUCCESSFUL CIRCUIT



A Hartley oscillator, V2, coupled to the anode circuit of the short-wave detector.

The beat frequency sorted out by the detector is passed to the broadcast receiver by the choke and condenser coupling in the anode circuit. In case you may think the choke is a short-wave component, I ought to add that it must be a well-designed "broadcast" choke, because it has to deal with H.F. currents of these wavelengths.

You will notice in Fig. 2 in series with the oscillator H.T.+ lead a variable resistance R_2. This controls the amplitude of the oscillations generated by V_2; an important feature, as too strong an oscillation reduces the sensitivity of the convertor, and may cause an excessive H.T. consumption.

Component Values

Incidentally, this resistance control also has far less effect on tuning than a capacity control. The usual short-wave coil is used for L_1, and the split coil L_2, L_3 has the same total number of turns, arranged to make L_3 one turn more than L_2 for each coil range.

The remaining turn to balance L_2 and L_3 you will find at L_4, both L_4 and L_5 being each one or two turns wound near together on a small former. This fixed coupling is suitable for all the short-wave bands.

As regards valves, the detector should have an impedance round about 20,000 ohms, and for the oscillator a valve of the 10,000-ohm type usually gives the best results.

In Fig. 3 we have another interesting convertor circuit which I have found to be particularly suitable for short-wave work. Here an S.G. valve is used as detector, the screen grid being the input electrode with the normal control grid connected as a space-charge reducer.

Ingenious Arrangement

This is a very sensitive detector scheme which at the same time makes possible an ingenious and highly effective form of coupling between detector and oscillator. You will notice that the inner grid of the S.G. detector receives its positive bias via the oscillator reaction coil and the resistance R_2. This connection supplies the necessary coupling between the two valves, the amount of coupling increasing as this resistance is decreased.

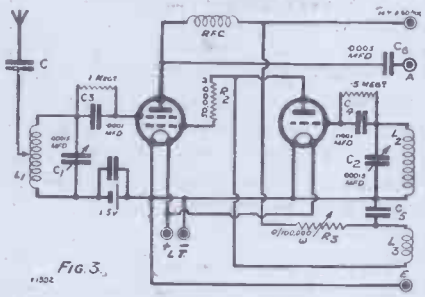
Normally, R_2 is a fixed resistance which also serves to drop the common H.T. supply to the correct operating voltage for the inner grid; incident-

An Ingenious American Scheme for Tuning

ally, this potential should not be much over 10 volts.

As in the circuit of Fig. 2, we have a resistance R_3 controlling the output of the oscillator, the circuit of which, you will notice, is of the so-called Reinartz type. The rest of the circuit is very similar to that of Fig. 2, the I.F. signal being transferred to the broadcast receiver by means of the medium-wave choke and condenser C_6.

VITAL VALUES



The values of the important components are given in this diagram of a two-valve convertor.

The values of important components are indicated in Fig. 3, and, as regards coils, the normal short-wave ranges are used for L_1, with one or two turns extra for L_2. The oscillator reaction coil L_3 has approximately half the number of turns of L_2, except for the wave-band above 75 metres, where only one-third the number of turns is required.

This circuit is also quite suitable for use with A.C. valves, when superlative results are possible. The type of valve required in the oscillator stage is one having an impedance round about 10,000 ohms. (Some valves of the 20,000-ohm class also function quite well as oscillators.)

Convertor Connections

If you have not previously handled a super-het. receiver you will be interested, no doubt, in a brief resumé of how the supersonic convertor is set up and operated. First of all the unit is placed close to the aerial end of your broadcast receiver, to obviate long leads, and terminals A and E connected to the aerial and earth terminals respectively of the receiver.

It may be necessary to adjust the latter's input circuit to give a medium degree of coupling; too loose a coupling here will appreciably reduce sensitivity. The next step is to tune the receiver to some wave-length clear of any transmission interference, which may be on either medium or long wave-bands; experiment later decides which gives the better amplification and selectivity.

Tuning Directions

In any case, you need only flick over a switch to change from one to the other. If a reaction control is used it must be adjusted near minimum, otherwise you may get an unpleasant interaction between receiver and convertor producing chirps and, in bad cases, howling.

The fixed tuned receiver now acts as the I.F. amplifier, second detector, etc., and all tuning is then done with the convertor dials. The tuning of C_2 is sharper than that of C_1, which appears to be rather flat.

This does not mean poor selectivity, which is actually decided by the tuning circuits of the receiver. When the combination is working properly, short-wave stations slide in just like broadcast transmissions on a powerful receiver, there being no whistle to resolve.

The oscillator dial can be used as the main tuning dial, the flatter tuned aerial circuit then being brought into resonance for maximum volume.

The H.T. voltage of the oscillator valve is also set at a low value, and then increased for maximum volume and clear reproduction. When once adjusted it requires little further attention.

> Apart from the remarkable results obtainable with this type of supersonic heterodyne, one of the operating features which makes it so much more successful than the old-time super-hets. is that you can choose any I.F. you please merely by altering the receiver tuning.
>
> This helps to dodge external interference and to get the best conditions for high amplification and clear-cut tuning under varying conditions of reception.

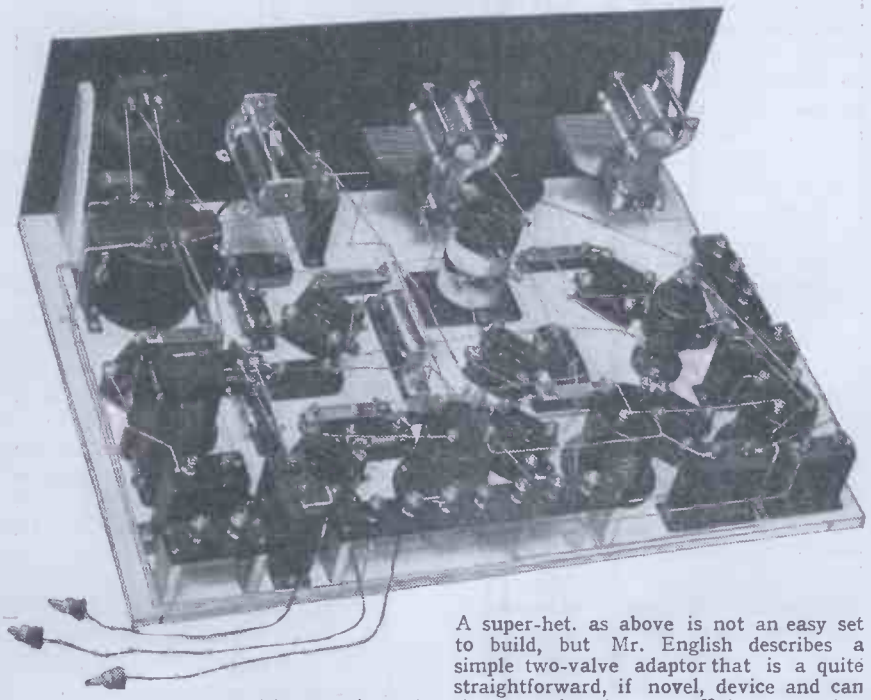
Another Advantage

Now the operating details I have so far given you are more or less the same as those which apply to the conventional super-het. The greater flexibility of the adaptor idea, however, opens up possibilities for more cunning tuning methods.

An ingenious scheme developed by American short-wave experts consists in fixing the tuning of the oscillator and varying the intermediate

(*Continued on page* 675.)

NOT AN EASY SET TO BUILD!



A super-het. as above is not an easy set to build, but Mr. English describes a simple two-valve adaptor that is a quite straightforward, if novel, device and can be used in conjunction with an ordinary broadcast set for the very efficient reception of short-wave transmission.

TROUBLE TRACKING

On this page the Chief of the "M.W." Query Dept. discusses, month by month, some of those common difficulties and troubles which can be so perplexing. This month he describes two interesting faults which he came across recently.

I LIKE to describe on this page the various types of faults I come across from time to time, because I believe that by so doing I shall be helpful to others who may meet with similar troubles.

For example, a set I had on test recently suddenly went "dead," and the only sounds were a faint hum in the speaker and slight "motor-boating." Since the receiver had been working well only an hour before, I was naturally puzzled, and immediately suspected a faulty contact or a doubtful H.T. connection.

A Defective Fuse

I went over all the terminal connections and tested out the H.T. circuit from the H.T. battery to the terminals on the set with a voltmeter. Everything proved to be O.K., so finally the fuse came under suspicion.

There was no reason why the fuse should have blown, but I felt that I would like to eliminate the possibility of this being the source of the trouble, so I connected a piece of copper wire and another fuse across the H.T.— and earth terminals. The set immediately burst into life. The first fuse *had* gone, although I don't know why it should have done so, because I had not at any time shorted the H.T. across any part of the L.T. wiring. I expect the fuse bulb filament was mechanically faulty. A trouble like this can be very puzzling.

A Faulty Portable

Then there was another case—a portable set in this particular instance. The receiver wouldn't function at all, and so it was brought along to me. Now my friend had had several years constructional experience, but he confessed himself beaten.

It was a well-known commercial portable, beautifully made, but like most of them somewhat inaccessible. Anyhow, I applied one or two tests. I joined a voltmeter across each of the filament sockets of the valve holders and found that the L.T. side was O.K. I tried the valves themselves in another receiver. There was nothing wrong with them.

Testing the Plate Circuits

I then replaced the valves and tested the plate circuits with a milliammeter. This, of course, was quite easy since it only necessitated connecting the meter in series with the appropriate H.T. + lead and watching the needle. The valve maker's pamphlet or catalogue tells you approximately what current the valve will take with a known H.T. voltage and grid bias.

In this case the test showed that there was a "break" somewhere in the anode circuit of the last valve.

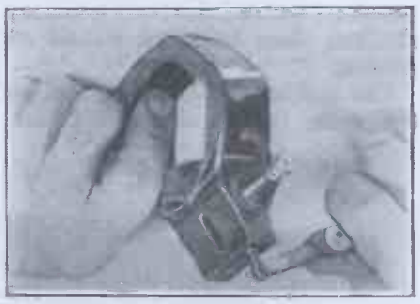
In other words, when I joined the + terminal on the milliammeter to the 108-volt tapping on the H.T. battery, and the other terminal on the meter to the wander plug normally inserted in the 108-volt socket, the needle remained at zero.

The next procedure was to test the speaker windings for continuity. Not too easy in this instance, since it meant removing the loud speaker and frame-aerial windings from the lid.

However, there was no alternative, so out came the whole assembly. Result—loud-speaker windings O.K.

Quite frankly I was now beginning to feel rather worried. You see, the only component in the anode circuit of the last valve was the loud speaker. This we had proved to be in order. The valve was not faulty, neither was the filament circuit. The H.T. and L.T. batteries gave their correct voltages, and the flexible leads from these batteries were perfect. Yet the last valve would not function.

A HELPFUL TIP



Do your signals come and go? If so, try opening up the pin of your aerial coil with the aid of a penknife. Carry out the same procedure with the aerial coil holder. If you get crackling noises, have a look at your reaction coil and make sure that the pin and socket connections are O.K.

The Effect of Acid

I looked carefully at the valve holder itself, but there was nothing wrong with it. Finally I decided to test the leads from the speaker to the H.T. + connection and to the plate socket of the valve holder.

That was where the trouble proved to be. There was a break in the lead which joined one side of the speaker to the anode of the valve The two leads ran in grooves beneath a piece of wood on the back and bottom of the case.

The defective lead had been "eaten away" by acid and had finally developed a break. The acid action had probably been going on for a considerable period. It may have been started by spray from the L.T. battery, which, of course, was in the containing case and near the lead.

The Remedy

I renewed *both* speaker leads (the second one as a precaution) and the set worked perfectly.

Now this fault was really a simple one, but it gave me a lot of trouble owing to the fact that the cause was hidden by the wooden strip used as a protective covering.

Moreover, the average rubber covered flexible connection does not usually give trouble.

The WORLD'S FIRST "TWIN"

Great Britain was the originator of broadcasting's boldest experiment—the sending of "twin" programmes from a dual station. The romantic story of this triumph of radio engineering is racily recounted below.

By a Special Correspondent.

NEARLY everyone whose business or pleasure takes him along the Great North Road will have noticed, near Hatfield, on the London side, the four masts and buildings of the London broadcasting station.

People passing the place will nudge one another, and nod, and say "That is Brookmans Park." But no enthusiastic listener ever takes off his hat to it, though broadcasting engineers the world over will tell you that that is what Brookmans Park deserves.

In its own unostentatious way it is a triumph. A world-beater.

When we think of London's broadcasting station we must remember New York's recent experience. Not very long ago it was decided, in true American fashion, that New York should have the world's most wonderful wireless station.

A Gigantic Failure

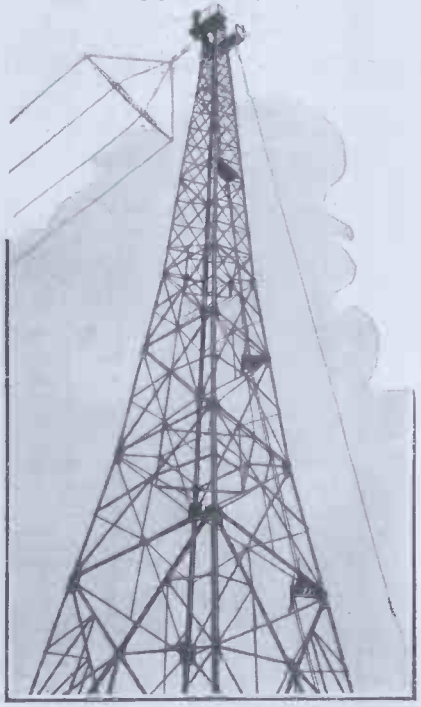
Every trouble was taken, no expense was spared, a site was chosen at Rocky Point, and New York listeners tuned-in for the test transmissions in the confident expectations of hearing the world's loudest, clearest, purest broadcasting station!

Did they? They did not!

From the listener's point of view America's super-station at Rocky Point was nothing more nor less than a "washout." The British station at Brookmans Park, on the other hand, has been an unqualified success, and yet in some ways it was a far more difficult proposition, for it was the first of the "twins."

It sends out two transmissions, from virtually the same point, on two different wave-lengths (London Regional 356, and London National 261). And here for the first time in broadcasting history a single power-house puts out two programmes, side by side, and gives listeners a double service without a trace of "back-chat" between them.

A WORLD-BEATER



A view of the top of one of the four 200-ft. masts at Brookmans Park.

Some of the problems which cropped up and were successfully dealt with have been outlined in a paper by Capt. P. P. Eckersley, M.I.E.E., and N. Ashbridge, B.Sc., the responsible engineers who planned and carried out the project for the B.B.C.

And in spite of the gigantic differences in the power involved the listener will be interested to know that the problems were really *listeners'* problems—magnified a million times or so, but in the main the same old problems which every householder has to consider when he instals a wireless set.

There were, for instance, the questions of the power supply, the bother of battery charging, the difficulty of dodging the other fellow's aerial, the microphonic-valve nuisance, and the perennial problem of finding the best place to put the whole affair.

No Chances Taken

The Brookmans Park site was finally chosen because it appeared to be "just the place." It gives the right strength over the whole of the London area; it was far enough from the sea to prevent the wastage of signals over water where there were few aerials to pick up the programmes, and the necessary 'phone lines, etc., were close by. But, remembering Rocky Point, no chances were taken.

The large flat field *looked* all right, but to make sure there were no snags underground an experimental station was put up and a motor-van containing field-strength measuring apparatus toured the London neighbourhood, to pick up the programmes from it.

Ten thousand miles were travelled by the van in this way before the

engineers were satisfied that the site behaved normally. Just the same meticulous care appears to have been taken at every step, and this is fortunate, for such a station not only costs a great deal of money, but it may have to carry work of national importance during an emergency.

There are four masts, each 200 ft. high. They are lined up as two pairs, with the aerials 300 yards apart, and the station building half-way between them.

"Reg." and "Nat."

"Reg," the London regional programme, goes out from the pair of masts which lies towards Hatfield, and it is interesting to note that Reg's masts are insulated at the base.

The southerly pair of masts which carry the "National" aerial have been tried, insulated, earthed (or partly earthed), and experiments are still going on as to which way gives the best results. (Much higher masts would have been used but for the fact that the Air Ministry placed a limit of 200 ft., on account of flying danger.)

The station building is placed exactly between the two aerials, with two feeder arms running out right and left to the mid-point of each aerial system. This building must have been a pleasure to the man who designed it.

It has its two complete but separate broadcasting stations, together with the necessary power to run the whole service for three months. For Brookmans Park has a self-contained generating plant where it makes its own H.T. and L.T. by means of Diesel engines working from crude oil.

The power-house contains four Diesel engines, each driving a D.C. generator, and the output of these is "floated" across a 2,000-ampere-hour battery. This huge "floating" battery not only compensates for variations in the supply voltage, but itself is capable of taking the load of one generating set in the event of failure of an engine or generator.

Incidentally it supplies the power for lighting, running the workshop motors, etc., and this scheme has the advantage that it helps to keep the battery in condition.

Seventy-Five Kilowatts

The whole station building has been planned for "step by step" handling of the power, and there is a steady progression from the crude oil which drives the engines to the feeder lines which supply the aerial with the finished programmes.

Each transmitter is capable of putting 75 kilowatts in its associated aerial. And though both run from the same building, there is no sort of coupling between the two, and a breakdown in one would have not the slightest effect in the other.

One of the funniest little puzzles that had to be tackled was placing the powerful motor-generating plant as far away as possible from the delicate machinery, and, of course, to prevent it from affecting the valves.

Everyone knows how even a four-valve set will make the loud speaker "ring" if vibrations are not guarded against, and, of course, a trace of this kind of trouble during transmission would deafen every listener in the country! So the four engine units are mounted on a special block of concrete 6 ft. in thickness, 32 ft. across, and 35 ft. 6 in. in length.

This block weighs somewhere about 600 tons, and to make it "anti-microphonic" the whole is cushioned on a kind of huge cork mat, 2½ in. thick. There is a 3-in. air space all round this huge concrete bed, and so efficient are the arrangements that even when "running full pelt" there is no detectable vibration, even in the battery-room which adjoins the power-house.

Cooling the Valves

Remembering how even an ordinary power valve gets quite hot when it has been running for some time, it might be expected that elaborate precautions have been taken with high-power transmitting valves. Up to seven thousand gallons of water per day is required by the Brookmans Park station, and the valve-cooling arrangements are really elaborate.

Standing outside the building in a concrete tank is a group of pipes through which the valve-cooling water passes. The tank water is allowed to trickle over the pipes and, of course,

"SPARKLING" FUN AT CHRISTMAS

A "shocking" application of science to Christmas fun and festivity.

Changing a Valve in Fourteen Seconds!

provision has to be made so that even in the summer the cooling is sufficient, whilst in the winter there must be no interruption from frost.

Each of the twin transmitters requires a *separate* power supply, and takes well over a thousand amps. for filament heating alone! The water-cooled valves want 10,000 volts on their plates, and these valves alone take 16 *amps.* of H.T. current.

A good example of the care taken in design is afforded by the fact that it was arranged to cut out a valve which was faulty and bring in a good one without even the necessity of cutting off the power and water supply.

Very Quick Work

At the present moment a defective valve can be changed in about fourteen seconds. When a breakdown comes along, before you can get out of your chair and fiddle about with your set to see what the trouble is the engineer can have a new valve inserted and the programmes going out again.

LITTLE THINGS THAT MATTER

Loud-speaker leads should be kept well away from the high-frequency and detector ends of the set.

* * *

On no account should an aerial lead-in be run quite close to an earth-wire.

* * *

An electrical pick-up adaptor for gramophone reproduction can be plugged into the detector valve holder or one of the low-frequency stages, but not into the H.F. end of the set.

* * *

When buying an H.T. battery ascertain from the maker's leaflet how many milliamps it is rated to supply, and make sure that your set's anode current is not greater than this.

As in a receiving set, some of the other valves have quite low voltages in comparision; the modulator, for instance, requiring a mere 3,500 volts on the plate. Grid bias alone must have been something of a problem, for the final power stage was 200 volts negative, while the negative grid volts supplied to the penultimate stage reached the very respectable figure of 2,000 volts!

Of particular interest are the safeguarding schemes, which not only protect the parts from danger, but indicate if anything is wrong in any of the circuits. There are leak indicators, flashing lamps, buzzers and many similar contrivances.

Safety First

The really dangerous apparatus is housed in parts of the building which it is impossible to enter without switching off the H.T. first, as the opening of the door does this automatically.

One of the biggest thrills of all must have been at the short-circuiting tests, when, just to see what would happen, negative was joined to positive, and all the fuses blew themselves to smithereens! Every safety device stood up to the test nobly, but it must have been a great moment.

Incidentally, provision had to be made for a quick change-over of apparatus that becomes defective.

In addition to the general earthing of the station, which consists of a grid of wires buried in the ground when the foundations of the buildings were laid, a separate outside earth is arranged under each aerial. This consists of a number of copper wires running out radially from the feeder hut, which stands exactly underneath the centre of the aerial.

Each wire runs out ten degrees away from the next and is buried about 9 in. below the surface, the length being arranged so that the H.F. earth system stretches out to about a quarter of a wave-length beyond the dimensions of the aerial. Another interesting point is that these are really earth *wires*, and each does not terminate in an earth plate, as was done with earlier broadcasting equipment.

Best in the World

In a short article like this it is impossible to do more than just touch briefly upon some of the striking features of a station of this size. But enough has been said to show that the remarkable efficiency and reliability of the Brookmans Park transmissions are not due to accident.

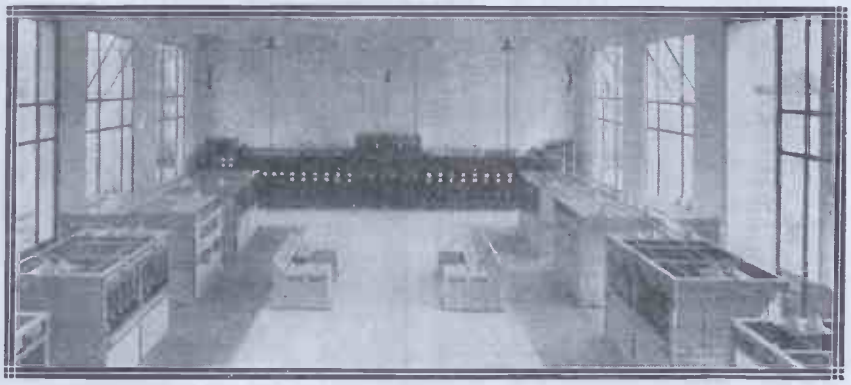
The world's first "twin" transmitter came into being as the result of a brilliant conception, carefully planned in every detail. It provides Britain not only with the nucleus of the best broadcasting service in the world, but with the proud boast that her radio engineering technique is second to none.

The Checking Sets

Finally, there is a well-equipped test room, with a cathode-ray oscillograph for checking the degree of modulation, and other "monitoring" apparatus. Included in this is a constant-amplitude valve oscillator—which is used for measuring the frequency characteristics of the lines, etc.—and some elaborate gear for checking loud speakers.

There are also two checking sets, selective enough to cut out signals of equal strength when separated by 50 kilocycles per second from the frequency to which the receiver is tuned.

THE "REGIONAL" AND "NATIONAL" AT HOME



A general view of the transmitter hall at Brookmans Park, with "Reg" on the left and the "National" on the right. Note that even the desks are in duplicate.

Out With the O.B. Van

Intimate and exclusive details about one of the most fascinating aspects of broadcasting by a B.B.C. official. He gives you a description of the B.B.C.'s latest O.B. van and how the engineers overcome the many difficulties they encounter in the course of their most interesting work.

IF you see a plain grey-blue van, bearing the B.B.C. insignia, touring your district, don't jump to the conclusion that it is tracking "pirates" or "howlers."

It is more probably the new B.B.C. outside broadcast van engaged on its legitimate job—and not an easy job, either.

Several Each Week

A glance down the programme list shows that during the week there are at least two or three items which are definitely outside broadcasts (dance bands, unless from a new hall, hardly can be classed as "O.B.'s," for the microphone arrangements are known to the engineers), and on many of these the van is used.

Let me tell you what this new van is like and how you get, by its aid, broadcasts of the Cenotaph Ceremony, the R.A.F. Display, and the Tidworth Tattoo. And then, when you know, and when the van comes to your district, you won't be tempted to hang around the door and peep inside—which I can truly say is the thing the engineers detest most.

The B.B.C. van, on a British lorry chassis, has a platform on top where commentators can stand, as they did last year at the R.A.F. Pageant. Railings around this platform prevent the "mike," or the commentators, from slipping off on to the heads of those below; or, at least, they *should* prevent such a catastrophe, but one Grand National broadcaster—I think it was Geoffrey Gilbey—could tell some funny stories about this.

A Complete Studio

But I digress. Down below in the van is a completely fitted-up studio, with a red light on the door, and a control and amplifier compartment.

PAST SUCCESSES

Here are some photographic reminders of some of the wide activities of the Outside Broadcast staff of the B.B.C. Above is a view of the Hendon Royal Air Force Display, which has proved one of the most successful of all O.B.'s. To the left is a view of the wireless van in the Richmond Mews on the occasion of one of the British Legion Cenotaph services which was relayed to radio listeners.

RELAYING A CENOTAPH SERVICE

By an OUTSIDE BROADCAST ENGINEER

The studio is pretty well ventilated, but it does get infernally hot in summer, and the only remedy is to open the outer door of the van.

This demands the help of another engineer, or any small boy who is handy, to keep away the gapers at the door. The microphone is so sensitive to the stray questions of engineering onlookers.

The "mike," incidentally, is the usual studio Reisz type on a Sorbo stand, and beneath is a small reading desk as in the No. 6 studio.

The "Heart" of the Van

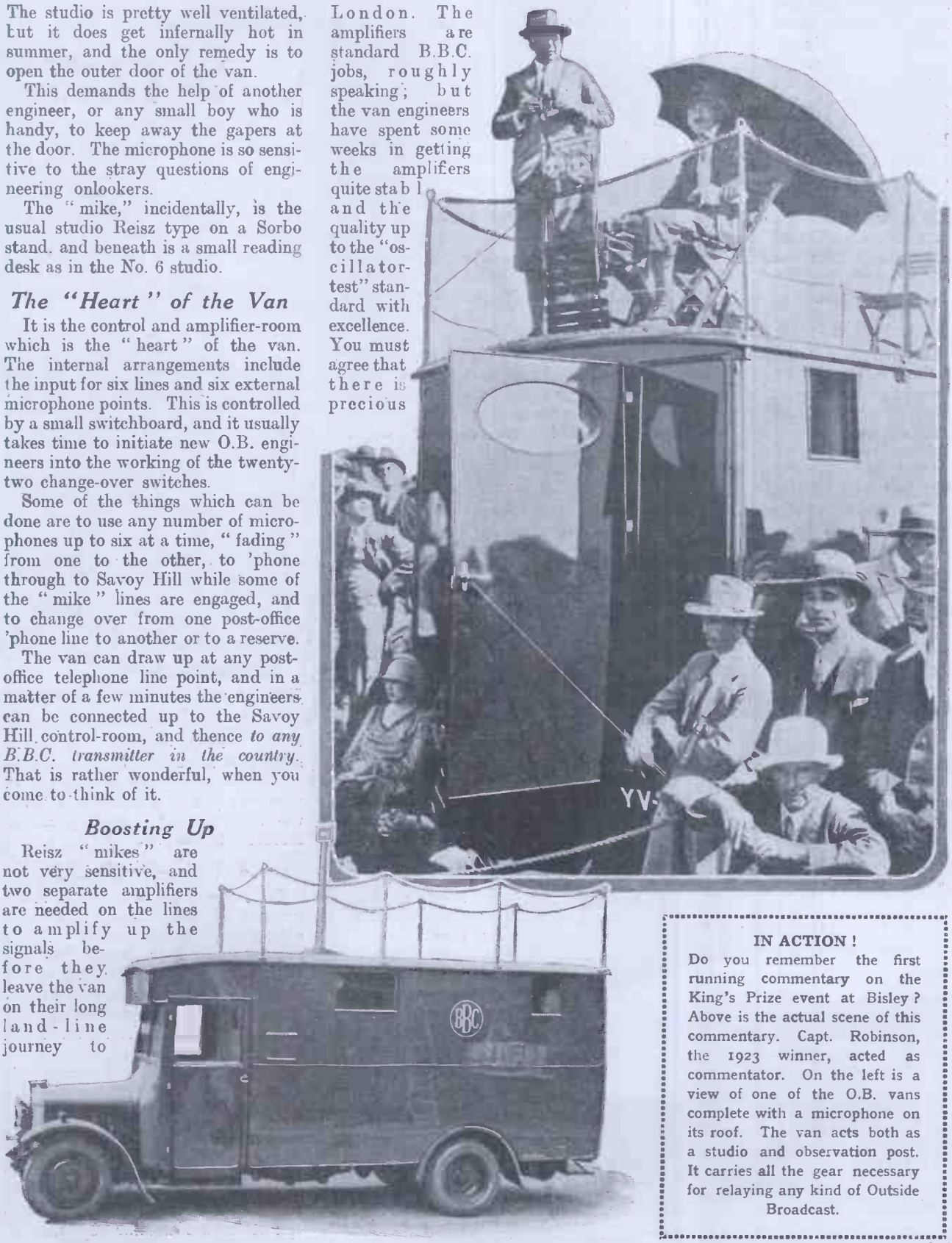
It is the control and amplifier-room which is the "heart" of the van. The internal arrangements include the input for six lines and six external microphone points. This is controlled by a small switchboard, and it usually takes time to initiate new O.B. engineers into the working of the twenty-two change-over switches.

Some of the things which can be done are to use any number of microphones up to six at a time, "fading" from one to the other, to 'phone through to Savoy Hill while some of the "mike" lines are engaged, and to change over from one post-office 'phone line to another or to a reserve.

The van can draw up at any post-office telephone line point, and in a matter of a few minutes the engineers can be connected up to the Savoy Hill control-room, and thence *to any B.B.C. transmitter in the country*. That is rather wonderful, when you come to think of it.

Boosting Up

Reisz "mikes" are not very sensitive, and two separate amplifiers are needed on the lines to amplify up the signals before they leave the van on their long land-line journey to London. The amplifiers are standard B.B.C. jobs, roughly speaking; but the van engineers have spent some weeks in getting the amplifers quite stable and the quality up to the "oscillator-test" standard with excellence. You must agree that there is precious



IN ACTION!

Do you remember the first running commentary on the King's Prize event at Bisley? Above is the actual scene of this commentary. Capt. Robinson, the 1923 winner, acted as commentator. On the left is a view of one of the O.B. vans complete with a microphone on its roof. The van acts both as a studio and observation post. It carries all the gear necessary for relaying any kind of Outside Broadcast.

How They Do O.B.'s in Germany

little flaw in transmissions such as the R.A.F. and the big horse-races. And, of course, there is much more behind these big O.B.'s than the listening public realises.

The Post Office has to lay special lines in some cases (and the cost of these has to be agreed to by the B.B.C.), and the O.B. van men have to work a fortnight or so in advance, checking up quality and arranging the positions of the microphones at the other end. I remember that at one Aldershot Tattoo broadcast the microphone lines were hidden in a deep trench dug by a company of Royal Engineers.

Accumulator High-Tension

On the night before the broadcast, whatever it may be, the charging plant in the van is switched on and the accumulators are brought up to full charge. The B.B.C. still uses accumulators for high-tension supply, except on such extraordinary occasions as the Boat Race transmission.

The Post Office telephone exchange people have to be reminded of the broadcast and the special 'phone-line arrangements, for it is easy for a London exchange girl to "break" a line accidentally—and then the van engineers get hectic!

Quite early in the day each line is tried in turn. A storm or even a heavy rainfall overnight so easily upsets long reaches of overhead 'phone line.

And if each line really is right, the quality perfect and the transmission faultless, then the B.B.C. van engineers are considered merely to have done their duty. I have been a van engineer, and I know!

The only consolation is that they have a much more hectic time abroad. A few months ago I had the opportunity of seeing a German "O.B." carried out by the Westdeutsche Rundfunk broadcasting people.

Over there Saturday afternoon football broadcasts are a regular thing, and a running commentary is given over a portable microphone carried by an engineer on the line.

A Lively Time

The microphone is carried on a stand strapped to the man's waist, and from this four 'phone lines trail off to the van standing at the gates of the ground. There are the amplifiers which boost up the signals before passing them on to the usual 'phone lines.

All the time the broadcast is going on the announcer signals to the van men by a sort of deaf-and-dumb code!

There is also another van fitted up with a 75-metre transmitter, which is used when the local 'phone lines to the station control-room is unusable.

Those engineers are not to be envied! Ordinary land-line O.B. work is bad enough and full of pitfalls, but when it comes to putting outside broadcasts through a tricky short-wave transmitter in touch with the control-room, then I hand the palm to the Westdeutsche Rundfunk!

INSIDE THE RADIO VAN

Engineers at work in one of the B.B.C.'s O.B. vans.

PROTECTING THE BATTERY

Preventing Short-circuits.

WHEN carrying a flash-lamp battery about for the purpose of testing in a portable radio tool kit it is generally a difficult matter to make sure that the electrodes of the battery will not short against some metallic object or other.

STOPPING SHORTS

How the neat little cover is arranged to protect the electrodes.

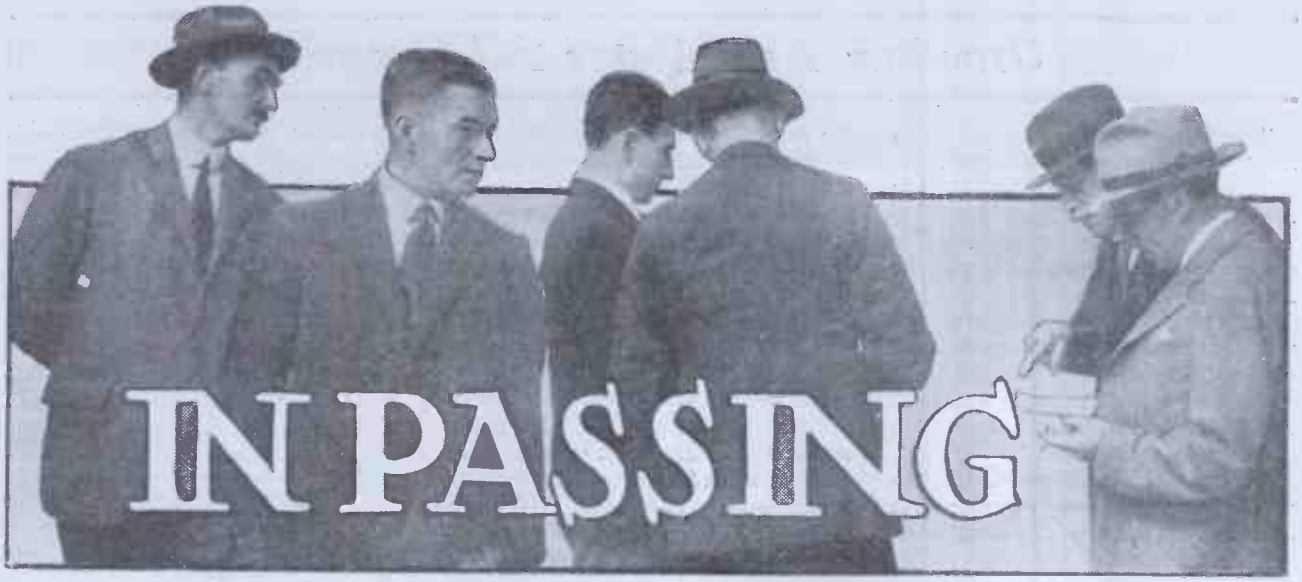
The best way to overcome an uncertainty of this nature is to adopt the method of the battery manufacturers themselves.

A Valuable Shield

Instead of a paper or card "seal" for one of the battery electrodes, obtain a rather stiff sheet of celluloid about 4 in. by 1½ in. in size. Immerse this in hot water for a minute or two in order to soften it, and then bend it over the longer electrode of the battery in the manner shown in the illustration.

The celluloid sheet will immediately harden to a permanent U-shape, and, as such, it may readily be slipped over the battery and kept in position by means of an elastic band.

A battery thus protected may be carried about in any tool kit without fear of its short-circuiting through contact with a metallic object.



IN PASSING

The True Story of a Radio Christmas

HE that is a slave to nothing and nobody may be a very choice fellow, but in my opinion he is not the sort of man to go walking with. He is not, as we say, human—in the sense that you and I are human. He feels nothing intensely, except his abhorrence for slavery. He acts

A SLAVE NO LONGER

". . . Then I waited for the return volley. . . ."

in all matters and in all circumstances like a rational being—and is thereby so hateful that I should like to push his face inwards!

They used to tell me that I was becoming a slave to radio, an abominable libel!

"Well," said Somebody, "you switch on directly you come in, sometimes before you take off your overcoat, and you have the thing blaring away till the ether has packed up and gone to bed."

Sheer Laziness

"Simply because I know that you and the youngsters like it," I protested. "When the set broke down anyone would have thought I had stopped your grub—the way you all sniffled and moaned and looked at me as though I were a baby-strangler!"

"Absolute rot! You let the batteries go to pot from sheer laziness, and then when the Queen's Hall concerts began you sent the set away to be altered, when you knew all the time that you had sizzled up its inside somehow!"

"Anyhow, I'm *not* a slave to the blessed radio. Mrs. Walker next door told Walker that *you* kept it going all day from the time the B.B.C. opens up; and her baby is teething and she wants a nap of afternoons!"

A Miserable Feeling

"I may have done so once or twice, on dull days, but I don't sit idle in a chair for hours at a stretch, waiting for some ridiculous Hamburg or Oslo to begin."

"Oh, all right, *all* right! I'll show you that I'm not a slave to the darned thing. I'll have a radio-less Christmas—and see how you like it."

"That's right! Now go to the other extreme. Just like a man!" etc., etc.

That was last Christmas. I admit that from sheer force of habit I had the batteries all shipshape, but I told the newsagent not to send the "Radio Times"; I got a spare valve—just in case some friend should come S-O-S-ing to my door on Christmas evening. Right up to bed-time on Christmas Eve the household did not realise the fact that I had determined to show Somebody that I was not such a slave to radio as Somebody herself was, and I chuckled to think of the sensation I should cause on the morrow. A little later, thinking it over in bed, I felt less joyous about it. My household refuse to pay me the respect and admiration which is due to me, and I had a miserable feeling that my squib was going to be damp.

What Malevolence!

The Day dawned. Whilst the customary greetings and gifts were being exchanged I felt like a snake in the grass. The boy fawned and frisked around the receiver—or seemed to do so—and reminded me of a puppy watching its dinner being prepared. Then Someone asked where the "Radio Times" had got to.

"Oh," I said airily—about as airily as a paving-stone—"I stopped it. As I am doing without the radio this Christmas—not being a slave to it—I saw no sense in buying a copy of the programmes." Then I waited for the return volley.

GRANDMA ARRIVES

. . . We surged round her in the hall . . .

Oh, my comrades! What malevolence a small woman can pack into one glance of her quite ordinary eyes! Somebody's eyes bored clean through me and made a couple of shot holes in the wall.

Grandma Annihilates All Opposition

"You mean—we are not going to listen in to-day, or to-morrow?"

"Precisely," I replied, baring my breast, as it were, to the stroke.

"Well, I'll tune-in myself. *You* can go upstairs if you don't want to hear."

"Oh, no! This is a radio-less Christmas. We mustn't be *slaves* to extraneous entertainment. We must play whist and musical chairs, and think noble thoughts."

"You mean it, then?"

"Yep! I have abstracted an essential part of the set, so you can switch and tune till you are blue in the face, but the response will be a citron!"

"Of all the mean—— Well! All right, my man, just you wait!"

One of the soundest notions is that the unknown holds more terror for us than the known. For example, you can exist with a known mother-in-law, but the anticipation of meeting an unknown uncle of your wife—especially if your wife warns you that "he is a bit of a rough diamond, but a real good-hearted man"—provides many *mauvaises* quarters of an *heure*, as our Gallic neighbours might say—if drunk!

Just You Wait!

Imagine, therefore, my horror when Somebody said "just you wait!" I had heard it before, and it was never worth waiting for. Quite the reverse! The result was invariably a stinger for yours affectionately. Women can be positively *ominous*, believe me! If a woman were a man one could give her/him a clip on the map and say, "Cough it up," but these feminine,

"BRITISH BEETLES"

He gave his beautiful lecture one thousand and seventy times . . .

female sort of women just look at a fellow and say "just you wait," and then become icily polite and attentive till the blow falls. Phew! Sometimes I think that polyandry is a darned good institution. It would be a plucky woman who would put it over the serried ranks of four husbands! Stout fellows all, shoulder to shoulder!

So there I was—"just you wait." I retired to my study and thought it over. What *could* she have up her sleeve? I knew that I could stave off the boy with a technical discussion of the principles of the steam-engine. The girl? Well, she would be awkward, but she was a perfect dear, and anything that daddy said went down in the end. (She knows I am the sole fount of silk stockings, etc.)

Here She Comes!

Then my eye rested—"rested" is scarcely the right word, though—on a vase which held pride of place on my fine oaken mantelshelf. It boasted at least eleven colours and made my room look like Vesuvius in Hades. The gift of my wife's mother, the strongest-minded old lady since Queen Victoria passed away! Grandma—who in less than six sentences could make a coal-heaver show her proper respect! Grandma—who had a heart of gold—plated with steel—a tongue like a cat-o'-nine tails, and about £15,000 in Rails and Government securities! Ha! Somebody was relying on Grandma, eh? And I had clean overlooked the fact that the old lady was to spend Christmas with us. When I went down for my morning bracer I was very thoughtful—in fact I was so preoccupied that I slightly overdid the gin——

Grandma arrived in a taxi; brisk, business-like and full of repartee. We surged round her in the hall and made her welcome, but there was not the slightest tincture of conviction in my contribution of "Hello, mother! Lovely to see you here for yet another Christmas. Can't be jolly without our Grandma!"

Turn It On

"Just in time to hear the bells," answered the old dear, running her fingers through her curls and lighting a "gasper."

"Ye-yes," I said, smiling faintly. "Pretty bells—St. Oswald's—wind's just in the right direction."

"What do you mean, Willie?" she retorted. "St. Oswald's? No, no! I mean the bells of Minchurch Cathedral. On the radio!"

"Oh—you mean radio! Radio, you said?"

"Willie, whatever has come over you? Radio I said and radio I mean. Why don't you turn the thing on? Put the loud speaker over *that* side—I'm a bit deaf on the left wing to-day. Poor dear Canon Chillicum, my father's best friend, was at Minchurch for sixty-five years, and these bells were his life's work, you might say. One thousand and seventy times did he give his beautiful lecture, 'British Beetles,' in aid of the Bells' Fund. Go on! Don't stand goggling there man!"

COMPLETE DEFEAT

"The joke's on you, Willie!"

"But, Grandma—I tell you it is not in working order."

Grandma opened her bag, abstracted her spectacles, put them on and glared balefully at me. Not for nothing did the tradesmen call her "Old Gimlets"! Have a good look into the eyes of the man-eating tiger when you are next at the Zoo and you've got Grandma to the life.

Abject Surrender

"You—you miserable——"

"The children—er——" I faltered.

"Run away, my beauties, and see if the pudding is boiling," said she—and they slunk, absolutely slunk away.

"Now," began Grandma, pulling up her sleeves, as it were, "what *is* all this nonsense? Here's Christmas and here am I, and you calmly stand there—don't slouch, Willie!—and tell me you have shut down the radio. If *you* can't make it work—and I'm not surprised—ask the boy to show you how to. Call yourself a wireless man? Here—where is it? I'll do it myself, old as I am, you poor, miserable——"

"All right, Grandma, I tell you it's all right—only you won't let me explain. It's just a joke on——"

At that moment Somebody popped her head into the room and said, "The joke's on you, Willie!"

So we were slaves to radio, and we are going to be so again this Xmas—or Grandma will know the reason why!

ALL-BRITISH

LISSEN TOREX

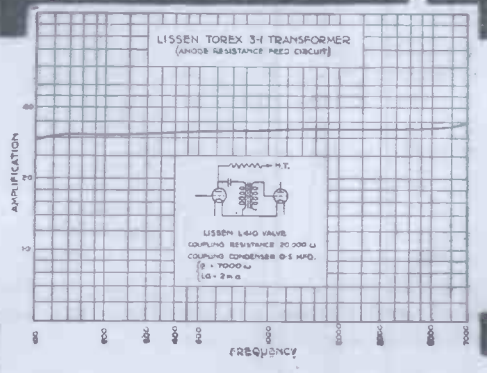
The 5/6

TRANSFORMER

WITH AN EXCELLENT CURVE!

SEE the curve of this new Lissen Torex Transformer. Notice the remarkably even amplification it reveals—almost a straight line over the whole band of audible frequencies. This is the sort of curve you expect from an expensive transformer—yet Lissen have achieved it in a transformer to sell at **5/6.**

This Lissen Torex Transformer is a neat, compact component, in a moulded bakelite case which is hermetically sealed and completely insulates the windings. It is proof against shorting, leakage and moisture.



The ratio is 3 to 1. So the Lissen Torex is a general-purpose Transformer which you can use in many different circuits. It is particularly suitable for use in an anode resistance feed circuit and gives splendid results. Test it out in your next "hook-up"—get a Lissen Torex Transformer from your dealer. **Price 5/6.**

LISSEN LIMITED, WORPLE ROAD, ISLEWORTH, Middlesex

VALVE FACTS and FIGURES

The ordinary receiving valve is full of fascination if one will only take the trouble to dig out some of the facts. The following article by K. D. ROGERS discusses some interesting data that is of vital importance to every valve user.

WE are so accustomed nowadays to take the thermionic valve for granted that we rarely think how wonderful a piece of mechanism it is.

I expect most of my readers know roughly how the receiving valve is made, but the following facts may be of interest to those who are not familiar with the process.

Water-Cooled Filaments

Beginning its history in about 1901, when Prof. Fleming first investigated the Edison "shadow" on the electric lamp, the valve has rapidly grown until to-day, just under thirty years later, it is one of our most valuable of all radio components, and ranges from the well-known dull-emitter working from a 2-volt battery to the new gigantic water-cooled valves (with water-cooled filaments, too) used for the new Polish station built at Chelmsford by the Marconi Co. These latter valves cost £500 each.

The filaments of most valves are made from pure tungsten rod, which is driven through dies of successively smaller diameters, until the wire reaches a "thinness" so small that it is barely visible to the naked eye.

Inside the Bulb

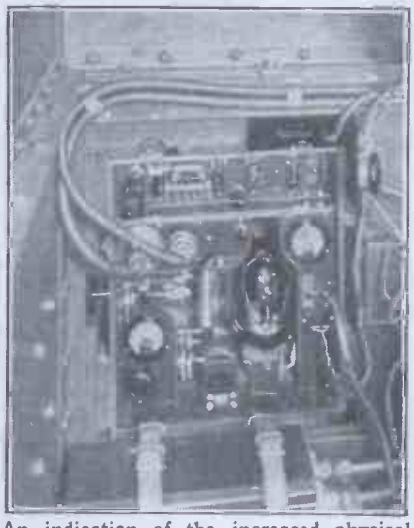
Don't forget that is not the filament you see in your valve—that is considerably thicker, because after the filament wire has been "drawn" it is coated with special oxides, or metallic salts, to give it the highly emissive properties of the dull-emitter.

Then the filament, grid, or several grids in the case of tetrodes and pentodes (wound with molybdenum wire in spiral form), and the nickel plate are assembled on supports firmly fixed in the glass "pinch" at the base of the valve.

The whole lot is placed inside the bulb, together with a small piece of magnesium on the plate or on another small support, and then the valve is evacuated on the special pumps.

Then, when sealed, the valve is placed in a high-frequency induction

TOTALLY SCREENED!



An indication of the increased physical strength of the valve is given by the fact that nowadays reliable and efficient sets are installed in what must be the world's most uncomfortable (from the valve's point of view) vehicle—the army tank.

"furnace"—the anode gets red hot, the magnesium vaporises and absorbs any remaining gas left in the valve.

The magnesium condenses on the cool glass and we get that familiar silvered look. The valve is now said to be "gettered."

The fitting of base and pins, testing the valve, and packing remain to be done, and then the valve is ready for the market.

And when you get your valve what is the first thing you do? Look at the characteristics on the box, isn't it? To find out if it's the valve you require, how much H.T. and L.T. it should have, and how much grid bias.

A Grid-Bias Rule

I wonder how many of you realise that a rough-and-ready calculation of the grid bias can be obtained by doubling the magnification factor of the valve and dividing the figure thus obtained into the max. H.T.?

Thus a valve that will take 150 volts H.T. and has a magnification factor of 8 will require $\frac{150}{16}$ = roughly 9 volts, while a valve of the P.625 calibre, with a magnification factor of 6 and max. H.T. of 250 volts, requires $\frac{250}{12}$=20 volts or so. Actually the figure recommended is 24.

This little rule is more reliable among the L.F. and small power valves than among the larger types, while it does not hold with pentodes, of course.

On the Plate

And while mentioning the maximum H.T. voltage I should like to remind readers that the figures given by the makers are those of the volts *on the anodes* of the valves. Thus a valve rated at 200 volts maximum H.T. is reckoned by the makers to be able to stand with a large safety margin a voltage of 200 on the plate. And it is with that 200 on the plate that the grid-bias figures are given.

THIS CHRISTMAS CAPTURE THE SPIRIT OF DISTANT FRIENDS

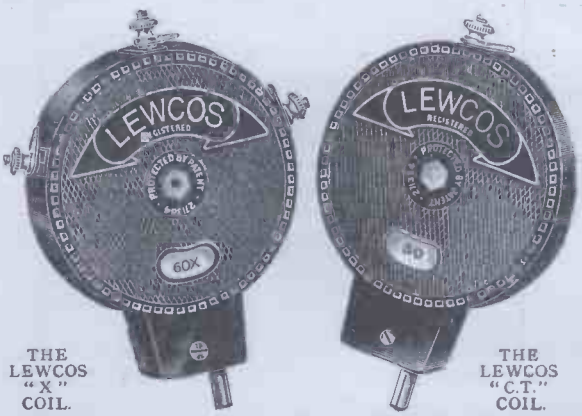
We, on our little island, are not insular-minded at any time, but at Xmas-time especially our spirit lives with distant friends, seeking to capture their surroundings and mode of life. This we can do through the medium of Radio, which brings speech and music from the ends of the earth into our homes.

In order to clarify and increase volume of reception it is essential to use the finest Radio components—Lewcos components—which are famous for their extraordinary powers of selectivity. Every Lewcos component lives up to its manufacturer's world-wide reputation for "perfection in every detail."

Through LEWCOS Regd. COILS

Lewcos "X" and Centre-Tapped Coils are specified for the "Tri-Coil" Two, described in this issue. Write for fully descriptive leaflet, Ref. R34.

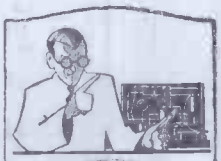
The Lewcos H.F. Choke is specified for the "Mains-Power" Three, described in this issue. The terminals of this Choke are arranged one at the top and the other at the base, to eliminate the risk of additional self-capacity. Price, 7/9 each. Write for fully descriptive leaflet, Ref. R33.



THE LEWCOS "X" COIL.

THE LEWCOS "C.T." COIL.

THE LONDON ELECTRIC WIRE COMPANY AND SMITHS LIMITED, Church Road, Leyton, London, E.10.



LEWCOS Radio Products for better reception

LARGE STOCKS OF LEWCOS RADIO PRODUCTS HELD AT ALL BRANCHES.

Look Out for that Lost Voltage

How often do valves get anything like the maximum allowable on the anodes? In the cases of S.G. valves, and sometimes detectors and in the L.F. side of the set, where H.T. is very important, it is not a rare thing for a valve to have but a half of the applied voltage.

Let us take an example. We will assume that a detector valve is resistance coupled through a 100,000-ohm resistance, and that also an anti-motor-boating resistance of 25,000 ohms is placed in series with the H.T. Quite a common sort of circuit. The valve, we will say, under those conditions takes ½ milliamp. How much of 100 volts applied H.T. is being used across the valve?

We must obviously find the working resistance to D.C. of the valve.

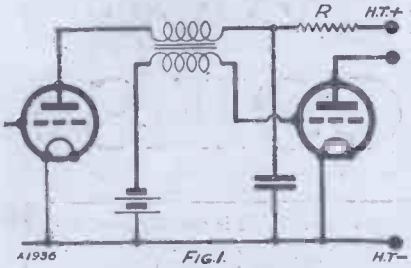
We must find the total resistance of the circuit, and then we know any resistance in addition to the 125,000 we already know about belongs to the valve.

$$\text{Now R (ohms)} = \frac{\text{Volts}}{\text{Current (amps.)}}$$

$$\text{thus R} = \frac{100}{\cdot0005} = 200{,}000 \text{ ohms.}$$

Therefore, the working resistance of the valve is 200,000—125,000=75,000 ohms.

WASTED WATTS.



In many cases the resistance R is of 25,000 or 50,000 ohms, and causes a considerable drop in H.T. across it. This should be taken into consideration when deciding the H.T. voltage to be applied.

Now, then, what voltage is being applied across the valve?

Obviously the 100 volts will be split up in the proportion of 25,000, 100,000, and 75,000; that is, there will be a drop of $\frac{25{,}000}{200{,}000}$ parts across the de-coupling resistance, a further $\frac{100{,}000}{200{,}000}$ across the anode resistance, leaving $\frac{75{,}000}{200{,}000}$ for the valve.

We therefore find that the valve has $\frac{75{,}000}{200{,}000} \times 100$ volts across it, i.e. $\frac{75}{2} = 37{\cdot}5$ volts. Not much is it?

In an L.F. stage things can be even worse, for with 37·5 volts many detectors will work quite well, but an L.F. valve with only that can hardly be expected to do much—especially if the owner makes the mistake of supposing the valve is getting all it should.

Take the L.610 (Osram and Marconi). It is rated at 150 volts, and properly biased at that voltage should pass about 3·7 or 4 milliamps.

Now the valve is not infrequently used—I have often seen it—with a 50,000-ohm resistance in the anode circuit. How much voltage has to be applied if we want 150 on the plate?

Obviously, the working resistance of the valve can be determined from $R = \frac{V}{C}$

i.e. $R = \frac{150}{\cdot004} = 37{,}500$ ohms. *Not* 7,500 *ohms*, which is the maker's figure.

Therefore, we have to arrange enough H.T. to be able to drop $\frac{50{,}000}{87{,}500}$ of the total across the anode resistance, leaving 150 across the 37,500 ohms of the valve.

100 Volts More!

Clearly, then, the voltage required is given by the following simple equation:

$$\frac{50{,}000}{87{,}500} \times V = 150;$$

$$\text{i.e. } V = 150 \times \frac{7}{4}.$$

$$\therefore V = 262{\cdot}5 \text{ volts.}$$

So we see that in order to get the correct maximum across the valve, under these circumstances, we must use over 100 volts more *applied* pressure.

A milliammeter is becoming more and more a necessity, for valve manufacturers seem to be gradually giving up the practice of telling their clients what H.T. and what grid bias to use with their power valves, and they are adopting a method that is distinctly awkward to anyone not possessed of a good milliammeter.

If you want to get the last ounce out of your set it is essential to use one or two meters while making voltage and current adjustments. A milliammeter is one of the most valuable aids to good reproduction that the set owner can have, and backed up by a good voltmeter or two will prove of inestimable value.

I refer to the practice of giving the valve's maximum anode voltage and its maximum anode current, and saying, "The valve should be biased so that the anode current does not exceed —— milliamps."

Without a meter it is difficult to do this in many cases, especially where mains units are employed and one does not possess a voltmeter capable of giving a precise reading of the voltage. (One really wants to take the voltage across anode and filament—with a high-resistance voltmeter—otherwise errors will creep in.)

"Up the Garden"

We could work out the voltage by the above resistance proportion method, but it is a tedious business, and it would be much better if manufacturers would give us more definite figures.

Of course, with a voltmeter and milliammeter one is O.K., but without—well, it is rather an unsatisfactory business to try to get the figures from the static curves, they may lead one quite "up the garden."

There are hosts of other facts and figures that could be mentioned and discussed, but space forbids and we shall have to leave them for another time.

WAVES THAT WOBBLE

By J. H. ROBERTS, D.Sc.

THOSE of you who experiment in transmission know perfectly well the peculiar vagaries to which radio transmission is subject from day to day, from season to season, and even in extreme cases from hour to hour.

Even those of you who are broadcast listeners, especially if you specialise in the reception of distant stations, must also have suffered frequently from the effects of fading and consequent difficulties of long-distance reception.

Particularly Marked

These effects are particularly marked when working with short waves, and although in some respects short-wave transmission has special and peculiar advantages, it also has some corresponding drawbacks.

From time to time we read of short-wave transmissions being picked up at almost incredible distances, although the power of the transmitter may be only a fraction of the power consumed in an ordinary incandescent electric lamp. These cases no doubt occur when the conditions are peculiarly favourable to the transmission of the particular wave-length in question.

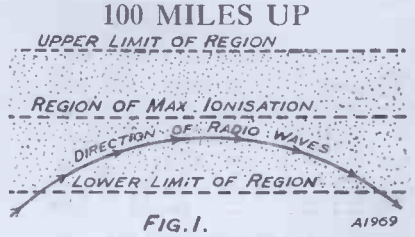


FIG. 1.

Showing how the path of the radio wave is gradually refracted in the ionised region.

I expect most of my readers have a general idea of some of the conditions which influence long-distance radio transmission, and we read frequently of the so-called Heaviside layer and other conducting and reflecting or refracting layers in the upper atmosphere.

"Fading," the bugbear of all "DX" listening, is too well known to need any introduction, but what of its causes? They are many and varied, but the chief ones are dealt with in this interesting article by our Scientific Adviser.

According to the explanations usually put forward, the theory of radio transmission would appear to be very simple, and to follow, in fact, very closely the laws which govern the transmission, reflection, and refraction of light waves.

Complicated Conditions

In point of fact, however, as soon as we look into the evidence a little more deeply we find that the conditions are extremely complicated, and notwithstanding the immense amount of research which has been devoted to this important subject the peculiarities of radio transmission and the various factors concerning it are still very obscure.

It would take many times the space I have available in this short article to give anything like a detailed account of these observations or theories, but you may be interested to have a short account of some of the experimental observations which are not so well known.

In the first place, when electro-magnetic waves are being radiated from an aerial the surrounding earth or ground acts as a reflecting surface, and the extent of the reflection (as distinct from absorption) depends upon the conductivity of the ground surrounding the aerial.

Like Light

If the ground is a good conductor (for example, wet or marshy ground) the reflection is comparatively good, whilst if the ground is extremely dry the absorption is high and reflection bad. In a general way this corresponds to the reflection of light from, say, an electric lamp which is placed above a horizontal surface.

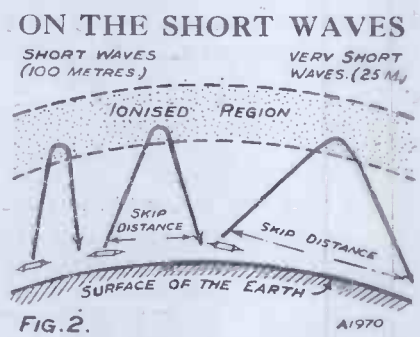


FIG. 2.

Waves of different frequencies are deflected differently, resulting in varying skip distances.

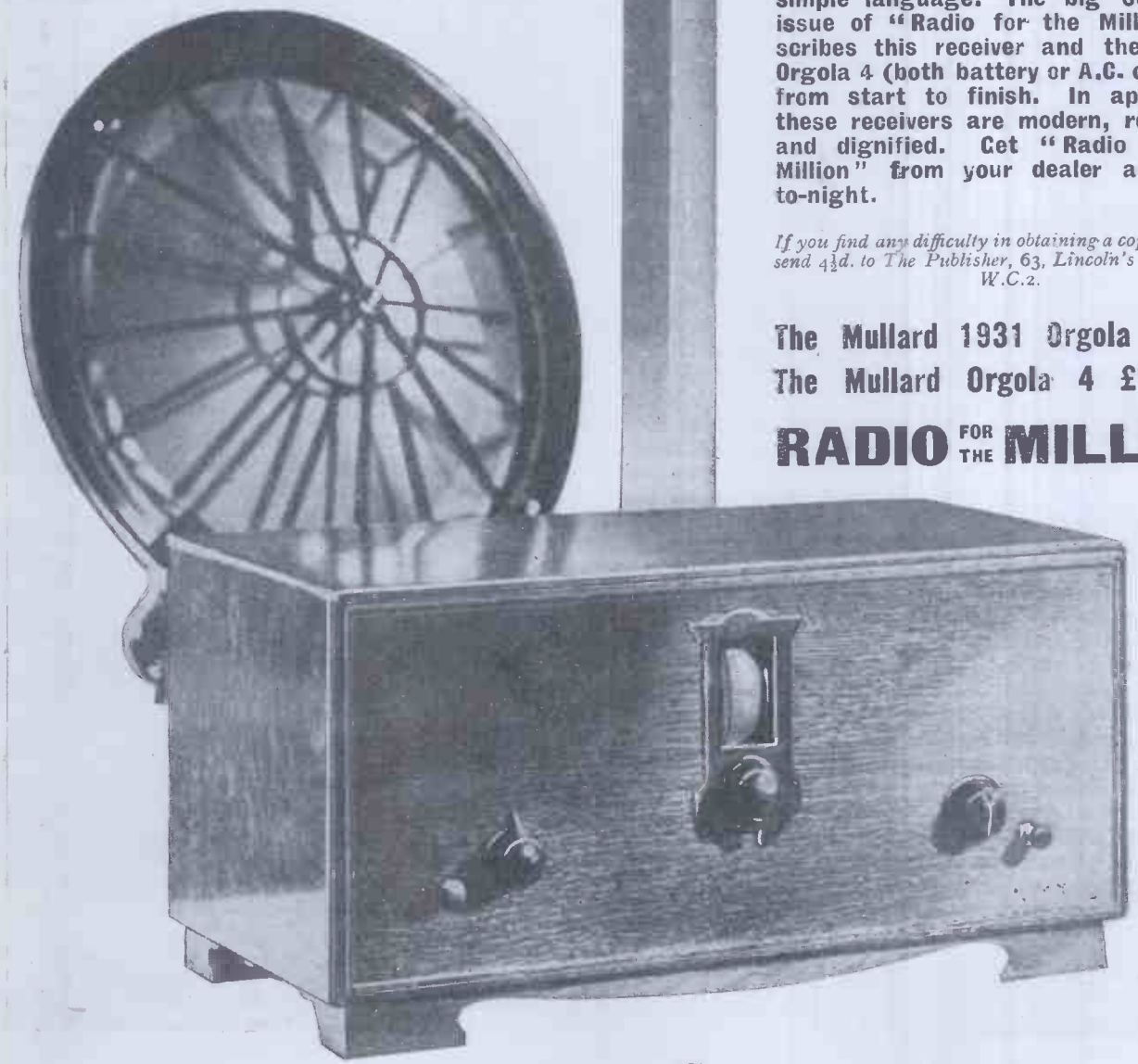
The radiation which travels upwards would obviously pass out into inter-planetary space if there were not some agency in the upper atmosphere

THE MULLARD 1931 ORGOLA RECEIVER HAS PASSED ITS TESTS!

HERE'S WHAT IT DID NEAR LONDON

The Test Engineer's Report:

"The test was conducted 8 miles from Brookmans Park with a low slung 40 ft. aerial. The two London transmissions were easily separated. As an example of selectivity Turin (291M) and the British Relays (288M) were received without a trace of interference. Zeesen and 5XX were also obtained without jamming. A preliminary search round the dial produced 5XX and 5GB Daventry, London Regional and National, Manchester, Glasgow, Madrid, Midland Regional, Milan, Hilversum, Kalundberg, Motala, Radio Paris and Huizen. Tonal quality and power were excellent. Both as regards simplicity of operation and general design, this receiver is outstanding in its class."



If radio sets wore laurels—if presentations were possible—if medals were worn . . . then we'd honour the 1931 Orgola. It did unusual things. It did interesting things. It did them extraordinary well near London.

Everything possible has been done to reduce the cost of construction to its simplest terms:—complete kits of components, big photographs, blue prints, simple language. The big September issue of "Radio for the Million" describes this receiver and the Mullard Orgola 4 (both battery or A.C. operated) from start to finish. In appearance these receivers are modern, restrained and dignified. Get "Radio for the Million" from your dealer and start to-night.

If you find any difficulty in obtaining a copy write and send 4½d. to The Publisher, 63, Lincoln's Inn Fields, W.C.2.

The Mullard 1931 Orgola £8-0-0
The Mullard Orgola 4 £13-12-6

RADIO FOR THE MILLION

Skipping About in the Ether!

which had the effect of deflecting it and sending it back towards the earth again.

These layers consist of so-called ionised masses of gas which act as fairly good conductors, and consequently a beam of electric waves on reaching such a layer at an oblique angle is refracted in such a way that it may actually be sent down again towards the earth.

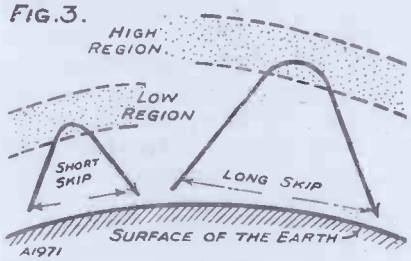
A Valuable Phenomenon

Incidentally, if it were not for the presence of these ionised regions in the upper atmosphere it is fairly certain that long-distance radio communication, at any rate on short waves, would be practically impossible.

Radiation in a direction below the horizontal, as well as the horizontal

INCREASING THE SKIP

FIG. 3.



As the ionised layer gets farther from the earth's surface, so the skip becomes longer.

radiation, and, indeed, radiation for a few degrees above the horizontal, may in certain circumstances be absorbed by the earth, and this absorption is less pronounced for short waves than for long ones.

Casting Shadows

This simple fact has the important effect that with short waves the "lower" rays can be used. Of course, the effects are somewhat complicated owing to the presence of hills and mountains, as well as large buildings, which, if close to the transmitter, may cast shadows; that is, may cut off to a large extent the radiation.

This casting of shadows is one of the disadvantages more or less peculiar to short-wave radiation. This can be simply understood by comparing with sound waves, where, as you know, the short high-frequency sound waves are much more easily stopped by a large object such as a building than is the case with the long low-frequency waves.

This is, in fact, a phenomenon which is true of all types of waves; it may be approximately expressed by saying that for the casting of shadows or for regular reflection the body which casts the shadows, or which causes the reflection, must be large compared to the wave-length.

Consequently the shorter the wave-length the smaller the body or object which can cast shadows for that particular radiation. Light waves being exceedingly short, a shadow may be cast by even an extremely small body which would be quite unable to cast shadows for even short sound-waves.

When Waves Jump

You have all heard of the so-called "skip distance" phenomenon with short-wave transmission. This skip effect is believed to be due to the reflection of the radiation from the upper atmosphere, and in one of the accompanying figures you will notice that as the reflecting or refracting layer in question is at different heights above the earth's surface so skip distance changes.

It used to be thought not so long ago that radio waves were definitely reflected from the under surface of an ionised layer in the upper atmosphere, just as a beam of light may be reflected from the ceiling of a room. Although something of this kind may occur occasionally, it is not usually the case. More generally the radio rays are refracted, that is, gradually deflected and bent over, by a region which will neither absorb nor transmit them.

Always Moving

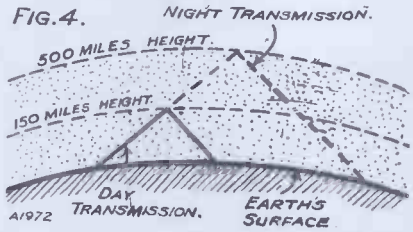
It is, however, convenient to think of the effect as actual reflection, and the term "equivalent reflecting layer" is sometimes used to mean a hypothetical reflecting surface placed at such a position that it would give the same net result as that which actually occurs in the refracting medium.

For short waves it may be said that the highest point reached by a ray is about three-quarters of the height of the "equivalent reflecting layer."

Another point which is sometimes not clear is the change in the position or height of the reflecting layer. We sometimes speak of this being higher at night than during the daytime, but this does not mean that the *same* ionised region shifts from one place to another.

"WHEN IT'S NIGHT-TIME . . ."

FIG. 4.



Night is the best time for the average short-wave transmitter, as shown above.

What it means is that at one part of the day the atmosphere is in the necessary ionised condition at a certain height, whilst at some other part of the day, or at night, it is some totally different layer of the atmosphere which is ionised.

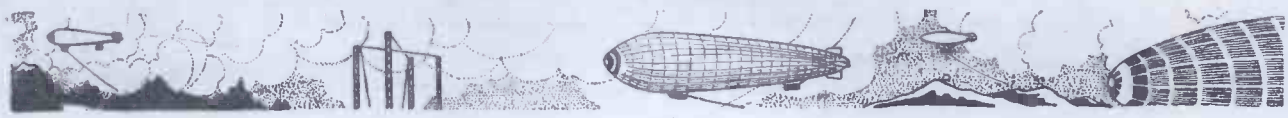
Well Above the Earth

As I have already said, it seems to be impossible to obtain any hard and fast data as to the variation of the electrical layers, but generally speaking the layers are lower in summer and higher in winter; lower in the daytime, higher at night; whilst they occupy what may be called intermediate positions in the early and late parts of the year and also in the early mornings and late afternoon.

The effective height under different conditions has been given somewhat as follows: Summer day, 50 to 100 miles; summer night, 150 to 200 miles; spring or autumn day, 80 to 150 miles; winter day, 100 to 150 miles; winter night, 300 to 500 miles. It is believed that over the Poles the layer is probably very low in the summer, owing to perpetual daylight; and very high in the winter, owing to continued darkness.

Now having drawn a general picture of the conditions which affect the

(*Continued on page* 673.)



WHAT RADIO DID FOR JERRAM

A very Christmassy story of a lonely business man, an impulse, and a radio romance.

By Higham Burlac.

TONY JERRAM checked the pounds column, jotted down a figure, and grunted in a non-committal way at the thought that the day's takings amounted to £83 9s. 4d. "Ten pounds down on last year! This Empire stuff flooding the market!" He flung his pen at the tray, snapped the brass fastener of his day book, locked the book up in his desk and straightened his back, sighing with relief. So that was over for twelve months! An infernal rush and tumble, this Christmas Eve trade in the establishment of A. Jerram, cigar importer.

A Day's Work Done

Now it was 10 o'clock, and A. Jerram was alone with his imported cigars, his pipe tobaccos, his cigarettes, snuff, and the day's takings. The manager, Jack Hooper, the errand boys, the packers, counter hands, clerks and cleaners, all had severed their apparent connection with A. Jerram and his cigar warehouse and scattered—Heaven and they alone knew where to. Even the painted Indian, who stood just inside the front door, his worn wooden nose evidence of the competition for his possession which raged between the local medical colleges—even "Sitting Bull," as Bart's called him, seemed to have given up trade definitely, irrevocably, for three days.

"Better get out, I suppose," thought Tony. "Bit chilly!" He lit a cheroot, put on his muffler, overcoat and hat, tried the handle of the safe, and then, as an afterthought smote him, opened the safe and took out twenty pounds, in ones and halves, stuffing them into his hip pocket. He shut the safe, switched out the light and made his way through the shop, dim as a cathedral, one small jet of gas flickering for the benefit of the zealous policeman. He stopped at the counter and, for some reason which seemed to him to have no solid basis, took up and pocketed a box of a hundred Egyptian cigarettes. "Never know!" he muttered. "Ought to write a chit for 'em! Do it on Thursday."

Outside, he changed his identity, and became one of "London's myriads." "Nar then, Carnera," grumbled a match-seller whom he accidentally jostled. Was the world really "all's right," when a purveyor of matches spoke thus to the sole owner of "A. Jerram, cigar importer," with nineteen branches and six foreign agencies? Home! Home! Where one is lord and master—of all except Mrs. Makeham, the housekeeper.

Nothing To Do!

Tony Jerram possessed neither kith nor kin, neither wife not child; not even a dog, canary or tame rat. Mrs. Makeham was just so much vocal furniture; no one had ever discovered in her any essence of humanity; no

XMAS PAST AND XMAS PRESENT

For years Jerram had pursued the same quiet existence, and then——!

She Introduced Him to Radio—and Romance!

being afflicted with human emotions could cook so diabolically, so magically perfect as she. Nothing is recorded of any Mister Makeham. Not even the date of his death is known; Tony believes that he is a myth and that the Makeham adopted the "Mrs." for professional purposes. So there is the groundwork—one Cigar Importer and one Mrs. Makeham; the C.I. aged 44 and the "Mrs." long past the curious, critical, cruel age of fifty. Christmas Eve, pots of money, nothing to do, nowhere to go, no one to call, nobody to talk to, drink or gamble with, make love to, murder, or read Browning to. Home, home! Where one will eat a divine supper, smoke a divine pipe, shuffle over the pages of the latest novel and roll into bed—as before!

"Good-night, Mrs. Makeham!" "Ah—good-night, Mister—er—Jerram!" Bang! The bolt of the front door. Click! The light in the hall. Yow, yow! Next-door's terrier-pup! Faint gramophone blare through the wall! The roar of a distant train! Sleep! Oh, Hades! What is life for?

On Impulse

This picture of an infinite series of pictures took about four-fifths of a second to pass across Tony's mental screen. The revulsion was so violent that the man in the opposite seat of the train was led to believe that Tony was wrestling in spirit, being possessed of religious mania. For Tony said aloud, roundly, and with emphasis, "No! By Gumps!"

A man in another corner, who had begun his Christmas rejoicings two days before, sat up abruptly and exclaimed, "Qui' ri'." This gave strength to Tony, who felt that every little helped.

At the next stop Tony alighted and made his way to a telephone booth. He positively would call up Jack Hooper at the Camberwich Athletic and Social and borrow a radio set for Christmas. Jack was a man who lived for cigar importing, football and radio; he had sung the praises of circuits—beastly things, which Tony vaguely associated with electric bells or judges—until Tony had come to think that radio is synonymous with glue-pot or fretsaw, but now in desperation Tony was clutching at what he thought might be the hencoop or plank to float him to solid earth on a sea of dance music and dissertations.

"Don't Laugh!"

"That you, Jack? Jerram speaking. Don't laugh! I want to borrow one of your numerous wireless sets to amuse me during Christmas. A bit tedious, y'know, without anywhere special to go. Eh? No, thanks all the same, Jack, but I won't intrude upon your family circle at Christmastime. Much too sober and sedate. Eh? You'll telephone home and ask 'em to have it ready? Thanks awfully! I'll take a taxi and gather up the gadgets. Who? Evelyn? Oh—your sister! Not that kid who came to the beanfeast in August? Sorry, sorry! thought she looked a kid. Can't tell how old they are nowadays. Well, so long—have a good time!"

The "Kid Sister"

So Evelyn was to be at home and deliver one radio set complete, Jerram, for the use of! Hum! Lucky Jack disclosed that she was twenty-four years old! Else he might have talked about dolls or school!

He told the taxi-driver to wait, and performed Teddy Brownishly upon the knocker. The door was opened immediately. "Watching for me," he thought. "Er—I'm—er—that is . . . ." He did not know whether to say "Jerram" or "Mister Jerram"; after all, he was Jack's boss. Horrid doubt! "My name is Jerram," he said, and was seized with a fear that Evelyn might reply, "Well, what of it?"

"Come in, Mr. Jerram! Jack's been through on the 'phone and the set's all ready."

"Er—thanks! Sorry to be such a nuisance—Christmas Eve and so forth. Awfully good of you all to bother." He hung his hat and stick on a ram's horn which sprouted from a wall, and followed Evelyn into a room furnished with radio receivers, whole and in bits. Ordinary furniture was represented by a settee and a table (covered with apparatus). Apparently nine volumes of every radio publication, in single issues, occupied the settee and the floor.

"She's Nice"

"Isn't it a mess?" said the lady, shaking a curly black head, as though in disgust. "Jack is the untidiest man that ever—well, I'm as bad as he is, almost. Now, I'll just finish wrapping up the set! Can I offer you anything? Coffee? Cocktail? Gasper? No?" Hey, presto! Gone!

Tony improved his seat on a pile of "Home Radio" and thought, "What am I doing here? I believe I'm nervous. She's nice. Ha! she said the set was all ready, and now she's *getting* it ready. That taxi is waiting. I don't know how to fix the set or work it. What a mess! Why does Hooper leave his books all over the floor? I'm fearfully hungry. Cuss Christmas. No, not at all. But—look where I am."

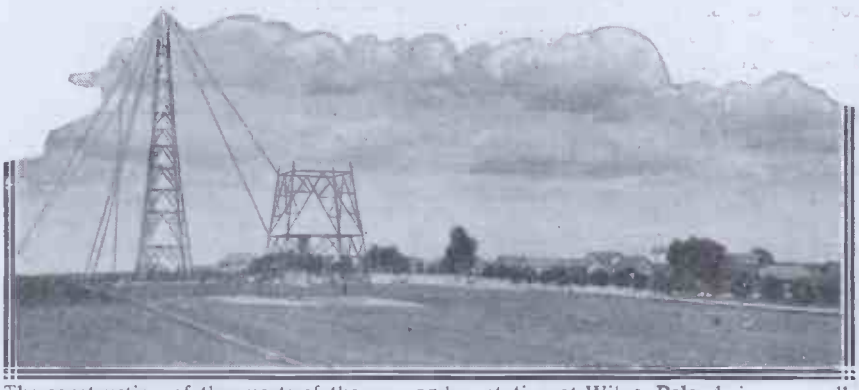
Paradise—For One?

"Here we are," said Evelyn, bouncing into the soliloquy like a terrier into a placid pond. "I'll help you carry them back to the cab. Be careful of the valves, though. And don't forget to orientate the set to Brookmans. Oh—and the reaction on this set is apt to be fractious, so look out!"

This gibberish—or Chinese—or Esperanto—occupied Tony's mind fully as between them they carried a portable, some boxes of valves, wire

(*Continued on page 666.*)

WILNO'S NEW STATION



The construction of the masts of the new 15-kw. station at Wilno, Poland, is now well advanced, and the station should be using them within a few weeks.

GET THOSE DISTANT STATIONS WITH NEARBY STRENGTH

TUNGSRAM Barium Valves have a performance scarcely matched by valves costing considerably more. Whatever programme you choose, music from Motala, a talk from Turin —TUNGSRAM Barium Valves bring it to you with the strength and clarity of a nearby station. And TUNGSRAM Valves have these additional advantages. Their unsurpassed performance gives to your set volume, glorious tone, clear-cut selectivity. Their long life and economy in battery use mean a substantial saving in the cost of your radio.

L.F., 5/6 ; H.F., 5/6 ; R.C., 5/6 ; Power, 7/3 ; Super-Power, 8/- ; A.C. Indirectly-Heated H.F. and L.F., 9/6 each ; A.C. Directly-Heated Power, 9/6 ; A.C. Directly-Heated H.F. and L.F., 7/9 ; Rectifying Valves, 10/- each. Tungsram Photo-Electric Cells, Nava E., £2 17s. 6d., Nava R., £3 3s.

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TUNGSRAM ELECTRIC LAMP WORKS (GT. BRITAIN), LTD.,
Radio Dept., Commerce House, 72, Oxford Street, London, W.1
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V.P..13

PRESERVING POWER

The economical running of a radio receiver is often of much importance, but waste of the power supply can occur only too readily, as shown in this article.

By a Correspondent.

How often does your set crackle and how often do you find that when there is a particularly interesting item on reception is not as good as it might be, or that the whole thing gradually fades away, and you are left with either distorted results or silence? These contre-temps and many small and obscure faults can usually be traced to the batteries.

Where Was the Fault?

For instance, the other day I was troubled with crackling in my own receiver and I could not trace it for a long time. I tried all sorts of cures, including a new mains eliminator (for I was not using H.T. batteries), another L.T. accumulator, and all the wires and connections seemed all right. I changed various components at the L.F. end of the set, even going so far as to change the valve holders, although I could find no fault in them.

The crackling seemed to stop sometimes, but always it started off again, and it was worse than ever. It was only an intermittent crackle, coming on occasionally, and was not particularly annoying except at widely spaced intervals, when it was a bit louder than usual.

Questions of Cost

What do you think the trouble was? The grid-bias battery. It was an old one. As a matter of fact, I had it in use for well over a year, and although it looked perfectly O.K., and had quite a good voltage, yet there were one or two cells in it which had obviously dried up and the battery wanted replacing.

That little story points its own moral. But replacing a battery is not a cheap task in some cases. For instance, your H.T. battery may cost anything from ten shillings upwards, and one does not like to have to replace that very frequently; in fact, to economise in batteries is one of the aims of the majority of listeners. But we can economise in the wrong way.

Suppose we have a three-valve set, and suppose that the total current required by our valves when properly biased and working at an anode voltage of, say, 120 is 12 milliamps. What sort of battery do we work them from? If we have a mains eliminator, then, of course, this does not apply, but if we use dry batteries, or wet accumulator for H.T. for that matter, what battery do we work them from? How big is it? How much does it cost?

Is it one of those small 60-volters which can be bought for about seven shillings upwards, or is it a large double- or triple-capacity battery?

True, the large batteries are more expensive—and when I say large I mean large in capacity, not necessarily voltage—but the initial expense is more than justified in the service which the battery will give.

About Accumulators

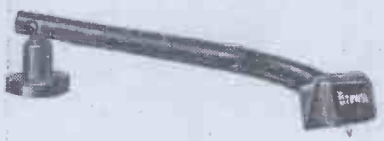
Ordinary small H.T. batteries are only designed to supply about 7 milliamps at the outside, and if our set takes more than that then you must get a larger H.T. battery if you want economical running.

Now about the accumulator. How often do we have it charged? When it runs down, I suppose. But how often does it run down? We should not take from it more than about a tenth in amps. of the figure on the case denoting its actual ampere capacity.

What I mean is this. If our accumulator is marked 20 ampere hours (actual), are we taking more than 2 amps. from it? If so we are likely to shorten the life of the battery.

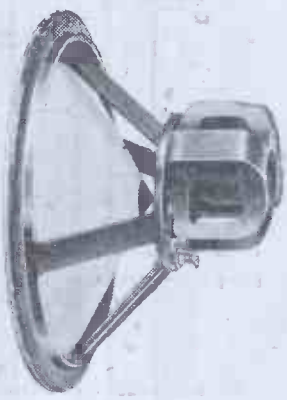
PARIS HEARD IN WASHINGTON

To mark the closing of the first session of the Congress of Inter-Allied War Veterans, at Washington, a broadcast was relayed throughout the States of a bugle call sounded at the Unknown Warrior's grave in Paris.



The **Brown** No. 4 Pick-up and Tone Arm. Price complete £3 3s.

LET



The New **Brown** Moving Coil Movement. Price £4 4s.

SPEAK YOUR CHRISTMAS GOODWILL!

CHRISTMAS—fun and frolic—let this one be even merrier than the last. Buy a **Brown** instrument, and its sweet music will gladden the festive time. Give **Brown** Radio this Christmas, too—let others enjoy this Yuletide. **Brown** Loud Speakers and Receivers give the very best in Radio performance—in range, volume, and in tone.

The **Brown** No. 4 Pick-up and Tone Arm is a great advance on former pick-ups. It gives greater volume (with an even quality of response)—sufficient to fill a ballroom when used in place of an orchestra. Tone arm designed to minimise wear on records. Provision made to facilitate changing needles. Complete £3 3s.

The **Brown** Duplex Loud Speaker. Its tone and powers of reproduction are amazing. Hear it and prove this for yourself. You'll agree, too, that its handsome appearance foreshadows its performance. V.10, Oak, £5 0s. 0d.; Mahogany, £5 10s. 0d.; V.12, Oak, £7 0s. 0d.; Mahogany, £7 10s. 0d.; V.15 (fitted with pitch control), £12 10s. 0d.

The New **Brown** Moving Coil Movement is one of the greatest **Brown** achievements; this new Permanent Magnet Moving Coil Movement has real moving coil quality. It reproduces the low notes rich and full—and the high notes purely and sweetly. Can be fitted to any Receiver. In handsome Mahogany case, it costs £6 15s. The price of the Movement alone is only £4 4s.

The **Brown** Screened Grid 4-Valve Portable Set. In fine Walnut Cabinet, fitted with a special **Brown** Movement for Portable Sets, this Receiver is fitted with a ballbearing turn-table and provision is made for connecting to additional Loud Speaker and Pick-up if required. The Batteries and Accumulators (unspillable) are of larger capacity than is usual for portable sets. Price, complete with valves, batteries, unspillable accumulator, turntable, tested and calibrated. Walnut, £19 19s.

The **Brown** Duplex Loud Speaker.

As British as Britannia

S. G. BROWN, LTD.,
Western Avenue,
N. Acton, London, W.3.

The **Brown** Screened Grid 4-Valve Portable Set.

THAT NECESSARY NEEDLE

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

Some fascinating facts of particular interest to radio-gram users.

THE record has been played through.

A slight turn of the screw, and the pick-up parts company with its needle. The latter, indeed, has had a short life and, often enough, a gay one. After its five or six minutes' journey through the tortuous track of the record, it is—or, at least, it *ought* to be—relegated to the instrument's "used needles" container, never to function again as a sound-reproducing stylus.

Despite its short-lived performance, however, an ordinary steel needle is a long time in the making, and its manufacture is one which calls for constant and regulated attention.

The Starting Point

High-quality steel wire is the starting-point in the production of radio-gram needles. It is first subjected to chemical and physical tests in order to make sure that its qualities are up to the standard required.

Next the wire is subjected to tension in order to render it perfectly straight throughout. Lengths of the straightened wire are then cut up by machines into pieces each approximately the length of the finished needle, each of these small lengths subsequently being trimmed and pointed by ingenious mechanical means.

Needles at this stage of manufacture look very like the finished product, except that they are duller. However, they are totally unfit for playing purposes, owing to their softness. It is therefore necessary for them to undergo the operation of tempering before they are fit for use.

The Polishing Process

The tempering of the needles is usually carried out by heating them in small furnaces to a high temperature. The process is one of the most vital in the whole range of needle manufacture, and the temperature of the furnaces in which the needles are heated have to be very accurately controlled.

In consequence of this tempering, the needles become very hard. They become brittle also, and they acquire a crystalline character internally.

After tempering, the needles are still unfit for playing. Large numbers are dirty and discoloured, and they have minute irregularities on their surfaces which would not only result in an unwanted degree of friction between needle and record, but would also cause many of them to fit badly into the pick-ups or sound-boxes.

Consequently, the needles have to be polished. It is rather a curious operation this needle-polishing process. Fine emery powder is mixed into a paste with oil, and the needles are stirred into the mixture. Masses of this emery-oil paste containing the needles to be polished are packed into sausage-shaped bags and then placed in a machine which rolls the packages about under pressure for a period varying from two days to a week, according to the exact type of finished needle required.

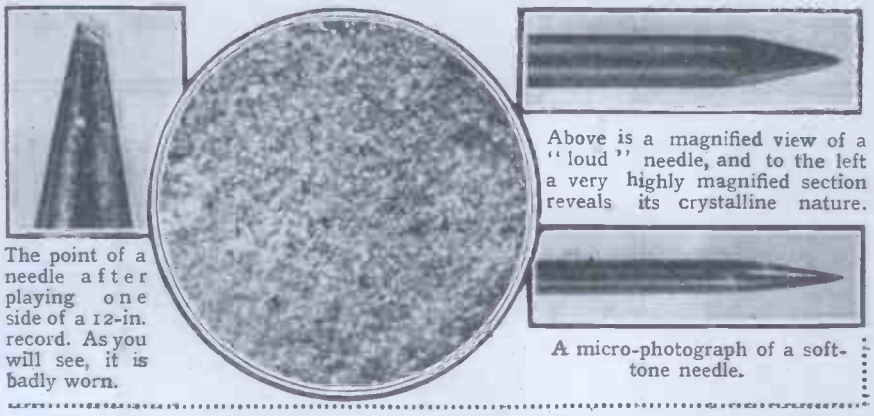
A Long Journey!

At the end of this time, as you may easily imagine, the needles present a rather undesirable appearance, covered over, as they are, with oil and emery paste. However, the latter mixture has done its work, and the polished needles are subjected to a cleansing treatment by immersion in a bath of boiling soapy water.

Finally, they are rinsed, dried in hot, clean sawdust and then packed into their familiar little metal boxes by automatic machines.

During its working minutes the needle has quite a lot to put up with. It traverses a track about 200 yards long during the course of a 12-in. record's playing.

NEEDLES UNDER THE MICROSCOPE



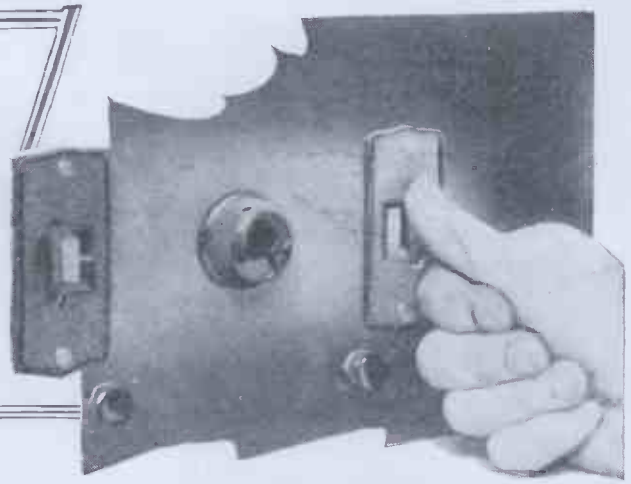
The point of a needle after playing one side of a 12-in. record. As you will see, it is badly worn.

Above is a magnified view of a "loud" needle, and to the left a very highly magnified section reveals its crystalline nature.

A micro-photograph of a soft-tone needle.

Tuning Troubles

by M.G. Scroggie, B.Sc.



THERE is little doubt that the most usual type of British receiver for broadcast reception is that which makes use of two tuned radio-frequency circuits, one at each end of a valve, which is, or should be, of the screened-grid species.

The simpler types of instrument with low-frequency amplification only, or untuned H.F., are hardly adequate for present-day conditions except for local station reception, and may not be ideal even for that.

Linking Variables

On the other hand, the multi-stage ganged-circuit receiver which is universal in America is still very much a minority in this country, for various reasons which need not be discussed here.

Attempts to simplify tuning by linking the variable condensers under the control of one knob have not been outstandingly successful in the case of the two-circuit tuner.

That D.X. Itch!

Almost invariably one circuit is associated with the aerial, whilst the other is a closed circuit; consequently, the electrical dimensions differ considerably and cannot always be brought into step by any reasonably simple arrangement of pre-set trimming condensers. This is more especially so when an open aerial is used.

Further, the moderate amount of H.F. amplification yielded by a single stage, and the immoderate desire for range possessed by the owner, result in the liberal use of reaction, or, alternatively, ultra-low-resistance circuits. In either case the slightest departure from perfect ganging causes a swift descent from the alpine steepness of the resonance peaks and corresponding dissatisfaction on the part of the operator.

This is connected with the psychological observation that the owner of a single-control receiver itches for another knob, with the object of getting the ultimate fraction out of the set.

What is the ideal method of controlling tuning?

The difficulties of providing satisfactory control in multi-valve sets are discussed, and solutions suggested in this extremely practical article.

As is usual when a dilemma is encountered, some sort of compromise is attempted. For the purpose under discussion this usually takes the form of a ganged control with provision for a limited degree of independent adjustment.

There are various ways of doing this. A simple method consists of the addition of a small auxiliary variable condenser in parallel with one of the main condensers. Preferably the latter is made slightly deficient in capacity, so as to allow of variation either side from normal by means of the "trimmer."

Auxiliary Controls

Another way of obtaining substantially the same result is to arrange the auxiliary control to rotate the "stator" or group of fixed plates of one main condenser through a small angle. This is not exactly equivalent to the first method if the condenser is other than of the "straight-line capacity" type, because the capacity change for a given movement of the auxiliary control depends on the setting of the main condenser when the latter follows some sort of fancy law.

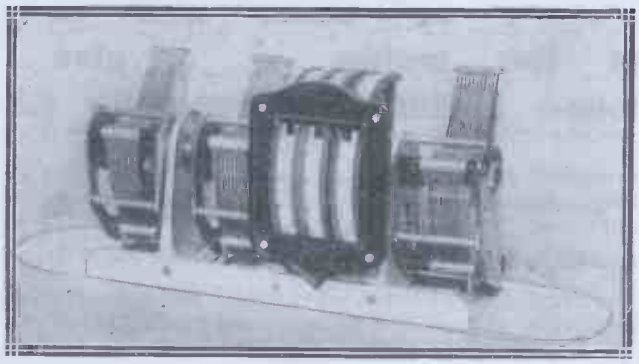
An elaboration of either of the foregoing which is sometimes used causes the auxiliary control to vary the capacity of both circuits simultaneously in a differential manner; thus when the capacity of one is increased, that of the other is decreased.

"Double Drums!"

The assumption underlying this idea is that when a station has been roughly tuned in with the main control the settings of the two condensers individually will lie equally on each side of the exact tuning points.

Of course, the auxiliary control need not take the form of an extra knob; it may be like the winding button of a watch, which engages different mechanism when it is pulled out slightly. Or an axial movement of the main control may serve to effect the trimming.

"SEPARATE—BUT GANGED"



A type of triple variable condenser which can be tuned as a whole or as three separate units, thus combining the advantages of linked and separate tuning controls. A very good method.

In yet another system of semi-gang control two discs or drums are employed, attached to the respective tuning condensers, and located close together so that one finger or thumb can move both simultaneously.

The digit is sometimes assisted in this performance by the provision of friction between the two discs. This scheme may be carried to the extent of a definite coupling between the two, save for enough backlash to allow of one condenser being rotated through a small angle independently of the other.

"It is a good plan to put the trimmer on the aerial circuit, because when no reaction is used the tuning will be flat anyway, but when selectivity is really required and reaction is pressed into use the trimmer is in the right position to do its work."

It is then not essential for the two controls to be very close together. A simple form of coupling is a stud projecting from one disc into a recess in the other. If the recess takes the shape of a slot, any desired degree of independence may be imparted.

Misleading

These devices, while falling short of the maximum simplicity of true single-control, at least guarantee that the two circuits are never outrageously out of tune, as they usually are when a two-control set is operated by a duffer.

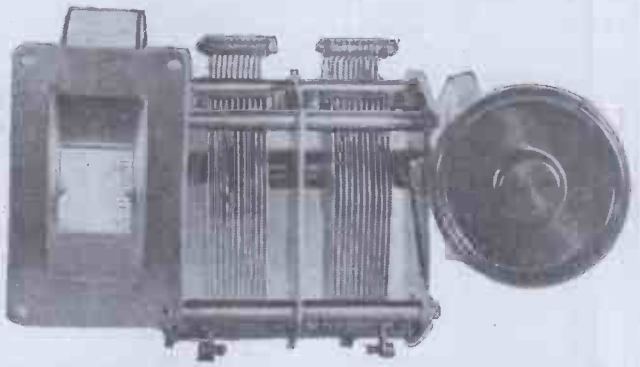
But actually they may tend to give a false feeling of security unless used intelligently, and that is precisely the manner in which we must assume they will not be used. To appreciate exactly what advantage, if any, is to be gained by semi-gang control, it is necessary to examine the action of tuning a little more closely.

This can best be done by looking at some experimental results, which the reader can easily verify by means of a two-control receiver, a convenient steady oscillator such as a local broadcast station, and if possible a milliammeter in the anode circuit of the detector valve for the purpose of converting it into a rough valve voltmeter. Visual observations are much more convenient and reliable than aural ones.

Two Damped Circuits

Reference has already been made to the importance in the present connection of the sharpness or otherwise of resonance. "Flat" circuits can easily be ganged without sacrifice of efficiency.

WHERE A TRIMMER IS NEEDED



Single-knob control of ganged tuning can be greatly improved by the use of a trimmer on one condenser section.

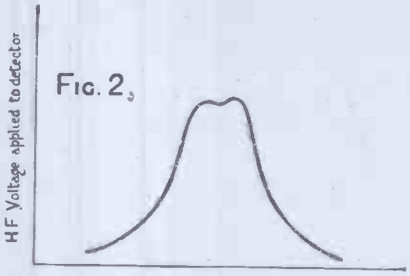
Let us assume first of all the rather improbable case of two equally damped circuits. If they are considerably out of step two equal resonances will be observed, as in Fig. 1.

Looking for the Humps

This is where the intelligence of the listener is in demand. If method A trimmer is provided, i.e. the type which varies the capacity of one circuit only, and that circuit happens to be the one which is in tune, then from the operation of it the person of only moderate experience will arrive at the conclusion that he is already as well off as he can be, as he may not think of looking for the other hump.

And if the circuit which is out of tune for the wanted station happens to be advantageously set for some other station, the impression gained of selectivity will not be high. If, however, the operator is fortunate in selecting the right peak, he will find that by moving the trimmer he can bring the other circuit also into tune, with vastly improved results both in

AN INTERESTING CASE



A double-humped effect is often obtained.

selectivity and sensitivity as indicated by the dotted curve.

If the detector is of the square-law type, then the improvement will be even larger than that indicated. Now if the two circuits are only slightly out of step, either by more accurate alignment or by previous adjustment of the trimmer, a flat-topped resonance results (Fig. 2).

Two Peaks

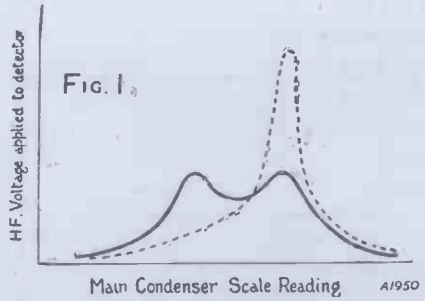
The discrepancy may not be noticed, and again the selectivity and sensitivity make a poor showing, though quality of reproduction will be good in respect of high notes.

The listener is likely to tune to the centre of the peak and the sequence of events is that he brings one circuit more into tune by the trimmer, and then because both circuits are affected by the main control he knocks it away again in trying to bring the other to the mark.

The differential type of trimmer may be designated method B. The result of using it, when tuned by the main control to one of the peaks, is either to separate or to close up the two. Neither of these effects is of any use, and our intelligent listener must step in, spot the two peaks, set the

The use of a ganged variable condenser is often quite unsatisfactory where two tuned circuits are concerned, a trimmer or the possibility of tuning each section separately is required if perfect control is to be assured.

COMBINING THE HUMPS



The effect of a trimmer in increasing selectivity in a set with two tuned circuits.

Don't Forget the Non-Technical Members of the Family

main control midway between them and then close them up with the trimmer.

Starting from Fig. 2, however, method B is just right, even in unskilled hands, and incidentally forms a rather useful tone control if the circuits are really sharp.

Method C, in which there is no trimmer, but two controls which can either be worked simultaneously or independently at will, is better when the separate peaks exist, because when one resonance has been obtained it is natural for anybody to try each of the controls in turn and the right one will soon be found.

Lastly, method D, with the lagging condenser, is interesting. If the amount of backlash is sufficient, the circuit directly controlled is always the one which comes into tune first, and therefore the other is always the correct one to move for fine adjustment.

This procedure fits in with one's natural inclination, and there is no likelihood of being misled. Against this must be set the disadvantage that whenever the main control is moved the trimming adjustment is lost and must be regained for each tuning point.

Not Very Practical

If the trimming adjustment when once made applies fairly accurately all over the scale, then this disadvantage is serious and method C is preferable.

The case of two equally damped circuits, though easy and instructive to consider, is not a very practical one. Almost invariably one circuit is sharper than the other; call it S for convenience, and the other one F. It is found that even with S only slightly sharper than F, the resonance when S is in tune is so much greater than that when F is in tune that the former will almost certainly be selected.

If the method A trimmer acts on S, therefore, it will be entirely ineffective and misleading. The obvious thing is to connect the trimmer to F. In practice F is usually the anode circuit so long as reaction is zero; but as reaction is increased the anode circuit overtakes the aerial circuit in sharpness, and at the threshold of oscillation is enormously sharper. This creates rather a nasty problem.

Trimming the Aerial

The best way out of the difficulty is to put the trimmer on the aerial circuit, because when no reaction is used the tuning will be flat any way, but when selectivity is really required and reaction is pressed into use the trimmer is in the right position to do its work.

Unless the aerial circuit is so very good as to be comparable with the anode circuit assisted by full reaction, the trimmer adjustment is not so vital as to be a serious let-down even if misused.

Method B does not show to advantage under the S and F conditions, for the reason that it is unlikely that one would tune initially midway between the resonances, even if they are both noticed. Operation of the trimmer is, therefore, likely always to reduce the reception, and thus be most confusing.

Comments on method C are precisely as before.

Method D, however, is seen in a still less favourable light, because, as with A, success now depends on whether the primary or driving control serves S or F. If S, then all is well, but if it tunes F, and the F resonance is too small to be noticed, the system is exasperating in the extreme.

What happens is that the control is moved round until S is past the summit of its peak (for one cannot locate the summit until it has been overstepped).

Intensely Irritating

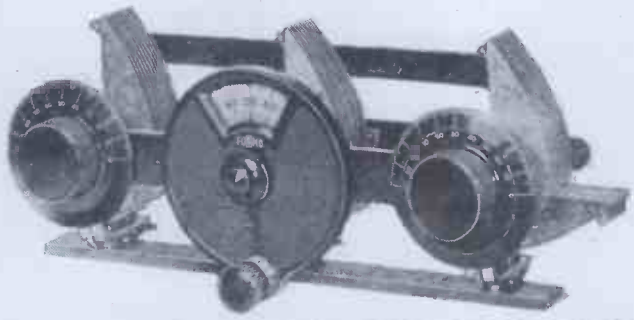
The control is now moved back a bit to recover the best setting, and annoyance is pardonable, for it is discovered that instead of doing so the S condenser is left standing, while the F resonance adds to the confusion in proportion to its influence on the strength of reception.

It is possible to get the hang of this system when the principle is understood, but it is likely to be intensely irritating prior to this state being reached. These effects can easily be studied with the assistance of two strips of paper moved after the fashion of a slide rule against a stationary reference mark.

Each strip should also bear a mark to represent the correct setting for resonance when it coincides with the fixed mark. All the semi-gang

(*Continued on page* 670.)

THREE-IN-ONE



A three-sectioned condenser in which each section can be separately tuned, or all three varied at once by using the centre control only.

"In two tuned circuits, where the aerial is one and the grid of the detector or anode of an H.F. valve is the other, the moderate amount of H.F. amplification yielded by a single stage, and the immoderate desire for range possessed by the owner of the set, result in the liberal use of reaction, or, alternatively, ultra-low-resistance circuits.

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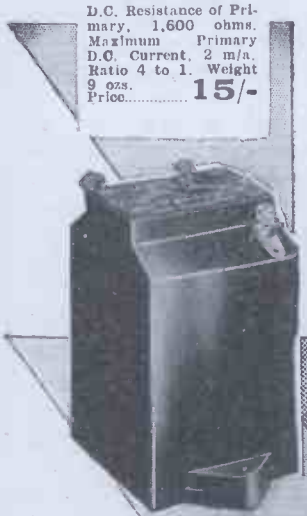

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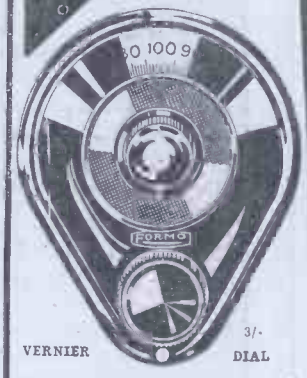

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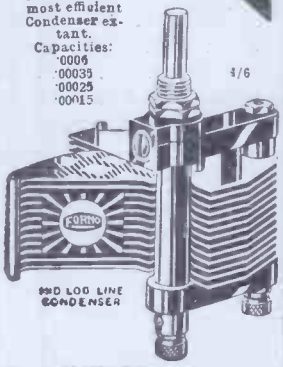

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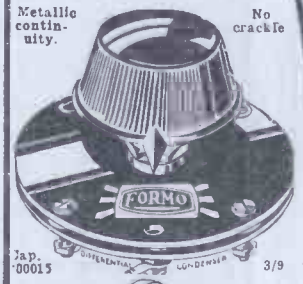

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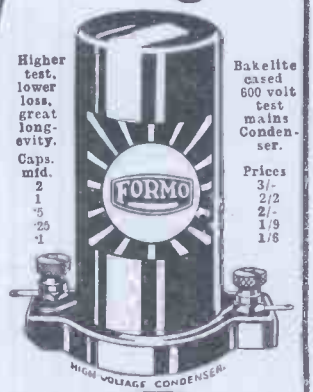

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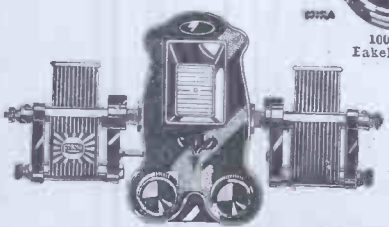

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C.W.4.

RADIO —IN— JAPAN

Some new and authentic details about the great progress that is being made in broadcasting in the land of the Rising Sun, which make fascinating reading.

From a Special Correspondent

PROBABLY there are quite a number of "M.W." readers who, if they ever think of Japan at all, regard that country rather patronisingly. They might be prepared to admit that the Japanese are a very nice people, and that they have made considerable progress. Nevertheless, it is probable they imagine them as living in paper houses and doing little else other than drinking tea from tiny cups in tiny gardens. But consider these surprising facts.

A radio exhibition was held in Tokyo during the earlier part of 1930. About 100 radio firms exhibited all kinds of sets, accessories, etc., of Japanese manufacture. Some 450,000 people visited that exhibition. Three television systems due to Japanese inventors were exhibited, one system enabling pretty good pictures, 3 ft. by 5 ft., to be received.

At one time Japan imported quite a lot of radio gear from the United States, Germany, England, and France, but now the total imports constitute a mere 1 per cent of their requirements.

Big Trade

The total radio sales in Japan exceed ten million yen per year (a yen is worth about 2s.), and these goods are handled by nearly 5,000 radio dealers belonging to various regional radio dealers' associations scientifically organised under the direction of the Radio Dealers' Federation. Japan has over 700,000 licensed listeners, and not very many "pirates," because the penalty on conviction for radio "bootlegging" is anything up to one year's imprisonment.

Well-Organised Broadcasting

Broadcasting in Japan is run by a broadcasting corporation constituted on non-profit lines under the strict supervision of the government. At present there are seven 10-kw. stations and one 3-kw. in operation, although a regional scheme very much on the lines of our own is in the course of development. Meanwhile five relay stations are being erected.

The Broadcasting Corporation of Japan seems to do much more for its listeners than does our own B.B.C. For instance, it runs a very excellent service scheme. There are over 1,500 service stations operating under the control of B.C.J. engineers.

Listeners are able to get technical advice at these stations and they can also take faulty sets along for expert diagnosis. Small repairs are executed without any charge at all. In any case, the engineers tell the listeners exactly what is wrong and give them advice as to the best way to overcome their difficulties.

The Corporation will, on request, even send service men to visit any troubled listener free of all charge.

Up to Date

An analysis of about half a million cases concerning defective receiving equipment was made a little while ago. The results are very interesting. Fifty-five per cent were battery-operated valve sets, 34 per cent mains sets, and only 11 per cent were crystal sets.

Those figures prove that Japanese listeners are every bit as

(*Cont. on page* 672.)

"MIKE" GETS DOWN TO IT!

Japanese radio may have high ideals, but "Mike" has to descend to a pretty low level in order to cope with his visitors! The above photograph shows a modern broadcasting studio in Japan, and you will see that the traditional "cushion on the floor" persists in face even of such modern progress as is exemplified by broadcasting. But perhaps Japan considers our Western "elevation" as curious as we do their customs.

HOW TO MAKE A PORTABLE

BY J.H.D.RIDLEY

Here is an invaluable article about the making of a self-contained set. Usually that is a difficult task, but our contributor lays bare some hidden snags and shows you just how to avoid them.

IN these days of all-mains receivers there is a tendency to prophesy that the days of the portable are numbered, for the convenience of just switching on and leaving the rest to the Corporation is inestimable; moreover, that there are no batteries to charge or replace, and that the quality is all that can be desired are factors in the argument that none can deny.

Where It Scores

It is further suggested that the portable trade has reached saturation point. One cannot but admit that the all-mains set has many advantages over the portable. It is only natural that it should be so, yet there are many points on which a portable scores which will justify its position in the market for many years to come.

In places where electricity has not yet penetrated, in outlying villages, in towns and cities where only gas is available—and there are many places such as this—and in flats, to mention but a few of the fixed locations, a portablehas many advantages.

There is the question of its portability—its main excuse for existence. How many times does one wish that "the speaker or the set were in the other room," or that we could take the set away with us in the car, move it into the garden, or take it to a friend's house?

Upright or Suitcase?

The possibilities are legion. And do not overlook the point that the portable is an intimate set. It is compact, ready for use at any moment, either to tour Europe or just pull in the Regional; there are no extras hanging on, with their attendant lengths of cable and flex.

In locations of intense interference your portable will give you selectivity where the ordinary aerial set would fail.

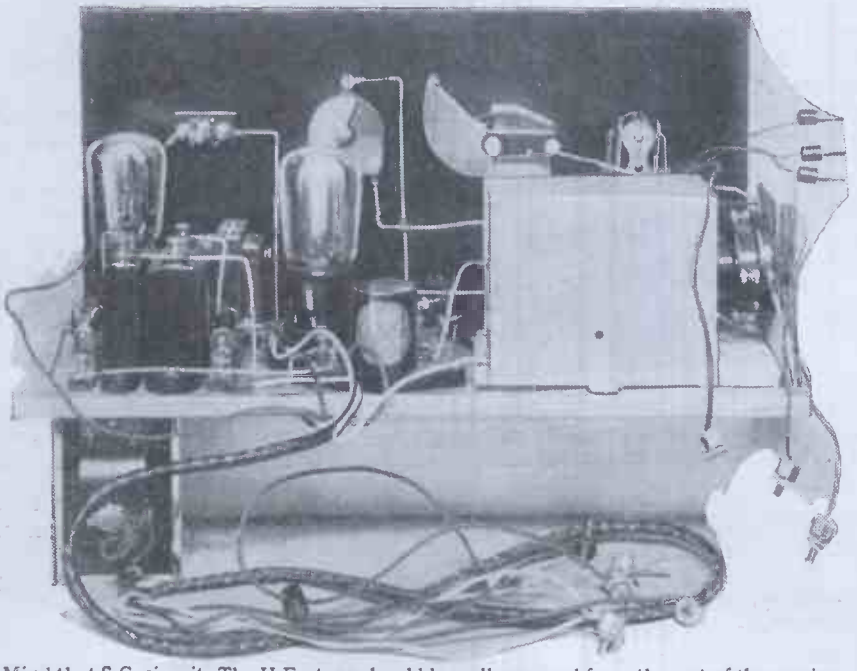
Almost the first point to be determined when designing a portable is the type of set that is required. Many people prefer the set to be of the upright type, whilst others have a leaning towards the suitcase model. Both have their advantages and disadvantages.

The main point in favour of the upright model is that it occupies less "floorspace" than its rival and also lends itself to more artistic external appearance.

Frame Fixing

From a technical point of view it is not so satisfactory, inasmuch as the whole of the apparatus, with batteries and accumulators, has to be housed within the frame aerial; which to say the least of it is extremely undesirable, due to the introduction of heavy H.F. losses into a circuit which is required to be of the utmost efficiency.

It is possible to reduce these losses to a small degree by mounting the aerial on the door of the set, so that



Mind that S.G. circuit. The H.F. stage should be well screened from the rest of the receiver, as shown in this illustration of a three-valve portable.

the apparatus is removed as far as possible from the frame.

Those people who own a portable where the aerial is disposed as mentioned above have only to open the door to note how enormous is the difference in volume when the aerial is removed from the set.

This is really the most important drawback with the upright type of portable and accounts for the much greater sensitivity usually associated with suitcase portables. Coming to this model we find that apart from the point just outlined, a second feature is that "it does not look like a wireless set."

Number of Valves

Just how much this affects the question is hard to determine, but it is most definitely a point which many people bear in mind when buying a portable. Presumably there is a majority who feel a certain embarrassment when seen carrying a wireless set around.

Therefore, on the score of efficiency and appearance we decide upon the suitcase model.

Next comes the question of the number of valves. If a screened valve is to be used, then the most useful number is four, with the usual combination of screened-grid high-frequency, leaky-grid detector, transformer-coupled first and second low-frequency stages.

If we use five valves, then the screened valve is dropped in favour of two straight H.F. valves, either resistance, transformer or aperiodically coupled to a similar leaky-grid detector valve, with either a resistance or transformer-coupled first stage, and a transformer-coupled output stage.

Most people who have tried them will say that for all ordinary purposes the four-valve combination is superior to the five. To develop the utmost amplification of the valve it is necessary to adopt some form of resonant circuit; in other words, to have a circuit which is adjustable to that wave which it is desired to receive.

Now if the grid and anode circuits be reasonably efficient and are brought slowly towards resonance, it will be found that the valve will oscillate before resonance is reached. In other words, the inter-electrode capacity of the valves is such that feed-back occurs within the valve as soon as the circuits approach tune.

Therefore, it becomes necessary in order that the set may "handle" nicely to introduce losses into either of the circuits (usually the anode circuit) so that the voltages in that circuit never reach a sufficiently high level to cause trouble.

"It should be realised that a frame aerial is an inductance of large physical dimensions capable of setting up a very intense field round the set. Therefore, if any part of the anode circuit of the H.F. or detector stage is in such a position as to couple to the frame, there is a very strong possibility that oscillation will occur."

The Single H.F. Stage

Now to get two H.F. stages of this nature working is almost impossible unless they are neutrodyned, and this is not an easy matter with portable receivers. But there are three ways out of the difficulty, of which only one is really popular.

The three are as follows: Use two valves, one fully tuned, but damped, with one resistance or choke-coupled. Secondly, two tuned transformer-coupled stages with a low step-up ratio between valves, and, thirdly, two fully-tuned stages each suitably damped.

The first scheme is the most popular, for it does away with a tuning control and, at the same time, gives reasonably good results coupled with economy in construction.

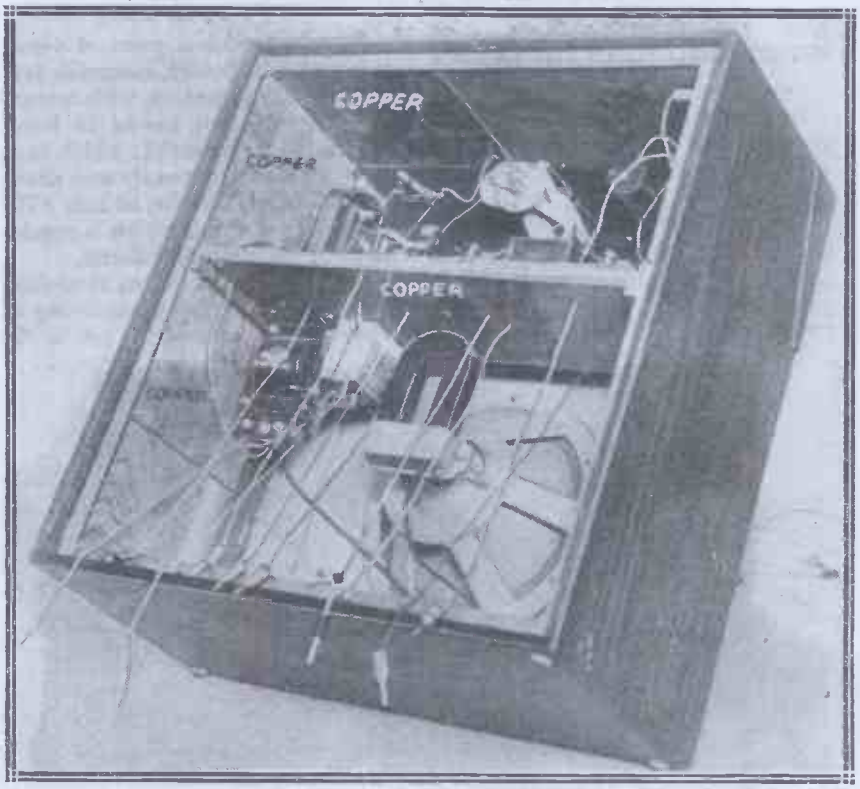
With a screened valve, however, one can make the grid and anode circuits as efficient as possible and bring them into resonance without fear of self-oscillation, whilst the amplification factor of the valve is so great that it exceeds the overall magnification given by two unscreened valves when coupled by any method, with the exception of the neutrodyne. This, therefore, decides the point in favour of a single screened-valve H.F. stage.

Capacity Coupling

The remaining valves are more readily disposed of. The detector is most suitable with leaky-grid detection, for this method has the advantage of greater sensitivity to weak signals.

The first and second low-frequency stages should be transformer-coupled to obtain maximum amplification, although great care has to be given to the selection of suitable components in order to avoid a bugbear which is common to many receivers on the

CAREFUL SCREENING IS ESSENTIAL



In the construction of the set illustrated above it was found necessary to screen the frame aerial from the receiver and the loud speaker by means of copper foil as shown.

Stray Feed-Back is a Fault that Must be Avoided

market at the present moment, namely, that of threshold howl.

Having thus briefly considered the merits of various types of sets and combinations of valves, it becomes vital to consider the best method of constructing the set so as to avoid as far as possible any stray capacities and couplings.

Feed-Back

Now, in the design of any set embodying an H.F. stage—more particularly a portable—it is absolutely essential that there be a minimum stray feed-back, either by capacity or induction between the grid and anode circuits.

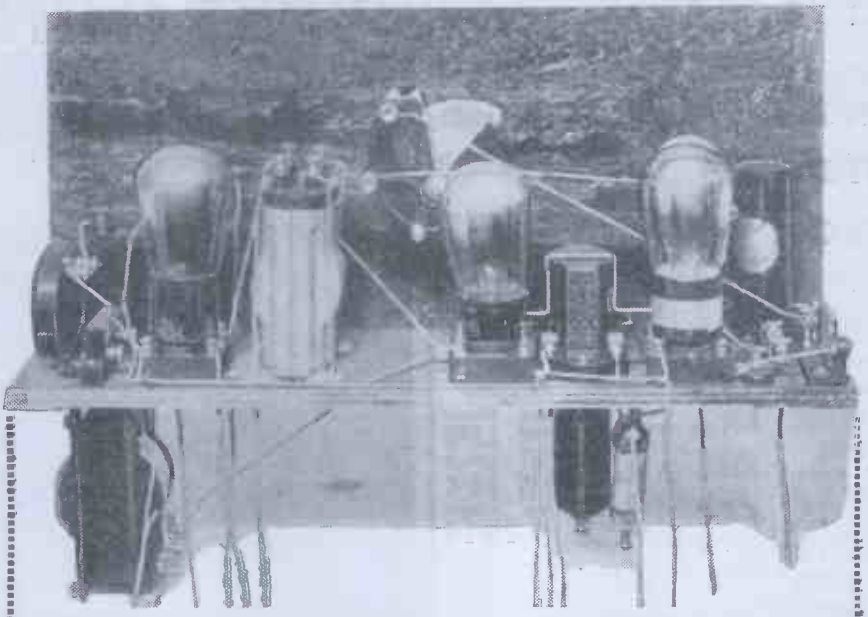
At some time or other many readers must have come up against the trouble of persistent oscillation. By this is meant that even with the reaction control set at zero the set persists in oscillating.

The Wiring

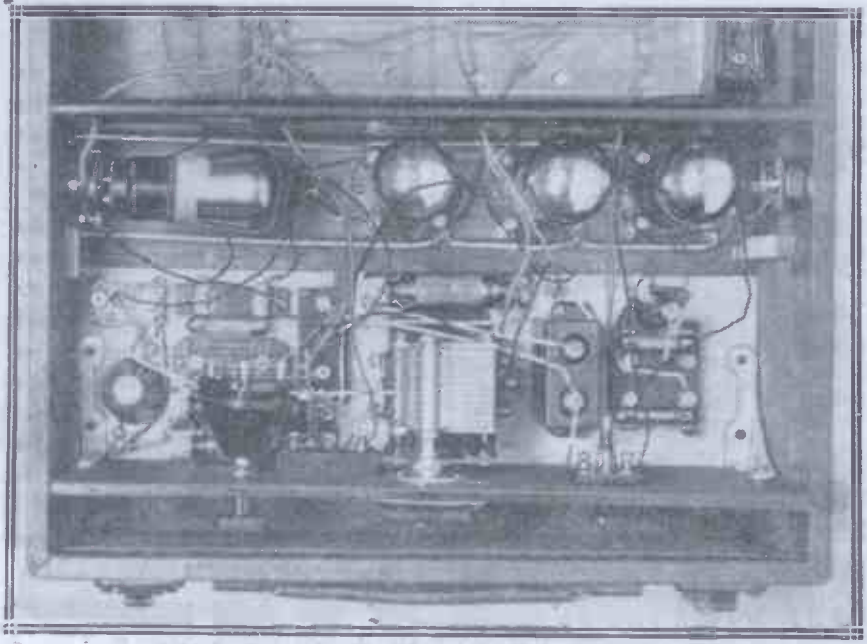
This effect may sometimes be stopped by touching some part of the input or frame circuit or of the anode circuit. In most cases it is due to some form of feed-back between the frame and the anode circuit of the screened valve.

Sometimes it may be that one of the frame leads has come loose and is in close proximity to the terminal on the top of the screened-grid valve, or a wire which may run for switching purposes from the anode compartment to the grid compartment has likewise become loose and is close to some component associated with the other circuit.

IN THE UPRIGHT KIND OF CABINET—



The above photograph illustrates the method of building the set on a platform to go above the loud speaker and battery compartment of a cabinet type of portable, while the underneath illustration shows how the components and valves of a suitcase model are stowed away.



—AND IN THE SUITCASE PORTABLE

It is only by exercising the greatest care in distributing the components and laying out the wiring that this trouble can be avoided, in addition to which one must take care to screen carefully the circuits in question.

It should be realised that a frame aerial is an inductance of large physical dimensions capable of setting up a very intense field around the set. Therefore, if any part of the anode circuit is in such a position as to couple to the frame, there is a strong possibility that self-oscillation will occur.

Oscillation

By allowing the set to fall into oscillation through H.F. feed-back one is removed farther away from the true oscillation point which is governed by the reaction condenser and detector valve.

The H.F. valve itself should not oscillate, but merely amplify the radio frequencies picked up by the frame and delivered across its grid and filament.

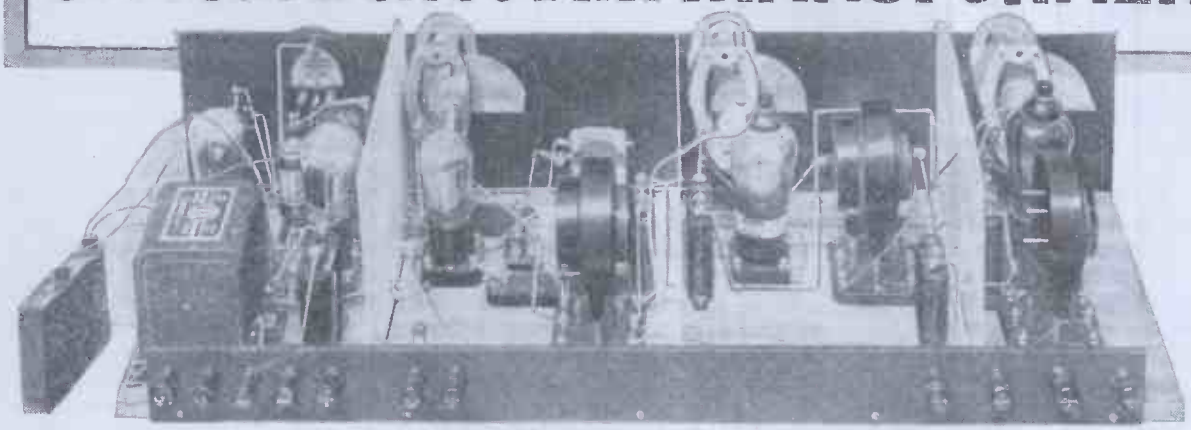
Like L.F.

By leading signals by the most efficient path to the grid of the screened valve, and allowing no leakage or feed-back, the valve is allowed to amplify these minute impulses to its full capacity, in exactly the same way as an L.F. valve deals with the rectified component of the detector valve.

To obtain the maximum efficiency from the screened valve it is essential

(Continued on page 677)

CONCERNING H.F. TRANSFORMERS



By L. CAVENDISH.

An account of some of the problems met with in the design and use of H.F. transformers in modern radio receivers.

THE design of the high-frequency transformers of a receiver has always been a vital factor in the sensitivity and selectivity of the set. Since the introduction of the screened-grid H.F. amplifier, the correct design as well as the construction and operation of the transformer has become a matter of still greater importance than before.

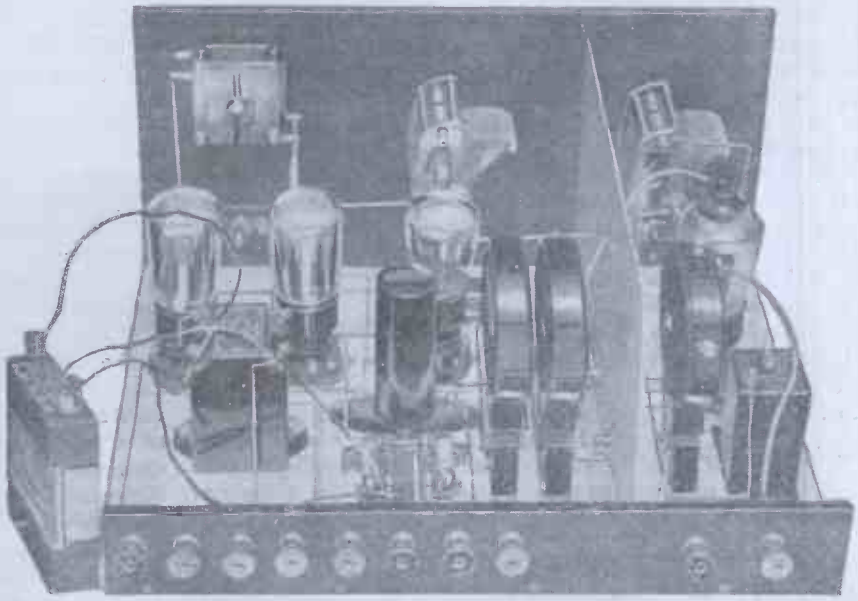
Amplification Factor

The screened-grid valve, as you know, is distinguished for its high-amplification factor and small internal or inter-electrode capacity, and whereas with former types of H.F. valve it was only possible to obtain an amplification of perhaps 12 to 15 when used with a tuned H.F. transformer, the amplification factor of a screen-grid valve may be (theoretically) as high as 300 or even 400.

Unfortunately, this does not mean, however, that an overall amplification of this amount, or, indeed, anything approaching this amount, can be obtained *in practice*, because we must use the valve with corresponding transformers, and it has been found practically impossible to design a transformer which will give, at broadcast frequencies, anything like the full value theoretically obtainable from the valve.

It is possible, however, with correctly designed H.F. transformers, to get an overall amplification of perhaps 20 to 40.

WHAT MODERN DESIGNERS DO



A very excellent example of one of the simplest kind of H.F. transformers—two plug-in coils in close proximity—and the simplest kind of H.F. screening. Simplicity is, of course, one of the main aims of the modern set designer.

Not only is it essential that the H.F. transformer shall be properly designed and operated correctly in relation to the valve, but also, when more stages than one of screen-grid H.F. amplification are used, it is essential to isolate the individual stages from one another so that the completed amplifier shall be stable—that is, shall not be liable to oscillate.

H.F. Transformer Design

As regards the design of the H.F. transformer, one of the first points is that this should have as low an H.F. resistance as possible. It has been found that, apart from mere practical considerations, it would be an advantage to have a former perhaps 5 in. or 6 in. in diameter and to use fairly heavy wire for the coils, but in practice this is more or less out of the question, particularly when we have to make provision for shielding between stages.

In the practical conditions which confront us, a limit of perhaps 2½ in. or 3 in. is placed upon the diameter of the formers if the set is not to become too bulky. When a smaller former is used for the winding of the

Iron Screens Act Differently at Different Wave-lengths

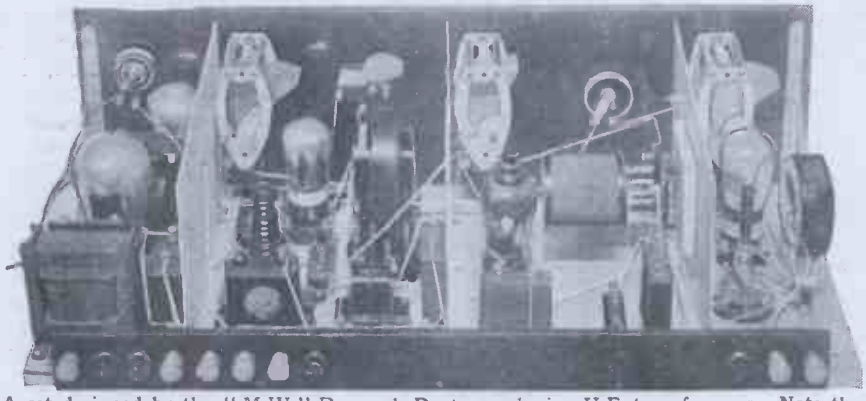
coil, correspondingly smaller gauge wire must be used, otherwise we might again increase the H.F. resistance, which is precisely what we wish to avoid.

Winding Space

It may be stated as a general rule-of-thumb in regard to H.F. transformers of the solenoid type that the winding length of the coil should not be greater than its diameter, otherwise the leakage flux becomes large and the inductance for the length of the wire used is small.

The H.F. resistance of any type of coil may be decreased somewhat by "spacing"; this spacing depends on circumstances, and may in some cases be equal to the diameter of the wire.

A VERY TRICKY BUSINESS



A set designed by the "M.W." Research Dept., employing H.F. transformers. Note the special screening mounting adapted in one case to get efficient shielding with a minimum of losses and without introducing complications.

To give a case in point, it was found during a series of tests on different sizes of coils and different gauges of wire, with various spacings, when using a coil 1¼ in. in diameter and No. 30 gauge enamelled wire, spaced 66 turns to the inch, that the H.F. resistance was about as low as could be obtained, bearing in mind the question of shielding.

Using a coil 1¼ in. in diameter with No. 30 enamelled wire, spaced 88 turns to the inch, the radio-frequency resistance at broadcast wave-lengths was roughly 10 per cent greater than with the 66 turns to the inch.

The Primary Winding

Having determined the size of the secondary of the transformer, it is necessary to turn our attention to the primary winding. The size of the primary in the case of an H.F. transformer used with a screened grid valve is limited, for if too large an inductance is used the primary circuit is tuned to some point in the broadcast band by the internal capacity between the screening-grid and the plate. You will note that this inter-electrode capacity is directly across the primary of the H.F. transformer.

It is an advantage to have the primary as large as possible consistent, of course, with keeping it down to the desired wave-length. The coupling between the primary and secondary should be made as large as possible, and this means that the separation between the two windings should be small.

This is not so easy as it sounds, however, for there is a danger when the inductive coupling is increased for the capacity coupling to be increased at the same time, so that the amplification of the transformer is correspondingly reduced. To overcome this the primary may be slot-wound.

Isolating Stages

Now we turn to the question of isolating each tuned circuit so that the reaction between stages in the completed H.F. amplifier may be as small as possible. If shielding is not employed there will be coupling between stages due to stray H.F. electro-magnetic fields, and this will throw the circuit into oscillation long before the maximum amplification has been reached.

You must bear in mind, however, that although you gain a very important practical advantage by the introduction of shields, the actual amplification of each stage is somewhat reduced by the presence of the shield, and this effect also depends upon the character and formation of the shield and upon the nature of the metal used.

Curiously enough it has been found that copper, aluminium and brass when used as shields give results very close to one another, but iron, which was used in some experiments, gives at certain wave-lengths rather different results.

Using a copper pot 2½ in. in diameter the amplification obtained from the stage was about rather more than 90 per cent of the amplification obtained with the unshielded coil.

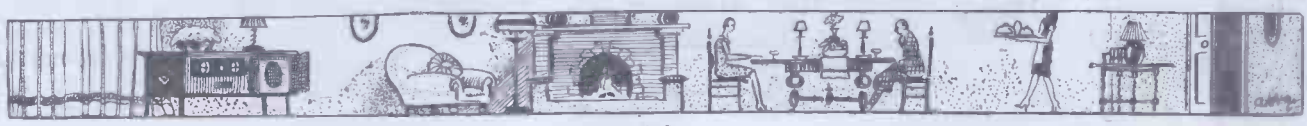
An iron shield was experimentally used in order to see what effect the magnetic metal would have, and it was found that for fairly high frequencies (tuned to about 200 metres) about 86 per cent of the unshielded amplification was obtainable, but at some longer wave-lengths, about 500 metres, the figure dropped to about 60 per cent.

Bringing in the Leads

If it were not for the fact that the leads have to be brought up to the shielded transformer, the actual coupling between several stages of H.F. amplification could be extremely small.

This emphasises the importance when building an H.F. amplifier of keeping the leads very short. The H.F. current may be kept out of the H.T. supply by the use of by-pass condensers and H.F. chokes, which are very important if the maximum amplification practically obtainable is to be secured.

The general question of H.F. amplification using screened-grid valves really comes down to obtaining as large as possible a magnification at each stage and isolating the different stages as efficiently as possible, with the minimum of consequential loss.



MAKING TALKIES

Both microphone and thermionic valve play vital parts in the recording of talking pictures, as you will see from this fascinating account of the processes involved.

From a Correspondent.

NOTHING less than amazement can follow an introduction to sound-picture recording systems and practice. Attending performances of sound-pictures prepares us inadequately for the magnitude of the additions and changes which sound has introduced in motion-picture procedure.

What appears in mechanical effect to be a simple audible supplement to cinematography requires not only much new apparatus, but new talent and technical training, new care and habits: the complete transmutation of a large industry.

The buildings which shelter the stages are electrically connected with an entirely new building containing the sound-recording and auxiliary equipment.

The stage itself is the first, and the only acoustic, element. To fill its new important function the old stage had to be recast to satisfy acoustic as well as visual needs.

Difficult Problems

The acoustic problems of sound-scene stage designs are for many reasons far more exacting even than those of theatre stages, in which sounds are directly projected from actors to audience.

Obviously, the stage problems are at least doubled by the fact that two steps, the recording and the reproducing, take place in between the original playing and the final hearing.

Inability to see the whole of the original sound-scene stage in the final picture makes it impossible for the audience to accomplish the unconscious psychological adjustments which assist it in the theatre.

The microphone lacks the binaural property of the ear which helps us to distinguish the directions of sounds. Finally, the intensity level used in reproduction is so much higher than the level of the stage-sounds recorded that threshold of audibility may be disconcertingly audible when reproduced.

Testing equipment is used every morning to test every link of the recording apparatus.

Reducing Reverberation

Hence, the motion-picture architects construct the sound-stages to exclude outside noises by multiple walls with intervening air-spaces, and usually to reduce reverberation of inside noises by coverings of sound-absorbing materials on the walls and the ceiling. To counteract special and varying acoustic features introduced by scenic "sets" the person who is responsible for the sound effects places further reverberation damping in the form of portable sound-absorbing "flats." In general, he seeks acoustic conditions intermediate between the objectionably "live" and the objectionably "dead," but the extent to which he finds damping desirable depends upon the sound and scene to be recorded.

The "Monitor"

Playing in the past only to spectators—the cameras, actors on the new stage play also to listeners—the microphones (see diagram). These sound-sensitive instruments are usually suspended from the ends of long, movable booms, and are electrically connected by flexible cables with a microphone junction box in the stage wall.

In the "monitor" room, above and behind the cameras, sound-insulated from the stage, and constructed to simulate theatre acoustics,

A "Light Valve" That Photographs Sound

sits the "monitor." He watches the acting through a bay window and listens to the sounds presented him by the "monitor" loud-speaker. It is from this position that he directs all the activities, before and during recording, for which he is responsible. On his monitor table, to which the microphone circuits are independently led, volume controls permit him to "fade" the microphone currents individually and collectively, and thus entrust him with control over the balance, quality and volume of the sounds passed on to the recorders. To ensure that the sound volume is always within the distortionless range of the recording system, a volume-indicator is provided on the table.

lens for close-ups. Several booths may be used with each scene, to provide the film-cutter with a choice of viewpoints, from which the pictures are all synchronised with the same sounds.

Disc and Film

After being amplified in the monitor room the sound currents are passed for further amplification and final recording to the recording building, in which attendants have charge of two disc and two film recorders, driven by synchronised motors in step with the cameras facing the stage. When film is to bear the sound record ultimately released, he operates both film recorders simultaneously, shining on sensitised film and recording the sound as a photographic track of varying darkness. After recording, directors and actors can immediately judge the dramatic effect of the record, without waiting for processed films or discs, by using a play-back reproducer on the wax. This instrument differs a little from reproducers used with hard-finished records in theatres, chiefly in the care with which it is designed to minimise damage to the soft wax.

Synchronisation

The driving systems for camera and recorder motors are synchronised by electrically interlocking all motors through a single distributor to a motor whose speed is kept constant by an electrical governor.

Thus the sound-scene recording system comprises rather a large number of pieces of apparatus, decentralised and interconnected. Because of this and the fact that failure during recording is seriously expensive special routines have to be followed which are similar to those of large telephone stations. A test man, equipped with suitable measuring apparatus, anticipates trouble by testing each channel daily before it is put in use.

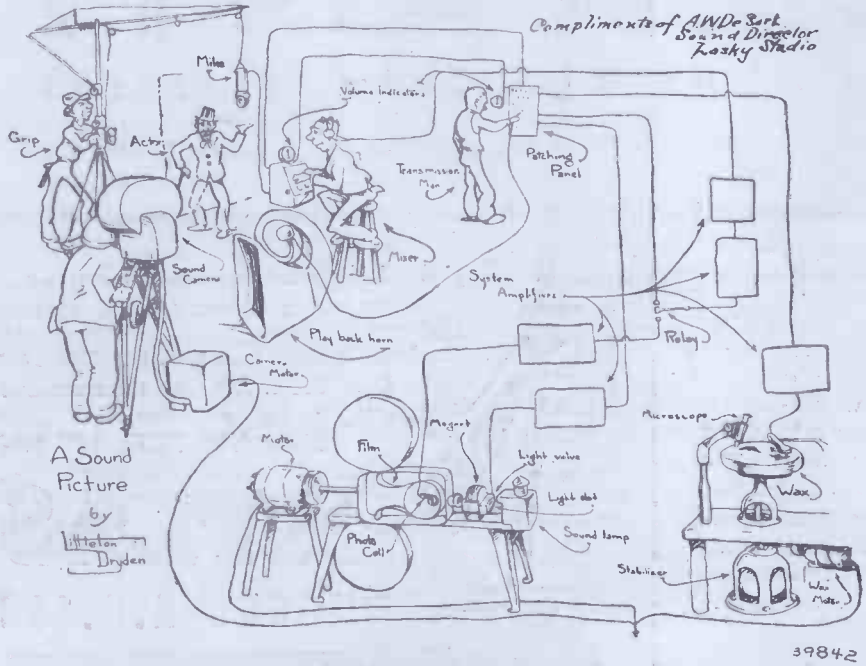
Actors rehearse to such proficiency that silent direction is satisfactory. The "monitor" meanwhile fixes the locations of the microphones, and at a final rehearsal verifies his judgment, using the entire recording system except the films and records themselves. When the recording media have been inserted in the machines, the "monitor" signals the recording-room to "interlock."

Ready to Record

By master controls the recorder attendant locks the motors by closing one phase of their three-phase power supply, places start marks on discs and films, and signals that all is ready. On receiving a signal from the monitor he then closes the polyphase and direct-current supplies, and, when his meter shows that the motors are up to speed, lights red bull's-eye signals at all stations, which indicate that recording is in progress.

A remarkable feature of the system is the number of stages through which the sounds pass, to emerge at length with extraordinary fidelity.

AS SEEN BY AN ARTIST



Here is a sketch by an American artist that shows the whole process from start to finish.

During recording, the mechanics of play must be acoustically as well as visibly suppressed. Absolute silence is required of directors and stage-hands; they even wear shoes whose soles are covered with rubber.

Excluding Noise

The noise of cameras and motors is excluded by enclosing them in sound-proof booths, fronted with clear glass windows and mounted on rollers for mobility. Camera booths are constructed for one and for two cameras, of which in the latter case one is used with a telescopic

for insurance against costly failure of one. A wax recorder is also operated, to provide a record for immediate play-back. By a special control adjoining each machine he adjusts the volume of sound to its proper level before recording begins.

In the wax recorder the sound currents actuate a sharp stylus of sapphire or ruby, shaped to ensure a clean cut, which records the sound as lateral variations from a smooth spiral groove in a polished disc of metallic soap. In the film recorder the currents operate a "light-valve,"

Broadcast Tens

CHRISTMAS records form quite a refreshing diversion from the ordinary run this month, and the ***Laughing Waits,*** a humorous Christmas sketch, on 638, give a couple of sides well suited to the festive season. ***Good Christian Men Rejoice*** and ***While Shepherds Watch Their Flocks By Night,*** sung by the choir and congregation of St. Martin-in-the-Fields, on 610, is another record well worth hearing.

Numerous other Christmas records, which we have not the space to mention, figure in the Broadcast catalogue, and no Yuletide gramophone programme would be complete without at least a few of these cheery discs.

Broadcast Twelves

The larger Broadcast records are remarkably good this month, we think better than they have been for some time. We especially liked Sophie Tucker's recording of ***Follow a Star*** and ***I Never Can Think of the Words,*** on 5195; and those of our readers who "follow *this* star" would do well to get the disc.

One of the most fascinating little tunes in the Broadcast Twelve Super Dance records is ***The King's Horses,*** which appropriately enough seemed to come into prominence round about Lord Mayor's Day.

Columbia Graphophone

Many Xmas records appear in the Columbia list, two of the best being Tommy Handley's ***The Origin of Boxing Day*** and the J. H. Squire Celeste Octet playing ***Good Company.***

Memories of Chopin, also played by the J. H. Squire Octet, on DX123, and the ***Tannhauser and Lohengrin Selections,*** by the Regal Cinema Orchestra, on DX122, will surely prove extremely popular.

Three O'clock in the Morning and ***The World is Waiting for the Sunrise,*** by Ted Lewis and his Band, on DB136, and Jack Payne's recording of ***There's a Good Time Coming,*** on the reverse side of which is ***Over the Garden Wall*** (DB132), make two noteworthy dance numbers.

Other interesting recordings are the flute duet on DB261, the banjo solo ***Swanee River Medley,*** on DB276, and the ***Entry of the Gladiators*** (an accordion duet), on DB263. These are all especially valuable as test records.

Decca Records

One of the most tuneful Decca records of the last month is the ***Overture from Semiramide,*** by Rossini, played by the Hastings Municipal Orchestra, on K537.

A brief selection from some of the records released during the month. They have been chosen because of their special value to the pick-up user. Owing to lack of space the list is unusually curtailed, but it is hoped more records will be dealt with in our January number.

Also Tom Jones and his Orchestra at the Grand Hotel, Eastbourne, playing ***The Lost Chord*** and ***Abide With Me*** (K540), will meet with general approval. This is the first appearance on Decca records of Tom Jones and his Orchestra, and it was made in the lounge of the Grand Hotel under the normal conditions of performance.

The Rhythm Maniacs give us a ***"Good News" Selection,*** a lively mixture of the chief tunes included in that snappy show; while ***All is Quiet on the Western Front*** (parts 3 and 4), on F1974, is a record that has an altogether unusual appeal.

H.M.V.

A wonderful variety of H.M.V. records is provided again, in our opinion the outstanding disc being the recording of ***Brigade Exchange,*** by the B.B.C. players, on D2046.

A good thriller following up the first record thriller which H.M.V. brought out some time ago ("The Safe"), is provided in ***The Murder on the Portsmouth Road,*** a Sexton Blake detective yarn, on C2004.

De Groot and his Orchestra provide us with ***Autumn,*** on C1966, and ***Traume,*** on the reverse side.

John McCormack, the famous tenor, sings ***Little Boy Blue*** and the ***Rosary,*** on DA1116, while an unusual record is provided by Gertrude Lawrence and Noel Coward (C2043) when they play ***Scenes From "Private Lives."***

In the lighter recordings we have ***Rolling Down the River,*** by Gene Austin, and on the reverse side of this is ***Dancing With Tears in My Eyes,*** by Johnny Marvin, on C572, a double-sided delight that should not be missed.

Finally we should like to recommend the new Mayfair Orchestra's rendering of ***Follow a Star,*** on C2020.

Piccadilly

An interesting xylophone solo, with a piano accompaniment, forms the subject of Piccadilly record No. 624, when the ***Aeroplane Polka*** and ***Dance of the Marionettes*** are chosen. ***Sophie on the Sofa,*** a humorous duet by Sharp and Flat, on 628, ranks with Tommy Handley's ***We Must All Pull Together*** and ***We're All Happy,*** on 631.

Sitting on a Rainbow and ***On the Sunny Side of the Street,*** on 633; ***The Last Waltz,*** on 636; and ***Sunshine Come Back to Me,*** on 635, are dance numbers which we would recommend for pick-up users.

Zonophone

Megan Thomas, singing ***The Waltz Song,*** from "Tom Jones," and ***I Wonder if Love is a Dream,*** on 5691, provides a couple of typical soprano songs which are sung without any sign of the shrillness characteristic of so many sopranos. It says much for the recording that although this singer has a wonderfully high register no blasting whatever is noticable.

Maurice Elwin, the crooning baritone, in ***If I Had a Girl Like You*** and ***It Happened in Monterey*** (5693), and Foster Richardson in ***The Cobbler's Song*** and ***My Desert Flower,*** from "Chu Chin Chow," are three discs well worth having.

WHAT RADIO DID FOR JERRAM

—continued from page 642

and what not, to the throbbing taxi.

"There," said Evelyn, "that'll be quite safe, I think. Do you know—of course you do—how to instal all this?"

"Miss Hooper, I am as ignorant as anything; I don't know one end from another."

"Oh, in that case I'd better do it for you. Hop in and make room. It won't take me more than ten minutes."

Too Many Colours!

"But—er—Miss Hooper——"

"That's all right. Tell the man the address."

They glided out of Beech Avenue into a London whose lights seemed to Tony to have gone wrong. Too many colours—pink predominant. He smelt an odour which reminded him of any theatre's foyer. It was her face powder—bless his heart!

He said, "Do you like Egyptian cigarettes?" "I eat them alive, when I can get them," answered Evelyn, swaying towards him as the cab ported its helm and slithered round a corner. "Why?"

"I wondered—that's all. Y'know, I suppose I think in terms of tobacco!"

Tony opened his door and ushered Evelyn into his dim-lit hall. "Great Scott! Look at this!" he said. "Here's a note from Mrs. Makeham: '*Gone to see sister at Charlton who is ill. Back at 8 a.m. Pudding in oven.*' I say! the house is empty."

His consternation was apparent in his tone of voice.

"Cheerio. Then I can bang about while I put you up an inside aerial."

She hustled the bundles out of the cab and into the house. "Where shall we have it?" she queried. "In here? Righto! Hold it upright. There! Now tell the man to wait."

A "Rush Sensation"

The sight of her bending over the set, shaking her curls back while she adjusted the valves in their sockets, sent a rush sensation over the frame of the lonely cigar importer. In fact, a new world, fraught with marvellous joys and exquisite terrors, burst upon his view, so that he was constrained to retreat to the kitchen for an inspection of the pudding, which proved to be dried to a wisp. He returned in haste.

"There we are!" said the imperturbable maiden. Just a chunk of flex round the cornice and we have the 'Regional' as clear as crystal! Do you like it? Do you? Listen! Christmas bells from Saintwich Cathedral. Aren't they just lovely?"

They listened awhile in silence. Then Tony said, "Perhaps you'd better be going. I wish—I wish—— It's late; I've settled the taxi. Thanks so much; yes, I understand. I twiddle and twiddle—always twiddling——"

She walked slowly into the hall and groped for her gloves.

But Plenty of H.T.?

"Look here," whispered Tony, "if I go back with you in the taxi I'll want to kiss you; so do you mind if I——"

"If you what?" she said, moving slowly to the door.

"If I do it now?" he whispered.

As their lips met she thought, "The poor dear has only about enough power in that battery to work the set a couple of hours. But he won't care—now!"

He didn't! He lived that kiss throughout Christmas, dreaming a dream which came true in the following June.

THE "MAINS-POWER" THREE

—continued from page 587

which you intend the finished set to occupy to the nearest mains point. Separate the two strands for a few inches, and bare the ends.

A Wiring Tip

Attach one end to the "common" input (or mains) terminal on the power transformer and the other to the on-off switch on the panel. Then take another piece of single flex and with it connect the remaining side of the switch to one of the other input terminals on the transformer.

You will find it has several, each marked with a different voltage. The correct one is that which agrees with the voltage of your mains. In the case of an odd voltage, choose the nearest one you can find.

When you eventually fix the power unit in place you will find that this last lead is a little too long; just tuck the slack away out of sight between transformer and panel.

The long twin lead will go off through a hole in the side or back of the cabinet, and be fitted upon its farther end with a two-pin plug or lamp socket adaptor for insertion in a mains point.

Before you attach the power unit to the set there is one more step. Attach about a yard of twin flex to the outer two of the three other terminals on the transformer above the mains input terminals (disregard the middle one).

Now you can fix the unit in position and make the connections from it to the set proper. The yard of flex we have just mentioned carries low-voltage alternating current to the "heater" terminals on the valve sockets, and the diagram shows you how to run this.

Earthing the Metalwork

If you find it easier you can use separate short lengths of twin flex from valve holder to holder, of course. Be careful, though, to keep these leads as far as you can from the grid leads of the detector and L.F. valves.

The rest of the wiring is a very straightforward job, but we must warn you to keep a careful look-out for the various connections to the metal-work. Some of these are marked "To foil"; see that they really do make good contact therewith.

For example, the earth terminal is wired to a screw near the 1,000-ohm variable resistance beside the S.G. valve holder. Polish up the copper round the hole for this screw and make certain of a good contact.

Loud-Speaker Connections

Again, note that a connection is made to one fixing screw of each panel bracket. See, therefore, that each bracket makes real contact with the copper foil. (Polish up underside of bracket and foil with a bit of glass-paper.)

Earthing connections are also made in the usual way to the vertical partition screen with small brass screws and nuts. See that the screen makes good contact with the copper foil in the same way as you did with the brackets.

Now there remains one final practical point. The original set was fitted into the Pickett cabinet seen in the heading photo on the first page of this article.

This cabinet accommodates the loud speaker in the lower compartment, so it was unnecessary to provide "speaker" terminals on the set. We just ran flex leads down to it from suitable points in the circuit.

(Continued on page 670.)

THE "MAINS-POWER" THREE

—continued from page 668

These are marked "L.S." in the wiring diagram. If you intend to house the set in the ordinary small type of cabinet it will be as well to provide the usual terminal strip, and place in this a pair of "speaker" terminals behind the third valve socket. To these take the two leads indicated on the diagram as going to "L.S."

A Surprise in Store

All the rest of the work you will be able to follow out for yourself quite easily, and then you come to the exciting moment of the first test.

The controls for selectivity, volume, and grid bias on the S.G. valve we have already mentioned, and you will understand what to do with them.

Apart from these it is just a matter of inserting the valves, joining up aerial, earth and loud speaker, and plugging into a mains point.

Then switch on the set, give the valves thirty seconds or so to heat up, and see what it will do. One thing it is pretty certain to do, and that is to give you an entirely new idea of what can be achieved with three valves!

TUNING TROUBLES

—continued from page 650

methods may be demonstrated in this way.

Summing up, in receivers in which one circuit can be relied upon to be much sharper than the other, the system in which a small auxiliary condenser is connected in parallel with the condenser which tunes the flatter of the two circuits is quite satisfactory.

When Reaction is Used

If one is fortunate in ganging it is not necessary to do much trimming once this auxiliary condenser has been set; the more so because of the flatness of the resonance. Conditions of this sort exist in portable receivers of the less efficient types. The adjacent drum-control system is also quite good in these circumstances.

If the sharpness of resonance is a somewhat variable quantity, owing to reaction or otherwise, one may still prefer to think along the same lines, holding that close alignment of the circuits is only essential when full reaction is used.

If, however, fool-proof but accurate tuning is required independently of such assumptions, then the first of the above two methods drops out.

Best All-Round System

Adjacent drum controls are thus seen to be the best all-round system for tuning two circuits. It is, of course, possible to extend the system to cope with more than two circuits.

This may seem a small matter to discuss at such length, but, after all, the majority of users of broadcast receivers do not wish to give any thought to the process of tuning-in, and the most likely sequence of adjustment made by a person casually working the controls must be given as careful consideration as the more technical points involved.

Even if a receiver is intended for the constructor's (or purchaser's) use, there are usually other less technical members of the family to whom the possibility of obtaining the best results almost automatically is an advantage.

SELECTIVITY IN RECEPTION

—continued from page 574

The pamphlet tells us that "sidebands or no sidebands," Dr. Robinson satisfied himself that the actual carrier-wave was amplitude-modulated, and that reception of one frequency alone should suffice.

It was therefore necessary to devise some form of correction which could redress the unfair balance obtained in the highly selective set, and give a uniform response for all audio frequencies.

Sideband Arguments

And, by the way, readers would do well to postpone their arguments about sidebands until later. After all, "sidebands or no sidebands," as the author of the pamphlet indicates, don't matter—for the moment. The point is—is the Radiostat system practicable? Sideband arguments can wait. In this case we are more concerned with practice tests than theory arguments.

We are told that the next job was to produce a receiving apparatus so selective that it would have nothing to do with any but the narrowest channel.

"One key to the problem was found in a special application of the super-heterodyne receiving set in combination with a quartz piezo-electric crystal. It is a remarkable property of quartz crystals that they will pass frequencies only a few cycles on either side of that for which they are ground. A crystal ground for a frequency of 107 kilocycles per second, which corresponds to a wave-length of 2,804 metres, was prepared, and the super-heterodyne set was, so to speak, built round this. By the oscillator the incoming frequency was "beaten up" to 107 kilocycles, and each of the three intermediate stages was sharply tuned to this frequency. Between the last intermediate frequency valve and the second detector was interposed a gate circuit containing the crystal.

"Almost Incredible"

"According to all the theories, if anything at all was heard it should have been an indescribable distortion of the transmission to which the set was tuned. Actually it was found that despite the deliberate cutting of sidebands excellent reception of both speech and music was obtained when the corrector circuit had been brought into play.

"The special super-heterodyne set built for the crystal gate type of Stenode Radiostat receiver contains a separate oscillator valve, a screen-grid valve as first detector and screen-grid first and second intermediate-frequency stages. In these last two valves any tendency to distortion is prevented by a progressive increase in both the anode and the grid-biasing voltages. It was found impossible to use a screen-grid valve as third I.F. amplifier. Instead a triode of comparatively low impedance is employed with generous negative grid bias. The second detector works on the anode-bend principle. This is a low-impedance valve heavily grid-biased."

We are then informed that in the circuits of all these valves the effects of persistence are allowed full play, and that the next step was the designing of a corrector circuit which would exactly counterbalance these effects, thus giving the set a straight-line response to all audio frequencies.

A model was eventually made—and this model, it is claimed, combines "almost incredible selectivity with irreproachable quality of reproduction."

The Crystal Gate

The author of the pamphlet goes on to say that "the crystal gate model was thought to be too selective for use by the average listener, and though not really difficult, the tuning is distinctly finer than is required by the man-in-the-street. It was decided to put in hand a simpler design in which the crystal was dispensed with. This has been done in a highly ingenious way by the use of special I.F. circuits. The broadcast model of the Stenode Radiostat is designed to separate transmissions working as close together as 5 kilocycles, and it accomplishes this with ease."

The author (his name is not given on the pamphlet, but we may assume that Dr. Robinson at least approved of the text) concludes by observing: "The listening public insists upon being able to hear foreign stations, and by the time that the regional scheme is completed none but the most selective sets will permit this to be done." And, finally: "The only known system which can give first-rate results in both respects is the Stenode Radiostat."

This pamphlet will not, of course, satisfy the sideband adherents, but it is an "official" *résumé* of the Radiostat system, and as such of definite value and interest.

RADIO IN JAPAN

—continued from page 652

up to date as are those in this country. Among the faults due to components and accessories, it was noticed that valves took the lead at 83 per cent. However, that is by the way.

The Broadcasting Corporation of Japan also runs a well-equipped research laboratory in which investigations into both transmission and reception are carried out by a large staff of expert engineers. There is also an expert committee that sits every weekday for the purpose of officially grading radio apparatus submitted to it by manufacturers.

Scientifically Tested

This gear is scientifically tested and must reach a certain standard of efficiency before being approved. As can be imagined, manufacturers are keen to get their products approved in order to facilitate sales. On the other hand, the listener benefits in that the standard of radio manufacture is kept up to a high level by this system.

The Broadcasting Corporation of Japan canvasses for new listeners just like any ordinary commercial concern canvasses for customers. It has a most enterprising publicity service and this co-operates with various outside organisations.

Text books and pamphlets, supplementing broadcast talks and other features, are supplied at cost price.

Instead of listeners paying one fee, which is divided between the government and the broadcasting corporation, the arrangement in Japan is that they pay a small yearly fee to the government and a small monthly fee to their regional broadcasting centre.

Helping the Listener

But in order to make it easier for them the Corporation has now arranged to pay the yearly government fee for every year after the first subscription of each listener.

Each of the Japanese broadcasting stations transmits for about seven hours per day. The programmes follow very closely on the lines of our own, although there is, perhaps, just a little bit more educational matter than we get. However, when it comes from a broadcasting corporation that does so much for its listeners as that of Japan, it would be curious indeed if that caused grumbles.

WAVES THAT WOBBLE

—continued from page 640

transmission, we can see more definitely what is meant by skip distance; this may be defined by saying that it is the distance at which the highest ray first returns to earth.

For a given height of the layer the skip distance will increase as the wave-length decreases, which means that at certain times we can work a station on, say, 42 metres, but not on 38 metres. For any given wave-length the skip distance will increase as the layer rises, since the limiting angle is lower and a given ray can rise farther before bending downwards.

Actual Skip Distances

Some idea of actual skip distance may be given by the following figures. If the height of the equivalent reflecting layer is 100 miles there will be no skip on 80 metres, a skip of 100 miles on 40 metres, 500 miles on 20 metres, and 1,000 to 2,000 miles on 10 metres.

If the layer height is 225 miles there will be scarcely noticeable skip on 80 metres, 200 miles on 40 metres, 1,000 miles on 20 metres, whilst a 10-metre wave will not return at all.

From this comparatively simple theory you might expect that no signals would be heard inside the skip distance, whereas in actual practice this is not always the case. The exceptions can be accounted for, however, as being due to the ground wave, or to what is called the "throw-back" effect, but this would take a long time to go into in detail, and does not affect the general theory.

Affected by Weather

The atmospheric conditions governing radio transmission are, of course, as variable as weather conditions, and it goes without saying that no general rule has ever been found to apply to these.

At the same time, just as intensive study has helped us to a very much clearer understanding of the causes of weather conditions, and enabled us to some extent to make short-period predictions of weather, so the study of short-wave transmission under all types of conditions has brought us very much nearer to an understanding of the phenomena in question and, what is more important, to the practical and reliable employment of short waves for radio communication over long distances.

THE "M.W." THREE

—continued from page 564

The ultra-selectivity of the "Star Turn" system is not needed on long waves, and all that we require here is a system of aerial coupling which gives just normal good selectivity and freedom from "breaking through" by the low-wave local station.

Such a system is available to "M.W." readers in the form of our "Interwave" method, and this is brought into action when the Selector switch is turned fully to the right. The remainder of the wave-change switching, of course, is carried out by the wave-change switch proper, which functions in the usual manner in conjunction with the dual-range coil unit.

Coupled by Capacity

The modification of the "Star Turn" circuit to suit the needs of the new "M.W." dual-range coil which we have referred to in passing is just a matter of the coupling between the two tuned circuits. In earlier sets of the series the coupling was of the simple inductive type.

A suitable small winding was placed in series between the lower end of the Selector coil and earth, and this was arranged to couple with the coil in the other tuned circuit.

To avoid the use of this special small winding and enable the standard coil unit to be used we have developed an equally effective method of capacity coupling.

A "feed" lead is taken off from the aerial circuit and passed through a condenser of the neutrodyne type to the "A" terminal on the dual-range coil. The normal aerial winding on the latter then gives the desired coupling effect, controlled by the setting of the "neut." condenser.

"Simple and Easy"

There you have the basic features of this, the latest and best of a series of receivers which is becoming famous for its amazing selectivity and a standard of sensitivity and power distinctly above the level of the best detector and L.F. sets of the older type.

The remainder of the circuit you will find easy enough to follow out, for it is on quite familiar and straightforward lines. The second tuned circuit employs our dual-range coil in the usual fashion, and forms the grid circuit of the detector valve.

Here you will note the usual differential reaction, and then follows a low-frequency amplifying circuit of the modern type with an output filter for the loud speaker. The only point for comment here is that there is no volume control. The reason for this you will discover later.

This brings us to the end of theoretical matters, and so to the constructional side. Here there is extraordinarily little to tell you, for the receiver is a particularly simple and easy job.

Valves and Switching

For the most part it is just a matter of looking over the diagrams and laying out the parts on the panel and baseboard in accordance therewith. It is advisable, by the way, to make a reasonably close copy of the detector and tuning end of the set, particularly in the positions of the coils.

Mention of the coils reminds us of a point concerning the "Selector." In some makes the positions of the terminals may vary a little, in which case just connect up by their markings. The exact positions do not matter.

Just one other constructional tip: Those who have not used the "Spaghetti" type of resistance before may be puzzled by the mounting of the 25,000-ohm specimen in this receiver. It will be found to have eyelet ends, and these are connected straight to the terminals of the compression condenser with which it is associated.

Now for the working data for the finished set. We shall have a good deal to say about the actual tuning, so we must give the general data very briefly.

Valves: H.F. or special detector type in first socket, L.F. type in middle socket, power or super-power in socket nearest the 2-mfd. condenser. Voltages: 60 to 100 on H.T. + 1; 120 or more, according to rating of valves, on H.T. + 2.

Switching: For long waves open wave-change switch, turn Selector knob fully to right. For medium waves, close wave-change switch, set Selector to one of the intermediate studs.

Selectivity Settings

Selectivity, on long waves is controlled by compression condenser on baseboard. Normal adjustment is with knob unscrewed a little from maximum setting. Unscrew farther for greater strength, but somewhat lower selectivity. Screw right down for maximum selectivity.

On medium waves selectivity is governed by setting of neutrodyne-type condenser. Normal adjustment is at maximum (moving plates fully engaging with fixed). For abnormally high selectivity reduce a little and apply reaction carefully.

Note.—The volume of the local can be controlled quite nicely by setting this condenser to a suitable very small value.

Now about the tuning. The first thing to grasp is that searching is done just as usual on the condenser dial, and it is *not* necessary to set the Selector accurately before you can hear your station (unless it is a very weak one indeed).

How to Tune

As a rule, you set the Selector very roughly, pick up your station on the condenser dial with the aid of a spot of reaction, and then bring the aerial into exact tune by varying the Selector. This naturally makes searching delightfully simple.

For example, suppose you are listening to the Brookmans Park National transmission, the tuning dial will be at a low reading, and the Selector on one of the first studs, i.e. nearly round to the left. Imagine now that you want to go over to 5 G B, the Midland Regional.

Leave the Selector alone, and sweep upwards on the tuning condenser. As soon as you have passed the Brookmans Park Regional transmission bring up reaction a trifle and continue to revolve the dial. Getting on towards the top you will find 5 G B at rather poor strength.

Dial before Studs

Tune it accurately on the dial, then turn the Selector knob in search of the correct stud. You will find it in a few moments, and the increase in volume which follows will probably enable you to reduce reaction almost to minimum again if your aerial is reasonably good. (This applies to the South and Midlands, of course.)

Similarly, to find stations on other portions of the dial you can adjust the dial first and the Selector afterwards. If the station is likely to be weak, start by putting the Selector roughly where it should be. You will soon find out how it goes for corresponding parts of the tuning dial.

With that final hint we can leave you in the confident expectation that you will soon agree with us that this instrument represents a close approach to the ideal in selectivity, power, and quality.

SHORT-WAVE SUPER-HETS

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frequency. In practice this turns out to be even more useful for intensive searching of the more crowded wave-bands, and can be used with either of the two convertors I have described in the foregoing paragraphs.

For the most satisfactory results it is advisable to use a receiver with fully screened tuning circuits and one-dial tuning, or controls approximating thereto. The convertor and receiver are set up as described, and the oscillator dial set to somewhere about the middle of its range.

Stations Spread Out

This throws a narrow band of wave-length on to the receiver dial, which then becomes the main tuning control, the aerial tuning condenser C_1 being subsequently adjusted for maximum volume. The great advantage of this scheme is that each narrow wave-band is spread over the entire tuning scale of the receiver.

Each setting of the oscillator dial places a different wave-band on the receiver dial, which band will be 1,000 k.c. wide if the receiver tuning covers 200–600 metres. This will give you an idea of how short-wave signals can be well spread out.

A concrete example may perhaps give you a clearer insight into this rather unconventional way of tuning. Suppose the receiver tuning covers 200 to 600 metres, corresponding to a frequency band of 500 to 1,500 k.c.

A Practical Example

Then with a fixed oscillator frequency of 9,500 k.c. a change of aerial tuning from 27 to 30 metres (approximately 11,000 k.c. to 10,000 k.c.) will obviously produce an I.F. band of 500 to 1,500 k.c., which fits the frequency band of the receiver.

Thus all stations between 27 and 30 metres will be spread over the entire receiver dial. Similarly, if the oscillator frequency is 20,500 k.c. we can place 13·6 to 14·3 metres on the receiver. You can check these examples by working from the formula :

$$\text{Wave-length} = \frac{300 \text{ million}}{\text{frequency}}.$$

When constructed with modern components, and the new ideas in design and operation which I have described, the supersonic heterodyne has proved to be remarkably successful for short-wave reception.

IS AUTOMATIC BIAS SATISFACTORY?

—continued from page 617

H.T.— goes direct to all the kathodes in the set except the detector, otherwise the voltage drop across the bottom part of the resistance R_3 would be too great and more than the required 3 volts would be obtained, especially if the output valve were a large one taking a heavy plate current.

Directly-Heated Output Valve

Now, supposing the output valve on the set is not indirectly heated. Then to get automatic bias it will be advisable to have a separate winding for its filament, whether it is a 6-volt or 4-volt valve. I know if it is a 4-volter it will be a temptation to let one winding do for all filaments.

Don't give way to it, have a separate winding.

Now we can get the bias quite simply by connecting the required value of resistance (depending on the plate current taken by this valve) between the centre-tap of the winding feeding the output valve and the common H.T.—.

The grid return of this valve will now go to the common H.T. negative, probably the chassis of the set, which is no doubt screened and boxed, and the valve will get its correct bias without the necessity for a special bias lead. Fig. 7 gives all the necessary details and should need no further explanation, R being the resistance the voltage drop across which gives the required bias.

Using Push-pull

Push-pull is a form of output stage that is used quite a lot nowadays, and this requires a few words on its own. Firstly, it is highly desirable that the secondary winding of the input transformer should be split so that separate bias can be applied to each valve.

The Varley push-pull is a kit that uses this method of construction for one. Incidentally, it is the one and only make of push-pull transformers that I have actually used in which either valve can be removed without buzzing or motor-boating resulting.

To return to the split winding, it sounds at first as if it might rather complicate matters if we have to have separate bias, but I have found a rather curious effect with a circuit I used to get two values of automatic bias. I was using two AC/P valves in push-pull, the common H.T. return being used for bias, since the H.F. valve got its bias from a resistance in its kathode lead, while detector and first L.F. had a small battery.

The H.T. current passed by these two valves was just right to enable me to get the required bias by using a 400-ohm resistance. So I used an ordinary potentiometer of this value for the purpose, and connected it as shown in Fig. 8. The grid return of one valve was connected to the end of the resistance at A, while the other was connected to the slider B. By this means I was getting a compensating effect by means of which almost any variation in bias such as would be needed under working conditions could be made, and even very dissimilar valves matched up so as to give satisfactory results.

A Compensating Effect

You will see what was happening, of course, if you look into the diagram at all closely. When I reduced the bias on V_1 the plate current rose, with the result that more passed through this valve than through the other.

At the same time the increase in plate current of the one valve increased the IR drop across R so that bias on the other valve rose. Since the bias on each valve depended, therefore, on the current taken by the other, the compensating effect referred to above was obtained.

Lastly, we can get our bias by the use of a bias mains unit built in the same way as the H.T. mains nnit. A separate rectifier valve is fed from a winding designed to give the maximum value of bias required and a potential divider connected across the output enables any desired value of bias to be obtained.

G.B. Mains Unit

The complete circuit diagram is shown in Fig. 9. The usual H.T. mains unit is indicated in skeleton form, while the grid-bias mains unit is shown in detail. The mains transformer has two extra windings. One of these feeds the filament of an extra rectifier, the output being suitably smoothed by means of choke Z and condensers C_1 and C_2.

A tapped resistance R is connected across the output, a tapping point being connected to H.T.—of the H.T. eliminator. The tappings 1, 2, 3 enable positive bias to be obtained, while 3, 4, 5, etc., give increasing values of negative bias.

HOW TO MAKE A PORTABLE

—continued from page 656

that there should be no feed-back between its two tuned circuits; namely, the grid circuit (frame aerial) and the anode circuit.

H.F. into L.F.

As the anode circuit of the screened valve is also associated with the grid circuit of the detector valve, it is a wise precaution to include in that circuit compartment all wiring and components that are connected with the grid-filament input to the detector, even down to the valve holder itself, if possible.

At the same time, the output from the detector should be separated carefully from the input leads, both physically and electrically, so that there is a minimum tendency for any H.F. leakage into the audio side of the receiver, which will only lead to poor quality, coarse reaction control, threshold howl, and sundry other objectionable effects.

A Central Earth

The feed to the detector valve is, in the majority of cases, taken through the primary of a transformer, and in order to overcome threshold howl it is advisable to select a transformer with a fairly low inductance primary. This point is very desirable where the second stage is also transformer-coupled, for the overall amplification is so high that the slightest instability in any circuit will greatly upset the performance of the set.

Another point which has been found to be advantageous is the centring of all earth returns to a common point, rather than connecting to the nearest point of earth potential.

Feedback Faults

On many occasions this method has cured obscure defects in portable circuits. It should be realised that either audio or radio feed-back in any set—more especially a portable—will in ninety-nine cases out of a hundred result in poor quality reproduction.

The feed-back is always due to faulty layout or wiring, for by careful thought all wires and components can be safely positioned to give satisfactory results.

It is impossible to stress this point too strongly, for once these troubles are settled all is more or less plain sailing.

THE QUEST FOR QUALITY

—continued from page 573

average receiver to reach a pretty high standard. It is possible to overcome, or rather to compensate for, many of the faults in the average loud speaker by introducing deliberate distortion in the set for counteracting that other distortion.

An account of the various ways of doing this was given in an article called "Frequency Faking" that recently appeared in "M.W."

An Improvisation

But frequency faking is at best but an improvisation. It is legitimate to introduce an over-amplification of low notes in a set in order to compensate for an under-production of low notes in a loud speaker, but I do not think we want to regard such a scheme as a final solution.

Surely it is much better to concentrate on getting a straight line at every step. By all means resort to frequency faking to cloak the inadequacy of present apparatus, but do not let us lose sight of its limitations.

For instance, will it ever be possible to arrange a bass distortion in a set that coincides exactly with an opposite effect in a loud speaker? Maybe it will, but it implies an accurate matching between one definite amplifier and one definite loud speaker operating in certain closely-defined circumstances.

Making the Best of It

Commercially this is not a proposition likely to appeal to the manufacturer. So in our quest for quality we must look much farther ahead than the measure of the success our present improvisations might obtain even if developed to their logical conclusions.

On the other hand, I repeat that there can be no harm in diverting a little from our main aim in order to apply to their best advantage our present not too bad circuits, components and accessories.

Anyone who refused to travel in a present-day motor car because of the possibility of something much better being evolved in the future would be an impractical idealist, and much more so would be the manufacturer who, having the opportunity to do so remuneratively, refused for the same reason to make cars.

RADIO NOTES AND NEWS OF THE MONTH

Passports for Portables

At the conference of the Union Internationale de Radiodiffusion, which finished a few days ago at Budapest, one of the matters which came up for discussion concerned tourists' portable sets. If any of our readers have been abroad with a portable set they know to their cost the difficulties that are put in their way.

What with signing forms, customs dues, tipping, etc., one would think that anybody going abroad these days with a portable set was a sort of super-spy.

However, the Radio Union hopes to change all that, and we wish them good luck.

Only a Rumour!

Rumours about the Pope's wireless station at the Vatican have been numerous and varied. Certainly the rumour has been very strong that the Pope himself will broadcast to the whole world.

We see in the "Catholic Times," however, that these rumours have become so strong that the official organ of the Vatican City declares that not only are such rumours not confirmed, but there has never been any intention of the Pope broadcasting.

Have You Heard It?

The station, by the way, is practically ready, and all that now remains is that the electrical power arrangements have to be altered in order to supply the transmitter with the necessary juice. Probably by the time this issue is on sale, however, many of our readers will have picked up experimental transmissions from the Vatican broadcaster.

A Fine Record

Last year the total length of the B.B.C. transmissions amounted to 64,467 hours, and out of this total the aggregate length of breakdowns only amounted to 19 hours 20 minutes. This works out at a percentage of 0·03. The B.B.C. engineers ought to be very proud of themselves for this remarkably fine record.

"There's a Good Time Coming"

Lately the papers have been full of the striking evidence of the success

(*Continued on page* 679.)

RADIO NOTES AND NEWS OF THE MONTH

—continued from page 678

of the radio industry this year, and, in fact, the industry has been pointed to as evidence of the dawn of an era of better times in Britain.

Certainly the wireless trade is doing very well. One firm said that business during October showed a 20 per cent increase over the same week of last year, the second week 50 per cent, and the third week 130 per cent.

This is the sort of thing which makes one realise that all is not so black as it is painted in the industrial world to-day.

"Canned" Concerts

What did you think of the mechanical broadcasts?

The B.B.C.'s idea of broadcasting famous people via gramophone records was certainly a bright one, but there seems to be some argument as to whether this scheme can be termed really successful.

We, for our part, think such broadcasts of outstanding interest, but it would be interesting to have the views of our readers on this innovation.

A Pleasant Surprise

The Northern Wireless Orchestra has got another lease of life, for its members have had their contracts extended until March 31st, 1931.

Readers will remember that it was announced by the B.B.C. a little while ago that the Northern Wireless Orchestra would function in its fully constituted form until the New Year, and this unexpected extension of its lease of life certainly came as a pleasant surprise to Northern listeners.

Popular Wireless

Here are some figures that will open your eyes. There were 13,478,600 wireless sets in use in the United States on July 1st, 1930. This works out at about one set to each nine persons.

New York State, with 1,752,000, had the largest number, followed by California, with 1,470,000 receivers.

That National Theatre

Readers have no doubt seen in the press the suggestion made by Mr. Harley Granville Barker, the dramatic author, that what he calls a portion of the "profits" of the B.B.C. should be allotted by the Government for

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RADIO NOTES AND NEWS OF THE MONTH

—continued from page 679

the purpose of establishing a National Theatre.

"A credit of about £1,000,000 would be needed to meet the cost of a National Theatre," said Mr. Barker. He doesn't think it practicable to raise a credit of a million pounds by private subscription; he thinks we ought to look for public money, and he wants official approval of his scheme.

Listeners' Money

Well, if listeners have any say in the matter he won't get it, for, to begin with, as the B.B.C. points out, there is no such thing as "profits." The money received by the B.B.C. has its origin in the licence fees paid by listeners, and those fees are paid for one thing, namely, broadcasting; but Mr. Granville Barker wants a National Theatre subsidised out of money subscribed by listeners to the B.B.C.

The Bold Truth

Radio drama is not so tremendously popular that listeners would get their money back in any way in the form of entertainment from relays from the National Theatre. In short, a National Theatre simply means a theatre where plays would be put on which could not pay their way because the public simply doesn't want them; a theatre which would exist because of a subsidy.

That subsidy is certainly not going to come out of the listeners' pockets, and it is quite likely that if the scheme is pressed at all the matter will be brought up in Parliament.

Worse than the Road Fund

Mr. Holford Knight, K.C., M.P., who is a member of the National Theatre Executive Committee, stated the other day that any Government with a whiff of audacity would concentrate on its promotion, i.e. the National Theatre scheme subsidised from listeners' money. "Audacity" is a good word; it would be a million times worse than the Road Fund.

No More Rake-Offs

It is up to listeners to watch this scheme very carefully, and see that their money is not used for any purpose other than broadcasting. As it is, the Post Office and the Treasury take a very large rake-off, and the B.B.C. programmes are not so tremendously marvellous that they cannot do with every penny for their improvement.

Where Is It?

The "Daily Mail" was asking the other day: "Where is the powerful and mysterious wireless station that is broadcasting threats against the Red rulers of Moscow in the name of General Koutepoff?"

This station is supposed to be operating in Russia, somewhere on the shores of the Bosphorus, in Anatolia, in Rumania, in Bulgaria, Poland, Persia, and in fact all over the shop.

Listen Carefully

It is reported that the broadcast voice from this station prattles something like this: "Listen, all Russia! Koutepoff speaking. The time to avenge the wrongs and sufferings of Russia is at hand. The pagans who are holding holy Russia in their bloodstained hands are doomed. I have spoken! Listen carefully."

Like a Thriller

It sounds like a thriller, doesn't it? Anyway, the Dictator of Russia, Stalin, is said to have given orders to locate the station and to bring the speaker to him dead or alive. Koutepoff, by the way, was the White Russian leader living in Paris who was recently kidnapped in a car in daylight. It is thought that he was kidnapped by the Ogpu.

Radio and Poetry

Mr. Masefield, the Poet Laureate, whose play "Pompey the Great" was recently broadcast, delivered a lecture the other day in the course of which he said that broadcasting could be a great asset in the dissemination of poetry. To him it seemed a joy to speak to people five thousand miles away, and to feel that people whom he could not see might be listening to poetry and hearing sentiments expressed which might let them go to their beds with feelings of joyfulness and happiness.

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