Simpson

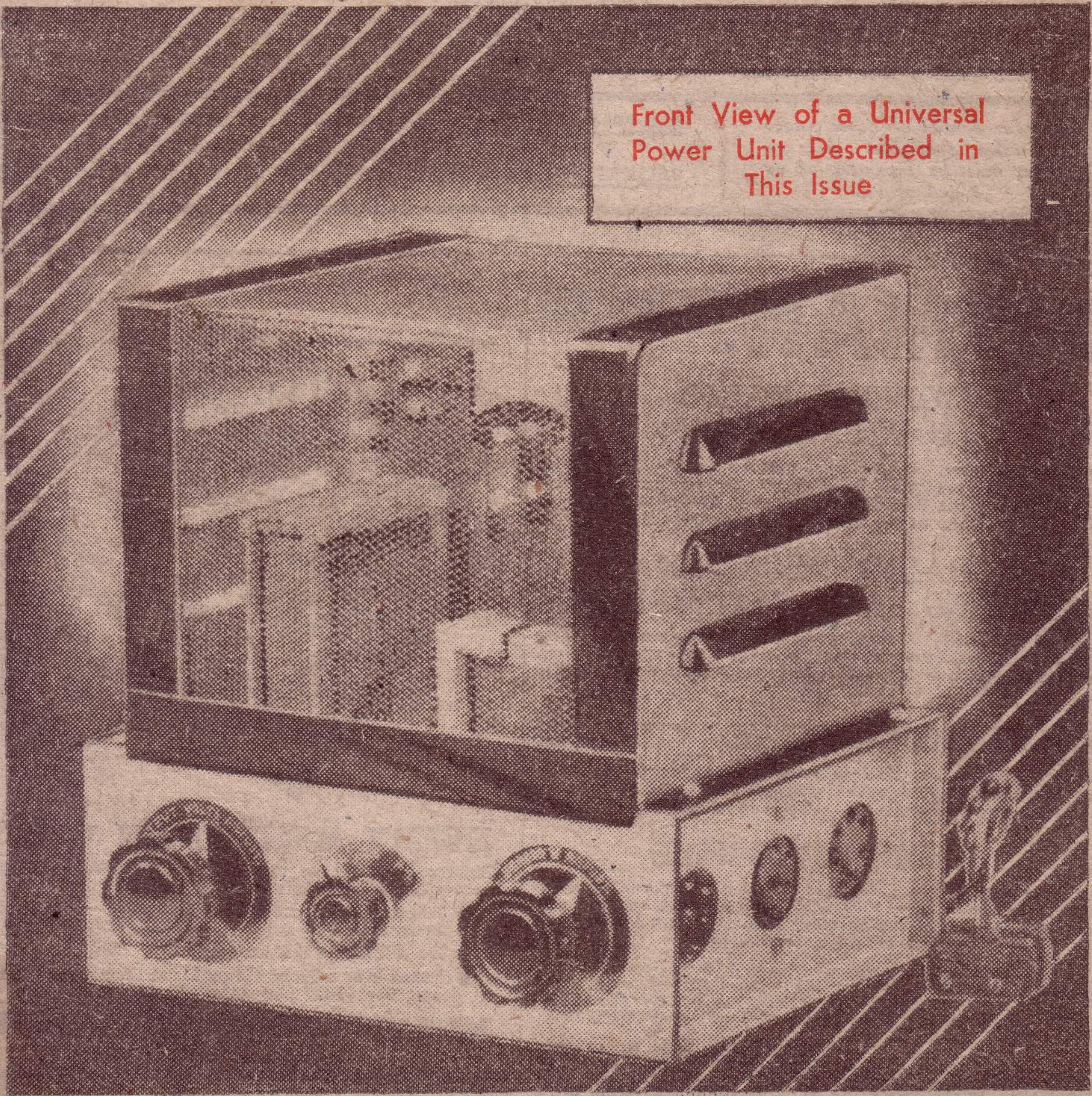
AN ALL-WAVE THREE-VALVER

Practical Wireless

9D EVERY MONTH

Editor F. J. CAMM

Vol. 21 No. 462 NEW SERIES DECEMBER, 1944



Front View of a Universal Power Unit Described in This Issue

Practical Wireless

and PRACTICAL TELEVISION

13th YEAR OF ISSUE

EVERY MONTH.
Vol. XXI. No. 462 DECEMBER, 1944.

Editor F. J. CAMM

Comments of the Month

By F. J. C.

Post-war International Policy

AN indication of the thoughts of America on the question of post-war broadcasting from a political standpoint are made clear in a statement by Elmer Davis, Director of the U.S. Office of War Information, and Mr. Nelson Rockefeller, co-ordinator of Inter-American Affairs, in speeches which they made at a meeting of the U.S. Federal Communications Commission.

They urged that additional facilities be provided to enable the U.S. to make *virtually unlimited international short-wave broadcasts after the war.* Mr. Davis said that their national interests will be served by a much wider dissemination of American news throughout the world than was known before the war.

There will be times "when the Government will find it to the national interest that our leaders should be able to address directly anyone in the world."

The Federal Communications Commission held hearings preparatory to a general reallocation of broadcasting space in the radio spectrum. Results of the hearings have been reported to the U.S. State Department, which is planning an international radio conference next spring.

Also appearing at the hearing was Mr. Paul W. Kesten, Executive Vice-President of the Columbia Broadcasting System, who advocated a revolutionary change in U.S. broadcasting. He proposed a nation-wide system of frequency modulation permitting ten major networks, and up to 5,000 stations.

Frequency Modulation

MR. KESTEN who also endorsed continuation of international broadcasting, pointed out that his proposal to establish frequency modulation as the nation's chief method of transmission would assure stations equal power and comparable wavelength.

He said that such an arrangement would result in the most democratic licensing of broadcasting facilities ever provided.

Frequency modulation permits virtually static free reception and reduces interference from other stations to a minimum. Under frequency modulation individual stations should have considerably reduced range which in most instances would be confined to their immediate surrounding area.

Mr. Kesten called international broadcasting "the greatest single instrument created by man for developing international goodwill—goodwill that comes back to us from the hearts of the common people, and not merely from the lips of the statesmen of foreign countries."

Mr. Kesten added, "If we close the door on international broadcasting, we close doors to men's minds in a hundred countries of the world."

There can be no doubt that after the war considerable developments will take place in frequency modulation. We are not behind any other country in broadcasting technique, and it is time that the Government announced, as America has done, its post-war broadcasting policy. It has not yet done so, and the radio trade is hampered by the further disadvantage that it does not know what the policy of the Government will be in relation to post-war industry. Will the Government issue a ban on new radio businesses until older ones have recaptured the pre-war markets?

In what order of priority will particular industries be grouped? The Government has announced its plans for demobilisation, but unless some early statement is made on the post-war industrial set-up there will not be jobs to which men may return. After all, industry requires a security scheme as well as the individual.

Television

AS far as television is concerned this country has consistently led the world. In fact, it is true to say that other countries are still far behind. We have no doubt that this country intends to take its rightful place in broadcasting, as well as in industry, but, it would be encouraging to hear what has been done or what is proposed. America has laid its cards on the table, both in connection with broadcasting and industry.

"Your Post-war Receiver"

THE competition set in our issue dated October, 1944, attracted an enormous number of entries, and the judges have not yet completed their task of ascertaining, from the specifications received, what is by popular vote the set most generally required after the war. We shall, however, publish the result in our next issue.

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The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

ROUND THE WORLD OF WIRELESS

Storm Stopped Radio

IN New York recently, where a 95 m.p.h. wind swept through the city, accompanied by a torrential downpour, underground railway services were disrupted and broadcasting broke down. Many down-town streets were axle-deep in water.

The Late S. H. Rawlings

MR. S. H. RAWLINGS, well-known Joint Managing Director of The Automatic Coil Winder and Electrical Equipment Co., Ltd., passed away on September 17th at the age of 64. He had been in ndifferent health for a very long period, but his amazing reserves of energy and tenacity enabled him to make a series of recoveries and he remained at the helm until within a few days of his death. The cremation took place at Cambridge on September 20th and was attended by members of his family and a large gathering of employees and friends.

Sydney Rawlings was a great character, perhaps best summed up in the apt words of a business acquaintance, who refers to his "cheery, emphatic, dogmatic, kindly personality." He was a power and an inspiration to all who worked for and with him.

He founded the company in 1923 and was joined three years later by Mr. B. G. Donne who, with Mr. Jack Rawlings, will carry on unchanged the policy of the firm, which has proved so successful and has resulted in continued expansion culminating in a noteworthy and invaluable contribution to the war effort, the full story of which will make interesting reading when it can be revealed.

Automatic Radio-range Monitor

BY instantly warning both the flyers and ground crews of a shift or fading in any radio course, a new automatic radio-range monitor, manufactured by Islip Radio Manufacturing Corporation, represents an important improvement towards airway safety. The monitor acts if any radio course shifts as little as three degrees from its normal setting and may be adjusted to operate all warning devices with a range course shift of less than one degree.

The course monitor receiver is located directly on the radio course 1,200ft. from the radio-range station. Interlocking A and N signals transmitted by the range station are received continuously by the monitor. A shift in course is indicated by predominance of either A or N signal. If this should occur, the monitor receiver automatically transmits an electrical impulse to the airport's monitor board, which flashes a red light and sounds a siren to warn the ground crew. Simultaneously the monitor dials the range transmitter, which instantly signals a warning at the end of each A-N cycle to all pilots. The same warning is given if the link circuit relay fails to interlock the A and N signals correctly or becomes locked, if the output of the radio-range station drops below a predetermined level, or if more than one-half of the range's station identification call is not being transmitted.

New R.T.R.A. Branch

A NEW area organisation of the Radio and Television Retailers' Association, covering Hampshire and Sussex, was formed at a well-attended meeting of members of the Association recently held in Chichester. H. A. Curtis, secretary of the association, in opening the meeting, reported on the growth of the association, which accounted for the proposal to form a branch for the area. Officers were elected as follows: Chairman: R. R. Day (Bournemouth); Vice-chairman: S. Burbidge (Brighton); Hon. secretary and treasurer: E. J. Munt (Chichester).

"Appointment with Fear"

EIGHT million listeners who like to keep an "Appointment with Fear" had the opportunity again on October 5th. The feature will be continued for ten more consecutive Thursdays.

The series is again written by John Dickson Carr, master of the radio thriller, and produced by Martyn C. Webster. Between them, they can be guaranteed to make the listener's flesh creep and his hair rise on end. Despite this, his brain can be busy working out the solution, for Carr plays fair by the listener, giving him all the clues. "Appointment with Fear" aims at horrifying the listener, but it is horror divorced from real life and seldom, if ever, deals with any aspect of the war. The storyteller is once more the Man in Black, played by Valentine Dyall.

Members of the A.T.S., after being trained as radio telephone operators, take over on a searchlight site, and maintain communication between units.

The first of the new series, broadcast on October 5th, was "I Never Suspected," which starred Eric Portman and Linden Travers. It was set in a London suburban cinema, one of those large, converted theatres with stalls, circle and gallery. The chief cashier goes home, leaving the key in the safe, and returns to fetch it at 2 a.m., accompanied by her boy friend. She gives him her key to the building and he comes out a few minutes later to tell her the cinema is empty, but that the film is showing even though no one is in the projection room. Add to this the head commissionaire's body lying in the aisle, and listeners were assured of an absorbing half-hour's listening.

The second play, "The Devil's Manuscripts" (October 12th) told of an author who found a friend reading one of his ghost stories in broad daylight and challenged the gentleman to read one in a haunted house at midnight, vowing that the atmosphere of both house and story will prove overwhelming.

"Death has Four Faces," on October 19th, dealt with a man killed in the street before witnesses, yet no one comes near the victim and nobody threw the kinfe which killed him. This inexplicable happening is set against the pre-war background of a French gambling resort.

These are but three of the twelve plots tending to titillate the palates of those listeners who enjoy detective stories. All bid fair to be well up to the standard of "Appointment with Fear."

The Imaginary Village

THE village of Dylsford only exists on the air, yet it has become so real that people want to go and see it. Programmes about it have been broadcast for over a year on Wednesdays, and this typical English village is now known all over Britain.

The imaginary village of Dylsford was created because an official of the B.B.C. Schools Department was struck by the interesting experiments in local study carried out in some village schools. It seemed to him that other schools might benefit by knowing of such activities. Starting from the village school, with the boys and girls and their schoolmaster as the characters, the story develops through the Explorers' Club which they form.

It was expected that schools of the same pattern as the Dylsford one would follow the broadcasts and form their own Explorers' Clubs, but, surprisingly, town schools show considerable interest in the series because it brings the countryside into the classroom. Adults go further: they want to visit the village.

When the producer visited Edinburgh the commissionaire at Broadcasting House said to him, "Excuse me, but can you tell me where this village of Dylsford is? I had a gentleman in here the other day who said he'd searched every map of England he could lay hands on but still couldn't find it." The fact that a townsman in Scotland listened to a programme about an English village devised for rural schools showed how real the imaginary village has become.

Early broadcasts have pictured the young explorers visiting the quarry, the woods, the railway station and the nearest dairy farm and talking with the vicar, the blacksmith, the postmistress and the squire. While doing so, they have learned a great deal, not only about the history of their village but of how people live to-day.

Forthcoming broadcasts will tell of visits to the innkeeper.

The last broadcast was on July 5th. The new series, "In Dylsford and Beyond," begins on November 8th in the Home Service.

"Getting Things Done"

MANY people are inclined to look on "politics" as something remote from their everyday lives. "I'm not interested in 'politics,'" say both the housewife and worker in the factory. "I'm interested in school meals for children, better education all round, a piped water supply in the villages and a new hall for our meetings. And when the war is over we want to be sure that there is full employment for everybody."

All these are "politics," and all of them things we can help to get done. But how can we take the necessary steps? Someone reminds us that we have the vote, or can write to the papers, but General Elections are infrequent and when we write to the papers the editor too often "regrets." Most of us feel we must leave it to "them," the unknown people who get things done, or fail to get them done.

There are, however, ways and means of direct or indirect action, both by individuals and groups, and a series of 12 weekly broadcasts which began on Monday, October 2nd, will discuss many of them. Some of the broadcasts will be talks, some dramatisations of events that might happen, with a spoken commentary. In others, witnesses with appropriate qualifications will be examined by questioners.

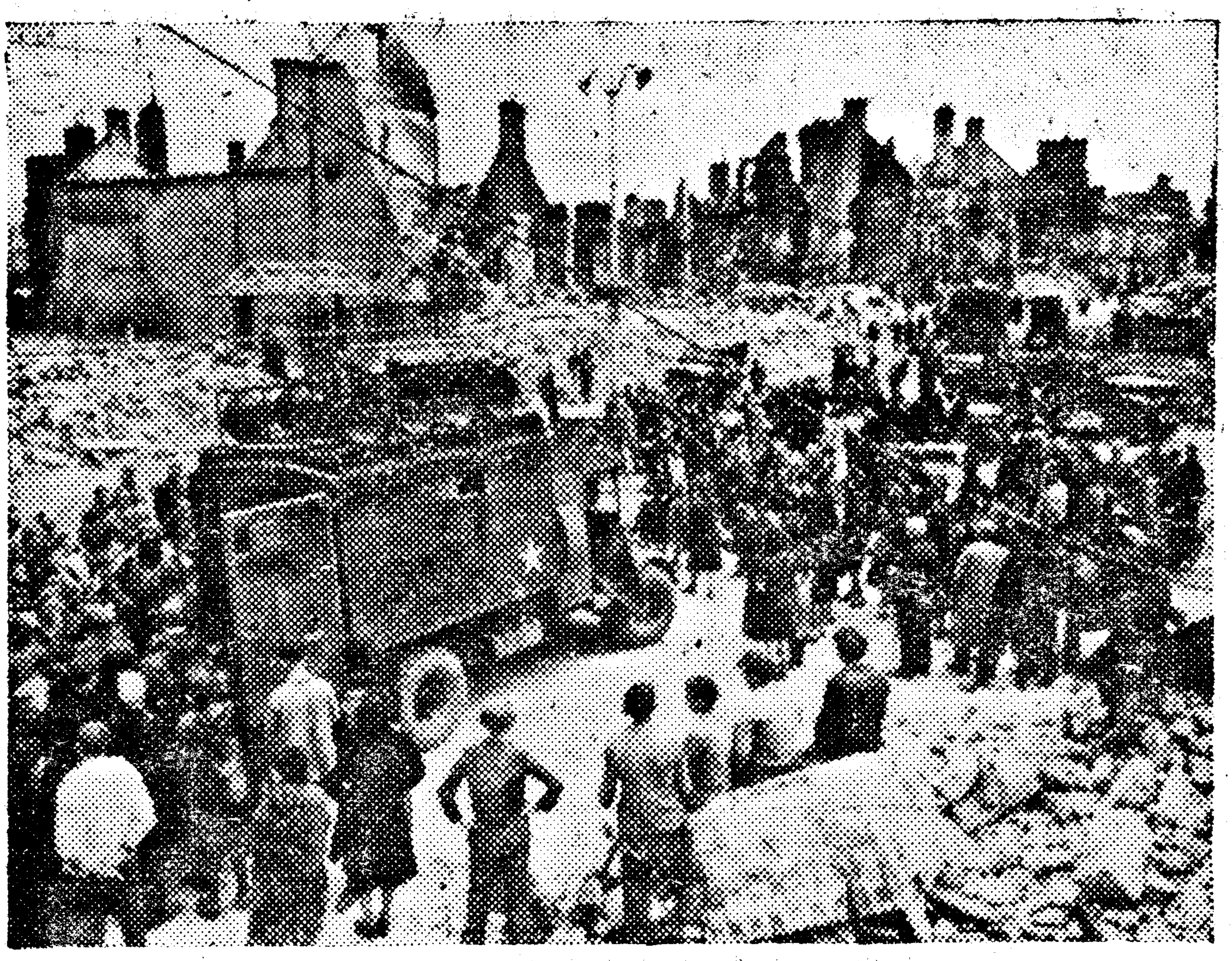
In the opening broadcast a speaker discussed the question "What Can I Do About It?" He described the way democratic action works, its difficulties and possibilities. In the next two talks questions were asked about two subjects that affect us all, the Housing Problem and the Education Bill. In the following three talks the speakers looked at the *means* of action, getting things done through local government, voluntary bodies and through political parties.

"Using the Vote"

ON November 13th the first of four talks on the way in which the elector chooses his representative will discuss "Using the Vote," and give the background to a General Election. Three more talks in this section will be on "What is Public Opinion?" "Are the People Always Right?" and "Public Opinion and Foreign Policy," or "What Can *I* Do to Prevent a Third World War?"

In the two concluding talks speakers will pick up threads that have been running through the whole series. On December 11th the important question of leaders will be dealt with in a controversial and impromptu discussion. In the last broadcast three speakers will consider the second thread. What are the dimensions of democratic actions? Is it inevitable that democracy should work slowly, or can the process be speeded up without the sacrifice of individual freedom? If so, how?

The aim of these talks is to try to solve the problem of how to make democratic government work. No one will claim that action is easy, but it is not enough merely to analyse the difficulties. What we need to know is "What can I do about it," and it is hoped these broadcasts may supply some of the answers.



A mobile loudspeaker van in the French town of Isigny announcing news from General de Gaulle.

YOUR SERVICE WORKSHOP

A Universal Power Unit

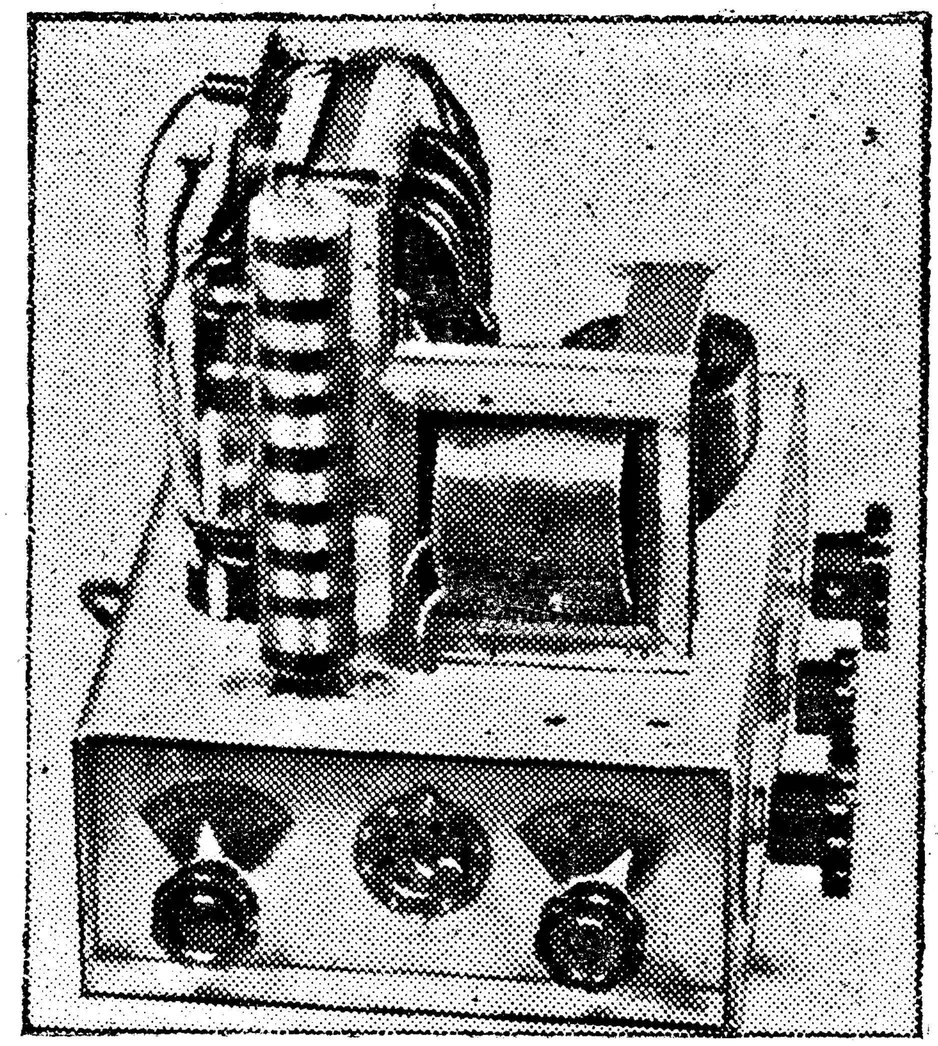
For A.C. and A.C./D.C. Operation

By STANLEY BRASIER

THIS power supply unit is universal in respect of alternating current, in that it will supply power to apparatus, whether designed for A.C. 4-volt or 6.3-volt valves or universal operation. In other words, the unit will not operate from D.C. mains because, assuming we are on A.C., there is obviously no point in it. Nevertheless, the unit can be used to power A.C./D.C. apparatus including the heater circuits.

Circuit

The circuit diagram is shown in Fig. 1, which shows that the mains transformer has, in addition to its usual 4-volt heater winding, another giving 6.3 volts. The H.T. is rectified in the usual manner and gives an output of 350 volts at 100 milliamps. Smoothing is exceptionally good and is carried out by L1 and either L2 or the field coil of a mains energised speaker, in conjunction with C1, C2 and C3. Further smoothing is possibly effected by R1 and R2 and VR1, although this is not the reason for their inclusion. They are used in order to control the voltage of the main H.T. output. This it does quite effectively over a reasonably wide range, but voltage control—when dealing with various current loads—always presents a difficulty, so one cannot expect in all cases to get the volts down to a very low figure even if it were wanted.



The completed Universal Power Unit chassis.

There is another output for screening grids which is controllable within the limits usually required. Two other H.T. outputs are fixed, one coming from the output of the first L.F. choke, and consequently at a high voltage, and another from the mains input via R4, and which is therefore unsmoothed. On the low tension side, there are three outputs. One at 4 volts C.T., one at 6.3 volt C.T. and one for universal valves. This, of course, needs to be variable according to the number and type of valves it is to supply. To this end a tapped mains dropping resistor is used in series with a low value heavy duty variable resistor. With this arrangement it is possible to obtain the exact resistance and consequently the exact voltage required.

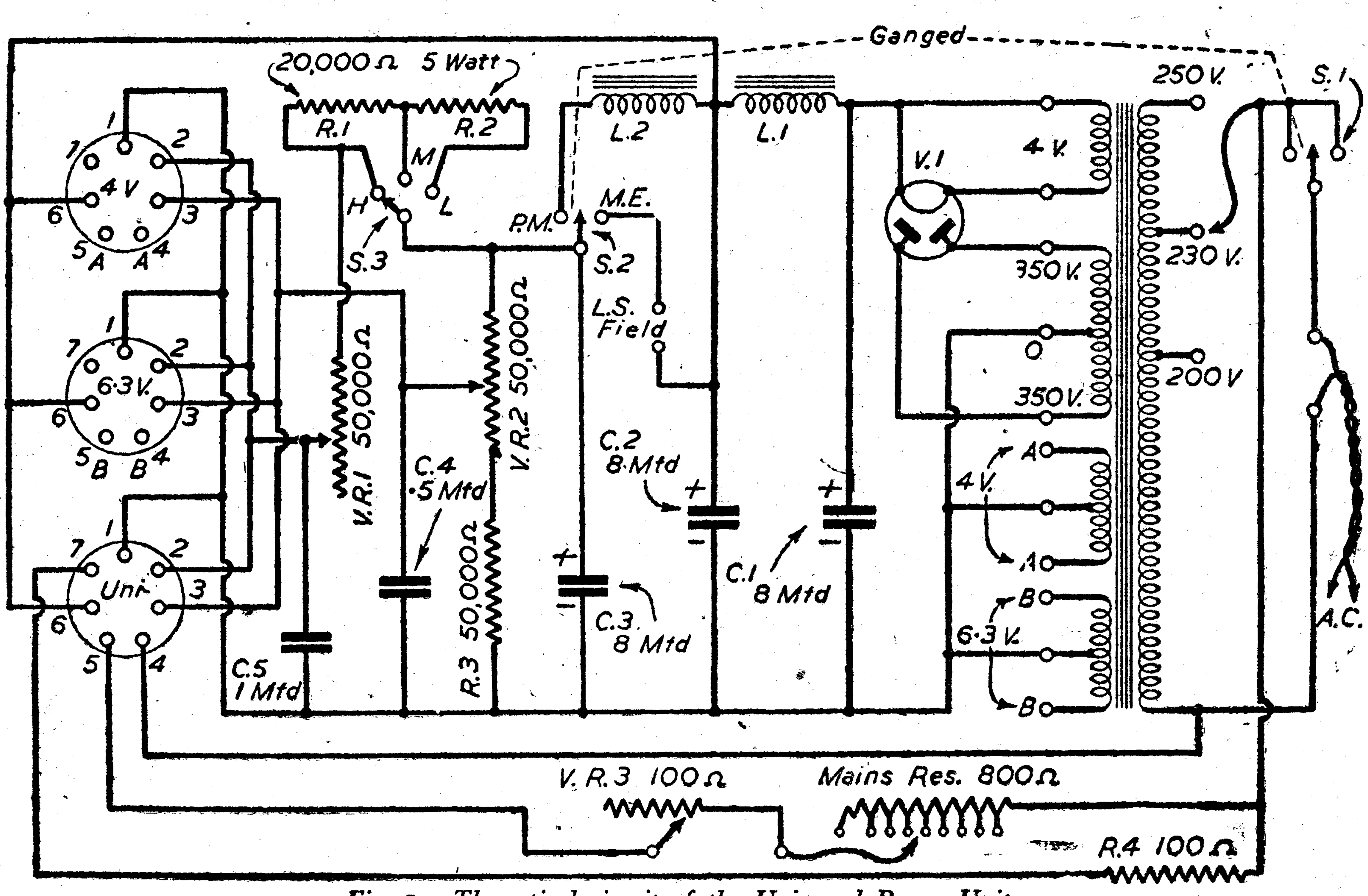


Fig. 1.—Theoretical circuit of the Universal Power Unit.

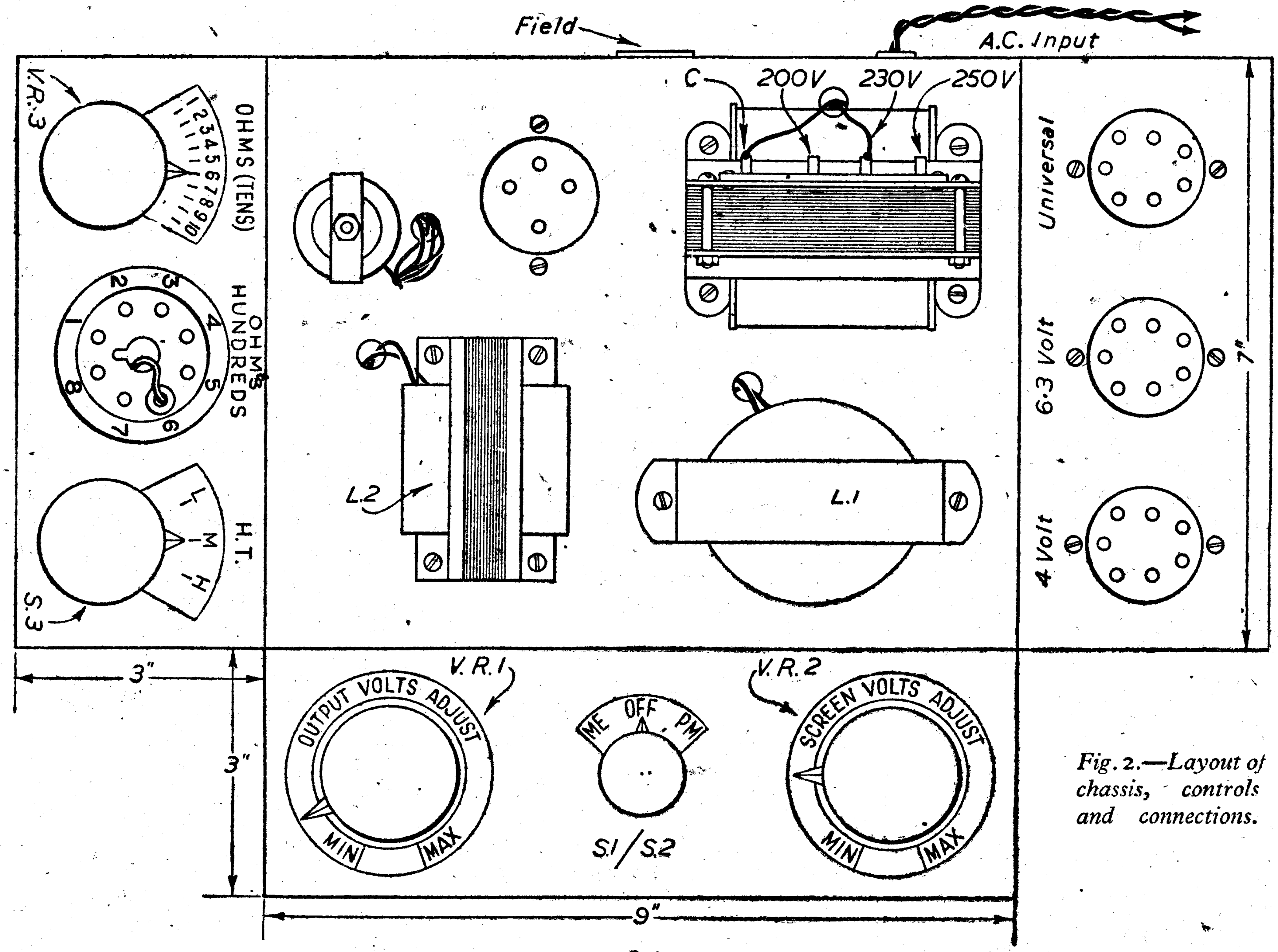


Fig. 2.—Layout of chassis, controls and connections.

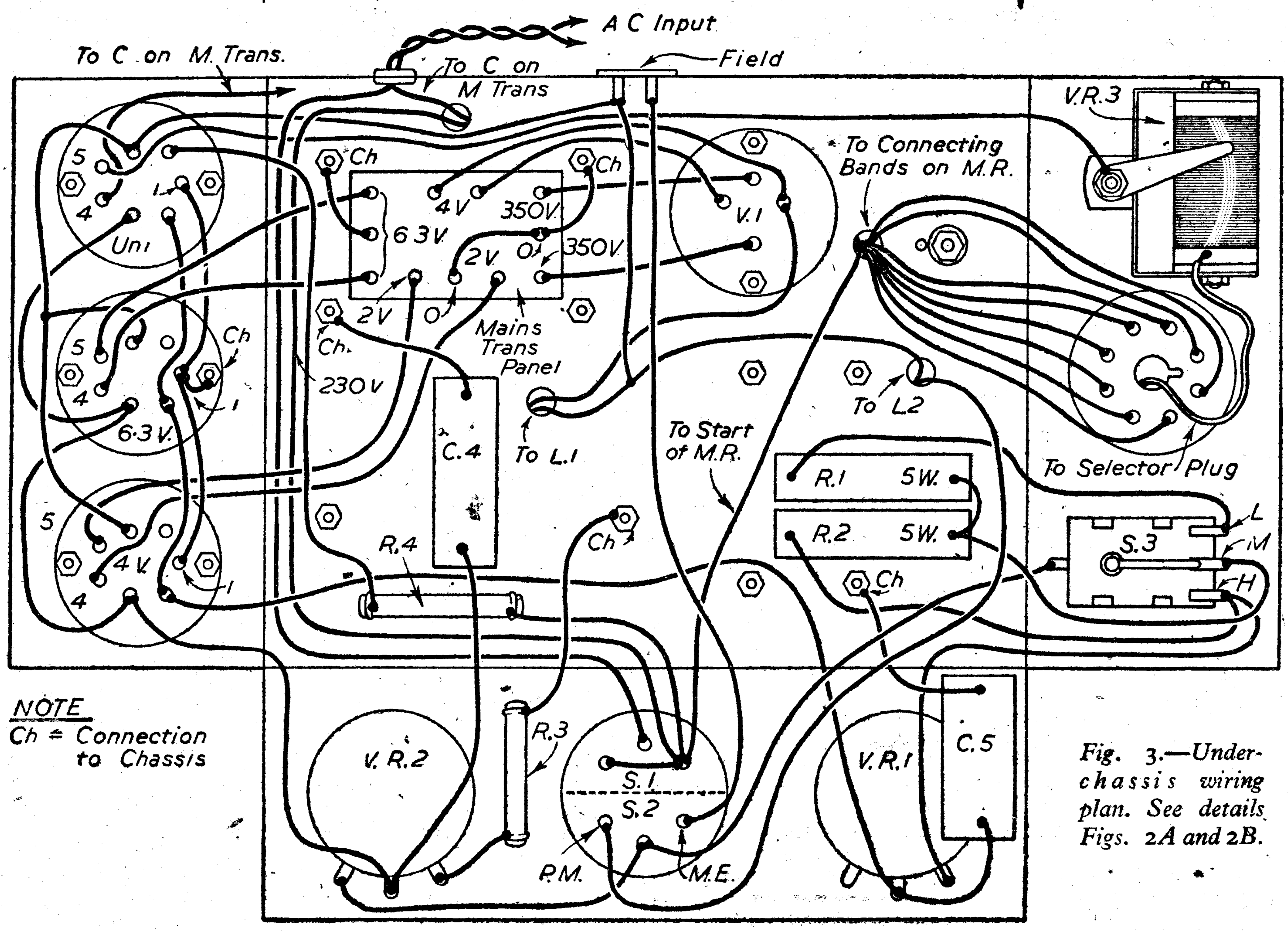


Fig. 3.—Under-chassis wiring plan. See details Figs. 2A and 2B.

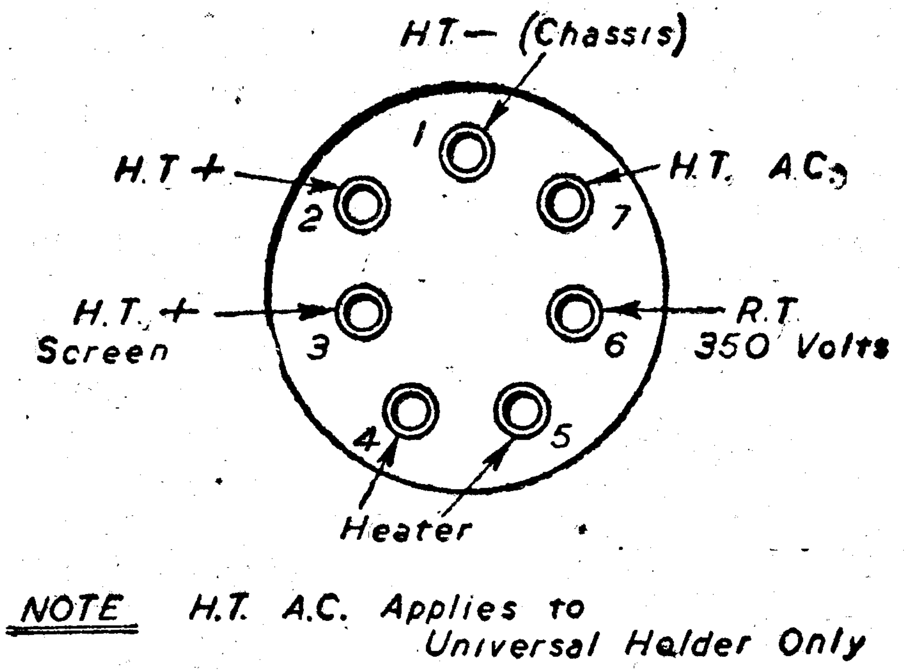


Fig. 2A.—Key to output connections. View from top of valveholders. H.T. A.C. applies to Universal holder only.

Components

Before proceeding further, it would no doubt help the prospective constructor to run through the specification of the various components. First, the mains transformer Upon the rating of this will depend the output of the complete unit. In the model shown the transformer gives outputs as follows: H.T. 350-0-350 v. at 100 m/a. L.T., 4 v. 2 a., 4 v. 4 a. C.T., and 6.3 v. at 3 a. C.T. It is possible to obtain this type through the various advertisers, although if a suitable component is on hand, but without the 6.3 v. winding, there are two methods whereby the transformer could be utilised. The first is to put on an additional winding, over the existing ones, to give 6.3 volts. This, of course, is only possible where there is room on the bobbin. The second method is to make use of another small L.T. transformer giving the required output. The primaries of both transformers would then be joined in parallel.

The rectifier V1 must be capable of dealing with the H.T. output from the mains transformer and either the directly or indirectly heated type is suitable. The L.T. choke C1 may be any good quality component having an inductance of approximately 25 henries at the maximum current given by the power supply. Resistance about 500 ohms. C2, the second choke, is one of the field replacement type, resistance 1,500-2,000 ohms. There is scope here, however, for using any reasonably high resistance choke because if it were say 1,000 ohms it is quite in order to make up the resistance to 2,000 ohms by including a resistor of 1,000 ohms (of suitable wattage) in series.

Actually, at the expense of less smoothing (when no L.S. field is in use) the choke in this position may be dispensed with altogether and a resistor entirely used in its place, so in this respect the constructor can decide for himself.

The switch S2, which provides for the use of a permanent magnet or mains energised speaker is a S.P.D.T. section of the main on/off switch S1. This is of the D.P.D.T. rotary snap action type, one section being put to the above use, the other serving to connect the mains input. So when switching on the unit, one turns it either to P.M. or M.E. as the case may be. The next switch S3 effects the inclusion or otherwise of the voltage dropping wire-wound resistors and in the model shown a Yaxley S.P. 3-way type is used.

The variable resistor VR1 presents rather a problem; its value needs to be high if it is to be of any use in varying the voltage on low current loads, yet its current-carrying capacity must, under adverse conditions, be fairly high. Unfortunately, these two conditions do not go hand in hand, so a compromise is necessary. However, in conjunction with the fixed dropping resistors controlled by S3 a value for the variable one of 50,000 ohms provides reasonably good variation. Its wattage should be as high as possible, and, most important, wire-wound. VR2 is a standard potentiometer, also wire-wound.

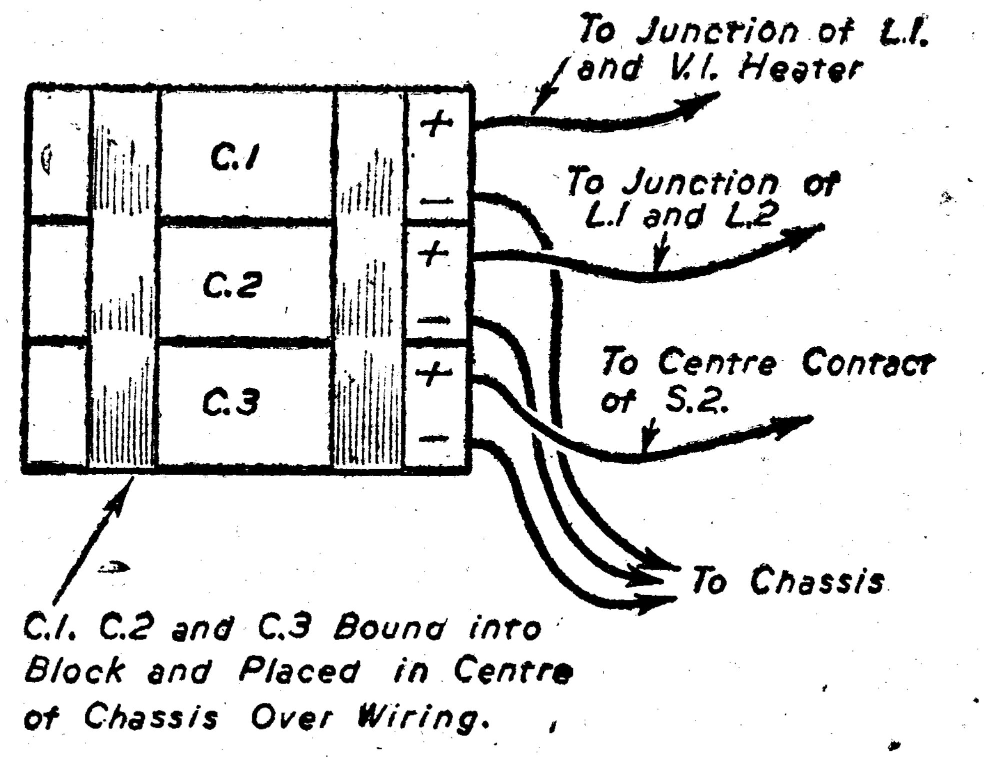


Fig. 2B.—C1, C2 and C3 are bound into block and placed in centre of chassis over wiring.

The mains dropping resistor should be designed to carry 0.3 a, and have as great a resistance as possible in order to provide for the largest variation in the heater chain voltage. In this model it is 800 ohms, and, so that the resistance may be adjusted in steps, connecting bands were fitted at every 100 ohms. The leads from these are taken to the pins of an octal valve holder, situated on the left side of the chassis, and a small plug is used as a selector.

A suitable component as represented by VR3 may be difficult to secure. It is a variable resistor of 100 ohms, which must carry 0.3 a. Very often one may find an old power rheostat in the junk box—possibly intended for controlling filament current of the old type battery valves—and this would be ideal. No such good fortune befell the writer, however, so one was made up fairly easily from odds and ends, and a suggested design is shown in Fig. 4. The former is about 2in. long by 1in.

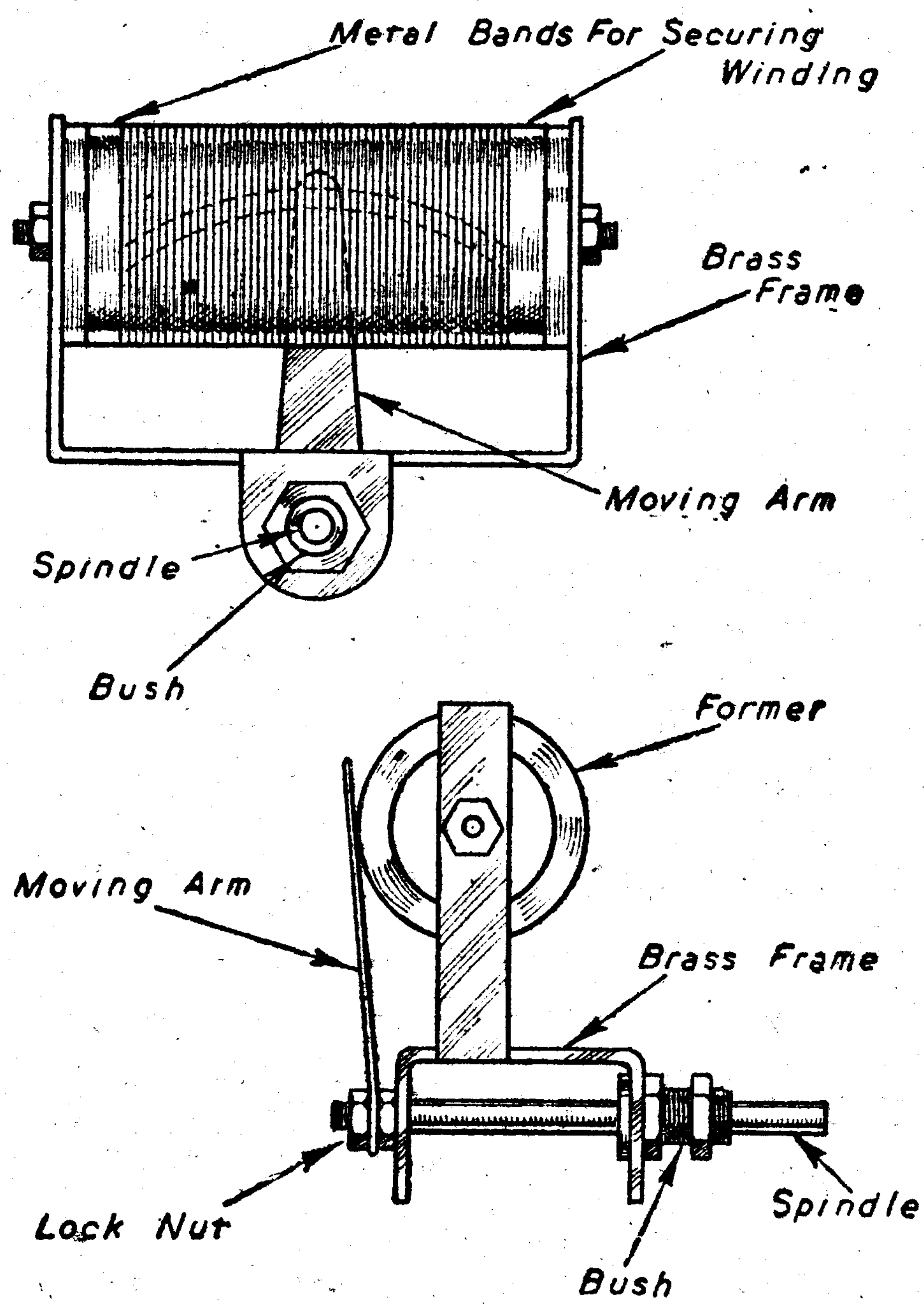


Fig. 4.—Suggested method of constructing the variable power resistor VR3.

diameter and was cut off an old mains dropping resistor former. A metal band is fitted at each end, and the former wound to 100 ohms, using suitable enamelled-covered resistance wire. A framework of stoutish brass is fitted to carry the panel mounting bush (taken from an old volume control), and the movable arm which travels arcwise over the former. A slight disadvantage is that the fixing bush is live to the arm, and must, therefore, be provided with insulating washers when fitted to the metal chassis. This point must also be given due consideration in regard to VR1, VR2, S1/2, and S3 if, in any case, the moving arm or slider is live to the spindle and fixing bush.

Although, as its name implies, this power unit may be put to any use, it was intended to be used frequently in conjunction with the push-pull amplifier described in the last article, so it has been designed to conform to it more or less in appearance. A chassis was made up

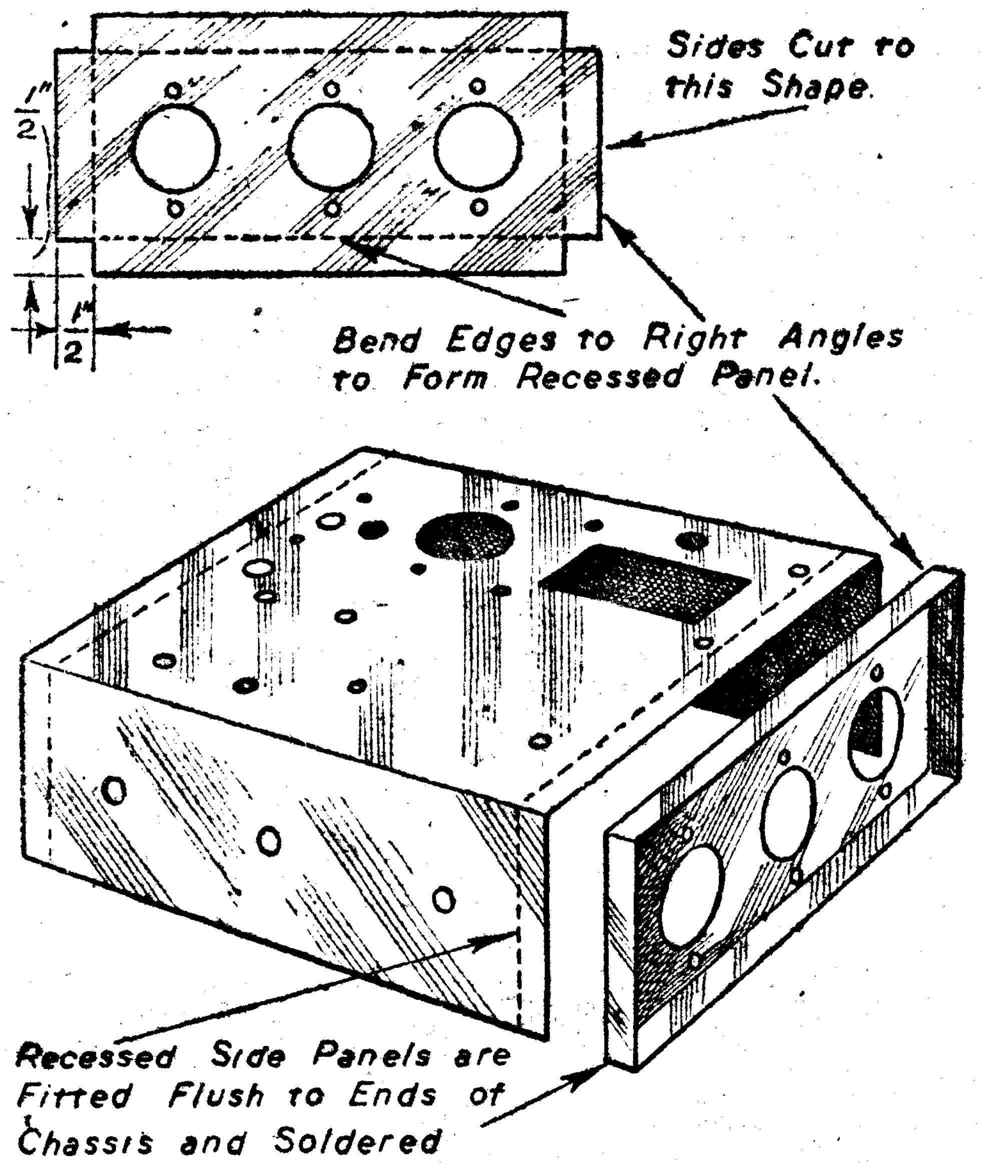


Fig. 5.—Chassis construction.

measuring 9in. × 7in. × 3in.; a fairly rigid construction is desirable, since the weight of the components is considerable. For this reason it was made in three sections, i.e., the main piece, consisting of the front, top and back, and the end sections, which, as can be seen, are recessed to the extent of about ½in. When these ends are fitted into the main chassis and soldered a very strong job results. All holes should be cut or drilled before bending the pieces, and it is as well to ascertain that VR1, mounted on the front panel, will not foul the switch S3, mounted on the side. When assembling the components, it was found convenient in the original model to leave out C1, 2 and 3, the cardboard electrolytics, until all other wiring had been finished. This is kept low down on the chassis—looking at it from the underside. The condensers are then bound into one flat block and fitted into the centre of the chassis and secured by some means most convenient. Finally, the flexible condenser connections are soldered to the appropriate points.

It will be seen from the illustration that the cover is slightly different from that made for the amplifier. The ends were made from pieces of tin plate and ventilation louvres were cut in. The front, top and back consists of perforated zinc, as before. Apart from being much stronger, this method of construction conceals the rough edges of the perforated metal, and altogether produces a neater and better-looking job.

Before putting the unit into use it is helpful if one takes the trouble to calibrate the dial plate of VR3, the variable heater resistor, and the octal valve holder, to whose sockets are joined the leads from the 800 ohm mains dropping resistor. The sockets are marked in 100's of ohms up to 800, and VR3 in 10's up to 100 ohms. Subsequently, any value to the nearest 10 ohms, or even less, may be quickly provided for without measurement.

The connections between the instrument and the apparatus with which it is to be used are quite straightforward, that is, via the appropriate valveholder. The centre one is for 6.3 v. valves, the one nearest the front for 4 v. and the remaining one for use with a universal chassis operated from A.C. mains only. The writer has made up two or three cables attached to a seven-pin valve plug which can be fitted quickly to any receiver or apparatus, only those leads which are applicable being connected. For instance, if we require to power a receiver in which there was just one main H.T. line needing 250 volts, we should not need to join up wires from pin No. 3 (screen), pin No. 6 (H.T. 350 v.) or pin No. 7 (H.T./A.C.). There are occasions, however, when connections to these will be needed. It should be noted that except for the different voltages to the heater sockets, the connections and voltages to the remaining pins on each holder are the same, for they are merely joined in parallel. The idea is so that one can just plug in to 4 v., 6.3 v. or universal, as the case may be. On the universal holder, pin No. 7 provides for an A.C. high-tension connection at mains voltage. This is useful when, say, a universal chassis has been made up including rectifier. Under these conditions the only connections between unit and chassis would be to pins No. 4 and 5 (heater chain) and pin No. 7 (H.T./A.C.) for the rectifier. Alternatively, if no rectifier were included the H.T. may be taken from the other pins.

It is essential, when using A.C./D.C. apparatus, that *no direct earth connection* is made either to the *power unit or the chassis* with which it is used. For this reason, no earthing point has been provided on the power unit and the usual precautions must be observed with regard to chassis being possibly at mains potential. When used with an A.C. chassis it may be earthed in the usual manner and this will automatically earth the power unit.

The H.T. control cannot be calibrated in volts if different loads are to be dealt with, so the simplest means of obtaining the desired voltage for any particular apparatus is to measure the output, on load, with a high-resistance meter and adjust it, if necessary, by V.R.1—S.3 being at "high." If the voltage cannot be reduced sufficiently due, for instance, to a low current load, then S3 may be turned to "medium" or "low." In general, however, unless it requires to be otherwise, it is advisable to keep it at "high."

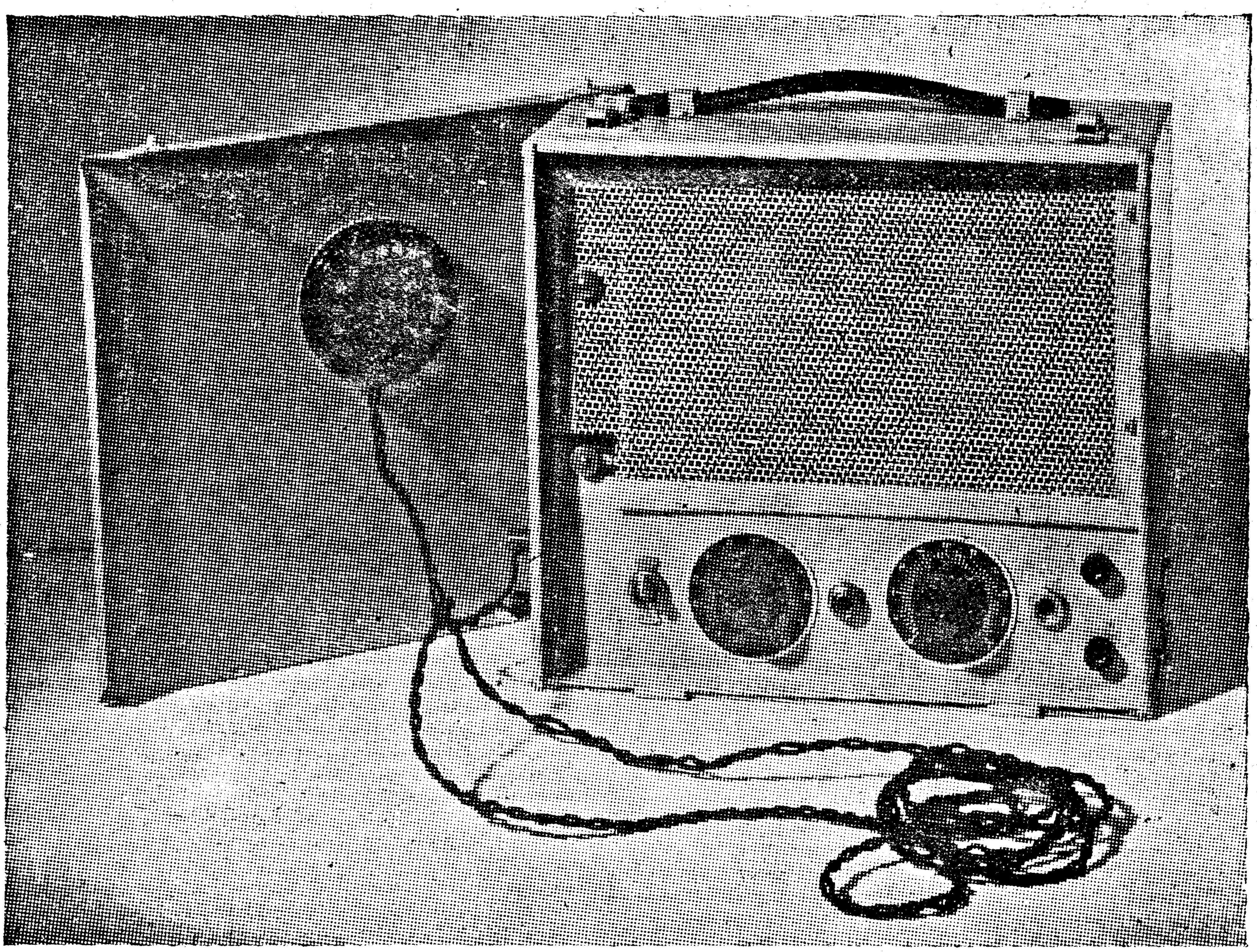
Provision has been made for a nominal field resistance of 2,000 ohms, but lower values may be compensated for by adjustment of the voltage dropping controls. The variable screen tapping is useful where, in some cases, a separate feed is desirable, but it is important that no great current be drawn from this tapping. So long as it is used for the purpose for which it is intended, no harm will result.

PREVIOUS ARTICLES

Sound Amplifying Equipment—4

Final Assembly, Testing, Power Supplies and Operation

(*Continued from page 494, November issue*)



General View of the Completed Amplifier.

ASSUMING that the completed chassis has been subjected to a thorough visual examination, and the usual elementary tests have been applied to check for continuity and short-circuits, the amplifier should be given an operational test before proceeding further with assembly work.

If a suitable mains unit is not available, the L.T. and H.T. supplies could be taken from an A.C. operated set, provided two of its valves are removed to compensate for the L.T. load imposed by the amplifier, and provided the H.T. supply is in the region of 250-300 volts.

The two specified valves, namely Cossor 41MH and 41MHL, or their equivalents, should be inserted in their respective valveholders and a pair of headphones connected to the monitoring jack, J2. With the fader set to zero, i.e., the centre of its scale, plug in a pick-up at J1 and using a record of, say, an orchestral piece, gradually turn the fader control up until the signal in the 'phones is comfortable. Make two or three checks in this manner, and listen to all instruments to determine whether response is good and free from distortion. These tests will only cover V2, therefore if all seems well with that stage, the microphone stage, V1, can be checked.

Connect this positive side of the microphone battery to the lead coming up through the top of the chassis, and, as the negative connection is made via the case, when the unit is completely assembled, a temporary connection must be made between the negative terminal on the battery and the chassis. To avoid having to remove any paint to ensure a good connection, the lead could be plugged in one of the earthed sockets of the microphone input. Connect the transverse current microphone, put the battery switch (on the left-hand side of the panel) on, and with the fader control turned full up, i.e., the maximum opposite setting to that for the P.U., operate the volume control, R1, until signals are heard.

It is not always easy to test a microphone, even if help is available, as the range of frequencies covered is likely to be very restricted. Assuming that the radio available, by which is meant the "domestic" set, is capable of giving reasonable quality, it is a good plan to place the microphone in the same room and tune the receiver to music, thus allowing the amplifier under test to operate under conditions closely approaching those which will be met in practice. If sufficient microphone cable is to hand, the above suggestion will also allow tests to be made with the amplifier remote—say in another room—from the sound source, thus giving one a chance to check up on cable effects, etc. Later, tune the receiver to a speech transmission and, if possible, wait until the announcer is heard, as this is always a good test, as most of us are thoroughly familiar with their voices, therefore any distortion should be readily detected.

With the microphone still in circuit, set the turn-table going and check up on fader, turning the "mike" volume control down gradually as the fader comes over on to the P.U. input. All these tests are suggested in the absence of suitable meters, but if frequency records and a valve-voltmeter are available, naturally they would be used instead, as one could then obtain actual figures, etc.

Fitting into Case

When, and not until then, you are perfectly satisfied that all is well with the chassis assembly and its operation, the fitting of the case can be undertaken. First see that the handle is fitted properly to the top of the case, and then clean the tags of the tongue projecting from the left-hand inside of the case, until bright metal is showing. Remove the insulated heads from the four "mike" input sockets, and also the bolts securing the supply input valveholder on the opposite end of the chassis. Opening the sides of the case slightly, drop it down over and around the chassis, the input sockets being pressed in to allow the case to come right down, then press input sockets back in position so that they now project through the case, and replace insulated heads and tighten up. Don't exert too much pressure, as some of these heads have a nasty knack of splitting or stripping their threads. Place bolts through case, chassis and supply input valve holder and bolt up. The bottom can now be placed in position and secured by the three round-headed screws, i.e., one at each side and one in the centre of the back.

The microphone battery consists of an Ever-Ready No. 126, which is fitted with terminals, and this is housed in a vertical position on the top of the left-hand side of the chassis, the positive terminal being at the bottom. Connect this to the lead provided, and the top or negative terminal to the tag of the metal tongue which is part of the bracket to which the protecting perforated zinc panel is fastened. Insert the valves, and then screw in position the panel, care being taken to make quite sure that the rectangle cut out of it to provide clearance for the positive battery terminal, is sufficient to eliminate any possibility of a short-circuit being set up.

Operators' Microphone

This is housed in the case already provided for it inside the lid of the case. It is a transverse current model, and capable of giving very satisfactory results, in spite of its small dimensions. It is sold without case, and is circular in shape 1 7/16in. in diameter × 3/8in. thick. The interior of the tin case on the lid is lined with cotton-wool: the back of the microphone inset is stuck to a piece of cardboard 7/8in. wide × 2 3/4in. in length, the ends of which are bent at right-angles, so that the strip fits into the tin case and is held in position with a spot of adhesive. Around the microphone and over the cardboard strip is placed more cotton-wool to deaden the case as much as possible. The lead consists of a 5ft. length of thin twin silk-covered flex, the free ends of which are fitted with two plugs to match up with the input sockets. When the microphone is not in use the leads are wound round the case, a rubber band placed over them keeps the coil secure.

As mentioned before, the "mike" is not intended for use as the main microphone, but solely to provide a quick and easy method of testing amplifier and line, and also to allow the operator to pass back any requests or instructions to those looking after the power amplifier, which may be some distance from the microphone and pre-amplifier sites.

When designing a power amplifier having reasonably high gain, one is concerned with the elimination of valve-hiss and hum, and, as regards the latter, so many items can be responsible for its introduction that it is hardly feasible to deal with causes and cures in detail in this article. However, we can deal with the most likely sources, and if the suggestions offered are observed much will be done towards securing the highly desirable silent background.

Operation and Hum

Faulty and/or inadequate smoothing of the H.T. supply contributes a great deal towards hum, and this is likely to be particularly so in the case of the voltage amplifying stages having a high-gain, but it can also be troublesome in the output stage if this consists of a single valve. When the output consists of two valves in push-pull the possibility is reduced as any hum ripple should cancel out. Generally speaking, suspicion should rest on the smoothing condensers, one or both of these may be faulty or their capacity too low, and the L.F. choke.

For the latter it is always advisable to use a thoroughly reliable make of component, which can be relied on to provide the required value of inductance at the H.T. current which will be passing through it. It should be remembered, that apart from the risk, particularly in a cheap component, of the winding breaking down if its current rating is exceeded, the inductance value will fall as the current is increased about the maximum for which it is designed.

In the voltage amplifying stages the trouble might be due to faulty or inadequate decoupling, and attention should be given to the decoupling condenser and its associated resistor as their values may be too low or the components defective. It does happen, in certain cases when it becomes necessary to use double-decoupling, and this can be provided by replacing the decoupling resistor (assuming it to be of maximum value for the valve under consideration) by two resistors each having a value equal to half that of the original component. They are connected in series, and their junction point earthed through another high-capacity condenser.

Other sources of hum are generally classified under a wide heading such as "pick-up" or "interaction," but it is better to think of the causes under two distinct classifications, namely, magnetic induction, and electrostatic induction. With the former, one is concerned with iron-cored components such as L.F. transformers, chokes and microphone transformers. The obvious remedy is to keep such items well out of the field of the mains transformer and any wiring carrying raw A.C. When the trouble is due to this form of induction, a cure can often be achieved by trying the troublesome component in different positions, i.e., partially rotating it about its horizontal and vertical axes. In the output stage, it may happen that the output transformer is to blame, therefore, if all other tests fail, attention should be paid to that item. With electrostatic induction, the trouble is more often than not connected with the grid circuits of the voltage amplifiers, in particular, the first stage. Cures usually involve screening the valve, if it is not of the metallised type; screening grid leads, and, in some cases, the valve-holder pins or, better still, the complete under chassis wiring of the stage from its adjacent stage. Earthing the metal case of volume controls and the cores of L.F. transformers, and using a good make of screened cable for the input leads, especially for microphone work. No mention has been made about layout of components in any of the above causes or their remedies, as it is assumed that reasonable care has been taken in that direction, as it s far more important than many constructors seem to appreciate; in fact, if due thought is given to layout of components *and wiring*, much will be achieved against preventing the troubles mentioned.

This brief discussion on hum, etc., may seem out of place when we are solely concerned with the operation of the pre-amplifier, but from the above, it should be appreciated that by using a pre-amplifier remote from the main amplifier, which invariably carries all the mains equipment, a step is being taken in the right direction towards securing that silent background.

L.T. and H.T. Supplies

The valve-holder fitted in the right-hand side of the chassis provides a quick and satisfactory method of connecting the external supply leads to the unit. The anode pin is the H.T. positive; the grid pin is the H.T. negative and earth; for the L.T. the two filament pins are used.

The H.T. supply line can have a voltage of 350 volts or 250 volts. If the former, a resistor of 25,000 ohms should be connected in series with the H.T. lead, at *the mains unit end*, i.e., at the main amplifier. This resistor should be decoupled with a 4 or 8 mfd. condenser. If the line voltage is 250 volts, the value of the external resistor can be reduced to 10,000 ohms.

The L.T. supply is best taken from a separate transformer, this is assuming that the pre-amplifier will be used, say, 15 to 25 yards from the main amplifier, unless the mains transformer has a spare heater winding rated at 5 volts at 2 to 3 amps. The normal 4 volt heater winding is not really satisfactory, as it is *not* advisable to have the transformer close to the unit, and if any distance separates them, as it should do, it will be necessary to use very heavy gauge cable to prevent voltage drop when 2 amps. is flowing. By using a 5 volt winding, which, incidentally, should supply only the valves in the unit, it is possible to use a reasonable length, say, up to 25 yards of heavy lighting flex, without reducing the heater voltage at the valve pins below the required 4 volts. For shorter runs, ordinary 5 amps. lighting flex will do, but it is a point which must be watched.

One important factor connected with the heater supply is the centre-tap of the winding. This must be a true electrical centre, otherwise, some of the troubles mentioned under hum, etc., may be introduced. If any doubt exists, it would be better to ignore the centre-tap and connect across the winding a 30 ohm hum-dinger, and adjust it until all trace of interference is removed. The component should preferably be mounted close to V1; if stiff wire is used, it can be wired just clear of the valve-pins. With the unit in question, it was not found necessary to use one, but that does not mean that all transformers will be as good as the one used by the writer.

Microphone Input

With the average type of "quality" transverse current microphone, quite long leads can be used between "mike" and pre-amplifier, provided, of course, that the cable itself is of decent quality and screened. The limiting factors are the impedance of the microphone, the capacity and resistance of the cable. With the type of microphone mentioned, lengths of 75yds. can be used with an instrument having an impedance in the region of 450 to 500 ohms, without any appreciable loss, but, as mentioned above, it all depends on the gauge and quality of the cable.

The two pairs of input sockets on the pre-amplifier are connected in parallel, it being intended to plug the chief "mike" in the top two, and leave the other pair for the operator's microphone when needed, it being a simple matter to flick one of the plugs in or out.

The volume control R1 is directly across the secondary of the "mike" transformer and, of course, the grid circuit of V1, therefore it only controls the microphone input.

The "fader" is R5, and that controls both "mike" and gramo pick-up inputs to V2, and is intended chiefly as a fader. The P.U. is plugged in to J1, while J2 is for the monitoring headphones, the actual output from the pre-amplifier being taken from the two sockets on the right-hand side of the panel.

When operating, it is better to keep the 'phones out of circuit, plugging them in only when it seems necessary to make a check, and if proper initial tests are carried out. the need should not often arise.

Another item to remember is, it is far better to have the controls on the pre-amplifier turned right up than those on the main amplifier, therefore only use the volume controls on the unit to reduce input-output if for some reason or other the main amplifier is getting more than it can handle. In other words, let the operator on the main amplifier look after his input or the ultimate gain.

(To be continued)

Concerning Atmospherics

ALTHOUGH atmospherics seldom make wireless reception impossible in this country, they are, nevertheless, very disturbing at times. Common causes of atmospherics are lightning discharges in the atmosphere, or the gradual equalising of potential between charged clouds or a cloud and the earth. Unfortunately for the listener, these atmospherics have no particular frequency, so that they cannot be tuned out by ordinary means. Another point to bear in mind is that the atmospherics may be much stronger than the signals from a distant station, consequently, when conditions are bad, it is useless to introduce very much amplification, because in that case the atmospherics would be amplified as well as the incoming signal.

Background Noises

Sometimes you may be doubtful as to what is causing the background noises in your receiver—it may be atmospherics or only a failing battery. A simple method of proving this point is to disconnect the aerial and earth. If the trouble ceases it is evident that atmospherics were the cause. When atmospherics are about, the listener soon discovers that, no matter how carefully the set is tuned, they still persist in coming through, but with decreasing intensity as the lower wavelengths are tuned in. The aperiodic nature of atmospherics makes it extremely difficult, if not impossible, to entirely eliminate them. Engineers and scientists have been trying ever since wireless was first introduced—to get rid of atmospherics, but so far without any real success. Different methods have been tried out, but they are too complicated to be of any use to the average amateur.

Cutting Down Atmospherics

One of the simplest ways of cutting down the intensity of atmospherics is to lower the aerial. A long, high aerial seems to be a much more efficient collector of atmospherics than a low one. When altering the aerial, however, it must be borne in mind that when in its lowered position its signal pick-up efficiency will be reduced, which will mean more amplification for bringing in a distant station. The extra amplification might increase the intensity of the atmospherics, but if the required signals can still be heard at good strength on the lowered aerial, without additional amplification, then the effect should be a reduction of interference.

A By-pass for Static Discharges

A high resistance connected between the aerial and earth terminals of a receiver is sometimes effective in cutting down atmospherics, by acting as a by-pass for the static discharges. Try various values of resistance until the desired result is obtained without unduly diminishing the signal strength. A spaghetti resistance is very handy for this purpose.

Another dodge worth trying is to use the earth as an aerial by disconnecting the latter from the set and connecting the earth lead to the aerial terminal, leaving the earth terminal disconnected. This arrangement considerably reduces the range of the set, but often completely cuts out atmospherics, so that reception from the local station can be enjoyed even when conditions are bad.

Short-wave Radio—4

Testing the Single-valve DX Receiver. Using an Eliminator. Adding an L.F. Stage. A.C. Operation

By 2CHW

(Continued from page 511, November issue.)

IF the constructor of the DX One-valver described in the previous issue intends using battery H.T. supply, a voltage of 60 to 70 volts will be found sufficient with the specified type of valve. If, however, a 120 volt attery is used, the initial tests should be made with, say, 60 volts, and, after putting the receiver through a general test, using each coil in turn and paying particular attention to the operation of the reaction control and the setting of the aerial series condenser, repeat the procedure with various values of H.T. until the most satisfactory voltage is determined. Although modern valves adhere very closely to their specified characteristics, it is always advisable to carry out the procedure mentioned as slight differences in individual receivers, aerials, etc., often necessitate different operating voltages.

With a simple receiver of the type in question, and for that matter, any "straight" S.W. circuit, one is well advised to devote a generous amount of time—and patience—to the preliminary adjustments and observations. For example, the slightest indication of "dead-spots" in the reaction must be eliminated, and this can only be done by testing each coil over its whole frequency range for smooth reaction, and this will involve finding the most satisfactory setting of the aerial series condenser, and the best value of H.T. The condenser has to be adjusted until the maximum signal is received, *consistent* with the required degree of selectivity and the complete absence of "dead-spots," and this alone, if carried out properly, will take an evening or two. Once the setting of the aerial series condenser has been determined, it should not be touched, neither should the aerial be altered. Some amateurs prefer to find the best setting for each individual coil; this method has its advantages provided the exact dial reading of the A.S. condenser is noted for each coil, and set according to the range in use. The disadvantage, however, is that the calibration of the receiver is slightly more complicated, as any variation in the A.S.C. has its effect on the setting of the tuning condenser.

Using an Eliminator

The receiver will operate quite satisfactorily in conjunction with a well-designed H.T. eliminator, in fact the writer always uses one, but the stipulation "well designed" is stressed, as all eliminators are not necessarily suitable for use with a sensitive S.W. detector. Although a battery supply to the filament of the valve does much to reduce the possibility of hum, there is always the danger of the trouble being introduced when an eliminator, especially if it is operated off A.C. mains, is used through magnetic and/or electrostatic induction, or inadequate smoothing. It is, therefore, well to keep the eliminator unit well away from the receiver, and enclose (the former) in a metal case which can be earthed. This will not, however, eliminate hum due to poor smoothing arrangements, so if this is the cause of the trouble, the only remedy is to increase the efficiency of the smoothing circuit by (1) checking up on the smoothing choke and condensers, and, if necessary, replacing them with components having higher values or better characteristics. This is most likely to apply to the choke and the condenser on the output side of it; it is not always advisable to alter the capacity of the condenser(s) on the rectifier side of the choke, as the value may be the maximum for the rectifier concerned. Assuming that the components are above suspicion, the best remedy is to connect in series with the H.T. lead to the detector another good L.F. choke, together with an additional 4 or 8 mfd. condenser connected between the set side of the new choke and the H.T.-negative line. This will improve smoothing and at the same time reduce the voltage slightly, but, as the supply is likely to be above that required for the valve concerned, it will be necessary to include a voltage dropping resistor also in series with the H.T. lead.

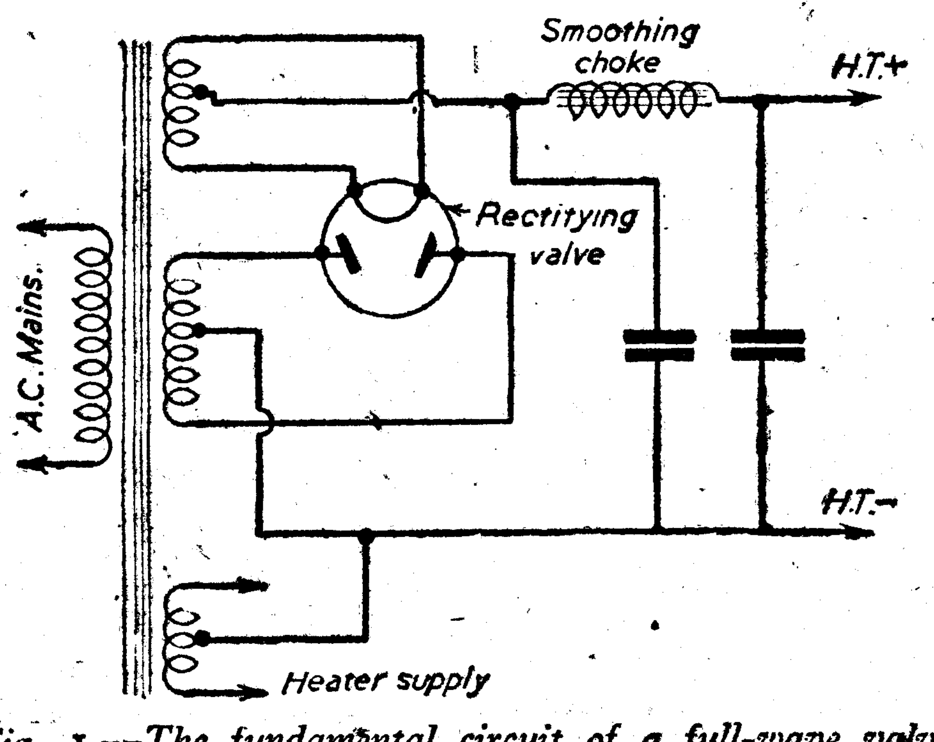


Fig. 1.—The fundamental circuit of a full-wave valve rectifier showing normal smoothing arrangements.

A typical full-wave valve rectifier circuit is shown in Fig. 1 in which the normal smoothing arrangements are included. The suggested additional choke is shown in Fig. 2 the D.C. positive and negative D.C. terminals being connected to the Pos. and Neg. output on the eliminator. Owing, however, to the fact that the valve will require only 60 to 70 volts at, say, 2 mA's, and assuming that the supply from the eliminator is 120 volts, it will be necessary to drop approximately 50 to 60 volts, that is, allowing for a slight increase in output voltage from the eliminator owing to the low current drain, by connecting a resistor having a value of 30,000 ohms in series with the H.T. positive lead. The best place for this resistor is between the D.C. positive terminal of Fig. 2 and the H.T. positive terminal of the eliminator, thus allowing another additional smoothing condenser to be connected as shown by the broken lines, and, incidentally, the choke to give its maximum inductance owing to the low current flowing.

If, as with some commercially produced eliminators, an 80-volt socket is provided, the H.T. supply could of course be taken from that point, in which case it then may only be necessary to use the L.F. choke plus one smoothing condenser.

Adding an L.F. Stage

When the constructor has brought the single-valver to its highest state of efficiency, an L.F. stage can be added with good advantages. The additional amplification which will be obtained will convert the set into one which will be able to produce a surprising log. Those elusive transmissions which previously had been just too weak for identification, etc., will now come in at good 'phone strength, thus the apparent range of the receiver will be increased, without sacrificing the signal-to-noise ratio.

The L.F. coupling can take the form of transformer or resistance-capacity coupling; the former will give slightly more gain but, if an eliminator is to be used, the resistance-capacity method is recommended. Individual constructors have their own opinions about

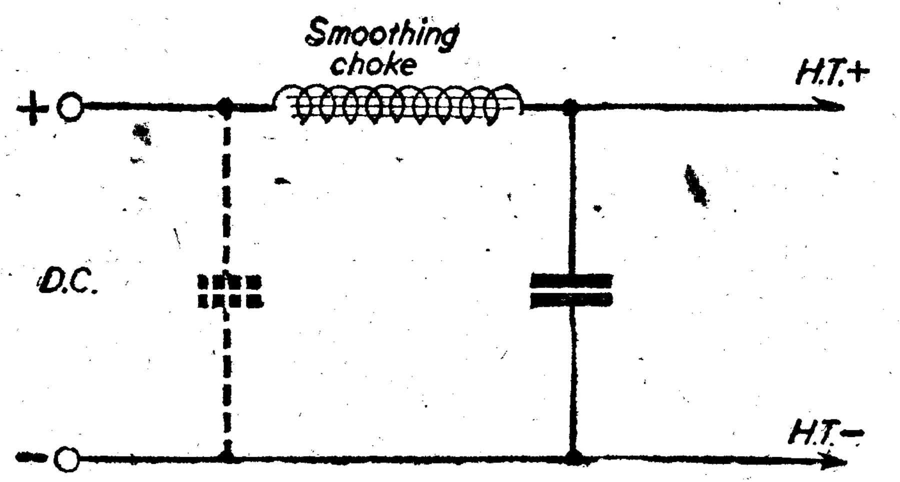


Fig. 2.—The additional smoothing components should be connected in this manner between the eliminator and set.

the relative merits of the two forms of coupling, but for the circuit in question the writer favours R.C.C. and the layout of such a stage is shown by Fig. 3.

The additional parts are arranged on a small baseboard having the same depth as the original. The 'phone terminal mounting block is swung round to the side, and instead of the 'phones a resistor having a value of 50,000 ohms is connected across the two terminals. The .01 mfd. coupling condenser is connected to the original 'phone terminal, which is joined to the anode—via the S.W. choke—of the detector valve.

The extra valve-holder is of the 5-pin baseboard mounting type, the filament terminals "X" and "Y" being linked up with those of the detector valve-holder. The original H.T. pos. lead is still used to supply the detector, but it will now be necessary to feed it with approximately 120 volts, owing to the anode load resistor of 50,000 ohms being in series. The H.T. pos. 2 should be taken direct to the 120 volt or 150 volt tapping, the latter if an eliminator is used. The recommended valve is the Cossor 220HPT, a high slope output pentode, but other makes of similar characteristics will be quite suitable. The lead marked G.B.—, connected to the 1 megohm grid-leak, is taken to the 4½ volt negative socket in a grid-bias battery, the positive socket of which is connected to the H.T., L.T. negative earth line. The complete circuit is shown by Fig. 4.

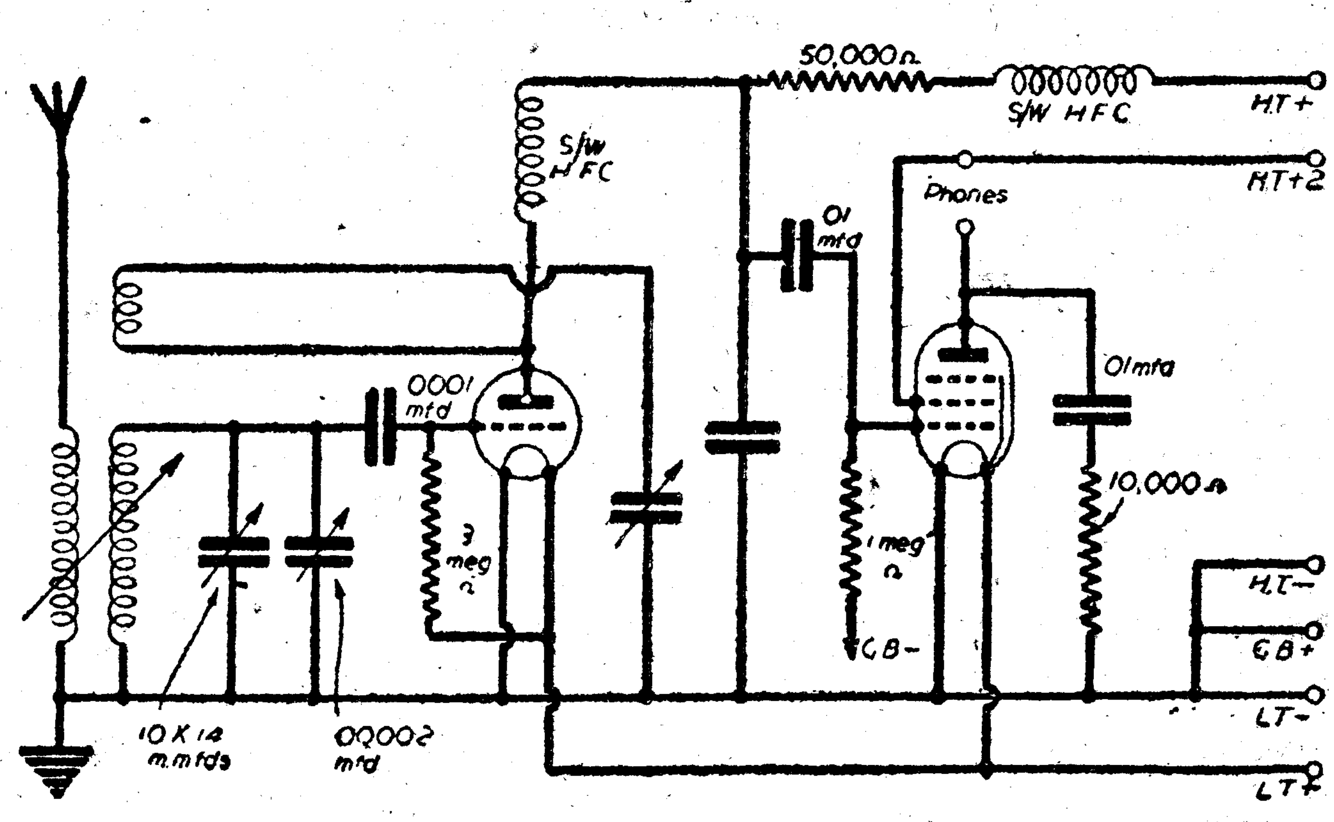


Fig. 4.—The complete diagram of the modified circuit which now forms an efficient two-valver.

A.C. Operation

To enable the single-valver to be operated from the normal L.T. and H.T. supplies from an A.C. receiver or suitable mains unit, it will be necessary to replace the existing 4-pin valve-holder by one of the 5-pin type. The filament connections, which now become those for the heater, *must be* disconnected from earth and chassis, etc., and have soldered to them a suitable length of twisted twin flex. The additional pin, i.e., the 5th, is the cathode connection, and this can be taken direct to the nearest earthing point. To reduce the possibility of hum, etc., two .01 mfd. condensers should be connected in series and wired across the heater pins, the junction point between the two condensers being taken to earth.

The usual precautions must be taken regarding the value of the applied H.T.; but it will be found that the actual voltage can be higher than with a battery-operated type of valve. A suitable A.C. valve for the detector position is the Cossor 41 MH metallised.

The grid leak must, of course, be disconnected from its original position on the negative filament, and joined to cathode or earth.

Adaptor and Converter

If one goes to the trouble of operating the single-valver off A.C. supplies obtained from an existing receiver more use can be made of the S.W. set by using it as an adaptor or converter. For the former the primary of a good make of low ratio L.F. transformer should be connected in place of the 'phones and the secondary taken to the P.U. sockets of the broadcast receiver. This will allow full use to be made of the L.F. side of the latter, but care may be necessary to see that hum is not introduced by long leads or by the L.F. transformer coming within the effective field of the mains equipment in the set.

If the broadcast receiver is of the "straight" type, and includes one or more stages of H.F. amplification, the single-valver can be used as a superhet converter, thus converting the installation into a simple but quite effective S.W. superhet receiver. For this operation an H.F. choke of the usual broadcast band type should be connected in series with the existing S.W. component, i.e., between H.T. positive and S.W. choke, and a .0001 mfd. condenser joined to the junction point between the two components. The free side of the condenser then forms one side of the output, the other side of which is taken from the common negative earth line of the S.W. set. The condenser output lead is inserted in the aerial terminal of the broadcast receiver, which must be tuned to the lower end of the *long waves*. The other output lead is taken to the earth terminal of the set, and the aerial transferred to the single-valver.

To operate adjust the reaction control of the S.W. set until the circuit is "alive" or just in a state of oscillation and then tune it in the normal manner.

If the broadcast set is of the superhet type it is better to withdraw the frequency changing valve, and connect its anode connection to the H.T. end of the S.W. choke in the S.W. set, no additional H.F. choke or H.T. supply lead being necessary.

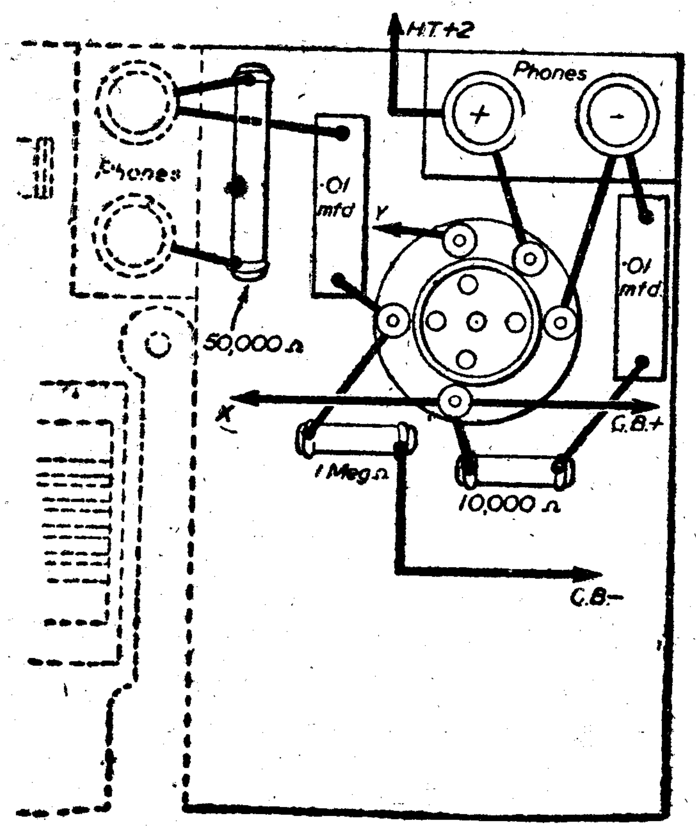


Fig. 3. — The layout and wiring of the parts for the L.F. stage, the valve being an L.F. pentode.

(To be continued.)

ON YOUR WAVELENGTH

By THERMION

Front Page News

SOME of our news editors have a peculiar sense of news value. On the front page a few weeks ago appeared, side by side with the news of Aachen battles, a paragraph, under bold headlines announcing the world-shattering fact that one of the B.B.C. organists had resigned after a number of years' service. Perhaps I should only be surprised that it did not occupy the main headlines, whilst the Aachen news was hidden in some obscure paragraph near the comic strips, which are a most important feature of modern journalism.

Radar in 1911

HUGO GERNSBACK, the editor of *Modern Electrics* (he called on me when in London just before the war, when we had a most interesting discussion on American and English journalism), has sent me a copy of a story in that journal for December, 1911, and I quote it to show that Radar, or rather the idea of it, is by no means new:

"At first thought it might be considered a difficult feat accurately to locate a machine thousands of miles distant from the earth, speeding in an unknown direction somewhere in the bottomless universe. The feat, while remarkable, is easy to accomplish by any up-to-date scientist. As far back as the year 1800 astronomers accurately measured the distance between the earth and small celestial bodies, but it was not until the year 2659 that the famous scientist 124C 41 succeeded in accurately determining the location and distance of space flyers, far out in space, where not even the most powerful telescope could follow any more.

"Pulsating Polarized Ether Wave"

It has long been known that a ***pulsating polarized ether wave***, if directed on a metal object, could be reflected in the same fashion as a light ray can be reflected from a bright surface or from a mirror. Moreover, the reflection factor varies with different metals. Thus the reflection factor from silver is 1,000 units, the reflection from iron 645, alomagnesium 460, etc. If, therefore, a polarized wave generator were trained towards the open space, the waves would take a direction as shown in diagram, providing the parabolic wave reflector was used as shown. By manipulating the entire apparatus like a searchlight, waves would be sent over a large area. Sooner or later, if the search is kept up, these waves must come in the direction of a space flyer. Then a small part of the waves would strike the metal body of the flyer and these waves would be reflected back to the sending apparatus. Here they would fall on the *Actinoscope* (see diagram), which records only the reflected waves, not the direct ones.

From the actinoscope the reflection factor is then determined, which accurately shows from which metal the reflection comes. From the intensity and the elapsed time of the reflected impulses, the distance between the earth and the flyer is then accurately calculated with but little trouble.

Reflection Factor

The reflection factor of magnelium (the metal of which Fernand 60O 10's machine was constructed) being 1060, Ralph located his rival's space flyer in less than five hours' search. He found that 60O 10's machine at that time was about 400,000 miles distant from the earth and that the abductor of his sweetheart apparently was headed in the direction of the planet Venus. A few seconds' calculation showed that he was flying at the rate of about 45,000 miles per hour. This was a great surprise for Ralph and it delighted him at first. He knew that 50O 10's machine was capable of making at least 75,000 miles an hour. This was certainly as strange as it was puzzling. Ralph reasoned that if he were in his rival's place, he certainly would speed up the flyer to the utmost. Why then was 60O 10 flying so leisurely? Did he think himself secure? Did he think that nobody could or would follow? Or did he have trouble with the *Anti-Gravitator?* Ralph could not understand it. However, his mind had already been made up. He would of course chase his rival, head him off, and, if necessary—yes, he would kill him.

He gave sharp and quick orders to his attendants and ordered his space flyer, the "Cassiopeia," to be made ready within one hour. Provisions sufficient to last for six months were put on board and Ralph himself brought a large number of scientific instruments to the flyer, many of which he calculated might turn out to be useful. He also ordered a large amount of duplicate parts of the flyer's machinery to be put on board in case of emergency, and he then bade farewell to his family."

Clubs

THE secretary of the British Short Wave League, apropos my request to club secretaries in the previous issue, has written to state that they have confined their efforts to holding the League together as a nucleus upon which to build our post-war organisation, which we have successfully managed in spite of difficulties due to wartime conditions. At present local chapters are holding regular meetings at London, Teesside, Manchester, Bath and Liverpool, and further chapters will be formed as membership permits. We are now developing our post-war plans for the expansion of the League, and to this end are publishing shortly a Listener's Handbook, a copy of which will be sent you when ready, and are also proposing to enlarge our monthly "Review."

THE PSEUDO EXPERTS PUNK

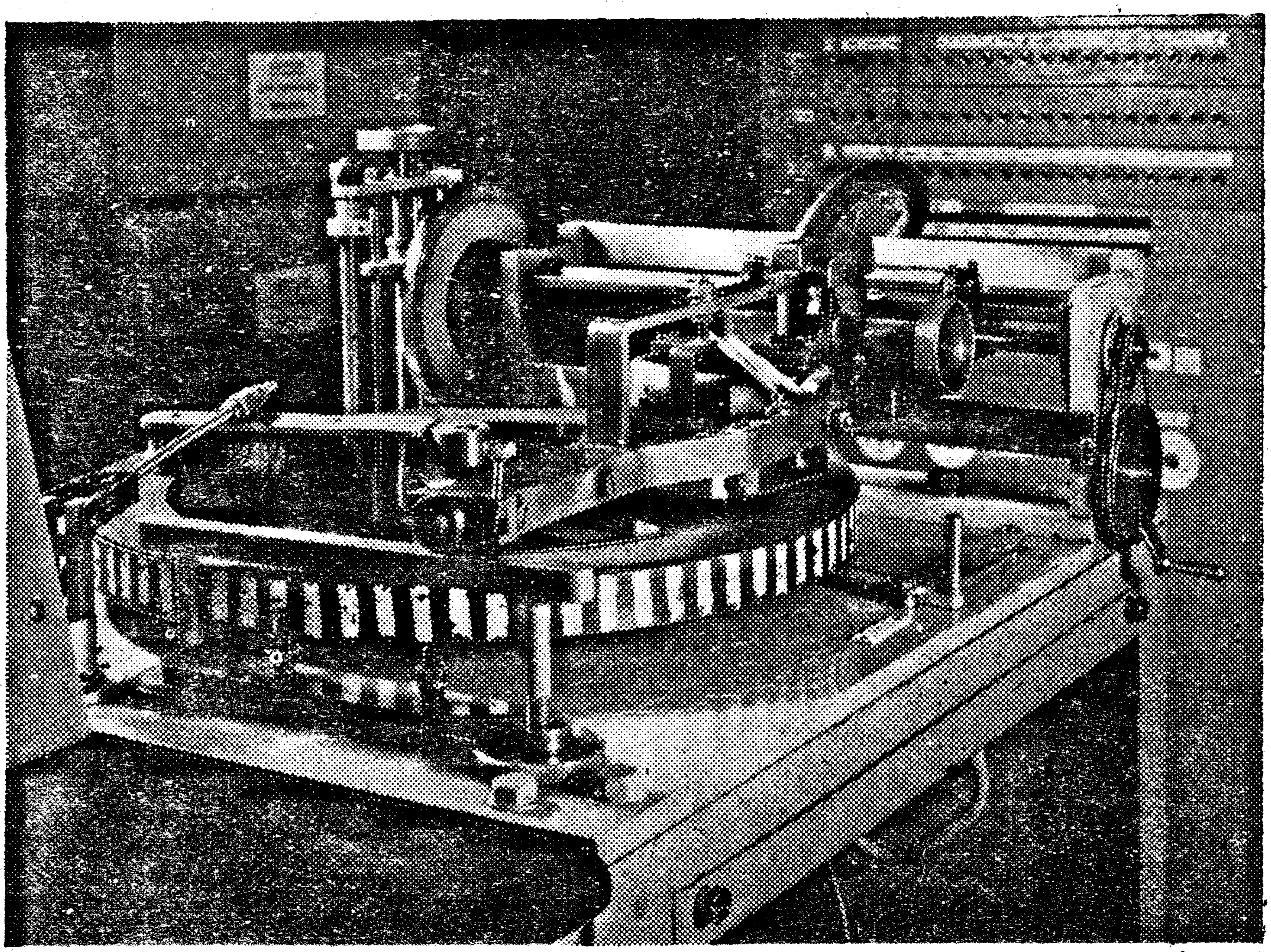
[A Sunday newspaper recently published an ill-advised article to the effect that thousands of television sets would be on sale immediately after the war. Here are the actual facts: The B.B.C. has denied it, and radio manufacturers say there will be no television receivers till the B.B.C. puts out worth-while programmes several nights weekly.]

Although you may see it in print,
Always take a fresh squint,
For the moon is *Not* made of green cheese.
And when some of our papers
Indulge in strange capers,
Read "cum grano salis," please.
When they boost television,
Just treat with derision
What half informed "experts" indite.
Their knowledge is nil;
It makes real experts ill
To wade through the piffle they write.
Television will come,
But the chances are glum
Of it starting when peace is declared.
And reports that it may
Can be swept right away,
For they're based upon premise absurd.
Half-knowledge despise,
Built on rumour and lies.
And here once again be it said.
As it was in the past—
It's a truth which will last—
"Fools rush in where the angels **won't tread.**"

"TORCH."

Direct Disc Recording—2

The Various Types of Recording Blanks



The M.S.S. Disc Recording Machine.

IN this article the various types of recording blanks are discussed; the requirements of a good blank; faults to look for when choosing the type best suited to our purpose; preparation and treatment for cutting. The *blank* is the unrecorded disc; the *disc* is the complete base with its coating either before or after recording and may be either single or double sided; strictly speaking the *record* is what is on the disc, not the disc itself, i.e., a double sided disc has on it two records; a *pressing* is either a single or double sided disc produced by pressing from the stamper in the production of the commercial types of discs.

Before the war, although there were at least eight well-known makes of blanks available, only one British manufacturer was making them in any quantity, the remainder being either American, Dutch, French or German. So great has the wartime demand for blanks become, that two other British firms are now turning out large quantities for use in the various government and services organisations, and the outlook for peace-time supplies begins to look far more healthy.

Fairly exhaustive tests show, however, that the British types, although well up to the average, fall short of the best American blank, and although this may be due to the war conditions in regard to available materials, workmanship, etc., it is the author's opinion that the technique of mixing and applying the lacquer coatings is far more advanced in the U.S.A. than in this country and that there is room for considerable improvement in the matter of uniformity of physical and chemical characteristics of the blank and its coating material.

A great deal of useful work can be done by the home enthusiast with a bent for chemistry, especially nowadays when blanks are not available in any shape or form for the private user. One or two studios, still open, obtain them for official purposes on special priority, but are not allowed to pass them on to the public either in blank or recorded form. This condition is strictly enforced, although it has for some little time been relaxed in the U.S., but it is still impossible to get a permit to import foreign discs.

Types of Blank

There are three main types of blanks suitable for direct recording, i.e., 1. Metal base, either aluminium or zinc. 2. Glass base. 3. Plastic-homogeneous, consisting entirely of the material on which the record is cut.

The first type is almost invariably coated with a lacquer usually referred to, quite incorrectly, as cellulose acetate. In point of fact it is far more likely to be cellulose nitrate or one of the same family. The second type has the same coating, although it was possible up to the outbreak of war to obtain a glass base with a gelatine coating which gave very excellent results indeed: providing certain rather carefully controlled conditions were kept to in preparing and cutting the blank. The third type is rarely used for direct cutting, but comes into its own for the embossing method of recording and will be treated later on in this series.

There are some half a dozen different types of lacquer-coated blanks available, all with a base of one or other of the following: Cellulose nitrate, acetyl cellulose, ethyl cellulose, or one of several resins, and all depending upon the closely guarded secrets of the individual firm making them. It may be of interest to readers to know that there are at least two large British chemical firms who have several types of lacquer suitable for direct recording blanks.

All the types mentioned are, of course, brittle in their normal state, and to enable them to be cut and to retain a perfect groove, some form of plasticizer has to be added which enables the blank to remain soft enough for cutting. The type of plasticizer used and the amount go far in determining the hardness of the coating and, of course, the cutting characteristics, noise level, etc. A hard disc has a better high frequency response and lasts longer than a soft disc, which usually has a lower noise level. Other factors come into the choice of the best compromise between easy cutting and long life with good response, and in a good class blank can be safely left with the manufacturer, although it should be noted that when purchasing blanks it is sometimes possible to obtain a hard or a soft type, and the purchaser should always state which he requires and treat it accordingly. Either type has its best conditions; we are, of course, leaving out the bad disc which may be too hard in one batch and too soft in another.

In order to apply the coating to the base it is necessary to add to the lacquer a solvent to allow it to flow easily. The better class manufacturers do not issue discs before this solvent has had time to thoroughly dry out, but it is a fact that some discs do appear from time to time which are still "soft" in patches and if used will prove awkward in cutting, or perhaps, even worse, will cut apparently correctly but after drying out will be found to have a distorted groove in parts, due to the drying out process having been completed after being cut. Something of the same sort occurred with a pre-war type of blank, which was subjected to heat treatment after recording to enable it to be hard enough for playback on an ordinary gramophone; the grooves were quite often horribly distorted.

Several very definite requirements are essential in a good blank; the two main ones can best be discussed under separate headings.

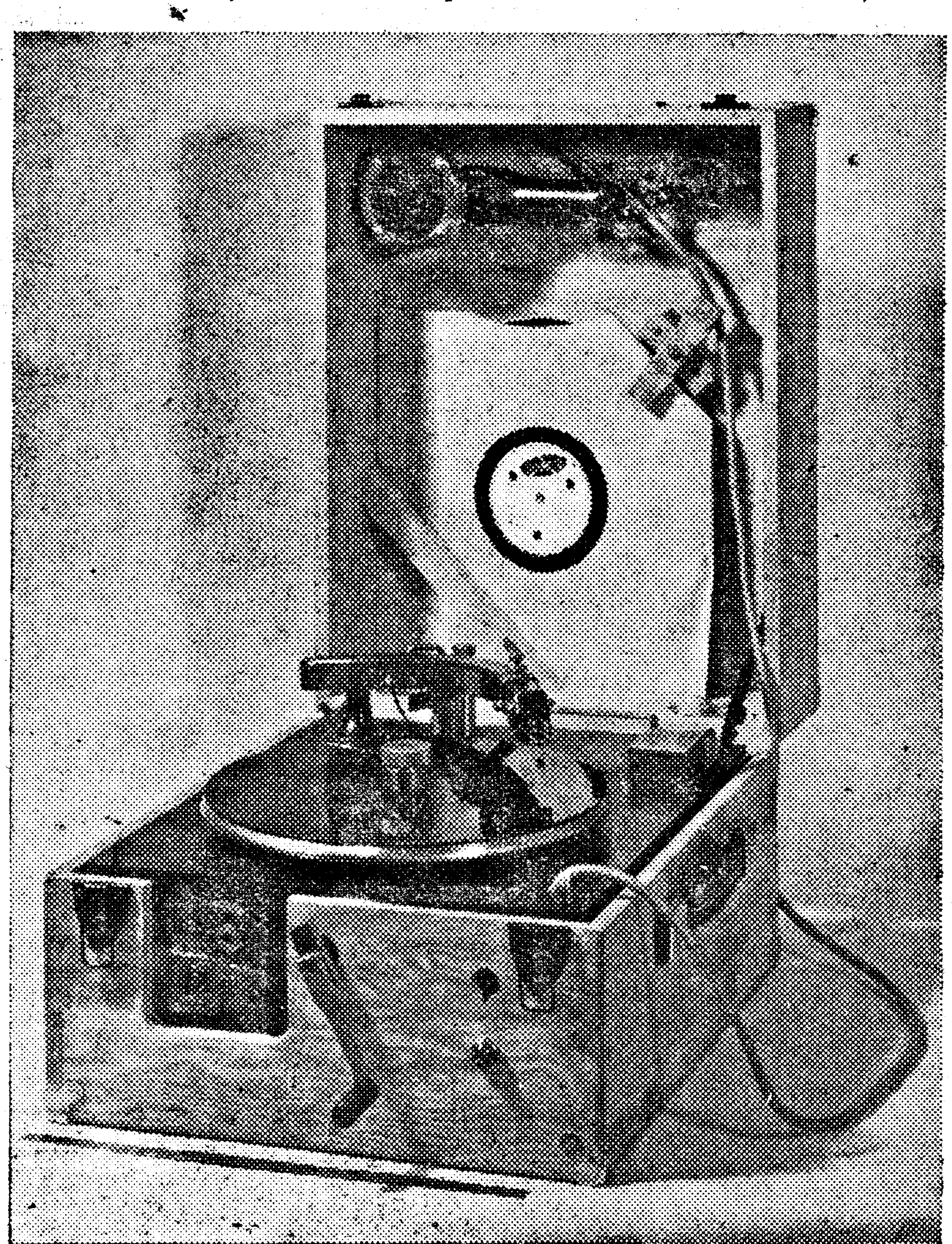
Uniformity in Physical Characteristics

A good blank must be flat and capable of offering a perfectly level face to the cutter during the cutting operation. There should be no suspicion of any up and down motion due to warping or bent base, otherwise the cut will be alternately light and heavy, giving rise to all sorts of weird noises in playback. No disc should be tolerated that is more than 1/16in. from a true plane. The glass base discs score on this point over the metal types, as the former are almost always flat, although, if of very thin glass and single sided, there is a tendency to warp even with glass, due to the pulling effect of the lacquer when drying out. This trouble has been very noticeable with British manufactured blanks using a thin aluminium base with a single side coating and it has occurred far too often with the double side types in the past year or so, even with the heavier metal bases.

Much greater care is required in stamping out the discs, and in punching the centre holes. Some writers favour the use of a packing washer about 1in. wide placed under the blank on the outer edge, which packs up the edge and helps to stop any unevenness at what is the worst part. A slightly deeper cut will be made at the outer edges, but the tendency to jump up and down will be stopped, or at any rate held within reasonable limits. This is, of course, only a compromise and should be avoided wherever possible as no amount of packing, however carefully done, will rectify an uneven disc.

Some manufacturers dish the centre of the turntables so that when the clamp is screwed down the disc tends to "sit into" the dished part, and so offers a method of taking up any unevenness in the disc. This does occasionally apply when using an aluminium disc, but not with the zinc base types, and will almost certainly crack the glass types. It is far better to have a perfectly flat turntable, and for the manufacturer to make sure that his discs are really flat, as they most certainly should be, and for the user to see that he buys only from those manufacturers who take the trouble to turn out first-class discs, and supply them properly packed.

One other point to watch is the centre hole, which



The B.B.C. midget recorder. It is completely self-contained with automatic operation by push button.

should be 0.286in. with a tolerance of 0.001in. This is very important, and is liable to be forgotten in recording because in one way it does not matter as the disc is clamped down and cannot move. However, once the recording spiral is cut it has a definite relation to the centre hole used during the recording. If the disc is moved and put on the playback turntable it is essential that it should fit snugly and not be free to move about, otherwise the disc will "walk" slightly, causing the pick up to swing instead of tracking properly, and the result will be what is known as a "swinger," and the reproduction will suffer in direct proportion to the amount of play in the centre hole, varying from a very slight alteration in pitch to a really distressing wow, which will be especially noticeable on music.

This trouble is especially noticeable in the glass base discs due to difficulty in machining the glass. The thickness of the glass base used is of the order of 0.065in.

Uniformity of Chemical Characteristics

A blank when cut with a first-class steel or sapphire stylus should give a clean cut which will appear bright and polished, the thread or swarf coming away in a continuous shiny spiral with no suspicion of kinks or curls. Any one blank out of a batch from the same manufacturer should behave in the same manner, even if purchased at several months' interval, and all the blanks should behave in the same manner, and not require different treatment.

It cannot be too strongly emphasized that the coating of the blank should be as perfect as is possible in the present stage of the art, both in its form and its application, and it must be remembered that not even the finest recording equipment would be capable of producing good results if the blank were not capable of faithfully accepting and storing the minute engravings recorded on it. It should be even the reverse, as indeed it often is, in that the blank should be so perfect as to show up the imperfections in the recording equipment; it is not long ago that blanks were incapable of doing this, with the result that many poor types of recording equipments were sold to an unsuspecting public.

The coating applied to the base is usually of the order of from 0.006 to 0010in., and is applied by one or other of three means: 1. Spraying; 2. Dipping; 3. Spinning; and in one other case at least to the author's knowledge a combination of 1 and 3. Each manufacturer has his own pet theory as to which method is best, and from the point of view of the user there is not much to choose between them, always provided they are carried out correctly. Straightforward spraying is probably the least acceptable method from the standpoint of a perfect finish, but it is favoured a good deal on account of its comparative ease of operation with modern spray guns. The coating being usually applied in from three to five operations. Dipping, if carefully carried out, gives a very excellent finish, whilst spinning by itself is inclined to "throw" the lacquer to the edges if not very carefully controlled.

In all cases it is, of course, essential that a perfectly flat surface is obtained with no swirls, air bubbles, or bits of grit or dust, and the very greatest care has to be taken in the preparation and application of the lacquer.

In connection with the thickness of coating applied it should be remembered that two points are the governing factors:

1. The coating must be thick enough to accept the usually accepted depth of cut without any risk of the cutter going through to the base material. 2. It should be as thin as possible, consistent with the requirement of (1) and the necessity of allowing an acceptable number of playbacks before wear becomes apparent, in order that the base material may suitably support the groove walls and give them strength. If the coating is too thick the playback needle will be inclined to push the coating as it tracks a groove, and so the groove wall will be distorted and will also affect the next groove, causing an echo effect on playback.

It will, therefore, be appreciated that the type of lacquer used and the method of application to the base material is a subject which calls for considerable forethought, and no little skill if the final results are to be in the very first class. The question of the correct viscosity of the lacquer, temperature of the room in which the coating is being carried out, etc., has not been discussed because they are functions of the particular types in use, and it would be impossible to go into details and lay down hard and fast rules in the space available in this series.

Treatment of Blank for Cutting

Assuming that we have a first-class blank ready for cutting, certain points concerning the treatment of the blank for cutting are worthy of mention. All the usual types of cellulose nitrate blanks have a static electrical charge which may be as much as 5,000 volts—the glass-coated types being the worst offenders. This charge is, of course, quite harmless to the user, but it has a very definite nuisance value in that while cutting the swarf sticks to the surface of the blank and is very difficult to remove, this can be particularly annoying when cutting from outside to inside as the swarf tends to pile up and impede the path of the cutter, and if not cleared, will, in fact, cause the cutter to jump and spoil the groove cut, breaking the continuity of recording.

In the better types of professional recorders a suction swarf remover is usually built in, which if properly adjusted is completely satisfactory. Others have fitted a special type of brush which is held down on the blank by means of a spring, and is caused to move to and fro slightly so as to catch the swarf and throw it towards the centre pin. This method works quite well provided the brush pressure is sufficiently high to move the swarf, but it is a method which the author strongly deprecates, as even if a soft camel hair brush is used the surface of the blank is scratched. If any reader wishes to cure himself of the habit of using this method let him put a fresh blank on the turntable, apply the swarf brush in the usual manner and allow the blank to rotate for, say, 15 seconds and then examine the surface carefully, when he will find it to be one mass of minute scratches, which, even if not serious, cannot improve the quality of the recording, and when it is realised that in actual cutting the brush is also rubbing the swarf over the surface as well it is easy to understand that it is an undesirable method. The best method of all is to cut the disc from inside to outside, in which case the swarf is left behind and never need be bothered about till the end of the recording. This method has other definite advantages which will be discussed later in the series when we deal with cutting.

If it is essential that one should cut outside to inside, as when producing a master for pressing purposes, then it is advisable to apply to the blank one of the several excellent antistatic dopes, which, if properly applied and polished off, completely cures the trouble and does not in any way spoil the blank. The author makes one up, which, if applied to a batch of blanks in the morning, renders them "antistatic" for the rest of the day.

One further point should be mentioned, and that is the advisability or otherwise of using a polish or "hardening" dope. Present-day blanks are manufactured with a view to giving a reasonable playing time, and the coating, if it is correctly cut and played back with a lightweight or counterbalanced pick-up, needs no assistance from polishes.

Admittedly, a slight application of polish may give two or three extra playings; on the other hand, it is far more likely that it will reduce the number of first-class playings owing to the amount of dust and grit which it will attract. Leave polishes and cleaning waxes well alone.

(To be continued.)

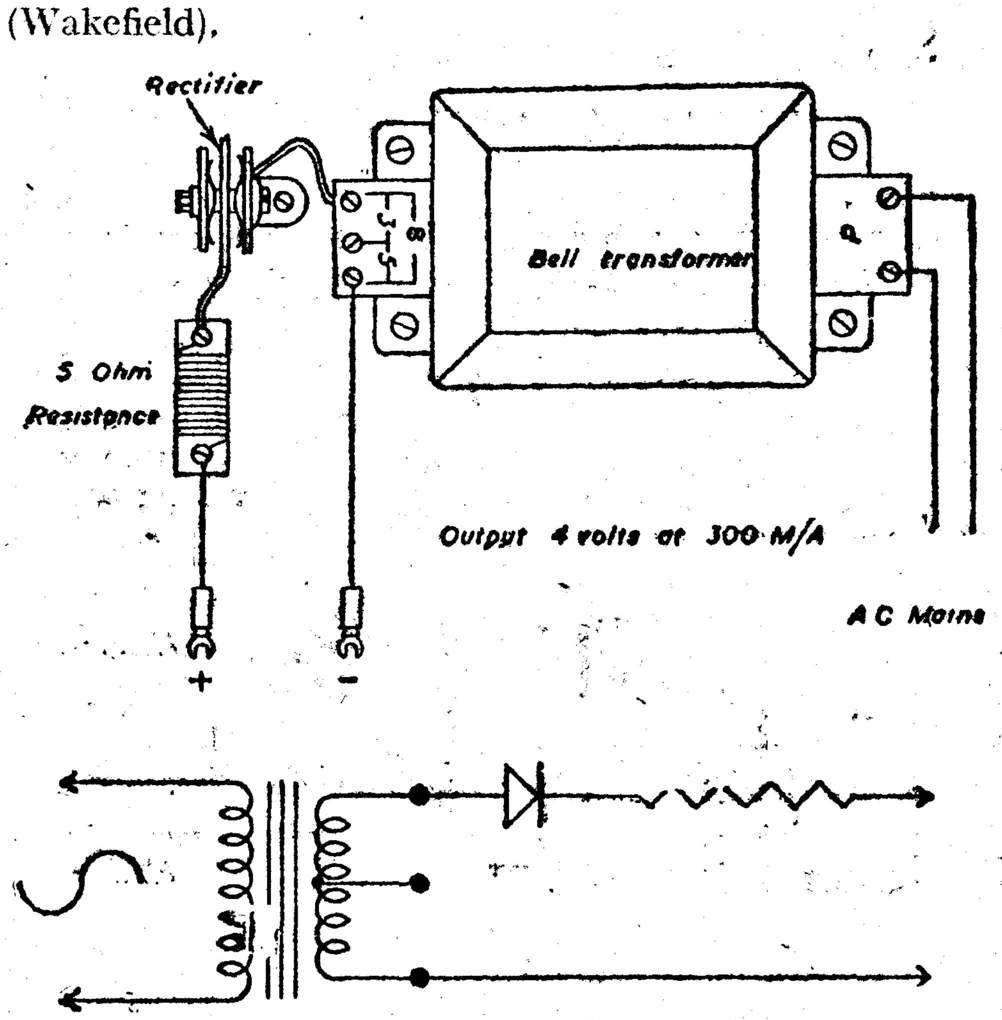
Practical Hints

A Small Trickle Charger

REQUIRING a small trickle charger for home use, a very efficient unit, as shown in the sketch, was built up from odd parts.

An ordinary bell transformer having 3.5 and 8 volt tappings at 1 amp. was used in conjunction with a small rectifier made from an old H.T. metal rectifier. The rectifier was dismantled, taking two zinc oxide plates and connecting them in parallel, this preventing overheating, and bringing the charging current up to approximately 300 mA. at about 4 volts.

The rectifier is mounted on a small metal bracket.—A. PILMER (Wakefield).



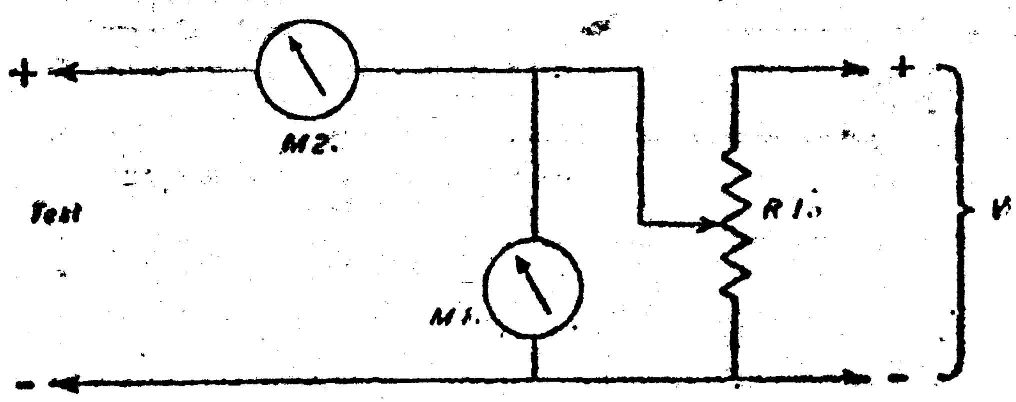
General arrangement of a small trickle charger and circuit diagram.

A Novel Voltage Test Method

WANTING to test some fairly high voltages without taking any current from the supply under test I assembled the circuit shown in the diagram. It operates as follows: The potentiometer R1 enables any voltage to be applied across the voltmeter M1; when the voltage across M1 is the same as the voltage across the test leads meter, M2 shows no current to be flowing through it. The voltage being tested is then the same as that shown by M1.

A 1 mA. F.S.D. moving-coil meter was used for M2. The zero adjuster was turned until the pointer indicated .05 mA. with no current flowing through the instrument—this enables a backward movement of the pointer to be easily seen. M1 was a moving coil voltmeter; it should be of reasonably high resistance so that R1 does not need to pass much current. It must cover the voltage of the supply being tested, of course. The resistance of R1 and the voltage V depends upon the voltage being tested. A wire-wound potentiometer of about 50,000 ohms with a H.T. battery will do for voltages between 20 and 120 volts. In operation, rotate R1 until M2 shows no current; M1 then gives the voltage.

Care must be exercised in using the circuit.—Do not reverse the polarity of the test leads, or M2 will be damaged. The circuit being tested must have an internal resistance (as it usually will have), otherwise M2 will show no current for any voltage given by M1. A resistor of about 100,000 ohms (for high voltages) may be fitted in one of the test leads for safety, and to protect M2. —F. G. RAYER (Longdon).

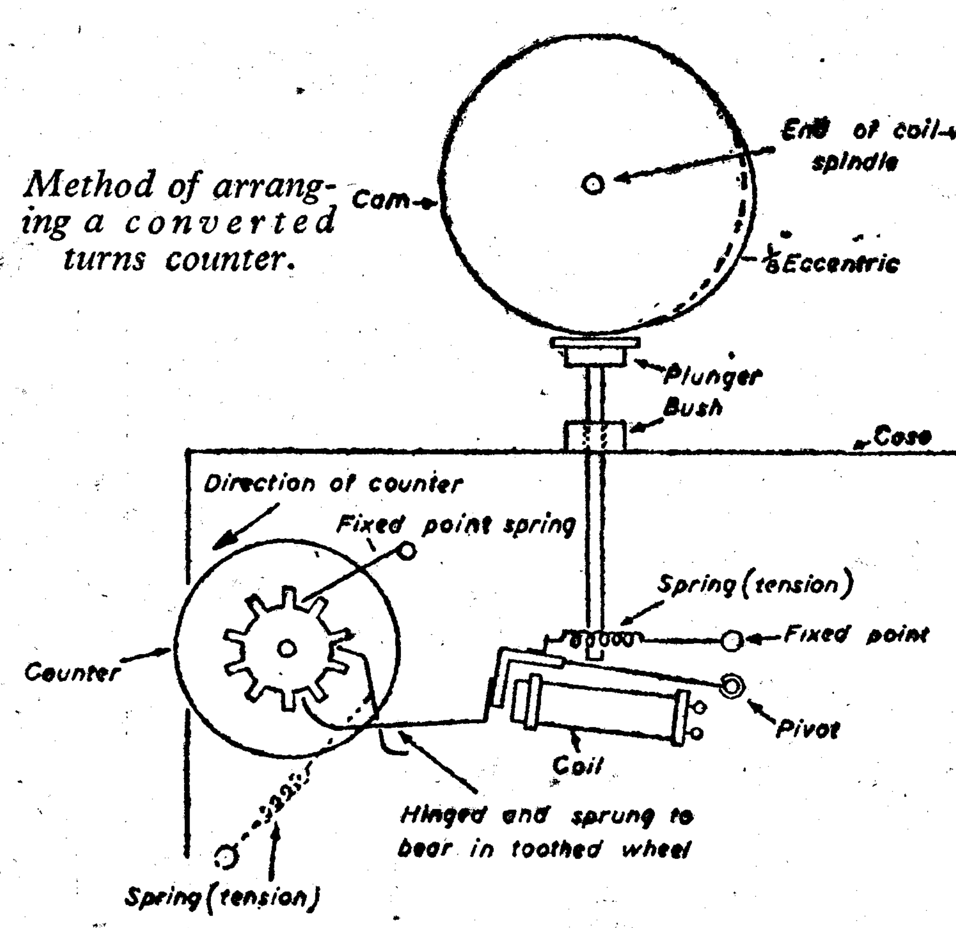


Circuit diagram for voltage testing by a novel method.

A Converted Turns Counter

HERE is a method of converting an electrical turns counter to mechanical operation for a coil winder. Readers who have found a rotary switch not sufficiently positive, 50 volts an inconvenient supply, or who have burnt-out coils, should find the idea useful. I think the diagram is fairly self-explanatory. I sweated a base to the case of the counter and fitted a plunger, as shown, to rest on the moving member of the relay.

Method of arranging a converted turns counter.

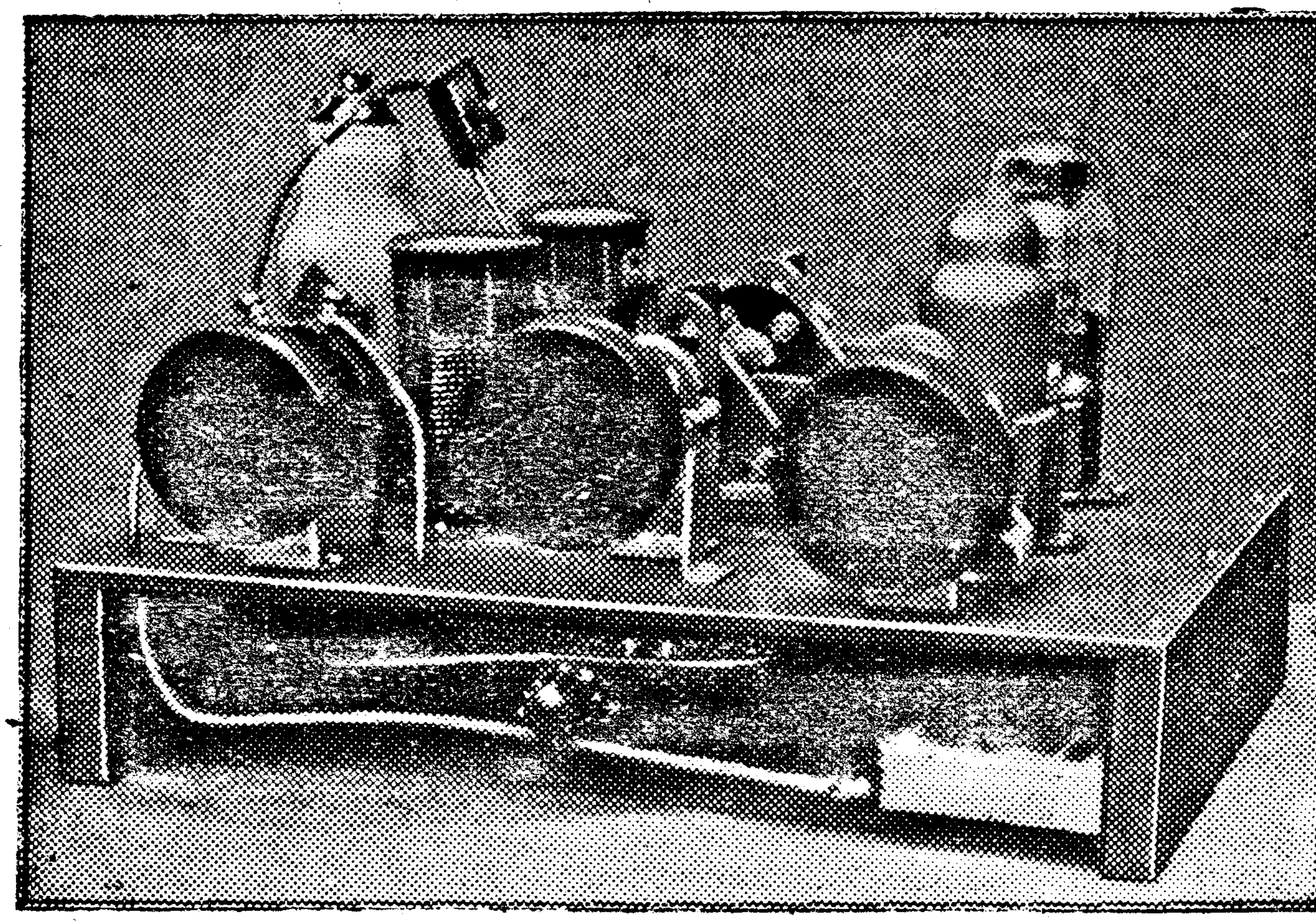


The plunger is operated by a cam on the end of the spindle of the coil-winder. It is ⅛in. eccentric over an arc of about 60 deg. The cam was filed up out of a piece of ¼in. ebonite.—D. KENNEDY (Saltdean).

A Simple All-wave Three

A Satisfactory Receiver from Available Components

By F. G. RAYER



The completed chassis with top screen removed.

PLUG-IN coils are used in this receiver to enable the various wave-ranges to be tuned, which simplifies lay-out and wiring and gives more efficient results on the lower wavelengths than when switching is employed. As nine different coils are available, the receiver can be tuned over any band. It will be found that results on the short waves are equal to those provided by a short-wave receiver, for the whole set is designed along low-loss lines.

The Circuit

Fig. 1 shows the circuit. The tuning condensers have a value of only .0006 mfd. in contrast to the .0005 capacity usually employed in all-wave designs. This simplifies tuning on the lower wavebands, and only slightly curtails the tuning range on the higher bands, the medium-wave band, for example, being from 225 to 550 metres with the specified coil. V.M. volume control is used, and a novel form of H.F. trimming which

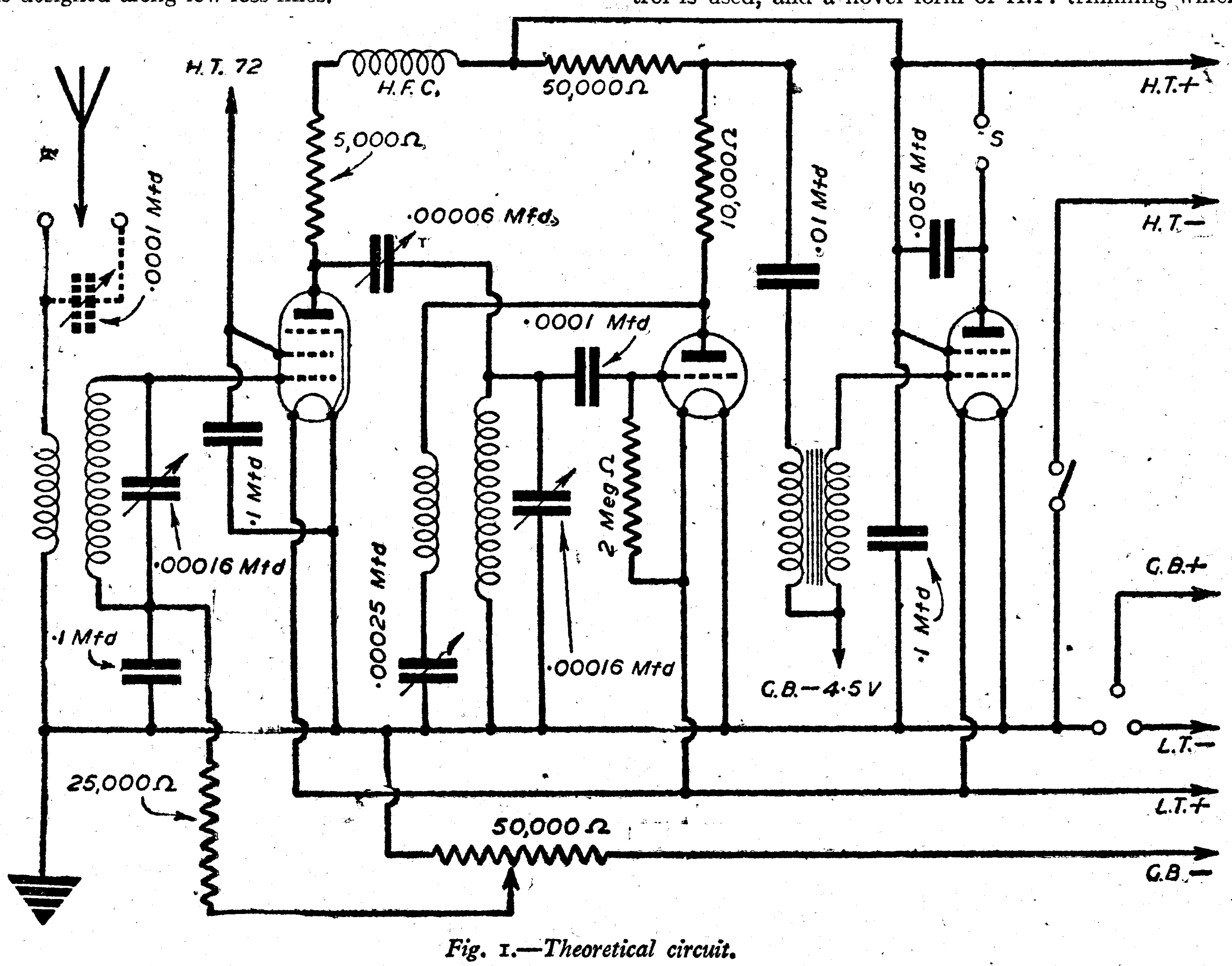


Fig. 1.—Theoretical circuit.

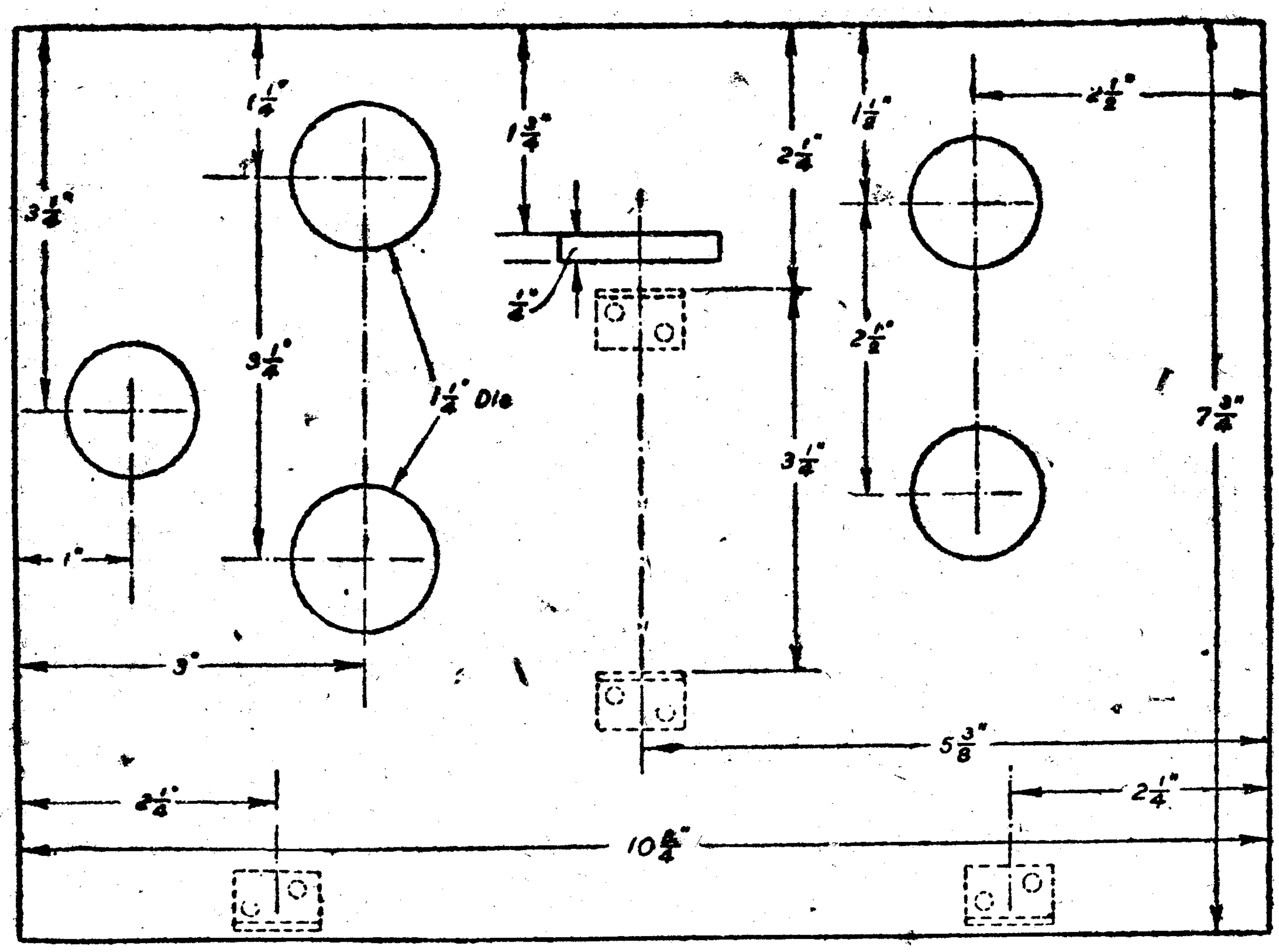


Fig. 2.—Chassis dimensions.

results in no loss of efficiency. A very useful degree of L.F. amplification is provided, and good speaker results assured.

Construction

For the specified components the chassis is drilled out as shown in Fig. 2. It is made of plywood, with side runners of ½in. thick wood, 2¼in. high. Drill out as shown and give the woodwork a good sandpapering. Then screw the side and back runners in position and varnish. The result will be a neat chassis.

The valve and coil holders, etc. (see Fig. 4) are secured with 6 B.A. bolts and nuts. The two tuning condensers are ganged by means of a flexible coupler of the insulated type. A metal one is not suitable as the spindle of the H.F. tuning condenser is not at earth potential. The spindle could be connected to earth, but then it would not be connected directly across the tuning coil, and tuning would not gang so well on the lower wavelengths. At this stage of the construction the

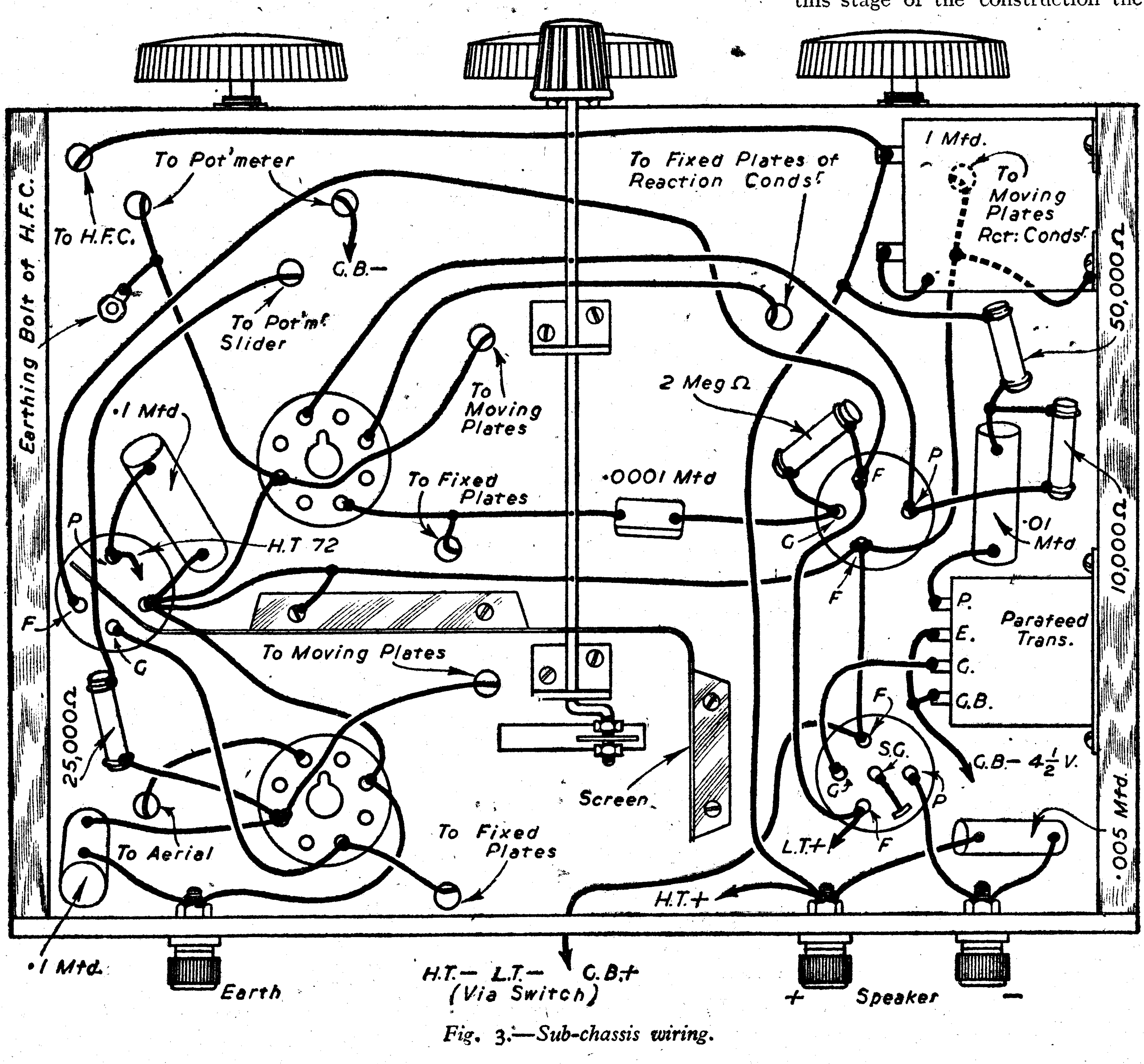


Fig. 3.—Sub-chassis wiring.

special arrangement for trimming the H.F. stage should be added. The detail in Fig. 6 makes this clear. The metal arm shown is cut out from aluminium or brass and secured below the fixing nut of the condenser. The slot is engaged by a cranked arm as shown. Operating the small knob below the chassis (see Fig. 3) results in the fixed vanes of the tuning condenser being rotated through a few degrees. This control should not be omitted, for it enables the last ounce of efficiency to be obtained and is especially useful on the short-wave band to bring the circuits exactly in tune.

It will be necessary to solder a thin washer to the rear component bracket so that the condenser cannot slide up and down the slot. A fibre washer is then fitted together with two lock nuts, leaving just sufficient play to give a smooth action. The cranked operating spindle is a length of 6 B.A. rod threaded at one end, and pivoted in small brackets bent up from scraps of aluminium. These brackets are secured by the bolts holding the two central component brackets, but the front one must be insulated by fibre washers to prevent the shorting of the V.M. bias via the operating spindle. When completed the movement should be smooth and free from back-lash.

A bracket will also have to be made to secure the lugs of the dual-ratio drive. The tuning dial and pointer are not shown for it may be desired to arrange these to fit a cabinet to hand.

A fairly heavy gauge of insulated wire should be used for connecting up, and it is recommended that the wiring run shown in Fig. 3 is followed. Note that the key-way of the coil holders faces the front of the set, and that four tags are left blank. The transformer and 1 mfd. condenser are mounted on one runner; other components suspended in the wiring. Flex must be used for the connections to the H.F. tuning condenser, and a little slack left, so that the whole component may be rocked, when trimming. The speaker terminals are insulated from the rear runner by wander-plug heads; the earth terminal is secured directly to the runner, and the aerial connection taken to the small ceramic insulator on the top of the chassis as shown.

The H.F. coupling condenser is suspended from the cap of the H.F. pentode to the fixed vanes of the tuning condenser as shown in Fig. 4. The 5,000 ohm resistor connected in series with the H.F. choke to prevent resonant peaks is also suspended in the wiring, and solid connections are used to prevent these components moving about.

When wiring is completed the screens should be fitted, the dimensions of these are shown in Fig. 5. They are cut from perforated zinc and fixed with small bolts. Figs. 3 and 4 show their location. They must be connected to the earth line of the set, and the top one prevents interaction between the tuning coils, while the sub-chassis one removes the necessity for screening any of the leads, which would result in some loss of efficiency. It will be seen that the H.F. stage is separated from the rest of the set by these screens.

The fuse shown in the circuit is connected directly to the H.T. minus plug. The on/off switch is mounted

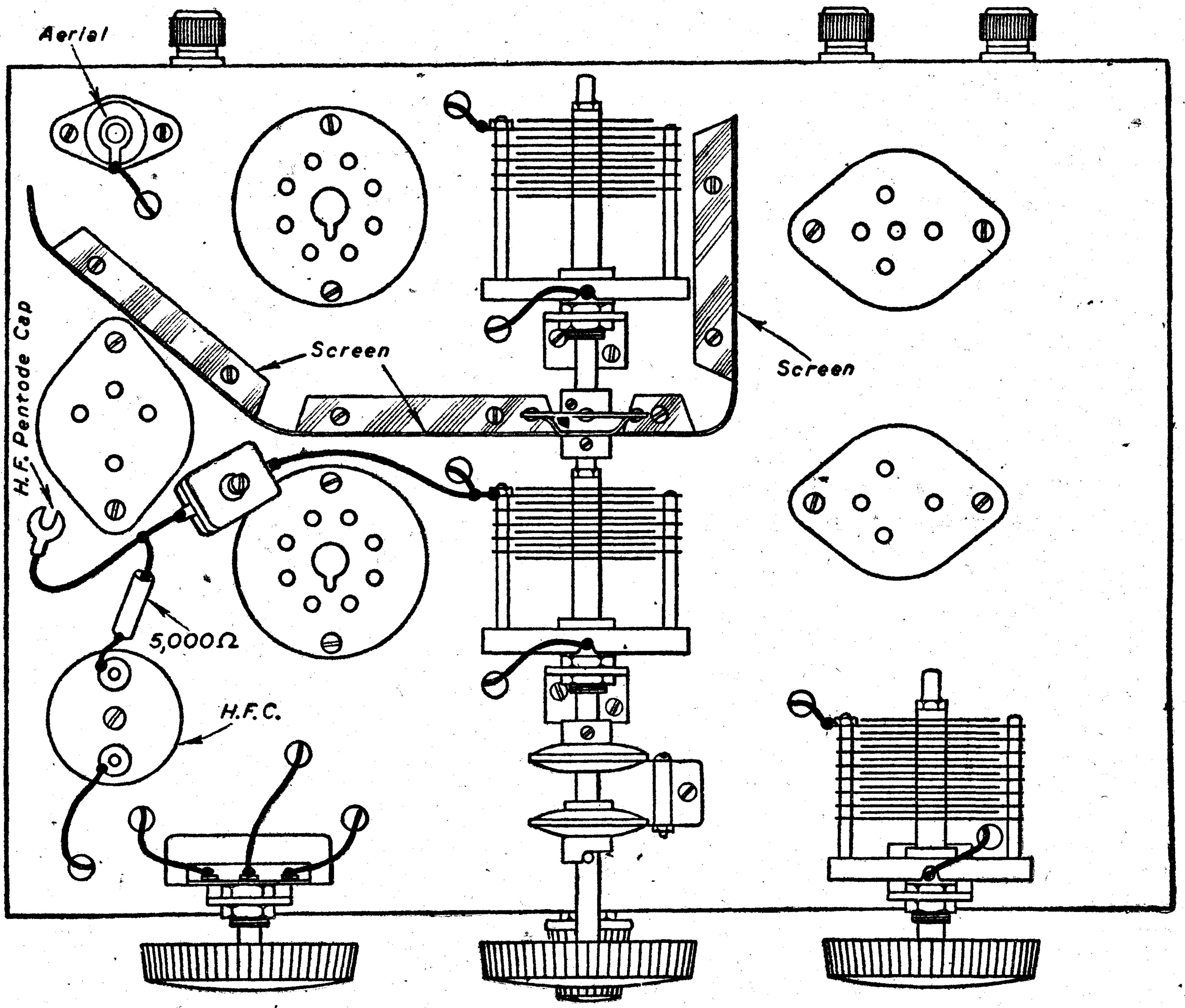


Fig. 4.—Chassis lay-out.

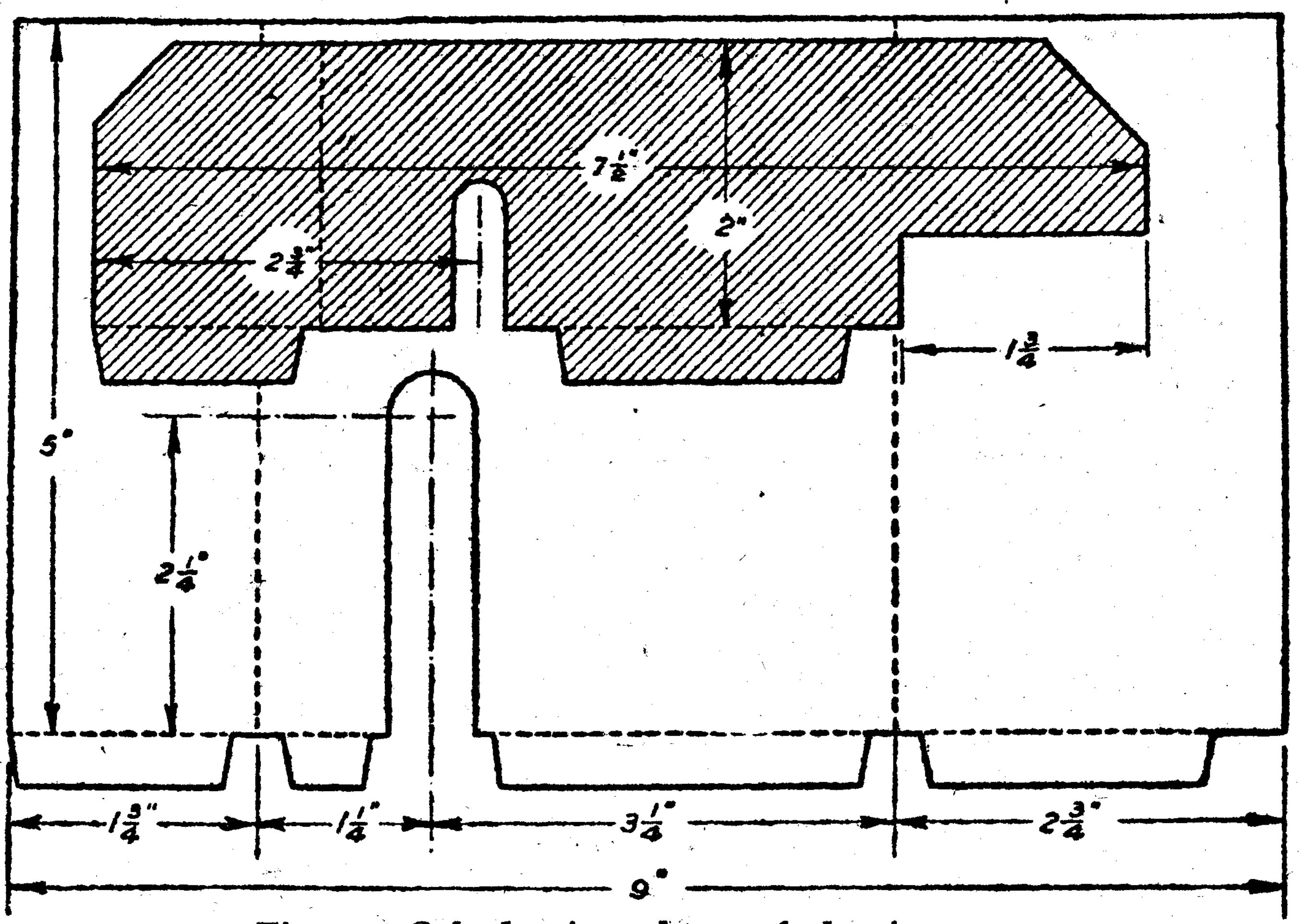


Fig. 5.—Sub-chassis and top of chassis screen.

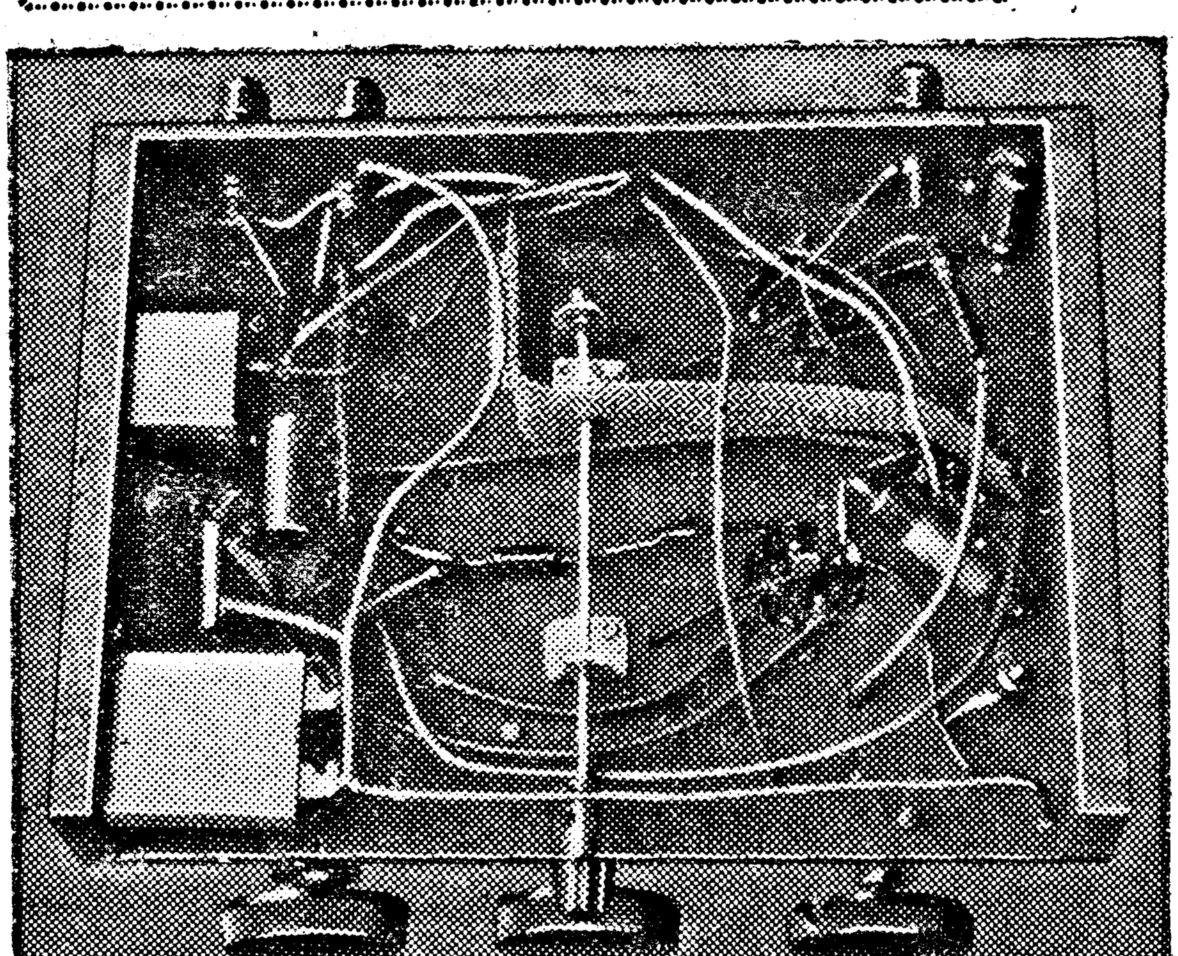
COMPONENT LIST

Premier Radio:
- Two 4-pin and 1 5-pin chassis valve-holders.
- Two chassis coil holders.
- Coils: 2 each of types 04B and 04F (or for waveranges required).
- Two .00016 mfd. short-wave tuning condensers.
- One .00025 ditto.
- 60 mA. fuse and holder.
- Four component mounting brackets.
- Insulated flexible coupler.
- Small ceramic stand-off insulator.

Parafeed transformer, ratio 4 : 1 (Austerity Radio, Ltd).
Screened high-frequency choke (Charles Britain Radio).
Automatic dual-ratio epyclictic drive (Webb's Radio).

Almost any Advertiser:
- Two .1 mfd. non-inductive paper condensers.
- One 1 mfd. ditto.
- One .005 ditto.
- .0001 and .01 mfd. mica condensers.
- 5,000, 10,000, 25,000, 50,000 and 2 megohm resistors.
- 50,000 ohm potentiometer.
- .00006 mfd. mica pre-set.
- .0001 mfd. pre-set (if required).
- On-off switch (3-point).

Valves: Cossor 210VPT, Mullard PM2HL, Osram KT2 (or similar types).
Connecting wire, zinc for screens, etc.



View of sub-chassis.

on the side of the cabinet and not shown in the diagrams. There is one connection from the set to it, other connections going to G.B. plus and L.T. minus, H.T. minus going to the earth line (see Figs. 1 and 3).

Trimming and Operating

To trim the circuits, insert two coils of the same type and tune to a weak station in the centre of the waveband. Set the small trimming knob below the tuning control in the central position. Loosen one of the set screws of the flexible coupler and temporarily secure a spare knob on the rear of the H.F. tuning condenser spindle. The front tuning control and the knob on the H.F. tuning condenser should now be individually adjusted until the station is properly tuned in with both circuits. Then secure the coupler and remove the spare knob. Any slight differences in the rest of the tuning range will be compensated for by adjusting the trimming knob until best volume is obtained.

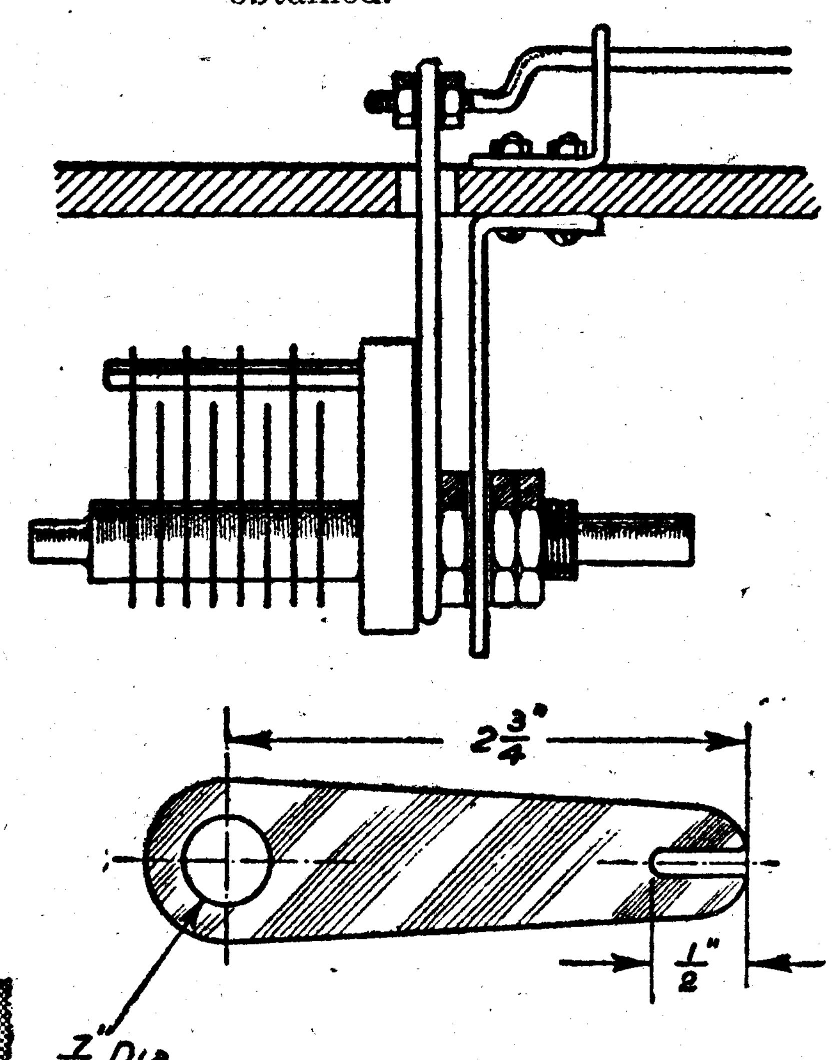


Fig. 6.—Dimensions of arm, and arrangement for trimming H.F. stage.

An additional pre-set condenser is given in the component list, but not shown in the diagrams. This is only needed if the aerial used is lon gor has considerable capacity to earth, when it should be connected in series with the aerial lead. As a pre-set condenser is also used for coupling the H.F. stage to the detector, it should be adjusted, before trimming, to the value which gives best results. It is then left alone to avoid upsetting the ganging.

The maker of the screened H.F. choke states this component is not in very good supply. It will be found, however, that an ordinary unscreened choke provides satisfactory results. Although the 5,000 ohm resistor makes the efficiency of the choke used of less importance, a good quality one should be used if possible. If it should prove necessary a small screen could be made for it from zinc and connected to earth to prevent it interacting with the tuning coils.

H.T. from L.T. Power Units

An Explanation of Some Methods of Obtaining High-tension Supply from Accumulators, With Particular Reference to the Vibrator-type Unit

RIGHT from the earliest days of domestic radio, attempts have been made to obviate the need for high-tension supply, especially in the case of battery-operated receivers. The reason is not hard to find, for it is well known that high-tension batteries, of whatever type, represent the major running cost. When a mains electric supply is available, the problem of high-tension supply is very easily solved; even then, however, the cost of the H.T. supply equipment is quite large by comparison with that of the receiver proper.

In the early days of broadcasting—when mains-operated sets were unknown—the question of dispensing with a high-tension battery was tackled by using valves with an extra grid between the control grid and the anode of a triode (this type of valve must not be confused with the screen-grid valve, which is different in principle).

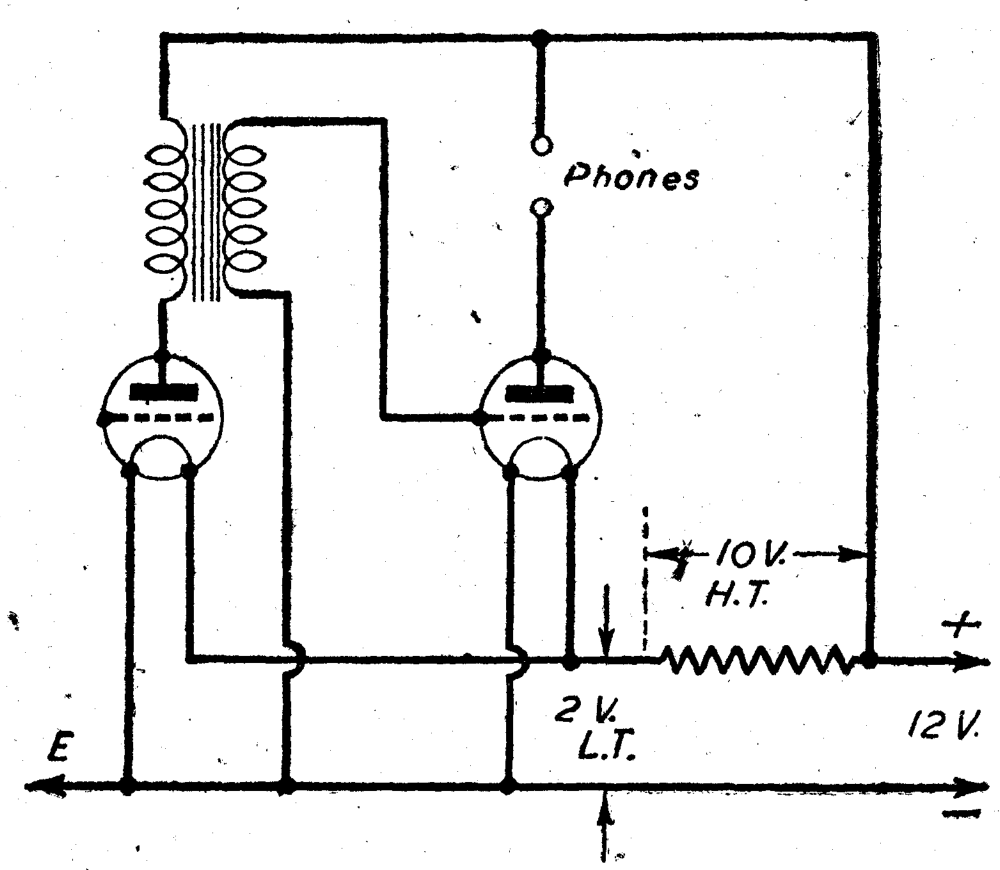


Fig. 1.—How H.T., of very low value, can be obtained by using, say, a 12-volt supply and 2-volt valves.

The idea was that by applying a very small positive potential to the additional grid, an effect could be obtained which would be comparable to the application of a much higher positive potential to the anode. Results of a sort were obtained with this system, but it never proved to be in any way satisfactory for general adoption.

H.T. from Voltage Drop

It is possible to design valves that will operate with a comparatively small H.T. voltage, but there are well-defined limits. And in any case, if a valve is fed with, say, 12 volts H.T., it cannot operate efficiently, and the maximum possible output in the form of high-frequency or audio-frequency voltage is extremely low. Even though a set may operate with 12 volts H.T., that is quite different from operating from an L.T. supply only, and the troubles resulting from the use of H.T. batteries remain.

A feasible scheme is possible when the L.T. supply is at, say, 24 volts—or even 12 volts. But such a voltage is seldom employed in the ordinary way. It might be possible to make a car-radio which would work (after a fashion) by using only the 12-volt car battery for both H.T. and L.T., employing a circuit of the type shown in Fig. 1. It is evident, however, that efficiency would be very low, and it is probable that it would be completely impossible to obtain sufficient output to make the speaker audible in a car on the move. When a 24-volt supply is available, as it is in many aircraft, the possibilities are slightly better, but efficiency would still be of a low order. In passing, however, it is of interest to note that some American aircraft are fitted with intercommunication amplifiers which are fed directly with both H.T. and L.T. from the standard aircraft accumulator. The valve filaments or heaters are in parallel, and are fed through a fixed voltage-dropping resistor in the positive supply lead. If the heaters are rated at 2 volts, there is a supply of 22 volts available for H.T.; even if 6-volt valves are used, it is possible to apply 18 volts to the anodes (less the voltage drop through the anode loads).

Using a Converter

In general, it can be taken as a fact that for anything approaching satisfactory receiver operation, a supply of high-tension is essential. The voltage required is from 100 upward. If such voltages are to be obtained from an L.T. accumulator, whether it be of 2 volts or 24 volts, some form of converter is required. There are two principal and widely-used forms of converter available; the rotary and vibrator types. Up to a few years ago, the first-mentioned was the only kind that was of much use when an H.T. current in excess of, say, 25 mA was required. Nowadays vibrator units capable of providing sufficient output for even large receivers are readily available.

Rotary Converters

The converter type of unit is nothing more than a motor-driven generator or dynamo. There are two armatures on a common shaft and you apply low-voltage D.C. to one and take high-voltage D.C. from the other. There are many special points in design which have been carefully studied and developed by manufacturers, but the machines produced are both efficient and extremely compact. As the output is D.C., rectification is not necessary; on the other hand, a certain amount of smoothing is normally required. This type of unit was widely used for the earlier car-radio receivers, but at that time it was comparatively bulky and certainly fairly heavy; it has been improved very considerably since then, and when mounted on rubber it is almost noiseless in operation. If it is made very compact, some form of cooling is necessary; that only involves mounting the machine in a reasonably exposed position on the car.

H.T. units of the vibrator type have increased in popularity very rapidly during the past six or seven years, and they have been improved beyond all recognition by comparison with the earlier samples. There may be some readers who will remember vibrator units as noisy (both mechanically and electrically) and rather unreliable starters. That is, the contacts often had a tendency to stick, with the result that the unit required a gentle kick to "bring it to life" after first switching on. All troubles of that kind are dead, as far as standard products for normal purposes are concerned, at any rate. A considerable amount of attention has been devoted to the development of suitable contacts and of suitable alloys for the actual vibrating armature.

Advantages of Vibrator Units

One of the prime advantages which has always been claimed for the vibrator type of "H.T.-from-L.T." unit is the light weight. This advantage still applies in general, but there are probably several rotary power units made to-day—although they are not on the open market—which weigh no more, and take up no more space than does a vibrator unit rated to give the same

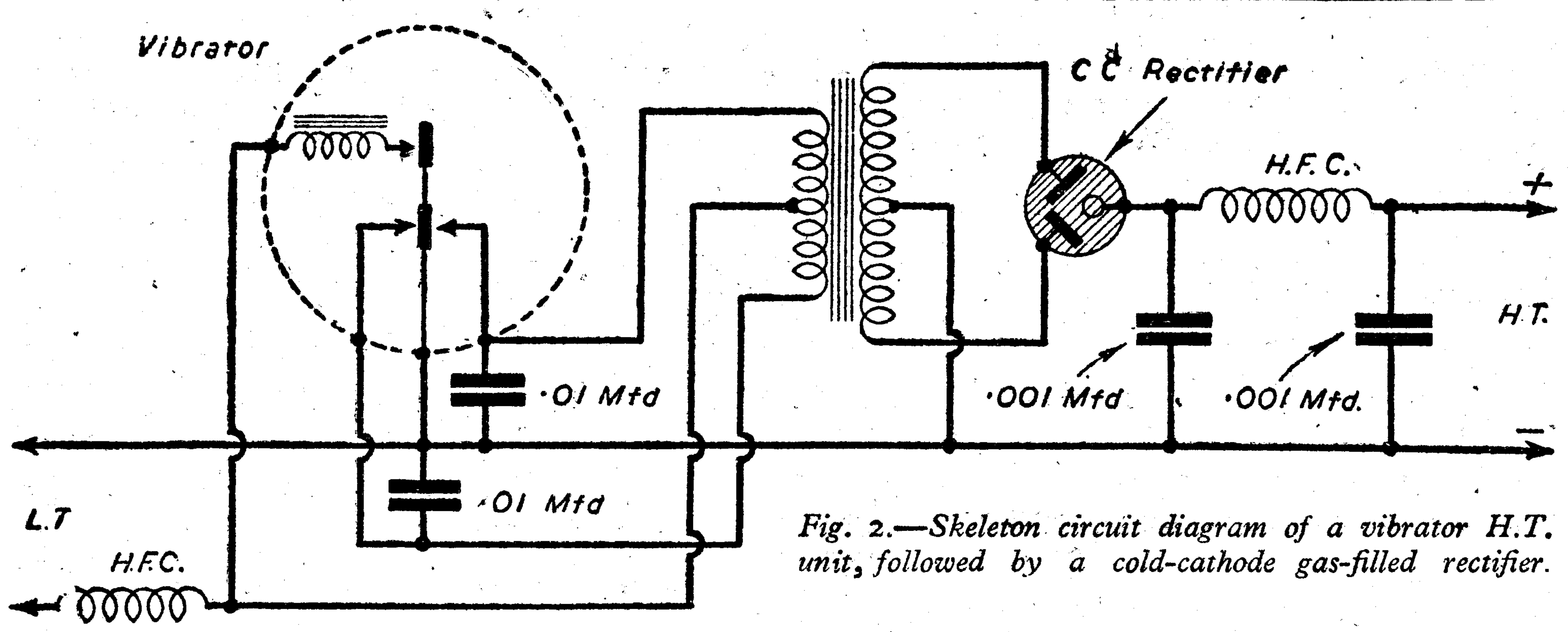


Fig. 2.—Skeleton circuit diagram of a vibrator H.T. unit, followed by a cold-cathode gas-filled rectifier.

output. In this respect it must be remembered that, whereas the rotary unit is complete in itself, the vibrator unit is only a component part of the vibrator power pack. In addition to the vibrator there is a step-up transformer, a rectifier and a full smoothing system comprising condensers and chokes. Of course, the rectifier is often only a part of the vibrator—the self-rectifying vibrator. In that case, the rectifier does not take up any additional space.

Self-rectifying Vibrators

The necessary smoothing components are generally quite small and light, because of the very high frequency of the A.C. output from the vibrator transformer. Fig. 2 shows a skeleton circuit of a non-rectifying vibrator power unit, and this should be compared with Fig. 3, which shows a similarly simplified circuit of a self-rectifying vibrator pack. One may ask for an explanation of the relative advantages and disadvantages of the two types of vibrator. A complete answer cannot be given very easily, but the salient points can be mentioned. The advantages of compactness and simplicity are fairly evident; efficiency, except when the H.T. current is not more than about 60 mA., is probably rather lower with the self-rectifying unit than it is when a separate rectifier is employed; at voltages in excess of 250 or so contact trouble would be more probable with the self-rectifying unit; in all cases, smoothing is simplified when a separate rectifier is used. That is not a complete catalogue, but it may help the reader to form a good general impression of the pros and cons.

How the Vibrator Operates

Fig. 2 shows the essentials of a vibrator-type H.T. unit, but the circuit is not necessarily complete, as considerable care has generally to be given to the suppression of all sparks, and the prevention of interference with the receiver itself. It will be seen that a step-up transformer with centre-tapped primary and secondary windings is used, and that the primary centre tap is permanently connected to one side of the L.T. supply. The two ends of the primary winding are connected in turn, through the vibrator contacts, to the other side of the supply. The secondary centre tap is "commoned" and is the negative output (H.T.) point; the ends of the secondary are connected to the two anodes of a full-wave rectifier, the cathode of which provides the H.T. positive connection.

Cold-cathode Rectifier

Special mention should perhaps be made of the rectifying valve, as the type shown may not be known to all readers. It is of the gas-filled pattern, and may be considered, rather as a gas-discharge tube. It is non-conducting until the voltage between its electrodes reaches a certain figure. As an example, the OZ4 rectifier has a striking or starting voltage of 300; the rated output of this valve is 300 volts 75 mA.

In the circuit shown in Fig. 3 use is made of a self-rectifying vibrator unit, which has one pair of contacts for the L.T. supply to the transformer primary and a second pair which are used for rectification. Rectification is brought about due to the fact that the connection to the ends of the secondary are reversed at the same times and rate as are those to the ends of the primary.

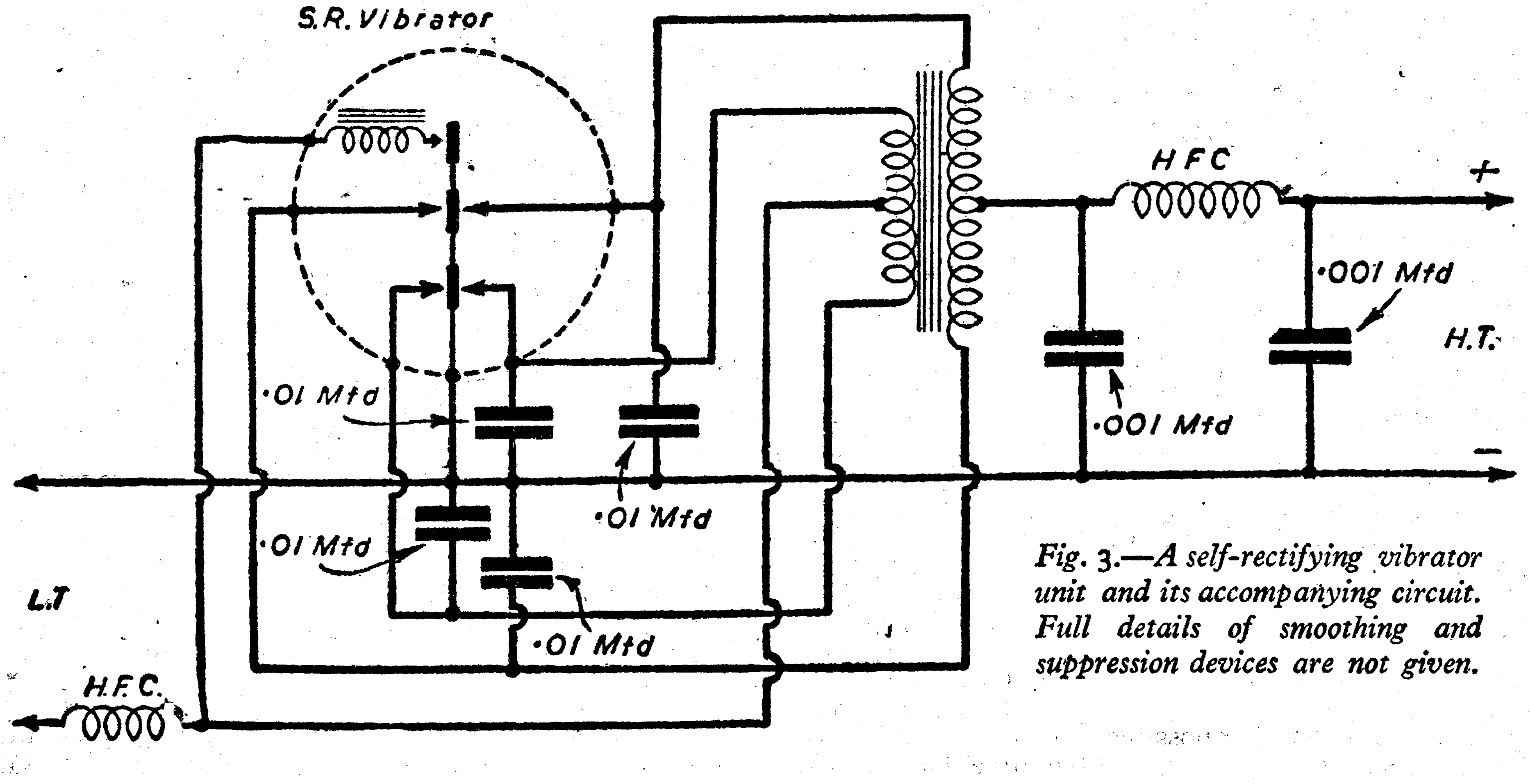


Fig. 3.—A self-rectifying vibrator unit and its accompanying circuit. Full details of smoothing and suppression devices are not given.

Spark and Noise Suppression

In all cases it is necessary to connect fixed condensers across all contacts, to prevent sparking and to prevent any "radiation" which would act as interference on the receiver. Sometimes resistors of values up to about 250 ohms are connected in series with these condensers to modify the time constant. It is also necessary to insert H.F. chokes at various points in the circuit, to prevent interference. Chokes are shown in the two most important parts of the circuits. That in the L.T. circuit must be of very low resistance, but that in the H.T. line can have a much higher resistance (and inductance) because of the comparatively low current with which it has to deal.

It will be noticed that the H.T. choke is used in conjunction with a pair of .001-mfd condensers. This system is not designed to effect complete smoothing, but rather to smooth out any H.F. content of the output; an iron-cored smoothing choke and the usual smoothing condensers are required in addition. This statement may be modified to a certain extent in that the inductance of the smoothing choke need not be as high as usual with a mains unit, due to the high frequency of the A.C. supply from the transformer, and hence the high frequency of the ripple in the rectified output.

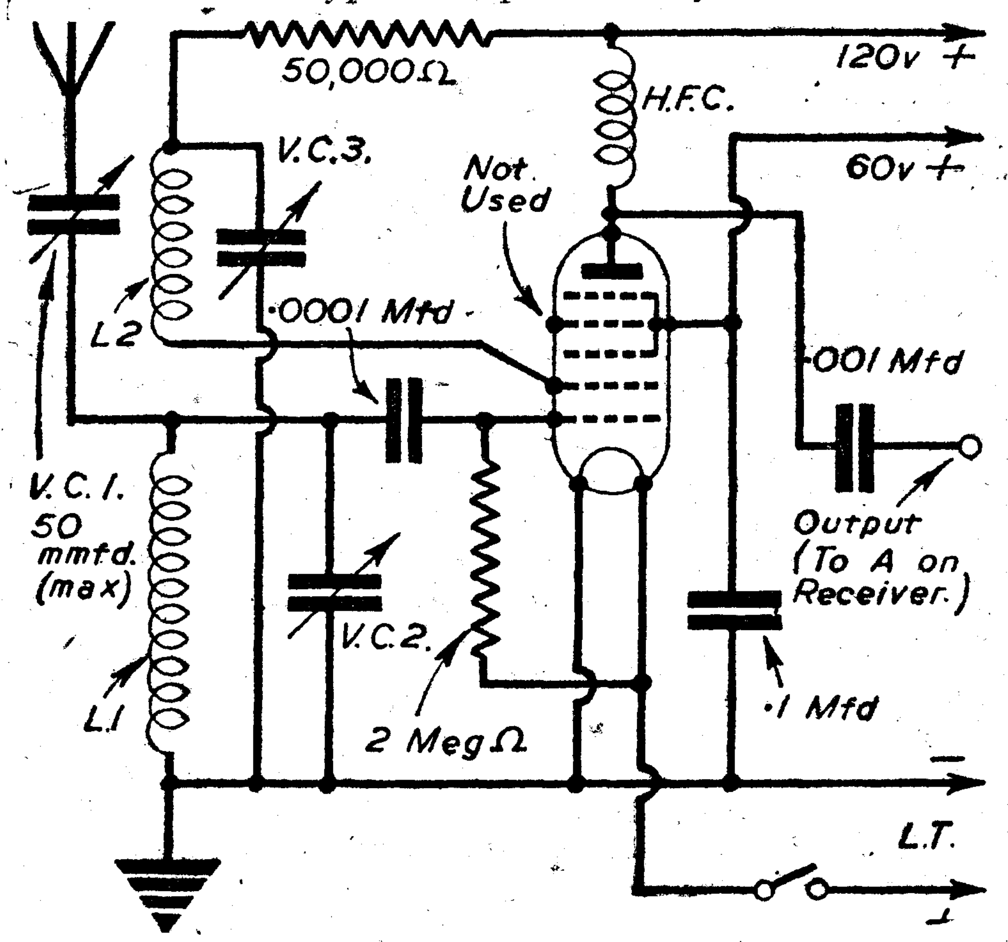
The two .001-mfd. condensers should be rated at no less than three times the rated rectified output, and failures have often resulted from the use of condensers having a lower safety factor. The explanation of this is that the output waveform from the rectifier is by no means that of a sine wave; it is generally more like "saw-tooth" formation with a very steep wave-front. The ripple is therefore prone to be very marked, and likewise the peak D.C. voltage.

A Simplified S.W. Converter

Using a Heptode Valve. By WM. NIMMONS

VARIOUS circuits have appeared from time to time in PRACTICAL WIRELESS showing S.W. converters in which a triode valve achieved the complicated process of frequency changing with the minimum of components. For example, only one coil and one tuning condenser was employed, in contrast to the usual method of tuning the signal circuit and oscillator circuit simultaneously by means of a ganged condenser. That such circuits worked, their publication in this journal is sufficient guarantee.

An oscillating valve generates many harmonics over and above the "fundamental" to which its grid or anode circuit is tuned; in fact, such is the abundance of these harmonics that one or other of them is nearly certain to "beat" with any incoming frequency and to produce a resultant frequency which can be passed on to the broadcast receiver, in the same manner as the more orthodox type of superheterodyne.



Circuit diagram of the S.W. converter using heptode valve.

Many constructors tend to fight shy of the more elaborate forms of S.W. converters, such as the types employing a heptode or pentagrid valve. Admittedly, such types need some care in their construction, and there is the added cost and complication of two tuned circuits. Short-wave ganged condensers are not easily had in these days, while the alternative—two separate short-wave tuning condensers—are awkward to handle and require expert attention if the best results are to be obtained.

I have been experimenting recently with a Mullard FC2 heptode valve to determine if it was possible to evolve a circuit which combined the virtues of the more complicated converter with none of the vices of the simpler type, and the figure shows the result.

It will be noticed that the two grids which normally serve only the oscillator section of the frequency changer, now become the signal *and* oscillator electrodes. The first grid is the signal-cum-oscillator grid, while the second grid is the oscillator anode. The output is taken from the usual anode after traversing through the whole valve. The usual control grid, i.e., the top cap, is not used.

It might perhaps be thought that we could apply a positive potential to the usual control grid, and so help the electrons along on their way to the anode. Such a potential, however, scatters the virtual cathode and renders the valve inoperative.

The coils used are of the simplest character, just a 4-pin coil with the windings L_1 and L_2. These are connected in the right sense to produce oscillations, as of course the valve must oscillate all the time while receiving stations. The coil, L_1, may be of 12 turns on a $1\frac{1}{4}$in. diameter former, and L_2 is 7 turns of thinner wire interwound with the other. Reaction condenser, VC_3, may be replaced by a .001 mfd. fixed condenser with a slight loss of efficiency. I mention this in case anyone wishes to have "one-knob control." But by controlling the depth of oscillation by means of a variable condenser one can obtain the utmost sensitivity for stations with widely varying strength, and this is to be recommended. The condenser, VC_2, is the usual short-wave condenser of .0001 mfd. to .00016 mfd., and should have a good slow-motion drive. VC_1, of 50 mmfds. capacity, is an important adjunct, as it enables the oscillator to generate suitable oscillations to beat with the incoming frequency, and should be carefully handled. In all cases it should be set for maximum signals. The H.F.C. should be an all-wave one, or a short-wave choke in series with a standard choke, the short-wave being next to the anode.

To use the converter connect up the aerial and earth, and join the lead marked "output" to the aerial terminal of the broadcast receiver. With all batteries connected (H.T. — is secured through the L.T. — connection when the same batteries are used for set and converter) switch the broadcast receiver over to the long waves and then tune on the converter. It cannot be stated what part of the long-wave band you should set the receiver to, but a preliminary trial should include the bottom, middle and top of the long-wave band, and you should then be able to judge which gives the best results. Once this has been found you will not need to touch the broadcast set, except perhaps to adjust the reaction, if it has any, as this increases the strength of signals.

Transformers of Various Types—1

An Explanation of the Principles of Their Design and Application

ONE might well open a discussion on transformers by answering the question, " What is a transformer ?" Briefly, it is a device by means of which the voltage of an A.C. supply may be increased or decreased. In parentheses, it should be added that if the voltage is increased the current is reduced, while if the voltage is reduced the current is increased. In other words, although a transformer can be used to step-up or step-down the voltage of A.C., it does not alter the total power available ; at least, it does so only in so far as there must be a certain amount of loss due to the lack of 100 per cent. efficiency of the transformer—as of any other device.

It is a fact, however, that a good transformer has a higher efficiency factor than has any other electrical (and probably mechanical) device. Efficiencies in excess of 90 per cent. are not rare, while a transformer whose efficiency was less than 80 per cent. would be normally regarded as a very unsatisfactory component. Those remarks apply principally to an iron-cored transformer operating on frequencies in the region of 50 cycles, and the efficiency does fall as frequency is raised. Nevertheless, a high-frequency transformer for use on, say, 3 megacycles can still show a remarkably low loss.

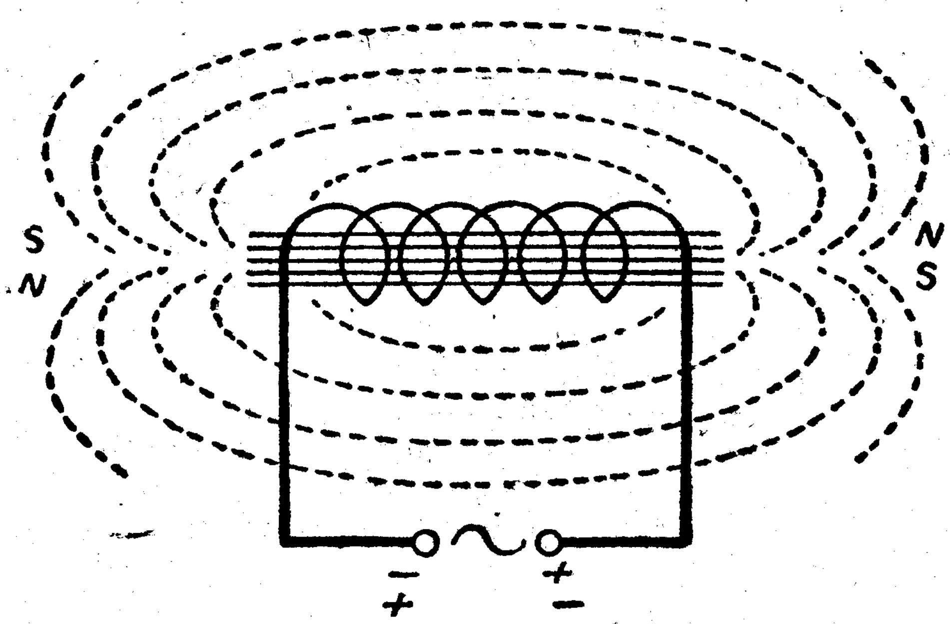


Fig. 1.—The lines of force round a coil connected to a source of A.C. An iron core is chosen, but this is not an essential requirement ; it is desirable when the supply is not of H.F., as it increases the inductance of the coil.

Cutting Lines of Thought

The principle of a transformer, of any type, is not difficult to understand. Imagine a coil of wire, wound on a soft-iron core, and connected to an A.C. supply, as shown in Fig. 1. There is a magnetic field around the coil, so that one end of the coil, or solenoid, has a North polarity, while the polarity of the other end is South. Each time the polarity of the A.C. supply changes, so does the magnetic polarity of the solenoid. And between the changes, the magnetic field collapses, only to be reformed as soon as the voltage has passed through zero.

If a second coil of wire is wound round the first, but not electrically connected to it, an interesting effect may be noticed. This is that if the ends of the second coil be connected to an A.C. meter it will be found that a voltage is developed between the ends of the coil. There is another interesting effect which is worthy of note. If the secondary winding is left open-circuited, and provided that the primary is suitably designed, there will be no consumption of current from the A.C. supply. This is due to the back-E.M.F. resulting from the inductance of the primary, which gives the effect of cancellation of current on succeeding half-cycles. It is sometimes stated that the primary current is watt-less, which means that the primary does not consume power.

But if a load is placed across the secondary winding so that the secondary consumes power, the primary will then draw a corresponding amount of power from the A.C. supply source. If the transformer were 100 per cent. efficient, primary and secondary power consumptions would be identical ; as it is not, the consumption of the primary is slightly higher than that of the loa d connected to the secondary.

Primary-secondary Turns Ratio

So far reference has not been made to the relative voltages applied to, and developed across, the primary and secondary windings respectively. The reason for the secondary voltage is that the lines of force which constitute the magnetic field " cut " the secondary turns. And from the principle of the generator (armature rotating between the poles of a magnet), it is known that a current is induced into the winding as each turn cuts a line of force. If, therefore, the number of turns, on either the secondary of our transformer or armature of our generator, is increased, so will the voltage across the winding increase.

An A.C. voltage can thus be stepped-up with a transformer by placing a greater number of turns on the secondary than on the primary winding. If the secondary contained 2,000 turns and the primary 200, the secondary voltage would be 10 times the primary. Both windings possess resistance, and therefore, if the current to be passed has to be raised, a stouter gauge of wire must be used for both windings.

The type of transformer explained is of the so-called double-wound type, but it is not necessary to employ two windings in order to produce the step-up and step-down effects. Use can be made of a simple, tapped winding ; this is described as an auto-transformer. Fig. 2 shows such a transformer, and indicates how step-up and step-down of A.C. voltage can be arranged.

" Reflected " Load

Another principle of the transformer which has not so far been considered with regard to low-frequency transformers—as opposed to mains or power transformers—is that if a load is placed across the secondary winding, an " image " load appears across the primary (see Fig. 2). For example, if a resistance of 10,000 ohms were connected across the secondary of a step-up transformer having a ratio of 1 : 10, the " image " load across the primary would be 100 ohms. This is due to the fact that any resistance across the secondary of any transformer has the same effect as a resistance equal in value to $\frac{1}{T^2} \times R$ connected across the primary. This applies where " T " is the turns ratio, and R is the value of the load resistance. When the transformer has a step-down ratio, the ratio " T " must be written as a fraction ; for example a step-down ratio of 10 1 would be written as 1/10.

Circuit Matching

Because of the " reflected " or " image " load, a transformer can be employed for matching purposes. One of the simplest examples is in the case of an output transformer used to feed a moving-coil speaker from, say, a push-pull pentode output stage. The A.C. impedance of the speaker speech coil would probably be in the region of 20 ohms, whereas the optimum load of the output stage might be in the region of 50,000 ohms. To match these two it is necessary to employ a transformer of the step-*down* type, and of such a ratio

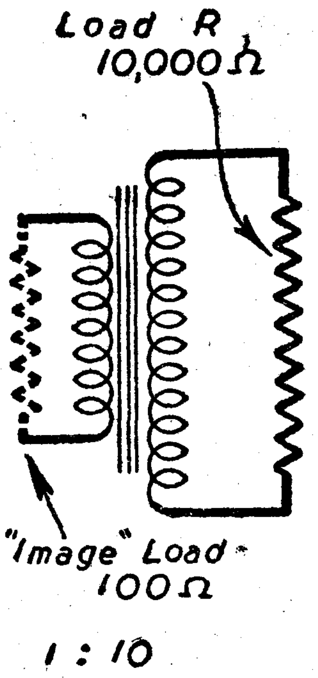


Fig. 2.—This diagram explains the "image" load resistance occurring across one winding when a load resistance is connected across the other

that the "image" load on the primary is equal to 50,000 ohms, while the actual load on the secondary is 20 ohms. The ratio can be found from the well-known formula :

$$R \text{ (Ratio)} = \frac{\text{Optimum load of output stage}}{\text{Impedance of speech coil}}$$

This formula was no doubt known to most readers before, although the reason for using it was perhaps not at all clear.

In the case of an inter-valve L.F. transformer the ratio is governed by the voltage step-up required rather than by any question of loading. Thus, if it were known that the maximum permissible grid swing of a certain valve were 20 volts (plus and minus 10 volts), and that the available audio-voltage in the same anode circuit of the preceding valve were 5 volts, it would be evident that a step-up ratio of 1 : 4 would be most suitable.

Ratio Limitation

Following this line of reasoning, it would appear that the amplifier valve mentioned could also be fully loaded if the audio-voltage from the preceding stage were only two, provided that the coupling transformer has a step-up ratio of 1 : 10. This is not borne out in practice, however, because to provide such a ratio would necessitate the use of an extremely large number of turns on the secondary winding. And the self-capacitance of such a winding would be so great that there would be severe losses, especially at the higher audio-frequencies. Not only would this cause frequency distortion, but it would also result in the effective step-up ratio being much smaller than the turns ratio. Perhaps it might be argued that a remedy could be found in the reduction of the number of turns on the primary winding, but a reduction of that nature would simply mean that the primary impedance would be reduced and that it would be much less than the optimum load of the valve. Because of that, the full audio-output voltage of that valve would not be developed across the primary winding of the transformer.

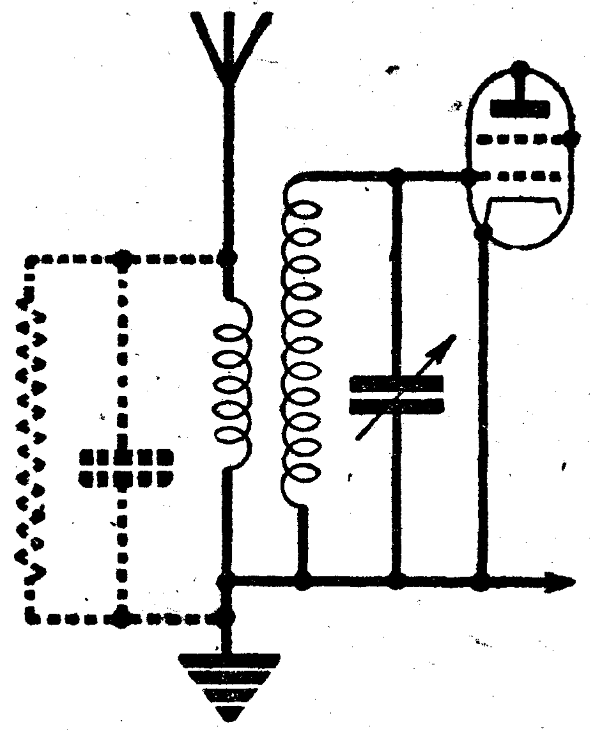
In practice, it is seldom satisfactory to use a ratio in excess of 1 : 5, whilst a much lower ratio is more often to be preferred when using modern high-mu valves.

H.F. Transformers

High-frequency transformers are often used without it being realised that what is just described as a coil is, in fact, a transformer. For example, consider the aerial and input circuit of a receiver, as shown diagrammatically in Fig. 3. The aerial is connected to a winding of a few turns, closely coupled to the tuned-grid winding. We know that the use of this arrangement gives far greater selectivity than can be obtained by connecting the aerial directly to the grid end of the tuned winding. But why? Simply because there is a comparatively low H.F. resistance between aerial and earth. Such a resistance connected across the tuned winding would cause marked damping and flatness of tuning. But because of the "image" effect referred to above, the "image" resistance across the tuned winding is very considerably less than the actual aerial-earth resistance. Considering the example taken previously—but this time "in reverse"—a resistance of 100 ohms between aerial and earth would appear as a resistance of 10,000 ohms across the grid winding, if the primary had one-tenth as many turns as the secondary.

The same principle applies to an inter-valve H.F. transformer where there is appreciable loading of the primary. This load is comprised of the A.C. resistance of the valve in series with the resistance of the H.T. supply. By using a step-up ratio the "image"

Fig. 3.—A step-up H.F. transformer used to couple the aerial to a receiver. The effect of aerial-earth resistance and capacitance on the tuned circuit is greatly reduced by using a step-up transformer. As a result, tuning is kept sharp.



resistance across the secondary is reduced; this is in addition to the advantage of increased H.F. voltage across the secondary.

Instead of using double-wound H.F. transformers, it is often as satisfactory to use an auto-transformer, as previously explained. The result, in the case of an aerial-coupling coil, is that the aerial is connected to a tapping on the tuned-grid coil. It should be mentioned here that capacitance across either primary or secondary winding is "reflected" across the other in the same ratio as is resistance. The difference is that a high capacitance across the primary of a step-up transformer is "reflected" as a lower capacitance across the secondary. The value of an H.F. transformer for coupling purposes is emphasised by this fact, because it is always desirable to have the lowest possible minimum capacitance in a tuned circuit. The lower this capacitance, the wider is the tuning range for a variable condenser of any given maximum value. Bearing in mind that the capacitance of an average aerial-earth system may well be as much as .0003 mfd., the importance of using a step-up transformer between the aerial and the first tuning circuit is obvious.

Many other examples could be given of the use of transformers of various types, but as the principles are the same in all instances it is considered that sufficient information has been given to enable the reader to work out most of his own problems as they arise.

DR. P. M. FISK

MULTICORE SOLDERS, LIMITED, manufacturers of Ersin Multicore 3-core solder wire, announce that Dr. P. M. Fisk has joined the Company and Associated Companies as Chief Chemist. He will be located at the Company's Research Laboratories at Oxgate Works, Cricklewood, N.W.2. Prior to joining Multicore Solders, Limited, Dr. Fisk was well known to the Trade in his previous positions of Chief Chemist to Crittall Manufacturing Company and Briggs Motor Bodies, Dagenham. His new appointment foreshadows even further developments in the technical advances that have been made in recent years in soldering processes by Multicore Solders, Limited.

More About Modulation

Details of Some Interesting Experiments

The System Explained

THE writer once made up an H.F. oscillator, and attempted to modulate the output by a gramophone pick-up with a view to tuning the resulting "signal" on a receiver at the other end of the room.

There is nothing very novel about such an experiment, since every signal generator can be similarly arranged to give a modulated output. But the experiment was of interest, because little or no modulation could be obtained until the oscillator valve had been given a fairly large negative bias. Both anode and grid methods were tried, with the same result.

The basic circuit for anode modulating is shown in Fig. 1. Here, the H.F. amplifying stage is indicated

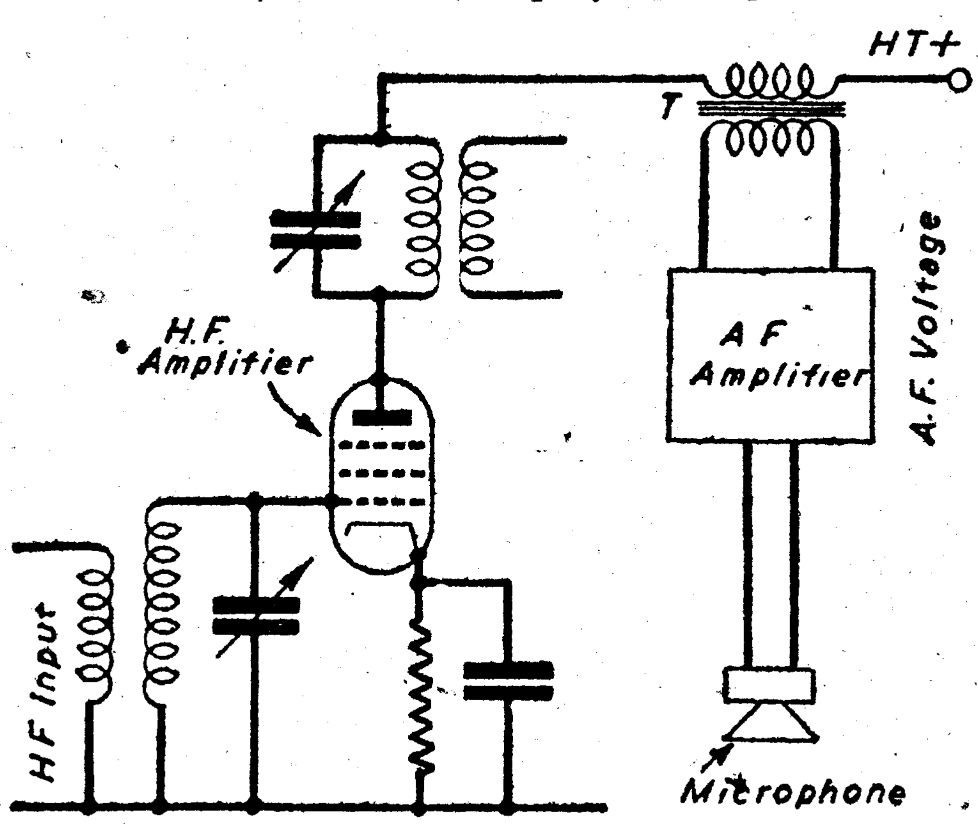


Fig. 1.—Schematic of arrangement for anode modulation.

as having an independent H.F. input, but it could equally be a self-oscillator. The microphone is connected to an A.F. amplifier, which delivers an output via the transformer T, in the form of alternating voltages at speech or musical frequencies, opposing and assisting the voltage from +H.T.

In other words, the anode potential of the H.F. valve will be caused to "swing" at audio-frequencies, and it might be expected, therefore, that the H.F. output into the anode tuned circuit should be modulated accordingly. It seems obvious, at first, that the A.C. output delivered by any valve is a function of the anode voltage, yet very little modulation was observable in this case.

The answer to the riddle, of course, is in the fact that we can vary the H.T. quite a lot without affecting appreciably the actual A.C. output. As long as the amplitude of the signal applied to the grid is constant, changing the anode voltage will have but little effect on the A.C. swings produced. For example, consider an A.F. power stage driving a loudspeaker. Even 50 v. or 100 v. more H.T. on the anode will not affect the power output and volume to any large extent, unless the grid signal is correspondingly increased. What change there will be is due to a certain amount of non-linearity of the valve characteristics.

What happens, then, to the extra power put into the stage? It will be found largely dissipated as heat at the valve anode. Precisely the same applies to the simple modulated-amplifier; with a constant amplitude of H.F. voltage on the grid, the fact that the anode voltage is varying at audio-frequencies is no guarantee that the H.F. output need vary proportionally. Except for a certain amount of modulation due to curvature of the characteristics, the net result is to cause a cyclic change in the power wasted at the anode.

Conditions for Modulation

As stated, when the H.F. amplifier was given sufficient bias, a very good depth of modulation was obtained, though careful adjustments were necessary in order to reduce distortion to a minimum.

Why is it that, now, the H.F. output is very largely under the control of the H.T.? In Fig. 2 (a) and (b) are shown two operating conditions possible with a large bias, namely Class B and Class C operation. In Class B, the initial bias is nearly to current cut-off. When H.F. potential is applied to the grid, output current is obtained during positive half-cycles only, and thus takes the form of rectified half-cycles. The result represents a high degree of distortion, but this will not matter a great deal in an H.F. amplifier because complete cycles will be completed in the tuned circuit—higher harmonics being by-passed by the tuning condenser. Class C, Fig. 2 (b), is an extreme case of Class B, where the rectified output pulses occupy less than a half-cycle.

Now, the effect of increasing or decreasing the anode voltage will be to shift the bias point, relative to the new voltages, i.e., to move the I_a–V_g characteristic to the left or the right, as shown in Fig. 3, where the initial voltage on the anode is assumed to be 100 v

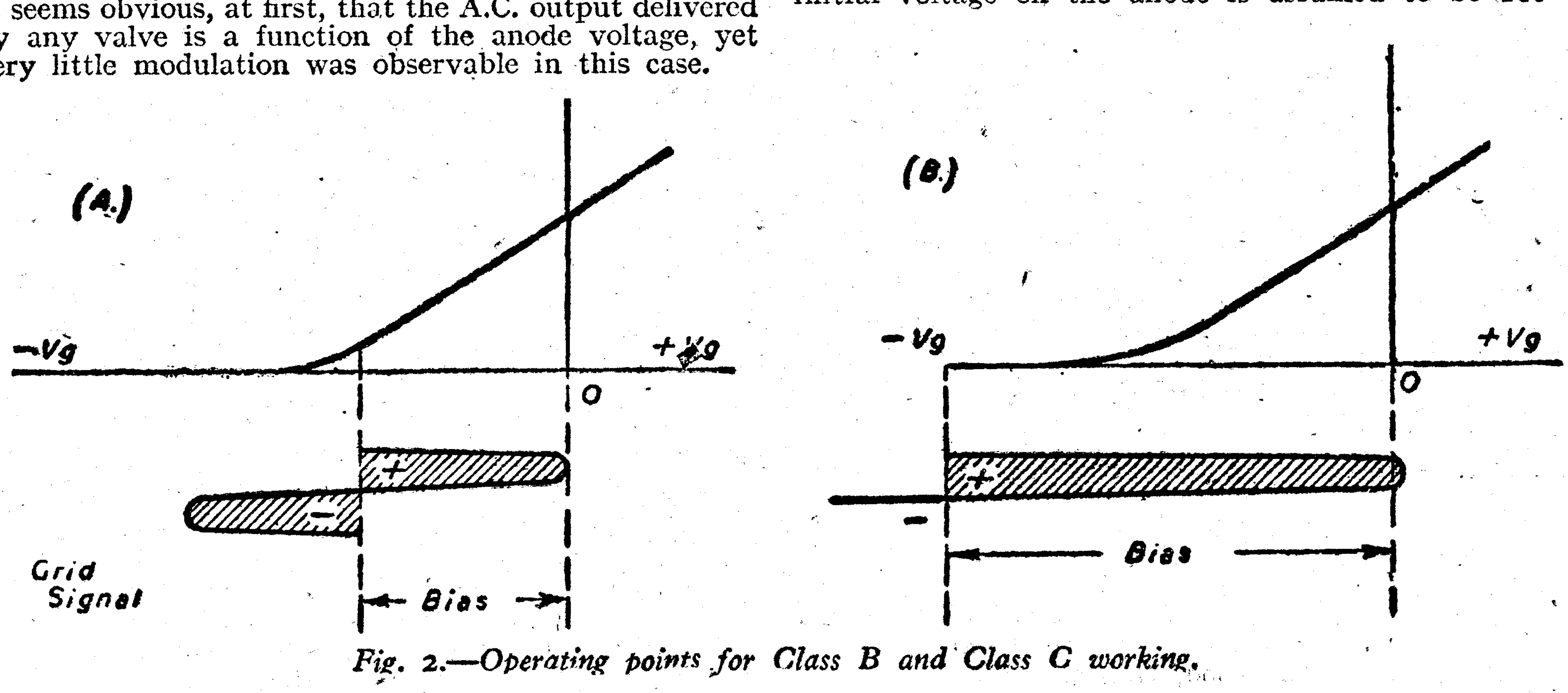


Fig. 2.—Operating points for Class B and Class C working.

The valve was initially biased to point P, the current cut-off point for this 100 v. characteristic. But at 150 v. we are no longer at cut-off, and at 50 v. the bias is much beyond the cut-off point—for this characteristic.

The important thing is that the H.F. stage is now delivering a *rectified* output, as described in Fig. 2. The negative half-cycle of grid alternating potential is without effect, hence the H.F. output will depend

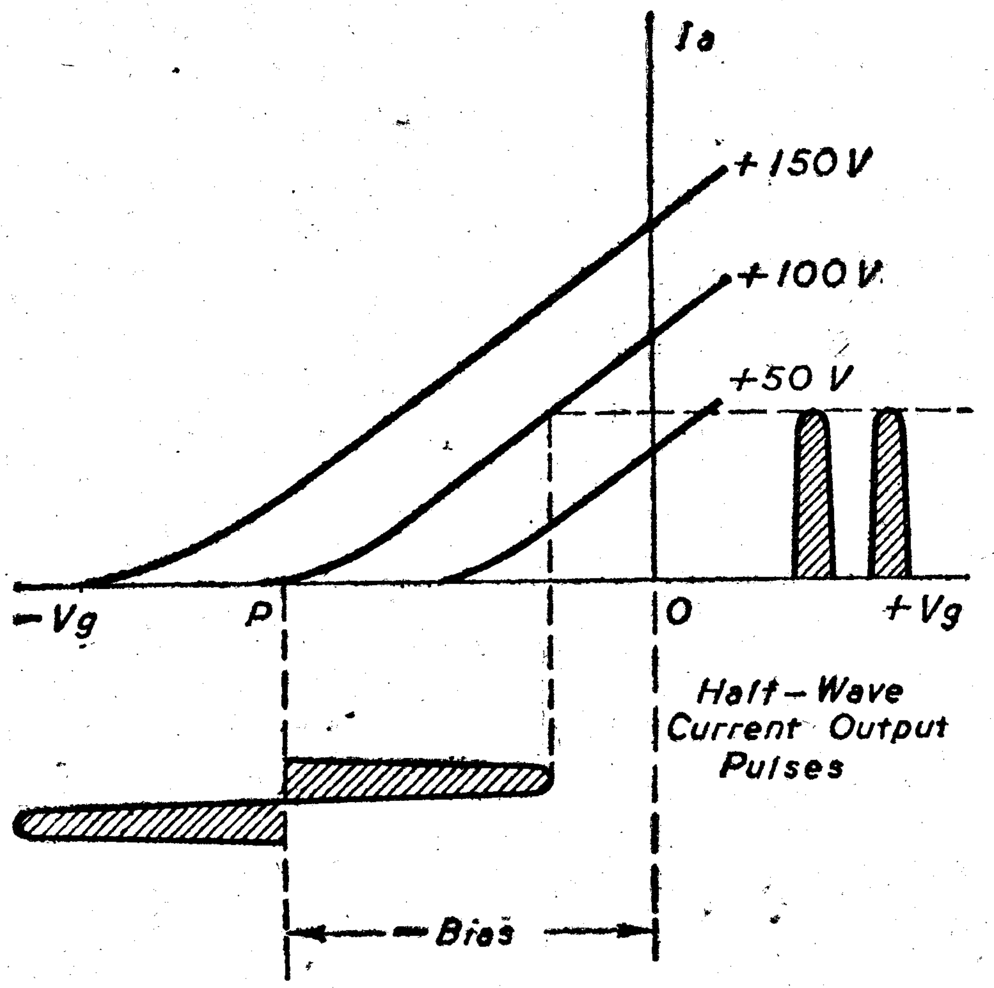


Fig. 3.—Showing the mechanism of anode modulation. With valve biased to point P on +100 v. characteristic, the a.f. voltage swings the anode potential between the limits of +150 v. and +50 v. The amplitudes of the rectified output pulses will vary accordingly.

upon the amount of potential swing, in the positive sense, which, in turn, depends on the bias point. Since the latter is relative to the anode voltage at any instant, the amplitudes of the output pulses will follow a variation in the H.T. at audio-frequencies. A little consideration will show the same is true if only partial rectification took place, e.g., due to curvature of a characteristic. With any such non-linearity, or asymmetry in the current output cycle, the mean value of the rectified H.F. must necessarily vary at audio-frequency, which can only be true if the amplitudes of successive pulses are similarly varying. As long as we operate under distortionless, or non-rectifying conditions, this will not be true: the mean value of a symmetrical A.C. cycle being always zero.

Grid Modulation

The principle still applies if we kept the anode voltage constant, and arranged the output voltage of the A.F. amplifier to swing the grid bias of the H.F. stage.

If the valve is delivering a distortionless H.F. output, the bias swing will give rise to an independent A.F. current component, but the symmetrical H.F. cycles will simply become superimposed upon this component, i.e., their amplitudes will not be affected. Control of the H.F. output implies that the A.F. component in the anode circuit must be the mean of the successive H.F. pulses themselves, as in a detector stage, which is another way of saying that rectification must take place.

Grid modulation (or "grid bias modulation") is a method of controlling the *efficiency* of the H.F. amplifier. The efficiency is the ratio, A.C. power output/D.C. power input. The anode input is constant, but we can get a large degree of control of the output if the valve is sufficiently biased to give a rectifying effect, as explained. Another way of looking at the matter is to say the bias controls the *effective amplitude* of the H.F. driving voltage on the grid, by which is meant the amount the grid potential can swing in the positive sense to the right of the cut-off point. If we operated linearly, with insufficient bias to cause rectification, the positive and negative half-cycles of driving voltage would be independent of bias variation.

We saw, too, that anode modulation results in a swing in the bias point, but *relative to the anode voltage at any instant.* It causes the effective driving voltage to increase, and deliver increased output over an interval, when the anode power input is proportionally increasing. Hence, the ratio, A.C. output/D.C. input, the efficiency, remains practically constant over an A.F. cycle, and we have "input control" instead of "efficiency control" as in the grid method.

Conclusion

From the above discussion it becomes evident that the essential condition for modulating is the same as for detecting, or extracting a modulation envelope, in the sense that rectification or its equivalent is necessary in both cases.

It is no more possible to "modulate" than to "detect" a signal by means of a circuit element whose voltage/current characteristic obeys simple Ohm's Law, because in this case H.F. and A.F. voltages would merely give rise to separate current components. But if the device has a curved, or non-linear characteristic, the fact implies that a third factor, e.g., its resistance, is a function of the applied voltages, when the current produced by one of the applied voltages becomes dependent upon the magnitude of the other voltage at any instant.

Class B and Class C methods give complete rectification, though, as seen, a simple "resistance" is not necessarily the variable factor here.

Generating Ultra Short-wave Oscillations

IN connection with the article in the September issue under the above title, it should be noted that optimum results are obtained if the electrons can be made to strike the anode at the point where they have just ceased to hand energy over to the anode circuit, and before they begin to extract it. This can be accomplished by arranging the magnetic field at an angle to the normal axis so that the spiral paths are drawn out into helical ones, the axes of which are inclined towards the anode. By a careful alignment, the electrons can be made to strike the anode at the critical moment when they are at the centre of their spiralling motion.

The angle at which the field is maintained in this method of magnetron employment prevents the effect of the dynatron and the resonance methods from affecting the oscillations produced.

The power output of the electron method is poor as is the overall efficiency, though extremely short wavelengths may be produced by the system. In practice the anode is, of course, split so that a tuned circuit may be incorporated.

A tuned magnetron circuit need not necessarily be external to the valve envelope. In some types of magnetron the tuned circuit consists of the anode segments themselves, with lecher attachments forming quarter-wave transmission lines.

The article was necessarily made very elementary, as the complete theory of magnetrons involves complex mathematical treatment. It is hoped, however, that an insight has been gained into the methods employed for the production of very high frequencies.

History and Development of Radio Science

Extracts from a Paper by HEREWARD WAKE Presented to the Institute of Practical Radio Engineers

(Concluded from page 516, November issue.)

MARCONI employed the coherer invented by Branley, with Popoff's automatic tapper for decohering after a signal was received. In fact, his apparatus differed very slightly from that of his predecessors when he applied for and was granted his first patent in England in 1896 for wireless telegraphy. From then on, however, Marconi made rapid strides in the advancement of the art, being successful in transmitting and receiving messages between two warships over a distance of 12 miles. In this same year Marconi was successful in enlisting the financial backing of a number of wealthy Englishmen, and formed the Wireless Telegraph and Signal Company; he was made a director of this company and placed in charge of all development work, although he was but then 23 years of age. In 1899 he adapted to wireless, Sir Oliver Lodge's principle of *syntony*, or tuning of circuits, perfecting it and obtaining a patent in 1900. It was a remarkable step forward in wireless transmission and reception, since it eliminated the interference of stations transmitting simultaneously, a problem of no mean proportions until that time. In 1899, Marconi was successful in covering distances up to 74 miles with his instruments, and ship and shore stations began to install his equipment . . . In 1899 the *New York Herald* engaged him to report the international yacht races held in October of that year, the result being, of course, long known before the ships returned to port. [Editor's Note: Another historian records that deForest was a competitor with his system of wireless telegraphy at an international boat race and that the two transmissions jammed. Marconi's famous transatlantic transmission of the letter S in the morse code (three dots) was made in 1901.]

Dr. Lee deForest

The most outstanding American scientist of all time had many financial setbacks in his early career. He invented the *audion tube* or the modern radio valve around which has been built an industry of gigantic proportions. Involved in patent litigation with Fessenden and others over his inventions, particularly in reference to the *electrolytic detector*—an aluminium cup filled with an acid solution into which was inserted a thin silver wire permitting unilateral conductivity of signals, an improvement on the coherer and decoherer —deForest, often finding difficulty in meeting weekly wage bills, persistently and bravely persevered with his ideas until to-day he is justly acclaimed as the "Father of Modern Radio." Taking Fleming's valve, invented in 1904, deForest placed in the vacuum tube or glass envelope a grid mesh of metal between the filament and anode, thus linking the functions of thermionic detection and amplification. This was in 1906, but again financial difficulties intervened, so that in 1912 he disposed of the patent rights to the American Telephone and Telegraph Company for a moderate figure compared with the actual value. To-day, however, this outstanding scientist has little need to worry about money: he is the inventor of *sound on film*, long-distance telephony, the high-frequency surgical lance, therapeutic diathermy apparatus and numerous other radionic devices of benefit to mankind. Still experimenting, inventing and striving, may he long continue to be with us.

The Crystal Detector Era

In 1907 came the *Pickard Crystal* and the subsequent development of the crystal-type of receiving circuit. Pickard at first used silicon, though he later experimented with iron pyrites, carborundum, galena and other materials.

The First SOS

In 1909 two American steamships collided off the Atlantic seaboard, the *S.S. Florida* and the *S.S. Republic*; the wireless operator, J. R. Bins, sending out the first distress signals were the means of saving the lives of all the passengers and crew before the *S.S. Florida* sank. This gave wireless telegraphy such publicity that soon after all ships above a determined tonnage were compelled by law to install transmitting and receiving apparatus.

The Radio Circuit Era

Then followed what can be best described as the "circuit era," which can well commence in 1911 with deForest's *Audion Tube Circuit*, and the subsequent development leading to the *reflex* circuits in 1917. Honeycomb types of inductances were first used in radio circuits about 1919; *loose coupling, reaction*, and *straight-types* of circuits following. From receivers of the single valve type, there followed so-called innovations employing as many as ten valves, and although Major Armstrong, an American, is credited with inventing the *superheterodyne-type* of receiving circuit in 1920, it has been hinted that it was first used by the Signals section of the U.S.A. Army during the First World War. No confirmation of this is, however, available. Names like Hartley, Hazeltine, Colpitts, Reinartz, Flewelling, Roberts, Grimes and Browning-Drake all revive memories of receiving circuit development contributed in no small way to radio's history.

The Boom Years

Then followed the boom years of the early marketing of receivers, the circuits carrying a weird semi-scientific series of names, the majority of which terminated in *dyne*. All of them were, however, adaptations, twists and distortions of the original circuit designs of the group of young Americans named in the previous paragraph. To-day, the "dyne" termination is generally recognised as applying to the super-heterodyne type of circuit only, which bids fair to become standard.

Broadcasting

It was in 1921, possibly a little earlier than the first few months of that year, when *broadcasting* began to show signs of becoming a commercial proposition in the United States of America, though in 1919 Frank Conrad, of Pittsburg, Pennsylvania, transmitted from his amateur or *ham* apparatus speech and gramophone records. His *station* later was accredited with the *call sign* KDKA and was receivable on *short waves* anywhere on earth. As receiver circuits developed so also did transmitter circuits, single installations using nearly 500 valves for broadcasting and transocean signalling, these valves, as an average, having but individual 15-watt outputs—not the 500-watt or 1-kilowatt ones as employed to-day.

Progress Checked Commercially by the Second World War

The development of commercial radio and television virtually came to a standstill when the present war broke out and will remain as such until it is ended. That this is not altogether arrested development will become soon apparent when hostilities cease, for then many secrets will be released that will disclose revolutionary methods of transmission and reception and again allow commercial marketing of radio apparatus on a greater scale than ever before.

Radar

In 1922, American scientists noted that a ship, if between a transmitter and receiver, blanked out signals. Pursuing their investigations they found that a ship and also an aeroplane would *reflect* or bounce signals back, making it possible to even have the transmitter and receiver at the one location. Painstaking research disclosed that an aeroplane could be detected in flight in the year 1930, and by 1934 one could not only be detected, but its direction plotted and the distance from the *radar* detecting apparatus. Much of the basic research was carried out by the American National Bureau of Standards under the supervision of Dr. John H. Dellinger. In 1935, R. A. Watson-Watt (now Sir R. A. Watson-Watt), a direct descendant of the Watt who invented the steam engine, a Scot by birth, improved upon and perfected this apparatus so that he was able to detect the approach of a distant aeroplane and follow it like a moving finger whenever it turned or twisted. Watson-Watt was made Director of Communications Development at the Air Ministry in 1938, and in 1940 was appointed Scientific Adviser on Telecommunications. His invention in this respect, radar, was, in this country, the greatest secret weapon of the war and one of its best-kept secrets—until July 17th, 1941. Undoubtedly, the reason for the revelation was that we badly needed radio technicians to operate and service the apparatus. Lord Beaverbrook broadcast an appeal for radio volunteers throughout the Empire and the U.S.A., from which can be quoted : " It is the radio that destroys the enemy in the darkness, that seeks him out through the clouds. It is the radio that sends the avenging fighter to the place where he will meet the lurking enemy and bring him to destruction. . . ."

Conclusion

There are many not mentioned in this brief survey who unstintingly contributed to the present stage of development, especially during the past 60 odd years. Maxwell, theroising the existence of electromagnetic waves longer than light or heat waves ; Hertz, experimentally generating these waves : Marconi, using them as a means of communication minus a connecting medium ; deForest, developing apparatus capable of transmitting and receiving them over a wide range of sound frequencies ; Armstrong, revolutionising reception by frequency modulation broadcasting so realistic as to be scarcely believable—free of incidental interference, still have many disciples zealously conducting countless experiments.

Many are the disappointments and few the triumphs ; but may their ilk continue, still believing that *radio has barely started.* They, like those of us who have taken up radio as a career, do not concur with the statement so often met with that " Radio Engineering is a specialised branch of electrical engineering," but that *it is* an entirely separate department of systematised knowledge. Hertz, in 1887, severed the joining link—if ever there was one ; Marconi and deForest *isolated it.* The most intricate of *machinery* employed by the electrical *engineer* becomes obviously cumbersome by comparison with the simplest of apparatus used by radio *technicians*—one is *wired :* the other *wireless.*

Data About Magnets and Speakers

Factors of Design and Construction

THE value of magnet steel to the user, whether it be the field magnet of a loudspeaker or for any other purpose, depends primarily upon the energy which, when correctly applied, a magnet will sustain in its external field. There are exceptions to this so far as the commercial value of a magnet steel is concerned but for the time being these can be ignored.

To those not accustomed to this manner of expressing the value of a magnet the meaning may seem a little obscure. To make it clear let us suppose that a magnet be constructed, jointed in some way, so that its poles could come together, then in coming together they could be made to do work, such as lift a weight through a height, and this could be at once expressed in ft./lbs. energy. As a matter of fact, in this way a magnet could do more work than at the outset existed in the gap, because there is also energy in the magnet itself which partly comes out and becomes available when the gap is closed, but this need not trouble us, the idea of a definite quantity of energy in the gap has been made clear.

Now the unit of energy employed to match B (expressed as lines of force per cm.^{2}) and H (in gauss) is the *erg*. We shall say nothing about this unit except that 10,000,000 ergs go to the joule, which is the electrical engineer's unit of energy, such as 1 joule per second = 1 watt, or 746 joules per sec. = 1 h.p., or 1 joule = .7373 ft./lbs. The ergs per cubic centimetre are given by the expression $\frac{B \times H}{8\pi}$, or conveniently, $\frac{B \times H}{25}$

or Joules = $\frac{B \times H}{25 \times 10^7}$

The most favourable or optimum value of B×H for different grades of magnet steel is usually to be found in the manufacturer's catalogue or handbook, thus as average figures, we may take column 2 of the following table as representing ' BH max." for cobalt steels of the percentages given:

Column 5 gives the cost per joule on the basis of prices given in column 4.

% Cobalt	BH max.	Joules per lb. of steel	Price per lb. pence	Price per Joule s. d.
3%	350,000	.080	13	13 6
6%	420,000	.096	16	13 11
9%	480,000	.110	19	14 6
15%	600,000	.136	25	15 4
35%	900,000	.205	45	22 0

The makers of magnet steel find it impossible to ensure every casting, or length of bar, coming out exact to sample, and the question of rejection limits is thus a matter of difficulty. Also, when deliveries are below sample, but not down enough to reject, the same difficulty arises. The fair solution in the latter case is clearly to pay on *computed energy content ;* when buying magnets it is *field energy* that is the commodity purchased. Thus in the case of a given magnet assembly the energy value is the measure of the B in the gap *squared,* the sample being taken as datum.

Loss of Field Strength

Another point of importance is the loss of field strength with time. In this different magnet samples differ greatly amongst themselves. It is commonly found that a sample which is exceptionally good, or above the average, holds its field better than one that is below standard in the first instance. Most of the loss takes place within the first month after being magnetised—after that the magnet has reached a stable condition ; but there are exceptions even to this. The reduction in field strength is commonly about 5 per cent. and 10 per cent., but is sometimes as much as 15 per cent., or even more.

The energy in the field of a magnet such as used in a moving-coil speaker, is not by any means wholly in the gap ; in fact, however careful the designer, at least half

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the energy external to the magnet assemblage is in the leakage field, that is to say in the lines of force that find their way from pole to pole by paths external to the gap. The greater part of this leakage is in the "fringes," that is in the region close to the edges of the gap proper.

So far as the energy in the gap itself is concerned its calculation is a matter of simple arithmetic if the field density B is known. In air (and, therefore, in the gap) B is the measure of H, hence the expression $\frac{B \times H}{25 \times 10^7}$ becomes $\frac{B^2}{25 \times 10^7}$; thus, supposing that in a certain speaker the gap has a volume = 1 c.c. and the desired B is 7,100 lines per cm.^{3}, the energy will be :—

$$\frac{7{,}100^2}{25 \times 10^7} = 0.2 \text{ joule.}$$

As a matter of general experience, with good straightforward design, the leakage field is 1.5 times the gap energy, or we have to multiply 0.2 by 2.5, giving 0.5 joule. Moreover, the iron parts of the magnetic circuit exercise a tax on the total in the region of 20 per cent., and we have therefore to supply 0.6 joule as the energy value of the magnet itself. Referring to the previous article, and adopting 15 per cent. cobalt steel, we find that the weight of the magnet will be .6/.36=4.4 lbs. And the cost .6 × 15s. 4d.=9s. 2d.

It is convenient thus to be able to explore the possibilities of any given specification without actually laying out a design; this preparatory computation enables the designer to predict approximately the cost before embarking on the actual preparation of drawings. The next step is to determine the length of the magnetic path. It is evident that the mere determination of the weight of magnet steel required tells us nothing of the shape or proportions required. Now the properties of a magnet steel are defined by a graph of the hysteresis curve for the steel in question. The only fact required beyond this graph is the "length" of the gap, that is the length the magnetic flux has to bridge. We will take this to be 1.25 mm. (or .125 cm.). The B having been taken as 7,100, this is also the value of H in the gap, and if the gap were 1 cm. wide we should require 7,100 gilberts. for a gap .125 cm. wide we need therefore .125 × 7,100 = 900 gilberts (approximately). With the addition of 20 per cent. for the reluctance of the iron and junctions in the magnetic circuit, we take 1,100 as the gilberts to be supplied by the magnet. Now, referring to the graph, we see that at B × H max. the value of H may be taken as 120 gauss. Dividing 1,100 by 120 we have 9.2 cm. as the correct length of the magnet, that is to say, the length of path in the magnet steel through which the flux passes.

The Speech Coil in the Gap

There are two complementary functions performed by the moving coil, the one of these is to receive electrical energy and the other to deliver this as mechanical energy to the diaphragm and so to the air. The speech coil in its magnetic field is thus a specialised form of electromotor, and is subject to the ordinary electrical laws—namely, the cutting of the magnetic lines of force by the conductor gives rise to back E.M.F., which may be calculated in the same way as the E.M.F. of a dynamo or electro-motor; and the current flowing in the winding gives rise to forces dependent upon the strength of the current, the length of wire in the winding, and the value of B in the gap. The calculation connecting the electrical and acoustic quantities based on these fundamental laws, is most instructive, but this does not form the subject of the present article.

The essentials for good performance from the standpoint of design are:

1. That the moving coil shall be capable of sufficient free movement, especially for the rendering of low tones.
2. That the maximum movement permitted shall not affect materially the mean strength of the field or the number of turns within the field.
3. There shall be no selective resonances such as will interfere with a good frequency characteristic.
4. There should be a certain amount of damping to avoid resonances.
5. The motional impedance should be high and the copper resistance low.

Now (1) depends very much on the centring; it is unusual to find the movement unduly limited by the surround, but the centring at the small end of the cone is often cramped. The importance of (2) is often overlooked. If, as in many of the moving-coil speakers of a season or two ago, the winding be made exactly the same length as the gap, just to match it exactly, then, when any movement of the coil takes place, the number of turns *in the gap* will diminish—this is inevitable. But it may be avoided by making the speech coil winding either much greater than the gap length, or alternatively very much less. In either case a quite considerable movement of the coil may take place without any change in the number of turns in the gap field.

On the question of clearances. There is a natural tendency on the part of designers to cut the clearances down to a minimum in order to obtain a stronger field for a given cost in magnet steel. In the writer's opinion the internal clearance between centre pole and sleeve should not be less than 5/1,000 of an inch, that is, a diametrical clearance of .01 in or about ¼ mm. and the external clearance about half as much again, i.e., a diametrical external clearance of .014in. It may be asked why a greater clearance on the outside? The reason is that if the sleeve touches the centre pole, very little harm is done, but if the winding should touch on the outside, not only will there be a much greater acoustical disturbance, due to momentary shorts, but actual injury may be done, and the coil may have to be rewound.

The question of resonant frequencies, (3) above, also the question of motional impedance and copper resistance (4 and 5), will be dealt with in a later article.

The first things we must specify when setting about the design of an electrically excited field magnet for an M.C. speaker, are the width (i.e., radial dimension) of the gap, and the field density B. So far as B is concerned, unless it is desired to produce something exceptional, in performance and sensitivity, B may be taken as 7,000 lines per cm^2. For a very high-class job the value may be taken as high as 10,000; beyond this it is very extravagant to go; a speaker designed in the Bell laboratory is reported to have had a value of B = 20,000, but this may be regarded as a *tour de force*. The gap width in a speaker for the ordinary user is commonly in the region of 1 mm.; a good rule is to make the gap 1 mm. per inch pole diameter −0.25 mm. This gives:

Pole Diameter			Gap Width		
¾in.	=	19 mm.	1 mm.	=	0.1 cm.
1 in.	=	25.4 mm.	1.25 mm.	=	0.125 cm.
1¼in.	=	32 mm.	1.50 mm.	=	0.150 cm.
1½in.	=	38 mm.	1.75 mm.	=	0.175 cm.

These figures may be varied to suit the winding, but it is not a bad plan to adopt the appropriate gap width as tabulated, and select the gauge of wire and number of turns to suit, a final adjustment of the gap dimension may then be made to give the necessary clearances, internal and external. (The internal clearance should be about .005in. and the external clearance (over the winding) about .008in. (Diametrical allowances, .01 and .016 respectively.)

The value of H in the gap (in air) is the same numerically as B, which we take as 7,000; therefore the *gilberts* required for the gap will be, gap width × 7,000. It being easier to follow a numerical example than symbolic expression, we shall take the gap to have a value 0.15 cm. (appropriate to a pole diameter 1¼in. as in table). Therefore gilberts = 7,000 × .15 = 1,050, and we know that ampère turns = .08 × gilberts = 840 in the present example. This is the value of ampere turns required for the maintenance of the field in the gap. We must now add the value necessary to carry the field flux through the iron circuit. The simplest way of dealing with this is to postulate some definite value of H in the iron, or

(*Continued on page* 36)

ampere turns per inch (two ampere turns per inch of length is equal to one (H) gauss in strength), and then to design the iron circuit accordingly from the magnetisation curve proper to the grade of iron used. Here are a few figures: In cast iron, 100 ampere turns to the inch will carry B=6,600 lines per cm. In wrought iron or special magnet mild steel casting; 40 ampere turns per inch will carry 14,000 lines per cm², or, 30 ampere turns per inch will carry 3,000 lines per cm².

On these figures we may reject cast iron as an unsuitable material, and take the lower figure, namely, 30 amp. turns per inch as having to be provided by the winding. In order to apply this with exactitude we should need to design the magnet core before we could calculate the amp. turns. To avoid this we shall assume that the length of the core circuit is 10in. and allow 30×10=300 amp. turns as required. Thus the total amp. turns to be provided will be:

For the air gap .. .. .. 840 amp. turns.
For the iron circuit .. .. 300 amp. turns.
Total 1,140 amp. turns.

In order to calculate the watts all we need do is to specify the *belt of copper*; given the area of copper provided to carry the 1,140 ampere turns it matters not the least whether it be one turn carrying 1,140 amps. or 1,140 turns carrying 1 amp., the value for the purpose of field excitation will be the same, and the dissipation in watts will be the same.

The following table is useful:

Density of Current		Watts Dissipated per Unit Vol.	
Amps. per sq. in.	Amps. per cm²	Per cu. in.	Per c.c.
600	93	,245	.0150
700	109	.335	.0205
800	125	.442	.0270
900	140	.620	.0380
1,000	155	.680	.0415
1,100	170	.820	.0500
1,200	186	.980	.0600

Thus if we prescribe a copper belt of sectional area= 1 square inch and call the current density 1,200 amps. per square inch which form the above table gives .98 watts per cubic inch. If we take the accompanying illustration as a rough layout, the mean circumference is 7.5in., and the power required 7.5×.98=7.35 watts. The sectional area provided for the winding needs to be at least 50 per cent. greater than that to be allowed for copper.

We may consider this excessive; if so, we may prescribe a belt of copper of 2 square inch section, then we may take the current density=600 and, from the above table, watts dissipated per cubic inch, =.245, and the power required is:

7.5×.245=1.84 watts.

This is unnecessarily low so that one of the intermediate current densities may be chosen; 1,000 amps. per square inch copper is a good average figure, giving a dissipation of copper loss=5 watts.

The correct gauge of copper to be employed is most simply calculated on the basis of *one turn only carrying the whole current.* Thus, if it be intended to work from a 12-volt battery, we will take the current in round numbers as 1,200 amps., then the resistance of the one turn will be .01 ohm, and since the length is 7.5in.= 19 cm. we have 1,900 cm. per ohm; from the tables we find this to correspond to 22½ s.w.g. To avoid ordering a split gauge we take the nearest, namely, 23 s.w.g. At 1,000 amps. turns per inch the belt has an area= 1.2 square inches, which corresponds to 2,650 turns requiring 50,000 cm. length of wire having a resistance of 29 ohms. At 12 volts the current will be 0.41 amp. and the amp turns=2,650×.41=1,100 and the watts dissipated (C^2R loss)=.41×12=4.9, which shows that the use of 23 s.w.g. (.024 in dia.) in place of the half-gauge size, may be justified.

A few words must be said as to the design of the iron circuit in the matter of sectional area. We have assumed that either wrought iron or a steel, such as Edgar Allen's special field magnet steel (which is nearly pure iron) is employed, and that the flux density B is approximately 13,000 lines per cm.², the question is what is the flux? The flux *in the gap* is the flux density in the gap multiplied by the gap area, which may be taken for the example under consideration=8 cm²× 7,000=56,000. But there is also the leakage flux, and this we only know from experience: *the total flux is about two and a half times the actual gap flux.* The total flux is therefore taken as 140,000 lines and the iron area required is $\frac{140,000}{13}$=10.8 cm.², or 1.7 square inches.

The core components should be calculated with an area (section) at no point in the path of the circuit less than this. This cannot be done in the actual neck of the centre pole, but that point does not need to carry the whole leakage field, part of the field has already leaked away; the neck should be kept up to as near the full pole diameter as possible; that is all that can be done beyond adding extra ampere turns in computing the total required. Allow for, say, 1 cm. length at a higher flux density. An addition of 50 to 100 amp. turns is usually an ample allowance.

NOTES

Some American Developments

AN acoustically balanced system of loudspeakers now permits telephone conversation at a distance from the apparatus without operating the usual "talk-listen" switch. Each station in the system is equipped with three speakers. One is used as a microphone, and the other two have their voice coils connected in parallel and out of phase with each other. Although perfect balance cannot be achieved by this arrangement, acoustic feedback is reduced and howling is eliminated.

A new signalling shutter, developed by Westinghouse, has proved sufficiently light, rapid, and durable to meet the rigid operational requirements for military signalling by interrupted light beam. The new device consists of steel shutters, made like a venetian blind, and operated by a lever mechanism. The shutter has been operated over two million times without showing measurable wear or deterioration.

Silver coatings, applied directly to crystal faces, overcome a tendency of piezo-electric crystals to undergo frequency changes when used in mobile equipment. Connections are made by springs or fine wires soldered to the thin film.

India and U.S. Radio Telegraph

AS a result of negotiations by the British and Indian Governments a new direct radio telegraph service has been inaugurated between India and the United States.

New Wavelength

THE wavelength on which the B.B.C.'s transmission for the Allied Expeditionary Force is now being radiated is 514.6 metres (583 kc/s) instead of 285.7 metres. The new wavelength was allocated to France under the Lucerne Plan, and was used by Alpes-Grenoble, the P.T.T. station.

Our Roll of Merit

Readers on Active Service—Forty-eighth List

J. A. Bowen (Pte., R.A.S.C.).
G. Walton (L.A.C., R.A.F.).
A. J. Howard (Sgt., R.A.F.).
M. Hayton (R.N.).
J. W. Knox (L.A.C., R.A.F.).
B. S. Jones (S./Sgt., R.E.M.E.).
C. A. Saunders (Sigmn., C.A.).
J. F. Sparrow (L.A.C., R.A.F.).
N. Oldroyd (R.N.V.W.R.).

Impressions on the Wax

Review of the Latest Gramophone Records

H.M.V.

AN exceptionally fine record, using the words in their fullest sense, has been released this month by H.M.V. I refer to *DB*6172, which is a 12in. record of Mozart's "Symphony No. 32 in G. K.318" performed by the B.B.C. Symphony Orchestra under the conductorship of Sir Adrian Boult. Apart from the actual work, which, in itself, is delightful in its structure and theme, and the superb performance by the orchestra, the record is an outstanding example of modern technique as applied to the actual recording.

The composition occupies both sides of the record. Part 1 being Allegro spiritoso, and Part 2: Conclusion, Andante and finally, Allegro spiritoso. The first part is built up around a fascinating recurring theme which opens with some distinctly challenging passages of a grand and spirited nature. The string section is provided with some brilliant material, and they form the main threads in a most charming pattern which links together the sudden exciting dynamic passages. Andante takes the form of a delicate but delightful tone picture, beautiful in composition and balance, and then Mozart carries one back into the energetic allegro spiritoso which sweeps on through those grand and exhilarating passages to a dramatic conclusion. The B.B.C. Symphony Orchestra, and Sir Adrian Boult, give an outstanding performance, and the record calls for every recommendation. Webster Booth, with the Liverpool Philharmonic Orchestra under the baton of Dr. Malcolm Sargent, makes a notable contribution to the already long list of his recordings for H.M.V. This month, he has selected "Onaway Awake Beloved" from "Hiawatha" (Longfellow—Coleridge-Taylor) and "O Vision Entrancing" from "Esmeralda" (Marziais-Thomas), and these he records on *H.M.V. C*3407. His rendering of these two well-known pieces is delightful, his splendid tenor voice being enhanced by first-class diction and effortless production.

"Hutch" has taken "Too Much In Love" from the film "Song of the Open Road" for one of his numbers this month, which he links with "I'll Be Seeing You" on *H.M.V. BD*1089.

"Sylvia" and "Blow Me Eyes" are sung—with orchestra accompaniment—by Robert Wilson, tenor, in a very pleasing manner on *H.M.V. BD*1088.

Joe Loss and his Orchestra give a fine performance of that popular fox trot "San Fernando Valley," and "Swinging on a Star," a good quick step, and I recommend these two numbers to all dance enthusiasts. The record is *H.M.V. BD*5859.

Eric Winstone and his Band have recorded two film hits on *H.M.V. BD*5858, they are "The Day After Forever" fox trot from the film "Going My Way" and "You're My Little Pin Up Girl," also a fox trot, from "Pin Up Girl." Two good numbers.

Swing Music 1044 Series Nos. 599, 600, 601 and 602, are on *H.M.V. B*9389 and *B*9390. The first record consists of "Riff Medley" and "Everything Depends On You," played by Earl Hines and his Orchestra, while Charles Barnet and his Orchestra have recorded "Little Dip" and "Murder at Peyton Hall" for the second (*B*9390).

Columbia

THREE masters of their individual instruments, namely, Denis Matthews (pianoforte), Reginald Kell (clarinet) and Anthony Pini ('cello), combine to make an outstanding recording of Beethoven's "Trio No. 4 in B Flat."

The work consists of three movements—Allegro con brio, Adagio and Allegretto, and these occupy five sides of three records, the sixth side being a pianoforte solo. "Adagio in G Major" (Bach), by Denis Matthews.

Like the Mozart work already mentioned, Beethoven's Trio No. 4 makes delightful listening, its melody being graceful, and not calling for, shall we say, a detailed understanding and analysis. The third movement is particularly pleasant, being formed by charming variations on an air from Weigl's "Amor Marinaro." In spite of the above, the trio calls for perfect finish and skill from the players, and the three mentioned in the first paragraph reveal complete understanding of the work and the mastery of their instruments.

A delightful record which I recommend to all is *Columbia DB*2151, on which Albert Sandler and his Palm Court Orchestra have recorded "Beautiful Spring" (Lincke) and "Acclamation Waltz" (Waldteufel).

Victor Silvester and his Ballroom Orchestra make a fine record with "It Had To Be You," a quick step, and "Good-night, Wherever You Are," a slow fox trot, on *Columbia FB*3057.

The next two Columbia records are *FB*3050 and 3051, and they form quite a change from the usual run of things. They have been recorded from the sound track of the film "Champagne Charlie." The first consists of the star of the film, Tommy Trinder, giving us "Champagne Charlie," and, on the other side of the disc "Everything Will Be Lovely" and "The Man on the Flying Trapeze." On the second record (3051) Trinder also records "'Arf of 'Arf and 'Arf," while, on the other side, Betty Warren says "Come On, Algernon" in a manner which Algernon no doubt found very captivating. Tommy is, well, typically Tommy, and puts over a very good show.

Parlophone

AS usual, I open my Parlophone selection with a record by that ever popular tenor, Richard Tauber. For this month he has selected "Plaisir D'Amour" and "Serenade" (Elkin-Toselli), two compositions which provide plenty of scope for Tauber's technique and range. He sings both in English. The record is *Parlophone RO*20532.

Geraldo and his Orchestra offer "Don't Sweetheart Me," a lively quick step, and "Swinging on a Star" a good fox trot, on *Parlophone F*2040.

Billy Thorburn's the Organ, the Dance Band and Me play "I'm In Love With Someone," a slow fox trot, and "Don't Sweetheart Me" on *Parlophone F*2039.

There are two Parlophone records in the 1944 Super Rhythm-Style Series this month, namely, Nos. 45, 46, 47 and 48. The first two are on *R*2948, and they are both played by Ida Cox and her All-Star Band, the numbers being "Hard Time Blues" and "Take Him Off My Mind," both by Cox, by which, I assume, is meant Ida. The other two are recorded by Vic Lewis and Jack Parnell's Jazz Men, on *Parlophone R*2949, and these consist of "Sugar" and "Why Begin Again."

Regal

REGINALD DIXON at the organ has made a fine recording of "Romberg Reminiscences," which introduces "The Riff Song," "Serenade" (Student Prince), "Lover Come Back to Me" (New Moon), "Will You Remember" (May Time), "Desert Song Waltz" and "Drinking Song" from the Student Prince. The record, which calls for recommendation, is *Regal MR*3740.

On *Regal MR*3741, Harry Leader and his Orchestra have recorded "Let's Sing a Song," a quick step, and "If You Ever Go to Ireland," a waltz—two nice numbers for dancing.

Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Curing H.F. Instability

SIR,—When wiring up circuits, by arranging the wiring in layers I have been able to cut down H.F. instability and all losses to a minimum. The components must be specially chosen, for those with terminals at their base or at their tops, i.e., some Mansbridge condensers have their terminals at the base, while T.C.C. condensers have theirs at the top. This can also be arranged with transformers, chokes and with the plate or grid tops of H.F. valves. Thus the grid wiring could be always kept at least 1½ins. from any other wiring, and the layers could be both above and below the chassis.—N. WHITE (Godalming).

Station WCBX

SIR,—Station WCBX, New York, U.S.A. is Brentwood, 15,270 mc/s, 19.65 metres. It broadcasts daily at 13.00, 15.30, 16.30, 21.00, 21.45 hours D.S. time, two hours ahead of G.M.T. The station is operated by the Columbia Broadcasting Company, New York.

Has any reader information of a station, Radio Jicarta; broadcasts in English on 16 metres.—JOHN J. RIORDAN (Cork).

Post-war Radio

SIR,—The June issue of PRACTICAL WIRELESS has just come to hand out here, and I have read with great interest the article on "Post-War Radio." The following may help to clear up a few points on the subject.

The question of the Morse code will be largely overcome, nearly everyone will be, at least, on nodding terms with the key and should find no difficulty, even though the examination speed is increased up to 20 words per minute.

The greatest difficulty, in my opinion, will be the allocation of frequencies to those of us that wish to carry on the good work, and as there will certainly be many thousands of applicants, the G.P.O. and associate bodies are faced with a somewhat severe headache! It will be very different from the days of twenty years ago; we thought that the ether was crowded even then, and the modern amateur of to-day would give up in despair at the very thought.

One thing is certain, however, and that is that the shorter wavelengths will be predominant for the amateur. The design of modern apparatus has driven the unsightly pole and sagging wire into obscurity, giving place to the more efficient dipole array. I do not know what the powers-that-be have in mind for their future broadcasting channels, but the present policy in operation, plus possibly a few shorter wave networks for Empire use, should leave ample scope for many amateur bands to work in complete harmony without overlap. The quality of the transmissions naturally depends upon the width of the frequency band in use, but here again we are not up against the experimental order of things as in 1921; components and the valves of to-day ensure satisfaction in this direction.

The vagaries of short-wave work have not altered to any great extent over a period of years, and the more or less "newcomers" must, of necessity, learn to accept conditions as they come, even though their gear is the latest in design, but if sufficient thought and care is taken with every detail of construction, aerial arrays, etc., these "off" periods should not worry them unduly. At a rough guess I should say that the future of the "ham" lies between 56 and 57 megacycles, leaving the shorter wavelengths entirely free for the great developments that will take place in television circles.

The granting of licences to prospective users of over 10 watts will naturally fall to those whom the Post Office judge have gained sufficient experience, either past or through the medium of their various jobs in the Services. The latter will count quite a lot as there is no room for "hit or miss" efforts, and the G.P.O. authorities would have no cause to hesitate in allowing them to operate on the higher dissipations.

The frequencies of the television systems will probably be increased and 200 mc/s a fairly all-round figure. The question of "shuttle services," however, remains to be gone into, as we do not know to what experimental lengths these things have gone during the past five years, but I don't visualise the huge reflector systems mentioned in PRACTICAL WIRELESS.

The losses on these frequencies are bad enough now, and we don't want an under-exposed picture, do we?

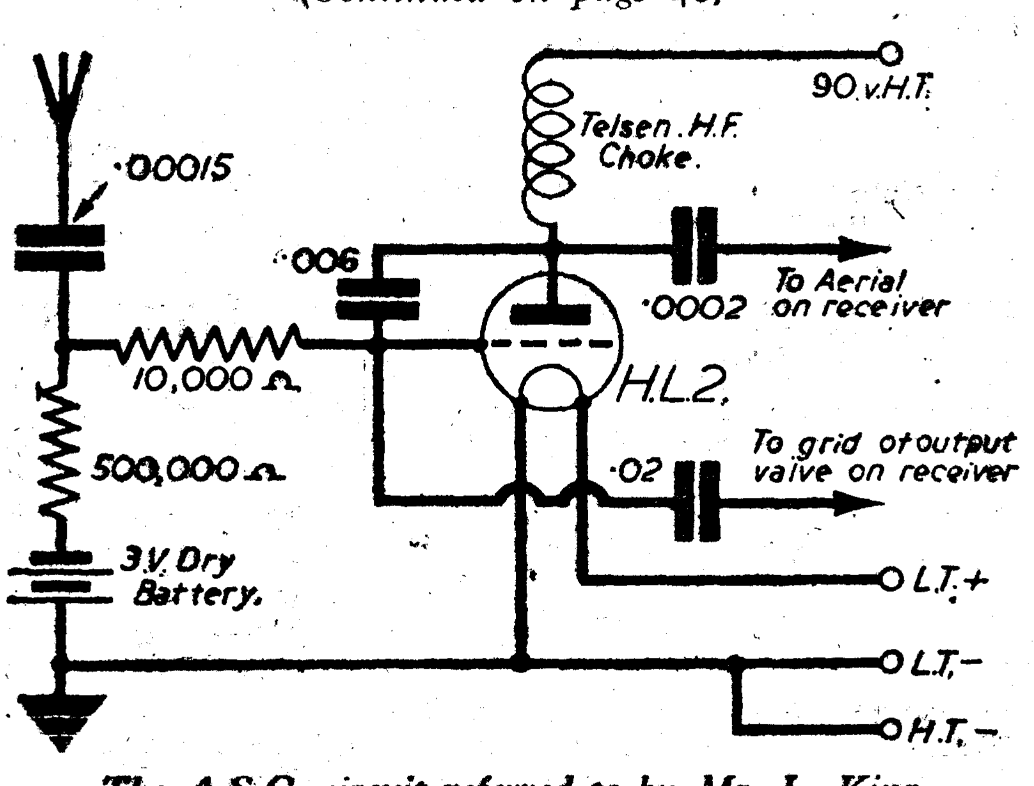
The trouble is that a reflector doesn't always live up to its name, and then again, what about the change of phase and re-change to synchronize TX and RXS? Would the result be like looking at an enlarged negative? How would colour television be affected? There are very many things to be taken into consideration when long-distance work is proposed, and which one can safely leave in the hands of the experts, without going into wild conjecture, and confine ourselves to the question of getting "on the air" again in as short a time as possible after the war. I have contacted several other amateurs on this island through the medium of the R.S.G.B., and we, too, have gone into all these things, backed by our experience of first-hand knowledge of reception and transmission in tropical areas, and which has done much to make us appreciate the difficulties that we used to work under in the good old days.

Your PRACTICAL WIRELESS is very popular out here, and one is apt to lose ownership at times, but it's all for the good of the cause. Give my regards to Thermion.—E. BOUSON (Ceylon).

A.S.C. Circuit

SIR,—I have been a regular reader of your excellent paper for nearly a year and have found it very helpful. I was very interested to read Mr. S. B. Hawkes' letter in your October issue as I have often experienced this trouble. A friend of mine recently gave me an A.S.C. circuit, which seems to work quite well. I have made a little unit up which I can add on to any of my sets. Here is the circuit for the benefit of any other readers who may like to try it. I have found that it is sometimes better to make the 10,000 ohm resistance a bit smaller to make the speed faster and I have arranged

(Continued on page 40)



The A.S.C. circuit referred to by Mr. L. King.

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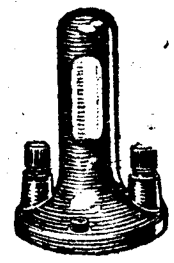

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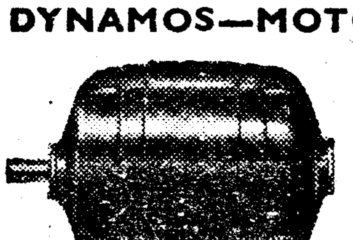

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a switch so that I can either have 10,000 ohms or 9,000 ohms.—L. KING (Southgate).

"Licences for Service Engineers"

SIR,—May I add my remarks to the discussion on employment in the radio industry.

First, I must say that I am in complete agreement with F. J. Grant when he says that many Army and Air Force trained mechanics could not earn a living in "Civvy Street." The average mechanic in the Services is just about the equivalent of the "repairer" of the radio factory. This job is usually done by youths and women for about 8d. to 1s. an hour. Also, the repairer works just about twice as quickly as the Service mechanic.

Other classes of Army radio men are: R.M.O.s, Armament Artificers and Technical Instructors. The average R.M.O. is too busy organising and handling paper work to get a lot of experience. He is usually more of a designer than a practical radio man.

The armament artificer is a good radio man, but needs to speed up if he is to be employed by a manufacturer.

The T.I. has an excellent knowledge of radio, from a blackboard point of view, but has little experience.

The above, of course, are general remarks, and there are plenty of exceptions.

Now, let me give the hopeful Army trained mechanic an idea of a day's output for a factory radio man. Excepting charge-hands and foremen there are two jobs that pay a living wage. Wages quoted are peacetime rates.

1. The tester. He aligns the tuned circuits of a radio receiver and locates obvious faults. He receives from 1s. 3d. to 1s. 8d., and in return "lines up" about 80 three- and four-valve sets, or 30 to 40 nine- or ten-valve sets. If he gets the higher rate he probably does his own fault-finding and does perhaps two-thirds of the above numbers of sets. The "final tester" gets about 1s. 2d. an hour and puts the finished "boxed" set through its paces, making any adjustments that have become necessary since the first test.

2. The fault-finder or "trouble-shooter." He is a highly trained specialist, who does nothing but locate faults, remedying the simple ones, and sending the more complicated ones to the repairer, who changes bulky components, etc. The fault-finder locates from 50 to 100 faults a day. My own record is 147. No two sets are alike, hence the variable figures. I would have readers remember that factory fault-finding is complicated by wiring faults. The queer results arising from this class of fault demand a special technique impossible to teach and acquired by long experience. The fault finder gets from 1s. 6d. to 1s. 8d. an hour. A radio factory doubles its staff during the brief season, consequently there are frequent mass sackings. I have always found a new employer before the rumoured day, because, fortunately, no two firms seem to have the same season.

F. J. Grant's £2 6s. a week leads me to believe he was a repairer. I can only hope that the Army gives him a better reward for his years of constant study.

In general, then, a radioman, to earn a regular wage, needs to be right on top of his job, and within easy reach of half a dozen factories. Also he must be prepared to work very hard indeed for a wage very little in excess of that of the general labourer.

May I suggest that for his own sake the Army-trained radio mechanic with another trade up his sleeve would be well advised to stick to it.

In conclusion, it has occurred to me that a large proportion of wartime factory employees must be newly trained. In consequence I have no fear of unemployment when I am demobilised.—F. W. FIRTH (Plymouth).

Identification Wanted

SIR,—Can any reader help me to find out whether there is a station by the name of SHONAN or SHONON, and where it is?—M. GOLDBERGER (Goole).

Leeds Radio Society

SIR,—I am desirous of contacting any members of the late Leeds Radio Society who would be interested to reform same or start a new club; also I should like to hear from anyone interested in radio matters, resident in Leeds or district, who would care to support the above project.—E. BENDEN (Leeds, 7).

Automatic Speed Control

SIR,—The group velocity in a wave-guide varies from zero to 186,000 miles per second (approximately) as the frequency is increased from the cut-off frequency of the wave-guide to infinity, so Mr. Hawkes can obtain automatic speed control by using the audio-frequency output from his radio receiver to amplitude, modulate the radio-frequency output from a microwave oscillator and feeding this into a considerable length of wave-guide.

Also, a device must be constructed which will increase the frequency of the microwave oscillator by a small amount between each sentence all the time the news at dictation speed is being broadcast.

Finally, an aperiodic microwave receiver fitted with A.V.C. must be connected to the other end of the wave-guide.

If Mr. Hawkes is able to obtain a wave-guide which does not cause too much attenuation, and spends enough time varying the length and width of the wave-guide; and the mean frequency of the microwave oscillator, and also the extent of the frequency sweep, I am sure he will manage to produce a very satisfactory A.S.C. system which will enable him to hear the news which is broadcast at dictation speed at normal speed, or ten times as fast as normal speed, if he so desires, after the necessary adjustments have been made.—L. WARNER (Malvern).

Experiences with 0-v-0

SIR,—I write to inform you of the interesting time I spent with the 0-v-0, details of which were published in the August number of your most excellent paper. I built the set, first in its original form, and received fairly good results. I later modified it, and, using home-wound coils, received improved results. The coils I used were wound on old valve bases, the number of turns being worked out from the chart in "Newnes Short Wave Manual." I was using an all-wood chassis, but did not suffer in any way from hand capacity. The results were truly amazing. I received, among many other stations, including America, Africa, Spain and the usual host of Germans. I am now converting this set into a two- or three-valve job.—ALEX. J. BRIONROSE (Stirling).

Crystal Set Experiences

SIR,—I was interested in Mr. J. H. Woodward's letter, asking for crystal set experiences. I have done a great deal of work on these sets in the past eight years with astonishing results. Perhaps Mr. Woodward would like to have a few of my experiences. My first attempt at making a small crystal set was met with much criticism over here in view of the fact that the nearest transmitter was many hundreds of miles away. Nevertheless I made the first one without success, but I managed to obtain a tiny set from England of the permanent detector type, mounted in a handsome cabinet of bakelite moulding, measuring only 2in. square by ¾in. deep. For seven months, day and night, I strained my ears in a silent room to try and catch a signal, but not a sound of any sort was heard. Finally I decided to strip it down and rebuild it, fixing the tuning condenser in series with the aerial, and a by-pass condenser of .005 mfd. across the output sockets. A month after this I managed to receive an almost inaudible signal for the first time. Then I built a large set with two tuning condensers, and several modifications and improvements, including short waves. I tried several types of crystal, but the best results were obtained with good galena crystals and silver cat's whisker, bathed in ether to remove finger grease before mounting in a dust-proof container. After about three years I became quite an authority on crystal setting for long distance. I regularly receive the B.B.C.'s African service, two German stations, and a few French stations on short waves just after sunset with amazing signal strength. On the standard broadcast band I receive after dark Sofia, Rome, Berlin, Budapest, Stuttgart, and a few less powerful stations with immense clarity. Here the question of selectivity comes in, but on the large set I can arrange for that by varying the degree of coupling between the aerial coils, at the expense of volume.

Both these sets now operate on galena crystals and silver tickler wound in a soft spring form, and only the slightest contact on a bright part of the crystal will increase the range to hundreds of miles. I still am unable to receive even the short waves during daylight.

An efficient aerial-earth system is important out here, and I experimented with various types, but the best I found is an inverted L type aerial of about 50ft. length 20ft. high, with a good thick wire down lead and a short earth connection.—J. A. ANASTASI (Malta).

SIR,—I was interested in the letters of both J. H. Woodward and D. B. Ellis concerning crystal sets. Even to-day a crystal set can have its uses. I thought these readers might be interested in the following summary of experiments I have made over many years.

(1) A modern tellurium-zincite detector will give a greater output than the old cat's whisker and crystal (even if the latter is new). This was found by measuring the output with a moving-coil micrometer with a constant input. Care should be taken to prevent stray capacities across the detector, which reduces the efficiency by allowing H.F. to pass in both directions.

(2) The tuning coil should be wound with fairly thick wire (say 22 s.w.g.) on a large diameter former. The output of a detector used with such a coil is about 5 microamps. greater than the same detector with a modern coil as used in valve sets. The detector—*not* the aerial—should be tapped down the coil to improve selectivity, as this gives more selectivity in relation to the signal strength lost.

(3) The aerial should be really long and high (which is not necessary with valve-sets and often overlooked); tuning the aerial to resonance with a second coil will slightly increase input to the crystal set.

It was further found that amplification without valves could be obtained by building a small transverse-current microphone on the diaphragm of an earpiece, the microphone being connected to a high-ratio transformer and battery in the usual manner. Two stages of such amplification were tried, but they were critical to operate and did not give very good quality. A commercially-made unit of somewhat similar types used to be on the market.

Before the war English amateurs were received on the 40 metre band with a crystal receiver; since stations as distant as Radio Moscow. I should be very interested to hear if anyone living *really* close to a transmitter can get fair speaker results. Detectors in parallel, to handle the power picked up, would seem to be indicated. I once heard an amateur state that if he connected a bulb between his aerial and earth the power picked up from the local station would light it. This is possible, as amateur transmitters know.—F. G. RAYER (Longdon).

SIR,—I noticed a letter in last month's issue of PRACTICAL WIRELESS asking for the experience of some of us "old timers," with "crystal sets."

My first entry into radio was in 1919 when I obtained an experimental licence from the P.M.G. I never used a crystal set myself but made up many for friends as required when broadcasting commenced. I started off with a four valver H.F., Det. L.F. P. and in those days had to be content with one or two half-hour broadcasts by Burndepts of Blackheath, Writtle, and the Dutchman. It was thrilling.

As regard the crystal sets. These were made up by winding 24 g. enamelled wire on a cardboard tube about 2½in. diameter by 6in. A track was made across the top of the winding and a slider on a square brass rod ran over the track for tuning. No variable condenser was used. The wound tube was secured to baseboard by a square wooden block each end. All wiring was on the underside. Two terminals A and E were at the back and two for 'phones at the front, with crystal cup and cat's whisker. A small fixed condenser was across the 'phone terminals. I used to charge them just the cost of materials—about 3s. 6d., and they bought a pair of headphones themselves.

Later I made up one or two more sets in a box-like form with the coil inside. As far as I can remember this coil was wound with 28 d.c.c. wire with coarse and fine tappings brought up to two sets of studs with wiper arms on the top of the ebonite lid of the box. I also rewound the bobbins of one or two pairs of low resistance 'phones with 50 s.w.g. d.s.c. wire. I believe I have still a little of this by me. Also a cheap stores used to sell the parts required to make up a complete pair of headphones in sixpenny lots. These made up into good 'phones, and the experience gained by assembly was worth while, and a good saving in pocket money which melted away on the new hobby.

In the early days component parts were hardly obtainable. Valves were either a soft Dutch make, or there was a good Telefunken. This was beautifully made, and compact. The anode was a round piece of metal about the size of a sixpence, over this was the grid just like the hairspring of a watch, and above that was stretched the filament. L.F. transformers we had to make, bobbin first, then wound with primary and secondary 3 to 1 and the core was lengths of soft iron flower wire bent backwards around the outside of bobbin and secured; the hedgehog type. Variable condensers had to be made up from plate stampings, moving spindles, and 2 B.A. brass threaded rod. Spacing washers for assembly: these had to be rubbed down to proper size on emery paper and tested with a micrometer, otherwise the moving blades would foul somewhere. Grid leaks were made with a line of indian ink on blotting paper mounted on a piece of ebonite. Fixed condensers were made up with copper foil and mica strips. The only resistances we used were, I think, the filament resistors to keep the filaments of the valves at 4 v. from a 6 v. accumulator to allow for drop as it discharged. A 4-valve set lit the room. Tuning coils we made, chiefly the basket pattern, and we had three of these mounted coupled together. First aerial coil then grid coil, and reaction next. The aerial and reaction coils were swinging and could be swung to or from the centre grid coil. In the very early days they were hung on a piece of round wood like a round ruler and just pushed or pulled away until the coupling was right. Very primitive. Later they were hinged mounts worked by extension rods. We also used to have double pole double throw switches to put aerial condenser in series for medium wavelength or parallel for long wavelength with the aerial coil. Construction in those days was very different to now. Before the loudspeakers came in the 'phones were put into a basin to get the loudspeaker effect. My first loudspeaker—an Amplion Junior—caused much stir.

H.T. batteries were made up with about 24 to 30 4½ v. flashlight batteries joined up in series, positive being soldered to negative. This was a trouble when some gave out, so soon we were able to buy small clips to join up with. Later I made up a box with ebonite lid on the underside of which was brass strips to make press contact with the batteries and at suitable intervals were plug holes for tappings by wander plugs.

In 1923 I had electricity (D.C.) and made myself an eliminator, and about 1929/30 when D.C. was changed to A.C. I built up an "all mains," and there were many snags until I got used to this.

I have never been interested in a superhet, or the multi-electrode valves. Am afraid I am too old to get used to these. The V.M. screen-grid valve is as far as I go, but I am very fond of push-pull output P.X.4.

Constructing has always given me much pleasure. Perhaps I might buy a modern set after the war. Am looking forward to television. Here in Sidmouth I am troubled by fading after dark.

My one snag now is deciding the different values of resistances and condensers, and each design published seems to give different values for the same valve. I am often puzzled. For instance—May, 1943 issue of "P.W.", page 227. Resistances for anode of V2(MS4B) 20,000 ohms and .1 megohms = 120,000 ohms. However much voltage at 3 m/a would get through. 200 v. is the maker's number.—HERBERT S. G. BRAY (Sidmouth).

Stations Identified

SIR,—Regarding the station heard by two of your correspondents calling "Hallo, Sabu," I have heard this station on 31.8 metres at 07.00 G.M.T. and on 49.3 metres at 18.00 and 19.00 G.M.T., calling "Hallo, Sabu," "Hallo, Jojo," "Hallo, Lulu," "Hallo Romo," etc. It gives news in English on the hour, followed by messages, usually in code, to "Sabu 67," etc. The station seems to be located in Britain, as "news from home" in the news bulletins means news from Britain.

Some American stations I have not seen mentioned in your magazine are WLWL, Cincinnati, on 15,230 and 17,955 kc/s; and WNRA, WNRI and WNRX, some of which are operating 24 hours a day on some of these frequencies: 18,160, 14,560, 13,050, 9,855, 7,565, or 6,100 kc/s. These last three are owned by N.B.C., and located at Bound Brook, N.J.—WILLIAM H. BORLAND (Alexandria).

Radiogram Circuits

SIR,—I was very interested in the radiogram circuits in the November issue of PRACTICAL WIRELESS, but, for various reasons, living in a flat, etc., I fear this method of reproduction would not be suitable.

Some years ago I constructed a popular radiogram, H.F., detection 2L.F. (resistance and transformer). The radio part of this instrument is now never used, as an all mains set has taken its place. The pick-up gramophone portion is used for records, but the reproduction leaves a lot to be desired, probably owing to the pick-up being switched into a circuit that is not really the most suitable for it.

I would like to convert the whole of this set into merely a gramophone, and wonder if you could publish some simple circuits for battery-driven amplifiers suitable for reproducing from a pick-up, and omitting the radio part entirely.—A. EYDEN (Seven Kings).

Record Groove Indicators

SIR,—I am sending you a suggestion which I think might be of interest to cine enthusiasts who add musical accompaniment to their films, and you might perhaps like to include in your magazine.

"His Master's Voice" sell a device called the Record Groove Indicator, for picking out selected passages on records. If one is giving a film show with recorded music accompaniment the use of this device is obviously too slow for a quick change of music in a darkened room. I have therefore thought out the following procedure, and marked out selected passages thus:

(1) I play the record with the Record Groove Indicator in the normal way until the required passage is about to begin and stop the motor at once.

(2) I lift out the pick-up needle carefully without disturbing the pointer reading on the scale.

(3) In place of the needle I insert in the small hole of the pointer a chinagraph pencil sharpened to a very fine point, and run the motor again, and, holding the pencil firmly so that it does not slide down the scale, I mark out a thin but clear circle line. This marks out the beginning of the selected passage. To mark the end of that passage I simply repeat the operation further on.

N.B.—To simplify matters, I mark the beginning of the selected pasage on the record with a white or yellow chinagraph pencil, and the end of it with a red chinagraph so that all you need do is to fade in with the music at the white line, and fade out at the red line. and if you are asking a friend to play the records for you during projection, this system makes his task particularly easy. I might add that the marking of the record with the chinagraph pencil in no way affects the quality of the music production, and any excess wax is soon removed by the playing needle after one or two playings.—P. DHUNJIBHOY BOMANJI (Harrogate).

Radio Clubs

SIR,—I see from your page in the October issue of PRACTICAL WIRELESS that you are compiling a list of radio clubs and societies; and that you desire the names and addresses of secretaries of these clubs.

I am the late secretary of the Leicester Amateur Radio Society, which was discontinued in 1940 as the majority of our members were either in the Forces or out of town.

I have been in contact with old committee members, and it was agreed to reopen the society in the near future, as plenty of youngsters in the town are interested in radio and electronics at the present time. It was also felt that we should endeavour to get the society functioning again before the return of our old members from the Forces, so that they would be able to come along again as soon as they were back home.

Before the war our activities included lectures by members, lectures and demonstrations by manufacturers, field days on 160 metres and 5 metre bands, practical direction finding, visits to B.B.C. transmitter studios and other places of interest; and one of our most popular evenings was a gramophone evening, where anyone could bring along their favourite record and hear it on a Voigt speaker and amplifier unit. We also held a questions and answers evening, which always provoked plenty of interest (this, by the way, was before the B.B.C. Brains Trust started, and we claim to be one of the originators of this scheme !).

I cannot give any details of future programmes as yet, but if anyone is interested in the reformation of the society I shall be glad to hear from them at the following address: D. Cross, Hon. Sec., Leicester Amateur Radio Society, 22, Stretton Road, Leicester.

We cannot, of course, hold field days at the moment, but we are looking forward to the time when we can get our transmitters on the air again; when, we hope, the standard of operating and procedure will be much improved.—DEREK CROSS.

Servicemen

SIR,—I have been following your editorial for the past 18 months, and I must congratulate you for putting up and keeping going such a good case for the radio serviceman, and for really going to town against the sharks in the trade. Such straightforward statements as you make get people to think, realise and eventually act. Keep it going, for it is through the medium of papers such as yours that servicemen will get the "breaks" they have been waiting for. It voices their desires and protests, so that the people who should know will know. And it seems to me that you keep a close watch on what we say, too, and every now and then put it all in a nutshell and present it in your editorial. Just what is needed, and thanks to you it is getting its proper due. You have the backing of thousands who want a better radio industry.

I haven't a complaint against PRACTICAL WIRELESS; in R.A.F. slang, I think it is "bang on," but I do hope that in the near future you will be able to introduce a series of modern articles on the television receiver, followed up by servicing procedure and practical hints. I feel sure it would be welcomed by radio servicemen. Perhaps you could put this suggestion forward to see if the response would make it worthwhile? Best of luck to PRACTICAL WIRELESS.—H. HUMPHREYS (Carlisle).

Sound Amplifying Equipment: Correction

THE 100,000 fixed resistor shown in the component list on page 494 (Sound Amplifying Equipment—3) of the November issue, as R1, is intended for R7. The 0.25 megohm volume control is R1, as stated at the top of the list.

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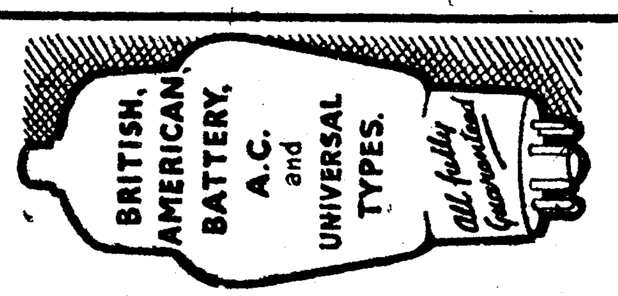

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(Continued top of next column.)

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(Continued top of next column)

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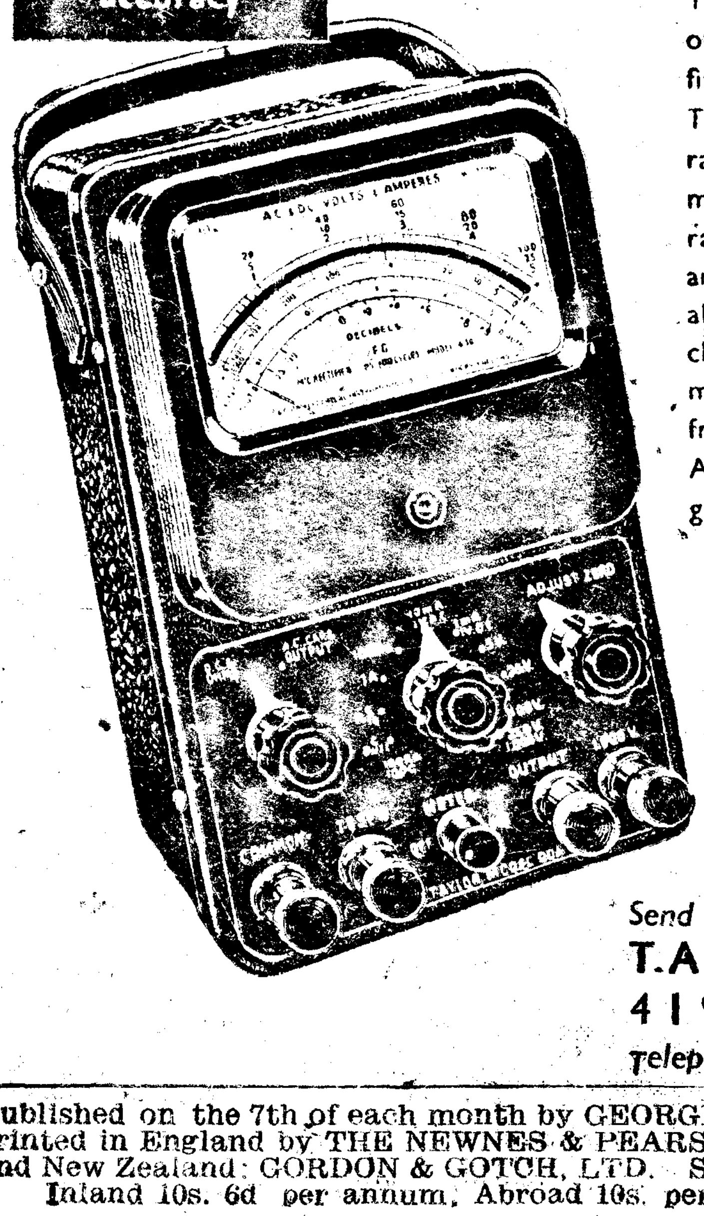

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