6D MONTHLY

The Wireless Constructor

EDITED BY
PERCY W. HARRIS, M.I.R.E.
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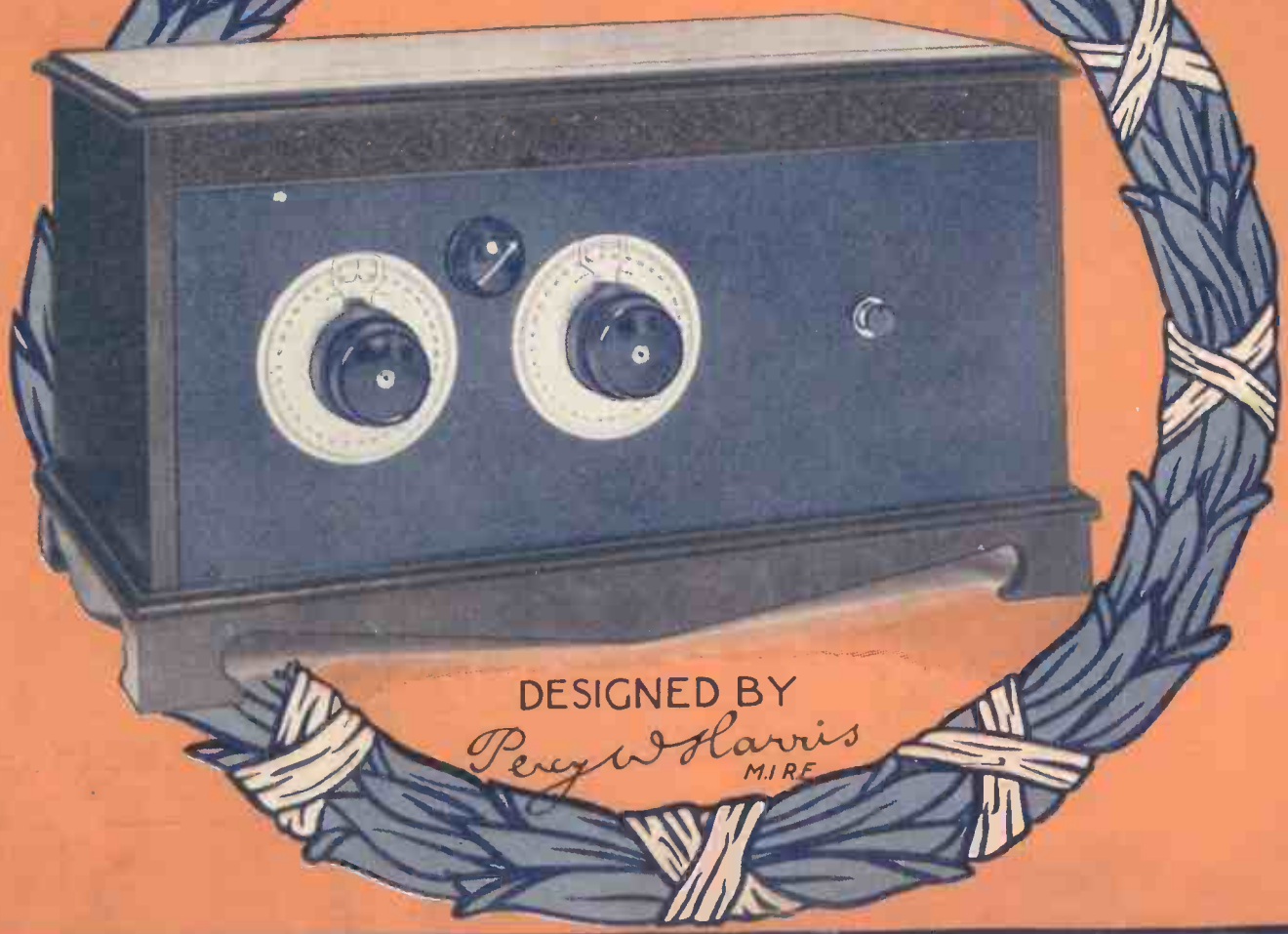
THE "CHAMPION" THREE

SCREEN-GRID-DETECTOR-PENTODE



DESIGNED BY
Percy W. Harris
M.I.R.E.

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

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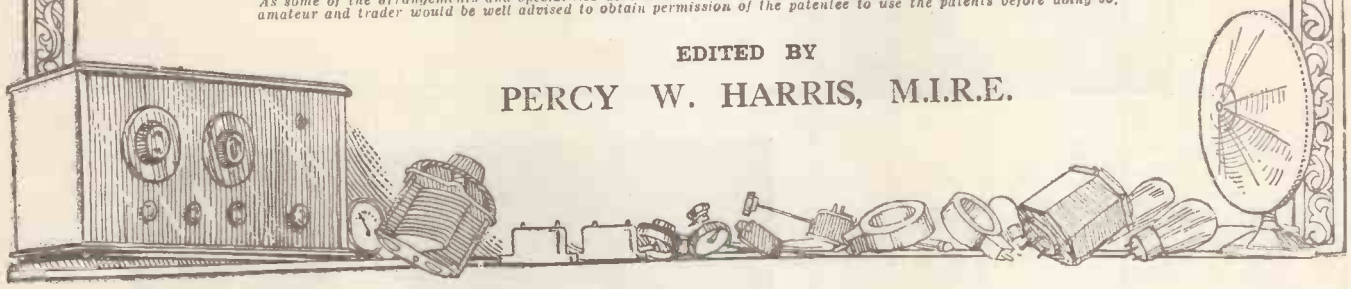

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THE WIRELESS CONSTRUCTOR

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

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THE EDITOR'S CHAT

On this page Percy W. Harris, M.I.R.E., the Editor of "Wireless Constructor," discusses the subject of sets ancient and modern.

THIS month the "Champion" Three marks an important step forward in the general efficiency of wireless reception. It further affords a very interesting contrast between the results obtainable when the broadcasting era first opened and those we can get now.

Then our valves were so extravagant with filament current that each took twice as much current as the total consumption of the "Champion" Three, while in magnification they were exceedingly poor. Our loud speakers were quite incapable of reproducing really low tones (even if our output valves had been capable of handling the necessary energy to give them). Neither neutralising nor capacity screening to prevent feedback were available to the home constructor, and, in fact, high-frequency magnification had to be deliberately kept within certain limits in order to prevent high-frequency oscillation.

The "Champion" Three

Contrast all this with the "Champion" Three described in the present number. Here, with only three valves, we can obtain results not achievable even with six valves in 1922. Low notes and high notes are reproduced with a fidelity which then would have been thought impossible; a single high-frequency valve of a special form brings in the distant stations so powerfully that many of them are as strong as the local, while the latest arrival in valves—the pentode—enables us with one valve to get a much better magnification than in those now far-off days was possible with two.

Variable condensers are now precision jobs, accurate and smooth slow-motion of the plates is obtainable with modern slow-motion dials, while the front of the set, housed in a handsome cabinet, carries one or two simple and symmetrically-placed controls in place of the bewildering array of knobs, dials, switches and brightly glowing valves without which no early wireless set was considered complete!

Details of the "Champion" Three will well repay study even by those who do not even contemplate building a set (or another set!) at the present time. In a sentence, the "Champion" Three represents the best three-valve set it has yet been possible to describe for the benefit of WIRELESS CONSTRUCTOR readers, and as such we present it with every confidence.

Budapest in Daylight on "Wireless Constructor" Set!

SIR,—I have not seen many reports re your "7-Valve Super-Heterodyne" (described in the July, 1928, issue).

The total stations received by me are 64, 50 of them on the loud speaker, about 25 of these 50 being audible two floors below the loud speaker, which gives you an idea of the volume.

As I have never tried for America, the two best receptions I think are Budapest (full loud speaker in daylight), which is 900 miles distant, and Rabat (Morocco), approximately 1,300 miles away, both of which are receivable any night.

Yours truly,

S.W.1. G. REID.

Major Segrave (with hat in hand), Britain's Speed King, before the microphone on his return to this country after breaking the world's speed record in America.

EXPERIMENTING WITH THE THIRTY-ONE NEW CIRCUITS

BY THE EDITOR.

IN this article in the series dealing with "Thirty-One More Tested Circuits"—the gift book presented with the WIRELESS CONSTRUCTOR, December, 1928—we have to deal with Circuits 23 to 25 inclusive. No. 23 is now very well known, being that of the "Stedipower" L.T. Unit designed to give low-tension direct current from alternating current mains up to a maximum of one ampere. This circuit, which was first published in the WIRELESS CONSTRUCTOR for August, 1928, was the first to make available to the home constructor a design which would enable him to run the filaments of any ordinary set from alternating current mains without change of valves.

"Stedipower" Junior

A good deal has been written about it in the WIRELESS CONSTRUCTOR, and no further comment is needed here except to say that over a year's use of the original model (and a use far greater than the average listener is likely to give such an instrument) has not shown up any deterioration in any of its parts. The unit still goes on delivering the full load without the slightest trace of hum or fluctuation in voltage output.

Circuit No. 24, "Stedipower Junior," is the same idea applied to the popular trickle-charger. The only comment needed is that a few trickle-chargers on the market give considerably less than half an ampere, and this device is intended only for those which give half an ampere. Typical examples of these are the Ferranti, Burndept, and Regentone.

An H.T. Battery Charger

In Circuit No. 25 a charger for high-tension accumulator for A.C. mains is given. This is a very simply made and useful unit which will enable those who have alternating current in the house and who use high-tension accumulators to rid themselves of the nuisance of periodically carting the whole high-tension accumulator from the house to some charging station, where, unless care is used in charging, the whole battery may be ruined.

The transformer TR is obtainable from a number of makers and is of the type designed for use with A.C. high-tension mains units. The primary marked "mains" should be wound for your house lighting voltage, and the secondary should be centre-tapped, capable of giving approximately 200 volts either side of the centre-tap, together with a filament winding. This is a standard type of transformer obtainable at a reasonable price from several makers.

Two rectifying valves are used of the single-wave type, the Mullard D.U.10 being very suitable here. Ordinary valve holders are used, and while non-microphonic properties, valuable as they are, are useless in devices where no listening is done, we still recommend the non-microphonic holder here, not for its originally designed purpose, but because it eliminates a good deal of shock, and therefore risk of breakage to which the valves might occasionally be subjected.

Here is a further chat on the practical applications of the circuits shown in the book given away with the December, 1928, issue of the "Wireless Constructor."

The milliammeter M should always be used, and the resistance R must be properly chosen. While theoretically this can be a fixed resistance when the correct value has been found, it is advisable to have it variable so that the charging rate may be exactly adjusted by turning a knob and watching the milliammeter.

The charging rate should not exceed 100 milliamperes if reasonably long valve life is to be expected. Suitable resistances for R_1 do not seem to be readily obtainable in British manufacture, but suitable American resistances are available in this country from Claude Lyons, Ltd., and The Rothermel Corporation, Ltd. Such resistances, owing to their large current-carrying and heat-dissipating powers, are more expensive than the ordinary filament resistances, but are well worth obtaining. We can recommend from experience the following, the agent's name being given in brackets after each:

Adjusting Charging Rates

Centralab giant power rheostat, type GR2000 (Rothermel Corp., Ltd.). Electrad Truvolt Unit, type C20 (Rothermel Corp., Ltd.). Power Clarostat, 200-ohm minimum type (Claude Lyons, Ltd.).

To charge high-tension accumulators, first of all set the variable resistance at its high-resistance position, connect up the accumulators and finally switch on. The valves should light at once and the variable resistance can then be turned until a current not greater than 100 milliamperes is indicated on the ammeter. The meter should be looked at occasionally and the charging rate adjusted should it rise or fall.

In ordering the transformer it is important that the filament voltage should be suitable for the D.U.10 valves.

A Cheaper Charger

A slightly cheaper charger can be made up using one double-wave rectifier, such as the Marconi or Osram U.5. This, however, will give a charging rate of a maximum of 50 or 60 milliamperes only. One valve holder is then used, and here, of course, it is important that the filament voltage of the transformer should be suitable for the U.5 valve. When wiring up the single valve holder for the U.5 remember that one plate is connected to the normal plate socket of the holder, and the other plate to the normal grid socket of the holder, the filament connections being as with ordinary valves.

The remaining circuits will be dealt with in our next issue.

THE "ACE" RECEIVER

by G.V.COLLE

This all-from-the-mains set represents the latest thing in three-valvers. It employs one of the new A.C. screened-grid valves and has enormous magnification powers.

LOUD-SPEAKER volume equal to that given by many five-valve receivers, simplicity of control, no coil changing, a dead silent background, and reasonable selectivity with enormous sensitivity, these are but some of the many interesting claims which can be made for the "Ace."

The receiver represents the latest in mains-operated receivers of the A.C. type, and is, in the writer's opinion, a good example of what can be achieved with really modern valves. Not only do the indirectly-heated A.C. valves give amplification about 50 per cent greater than ordinary three-electrode valves for any given stage, but the A.C. screened-grid valve incorporated in this receiver brings the volume up to a level which it will be difficult to beat with any three-stage receiver.

Tuning Circuits Employed

A considerable amount of experimenting had to be undertaken before this valve was made to function in the proper manner, owing to the lack of sufficient technical data relating to associated tuned circuits. Unlike the normal screened-grid valve, it was found impracticable to fit it in a receiver in a position to one side of a screen, because the external feed-back between the plate and grid circuit was sufficient to cause it to oscillate violently.

A glance at some of the photographs of the interior of the set will give one an idea of how this is partly overcome, namely, by inserting the valve through a screen and shielding the coils from one another by electro-static screens.

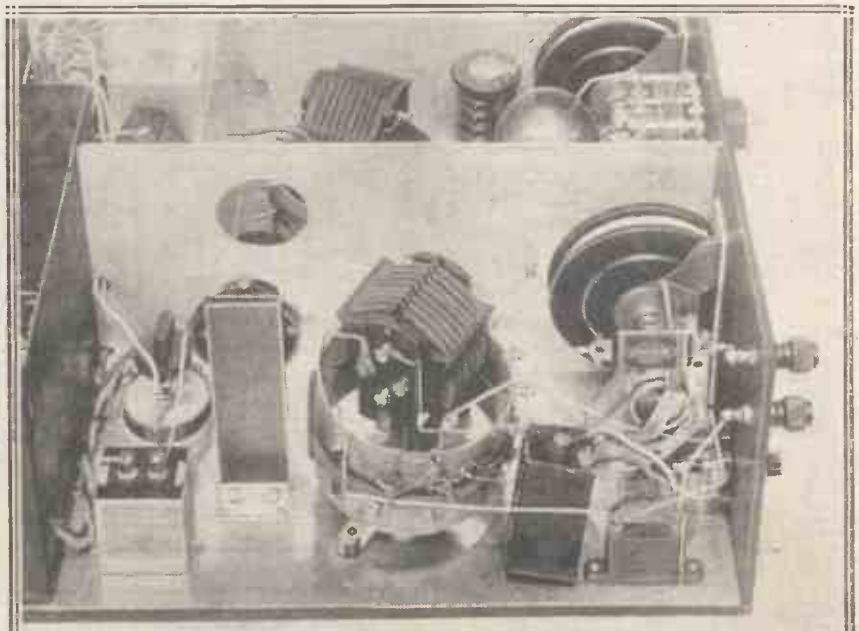
An interesting point in reference to this receiver concerns the tuning. There are, as will be observed, two "Titan" coil units for the purpose, one of which is employed for the aerial circuit and the other (in the central compartment) for the tuned parallel-feed.

Experiments with the set in its final form showed that while the aerial tuning was sharp, the tuned grid circuit had not sufficient selectivity. The writer thereupon included the primary winding on the second coil unit, so as to make it a parallel-fed H.F. transformer having a variable step-up ratio, rather than a plain tuned grid coil. This had the effect of increasing the selectivity of the whole receiver.

Controlling Selectivity

Actually, it has been found sufficient to connect the tapping clip on the second coil unit to the 16th (end) tap, the selectivity of the set being controlled by a similar tapping clip on the aerial coil unit.

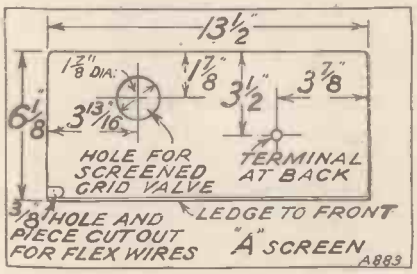
Moreover, owing to the enormous magnification given by the H.F.



The aerial tuning and grid circuits of the set. Note the "Titan" type of wave-change coils.

The "Ace" Receiver—*continued*

valve, a low tapping point can be utilised on the aerial coil to obtain the desired degree of selectivity, the resulting amplification still in most



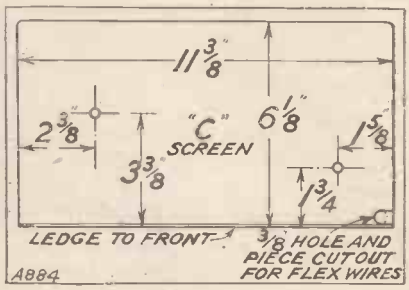
cases being sufficient to give loud-speaker signals, although, of course, depending on the strength of the signal in the first instance.

Turning, again, to the theoretical circuit, readers will by now have gathered that the circuit consists of three valves, namely, a screened-grid H.F., detector, and one L.F. stage, transformer coupled to the detector. The mains equipment included with the receiver consists of two A.C. transformers, one giving 4 volts A.C. output at 3 amperes for the filaments of the A.C. valves, and the other giving 200 + 200 volts A.C., which rectified by a U5 full-wave rectifying valve passes current up to 60 milliamperes at 200 volts for H.T., the load being partly taken up by a wire-wound potential divider. Both A.C. transformers are housed in a special iron screening box, together with a 4-mfd. condenser tested to 750 volts, and the rectifying valve, the whole being covered by a lid, and the box (and the H.F.) "earthed."

Pure "D.C." Essential

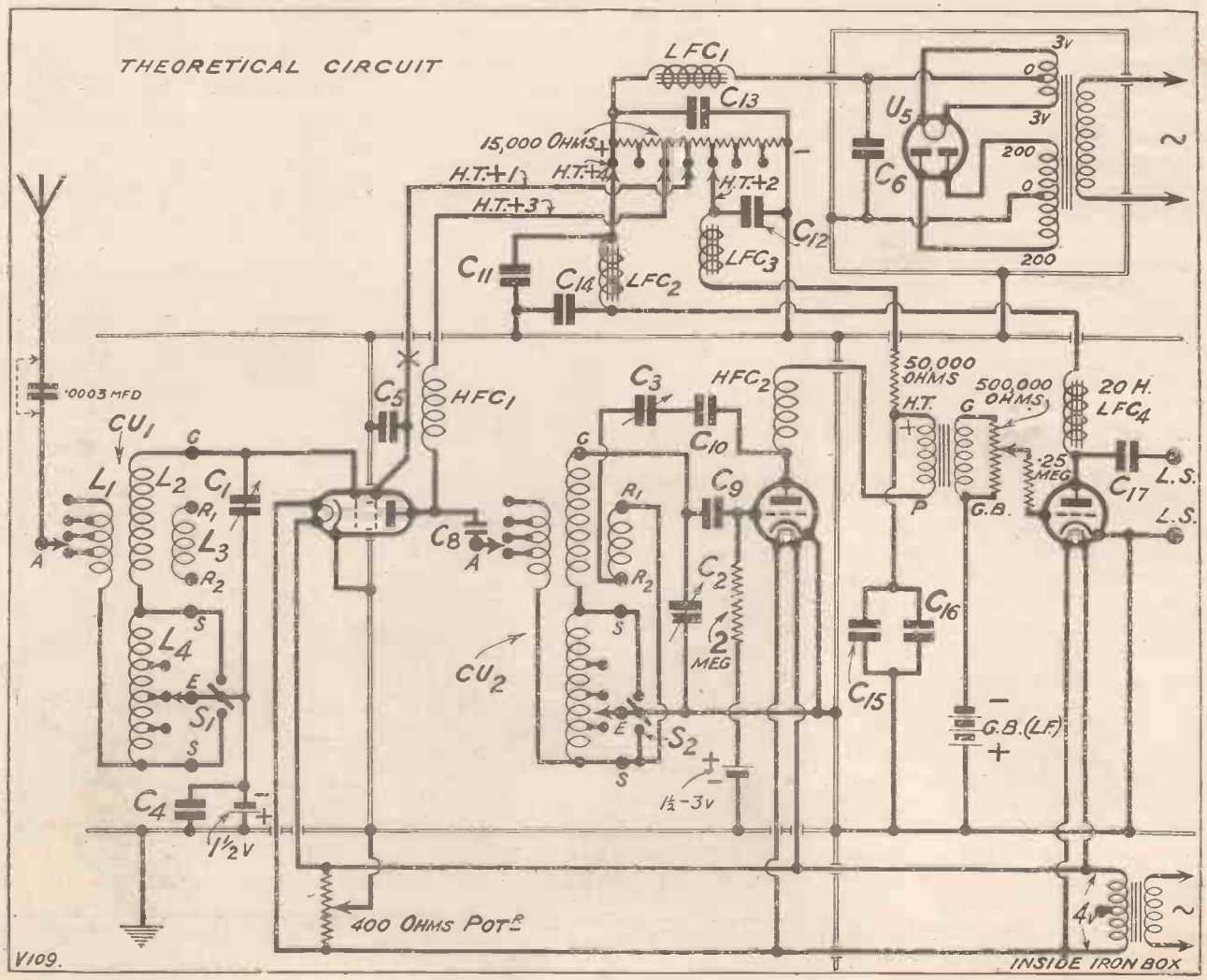
Between the potential divider and the H.T. + on the H.T. transformer a 28/14-henry L.F. choke is inserted with a further 4-mfd. condenser, the latter two constituting the primary smoothing circuit.

A choke filter circuit is included in the anode circuit of the L.F. power



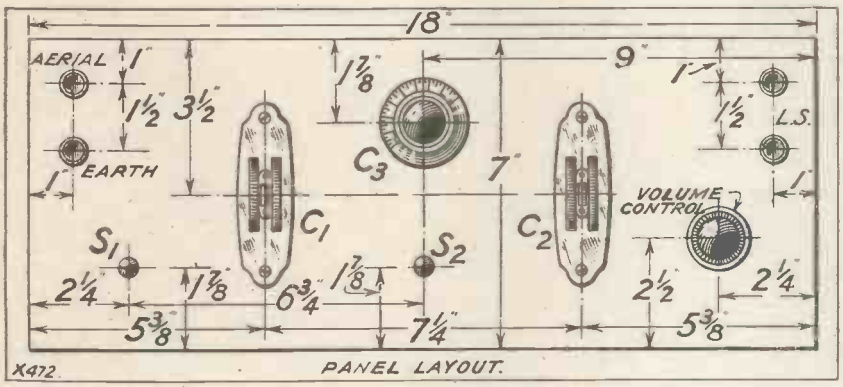
valve, and the H.T. to this valve is fed through this, and a further 28/14-henry L.F. choke with various by-pass condensers, to prevent the usual 50-cycle note from interfering with the A.C. currents set up across the choke in the choke filter.

The importance of smoothing out all irregularities in the rectified D.C.



The "Ace" Receiver—*continued*

supply to the anode of the power valve cannot be over-emphasised if hum is to be eradicated. In the same connection a certain amount of attention has to be paid to the detector, especially if a transformer is employed as a coupling medium.



Fortunately, the current flowing in a detector plate circuit is not large, so that a 150-henry L.F. choke with a large condenser, not less than 4 mfd., by-passing it, will give reasonably efficient smoothing, as recommended for this receiver.

Further, the writer has found it an advantage to include an anti-motor-boating device in the detector anode circuit, and this takes the form of a wire-wound resistance and 4-mfd. condenser (two 2-mfd. in parallel will do quite well).

Grid-Bias Batteries

Coming now to the H.F. valve, it will be noticed that no L.F. chokes are included in the H.T. + leads, because any slight irregularities in the supply do not appear to have any detrimental effect on the performance of the valve, the primary smoothing circuit being sufficient for the purpose.

On the other hand, the writer has found it essential to employ by-pass condensers across each of the screen-grid and anode leads, the condenser across the former being absolutely vital. Its capacity must not be less than 2 mfd., although 3 to 4 mfd. would be "playing for safety."

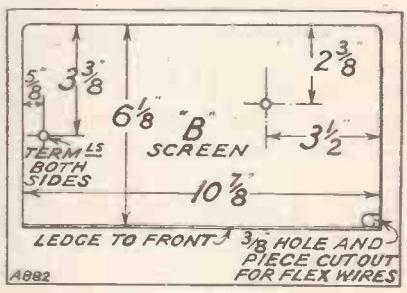
A point of great importance is the grid biasing of all the valves. It will be realised that the cathode (H.T.—) of the valves is zero, and therefore any grid voltage above or below (positive or negative) this point must either be obtained from a separate rectifying valve giving suitable G.B. voltage outputs or from separate batteries. Grid batteries are not very expensive, and, as compared to an elaborate separate rectifying equipment, seem to justify their existence, provided the voltages required are not more than, say, 20 volts.

The writer therefore feels justified in calling the "Ace" an all-mains receiver, despite the small G.B. batteries necessary, because he does not feel it would be to the reader's advantage to do otherwise; 1½ volts negative bias is applied to the control grid of the screened-grid valve and certainly increases the magnification of the valve.

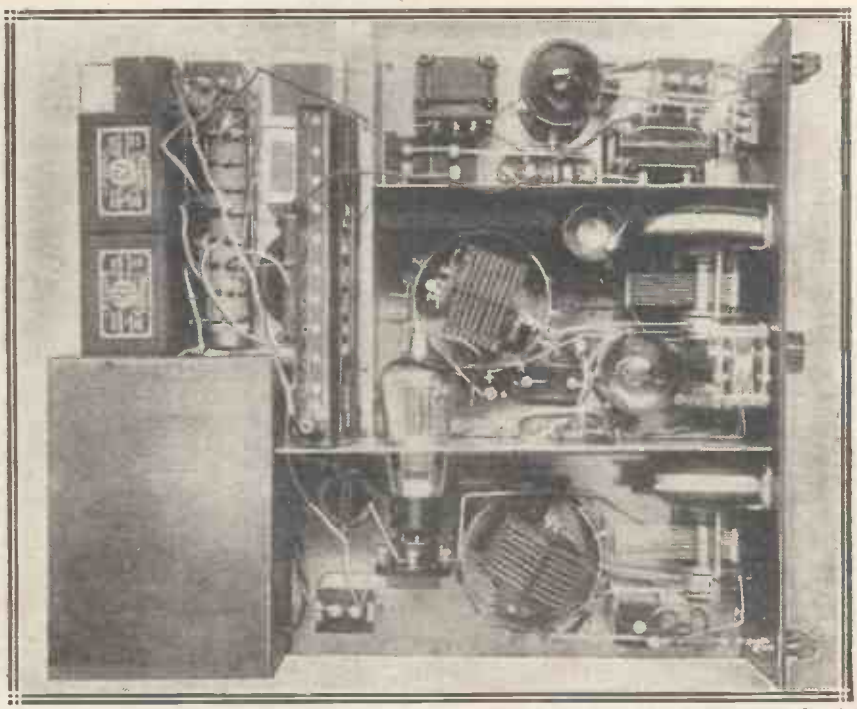
The grid-bias voltage on the detector valve can be either negative (for anode-bend rectification) or positive (for grid rectification); 3 volts positive seem to suit the valve with 60 to 80 volts on the anode. Grid bias on the L.F. valves varies between 7½ and 13½ volts, depending on the H.T. voltage applied.

Constructional Details

We now arrive at the constructional details, which should prove quite straightforward, although requiring a certain amount of explanation. Many readers will probably name the screens as being the greatest difficulty, and if they should undertake their construction they will probably require a certain amount of patience.



Dimensions are given for the vertical screens, but the writer would like to add that there are several firms willing to supply them ready



A general view showing the valves in position. Note how the screened-grid valve is fixed in relation to the screen.

The "Ace" Receiver—*continued*

cut to size if so requested. The original aluminium screens were obtained from Messrs. Burne-Jones, but it is understood Paroussi and Ready Radio Co. are also able to supply them. With regard to the three baseboard screens, these simply consist of flat sheets of metal cut to the dimensions given on the wiring diagram.

There is no terminal strip on this receiver, and therefore constructors can commence operations on the ebonite panel. It will be necessary to cut two rectangular holes for the variable condensers' drum dials, the dimensions being obtained from the combined gig and backplate supplied with the condensers.

Baseboard Assembly

When the panel assembly is completed it can be screwed to the baseboard, preferably while the latter is in position in the cabinet, so as to ensure a fit when once the receiver is completed.

We will now assume the baseboard is ready to receive the various components and screens. A handbrace with a couple of drills and the various screws to hold the components down to the baseboard should also be within easy reach, because once the flat screens are in position the components are mounted on them temporarily, so that the positions of the screw holes can be marked with a sharp-pointed instrument.

An Important Point

Carefully keeping each screen in position as it is taken in hand, drill through the metal at every point where a screw has to be inserted, the actual screws themselves holding the screen finally in position. The components can now be replaced and screwed in position with suitable screws.

Before treating the valve holders for the A.C. valves similarly, introduce small pieces of fibre sheet under their bases sufficient to cover them as a protection against loose screws coming into contact with the metal sheets. Treat any other components such as H.F. chokes in a similar manner should their bases offer no protection to "live" screws.

Components such as L.F. chokes, fixed condensers, transformers, grid-leak holders, coil units, potential divider, batteries, can be arranged on the baseboard without further ado, since they require no insulation. All components which fit in the iron screening box are attached to a wooden baseboard, the latter only being inserted in the box after it has been screwed to the baseboard of the set with four $\frac{3}{8}$-in. countersunk screws.

Drilling the Screens

In reference to this box, it should be noted that holes have to be drilled in the sides in the positions shown in the wiring diagram, to allow the leads from the A.C. L.T. transformer, mains input flex, H.T. + lead to pass through, a further couple of holes being provided for metal screws to make connection to the earthed sections of the receiver.

COMPONENTS REQUIRED

1 Cabinet 18 in. × 7 in. × 20 in. deep, complete with baseboard. Lid to fully open (Camco). (Caxton, Artcraft, etc.)
1 Ebonite panel 18 in. × 7 in. × $\frac{1}{4}$ in. or $\frac{3}{16}$ in. (any good make).
2 Titan coil units (Wearite, Burne-Jones, Paroussi, Ready Radio, Goltone, Berclif).
1 Iron screening-box 6 in. × 8$\frac{1}{2}$ in. × 6 in. deep (Burne-Jones).
1 A.C. H.T. transformer, to give 200 volts H.T. Specification 200-0-200 v. H.T. and 2·5 v.-0-2·5 v. L.T. for U5 rectifying valve. Type D.W. shown (Ward and Goldstone).
1 A.C. L.T. transformer, to give 3 v. + 3 v. output at 4 to 5 amperes. The one shown is rated to give 5 amperes at 6 volts from 250 v. A.C. mains. Used on 240 v. originally, it gave 3 amperes at exactly 4 volts (Heayberd).
3 Valve holders for A.C. valves (Metro-Vick). (Ordinary valve holder with special Metro-Vick adaptors can also be employed.)
2 ·0005-mfd. variable condensers, drum-drive type (Dubilier).
2 28 14-henry L.F. chokes (R.I.).
1 150-henry L.F. choke (Pye).
1 20-henry L.F. choke (Burne-Jones). (Pye, R.I., etc.)
1 500,000-ohm potentiometer volume control (Holzman). (Centralab, etc.)
1 ·0001-mfd. miniature reaction condenser (Cyldon). (Peto-Scott, Utility, etc.)
2 3-point switches (Ormond, Wearite, Bulgin, etc.).
3 4-mfd. condensers, tested 500 v. A.C. approx. (Hydra).
6 2-mfd. condensers, tested 500 v. D.C. approx. (Hydra).
1 2-mfd. condenser, tested 500 v. A.C. approx. (Hydra).
1 Potential divider, resistance approx. 15,000 ohms, with at least 7 tapping points. 10,000 or 20,000-ohm resistances of this specification can also be employed (Igranic, R.I., Pearl, etc.).
2 Vertical grid-leak holders (Dubilier).
2 Grid leaks, one 2 meg. and one ·25 or ·1 meg. (Dubilier, Lissen, Mullard).
1 ·0003-mfd. condenser (Dubilier). (Lissen, T.C.C., Atlas, etc.)
2 ·001-mfd. condensers (T.C.C.). (Dubilier, Lissen, etc.)
1 ·01-mfd. mica condenser (T.C.C.).
2 H.F. chokes, preferably of different makes (R.I.-Varley and Wearite shown).
1 L.F. transformer, ratio 3$\frac{1}{2}$ or 3 to 1 (Ferranti A.F.3). (Lissen, Igranic, R.I., Brown, etc.)
1 400-ohm baseboard potentiometer (Igranic).
1 Sprung valveholder for rectifying valve (Benjamin). (Lotus, C.E. Precision, Igranic, etc.)
1 1$\frac{1}{2}$-volt "T" cell (Siemens).
1 4$\frac{1}{2}$-volt grid battery, tapped every 1$\frac{1}{2}$ volts (any good make).
1 15- or 16$\frac{1}{2}$-volt grid battery for the L.F. valve (any good make).
1 50,000-ohm (approx.) wire-wound resistance (Edison-Bell). (Ferranti, Lissen, etc.)
Quantity of 2-mm. Systoflex and No. 20 S.W.G. tinned copper wire, screws, etc.

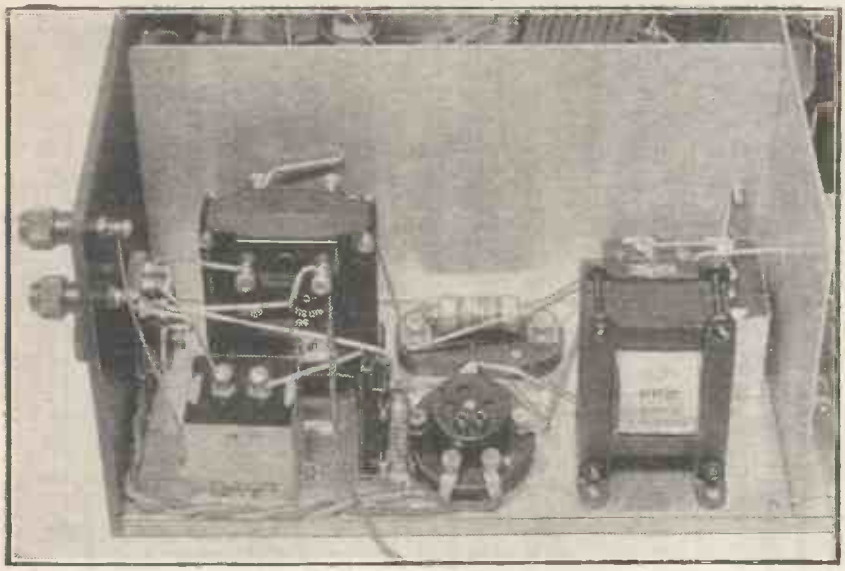
Aluminium screening:
1 Sheet aluminium, 9 in. × 9 in. and approx. $\frac{1}{32}$ in. thick.
1 Sheet aluminium, 13$\frac{1}{2}$ in. × 6$\frac{1}{2}$ in. and approx. $\frac{1}{32}$ in. thick.
1 Sheet aluminium 10$\frac{7}{8}$ in. × 4$\frac{1}{2}$ in. and approx. $\frac{1}{32}$ in. thick.
1 Vertical screen, 10$\frac{7}{8}$ in. × 6$\frac{1}{8}$ in. high, with flange $\frac{1}{2}$ in. wide (B screen).
1 Vertical screen, 13$\frac{1}{2}$ in. × 6$\frac{1}{8}$ in. high, with flange $\frac{1}{2}$ in. wide (A screen).
1 Vertical screen, 11$\frac{3}{8}$ in. × 6$\frac{1}{8}$ in. high, with flange $\frac{1}{2}$ in. wide (C screen).
(Original screens by Burne-Jones, and can also be obtained from Paroussi, Ready-Radio, etc.)

Accessories:
1 A.C. screened-grid valve (AC/S) (Metro-Vick).
1 A.C. Green Spot (AC/G) detector valve (Metro-Vick).
1 A.C. Red Spot (AC/R) L.F. power valve (Metro-Vick).

NOTE.—In case of instability, the AC/G valve may be substituted by an AC/X.

1 U5 rectifying valve (Marconi or Osram).
8 to 10 yards of twisted flex.
1 Mains plug, to fit point from which the current will be derived.

The "Ace" Receiver—*continued*



The last stage of the set, showing the Cosmos valve holder for the L.F. valve.

Do not fix the valve holder for the screened-grid A.C. valve to the baseboard (with the aid of its ebonite vertical support) until the "B" vertical metal screen is attached, because it is most important to see that the hole drilled in it for the bulb of the valve comes in alignment with the valve holder. Before finally fixing it in position, the writer would recommend the constructor to test for alignment by inserting the screened-grid A.C. valve through the screen and into its holder.

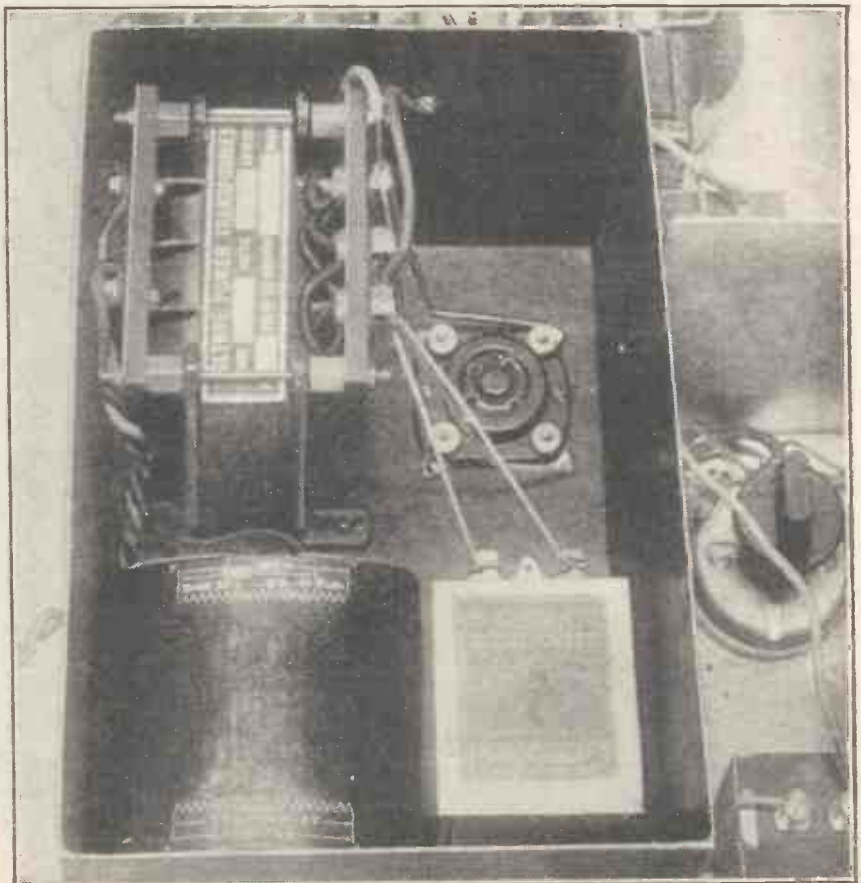
Positioning the H.F. Valve

The actual position the valve holder will take up in respect to the "B" screen can be determined by the flat screening disc inside the valve (and surrounded inside by a tube), which should become exactly in line with the thickness of the screen. Finally, in reference to the same point, it should be understood the centre of the valve holder from the top of the baseboard measures exactly 4¼ in., the holder being attached by two screws to a strip of ebonite 2 in. wide and about 5¼ in. long, the latter in turn being screwed to the baseboard by means of two small pieces of ⅜-in. angle brass.

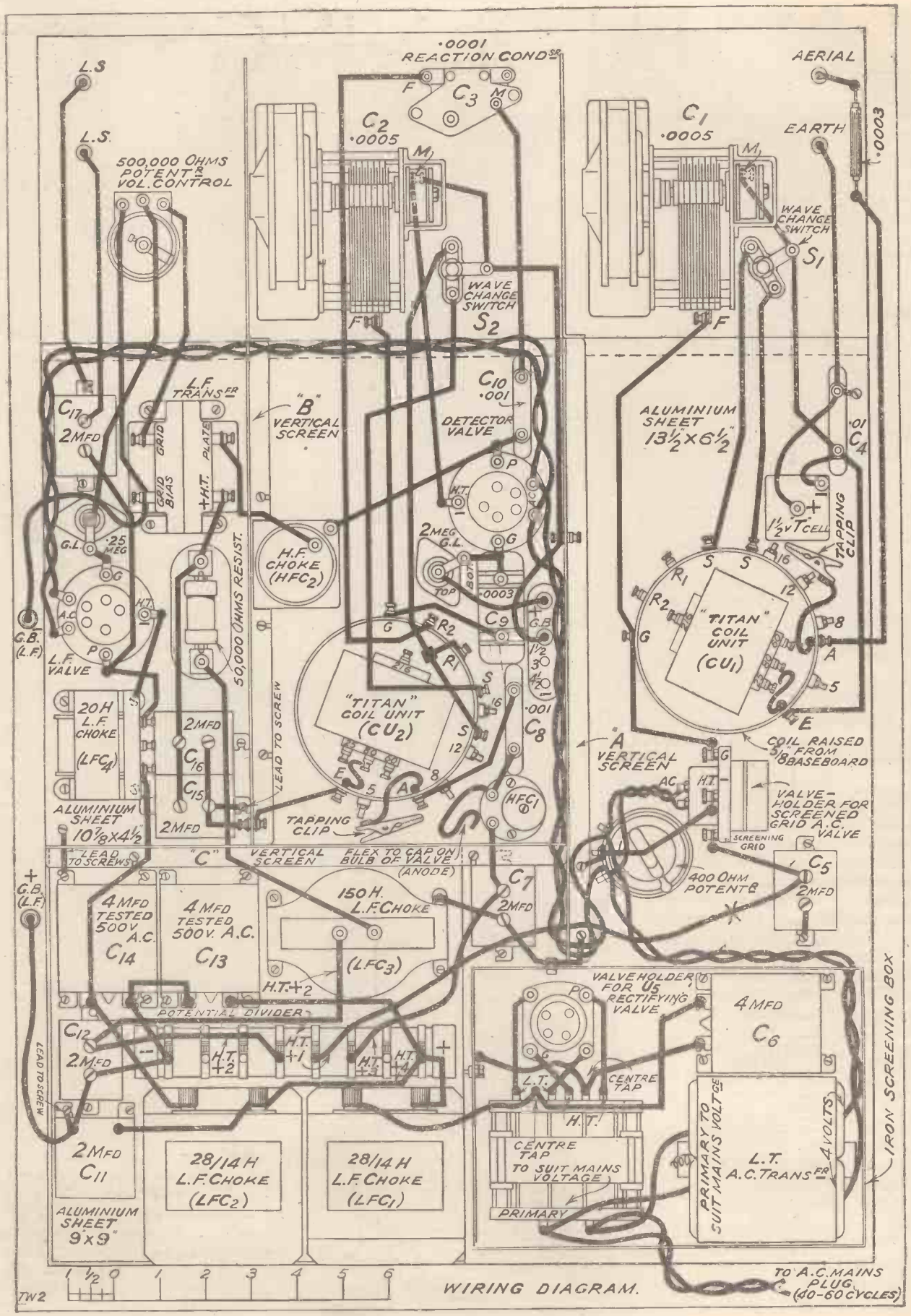
Now fit the remaining vertical screens and, once the positions of the screws holding them are determined, they may be temporarily removed to assist the constructor in the wiring. The general wiring of the receiver can be carried out with No. 20 S.W.G. tinned-copper wire and 2 m.m. Systoflex, the A.C. L.T. leads consisting of twisted flex, which is carried from valve holder to valve holder. While on this subject readers must realise the importance of using twisted flex, since it has the effect of confining the A.C. field to the leads, which should be kept well away from all grid and plate circuits.

To make a neat job of all the twisted flex connections, the frayed ends of the cotton covering can be covered with cotton thread, twisted round and gummed. After the wiring is completed, it should be carefully checked against the wiring diagram, the wires on the latter being crossed off as they are identified in the set. This completes the construction of the receiver, and now it only remains to insert the valves, attach the grid batteries, and adjust the values of the H.T. + voltages.

Full details on the operation and the installation of the "Ace" receiver will follow in the next number.



The mains transformers and rectifying valve are placed in an iron box to prevent interaction with the rest of the receiver.



WIRING DIAGRAM.

HAPPENINGS AT SAVOY HILL

By OUR SPECIAL COMMISSIONER

The Political Shimozzle

I KNOW it is easy to say, "I told you so," but I feel very much in this mood about the results of the B.B.C. effort to broadcast politics in a way with which all three Parties would agree. I was absolutely right when I said that listeners did not want the stuff, anyway.

Most sane people think that it is bad enough to have their newspapers spoilt during an election period; it was a general hope that, at least, the British ether would avoid the infection.

The obviously right course for the B.B.C. was to have stuck strictly to precedent, and arranged for the three addresses only, enabling listeners to absorb political wisdom from Mr. Baldwin, Mr. Lloyd George and Mr. MacDonald.

So much has entertainment value. No doubt with the best intentions, the B.B.C. has now earned the suspicion and dislike of all three Parties. The Conservatives didn't want it, anyway. Mr. J. C. C. Davidson is a determined opponent of microphone politics in any circumstances. The other two Parties wanted it, but, naturally, on the basis of equality of opportunity.

The B.B.C. began by asking the Parties to agree among themselves. This was a year ago. Then apparently Mr. Winston Churchill got the B.B.C. to adopt his personal plan—that is, double opportunity for the Government. This was argued for a year as the B.B.C. scheme and not as the Government scheme—which, in fact, it was.

B.B.C.'s Lost Prestige

But the Government seems to have been able to prevent the B.B.C. from stating the real authorship of the favoured proposal.

In the end the Opposition Parties gave way rather than have no chance at all at the microphone. The Government really hoped that there would be no agreement and that the thing woud fall through; but Mr. Churchill hung on and got his way, as usual.

The B.B.C. has lost heavily in prestige and reputation. In the political field the Corporation is now identified with the Conservative interest. In the event of a continuance of Conservative Government, of course, all will be well, and an interval of four or five years is long enough to dull the edge of bitter memories in such matters.

But if there is a change of Government, I shall feel much happier not to have been employed at Savoy Hill. There is no doubt at all that either the Liberals or the Socialists would make a thorough investigation of the B.B.C. and probably bring about sweeping changes both in personnel and methods.

The Moral Tone of B.B.C. Staff

Fleet Street has been full of rumours lately of scandal and moral outrage at Savoy Hill. I took the trouble to follow up all the threads that were recognisable, and am glad to be able to say that, for once, the old adage of there being some fire where there is a lot of smoke is not applicable.

The moral tone at Savoy Hill is exceptionally high. It is altogether wrong and unjust to infer that there is hypocrisy in the claims of the high standards which the B.B.C. makes for itself in all parts of its business. The lives of most people employed at the B.B.C. are models of asceticism.

Unpenetrable Gloom

For one thing, they don't get enough money to be anything else. For another thing, deep religious fervour is general. And, thirdly, B.B.C. staff are guarded, sponsored and shepherded in a way which I believe has no parallel elsewhere.

The little frictions of the home, which in other walks of life are sometimes allowed to fester into running sores of trouble, are dealt with promptly by either Sir John Reith himself or his administrative and ethical deputy, Vice-Admiral Carpendale, C.B.

The result is not only a good administrative machine, but a nucleus of almost Cromwellian austerity, reserve, and piety. The only snag about it is the gloom which appears to defy the penetrative qualities of any kind of cheer.

RADIO IN SIAM

This is the short-wave station at Bangkok. The two masts each carry an aerial; the one for 14-metre and the other for 18-metre transmissions.

Happenings at Savoy Hill—*continued*

More or Better Broadcasting?

I hear the old controversy about reducing the number of programme hours in order to improve them has been revived in an acute form. Those who believe in concentrated effort would not only wash-out provincial stations, but would transmit only about two-thirds of the time at present attempted.

There are many attractions in this argument, but the tendency of broadcasting all over the world is against it. Women's talks in the mornings, Fultograph and Television at odd moments, early and late, new utility services sandwiched in where there was an occasional spell of silence. No, the strength of sectionalised demand will overcome the concentrationists. It will not be long before the B.B.C. will transmit right round the clock, including the Empire in its range.

The B.B.C. and Soccer

The ingenious way in which the B.B.C. got round the difficulty about the Cup Final may doom all running commentaries from soccer matches if the F.A. and its members stick to their present attitude. By the simple expedient of a relay of commentators, the broadcast description is only a few minutes late, a somewhat ragged. Whether this is morally justifiable is another matter, and one which I do not propose to judge here.

"The Only Way"

Sir John Martin Harvey has been relating how, at his suggestion, the B.B.C. is to put on a special broadcast version of "The Only Way." I wonder whether the new anonymity rule will be applied in this case. I would lay long odds against.

The B.B.C. Report

The Postmaster-General is late again with his annual report of the B.B.C. for Parliament. I hardly believed that another report could rival the first in dullness; but I was wrong. The Report for 1928 is incredibly dull and non-committal. Not that I blame the B.B.C. Why should they tell any more than they have to? It is up to Parliament to extract more information; but I doubt if any action of this kind will be taken until the end of the Licence in 1935. Not more than a dozen M.P.'s know anything at all about the B.B.C.

Summer Programmes

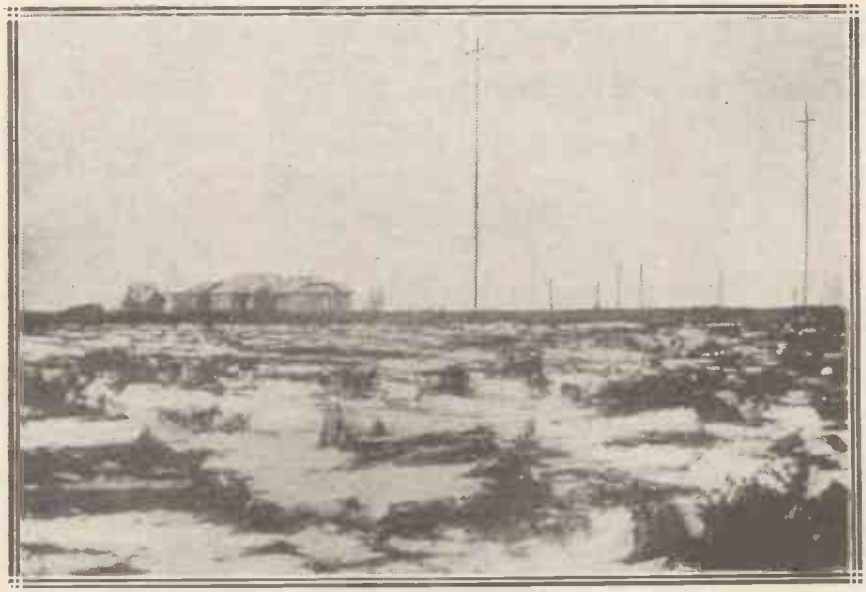
There is really good news this year about plans for summer programmes. There is to be a straight cut of educational and highbrow stuff, and a general replacement by light entertainment.

The only snag still to be surmounted is the Sunday programme. So far as I can learn, nothing has been done about this. There will be the standard run of religious services and severe music all the day and half the night. And with the rest of the week more in accord with the season the contrast will be all the more startling.

The time has come when there should be a regular entertainment alternative to all religious services and ethical disquisitions. As things are, most people who can do so go over to the Continent on Sunday evenings. I am not one of those who would stop religious broadcasting or lower the artistic tone of Sabbath transmissions, but I would be tolerant enough to provide decent entertainment for those who, for some reason or other, did not feel like religion.

The solution of this problem is, of course, personal to Sir John Reith. Will he act? He should realise that the Sunday programmes are quite good enough to stand up to any competition; and would, in fact, benefit from comparisons made possible in this way.

AN ARCTIC WIRELESS STATION



A view of the wireless station that has been built at Turuchansk, in the far north of Northern Siberia. This station forms the only link between the small white population and the outside world.

GRID BIAS

One often sees listeners blithely adjusting their grid-bias battery with the set fully switched on. How many of these, however, realise the danger of so doing? Very few probably, or otherwise they would certainly not risk spoiling their power valves, for that is what it amounts to.

As soon as the grid-bias plug is removed there is nothing, as we may put it, to hold the anode current of the valve down. This may injure the valve, for the emission may be lost.

When the emission is spoilt it means that hardly any electrons are emitted from the filament, and consequently there will be no anode current and therefore no signals.

Always switch your set off before making any adjustment whatever to the grid bias.

CALIBRATING THE NEW "ROADSIDE" FOUR

This wonderful portable set has so great a sensitivity that it will pay builders of the design to log their stations carefully, and thus have the score or more available programmes immediately to hand when desired.

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

THE New "Roadside" Four—the construction of which was described in detail last month—does not, of course, pretend to give with its four valves and small frame aerial the results obtainable with a similar circuit using an outside aerial, but its sensitivity is nevertheless much greater than many people would imagine possible in the circumstances.

While designed primarily for loud-speaker reception from comparatively few stations, when conditions are good it will bring in a surprising number. Thus before sitting down to write the present article we decided to try out, within a space of a couple of hours, how many stations we could pick up, and the list adjoining shows the results obtained.

Programme Strength Stations

The strength of reception varied, of course, from very "weak" to "full loud speaker," and sometimes during what may be termed the "identification period" strength would vary from a whisper up to all that could be desired for an ordinary living room. Such are the conditions of wireless reception, and no ingenuity of a set designer can eliminate fading due to natural conditions.

Certain stations, however, can be relied upon to give programme strength in all but exceptional conditions. These are (so far as the London district is concerned): London, Daventry Experimental (5 G B), Hilversum, Eiffel Tower, Daventry (5 X X), Radio-Paris. These may also be termed "daylight" stations, in that they are receivable in daylight as well as after dark.

Alternative Parts

As soon as darkness falls the range of the set increases and it is generally possible to receive two or three Germans quite comfortably on the loud speaker. After this the remaining stations are as variable on the New "Roadside" Four as on every other portable receiver of this size. For regular reception of many long-distance stations on a portable we must have recourse to the super-heterodyne principle and more valves, or else to portable receivers of rather a complex nature using more than one screened-grid valve.

In every WIRELESS CONSTRUCTOR set an effort is made to enable as wide a variety of alternative parts to be used as possible. Readers of the last article will have noticed that we said that "in the unlikely event of the set howling at audio frequency (this may happen if a different transformer is used), try reversing the secondary connections."

We have since taken out the original transformer and fitted a number of others for test purposes and have found that one or two of them do set up an audio-frequency howl if connections are not reversed. As the reversal of connections is an expedient which we do not care to adopt if the trouble can be cured otherwise, we have made a number of tests and find that if the fixed condenser of ·015 mfd. joined between one end of the radio-frequency choke and filament is replaced by a 1-mfd. Mansbridge type of any of the leading makes, the howl does not occur, not only with the make shown, but with no other make of low-frequency transformer we have yet tried, whichever way the secondary is connected.

In all cases, even with the original transformer, there is a slight improvement by substituting the 1-mfd. for the ·015-mfd. fixed condenser here. As there is plenty of space to do it, and as, furthermore, the Mansbridge type of condenser of 1 mfd. is cheaper than the mica ·015 mfd., we would recommend its use in all cases. When it is used, the secondary connections of the transformer should be tried both in the way indicated by the makers and also reversed. The decision which to use depends upon which way round sounds the better.

AN EVENING'S READINGS ON THE NEW "ROADSIDE" FOUR.

LOWER RANGE.			
Nuremberg ..	31	Stuttgart ..	96
Paris (Radio LL)	35	Hamburg ..	102
Malmo	45	Frankfurt ..	114
Munster ..	52	Rome	122
Turin	54	Langenberg ..	129
Copenhagen ..	82	Daventry 5 G B	136
London ..	89	Milan	143
UPPER RANGE			
Hilversum ..	90	Daventry 5 X X	142
Kalundborg ..	98	Radio-Paris ..	161
Motala	120	Huizen ..	170
Eiffel Tower ..	133		

The Batteries Advised

Considerations of space in the last month's issue prevented my saying much about the batteries for this set. In a portable set it is always wise to use the largest high-tension battery that will go into the space available. Both the Ripault 99-volt chocolate label and the Lissen 100-volt will fit in the space provided quite conveniently, and both will have quite a reasonable life.

So far as L.T. is concerned, I have used both Ediswan and Exide unspillable with considerable success, and indeed in view of the popularity of portable receivers most of the accumulator manufacturers now make suitable unspillable accumulators that will fit into this cabinet. It is wise, after the batteries have been fitted into place, to fill up the intervening spaces with corrugated paper, rolled-up newspaper, or some other material, to prevent rattling and movement.

Particulars were given in the last issue for a suitable quite inexpensive loud-speaker equipment, and I have since had the opportunity of trying a very excellent loud-speaker unit which will fit into this cabinet, and which is made by the firm of F. Squire. As this firm makes several different units it should be ordered for the New "Roadside" Four. A small "Blue Spot" can also be fitted.

Using an Ordinary Aerial

Readers who use a portable set both at home and outdoors may be interested to try experiments increasing the range of this set when an outdoor aerial is available. The simplest plan is to wind four or five turns of ordinary rubber-covered flexible wire round the open lid of the New "Roadside" Four (it does not matter in which direction), taking one end of the winding to an outside aerial and the other to earth.

This will automatically convert the set from a frame-aerial receiver into a loose-coupled receiver, for the frame aerial will act as the usual tuning coil and the coil round the outside of the box as the aerial coupling coil. The range of the set will then be very considerably extended.

THE P.M.G. and TELEVISION

Some details of recent developments in the always interesting Television situation.

THE official letter from the Postmaster-General addressed to the Secretary of the Baird Wireless Televison Development Company, Limited, which we daresay most of our readers have read, either in part or in full, in the daily press, was not so very unexpected in tone or in the logic of its point of view.

"Noteworthy Scientific Achievement"

To begin with, the Postmaster-General quite rightly gives the opinion that the Baird system is a noteworthy scientific achievement. Very few impartial critics of television to-day will disagree with that. We certainly never have, nor have our contemporaries, "Popular Wireless" and "Modern Wireless." But we have, in company with Captain Eckersley and other well-known people, maintained the point of view that although an invention may be a noteworthy scientific achievement, that is no criterion that it is satisfactory to be used as a public utility service. Many inventions in the laboratory are noteworthy from the scientific point of view, but from the point of view of applying them to practical everyday commercial needs are not necessarily satisfactory.

The Postmaster-General, however, points out that he does not consider the present state of development of television sufficient to warrant its inclusion in the broadcasting programmes within broadcasting hours, although he bases this view not so much upon the quality of the reproduction by the television receivers—which, no doubt, he has inspected and which he anticipates further experiments will improve—but upon the limited scope of the objects which can be reproduced.

The Wave-band Difficulty

Although this is a sound objection, it must also be borne in mind that Captain Eckersley and other B.B.C. experts have advanced other objections which if not insuperable are, in the present stage of television development, certainly very difficult to overcome. To quote but one example: the wave-band difficulty. However, the Postmaster-General is of the opinion that facilities should be given to the Baird Company so far as is practicable without interfering with the broadcasting service. These facilities are given with the object of allowing the Baird people to carry out continued and progressive experiments.

As far as the Postmaster-General is concerned, he states that he has no objection to the use of a B.B.C. station for experiments of this nature, as long as it is used outside broadcasting hours.

At this point we may take it for granted then that some sort of a *rapprochement* is now in course of development between the Baird Company and the B.B.C. authorities, and that in due course, although perhaps not for some months, television transmissions may be expected to be broadcast from one or more B.B.C. stations outside normal programme hours. Whether this will be after midnight, or whether some other time will be found similar to the Fultograph early experiments, remains to be seen.

In any case, when these experiments commence we understand from an excellent source of authority that they will be continued for at least twelve months, in order to give full scope to the Baird people; and if at the end of twelve months progress is satisfactory and the system has improved, there is every chance of television broadcasts being included during normal broadcasting hours.

It is interesting to note that the Postmaster-General in his letter goes on to point out that in order to find room for a television service in broadcasting hours it will be necessary to utilise wave-lengths outside the bands now being used in this country by the B.B.C. And this again raises the question of the great shortage of available wave-lengths, the future of the Regional Scheme, and the decisions promulgated not so long ago at the Washington Conference regarding the allocation of wave-lengths to this country and to European stations.

It also makes one wonder what is happening at Prague as this article is written, where a Conference is in progress concerning wave-lengths, and which is being attended by Captain Eckersley.

Opportunities for Experimenting

The Postmaster-General goes on to say that it is necessary to emphasise that in granting facilities for experimental television demonstrations, in which listeners, if they want to, can take part, the Postmaster-General and the B.B.C. do not accept any responsibility for the quality of the transmissions or for the results listeners may obtain with television receivers. It is rightly and emphatically pointed out that the object of granting these facilities to the Baird Company is purely to accord wider opportunities than the Company at present possess for developing the possibilities of the Baird television system, and although the Company may not be precluded from selling apparatus to any listener who wants to purchase it, the purchaser must buy at his own risk and at a time—and here is the important point in the Postmaster-General's letter—when the system has not reached a sufficiently advanced stage to warrant it occupying a place in the B.B.C. programmes.

"The position has now been made perfectly clear by the P.M.G. He thinks television . . . is a noteworthy scientific achievement, but he does not think it has reached the stage which would warrant it being utilised as an accessory to broadcasting. . . ."

Position is Quite Clear

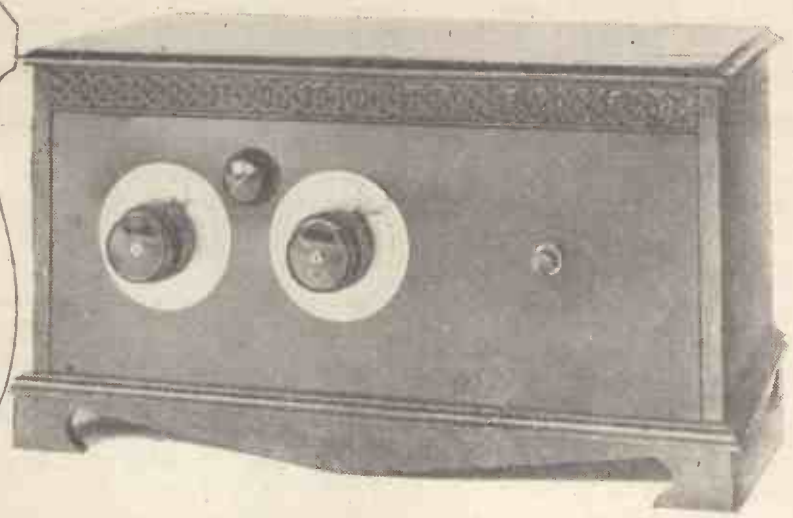
Therefore, the position has now been made perfectly clear by the Postmaster-General. He thinks television to-day, in particular the Baird system, is a noteworthy scientific achievement, but he does not think it has reached the stage of development which would warrant it being utilised as an accessory to broadcasting, and he wants to make it clear to listeners that if they purchase Baird apparatus in order to receive these television broadcasts when they

(*Continued on page* 119.)

The "CHAMPION" THREE

by

PERCY W. HARRIS
M.I.R.E



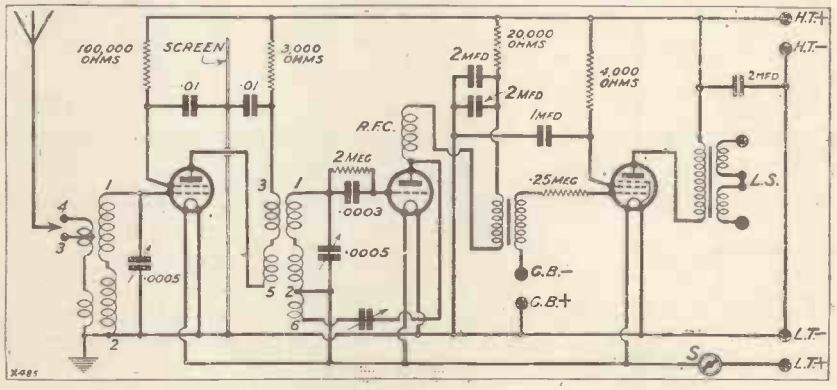
A powerful, long-distance loud-speaker set. The "Champion" will provide probably the most effective arrangement of three modern valves that has yet been introduced. Nevertheless, it is an inexpensive and easy set to build and is equally simple to handle.

"WHAT is the best I can do with three valves?" is a question often addressed to the editor of a wireless journal. The answer would be fairly simple if only the requirements of all readers were the same, but unfortunately there is such a vast difference between the needs of, say, the man who is at least fifty miles from the nearest broadcasting station and who wants to receive as many distant stations as possible, and his fellow enthusiast in the heart of London whose sole desire is to get the best possible reproduction from the local station and 5 G B.

Full H.F. Amplification

Again, we have to consider whether the reader wants single-control tuning or whether he will welcome two dials if only additional efficiency is to be gained thereby. In short, to quote the old saying, "One man's meat is another man's poison," and there is no one best arrangement for everybody.

A good measure of high-frequency amplification is always useful when distant reception is desired, and the scheme I originated in the "New Business Man's" Four, and since adopted in a modified form by Mr.



COMPONENTS REQUIRED

1 Cabinet 18 in. × 7 in., with 10-in. baseboard (Artcraft). (Pickett, Camco, Raymond, Gilbert, Caxton, etc.)
1 Panel 18 in. × 7 in. × $\frac{3}{16}$ in. or $\frac{1}{4}$ in. (Resiston). (Ebonart, Becol, Peto-Scott, Trolite, etc.)
2 ·0005 variable condensers (Lotus). (Cyldon, Lissen, Igranic, Utility, Burton, Bowyer-Lowe, Ormond, G.E.C., etc.)
1 ·0001 reaction condenser (Cyldon Bebe). (Utility, Peto-Scott, Igranic, etc.)
2 Vernier dials (Utility Micro, cursor type). (Ormond, Indigraph.)
1 On-and-off switch (Decko). (Lotus, Benjamin, Duco, Magnum.)
2 Panel brackets (Magnum). (Camco, Pilot, etc.)
2 6-pin bases (Wearite). (Lewcos, Colvern, Bowyer-Lowe, etc.)
3 Valve holders (Benjamin). (Lotus, Igranic, Formo, Whiteline, etc.)
3 2-mfd. condensers (Dubilier). (T.C.C., Hydra, Mullard, Ferranti, etc.)
1 1-mfd. condenser (Dubilier). (T.C.C., Hydra, Mullard, Ferranti, etc.)
1 ·0003-mfd. condenser and clips (Lissen). (Atlas, T.C.C., Dubilier, etc.)
1 Grid leak, 2 meg. (Lissen). (Atlas, T.C.C., Dubilier, etc.)
2 ·01-mfd. mica condensers (T.C.C.). (Atlas, Dubilier, etc.)
1 Standard screen 10 in. × 6 in. (Magnum). (Paroussi, Ready Radio, Peto-Scott, etc.)
1 R.F. choke (Climax). (R.I.-Varley, Igranic, Lissen, Colvern, Bowyer-Lowe, Wearite, Magnum, etc.)
1 $\frac{1}{4}$-megohm leak (Pye). (Dubilier, Lissen, Mullard, etc.)
NOTE.—If Pye leak is not used a holder also will be required.
1 L.F. transformer (Lissen Super 3½/1). (R.I., Ferranti, Igranic, Royal, Brown, Cossor, etc.)
1 Pentode output transformer (Igranic). (Marconi, R.I.)
1 100,000-ohm wire-wound resistance with base (Ferranti). (Dubilier, Varley, or Lissen.)
1 3,000-ohm wire-wound resistance with base (Ferranti). (Dubilier, Varley, or Lissen.)
1 20,000-ohm wire-wound resistance with base (Ferranti). (Dubilier, Varley, or Lissen.)
1 4,000-ohm wire-wound resistance with base (Ferranti). (Dubilier, Varley, or Lissen.)
2 Terminal strips 2 in. × 1½ in.
1 Terminal strip 6 in. × 1½ in.
10 Indicating terminals, as shown (Godwinex). (Belling-Lee, Igranic, Eelex, etc.)

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1 Binocular split-primary aerial coil (for each band). (Lewcos or Colvern.)
1 Binocular split-primary transformer (for each band). (Lewcos or Colvern.)
1 Screen-grid valve (2-, 4-, or 6-volt as desired).
1 H.F. or detector valve (2-, 4-, or 6-volt as desired).
1 Pentode valve (2-, 4-, or 6-volt).

The "Champion" Three—*continued*

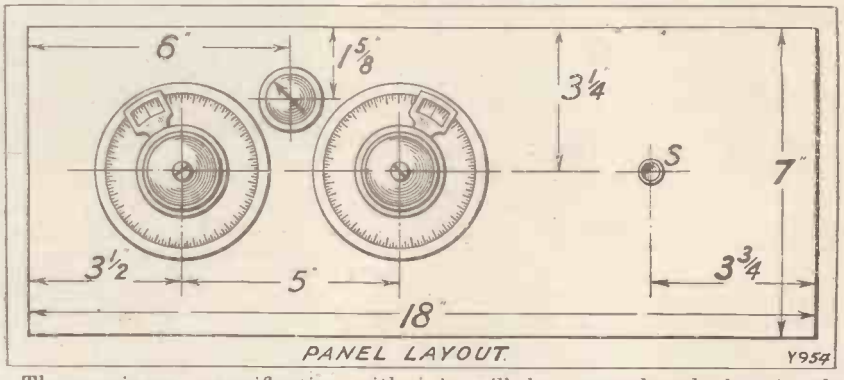
G. P. Kendall, B.Sc., in the "Titan" Three, published in "Popular Wireless," gives very good high-frequency magnification with the simplicity of single-dial tuning. At the same time, however, it is not suggested that this useful and interesting form of high-frequency coupling gives the fuller magnification possible with a screened-grid valve, if an additional tuning control is incorporated.

S.G., Det., and Pentode

In this article I shall try to give an answer to the query, "What is the best I can do with three valves," having in mind the requirements of the man who desires a good measure of distant listening, but who does not mind two tuning controls instead of one. As, obviously, we must have at least one stage of high-frequency, and a detector is also essential, then in a three-valve arrangement we are limited to one note-magnifying valve.

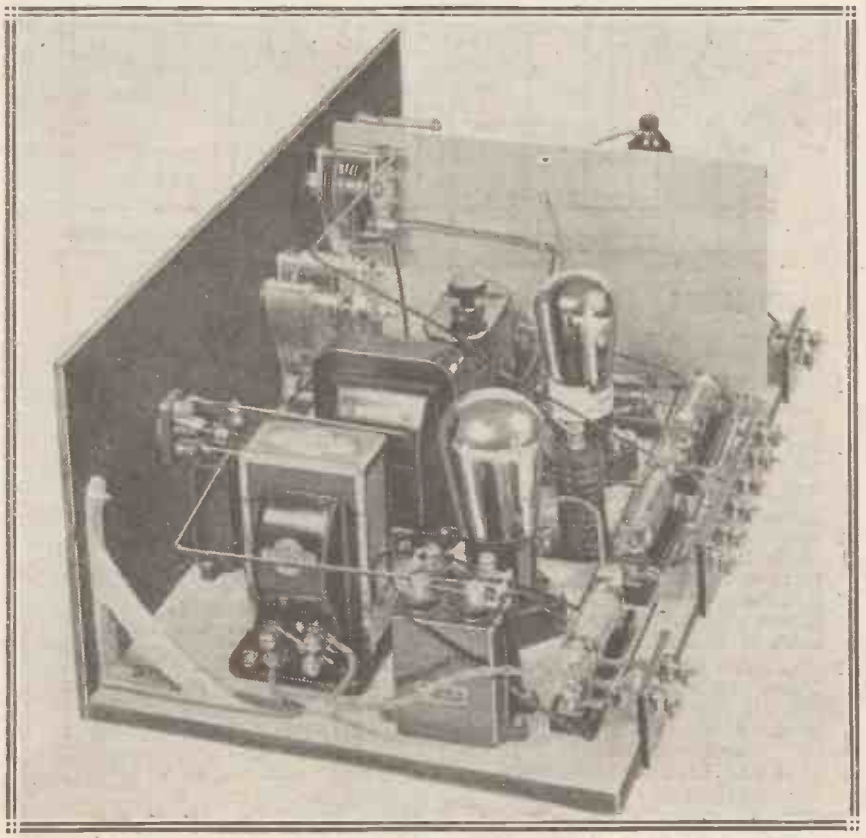
Obviously, also, to get the maximum magnification with one valve we must adopt the pentode, the newest of the many newcomers to our remarkably efficient range of valves.

A scheme, then, with a screened-grid H.F. valve, a detector and a pentode will be adopted, while in order to get very high efficiency from the screened-grid valve we must adopt some form of tuned coupling. Which form we adopt is quite interesting to discuss.



The maximum magnification with a screened-grid valve is obtained, roughly speaking, when we include in the anode circuit the highest possible impedance, for which reason the early screened-grid H.F. circuits were mostly of the tuned-anode type. This when properly designed gives a very high impedance at resonance. It was soon found, however, that an ordinary plain tuned-anode did not always meet our requirements for several reasons, one being that the selectivity of the set with such a coupling is often below modern requirements even when reaction was used. Incidentally it will be remembered that in the scheme used in the "New Business Man's" Four the selectivity lacking in the special form of coupling was to a large extent compensated for by the use of reaction in the *first* circuit.

It thus happens that a number of screened-grid circuits using a modified form of tuned-anode coupling have come into use, a tapping being made on the anode coil so that the whole of the tuned-anode circuit is not common to both the plate circuit of the H.F. valve and the grid circuit of the detector. At the same time, there are a number of sets using a plain tuned anode which are quite reasonably selective owing to the use of reaction on the tuned anode, plus a fairly loose aerial coupling.



The "Champion" Three uses an S.G. valve and a Pentode valve, the combination being a most effective and powerful one. The "Champion" is definitely a long-range loud-speaker set, as the calibration chart which appears on another page shows.

Great Selectivity

H.F. transformer coupling for a screened-grid valve has been steadily growing in favour for some time, for with a suitably chosen primary winding it is possible to get quite a high impedance, at the same time retaining the higher selectivity which is generally associated with the high-frequency transformer. When reaction is used with a high-frequency transformer in a screened-grid circuit, high magnification, good selectivity and excellent stability are all to be found.

Some readers may wonder why stability is mentioned here, in view of the fact that great claims for stability are always made for the screened-grid valve, but it must be remembered that there is still some inter-electrode capacity left; it is not all eliminated or balanced out, and with a very high

The "Champion" Three—*continued*

efficiency in the plate circuit of a screened-grid valve there may still be enough inter-electrode capacity to provide an undesired amount of feedback. Feedback in such a case may unduly sharpen the tuning in the first grid circuit, thus spoiling quality—a point we must not overlook in designing sets.

For the Long Waves

A long series of experiments has shown me that a high-frequency transformer of the "fieldless" type, together with what is often called "static" screening (a single sheet of aluminium or copper acting as a partition), eliminates all undesirable feedback, and provides a very stable and highly efficient screened-grid coupling system.

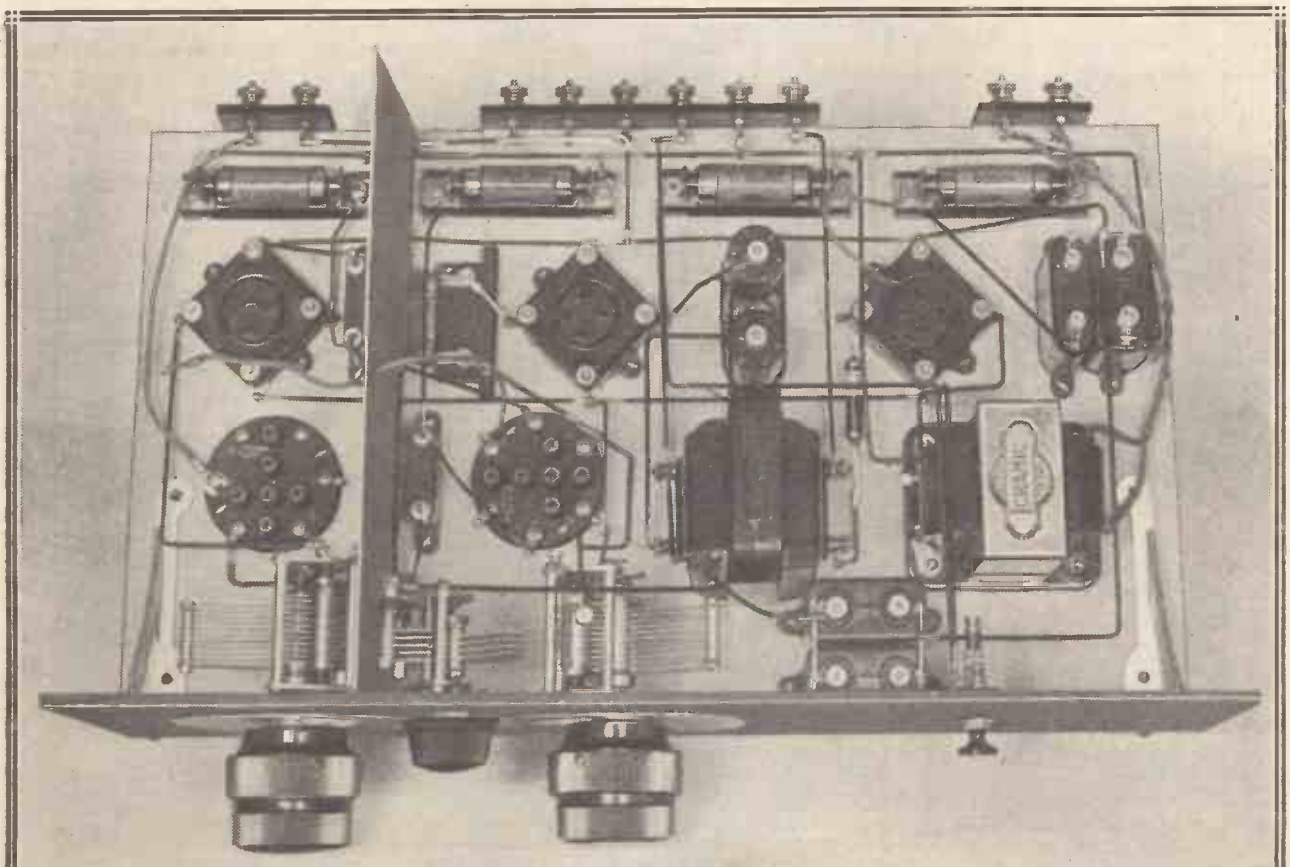
I have also established during experiments with the "Champion" Three that with the high efficiency of the carefully-chosen transformer coupling, simple vertical screening alone is not sufficient to prevent feedback with the ordinary solenoid type of coil. This does not mean to say that the set will necessarily oscillate, but that the feedback will be sufficient to affect the quality, particularly on the long waves. In view of the fact that standard six-pin bases are used with coils of what are generally termed the "split-primary type," the reader can, if he has the coils available, experiment for himself in this direction, for it is but the work of a moment to substitute a binocular coil for a single-layer or to use the new form of coil with interchangeable primary.

Such experiments, by themselves, may not be conclusive, as we have to satisfy ourselves that the degree of coupling between primary and secondary is the same in all cases, but the test is certainly worth trying.

The next point to consider was whether or not an attempt should be made to incorporate wave-change switching, and in view of the fact that wave-change switching with a high-frequency transformer and reaction cannot be obtained without sacrificing efficiency (remember we are aiming at the "best" three-valve scheme!), a six-pin interchangeable variety of coil was decided upon. Quite efficient wave-change switching, using the tuned-anode coupling, can be obtained, but the advantages of transformer coupling here seem so well worth having that the slight disadvantage of having to change coils was not considered sufficient to debar its use.

Efficient Output Coupling

In the detector circuit there is nothing to comment upon, grid leak and condenser rectification being used. The advantages of this form of detector, in my mind, outweigh the disadvantages in a set such as this. The output valve, a pentode, requires for efficient working a properly designed output transformer, and as there is considerable variation in impedance between different types of



By using black Glazite for the wiring, and a white wood baseboard, every lead is made very clear. You can follow practically every wire, and if you refer to this photo as well as the wiring diagram, while you are doing the wiring, the work will be greatly facilitated.

The "Champion" Three—*continued*

speakers in these days, the opportunity was taken to include the new Igranic pentode output transformer which has an alternative output arrangement to suit different speakers.

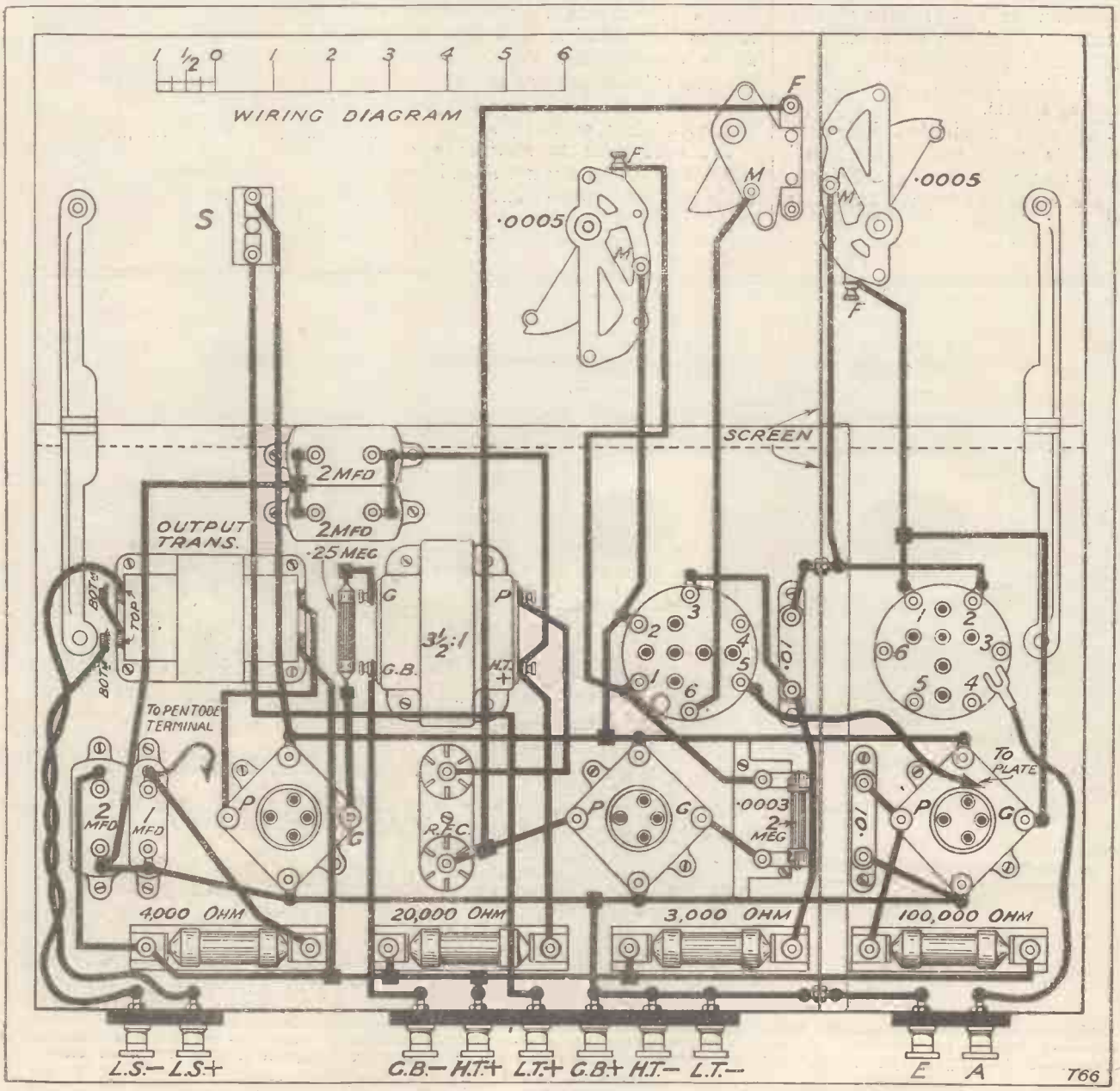
A Battery Safeguard

The growing use of mains units for the high-tension supply, and the fact that with high-tension accumulators it is highly desirable to charge the whole battery evenly rather than one portion at a higher rate than another, led me to adopt the scheme already incorporated in the "Air Commander" of one H.T.+ throughout, the necessary variation of voltage being obtained *in the set* by series resistances which also serve the purpose of de-coupling devices to prevent battery coupling.

A further advantage of the series resistance scheme is the protection of the high-tension source from serious damage in the event of a defect developing internally in either the screened-grid valve or the pentode. If, for example, excessive vibration or some other cause leads to the screening grid touching the plate of the screened-grid valve, without a series resistance the section of the battery between the screening grid tap and the maximum would be completely short-circuited.

Preventing Short-Circuits

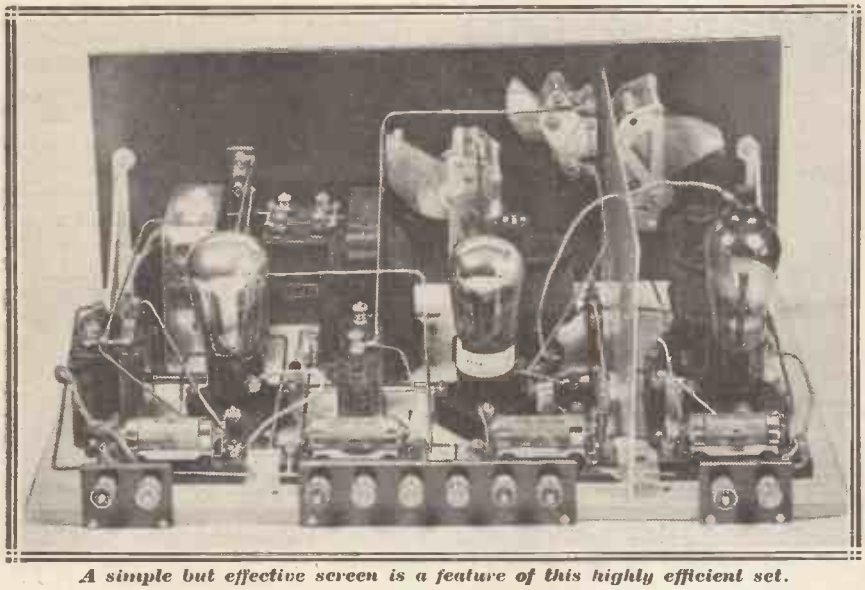
With the 100,000-ohm resistance used in the present set to bring down the voltage on the screening grid from the maximum to the voltage we require, the maximum current that can flow in a short-circuit between the parts mentioned is only a little over one milliampere. Similarly, the insertion of a wire-wound resistance in series with the priming grid of the pentode limits the current



The "Champion" Three—*continued*

that can flow there if internal trouble should arise.

Studying the theoretical circuit from the aerial end we find that a choice of tappings on the aerial coil which is in series with the ordinary primary winding is utilised as an additional primary winding so as to give the necessary higher impedance. Tapping No. 4 is not used.



A simple but effective screen is a feature of this highly efficient set.

is given to suit different degrees of selectivity, although it will be found that No. 3 tapping will suit on nearly all occasions. A resistance is incorporated in the feed to the screening grid, a mica condenser of ·01 mfd. being shunted from the screening-grid side of this resistance to negative low-tension. Similarly, a resistance is incorporated in the plate circuit of the screened-grid valve, also shunted, the condenser in each case affording an easy path back to filament for any high-frequency currents which would otherwise wander through the high-tension source and cause undesirable reaction effects.

Simple Screening

A standard vertical screen is used and it will be noticed that the first tuning condenser comes very near to this, or actually touching. As the moving plates of this condenser are at the same potential as the screen, this contact does no harm, so that there need be no worry about a short-circuit here. At the same time, one must be careful to choose a variable condenser which will fit into the space provided.

The plate of the screened-grid valve is connected to one end of the primary winding of the split-primary high-frequency transformer, but in this case the neutralising winding

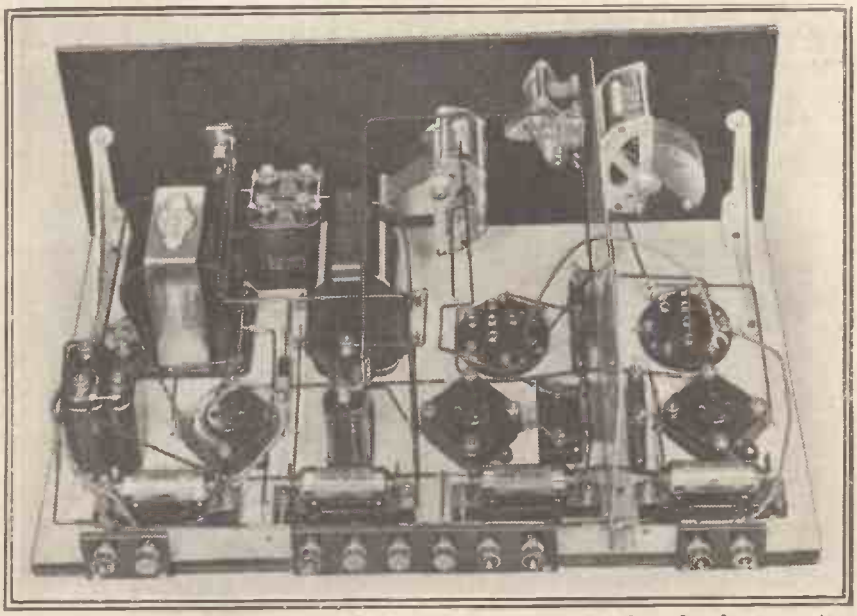
The secondary circuit of this high-frequency transformer is connected to the grid leak and condenser on the one side and to filament on the other, while the reaction winding is taken to the small reaction condenser connected to the plate of the detector valve. In order that the necessary reaction effects can be obtained, a radio-frequency choke is included in the plate circuit of the detector, and this is joined to the primary winding of a low-frequency transformer. The actual transformer used in the set has incorporated inside the case a condenser across the primary winding, a practice which is adopted by several makers.

The L.F. Transformer

In some cases, however, it will be found on examining the leaflet packed with the transformer that the best results will be obtained with a condenser of, perhaps, ·0005 mfd. placed across the primary winding. This should be done in all cases where the makers specify it, although it is not shown in the diagram.

Those who have read Mr. Kendall's articles on "What the Pentode Really Does," which have appeared in recent issues, will understand that the pentode has five electrodes—filament, control grid and plate as in ordinary L.F. valves, with two additional grids, one of which is connected internally to the filament and the other brought out to a terminal on the side of the base.

The pentode is plugged into the last socket in the ordinary way and the additional terminal is connected up to the positive H.T. supply at approximately the same value as that applied to the normal anode of the valve. Mr. Kendall has explained a few troubles which are likely to occur,



Note the wonderful symmetry of the layout of components. Ample space is allowed for everything on the baseboard, and the careful arrangement of components also results in a pleasing compactness.

The "Champion" Three—*continued*

and I am pleased to say that in the present set these have been allowed for. The set is completely stable, will work with any mains unit, without the slightest tendency to motor-boating, and even on very old and worn-out high-tension batteries. Indeed, so stable is the set that several thousand ohms can be inserted in series with the common high-tension supply without any trouble arising other than a reduction in strength, which is bound to come through the reduction in voltage.

The H.T. Consumption

It will be noticed that a wire-wound resistance is inserted in series with the additional grid, or "priming grid," of the pentode. The value of this resistance has been carefully chosen after much experiment so as not to cause too much reduction of priming grid voltage. The effect of this resistance (it is shunted to filament by a 1-mfd. condenser) is to provide a decoupling effect, and the value has been chosen so as to bring the high-tension consumption of the pentode down slightly without any appreciable reduction in the strength.

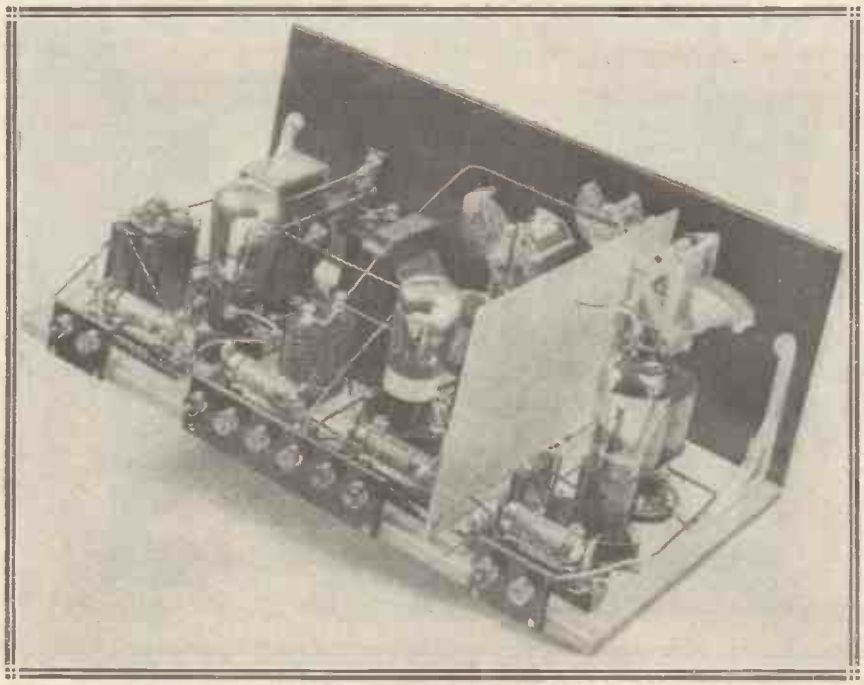
The overall consumption of this set is approximately 20 milliamperes at 120 volts, which, although fairly large, is not by any means an excessive figure when a pentode is used with other valves. Those readers who wish to avoid the large high-tension consumption of the pentode valve can use an ordinary power valve in the last socket, the only changes necessary then being to substitute for the special pentode transformer any good output transformer and to cut out the resistance and the 1-mfd. condenser which are used solely with the pentode valve. All other values and connections remain the same.

So much for general considerations. We will now examine the layout in detail. If the actual variable condensers illustrated are used, the position of the screen can be made identical with that shown, but if different makes of variable condenser are chosen, then the position of the screen may have to be altered slightly.

Condenser Positions

The frame of the first variable condenser, being connected to the moving plates, can be in actual contact with the screen, but it is essential that there should be adequate clearance between the reaction condenser and the screen at all points. Thus before actually drilling your panel, make sure that the two tuning condensers and the reaction condenser can be properly placed with regard to the screen.

As the set is not cramped, a slight alteration of the position of the screen and of the second tuning condenser can be made, if necessary, without substantially altering the layout, although the exact arrangement shown should be adhered to if possible. Where wires pass through the slots in the screen it is advisable to cover them (even when they are already insulated) with an additional covering of Systoflex tubing to prevent the original insulation of the wire being chafed and a short-circuit occurring.



Here you see the complete set with the valves in position. Note the connection to the top terminal of the screened-grid valve.

"CHAMPION THREE" CALIBRATION CHART.

LONG WAVES

STATION.	DIAL READINGS. (Mid-line Condensers.)	
Huizen (Holland)	160	160
Radio Paris (France)	153	149
Daventry (5 X X)	135	123
Eiffel Tower (France)	123	117
Motala (Sweden)	107	102
Kalundborg (Denmark)	75	67
Hilversum (Holland)	58	42

SHORT WAVES

Budapest (Hungary)	170	168
Munich (Germany)	167	164
Vienna (Austria)	163	159
Brussels (Belgium)	161	157
Milan (Italy)	159	155
Daventry (5 G B)	153	147
Langenberg (Germany)	147	142
Belgrade (Yugo Slavia)	144	139
Rome (Italy)	141	137
Brunn (Czecho-Slovakia)	138	132
Madrid (Spain)	135	130
Frankfurt (Germany)	134	129
Katowice (Poland)	132	127
Berne (Switzerland)	129	125
Glasgow (5 S C)	127	122
Hamburg (Germany)	123	119
Toulouse (France)	120	115
Stuttgart (Germany)	116	112
London (2 L O)	110	105
Bremen (Germany)	94	94
Gleiwitz (Germany)	93	93
Aberdeen (2 B D)	85	86
Bratislava (Czecho-Slovakia)	83	85
Belfast (2 B E)	80	82
Bournemouth (6 B M)	72	74
Turin (Italy)	64	69
Kaiserslautern (Germany)	62	67
Cologne (Germany)	Varies with different aerials	58
Horby (Sweden		57
Toulouse (France, P T T)		55
Newcastle (5 N O)		45
Nurnberg (Germany)		42
Malmo (Sweden		34

Received on evenings of 29th and 30th March, 1929.

Notice that the resistances are all placed in line with one another, as are the valve holders, while the two coil bases also are in line.

These and one or two other arrangements of the layout give the set a very pleasing symmetrical appearance, while the wiring can be

(*Continued on page* 116.)

WITHIN THE VACUUM

In this article the new Cosmos A.C. screened-grid valve is discussed, and other matters concerning S.G. valves are dealt with.

By KEITH D. ROGERS.

I HAVE just received for test one of the new Cosmos A.C. screened-grid valves, the AC/S, which is for operation on A.C. and has an indirectly-heated cathode. The valve is fitted with the now standard cap at the top for the plate connection, the screening grid being connected to the normal "plate" pin in the base of the valve.

And while mentioning the cap for the anode connection, I should like to emphasise the fact that when wiring up a screened-grid set the "plate" socket of the valve holder does not go to the anode circuit, but becomes the connection for the screened grid of the valve, the anode of which is now connected to the external circuit by means of a lead to the extra terminal on the cap of the valve.

The first of the indirectly-heated cathode A.C. screened-grid valves to be placed on the market—the Cosmos AC/S. With its magnification factor of 1,200 it is capable of providing tremendous amplification and is certainly a great achievement in valve design.

A great deal of misunderstanding about this point seems to exist among constructors, many of whom have written to say that published diagrams showing the "plate" *socket* of the valve holder going to H.T.+ 80 volts direct are *wrong*, simply because the writers forget that in a screened-grid set the "plate" socket becomes the screening-grid socket, and therefore does go to H.T. direct, or via a choke or similar device. The actual output of the valve is taken from the extra terminal on the cap—the anode terminal.

Characteristics of the AC/S

And now let us get back to the particular valve under discussion—the AC/S. This valve requires a filament current of 1 amp. at 4 volts, which current is taken from the secondary of the special mains transformer having a step-down ratio. About 1½ volts grid bias is recommended, while an anode voltage of 120–150 volts is required for the anode and a potential of 45–60 volts.

This voltage must, of course, be less than that applied to the anode, or the characteristics of the valve will be seriously upset. As is usual with screened-grid valves, the screening grid must be well by-passed to earth by means of a fixed condenser of at least ·01 mfd., while the insertion of an H.F. choke in series with the H.T. is often an advantage.

The impedance of the AC/S is 800,000 ohms, while the magnification factor is 1,200, giving a slope of 1·5. With such magnification and impedance the design of coils and tuning circuits to suit the valve is not easy, but with careful screening excellent results can be obtained.

Coils with exceptionally low losses are not recommended, for a certain amount of loss enables satisfactory stability to be obtained, while phenomenal amplification can be obtained.

The valve is not suitable for the constructor who has not tried H.F. amplifiers before, but the man who has some experience in H.F. stages and their screening will find it a most useful valve. The price is 25s.

Before we leave the subject of S.G. valves, I would like to remind constructors who use these valves and supply the H.T. from the mains, and who do not possess special high-resistance voltmeters, that they can use a milliammeter just as well. When the screened-grid or plate H.T. voltages are to be adjusted, the milliammeter is placed in series with the requisite circuit and the H.T. varied until the correct current is passing, which denotes that the correct H.T. is being used.

Checking H.T. Voltages

The currents taken by the screening grids and anodes of the valves vary with the particular makes, and the correct figures should be obtained from the makers. S.G. valves are,

Within the Vacuum—*continued*

in many cases, rather critical where the grid and anode voltages are concerned, and it is advisable to get them as exact as possible in order that the valves may operate at maximum efficiency.

The selectivity problem of screened-grid circuits still remains fairly acute, in spite of all sorts of arrangements for sharpening the tuning. The writer considers that where a station is very close, unless an efficient wave-trap is employed, one stage of screened-grid H.F. is almost hopeless.

"Flat" H.F. Stage

Recently I spent some time in a corner of Hertfordshire, about 55 miles from Daventry and 30 or so from 2 L O. The result on a four-valver with one S.G. stage was that while London was fairly sharp, 5 G B was far too broadly received and interfered with those stations round about —Brussels, Milan, Vienna, and even at times with Langenberg.

In such a case I am in favour of one stage of neutralised H.F., either in front of the screened-grid stage or else by itself, replacing the S.G. valve altogether. The neutralised system certainly gives selectivity and a wonderful freedom from undesirable background, a feature that the screened-grid valve is rather inclined to include in its distance-getting properties, with disconcerting success.

* * *

I have had a note from a reader asking why it is I so often recommend an H.F. valve for the detector position, instead of an R.C. valve, when followed by resistance coupling. The reason is that as a rule reaction control is more satisfactory with the H.F. valve, while on loud local stations there is far more likelihood of avoiding overloading, both of the detector and the following valves, if an H.F. valve is employed.

Bass reproduction seems more satisfactorily obtained if a valve with an impedance of less than 30,000 ohms is used in the detector stage.

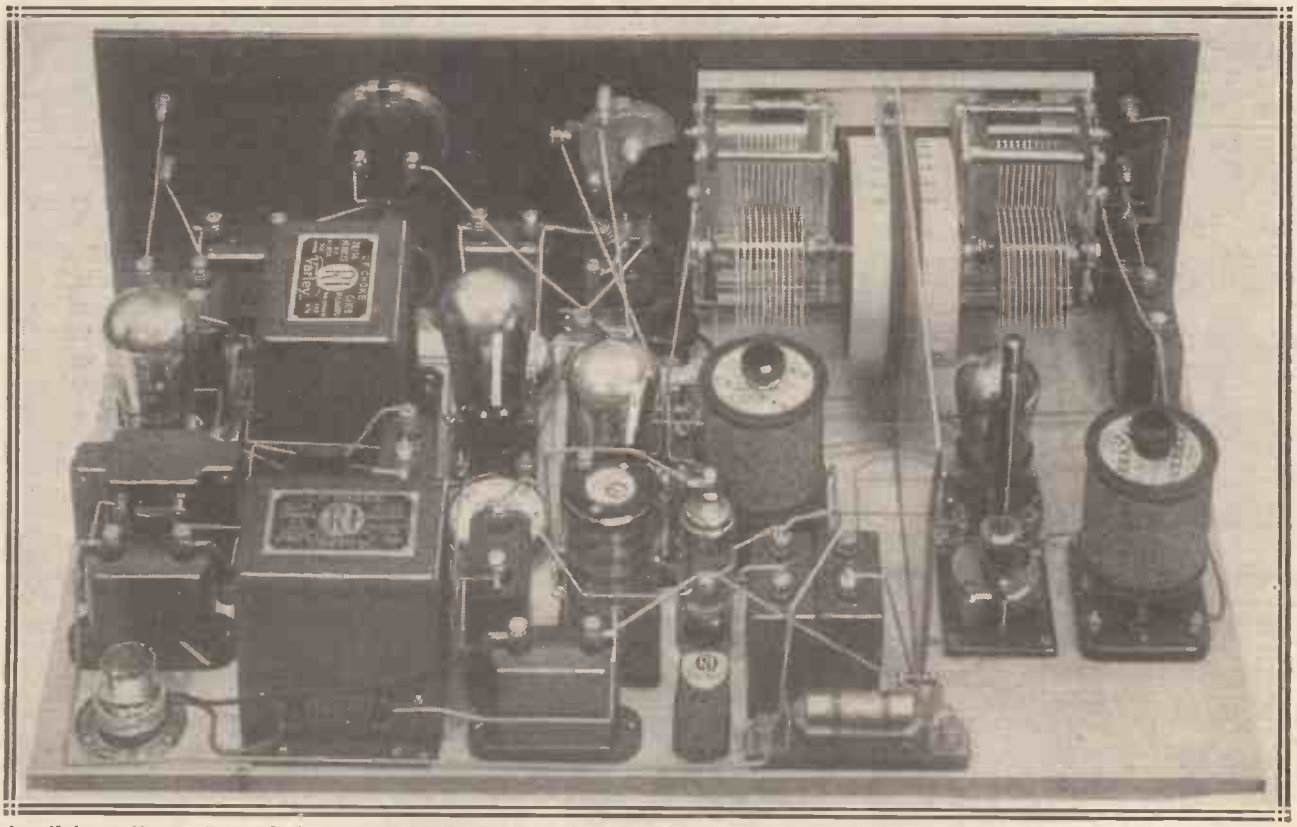
True, a higher magnification may be obtained by using the R.C. valve, but for all-round work—for both local and distant reception—especially when no H.F. stage precedes it, I much prefer the 20,000–30,000-ohm valve (H.F. class) as the detector. The anode resistance should then be not more than 500,000 ohms, or reaction control and possibly quality will be likely to suffer.

Detector Overloading

The question of the overloading of the detector valve is far more important than is generally realised, and I have very frequently been invited to listen to sets in which the detector stage has been the source of distorted results—due purely to overloading.

The usual milliammeter hunt for overloading in the last stage or even the penultimate stage is all very well, but we should not forget the detector in our hunt for the source of distortion.

And, finally, especially if we use S.G. valves, we must not forget that volume controlling by means of dimming the filaments of the H.F. valves can also cause horrible distortion, for the characteristics of the valve go all over the place when the emission is decreased.



An all-from-the-mains D.C. four-valver which employs a resistance-coupled detector stage. In such a set the use of an R.C. valve instead of the H.F. type for detector would almost certainly result in the overloading both of itself and of following valves.

CALIBRATING YOUR SHORT-WAVER

Using a short-wave set that is without wave-meter or calibration is like driving a car or motor-cycle at night without a light. Make full use of your short-waver by building the wave-meter described here.

By L. H. THOMAS.

THE first difficulty encountered by every aspirant to become a short-wave enthusiast is that of not knowing "where he has landed." It is always the same trouble—we have our first short-wave set proudly displayed, checked over, connected up, and we hear all manner of strange signals and noises without having the remotest idea of where we are, even if we really are on the short waves at all! This is distinctly puzzling to the unfortunate owner, more especially if it is his first valve set, and he is none too sure of the correct method of operating it.

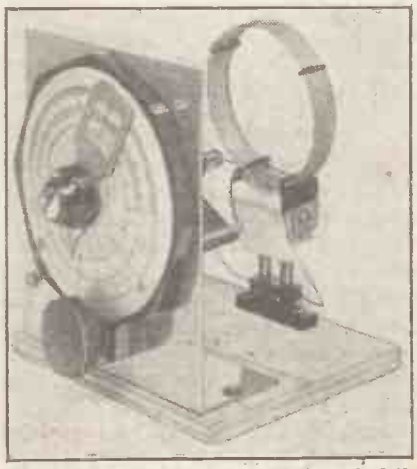
Simple and Cheap

The simple wave-meter described has the merits of being absurdly simple and very cheap, and there is no reason why any user of a short-wave set who still feels at sea should not invest in the necessary condenser and coil, and make up a duplicate instrument. The calibration curve of this should be near enough to that of the original to enable him to find the better-known short-wave broadcast stations without difficulty, and also to give him a rough calibration of the whole of his tuning scale on the receiver.

I make no claims that it is a precision instrument or in anything approaching that category. It is safe to say, however, that another wave-meter built up with similar components similarly placed will give a curve that will not vary from that of the original to any serious extent.

Using the Wave-meter

For those who are not familiar with the principles of the absorption wave-meter (and I advise them to make themselves familiar with it at the earliest opportunity) I will explain the method of using this little "pilot." The whole operation can be described in a few words. Tune the receiver into a station of some kind, and leave the receiver just oscillating. Bring up the wave-meter until the coil is about four inches from the receiver coils and roughly in the same plane, and rotate the dial until you hear either a distinct "plop" or find a place where the receiver stops oscillating altogether over four or five degrees of the wave-meter scale. If the former happens, couple the wave-meter a little closer until there is about one degree on the dial over which it stops the receiver oscillating. If the latter, loosen the coupling until the same thing happens. If it is coupled too tightly the absorption effect will be so great that,



Quite simple and neat, isn't it? And it is ever so easy to make.

instead of a sharply-defined point on the wave-meter, we shall have a wide band, and the taking of a reading with any sort of accuracy will, of course, be impossible.

Only one point will be found over the whole of the travel of the wave-meter dial at which this will occur, so that there will never be any ambiguity about the reading obtained.

As a matter of fact, after using the wave-meter for a week or so you will have "found your feet" sufficiently to dispense with it until the time comes when you have made another set, and are once more in doubt regarding its range of wave-lengths.

The wave-meter as seen in the photographs consists of a ·00015 variable condenser made by the Formo Co., mounted on its own screen, on a wooden baseboard. The metal screen serves as a panel. The size of the latter is 4½ in. by 5 in., and a standard coil socket is mounted thereon, with its centre line exactly 2 in. from the rear edge of the condenser screen. This measurement is given so that the length of the leads from the condenser to the coil may be kept constant.

Wide Range Covered

An Ormond metal dial is mounted on the panel (only one screw-hole has to be drilled for fixing it), and there are no hand-capacity effects with the wave-meter in use, since one end of the coil, the moving plates of the condenser, and the dial itself, are all connected to the metal "panel."

This particular dial was chosen on account of the ease with which fairly accurate readings may be taken. The condenser is a ·00015 "short-wave" condenser, and the manufacture of the coil socket is not important. The coil used is a Clark's "Atlas" No. 6 (six-turn) coil, and it must be remembered that a coil of another make or size, although perhaps possessing a similar number of turns, will not give the same curve by any means.

The range covered by this particular coil and condenser is so wide that it is hard to take readings that would be accurate enough to satisfy the average transmitter that he was within his wave-band. But for the purpose for which the wave-meter is to be used (i.e. "spotting" stations fairly roughly) it is an advantage to have a wide range covered by one coil.

Taking Readings

This obviates the necessity for changing coils, and perhaps altering the characteristics of the wave-meter every time.

I have taken four readings, using the 180° scale on the dial, from which readers should be able to make a rough curve. Incidentally, it is not recommended that the lower end of the scale (below 30°) should be used at all, as it is naturally at this end of the scale that a variable condenser is subject to the greatest variation, owing to such causes as distortion of the plates, etc.

The four readings are as follow:

180°—56·4 metres.
120°—33·2 metres.
60°—22·75 metres.
30°—18·35 metres.

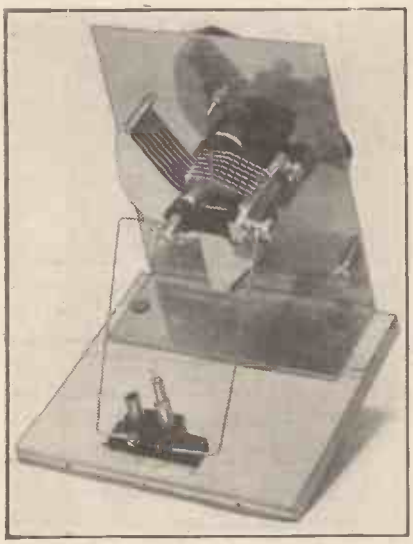
Quite a presentable curve can be drawn up from these readings, and I

Calibrating Your Short-Waver—*continued*

suggest that the reader who makes this should draw such a curve very roughly, which will probably put him on the right track and enable him to tune in a few identifiable stations from the known wave-lengths of which he will be able to plot a more accurate curve later on.

Convenient Calibrations

The 60° reading of 22·75 metres will probably come within a few degrees on your receiver of 2 X A D, the famous G.E.C. station at Schenectady, N.Y., whose exact wave-length is 21·96 metres. Once he is found there will be no difficulty whatever in finding other stations roundabout the same wave-length. The 120° reading, 33·2 metres, is fortunately quite near the wave-length of his brother station, 2 X A F, working



Two wires—the sum total of the connections—and yet the wave-meter is as efficient as can be desired.

on 32·79 metres (although I believe a change in this wave-length is imminent). At all events, there will be *very* few degrees on your receiver condenser between 33 and 30 metres, so that probably you will find either P C J J or 2 X A F, both stations always being in this neighbourhood, fairly close to the 33·2-metre point on the wave-meter scale.

A Short-Wave K D K A

Another broadcast station to look out for is 8 X K, the "short-wave edition" of K D K A, Pittsburg, on about 27 metres. Naturally, you should take care to look for him at a time when he is on, or you are liable to disappointment! Several of the short-wave broadcast stations are somewhat irregular in their behaviour, but if you try for three or four nights at about 11 p.m., you should succeed in hearing most of the Americans at some time or other.

5 S W is, of course, always on during the week, his wave-length being in the region of 24 metres.

Amateur stations now occupy the wave-length bands between 20·8 and 21·4 metres, and between 41·2 and 42·8 metres, and regulations regarding "off-wave" working are sufficiently strict to ensure that when you hear an amateur station he is really in his band! Thus you will find amateur transmissions in general useful for finding extra calibration points for your receiver, particularly as some of them (mostly the crystal-controlled stations) give their wave-length accurately when "signing off" at the end of a transmission.

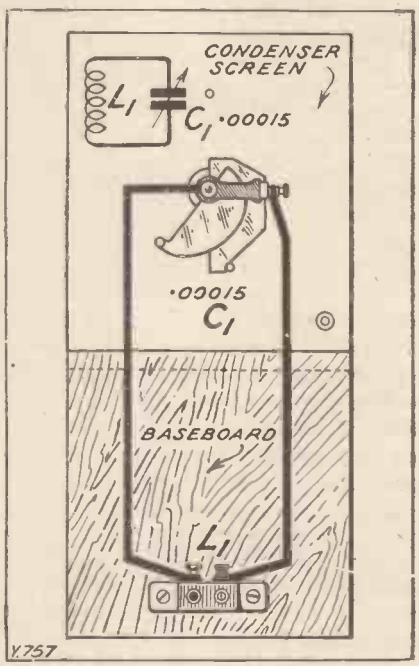
Regular Service

At present the only regular calibration service on short waves in this country is run by amateurs and for the benefit of amateur transmitters. R.S.G.B. members will have the full particulars of this service. It is to be hoped, however, that an official service will shortly be started, and possibly the co-operation of the N.P.L. may be looked for. At all events, such a service, no matter for whom it is run, will be deeply appreciated both by the qualified research man and the casual "short-wave broadcast listener," and the authorities may be sure of the thanks of all when any move in this direction is made.

Live Metal Panels

IT is not a pleasant state of affairs when one is liable to receive a shock by touching the panel of a set. Such, however, is possible in some cases. If your set has a metal panel and the H.T. supply is obtained from D.C. mains, then the panel will become live if the positive side is earthed. This is often the case.

It is, of course, necessary for there to be some sort of contact between the body and earth if a shock is to be felt, but such can occur in all sorts of unthinkable ways. The only real scheme to overcome the trouble is to insulate completely all components from the panel, and to connect same direct to the earth side of the fixed condenser which is invariably used



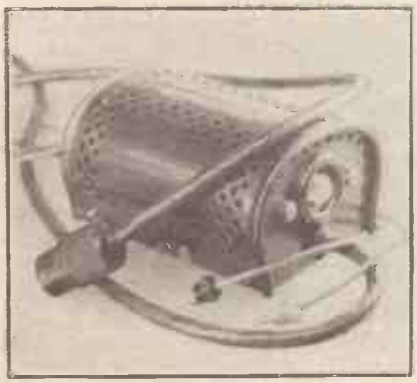
with D.C. mains, and which is connected in series with the earth lead. This will bring the panel to the same potential as the body, and shocks will be impossible from it.

At the same time, however, it will make it possible to short the mains by touching the panel with any of the wires connected with the filament. To avoid this, another fixed condenser must be inserted in the earth lead at some place between the actual earth and the point where it is joined to the panel.

Convenient H.T. Accumulator Charger

THE Oldham H.T. battery charger, type A.C.H.T.1, illustrated in the accompanying photograph, includes a Westinghouse dry metal rectifier and is made to plug into any lamp socket on the alternating current mains, and will charge high-tension accumulators of any voltage from 60 to 150. Considerable ingenuity has been displayed in the design of this instrument so as to give simplicity of construction together with safety and reliability.

Flexible leads terminating in wander plugs are provided, so that it is only necessary to remove the wander plugs connected to the set and insert the plugs from the charger and plug into the electric light mains when your battery is put on charge at once. The charging rate depends upon the voltage of the high-tension accumulator, and is greater with a 60-volt battery than with 150, but the rate is such that, if we take a tip from the shampoo advertisements and make Friday night "H.T. Charging Night," the high-tension accumulator will always be kept in good condition.



The Oldham H.T. battery charger described on this page.

Should it blow, a bulb used to protect the instrument against overload is easily replaceable at low cost, while if the mains should fail during the night while the battery is on charge no harm will be done as the accumulator will not discharge back through the charger. The whole device is very neat and well finished, and the cost of 55s. for the A.C. type is extremely reasonable.

A MONTHLY REVIEW OF TESTED APPARATUS

(Note: All apparatus reviewed in this section each month has been tested in the Editor's private laboratory, under his personal supervision.

It should be pointed out, however, to those readers of the WIRELESS CONSTRUCTOR who like experimenting, that no attempt should be made to adapt this unit for providing H.T. direct from the mains. It might at first appear that by adding a simple filter this could be done, but it must be pointed out that the rectifier is directly in series with the mains, there being no transformer to isolate them. Used for the purpose for which it is intended, it is a thoroughly satisfactory device, but no attempt should be made to use it for other purposes.

Hellesen H.T. Battery

Messrs. A. H. Hunt & Co., of Croydon, the English agents for the Hellesen dry batteries, submitted to us some time ago one of these batteries for test (99 volts maximum) of a generally convenient size for the average receiver. In accordance with the practice of this laboratory, voltage and internal measurements' tests were at once made, but before giving a report the battery was put into actual use on a wireless receiver, the high-tension consumption of which was adjusted to that of the average three-valve set. Not only has the battery functioned noiselessly, but the voltage on load after daily use for four months is well above that one would expect from this size of battery.

This only confirms our previous favourable experience with Hellesen batteries, which have always had a good name for constancy and reliability. We have no hesitation in recommending the Hellesen dry battery to readers of the WIRELESS CONSTRUCTOR as a thoroughly reliable battery of first-class performance.

A Neat Fixed Condenser

The Telegraph Condenser Company, whose fixed condensers are well-known everywhere, have now added to their line a particularly neat flat-type fixed condenser, an example of which, of a value of ·0003 mfd., is shown in the photograph. Provided with clips for grid leak and suitable for screwing flat on the baseboard, this is not intended to replace the company's well-known three-terminal series-parallel condenser (type SP),

This is the ·0003 model of the T.C.C. condenser.

What's New—*continued*

but is an addition to the line and is known as type M. The condenser, which is of the familiar green colour, has a pleasing and neat appearance, the clips are well made and do not tend to slip, and the capacity values on test come well within the margin of accuracy for such components, six examples picked at random all being within 4 per cent of the rated value, two being dead accurate. A very useful little condenser which is bound to have a wide sale.

A New L.F. Choke

Messrs. Burne-Jones & Co., Ltd., makers of the Magnum components, have sent us for test a centre-tapped L.F. choke with a nominal rating of 20 henries at 20 milliamperes, and lending itself to a variety of purposes, the chief of which is as an output choke in receiving sets, for which purpose our tests show that it is well suited. The design is such that the inductance is fully sufficient for the purpose when 20 milliamperes is flowing, and, of course, rising considerably as the total current flowing through the choke is reduced. The measured direct-current resistance proved to be 754 ohms, which is satisfactory, and the finish is good. The provision of the centre-tap enables the instrument to be used as an output choke in push-pull circuits, such as in Circuit No. 2 of "Thirty-One More Tested Circuits." We can recommend this component as a quite satisfactory L.F. choke for output circuits of normal receivers.

A useful L.F. choke (Burne-Jones & Co., Ltd.).

Remarkable New Transformer

Within the last few days we have received for test a specimen of the new "Hypermu" low-frequency transformer, manufactured by Messrs. Radio Instruments, Ltd. Accompanying it is a reproduction of the National Physical Laboratory's curve—or rather two curves, for the N.P.L. have tested it out in two different ways of connection.

To say that the response curve of this transformer is remarkable is by no means overstating the case, for it is appreciably better than the published N.P.L. curve of any other low-frequency transformer offered to the home constructor, regardless of price. Preceded by a D.E.L.610 valve, and using parallel feed, the amplification at 25 cycles is 50, rising slightly at 35 cycles to 54, remaining at this figure without variation to nearly 2,000 cycles, after which a slight rise occurs to 65 at 5,000 cycles and a slight fall again to 56 at 7,000.

Seeing that no speaker on the market will reproduce tones as low as 25 cycles, and that 6,000 represents the upper limit of what we require, it will be seen that we have here a transformer of quite exceptional merit. Added to this, the price is only 21s., and the overall dimensions are but 3 in. by 1½ in. by 3 in., with a weight of 13 ounces. Our practical tests fully confirm the impression gained from the curves, and we can unhesitatingly recommend it to the most discriminating listener.

For Pentode's Output

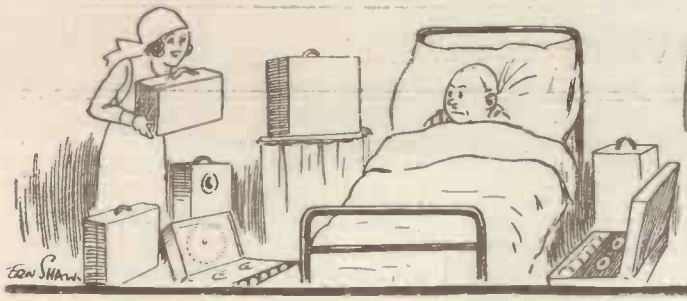
It is well known that the pentode valve, although it can be used without an output transformer, will only give the best results when a suitable high-impedance output transformer is used with it. The Igranic Electric Co., Ltd., have submitted to us for test their new Igranic pentode output transformer. This is designed to have on the input side an impedance suitable for the pentode valve, and on the output side are four terminals so that the best results can be obtained with loud speakers of different impedance.

In general appearance the Igranic pentode transformer resembles this company's model G L.F. intervalve transformer. It has an exceptionally large core and practical tests with a pentode valve show that it is excellently suited for the purpose for which it is designed. Readers who wish to use their pentode valves to the best advantage would do well to consider the purchase of such an excellent instrument, which is very well up to the high standard set by this company.

The new Weilo L.F. transformer.

A Good, Inexpensive L.F. Transformer

The Weilo L.F. transformer illustrated in the accompanying photograph is one of the best low-priced transformers which it has been our privilege to test, and, in fact, it compares very favourably with many transformers at much higher prices. Compared with our standard—a test to which all L.F. transformers are submitted in this laboratory—the reproduction over the whole musical scale was found to be very satisfactory, with only a slight falling off in the lower tones compared with the standard (a very expensive instrument), while the magnification given with the 5 to 1 ratio model tested (worked with a suitable valve preceding it) was remarkably good. Altogether we formed a very favourable impression of this transformer, having in view its low price—(the model X was tested)—of 11s. 6d. The transformer is of foreign manufacture and is sold in this country by Messrs. S. W. Lewis & Co., Ltd.



IN LIGHTER VEIN

By "Wireless Wayfarer"

"Now where is this pain of yours?" asked Dr. Miggles.

"There," I said, indicating my lower chest.

"Lie down."

I lay down.

You know those beastly ram-rod fingers that all doctors seem to possess. He prodded.

"That hurt?" he asked.

"Yes!" I yelled.

"And that?"

"Ow!"

"H'm. Go in to-morrow and I will have it out in the afternoon."

"Go in where? Have out what?"

"Hospital. Appendix," said Dr. Miggles, who is a man of few words.

"That hurt?" he asked.

"But couldn't you——?" I asked.

"No, I couldn't," snapped the doctor. "All the best men know that you can't have efficiency without the removal of dead-ends."

Somewhat shattered I returned home and summoned the professor, Goshburton Crump and Tootle to whom I broke the news.

The Unwanted Turns

"Splendid," cried the professor, "for years now I have been waiting for somebody here to get into your condition so that I could demonstrate my own little idea for stripping off unwanted turns."

From his pocket he produced an enormous clasp-knife and, picking up the poker, proceeded to sharpen it.

"Sit on his chest, Goshburton Crump," he cried, "and you, Tootle, hold his feet. Meanwhile, I will switch on the loud speaker for the topical talk which my paper tells me is now proceeding, upon 'The Love Story of the Earth Worm,' which will provide the necessary anæsthetic. This little job of surgical plumbing won't take two ticks."

"Stop!" I cried, fighting for time. "I have not yet made my will."

The professor agreed that that must, of course, come first. He had, he told us, devised an entirely new means of making wills and was prepared to guarantee that those drawn up on his lines could not be upset by any court of law.

"We will do Wayfarer's will now," he said, "and by this time next week there will be some rare fun in the law courts."

"But," I objected, "you can't have your fun till I konk out."

"Of course not," beamed the professor, lovingly fingering the edge of his clasp-knife, "but that's *quite* easy."

I Make My Will

Goshburton Crump having produced a notebook, I proceeded to dictate my last wishes.

"To my dear friend, Captain Buckett," I groaned, "I leave, free of estate duty, my entire overdraft. To Sir. K. N. Pepper the loud speaker that I borrowed from Primpleson, and to Primpleson the screen-grid and the pentode that Miss Worple lent me when she wasn't looking. I appoint you three my executors, or, should I say, executioners? In recognition of your valuable services I leave to Tootle ten thousand pounds."

"But you haven't got ten thousand pounds," said Tootle.

"No," I agreed wanly, "but that kind of thing always looks well in the 'Other People's Money' column. You shouldn't be so beastly grasping. The spirit is willing even if the funds are low. To Professor Goop any one grid leak that he may select from my collection and to Goshburton Crump my five-valve receiving set."

"Hi!" yelled the professor, "that set's made up almost entirely of parts borrowed from me. Obviously I must come in for it."

Goshburton Crump told him roundly that this display of mercenary-mindedness was very much out of place at such a time. In fact, he called it disgusting.

"Did you say disgusting?" queried the professor.

"I did," responded Goshburton Crump.

"You did?"

"Yes, I did."

Exit the Professor

The professor opened his mouth to emit a spate of words, and next moment Goshburton Crump was going equally strong. They shouted, they stamped, they waved their arms, both talking at once and neither hearing a word of what the other was saying, which was perhaps just as well. Then the professor swatted Goshburton Crump with the poker, and Goshburton Crump butted him in the fifth waistcoat button with his head and the professor collapsed on the hearthrug, and Tootle and Goshburton Crump carried him home, and I rang the bell and told Amelia Jane that if Professor Goop called he was on no account to be admitted. I made all my preparations, and rather looked forward to having in hospital a complete holiday from wireless.

* * *

I opened my eyes, but couldn't think where I was. The light seemed very strong, there was a filthy taste in my mouth, and there was a noise inside my head like Hamburg being heterodyned by half Europe.

—he produced an enormous clasp-knife.

"Would you like a glass of water?" said a feminine voice. I realised slowly that it emanated from a nurse who was holding a feeding-cup thing to my lips. Presently the world became rather more stable, and having learnt by inquiry that the alterations in the circuit had been completely

In Lighter Vein—*continued*

satisfactory, I felt more and more at peace. Next day my nurse told me that every bed was provided with wireless. Would I like to have it on?

I told her quite gently that I had had nothing but wireless for about ten years, and that what I now wanted was anything but wireless. During the day I was visited by the ward sister, the matron, the house surgeon and Dr. Miggles, each of whom recommended wireless as something to cheer one up. Since no real wireless man has ever heard anybody else's set without feeling slightly ill I went on declining firmly.

Next day I was asked if I would care to see a visitor. Mr. Goshburton Crump had called, they told me. I said that I should be more than delighted. Goshburton Crump came in, staggering under a burden that he was carrying.

My Troubles Commence

"My dear old chap," he said, "I have just brought you a little portable that I am going to lend you to cheer you up whilst you are in your present baseboard-mounting position.

Heaving a sigh I thanked him warmly. On the following day Tootle and Primpleson arrived at different times. Each brought a portable set.

Sir K. N. Pepper sent the most kindly note saying that he couldn't come since he was laid up with gout, but that he had sent me his portable to help to while away the time. Miss Worple floated in to the ward carrying

Goshburton Crump came staggering in.

nothing but a pot of hyacinths, and I sighed with relief—behind her came the porter carrying a portable set. Captain Buckett was as breezy as sailors are reputed to be. He brought oranges—and a portable set. Professor Goop entered arguing heatedly with Dr. Miggles, who had given him a lift over. He dropped the portable set that he was carrying on the foot of the bed and the feet of the patient, and waving his hand to me continued his argument.

"It is ridiculous," he said, "to stitch them up as you do."

"What would you recommend?" asked the doctor sweetly.

"Snap fasteners," cried the professor. "They save such a lot of trouble next time. Here we have a splendid case to test out my theory. I will just show you."

Dr. Miggles had quite a business getting the professor out, but fortunately for me he accomplished it in the end.

Nineteen Portables

At the end of the first week I had nineteen portable sets and a dozen tomes on the theory of wireless, which the doctor refused to allow me to read on the ground that they were too exciting. As soon as I could handle a pencil I wrote to Mr. Hercy Parris to tell him what had happened. Did I get sympathy? Did I get my holiday from wireless? Do pigs fly?

"Dear Wayfarer," he wrote (he did really), "I have no doubt that the decrease in your total inductance will be amply compensated by increased capacity. This I propose to charge to full voltage when you are next able to lunch with me. I can picture you running a neon lamp over yourself to discover where fresh positions of the nodes and antinodes occur, after which I presume that you will recalibrate yourself. I trust that your progress is such that in a few days you will be displaying an illuminated dial."

Wayfarer—"Wireless Engineer"

As soon as I was able to get up the matron suggested that for a little change I should employ myself in adjusting the hospital set. When I had done that there was another one over in the nurses' home. And what is more she had a private one that I might like to play with, and she knew that the house surgeon had one, too. I told her that I was having a holiday, to which she replied that she had heard from my friends that I never had anything else.

She assured me that a spot of work would probably do me a world of good. In despair I resolved t devote my energies to visiting and cheering up the other patients—all of them were reading the WIRELESS CONSTRUCTOR and begged me to tell them more about the subjects of various articles.

The day of my discharge came at length. I was handed a form with various questions to answer.

"Have you received back all the personal property with which you entered the hospital?" asked the first.

He dropped it on the patient's feet.

"No," I wrote.

"If anything is missing," said No. 2, "please state what it is!"

"One appendix, my only one," I replied.

APPENDIX.

[Owing to the removal of this component from our contributor this feature cannot be inserted.—Ed.].

Useful Measuring Instruments

WE have just received from A. H. Hunt, Ltd., of Tunstall Road, Croydon, a copy of their catalogue No. 60. This is a new list in which is detailed a complete range of moving-coil commercial ammeters and voltmeters, moving-iron dead-beat voltmeters and ammeters, and moving-coil dead-beat ammeters and voltmeters. In a covering letter, A. H. Hunt, Ltd., tell us that all of these instruments are available in a variety of finishes and fittings, all being of exceptionally good quality and accuracy and at highly competitive prices.

As a matter of fact, these instruments (for which A. H. Hunt & Co. are the sole agents for Great Britain) are made in the same works as those detailed in their catalogue No. 138B and with which their name has been associated for over twenty years. The list is a very comprehensive one, and ranges from the general-purpose instruments up to dead-beat moving-coil models.

LABORATORY NOTES by the Editor

Under this heading the Editor discusses some of the many interesting points revealed during experiments carried out in the "Wireless Constructor" laboratory.

IN describing the "Request" Three in the March issue of the WIRELESS CONSTRUCTOR, the Editor pointed out on page 337 that, although it has frequently been stated that to get the best results a resistance shunted to filament by a condenser should be placed in the anode lead not only of the detector valve, but also in that of the first low-frequency stage, his experiments have gone to show that in a great number of cases at least, if not always, such a device in the anode lead of the first low-frequency valve is valueless, and that it is much better to take the 2-mfd. condenser sometimes recommended for this position and add it to the 2-mfd. condenser in the anode circuit of the detector valve.

American Researches

The experiments which led up to this conclusion have received striking confirmation in our American contemporary, "Radio Broadcast," which has just published an article, "Are Filters Needed in L.F. Amplifiers?" In the experiments described a two-stage transformer-coupled audio-frequency amplifier was made up and thoroughly filtered, and response curves taken of the whole amplifier.

This amplifier, which was specially designed, had an excellent characteristic, being practically flat from 100 to 8,000 cycles. Removing all filtering from the first low-frequency valve was tried, the result showing practically as good an overall response curve as with all the filter in circuit, the very slight difference being only noticeable in a carefully prepared curve, and being totally inaudible to the ear.

The importance of designing a wireless receiver to have a flat overall reproduction characteristic is, we are glad to find, gradually dawning upon set manufacturers. Some, but very few, have realised it for a long time, but too many imagine that a combination of two coupling units, each of which when measured separately has a flat curve, will give a two-stage curve of similar flatness. There has been far too much "back of envelope" experimenting in radio, and if some of the set manufacturers installed apparatus, competently handled, for measurement of the overall response curves of their receivers, they would get the surprise of their lives!

An Interesting Report

A very valuable paper, which should be studied by all who are interested in set design, was published in the Proceedings of the Institute of Radio Engineers for November, 1928. It is entitled, "Quantitative Methods Used in the Test of Broadcast Receiving Sets," and was contributed by A. F. van Dyck and E. C. Dickey, of the technical test department of the Radio Corporation of America. It is too long and too important to be adequately summarised in a few paragraphs, but the following quotations are of interest to all. After outlining when they began their experiments, the authors say:

A VALUABLE METER

A Weston set tester which is invaluable for tracing faults. Every circuit can be tested in a very short time.

Laboratory Notes—*continued*

"Early in this work it was found, as would be expected, that the determination of receiving set performance by measurement of individual parts (for example, the radio and audio amplifiers) was impracticable. This was chiefly due to the fact that results are usually different when reactions between parts are absent, as they are under measurements of parts individually."

Effect of "Dud" H.T. Battery

"Additional reasons arise from the fact that electrical constants of most receiving sets are changed seriously when connections are made to internal parts, and that more time is required for measuring parts than is needed for a single overall test. Sometimes measurement of individual parts is desirable or necessary, however, as when attempting to locate the cause of the inferior performance of a set, or when engaged in development and design of a new set, in which case segregation of the effects of the several parts is necessary."

The paper includes a curve showing the startling change in the overall response of a wireless receiver due to substituting a high-resistance or partially worn-out high-tension battery for a normal one, the curve with the high-resistance battery rising sharply round about the thousand-cycle figure. Those who have carried out laboratory experiments with battery coupling will not be surprised at the shape of this curve, but a further curve showing the effect of output load on fidelity will come as a surprise to many people.

A transformer manufacturer, for example, when he wants to obtain a curve of his low-frequency transformer, often thinks he is reproducing actual conditions in his tests by seeing that a valve is connected to the secondary of the transformer. This alone, however, is not sufficient, for in the curve just mentioned the shape of the overall curve using a resistance output load and that when using a loud-speaker output load (which is, of course, inductive) is entirely different; for where, in a particular case with a resistance, the curve gradually rises from 30 cycles, falling flat at 200 cycles, and peaking later at about 4,000, with a loud-speaker output load the curve rises very rapidly from 30 to peak sharply at 60, this gradually falling off to flatness at about 200, after which it maintains the same level as with the resistance load, but with not quite so high a peak in the upper range as before. Here, then, we have a case where performance in a set would be quite different from that expected from an ordinary curve taken with a resistance load.

TELLING THE WORLD

The operating engineer of the National Broadcasting Co., U.S.A., testing out some of the "mikes" used in outside broadcasts.

In the WIRELESS CONSTRUCTOR laboratory we have found it possible to build up receivers which run into audio-frequency oscillation with some makes of loud speaker, and are perfectly stable with others. This is one more confirmation that a transformer which has a good curve when measured as an isolated unit may give no better practical results, when used with a set and a loud speaker, than a transformer whose isolated curve is not so flat.

Choke-Coupled H.F. Stages

It also explains how occasionally one may come across a set which gives remarkably good quality although the component, and particularly the low-frequency coupling units, would be thought to be much inferior to normal.

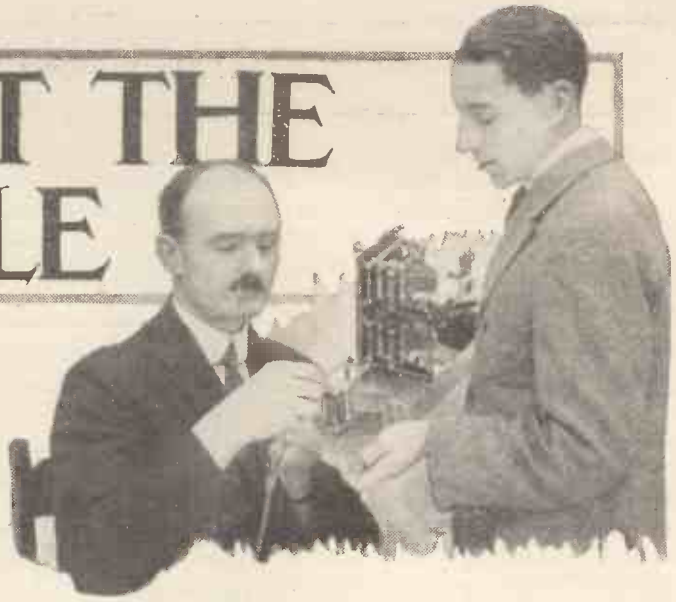
The sets which are now being brought out using choked coupling for screened-grid and other H.F. valves—and a surprising large number of commercial portables use choke-coupled H.F. valves—have drawn attention to the radio-frequency choke, and made it quite clear that chokes which may be thoroughly satisfactory in ordinary reaction circuits may fall down hopelessly when used for high-frequency choke coupling. Very inferior chokes will often pass muster in the anode circuit of the detector valve where the sole purpose of the choke is to deflect the radio-frequency component back to the filament through the reaction condenser and reaction coil.

Transformer Shunting Condensers

In the case of transformers which do not have a built-in fixed condenser across the primary, the impedance is often fully adequate to obtain reaction effects, and short-circuiting the choke makes not the slightest difference in practice! With other transformers containing built-in condensers the use of a radio-frequency choke is necessary, for otherwise the radio-frequency component would go through the built-in condenser, and through the high-tension source back to filament, instead of through the path we desire it to take.

There is no question that radio-frequency chokes will now be redesigned for high-frequency choke coupling, and we may expect very considerable improvements in this regard in the near future.

CHATS AT THE WORK-TABLE



Many points of practical interest to all radio constructors are dealt with under this heading.

By R. W. HALLOWS, M.A.

IN the old days, when we wanted to squeeze out of the small high-tension batteries then available every possible volt for the plates of our valves, it was customary to connect the batteries in series, that is, H.T. — to L.T. +. With a 6-volt accumulator and a 66-volt battery we thus obtained—when the battery was brand new, at any rate—a potential difference of 72 volts between the plate and filament negative. And on occasion, when we were unwise enough to ply the screwdriver inside the cabinet whilst the set was switched on, we obtained the same P.D. across the filament for one crowded moment of blinding light.

New Source of Danger

With the coming of the better and bigger high-tension batteries at lower prices the need for the few extra volts was not so pressing, and we acquired the habit of connecting the batteries negative to negative. Short-circuits became so rare that most of

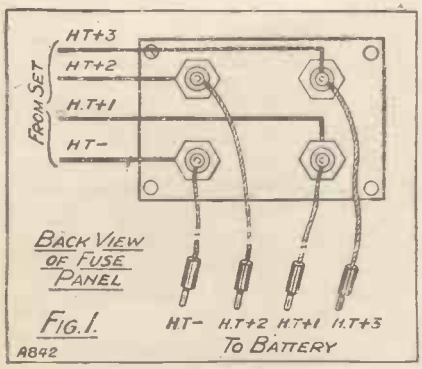


FIG. 1.

us ceased to bother about taking any precautions to minimise their possibly expensive results; in fact, the only short-circuit that could destroy a valve was one from H.T. + to L.T. +, a comparatively rare occurrence, since all the big exposed parts which might be responsible for a short are usually connected to L.T — and earth.

To-day, though, we have a new

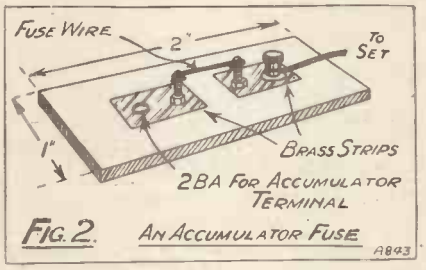


FIG. 2. AN ACCUMULATOR FUSE

factor in the multi-electrode valve. In the screen-grid pattern there is between the control grid and the plate a second grid, whose potential is usually 50 volts or so below that of the plate.

These two electrodes are very close together, and should an accident bring them into contact, the resulting short is likely to have serious consequences. This was brought home to me the other day when, after switching on, I found the set silent, and presently noticed a most unpleasant smell arising from it.

Bad for the Battery

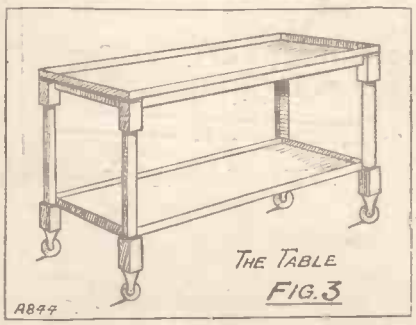
Hastily switching off, I traced the trouble by senses of smell and touch to the high-frequency choke in the anode circuit of the valve. This was hot enough to make one jump when the finger touched it. If you care to draw out the circuit of the screen-grid valve, coupled on the parallel-feed system, you will see that the short-circuit indicated places this choke directly across, say, the 75-volt and the 130-volt tappings of the high-tension battery, with the result that 55 volts are available to drive current through its windings, with nothing to obstruct it but their comparatively low resistance.

Besides burning out the choke, this is exceedingly bad for the portion of the high-tension battery involved. With the pentode, whose internal economy is still more elaborate owing to the presence of a third grid, all kinds of short-circuits are possible as results of rough or careless handling.

Snags in Using Fuses

I do not mean to say that these short-circuits are always occurring. That is not so, but they are liable to do so at the most unexpected moment, and it is as well to be on one's guard against them.

The obvious method is to make use of fuses of some kind, and here we have to be rather careful. To make



THE TABLE
FIG. 3.

everything safe it is desirable to have a fuse in each high-tension lead, and here lurks what may be a snag, if one does not take care. We want our fuses to blow before the current has reached dimensions likely to do any damage.

Flashlamps suggest themselves at

Chats at the Work-Table—*continued*

once as suitable for the purpose, and on looking through a list of various types we find one rated at, say, 4·5 volts, ·05 ampere. If it requires only 50 milliamps to light up its filament brightly the breakdown point cannot be a very high one; but stop a moment. If 4·5 volts drive 50 milliamps of current through the filament, what is the resistance of it? Dividing 4·5 by ·05 we have 90 ohms.

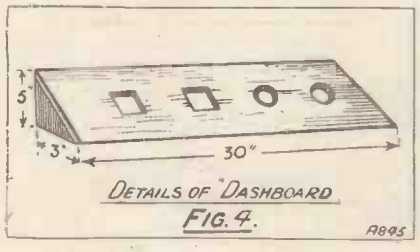
With such a flashlamp in the common negative H.T. lead and in every positive lead we are introducing 180 ohms of resistance into every plate circuit, and this, with a common battery, is quite sufficient to give rise to back-couplings and other undesirable results in many sets.

Special Micro-Fuses

If, therefore, we want to use flashlamps we must look for some other type. A pattern that I have found quite satisfactory is one rated at 2 volts, ·2 amp. The resistance of the filament is thus only 10 ohms.

Tests show that these lamps blow on the average at about half an amp. This may seem rather high, but it must be remembered that we have no need to protect valve filaments; what we are out to do is to protect the high-tension battery and the plate circuit components. Half an amp. for a fraction of a second will not hurt the high-tension battery, nor is it likely that other components will be damaged.

It is also possible to obtain some very neat little special micro-fuses which have a resistance of only a few



DETAILS OF DASHBOARD
FIG. 4. A845

ohms and blow at about 100 milliamperes. These, however, I have not yet had an opportunity of testing out, although the Editor tells me they are quite satisfactory.

Mounting Flashlamps

Fig. 1 shows a handy way in which a fuse panel can be made up. In a piece of ¼-in. ebonite 3½ in. square, four equally-spaced ½-in. holes are drilled. If there is any difficulty about making holes of this size, run through, first of all, with a ⅜-in. drill and then enlarge either with a D-bit or with an old file if that very useful tool is not available.

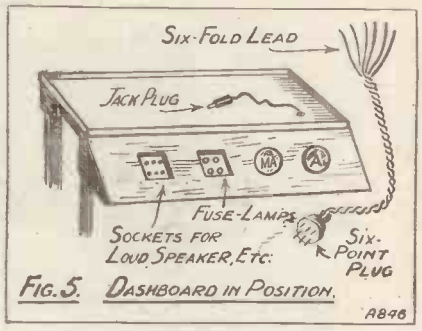


FIG. 5. DASHBOARD IN POSITION. A846

Into each hole insert a flush-fitting flashlamp-holder such as can be obtained from most electrical shops for sixpence apiece. The fuse panel may be mounted conveniently on the battery box, if one is used, at the back of the cabinet which houses the receiving set or under the table upon which it stands. One set of its leads goes to the terminals of the receiving set, the others are provided with wander plugs for connection to the battery.

With such an arrangement as this the battery is thoroughly safeguarded against short-circuits. If special micro-fuses are used this system may, of course, be adapted to suit them.

L.T. Fuses

In addition to fuses for the high-tension battery, I also use fuses for the accumulator. They cost practically nothing to make, they give no trouble, and one knows that they are there to protect this expensive component should an accidental short-circuit occur. It must always be remembered that if a short-circuit should happen, a big low-tension accumulator is capable of delivering a heavy amount of current for a considerable time.

A good deal of heat may therefore be generated should a short occur in an unprotected circuit and remain for a while unnoticed. Low-tension fuses are, I think, best fitted to the terminals of the battery itself. In Fig. 2 is seen a very simple way of making them up.

The only materials required for each are a piece of ¼-in. ebonite 1 in. wide by 2 in. in length, two strips of brass each ½ in. wide by ¾ in. in length, and two 4 B.A. ¾-in. screws, two 4 B.A. nuts and a terminal. The two screws are passed through the ebonite on what is to be the underside of the fuse.

One of them is connected to the terminal by means of one brass strip. The second brass strip has a 2 B.A. hole close to the end remote from the screw and a corresponding hole is made through the ebonite. To attach the fuse holder, remove the terminal nut of the accumulator and pass the shank of the screw through the 2 B.A. hole. Then replace the nut.

The Wire to Use

The lead to the set is connected, of course, to the terminal mounted on the screw holder. The fuse itself consists of a short piece of suitable tin wire. A very handy gauge for the purpose is No. 36, which blows under a load of 1 ampere. This will be quite sufficient for many sets using "point one" valves, but where the normal load exceeds about half an ampere the fuse may be arranged to blow at 2 amperes. This is easily done by twisting the wire double.

The fuse wire is placed in position simply by twisting one end of it round the first upright screw of the

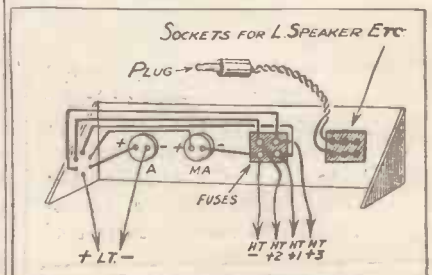


FIG. 6. CONNECTIONS OF DASHBOARD A847

holder, stretching it not too tightly, and taking a few turns with the other end round the second screw. Where an accumulator of two or three cells is used with lead strip connections between cells, the fuse holder may be used to replace one of these connectors. In that case, of course, the length of the ebonite foundation must be suitably adjusted. Since metal parts of the holder are exposed to some extent to the acid fumes, it is as well always to keep them greased with vaseline in order to prevent corrosion.

(*Continued on page* 120.)

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QUEER QUERIES

Some typical readers' problems reviewed and questions answered.

By P. R. BIRD.

Superannuated Super-Hets.

"WHAT has happened to the super-het. nowadays?" asks a Feltham reader. He goes on to say that only a couple of years ago it was everybody's aspiration to get a super-het., "but nowadays the set-designers have almost dropped them. Weren't they so very wonderful, after all, or do we home constructors get our legs pulled a bit over these wonderful new sets that go out of fashion whilst I am still saving up to buy one?"

He goes on to raise a lot more interesting radio topics (ranging from neutralising to Jack Payne's latest and brightest hit), but this particular question of continual changes in set-design is of sufficient general interest to merit special notice.

The real reason that the super-het. is being superannuated, and all these constant changes in circuits keep taking place, can be summed up in one word—Progress. It's going on all the time.

This radio business keeps on expanding, and it frequently goes off in new directions. You'll realise what I mean if you think over this particular instance of the super-het.

The Last Word

A few years ago there was no *efficient* high-frequency amplification on the low waves because the best valves then made would not behave themselves and remain stable on ordinary broadcast wave-lengths. But they would on long waves, so along comes the super-het., which was nothing more than a stunt for altering short waves into longer ones so that they *could* be amplified properly.

Very wonderful—but not the last word! For along comes Progress with circuits which made those same valves behave on both long and short waves, by means of neutralising. Was that the last word? Not a bit of it!

Along comes Progress once again, with screened-grid valves that don't even want neutralising to make them behave—they'll amplify as good as gold, and so theoretically beat both the other schemes.

(Neutralising and super-hetting both got round the difficulties, but the new fellows cleared these difficulties out of the way—a far better plan!)

But nothing's perfect (as the cynic said when he bit a good half-crown, and broke his bad tooth!), so even with the S.G. valve the search for better circuits and better apparatus continues. It certainly is sometimes a bit disappointing to find that what you thought was the last word is really only a prelude; but it does put pep into the radio game, doesn't it?

"*Excelsior*," Longfellow called it! Or, as Leonard Henry would say, it's "So we go on, and on, and on, and on, and ON——"

A Carpet Problem

Everybody knows that to spill the acid from an accumulator upon a carpet is a sure way of ruining the latter, but I have a good deal of sympathy with the wife of a Northampton reader who found her carpet ruined and blamed "the wireless," although her husband declared it could not possibly have been!

Apparently he had always been especially careful of the L.T. battery and had made a strong, lined case which completely prevented the possibility of any leakage of the acid. But, as his wife pointed out, there undoubtedly *was* a hole in the carpet, and it was where the wireless gear generally stood, so that it was very natural she should blame the latter.

Further inquiries elicited the fact that an old H.T. battery had been opened up and allowed to stand on its side for some weeks on this particular spot, which was hidden by the set, and though the unhappy constructor felt sure that this could not possibly have been the cause of the trouble, he thought he would write to see. The letter sent in reply explained as tactfully as possible that the paste inside an H.T. battery is really similar in corrosive effects to the liquid acid, though it is stiffened into a paste so as to prevent spilling and leakage. If this paste is allowed to escape from its container it will do damage similar to that of liquid electrolyte, so on no account must H.T. battery paste be allowed to touch clothes, carpets or similar fabrics.

H.T.B. Connections

People who are only just starting set-building for the first time (lucky people! What fun they have in store!) sometimes ask why sets have three or four different H.T. + terminals, and whether all these terminals should be joined by a wire and the plug taken to full H.T. +?

If someone asks you this, don't grin too noticeably, but just explain that each + lead should have a separate + terminal, which goes into the battery at the point where it gives best results. I know it's a temptation to smile in such cases, but, remember, we all had to learn.

RADIOGRAMOPHONICS

A monthly article for the gramophone enthusiast.

Simple methods of converting ordinary sets to take pick-ups are described.

By A. JOHNSON-RANDALL

THE impression is sometimes gained by the average wireless man that the use of a gramophone pick-up is a very complicated business. He has visions of very special apparatus, and of himself, with soldering iron in hand, making extensive alterations to the wiring of his receiver.

Although nothing is farther from the truth, there is perhaps justification for the misconception in that pictures of special amplifiers used by theatres for pick-up work look like power plants. Also the price of some electrical gramophones is enough to frighten anyone but those with very deep pockets.

Actually, with any set that employs a straight circuit there is no need for any alterations whatever inside the set. There is no need to have a special switch on the panel or even to fit a simple jack. While jacks and switches make for easy operation in changing from radio to the gramophone, exactly the same results may be obtained by using an ordinary adaptor.

Using an Adaptor

This consists of a special plug that fits into the detector valve-holder in place of the detector valve. The top of it is like a valve-holder and accommodates the valve that is removed from the holder. From the adaptor two wires run to the pick-up. There is one small point that has to be watched carefully with these plugs. One lead is joined to one of the filament pins of the adaptor, and it must be to the one that makes contact with the socket that is wired to L.T. negative.

The reason for this is quite simple. With the pick-up in place, the detector valve is being used as an L.F. amplifier. If the lead just mentioned runs to the positive pin, the valve will be worked with positive bias on the grid, and that this is obviously undesirable will be apparent to everyone. Actually the fact that the detector valve is being used as an L.F. amplifier raises another interesting point. It is the universal practice nowadays to use grid bias for all low-frequency amplifiers. Why, therefore, you will ask, can the valve under consideration work without distortion when its grid return is direct to L.T. negative?

The answer is that, actually, unless the voltage applied from the pick-up is very small, distortion will take place and therefore grid bias is advisable. The reason why very small voltages on the grid are not distorted is that the grid current does not start immediately the grid potential becomes positive. Most pick-ups, however, give as much "kick" as the average single-valve receiver, and grid bias is used on all modern two-valve receivers. With the plug adaptor just mentioned grid bias can easily be applied by connecting the battery in series with the lead that comes from the filament, the negative plug being connected to the side running to the pick-up. Since we are treating the valve as an ordinary L.F. amplifier, as far as grid bias is concerned, there is no reason why it should not also be considered in the same light as regards the H.T.

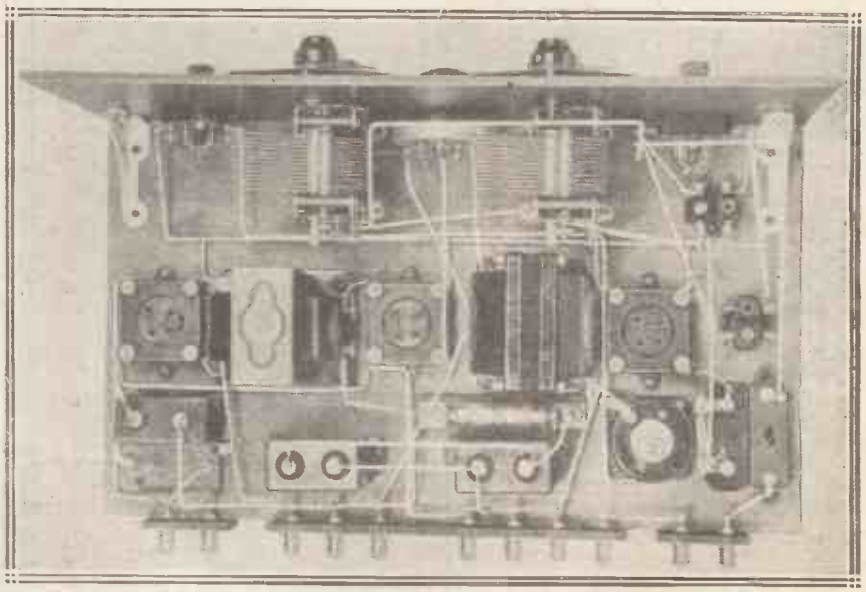
H.T. Voltage

To get the maximum amplification from a low-frequency stage, and also to avoid all possible distortion, it is usual to use as much H.T. voltage as is available. Providing, of course, that the maximum rating on the plate is not exceeded.

Therefore, increase the H.T. to the detector-valve tap if it is provided with a separate one. This point is of more importance than at first may be apparent.

The detector valve may be worked with quite a small H.T. value for

(*Continued on page* 114.)



The "Request" Three is a good example of a set in which the simplest way of connecting a pick-up is to use an adaptor.

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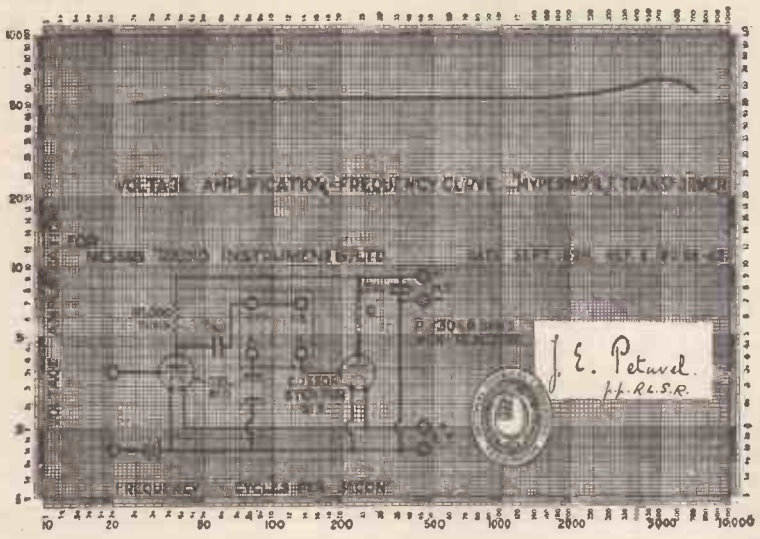

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BAIRD'S TELEVISION PATENTS

An interesting description of the principles of the Baird system, together with details of some of the latest patents in connection with it.

By SEXTON O'CONNOR

THE outstanding difference between broadcasting and television is that, in the former case, reception consists merely in recording the sequence of a number of sounds, one after the other in order of time, as in a song or simple melody. The matter is somewhat more complicated in the case of an orchestral performance, but even then the musical analysis of several sounds occurring simultaneously is carried out automatically by the human ear.

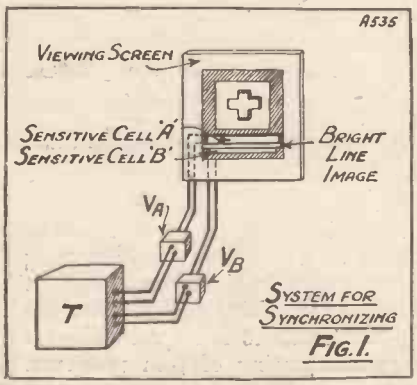


FIG. 1.

This faculty is not shared to an equal degree by all listeners, and in some instances it is only acquired after long training, but at all events it is definitely a subjective effort. In other words, it belongs to the personality of the listener, and is not primarily dependent upon the particular circuit arrangement of the receiving apparatus.

Persistence of Vision

When it comes to the transmission of pictures, however, the human eye is not so helpful. The receiving apparatus must not only receive a succession of picture signal-elements, but it must be able to distribute them in proper position and in accurate sequence over a certain definite area, such as a viewing screen.

It is true that the eye can be tricked or deceived to give the effect of movement or animation, if the pictures follow each other sufficiently rapidly. This is the well-known persistence-of-vision effect which lies at the root of kinematography.

The "accommodation" of the eye will not, however, go further than this. If the picture signal elements as received in television are not accurately distributed on the viewing screen, or if they do not reproduce the movement of the sitter at the transmitting end in absolute synchronism, the image on the screen will be displaced or blurred out of all possible recognition.

Synchronization

This question of synchronization is one of the most difficult problems to be solved in television. The difficulty is emphasised by the enormous speed at which each signal element follows the other. To ensure a true kinematographic effect, at least ten separate pictures (each built up of thousands of different "point" signals) must be completed in each second; otherwise the picture flickers, and the apparent movement takes place in jerks instead of being smooth.

Mr. Baird originally attacked the problem of synchronization in the following way. At the transmitting end a special synchronizing signal, derived from an A.C. generator having a frequency of 500 cycles per second, was transmitted through the ether on a separate carrier-wave having a frequency different from the wave carrying the picture signals.

The Receiving End

At the receiving end, the two carrier-waves were filtered out, and the rectified synchronizing signal (after being suitably amplified) was used to control the speed of an A.C. synchronous motor directly coupled to the D.C. motor driving the recording apparatus. The D.C. motor was, of course, adjusted approximately to the correct speed by hand, and the applied A.C. currents then preventing any "hunting" or deviation.

Once the transmitter and receiver are isochronous, i.e. rotate at the same speed, both can be brought into identical phase or "synchronism" by utilising a simple hand control of the motor at the receiving end.

It will be seen that such a method involves not only two carrier-waves of different frequency, which will take up valuable space in the available ether room, but an expensive motor equipment and separate amplifiers are also required in the receiving set.

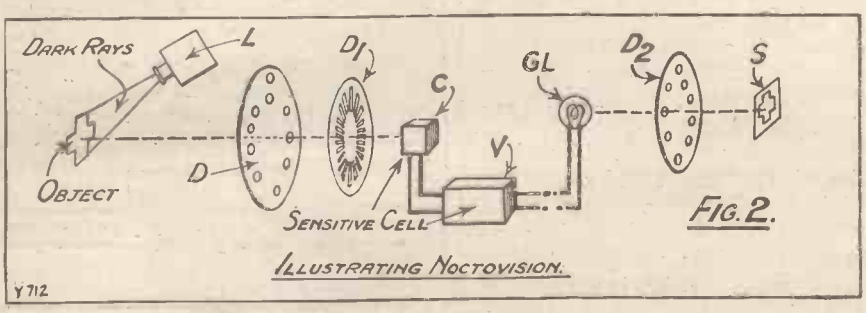


FIG. 2.

ILLUSTRATING NOCTOVISION.

Baird's Television Patents—*continued*

Patent No. 269,834, *granted to Mr. J. L. Baird.*

In this invention Mr. Baird describes a method of synchronizing the receiving apparatus with the transmitter which does not entail the use of a special or separate carrier-frequency.

At the transmitting end he associates with the object to be televised a specially bright image, which is distinct or separate from the actual picture and is also more intensely illuminated. He suggests as an example the image of the glowing filament of an incandescent lamp.

The image of this brightly lit object is then transmitted simultaneously with the actual picture, and is reproduced at the receiving end and thrown upon the viewing screen, either at the bottom of the screen, as shown in Fig. 1, or in some other position closely associated with the actual picture (shown as a cross).

Experts at work in the Baird laboratory at Long Acre, London. The photo was taken on the occasion of the sensational "Berengaria" experiment.

Ingenious Scheme

It appears as a bright line, and so long as the motor of the receiving apparatus is running accurately, it occupies a position exactly mid-way between two elongated light-sensitive cells marked A and B.

These cells are each connected in series with amplifiers and controlling devices VA, VB to a motor in the televisor box T, controlling the rotating discs used in reception. Now if, for instance, the discs in the apparatus T commence to run too slowly, the bright-line image will move upwards until it overlaps the upper sensitive cell A.

This immediately operates the control device VA, which, in turn, accelerates the speed of the motor until it again comes into step with the transmission. Similarly, if the receiving discs start to rotate too fast, the bright-line image moves downwards and overlaps the lower sensitive cell B. The latter thereupon actuates the control device VB to brake or lessen the speed of the motor.

It is interesting to note that Denes Von Mihály, the well-known television expert, has proposed to place a light-sensitive cell *within* the boundary of the picture as reproduced at the receiving end, and to energise this cell by the movement of a "control shadow" on or off it, so as automatically to regulate the speed of the motor used for controlling reception.

The motor is so adjusted as to run normally slightly in excess of the required speed, and the cell is then used as a check or brake to bring it accurately into step.

Powerful Light

Reference has already been made to the fact that the object at the transmitting end must be very strongly illuminated if a clear-cut picture is to be produced on the receiver. As prolonged exposure to intense light is naturally very trying, one method of alleviating the ordeal, in the case where a person's features are to be televised, is to divide the work of analysis between two light-sensitive cells, the separate responses being added together so that the original flood of light can be approximately halved in intensity.

Noctovision

Mr. Baird has now gone a step farther by making use of invisible light or infra-red rays as a means of exploring the object to be televised. This, of course, necessitates the use of a specially constructed photo-electric cell capable of reacting to such waves, which are actually more closely akin to radiated heat than to light.

Physicists already use a device known as a bolometer for detecting or responding to this form of energy. In one known form of bolometer the rays are made to fall upon and heat a zigzag grating of thin platinum. As the temperature of the platinum wire is raised its electrical resistance alters. This, in turn, upsets the balance of a Wheatstone Bridge, of which the platinum forms one arm.

Although the response is not,

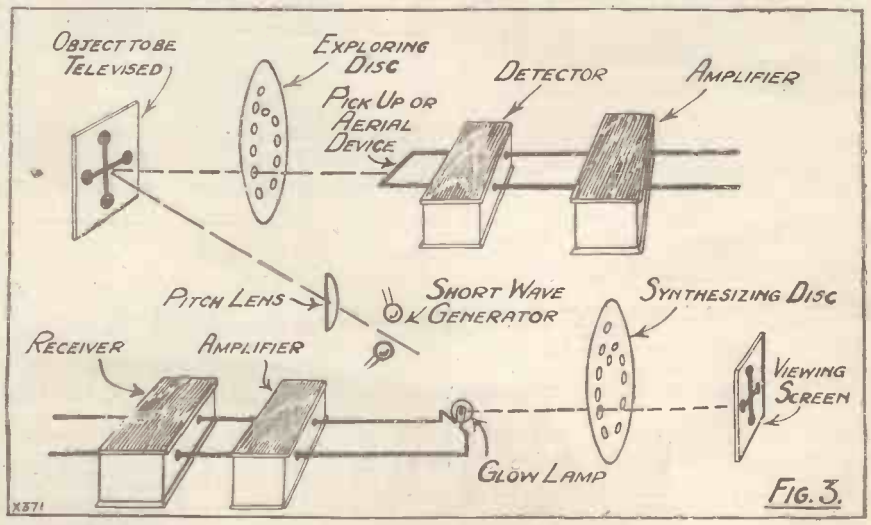


FIG. 3.

Baird's Television Patents—*continued*

in general, strictly proportional to the amount of infra-red energy received, it is approximately so within certain limits.

The general idea of exploring an object by means of infra-red rays, instead of ordinary light, is capable, according to Mr. Baird, of being extended to the detection of distant objects at night or in foggy weather,

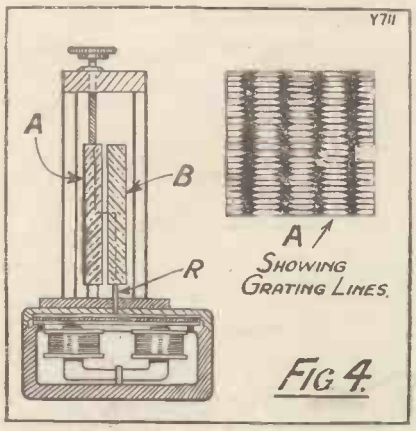


FIG 4.

and he has applied the term Noctovision to it.

Patent No. 288,882, *granted to Television, Ltd., and Mr. J. L. Baird.*

The apparatus used in televising an object by infra-red rays is shown in Fig. 2. The object (again shown as a cross) is subjected to a beam of infra-red rays, which are derived from an ordinary arc or a similar lamp L by interposing a thin sheet of ebonite, which is opaque to ordinary light but transmits the infra-red rays or "invisible light."

The Transmitter

The reflected rays are first passed through the usual exploring disc D, and then through a second rotating disc D_1, or interrupter, and so impinge upon the special sensitive cell C, or bolometer. Corresponding pulsations of current are thus set up in the circuits of the sensitive cell, which, after amplification at V, are fed into a wire connected to the distant receiver. Or they may be used to modulate a radiated carrier-wave.

At the receiving end, the incoming currents are first amplified by a valve amplifier similar to V, and are then applied to control the illumination of a glow-lamp GL, the fluctuating light from which is reassembled into a reproduction of the original object on a viewing-screen S, through a scanning disc D_2, rotated at the same speed as the disc D at the transmitter.

The same apparatus can be used to view a distant object hidden by fog or darkness. Infra-red rays are focused upon the distant object, assuming they have sufficient penetrating power, and the reflected energy, which is, of course, invisible, is then passed through the chain of operations described above, and finally produces a visible reproduction through the medium of the glow-lamp GL, upon the screen S.

Television Records

Patent No. 289,104, *granted to Television, Ltd., and Mr. J. L. Baird.*

The ordinary process of recording speech and music on a gramophone record is so well-known that it hardly needs explanation. This patent relates to the application of a very similar method for recording the light-and-shade effects of a picture in permanent form, so that the original scene can be reproduced from the permanent record as often as may be desired, by simply substituting a televisor receiver in place of a gramophone.

In transmitting a picture by television, it will be remembered that the scene is first analysed by means of a rotating disc and a light-sensitive cell, the varying electric currents

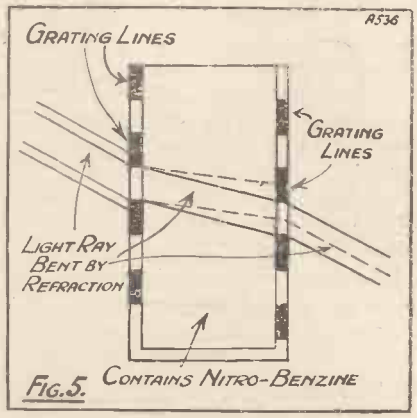
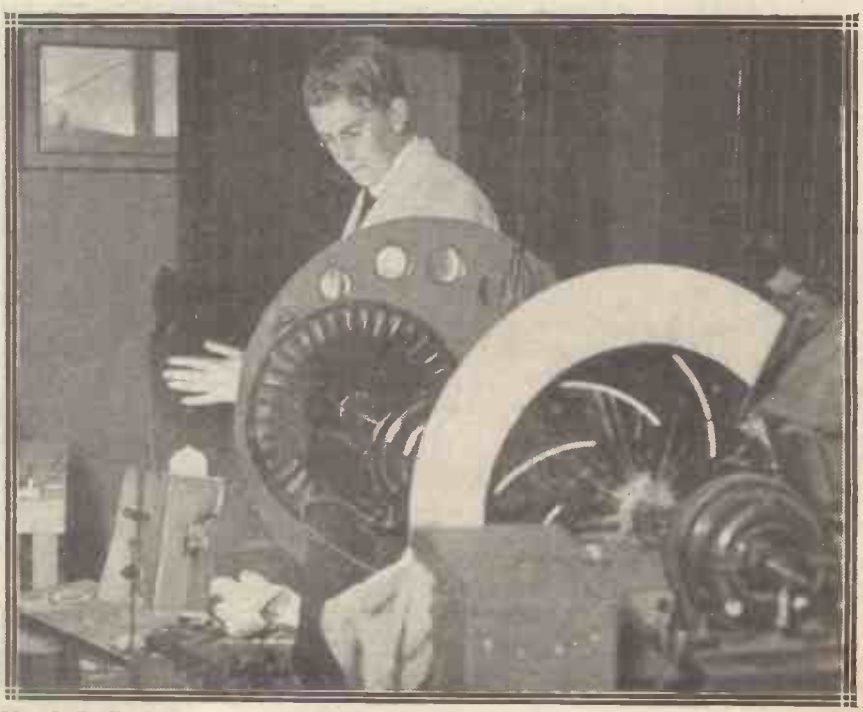


FIG. 5.

produced by the latter representing the corresponding light-and-shade effects which go to form the original picture.

At this stage, instead of transmitting the currents to a distant station, they are applied to a telephone receiver, and vibrate the diaphragm in much the same way as ordinary speech currents. A stylus or needle is mounted on the telephone diaphragm and is caused to form a

(*Continued on page* 122)



Mr. J. L. Baird and some of his earlier television apparatus. He is holding his hand in front of the scanning disc upon which are fixed numbers of lenses.

RECENT VALVE TENDENCIES

With the coming of the Pentode we may well wonder what in the way of valve design will be the next development.

By J. C. JEVONS.

THE appearance first of the tetrode, or four-electrode valve, and later of the pentode low-frequency amplifier, in which there are no fewer than five electrodes, all performing their separate and distinct purposes, makes one wonder where this business of complicating the inside of the bulb is going to stop.

It is no doubt all to the good, since the standard of performance of the new valves in operation is admittedly better than that of the ordinary three-electrode type. At the same time, it tends to make life harder and harder for the earnest amateur who tries to keep abreast of things.

The theory of valve operation was troublesome enough with only one grid to keep in mind. The introduction of a second grid for high-frequency work, originally to cope with space-charge and later to neutralise capacity-coupling between the plate and input circuits, did not tend to simplify matters. On the contrary, it still causes many stern visages to "sickly o'er with the pale cast of thought."

Quintodes and Sextodes?

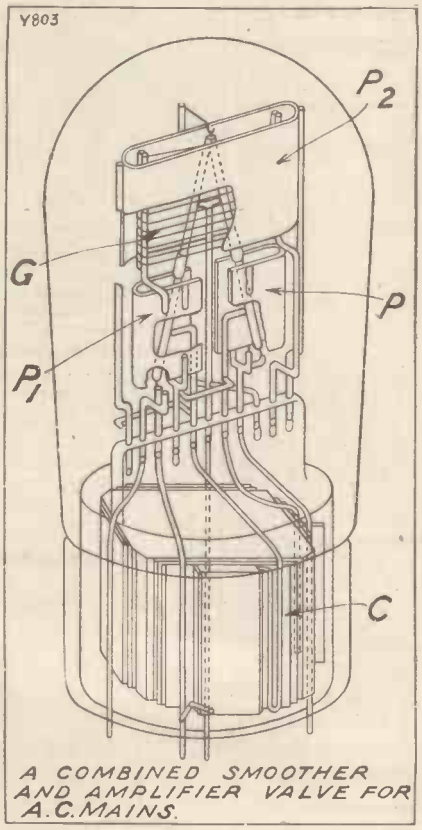
Now, on the low-frequency side, the manufacturers have thrust a third grid between the plate and the screening grid, thus making confusion more confounded. The theorists tell us that it increases output by preventing the screening grid robbing the plate through secondary emission. We may rest content to let it go at that, so long as it works all right in practice. But heaven help us when the Quintode and Sextode come along in due course.

Much the same process of evolution is to be seen in the case of the filament. Years ago some genius suggested the use of a second or alternative filament, which could be switched into circuit when the first burnt out. This was a happy inspiration. It did not achieve any great success, but at least the idea was simple and homely.

More recently the double-filament idea has turned up in another guise. In order to abolish the L.T. battery, the makers decided to introduce a special heating filament which could be fed through a step-down transformer directly from the A.C. mains.

So far so good. But the new filament could not be used as the true cathode or electron-emitter, because of fluctuations in the A.C. supply. It was, therefore, necessary to insert a second filament to prevent hum. The first filament heats the second (which is of high emissivity) by radiation, and the latter produces the necessary electron stream.

At this point the internal "mechanism" of the valve again comes into the melting pot. Owing to the fact that no heating current flows through the true filament or cathode, there is no voltage drop along it. Compare this with the ordinary valve where the filament is heated from a 6-volt accumulator.



A COMBINED SMOOTHER AND AMPLIFIER VALVE FOR A.C. MAINS.

There the positive end of the filament is 6 volts higher than the negative end, whereas in the indirectly-heated valve the filament is at the same potential throughout. Now the operation of any valve depends essentially upon the effect of the applied grid voltage in regulating the electron stream passing from filament to plate.

It is obvious that control will be much more effective where the incoming signal throws the grid positive or negative relatively to the filament as a whole, than in the case where the signal voltage is only measured against the mean or average filament potential.

Smoothing As Well!

By seizing on this point of advantage, valves with indirectly-heated filaments can be designed to have a "slope," or mutual conductance factor, from two to three hundred per cent higher than the average standard for the three-electrode type.

Going a little farther, it has recently been proposed to house part of the ordinary smoothing circuit inside the glass bulb, and to combine the lower part of the cathode with a special anode which serves to rectify the A.C. supply.

The internal arrangement is illustrated in the diagram. The lower right-hand leg of the filament co-operates with the plate P to rectify the A.C. supply. The rectified current then flows between the lower left-hand leg of the filament and a second plate P_1, the combination acting as a saturated valve or current-limiter to smooth out fluctuations. The rectified voltage is then passed on to the plate P_2 in the "upper story" of the same valve. This is fitted with control grid G, which together with the apex of the filament operates as an ordinary amplifier. Smoothing condensers C and resistances are housed in the lower part of the bulb, as shown.

The Loewe Valve

The idea of combining the whole bag of tricks inside the glass bulb has, of course, been developed on somewhat different lines by Dr. Loewe. Provided the existing patent difficulties are successfully surmounted, we are likely to see a lot more of the Loewe valve in the near future. At present its use is mainly confined to Germany, where it has proved immensely popular.

One may reasonably anticipate that the time is not far distant when the standard long-range receiver, for loud-speaker operation, will be reduced to an extremely small number of valves.

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OUR NEWS BULLETIN

Some of the More Interesting Happenings in the Radio World this Month.

International Wave-lengths

IT is reported that the conference which Captain Eckersley has been attending at Prague was conducted with a good deal of secrecy. "International Wave-Lengths" was the subject of most importance before the technical conference. Exactly why the delegates decided to exclude both the Press and the public from their deliberations is unknown, but we hope that as a result of this extraordinary secrecy the deliberations of the experts will lead to results which will justify this strange behaviour.

From the Antarctic

Commander Byrd, the Antarctic explorer, gathered his expedition together a few days ago, as one newspaper put it, "in the frozen wastes," to hear from and send messages to their New York friends twelve thousand miles away. It is reported as one of the most "eventful incidents" in the history of radio.

A Unique Experience

Commander Byrd's message was received by the "New York Times" and was received with "long cheers." The applause was instantly carried back to Commander Byrd by the "New York Times" transmitter, so he had the unique experience of hearing his own speech cheered twelve thousand miles away!

Those Dance Band Broadcasts

As our readers know, various hotels have withdrawn permission from the B.B.C. for their dance bands to be broadcast. But this has not caused a great deal of worry at the B.B.C. headquarters. What did cause worry was the possibility that a combination of interests would stop the B.B.C. from using all copyright music, but, luckily for the listeners, this difficulty has now been overcome.

Another B.B.C. Dance Orchestra

We also understand that the B.B.C. is going to rely more and more upon its own band resources, and Mr. Jack Payne, who has made such a great success of radio dance music, is understood to be forming a second B.B.C. dance orchestra, and probably a third orchestra late in the autumn.

S.O.S. at Sea

When listening-in recently, the skipper of a Fleetwood trawler, Capt. Benn Radford, heard an S.O.S. asking him to return to Fleetwood at once, as his nineteen-year-old nephew was ill. This nephew was also a brother of one of his crew. The trawler was then fifteen miles west of the Lune Lightship. Fishing operations were immediately suspended and the boat raced for port at top speed.

Manchester's New Studio

Manchester station's new home is at Broadcasting House, Piccadilly, Manchester. All the rooms on four floors of the Piccadilly building have now been converted into offices and studios. The big studio is reported to be the latest thing of its kind, and all the newest devices for sound effects, dramatic effects, etc., have been incorporated in this up-to-date broadcasting station.

Flotsam and Jetsam

It is to be hoped that Mr. Flotsam and Mr. Jetsam, the popular entertainers who broadcast a turn from the Alhambra Theatre a week or two ago, will be heard more often. They ceased regular broadcasting in October, 1927, when they were probably the greatest favourites on the B.B.C.'s programme list. It is said that after one of their broadcasts from 2 L O they received something like three hundred letters of appreciation from listeners!

The Regional Scheme

It was reported in the press recently that the Regional Scheme would not be proceeded with, and that although the Potter's Bar station would be completed, the other four Regional stations were going to be abandoned. This rumour got about owing to the fact that the B.B.C. has now been able to work six relay stations simultaneously on a common wave-length of 288·5 metres. Future arrangements would be made, it was said, for all the B.B.C. stations to work on a common wave-length.

Get a Move On!

However, the B.B.C. denies that there is any truth in this story, and states that the Regional Scheme will be carried on.

But exactly when it will be completed nobody seems to know. In fact, for the last four years the Regional Scheme has been very much in the air and, as far as we know, only one site has been chosen, viz., that of Potter's Bar. It is about time something really drastic was done to settle this question of the Regional Scheme.

From Pole to Pole

It is reported that the wireless operator of the American Hobbs' Arctic Expedition has had wireless communication with Commander Byrd's South Polar Base over a distance of about 12,000 miles. This is the first time that the Arctic and the Antarctic Expeditions have been in communication, and constitutes a record in short-wave transmission and reception which ought to make some of our short-wave fans green with envy.

Europe's Biggest Broadcaster

The Swedish Government has placed an order with the Marconi Company for the building of a station which will undoubtedly be the most powerful broadcasting station in Europe. It will have an aerial energy input of no less than 60 kilowatts. This is about double the rating of the station now being built at Potter's Bar under the B.B.C.'s Regional Scheme.

An official of the Marconi Company stated that the actual difference is not so very great, and, in fact, that on an equivalent basis the superiority of the new Swedish station to that of Potter's Bar would be about the ratio of six to five, that is, against the B.B.C.'s 30 kilowatts the Swedish output will be about 36.

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OUR NEWS BULLETIN

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The new station is going to be built near Stockholm, and should be ready in about a year's time.

The Plan de Prague

The new wave-length plan fixed up at Prague is supposed to come into operation about June 30th. It will be known as the Plan de Prague, and is based on the old Plan de Bruxelles which was started last January and which has proved so unsatisfactory.

It is stated that the new plan is important for two special reasons: it is personally organised by the Postal authorities of all countries, and is the first scheme based on something more solid than the general arrangement of broadcasting authorities.

Russia, Too

Another point is that Russia has now come in line with other countries, and has agreed to accept the wave-length fixed by the Union Internationale de Radiophonie.

The wave-length plan consists of a series of readjustments so as to give Russian broadcasting stations wave-lengths next to those of stations in Western Europe. Owing to the distance, of course, interference should not be very great.

Britain Not Much Affected

The British broadcasting wave-lengths will be fixed in due course. It is understood that the variation in the present wave-lengths will be very small. For instance, 2 L O will drop from 358 to 356 metres, and 5 G B from 482 to 479 metres. Nearby stations will probably be Russians on this wave-length band. In fact, it works out about half a wave-length change all the way round, and the new arrangement will be hardly noticeable to listeners.

Politicians' Delight

Mr. A. M. Aylesworth, the President of the National Broadcasting Company of U.S.A., has been in Great Britain on a visit. The N.B.C. of America sends out programmes from sixty-five stations to approximately fifty million listeners in the United States. Mr. Aylesworth recently said:

"I look forward to the day when the great statesmen of England and the U.S.A. will be able to address simultaneously by means of wireless a public on both sides of the Atlantic."

The Listening Habit

"We want to hear your scientists, we want to hear your men of learning," he said; "and above all, your politicians. We can see them on the movies, but radio is nearer the real thing, and in the United States we have developed the listening habit to a remarkable degree, so that this listening has become a national attainment."

A B.B.C. Loss

Listeners learnt with surprise recently that Capt. A. G. D. West, Chief of Research at the B.B.C. for six years, has resigned his post to join His Master's Voice Gramophone Company. Readers will remember that a good many of the inventions and developments of British broadcasting in recent years have been due to Captain West. For instance, the echo room, experiments in eliminating fading, and relays from America are a few of the successes which stand to his credit.

Capt. West's New Post

We feel sure that all our readers will join in wishing Captain West great success in his new post, but at the same time regretting that the

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OUR NEWS BULLETIN

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B.B.C. should lose such a fine engineer.

We understand, however, that Captain West will still be able to place his experience and knowledge at the service of the B.B.C. in the capacity of Adviser on Acoustics.

School Wireless

Educational authorities are likely to be asked in the near future to undertake a further extension of the scheme of instruction in schools by wireless. It seems to be an opinion expressed rather widely that broadcast lessons should now be given a recognised place in school programmes. This move is to be made by the Central Council for School Broadcasting, a committee which was set up as a co-ordinate body by the B.B.C. and educational authorities throughout Great Britain and Ireland.

The Instalment Plan

Broadcast lessons were first introduced into schools in 1923, and it is stated that now more than 5,000 listening-in schools exist in the country.

In one school a wireless set was built and erected as the result of a collection made by the children out of school hours. Parts were purchased week by week with the pennies collected and the set was built by the children.

RADIOGRAMOPHONICS

—*continued from page* 100

radio reception in order to ensure a really smooth control of reaction. With the same voltage in use for gramophone work the valve would be overloaded, and no matter how carefully the rest of the set was designed for distortionless amplification, poor results would be obtained.

The question of grid bias and H.T. applies just the same whether an adaptor is used or not. If switching is employed, there is no reason why the change of H.T. voltage should not be made by means of the switch.

When a pick-up is to be connected directly into the circuit of a receiver, either by means of a switch, jack, or by actual soldered connections, if radio reception is not required it is not always clear where to join the leads. If the detector valve is to be utilised, and this is desirable unless small volume only is required, the leads have to go across the grid and negative filament contacts.

Grid Connections

It is also necessary to break the circuit from grid to filament via the grid leak and condenser, and tuning coil. The best way to do this, whether the grid leak is across the grid condenser or runs straight to the filament, is merely to remove it, although actually when it is not used in the parallel position it will have very little, if any, effect on the strength of the music.

The points covered by this article may seem very elementary to some readers. It must be remembered, however, that there are always beginners, and a sound knowledge of the fundamental points of a subject is the best guarantor of good results.

THE "CHAMPION" THREE

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simplified very effectively in this way. The layout is the result of a good deal of experimental work, and I would suggest that it be adhered to as closely as possible if the remarkable results which the set is capable of giving are to be obtained.

In the list of components the actual makes of parts used in the set are printed in brackets immediately following each item, and suitable alternatives which can be recommended are also given. Any good first-class low-frequency transformer can be used, but it is essential that a special pentode output transformer be incorporated.

Output Transformer

The output transformers designed for use with ordinary valves *will not do*. I do not say that you will not be able to get loud-speaker results with an ordinary output transformer, but the excellent quality which the pentode is capable of giving is unobtainable without a specially designed output transformer.

To check up whether your particular choice of variable condenser can be fitted in the actual layout, the best plan is to screw the panel brackets in place on the baseboard and temporarily to attach the vertical screen in the position shown on the layout chart. Now mark on the back of the panel the position of the centre spindles of the variable condensers and reaction condenser, and with the panel propped in position against the brackets (you may as well secure the panel temporarily in place to save a lot of bother), hold the spindles against the marked points and see whether the plates clear in all positions.

A Wiring Tip

If with the particular makes you have chosen there is any fouling, then shift the position of the screen slightly and make new markings for the spindles. Remember that in order to keep a symmetrical layout the position of the reaction condenser spindle must come exactly half-way between the centres of the two tuning condensers.

When these vital points are decided, attachment of the remaining components is very simple and you can proceed with the wiring-up quite comfortably. Do not forget the additional insulation for the wires passing through the slots in the screen. A single length of large-size Systoflex will be more than enough for this job and you will have some over for further sets.

This Systoflex tubing must be large enough to slide over the particular kind of wire you are using for wiring up. Use a No. 16 gauge insulated wire for preference, as this enables the leads to be bent to shape and to hold their shape with good appearance. Soldering lugs will be found more easy to use than bending the wire under terminals, for while it is simple to bend a loop at one end of the wire and to solder the other, the making of two loops accurately is by no means easy, as you will understand if you try it! Soldering lugs screwed under the terminals and a good hot soldering iron help more than anything to make a neat-looking joint.

Loud-Speaker Connections

On examining the output transformer it will be found that on the output side there are four terminals representing the ends of two separate windings. When these windings are joined in series (by joining the I on

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THE "CHAMPION" THREE

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one side to the O on the other, and connecting the loud-speaker terminals to the remaining pair), this will be found to suit most speakers. When the two windings are in parallel (two I's and two O's joined together), better results will be obtained with certain types of speaker.

A Simple Comparison

The series arrangement will be found to suit the average speaker, and the parallel the moving-coil speakers, the Amplion Lion, and one or two others. In any case, it is a very simple matter to compare results with the two arrangements. For neatness twisted flexible wire is used to connect the output transformer to the two loud-speaker terminals. Of course, stiff wire can be used, but flexible wire makes it much easier to change the terminal arrangements when desired.

The choice of valves is important if the very best results are to be obtained. There is no question that the four- and six-volt pentodes and screened-grid valves are superior to the two-volt varieties.

In cases where the economy of two-volt supply is important, then naturally the reader will choose two-volt valves; but where the choice is open to him I suggest that he uses either the four- or the six-volt variety. There is, however, very little difference between the four- and the six-volt types, or at least far less difference than between the twos and the fours, and therefore on general grounds the four-volt will be found very satisfactory. As a detector valve, one of the H.F. types, or one of the valves specially designed for detection, should be used.

Pentode's Grid Bias

The values of resistance given will be found generally satisfactory, assuming that a high-tension supply of 120 to 150 volts is used. Lower than 120 is not recommended, or higher than 150, with the particular arrangements shown.

The grid bias on the pentode should be at least the figure given by the manufacturers for the high-tension voltage adopted, and in common with a number of other experimenters I have found it a slight advantage to use two or three volts *more* than recommended. This effects some appreciable economy in high-tension

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THE "CHAMPION" THREE

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consumption without any noticeable reduction in efficiency.

In view of the fact that the set is self-neutralised there are no tiresome preliminary adjustments to be made.

The aerial connection should be placed on terminal 3 of the first six-pin base. There will be no difficulty in picking up stations, and you will probably find a good number before you even try the reaction. The reaction control will be found very smooth and will add considerably to the strength of distant stations.

Sharpness and Sensitivity

It is not often that one comes across a set which gives the same thrill as the "Champion" Three when first tried. The amazing sensitivity and the comparative sharpness of tuning reminding one more of a super-heterodyne than anything else. In fact, when I first sat down to try out the finished model on the evening before Good Friday I began to jot down the dial settings.

On this Thursday evening and on the following evening (Good Friday) I identified with certainty 40 stations on the loud speaker, the dial readings being given in the accompanying list. A number of others were heard but could not be identified.

The readings on the lower end of the scale are likely to be somewhat different on each aerial, whereas on the second dial they should be approximately the same on all aerials provided the same type of variable condenser and binocular coil is used. If at any point the tuning on the first dial seems to be particularly flat, this can be immediately remedied by changing on to the other aerial tap.

This remark incidentally applies to any receiver with a tapped aerial coil. No series condenser has been included in the aerial of this receiver, as tuning was found to be sharp enough with this omitted.

The Best 3-Valver

High-tension consumption of this receiver when used with 120 volts H.T., and with 3 volts more grid bias than recommended by the valve makers (4-volt valves used throughout), works out at 20 milliamperes, and care should be taken that adequate high-tension supply is available.

The "Champion" Three certainly represents the best that has yet been done with three valves in WIRELESS CONSTRUCTOR designs.

THE P.M.G. AND TELEVISION

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begin, these listeners will do so at their own risk.

It is pretty clear from the foregoing what the Postmaster-General thinks of television to-day, and it is pretty clear, despite the rumours that have been spread about that certain interests are trying to crab television, that every possible facility will be given to the Baird people to do what they can to prove that their system warrants inclusion in the B.B.C. programmes and, in due course, to prove itself worthy as an auxiliary to ordinary broadcasting.

Two Wave-Lengths Required

It must be borne in mind that if television does reach the stage which would warrant its inclusion in the programmes, it will be necessary to have two wave-lengths for each station —a wave-length for the broadcasting of television and a wave-length for the speech auxiliary. Here again interesting possibilities are opened up with regard to the future of British broadcasting in this country.

According to the plans for the present Regional Scheme, no such facilities are taken into account. Consequently a rumour got around a few days ago that the B.B.C. had more or less scrapped the idea of proceeding with the Regional Scheme, that only the Potter's Bar station would be built, and that the others would now be abandoned.

Rumour Quite Unfounded

This rumour was also based on the idea, quite apart from television, that the practice recently inaugurated of working six relay stations on one common wave-length had proved so satisfactory that the B.B.C. had another plan, based on the idea of working all its stations on one common wave-length. However, although this rumour obtained a good deal of publicity, we are informed on an excellent authority—no other than that of the B.B.C. itself—that there is no truth in this rumour and that the Regional Scheme is being proceeded with.

That is about all one can say at the moment regarding the television situation. We can only offer our congratulations to the Baird Company on the success of their endeavours to obtain the necessary facilities, and to wish them good luck during the next twelve months and success with their scheme.

CHATS AT THE WORK-TABLE

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Radio Furniture

The man who has not a wireless room of his very own is often rather handicapped in his experimental work, since there is liable to be a certain amount of opposition from other members of the household to the presence in sitting-room or drawing-room of something reminiscent of the kitchen table, festooned with wires and covered with a heap of dust-collecting gadgets.

A Wireless Table

I have recently provided myself with a wireless table which is so satisfactory to all concerned that possibly a description of it may be found useful by readers. The foundation is a dinner wagon of the kind shown in Fig. 3, in dark fumed oak, provided with rubber-tyred wheels about 3 in. in diameter. Since the overall measurements of the top are 30 by 18 in., it provides ample room for even the largest wireless sets, and the shelf below is extremely handy for holding other gear.

My own batteries rest on the floor underneath the table, where they are out of sight. If, however, they are not of very heavy weight they might be placed on the shelf in question, though in such cases I would recommend that a little strengthening should be done by means of angle brackets. In experimental work or otherwise it is of the greatest advantage to be able to make connections quickly, and a means of enabling this to be done was devised and will be described in a moment.

An Instrument Dashboard

Further, a kind of dashboard was fixed to the front of the table to support such instruments as are generally needed, as well as a high-tension fuse panel and another small panel fitted with sockets, which enables the loud-speaker telephones or Fultograph to be plugged in as required.

The simple details required for making the dashboard are given in Fig. 4. It will be found that the slope provided sets the instruments at just the right angle for seeing a reading when one is sitting at the table. Those that I actually use are a milliammeter connected into the common high-tension negative lead

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CHATS AT THE WORK-TABLE

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and an ammeter connected into the corresponding low-tension lead.

With these one really knows almost everything that one needs to know about the set and batteries. The normal H.T. current for any particular combination of valves is known as well as the L.T. consumption. If signal strength declines, a low reading of the milliammeter accompanied by a normal reading of the ammeter shows that the high-tension battery is running down; a low reading of both instruments indicates that the accumulator will do well to visit the charging station.

Useful Trouble Tracker

In this position the milliammeter is also an invaluable tracker down of trouble in almost any part of the set, and methods of using it for this purpose have already been described in the WIRELESS CONSTRUCTOR. Naturally, the individual constructor will arrange the dashboard and its gadgets to suit his own requirements. Fig. 5 shows it mounted upon the table.

Screws secure the bevelled-off top edge to the top of the table, whilst the triangular end-pieces are fixed to the tops of the legs either by plain brass strips or by small angle brackets. The dashboard seen in Fig. 5 is so arranged that all the connections to the receiving set, H.T. + 1, H.T. + 2, H.T. + 3, H.T. —, L.T. +, and L.T. —, are taken to a six-point socket fixed to the right-hand triangular end-piece.

A six-point plug provided with the same number of flexible leads makes the connection between this socket and the terminals of the receiving set. One can thus switch everything off simply by pulling out the plug.

The Small Panel

Fig. 6 shows the dashboard connections semi-diagrammatically. It will be seen that L.T. + goes straight to the appropriate terminal of the accumulator from the socket of the six-point plug, whilst L.T. — is taken to the battery through the ammeter. H.T. — is led through the milliammeter and the fuse lamp to the battery, whilst the remaining H.T. leads go to appropriate sockets of the battery via flashlamp fuses.

The small panel containing the connecting points for the loud speaker and so on has three pairs of sockets all wired in parallel.

BAIRD'S TELEVISION PATENTS

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"sight" record or track on a suitable disc.

The shape of the track obviously corresponds to the fluctuating output from the light-sensitive cell, and by using such a record to control a televisor receiving set the original picture can be repeated as often as desired.

An ordinary "sound" track can be impressed simultaneously with the "light track" upon the same record, and in this way it is claimed that both a visual and audible reproduction can be secured, say of a famous statesman in the act of delivering a speech.

Patent No. 292,185, *granted to Television, Ltd., and Mr. J. L. Baird.*

As an alternative to the use of infra-red rays for exploring the scene to be televised, electro-magnetic energy or ether waves of a wave-length somewhat longer than radiant heat, but very much smaller than anything at present used for wireless communication, is the next suggestion to be brought forward.

A Light Valve

It is not stated how the ultra-short ether waves are to be produced except that the generator may consist of two metal spheres across which a spark-discharge is set up.

In Fig. 3 the object to be televised is again shown as a cross.

Patent No. 291,634, *granted to Mr. J. L. Baird.*

This describes a form of light valve or trap, which is suitable for use either in television or for signalling by a "photophone," where the variation of a light-ray is used to produce an audible signal, and vice versa.

Two relatively-movable plates, marked A and B in Fig. 4, are ruled with grating-lines spaced anything from one-fiftieth to one five-hundredth of an inch apart. The plate A is fixed in position by a three-point mounting, so that the relative inclination of the two sets of gratings can be adjusted to any desired angle.

The plate B is supported by a rod R fixed to the diaphragm of a telephone receiver, so that as the latter vibrates under the action of speech waves, the opaque grating lines move closer together or farther apart, and so permit the passage of less or more light from a lamp or other source of illumination. As applied to a television system, the grating lines are ruled, as shown in Fig. 5.

KING'S COLLEGE CENTENARY

THE Centenary of King's College, London, draws attention to the history of an institution that is as modest in its position in the Strand as in making its needs known to the world. One of the oldest colleges in London, it has had to struggle consistently against financial difficulty, while its teaching has been as advanced as in those universities where an endowment capital is assured. To-day there are twice as many students as before the war, and because the authorities are almost entirely dependent upon a fluctuating fee income, there is no surplus either to provide endowments or additional accommodation.

Notable Discoveries

Some of the discoveries, inventions and investigations made in the laboratories of the college during the last hundred years are : electric telegraph, Prof. Sir Charles Wheatstone, F.R.S., and W. F. Cooke ; invention of Daniell cell, J. F. Daniell, F.R.S. ; discovery of existence of electro-magnetic waves, Prof. James Clerk Maxwell, F.R.S. ; quantitive basis of the design of the filament of the thermionic valve, Prof. O. W. Richardson, F.R.S. ; investigations on wave form of atmospherics and the effects of thunderstorms on radio-telegraph receivers, measurements of the height and investigations on the influence of the Heaviside Layer in causing signal fading, Prof. E. V. Appleton, F.R.S. ; properties of selenium now utilised in selenium cells, Prof. W. Gryll-Adams, F.R.S.; invention of continuous - current dynamo and invention of shunt-wound dynamo.

The attention of our readers is drawn to the special arrangements

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KING'S COLLEGE CENTENARY

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which are being made to secure endowments of £50,000 for the Chair of Physics, now occupied by Prof. E. V. Appleton, F.R.S., and the Chair of Electrical Engineering which, since the untimely death of Prof. J. Hopkinson, F.R.S., in 1898, has been held by Prof. Ernest Wilson, Wh.Sch.

Discoveries and inventions which have been made in the laboratories of the college, the promise of new developments contained in the original investigations which are now being carried on, and the continuous supply of personnel trained in these two departments, are of immense value to the electrical and allied industries, and it is hoped that the firms to whose benefit the College contributes in so many ways will generously support the ambition to place the two chairs in the position of dignity and financial security which their importance deserves.

Modern Essentials

The Engineering Department was founded in 1838 and now forms a separate faculty of the college, comprising departments of electrical engineering, civil engineering and mechanical engineering, each under a professor.

The college needs £350,000, not only to establish Chairs in the various Faculties, but to improve the buildings which may have the dignity of a century upon them, but are certainly lacking in modern essentials. It is not a large sum in proportion to the wealth and means in industry, and King's College feels justified in appealing to the unfailing generosity of our readers.

LOUD-SPEAKER AND GRAMOPHONE EQUIPMENT

I HAVE just been perusing a book on the above subject by the B.T.H. people, specialists in sound reproduction. In it is described one of the most comprehensive ranges of sound reproducing devices ever issued. As evidence of the success of this firm's products it is interesting to note that the B.T.H. C2 loud speaker has proved one of the most popular ever placed on the market, the sales already exceeding 112,000. This is a remarkable figure for a horn type loud speaker, and the makers claim that it will give reproduction and a volume of sound which is a revelation to any listener.

The R.K. Speaker

Details of the famous B.T.H. R.K. loud speaker are particularly interesting. There are several models, for so great was the success of the original venture that the B.T.H. firm were compelled to extend their programme and place upon the market the junior R.K. equipment, which can be sold either as a whole or in sections. An interesting point mentioned is that purchasers of the separate R.K. loud-speaker unit should appreciate that for the really satisfactory operation of all moving-coil loud speakers (no matter whether B.T.H. R.K., or other kinds), a large power amplifier employing one or two super-power valves is a necessity.

The book is profusely illustrated, and there are some very interesting diagrams, particularly those showing the complete circuit diagrams of the junior R.K. equipment and of the electric radio-gramophone equipment. Full details of prices, etc., are given so that not only the ordinary music lover is catered for, but the proprietors of cinemas, theatres, cafés, showrooms, etc., who wish to provide their patrons with high-class music are invited to apply to the B.T.H. Company for particulars of apparatus suitable. (The address is: The British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2.)

A. N.

THE L.T. "STEDIPOWER" IN ACTION

"Having been laid-up for a few weeks I have not yet got the 2-amp. model L.T. 'Stedipower' in operation, but the 1-amp. model has been running for about six months over six hours daily and functioned satisfactorily. It is only by looking backward that one realises the trouble and expense that the 'Stedipower' has cut out."

Extract from an Ashton-on-Ribble reader's letter.

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R/R

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The results obtained from 'Met-Vick' Skeleton Resistance Units cannot be improved upon, even by using expensive wire-wound resistances. The values of the components have been carefully calculated to give maximum amplification per stage, and as moulded resistances and leaks are used, their values are retained indefinitely and they are noiseless in operation.

For Mains or Battery operation all one price.
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The 'Met-Vick' Elastic Aerial Unit enables you, in effect, to vary your aerial backwards and forwards to any required length from maximum to zero. It is as though you had a thousand aerials at your command, and gives utmost selectivity combined with signal strength for any station. Prices from 12/6 to 17/- according to type of set.

Ask your dealer for Section 'D' of Radio Catalogue which fully describes these components.

MET-VICK Components, Valves and Sets

Metro-Vick Supplies, 155, Charing Cross Road, London, W.C.2

(Proprietors: Associated Electrical Industries Ltd.)

RP
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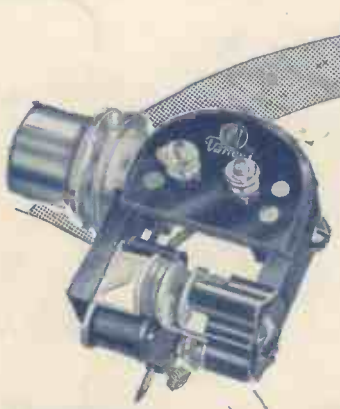
The Truth about Gramophone Electrical Reproduction



COMPOUND MASS SUSPENSION GRAMOPHONE PICK-UP
£3:3:0

GRAMOPHONE AUTOMATIC PICK-UP ARM
£1:15:0

BI-DUPLEX WIRE-WOUND RESISTANCE CAPACITY COUPLER

Type A	**£1**
Type C	**17/6**
Type D	**16/-**

ANTI-MOBO
9/6

IT would be difficult to find a greater source of real enjoyment than good Gramophone Electrical Reproduction. It is realism itself, so truly does it reproduce music, song and speech alike. You can command the best music, the highest paid artists, and you are not at the mercy of bad programmes.

Such was the popularity of Gramophone Electrical Reproduction, that in response to the rapidly growing demand, hastily executed designs failed to give satisfaction and resulted in obscuring its real beauty.

Not so in the case of R.I. & Varley. Every component in our Gramophone Amplifier is the outcome of months of intensive research, and one and all combine to make **good electrical reproduction worthy of good electrical recording.** If you prefer it, we can help you to build your own Amplifier with components famous not only in the British Isles but in many parts of the Globe.

Our Compound Mass Suspension Pick-up and Automatic Pick-up Arm add the final touch of perfection to Gramophone Electrical Reproduction.

Sections A and C of our Catalogue (free on application) give full particulars of these products.

VOLUME CONTROL
6/6

BI-DUPLEX WIRE-WOUND ANODE RESISTANCES
Prices, complete with Universal Holder
5/6 to 17/6

THE MARK OF BETTER R.I. AND Varley **RADIO**

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