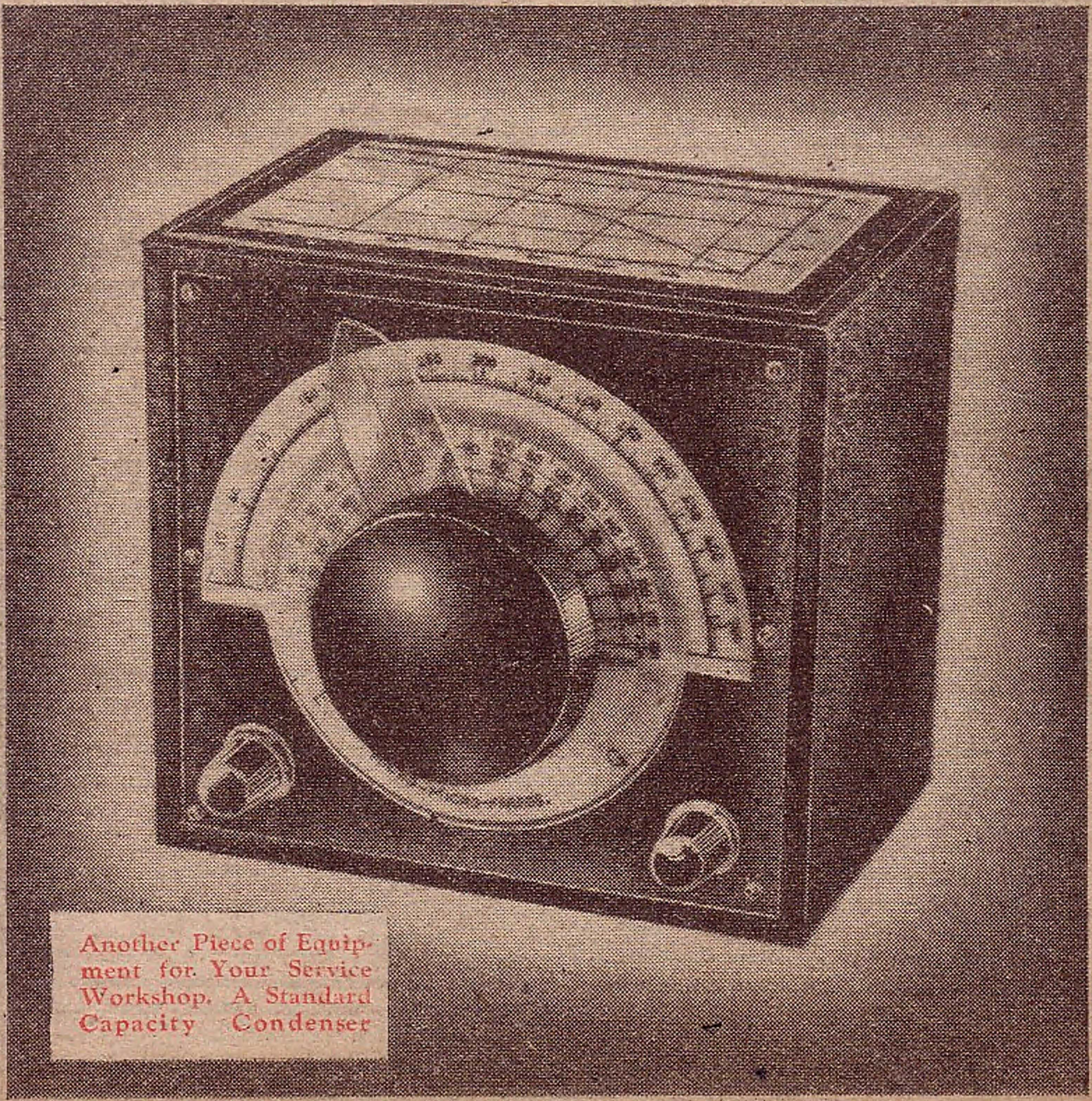
AN A.C. TWO-VALVER

Practical Wireless

9D EVERY MONTH

Editor F. J. CAMM

Vol. 20. No. 453 NEW SERIES MARCH, 1944



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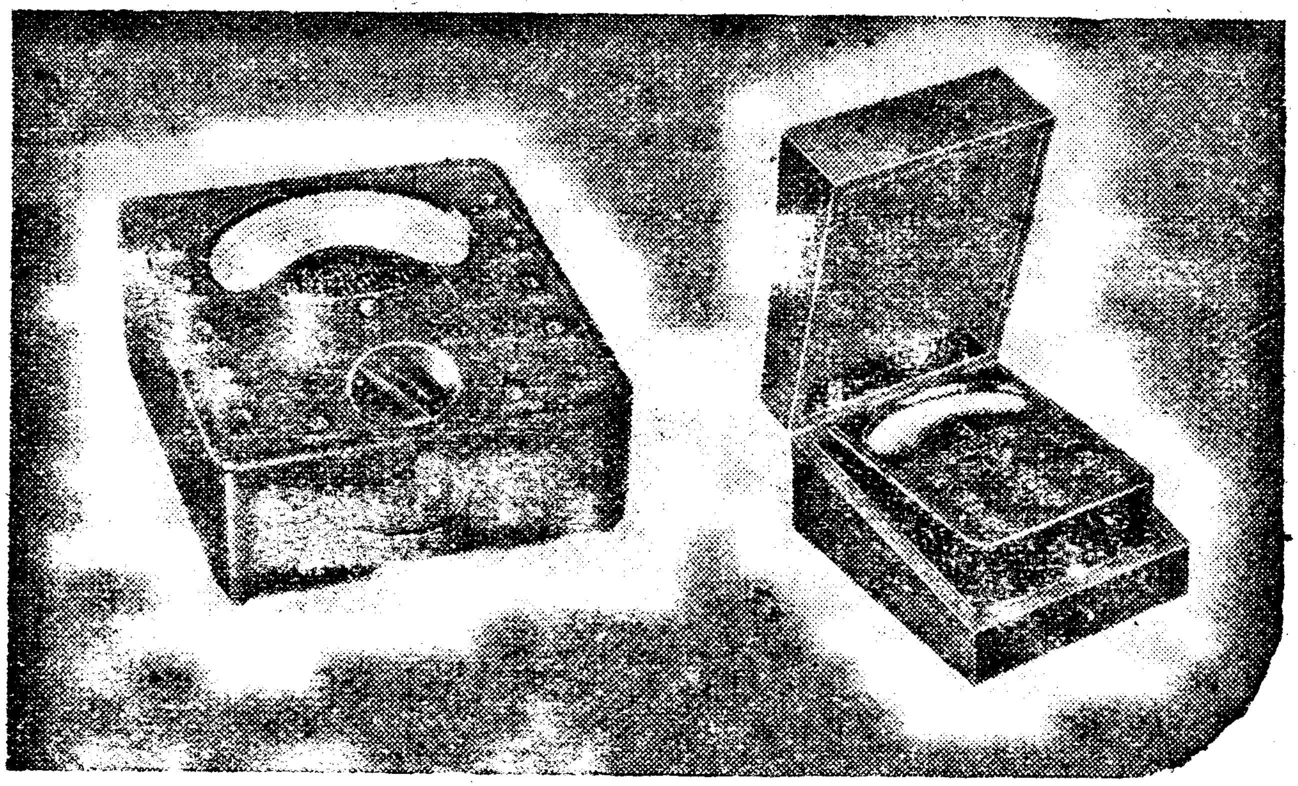

THE meters illustrated are two of a useful range of "AVO" electrical testing instruments which are maintaining on active service and in industry the "Avo" reputation for an unexcelled standard of accuracy and dependability —in fact, a standard by which other instruments are judged.

THE UNIVERSAL AVOMINOR
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A 22-range A.C./D.C. moving coil precision meter providing direct readings of A.C. voltage. D.C. voltage, current and resistance. Supplied with leads, test prods and crocodile clips.

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A high-grade 13-range D.C. meter providing direct readings of voltage, current and resistance. Supplied in case, with leads, test prods and crocodile clips.

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PREMIER RADIO

NEW PREMIER S.W. COILS

4- and 6-pin types now have octal pin spacing and will fit **International Octal** valve-holders.

4-pin Type

Type	Range	Price
04	9.15 m. ...	2/6
04A	12.26 m. ...	2/6
04B	22.47 m. ...	2/6
04C	41.94 m. ...	2/6
04D	76.170 m. ...	2/6
04E	150-350 m. ...	3/-
04F	255-550 m. ...	3/-
04G	490-1,000 m.	4/-
04H	1,000-2,000 m.	4/-

6-pin Type

Type	Range	Price
06	9.15 m. ...	2/6
06A	12.26 m. ...	2/6
06B	22.47 m. ...	2/6
06C	41.94 m. ...	2/6
06D	76.170 m. ...	2/6

Chassis Mounting Octal Holders 10½d. each.

New Premier 3-Band S.W. Coil, 11-25, 25-38, 38-86 m., **4/9.**

Rotary Wave Change to suit above, **1/6.**

Brass Shaft Couplers, ¼in. bore, **7½d.** each.

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Above speakers are less output transformer.

Pentode Output Transformers, 3½ watts. price **10/6** each.

Celestion 8in. P.M. Speaker, **29/6.**

Celestion 10in. P.M. Speaker, **49/6.**

The above speakers are fitted with output transformers.

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30 amps. Centre Zero Bakelite case, **19/6** each.

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Iron-cored 450-470 kc/s, plain and with flying lead, **7/6** each.

BAKELITE DIELECTRIC REACTION CONDENSERS

.0001 mf., **1/3.**
.0003 mf., **2/6.**
.0005 mf., **2/9** each.
.0003 mf., Differential, **2/11.**

H.F. CHOKES

S.W. H.F. 10-100 m., **1/8.**
Binocular, H.F.. **1/6.**

VOLUME CONTROLS

Carbon type, 20,000, 1 meg., and 2 meg., **3/9** each. Carbon type, 5,000, 10,000, **4/6** each. Wire wound type, 5,000 and 10,000 ohms, **5/6** each.

Mains Resistances, 660 ohms .3A, tapped 360 + 180+60+60 ohms, **5/6** 1,000 ohms, .2A, tapped at 900, 800, 700, 600, 500 ohms, **5/6.**

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Transverse Current Mike. High-grade large output unit. Response 45-7,500 cycles. Low hiss Level, **23/-.**

Premier Super-Moving Coil Mike. Permanent Magnet model requiring no energising. Sensitivity 56db. Impedance 15 ohms. Excellent reproduction of speech and music, **£5/5/-.**

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Crystal Mike. Response is flat from 50-5,500 cycles with a slightly rising characteristic to 8,000 cycles. Output level is minus 60db. Price **39/6.**

Chromium Collapsible Type Microphone Stand, 52/6.

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QMB. panel mounting, split knob type 2-point on/off, **2/-** each. DP on/off, **3/6.**

Valve Screens, for International and U.S.A. types, **1/2** each.

Resin-cored Solder, 7½d. per coil.

Push-Back Connecting Wire, 2½d. per yard.

Systoflex Sleeving, 2mm., **2/6** per doz. yards.

Screened Braided Cable. Single, **1/3** per yard. Twin, **1/6** per yard.

7-pin Ceramic Chassis Mtg. English Type Valveholders, 1/6 each.

Amphenol Octal Chassis Mounting Valveholders, International type, **1/3** each. English type, octal, **1/3** each.

Send for details of other radio accessories available. All enquiries must be accompanied by a 2½d. stamp.

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Practical Wireless
and PRACTICAL TELEVISION
12th YEAR OF ISSUE
EVERY MONTH
Vol. XX. No. 453. MAR., 1944.
Editor F. J. CAMM

COMMENTS OF THE MONTH BY THE EDITOR

Broadcast "Airata"

DURING the past few weeks there have been more mistakes in talks broadcast by the B.B.C. than in any other period of its history. The B.B.C. does not need to be reminded by us of the effect on the entire population of words which it radiates, and it should therefore use the most meticulous care, not only in selecting expert speakers to speak on matters of fact, but it should itself engage experts to vet their script, and to make quite sure that it is correct factually before it is broadcast; even experts make mistakes.

We all make mistakes, but their effect is not so widespread as when radiated over the air. The public is entitled to presume that what is spoken over the air, apart from mere expressions of opinion, is correct. Even in the matter of opinions the blue pencil of the B.B.C. editors needs to be carefully wielded so that false beliefs are not promoted or the public encouraged to run counter to the law. Nor should the personal views of B.B.C. speakers be radiated if those views are likely to give rise to popular clamour for a will o' the wisp.

Now jet propulsion has been very much in the news, and the B.B.C., with commendable promptitude, broadcast a talk in general language on the principles of this new craft. For reasons of national importance, obviously it could not go into questions of detail and design, and so, apart from the bald announcement that we were the first in the field with an aircraft of this type, the talk was confined to generalities on reaction propulsion, or to give it its more modern name, "jet propulsion.

Hero of Alexandria

THESE principles are well known. As far as we can trace they were first enunciated by Hero of Alexandria about a century before the birth of Christ, when he demonstrated the principle by means of his Æolipile, or steam turbine. The B.B.C. retains the services of experts in these special branches. In the broadcast to which we have referred listeners were solemnly assured that jet-propelled aircraft derived their power by the jet *pushing on the air behind*! Many listeners, therefore, will go through life in the firm belief that this is the scientific principle which governs jet-propelled aircraft. The statement is, of course, sheer nonsense. At one time it was supposed that an ordinary rocket ascended into the air because the explosive charge at its base "pushed on the air behind." It is now well known that it does not, for a rocket is more efficient in a vacuum.

A jet-propelled aircraft is driven by reaction pressure against the fuselage, or wings, and is thus comparable to the recoil of a gun. The great advantage, in fact, of jet-propelled aircraft is that it does not work against the atmosphere as does the airscrew of the normal type of aeroplane, and it is precisely because of this that jet-propelled aircraft will have a higher speed in the more rarefied regions of the Stratosphere and the Troposphere, where the air is too rarefied for efficient airscrew operation. We are yet to learn that the B.B.C. has published a correction of this erroneous statement, and this is all the more remarkable because on the same afternoon as the broadcast in English, the B.B.C. broadcast in German a technically accurate description of the principles of jet propulsion.

Errata

WE now suggest that each week the B.B.C. should include, at the end of its news items, another feature to be known as "Airata," in which it would correct errors made by speakers over the air during the previous week. In this connection it will be remembered that C. E. M. Joad expressed the view that justification could be found for a man wishing to take his own life. Now the disastrous effect of these views is that certain people with suicidal tendencies may gain the necessary pluck to carry out the urge of their conscience; one man did, but failed in the attempt. When he was arraigned before the magistrate he quoted Joad's views in support of his action. The magistrate suggested that no notice should be taken of Joad.

If this is the best that the Brains Trust can do, it should be abolished. The only questions put to it wth minor exceptions are those the answer to which can never be right and can never be wrong. An expert in philosophy is not necessarily an expert in everything else.

Solving Unemployment!

HERE is a further piece of illogical nonsense, broadcast by a woman speaker:

"By spending 16 millions a day on the war effort we have ended unemployment and we've produced a labour shortage. Well—yes I know it's investment in destruction. But why not a peacetime programme of full investment in construction. . . . In concrete terms, I should like to see a Land Commission and a National Investment Board added to our public institutions just to do this job of overseeing our economy in the public interest. . . ."

It does not seem to have occurred to the speaker that we have not solved unemployment by war. What we have done is to sacrifice the accumulated savings of years of private enterprise, and by putting people into the Services have taken them off the labour market and so created an artificial shortage.

Perhaps the B.B.C. will consider our suggestion for a weekly "Airata" feature.

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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.

ROUND THE WORLD OF WIRELESS

U.S. Freedom Station

IT is interesting to note that the landing of the Allied Forces on the north coast of Africa was considerably facilitated by broadcasts to the people of Morocco from a transmitter aboard a U.S. warship. The broadcasts, which appealed to the inhabitants to lay down their arms and help the Allies, came from a 5-kW transmitter which was originally intended for a broadcasting station in New Jersey.

Radiolocation to Aid Navigators

A RECOMMENDATION by the Select Committee on National Expenditure in a report on the salvage of ships states that wartime developments in radiolocation could be used after the war to reduce shipping casualties in darkness or fog.

Evidence was taken from eminent scientists and Trinity House representatives on the possibilities of using Government-owned radiolocation equipment after the war to improve the safety of navigation.

This photograph, taken nearly 40 years ago, shows Miss Belville during one of her visits to Greenwich, where she received a certificate as to the accuracy of her 100 year old watch, with which she took the correct time to business houses in London.

Berlin's Funkhaus Blitzed

IT was recently reported that one of the important buildings destroyed during an R.A.F. raid on Berlin was the Funkhaus, Germany's Broadcasting House.

Now Ready

PRACTICAL WIRELESS Indexes. The Index for Volume 19 can now be obtained from these offices, price 9d., by post 10d.

Indexes are also available for the following volumes: 11, 12, 13, 14, 15, 16, 17 and 18.

Marconi's Yacht "Elettra"

A RECENT report from Paris mentions that all the wireless equipment has been removed from Marconi's famous yacht, *Elettra*, and the vessel removed to a place of safety. Readers will remember that it was on this yacht that Marconi carried out pioneer experiments in connection with ultra-short waves.

Electrical Industries Red Cross Appeal

THE Electrical Development Association has just issued the 17th list of covenants and donations in connection with the above fund, which shows that the gross annual amount received from covenants is £11,155 15s., and from donations £6,484 15s. 6d.

Appointments

THE Postmaster-General, Capt. the Rt. Hon. Harry Crookshank, M.P., has appointed Miss P. M. James to be his assistant private secretary, and the Assistant Postmaster-General, Mr. Robert Grimston, M.P., has appointed Mrs. D. E. Mitchell to be his private secretary.

B.B.C. in French Victory Parade

A YOUNG French girl who has been working for over two years in the underground movement in a large town in Southern France writes to the B.B.C. that the speakers in our French service are no less popular heroes than the leaders of the Fighting French.

"Everybody," she says, "expects that on the day when the Victory Parade goes down the Champs Elysées in Paris they will see one car with de Gaulle and the Fighting French generals, and, just behind, a second car with Jacques Duchesne and the men of the London radio."

New R.S.G.B. President

MR. ERNEST LETT GARDINER, B.Sc. (G6GR), was installed as president of the Incorporated Radio Society of Great Britain at a meeting of the society held at the Institution of Electrical Engineers, London, on Saturday, January 29th. Following the installation Mr. Gardiner delivered his presidential address. Visitors were invited to attend the meeting.

Executive Members

STANLEY K. LEWER, B.Sc. (G6LJ), is the newly elected executive vice-president of the society, while H. A. M. Clark, B.Sc. (G6OT), and A. J. H. Watson, A.S.A.A. (G2YD), remain in office as hon. secretary and hon. treasurer respectively. Arthur O. Milne (G2MI) is the new honorary editor of the R.S.G.B. Bulletin.

The ordinary members of council for the current year are F. Charman (G6CJ), D. N. Corfield, D.L.C. (Hons.) (G5CD), Wing Commander G. R. Scott Farnie (GW5FI), F. G. Hoare (G2DP), Wing Commander J. C. H. Hunter (G2ZQ), W. E. Russell (G5WP) and H. W. Stacey (G6CX).

Wireless for the Blind Fund

LORD WOOLTON has received in response to his Christmas Wireless for the Blind Appeal about 65,000 letters containing £70,000. Donations ranged from a £500 cheque to a penny stamp. The previous highest amount raised for this fund was £42,103, after Lord Southwood's appeal in 1938.

Arthur Bliss Leaving B.B.C.

MR. ARTHUR BLISS, who has been director of music at the B.B.C. since 1942, is resigning from his post at the end of March.

Mr. Bliss was assistant director of music to the Overseas Service of the B.B.C. from 1941-42.

His successor will be Mr. Victor Hely Hutchinson, a South African, who is Professor of Music at the University of Birmingham and was on the staff of the B.B.C. from 1926-34. He is best known as a pianist, composer and a conductor.

He will take up his duties in September. In the interim Sir Adrian Boult will act as director of music.

Length Through Joy ?

IN one of the Dutch clandestine papers which has found its way to the B.B.C. there appears the following duologue:

"Why do the barbers in Holland now charge five cents extra for shaving Nazis ?"

"Because they have such long faces nowadays."

Week's Good Cause Appeals

CONTRIBUTIONS to B.B.C. Week's Good Cause appeals in 1943 set up a record for the last three years of the war. A generous public subscribed no less than £235,773, compared with £195,112 in 1942 and £227,501 in 1941. And this in spite of increased taxation and the ever-growing number of charitable causes in Britain! This is the second highest yearly figure in the history of the Week's Good Cause, and it is noteworthy that the lowest intake for any single year since the war started is greater than the response in any year in peacetime. The record reply to a single appeal was £101,756, subscribed to Lord Baldwin's appeal for King George's Fund for Sailors in December, 1939.

All told, a total nearing the million and a quarter pounds mark has been raised since the appeals were reinstated on a wartime basis in November, 1939.

Alice Delysia

AS most listeners probably know, that great artist Alice Delysia recently returned from the Middle East, where she had been entertaining our Forces for the last two years.

On January 20th she told listeners of her experiences, of the people she met and the songs she sang. As may be expected, easily the first favourite was "Parlez-moi d'Amour."

She left London on May 19th, 1941, and took two months to get to the Middle East. She appeared not only in cities like Cairo, Jerusalem, Baghdad, Damascus, but in the desert, and on one occasion had the experience of being caught by a sandstorm when she was singing.

The dance orchestra was under the conductor Billy Ternent. Script by Aubrey Danvers-Walker, and the production by Michael North.

Noisy Radio Sets !

THE Leicester Corporation have adopted a by-law preventing persons using their radio sets in such a way as to cause annoyance to neighbours.

Transatlantic Call

ANOTHER American contribution to this series of exchange programmes, featuring Boston, the chief town of New England, was given in the Forces programme on January 16th.

As a literary centre Boston was long supreme. Famous littérateurs associated with the city include Hawthorne, Longfellow, Benjamin Franklin and Henry James. Prescott wrote his "Conquest of Peru" and "Phillip II" at a house in Beacon Street, where he lived for the last 14 years of his life.

Boston people from the Fish Market, the historic Beacon Hill and the Navy Yard told listeners about the city and its famous Sunday morning custom when everybody eats brown bread and beans.

Limitation of Supplies (Miscellaneous) Returns

THE Board of Trade have issued an Order dated December 6th, 1943 (S.R. & O. 1943, No. 1637)*, under Regulation 55AA of the Defence (General) Regulations, 1939, requiring every person whose name was at July 31st, 1943, entered in the Home Trade Register, to make a return on Form Misc./17, showing, inter alia, the value of controlled goods supplied by him during the standard period (June 1st, 1939, to May 31st, 1940) and during the restriction period (February 1st to July 31st, 1943).

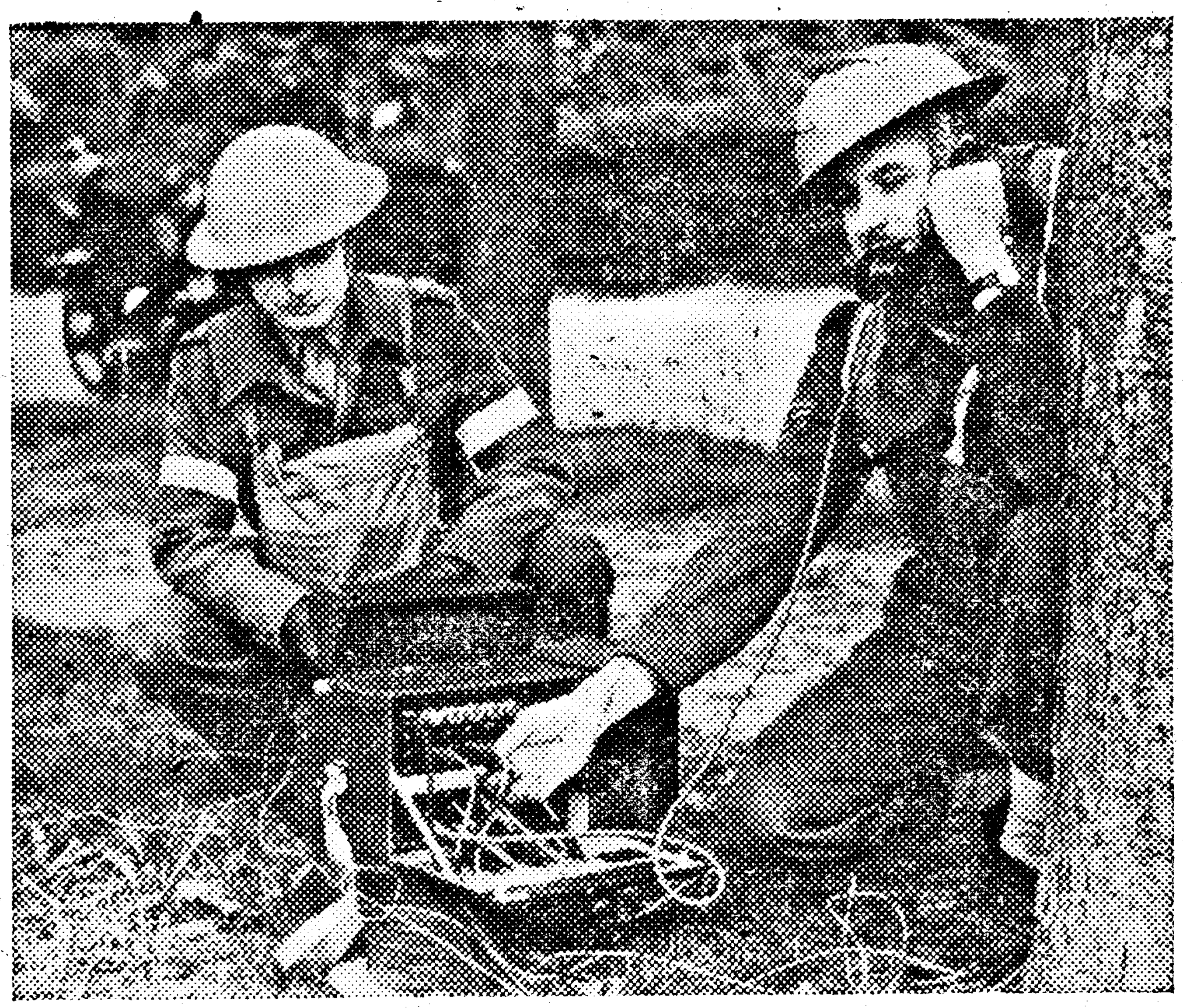
A copy of the appropriate form is being sent to each person concerned, but any trader who did not receive his copy by December 15th, 1943, should apply for one to the Chief Accountant, Board of Trade (Miscellaneous Section), North Gate, Prince Albert Road, London, N.W.8.

First Flights

"FIRST Flights," the variety programme expressly designed for cadets of the Air Training Corps, had a special edition on New Year's Day.

There is always an Amateur Talent Corner in which cadets of promise are given a chance to show their paces: on New Year's Day the microphone visited centres in England, Scotland, Ireland and Wales in its search for A.T.C. talent. Three cadets who have appeared in previous editions of "First Flights" were heard a second time, Ken Harwood, from Cheshire, and the Burt Twins, Simon and Timothy, from Weybridge.

W. W. Wakefield, M.P., Director General of the A.T.C., spoke to the cadets as usual, and there were also recorded messages of New Year greetings from all over the Empire. Air Marshal W. A. Bishop, V.C., D.S.O. and Bar, spoke for Canada, Lieutenant-General Sir Pior Van Ryneveld, Chief of the South African General Staff, for South Africa, Wing Commander (Killer) Caldwell, D.S.O., D.F.C., for Australia, and Wing Commander Nicholls, Commandant of the A.T.C. in New Zealand, for his country.



Canadian soldiers on manœuvres take over the rôle of telephone operators near a front line post. This portable exchange can be fitted up in any corner in a few minutes.

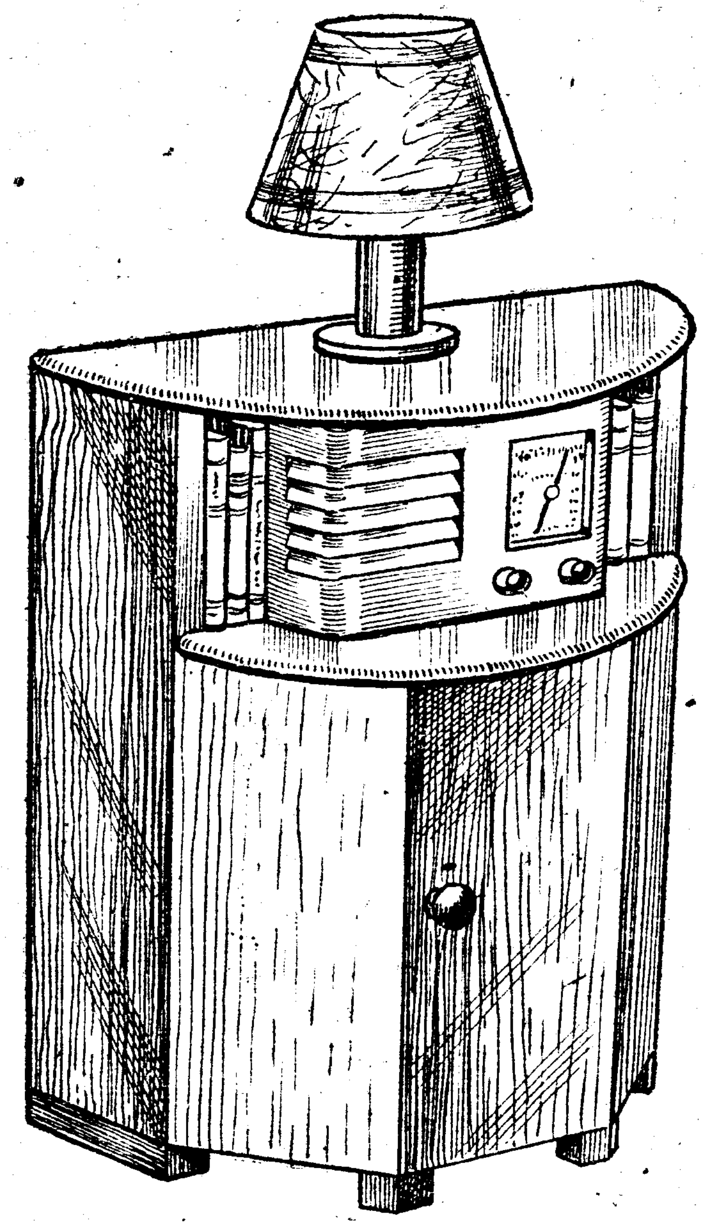
* Obtainable, price 1d., through any newsagent or bookseller, or direct from H.M. Stationery Office, Kingsway, London, W.C.2.

Resistance Cord Substitute

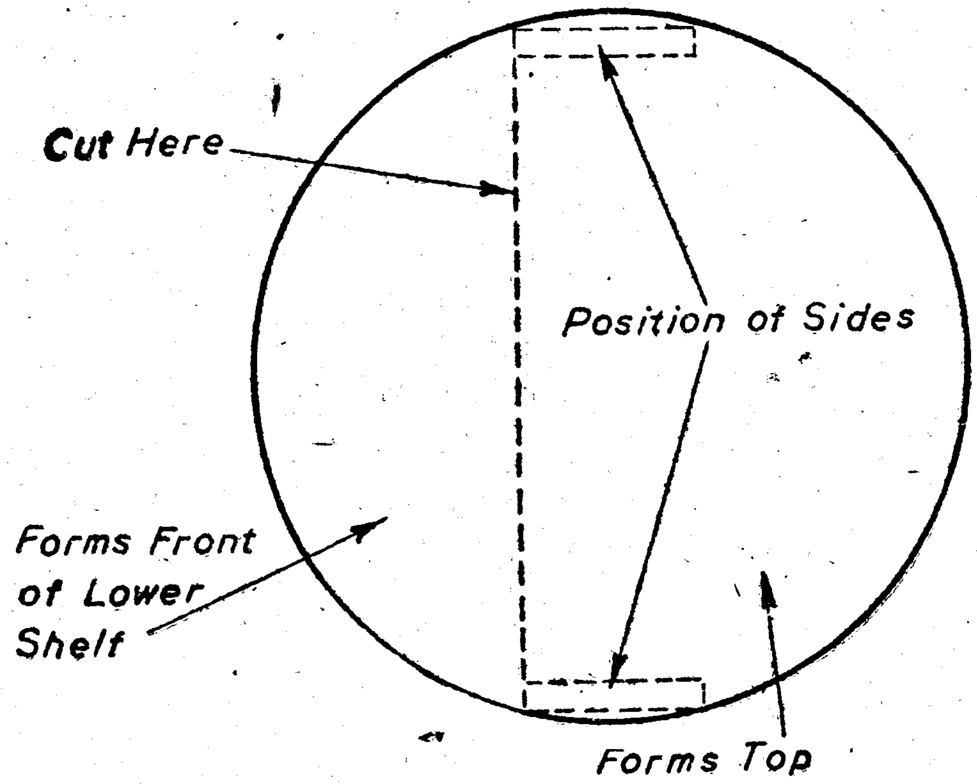
Method of Using an Electric Lamp for the Purpose

By S. H. THOMAS

OVERHEARING a request by a customer in a radio store recently for a new resistance cord for an American midget receiver which was rapidly deteriorating into a species of electric cooker, it occurred to me that few people are aware that an ordinary electric



The bedside table and cupboard, showing set and lamp in position.



The circular table top is cut, as shown, for forming the top and shelf of the bedside cupboard.

lamp serves the same purpose quite well—besides supplying "free" light!

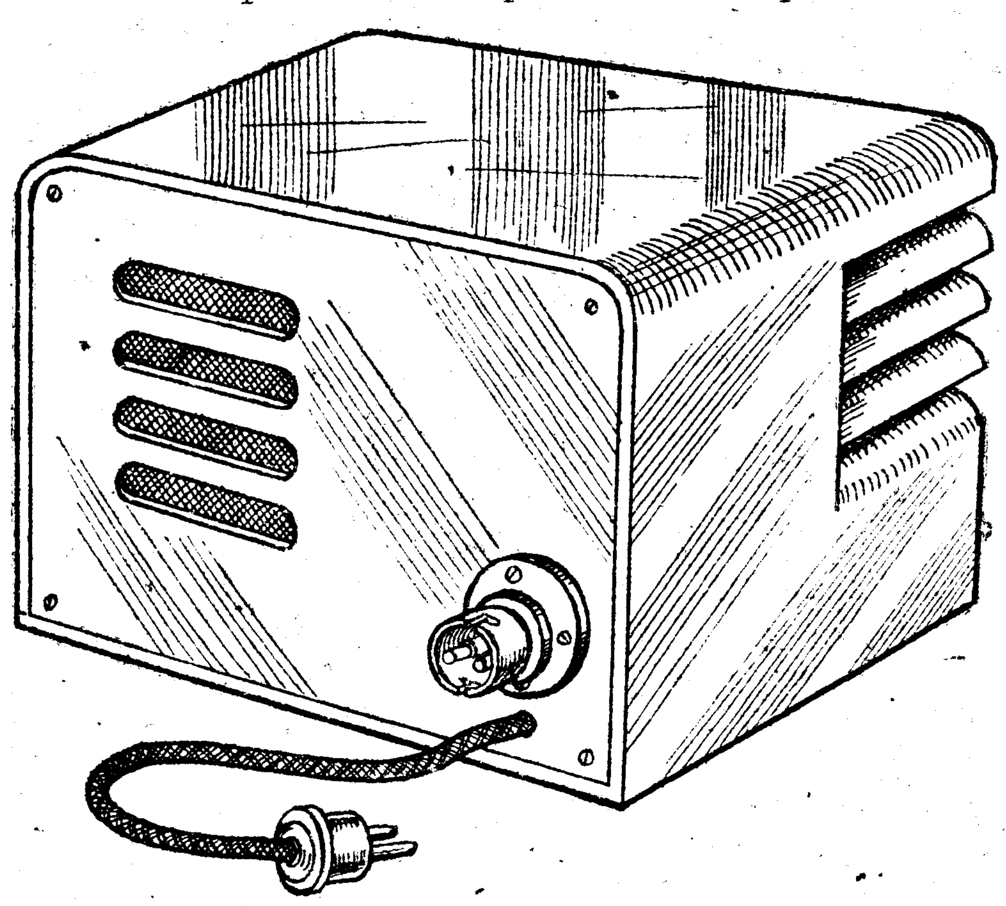
First of all, most present day overheating troubles, especially in industrial areas, are due to "pepping up" the mains, sometimes as much as 27 volts (this, I have, on good authority).

On a transformer fed set this can usually be overcome by using the highest alternative tapping on the transformer, e.g., on 230 volts supply use the 250 volt tapping.

Naturally this is not possible on a "direct-feed" circuit, and the only alternative is to increase the resistance.

Cords being unobtainable, I removed the old cord and inserted and ordinary B.C. lamp-holder through a hole drilled in the back of the set, connecting this in series with the set and a length of heavy flex.

On 230 volt mains a 40-watt lamp is plugged in, but the receiver can be used on 110 volt mains by shorting a B.C. adaptor which replaces the lamp.



Rear view of set, showing lamp-holder, flex lead and plug.

Use was made of the lamp (which, of course, lights up) by fixing up a table lamp, as shown in the accompanying sketch.

As a matter of interest, the bedside table and cupboard shown was constructed from the top of an old circular table (cut as indicated) and floor boards.

The receiver just fits under the top of the table and is secured in place by squeezing "small" books in either side.

I would add that excessive heat is no longer experienced and tone appears to have improved—although a slight drop in "all out volume" (never used) is just noticeable.

The best procedure is to turn the volume control on full, then insert, first a 5-watt lamp, followed by a 15, 20, 40, 60, etc., and so discover the lowest powered lamp which will give sufficient volume for comfortable hearing.

A Simple A.C. 2-valve Receiver

A Useful Local-station Receiver, Ideal as a Stand-by and Economical to Run

AN A.C. receiver was recently required in the shortest possible time. The main requirement being that the Forces, European News, and Home Service programmes should be received at reasonable volume. The ultimate receiver, although simple and orthodox in design, was so successful that it is ideal for those who require an "easy-to-make" local station receiver.

The circuit, the diagram of which is shown in Fig. 1, consists of a leaky-grid triode detector with reaction, transformer coupled by the parallel feed method to a high-efficiency output pentode. Power from the mains is derived from the mains transformer which, in this case, provides outputs of 6.3 volts at 2 amps. for the receiving valve heaters, 5 volts at 1 amp. for the rectifier heater, and 300-0-300 volts at 60 milliamps for the rectifier anodes. Smoothing and voltage dropping is effected by a standard 2,000-ohm field mains energised speaker in conjunction with C9 and C10 which are in the form of a can-type 8+8 mfd. electrolytic. Here it may be stated that cardboard type block electrolytics may be used instead.

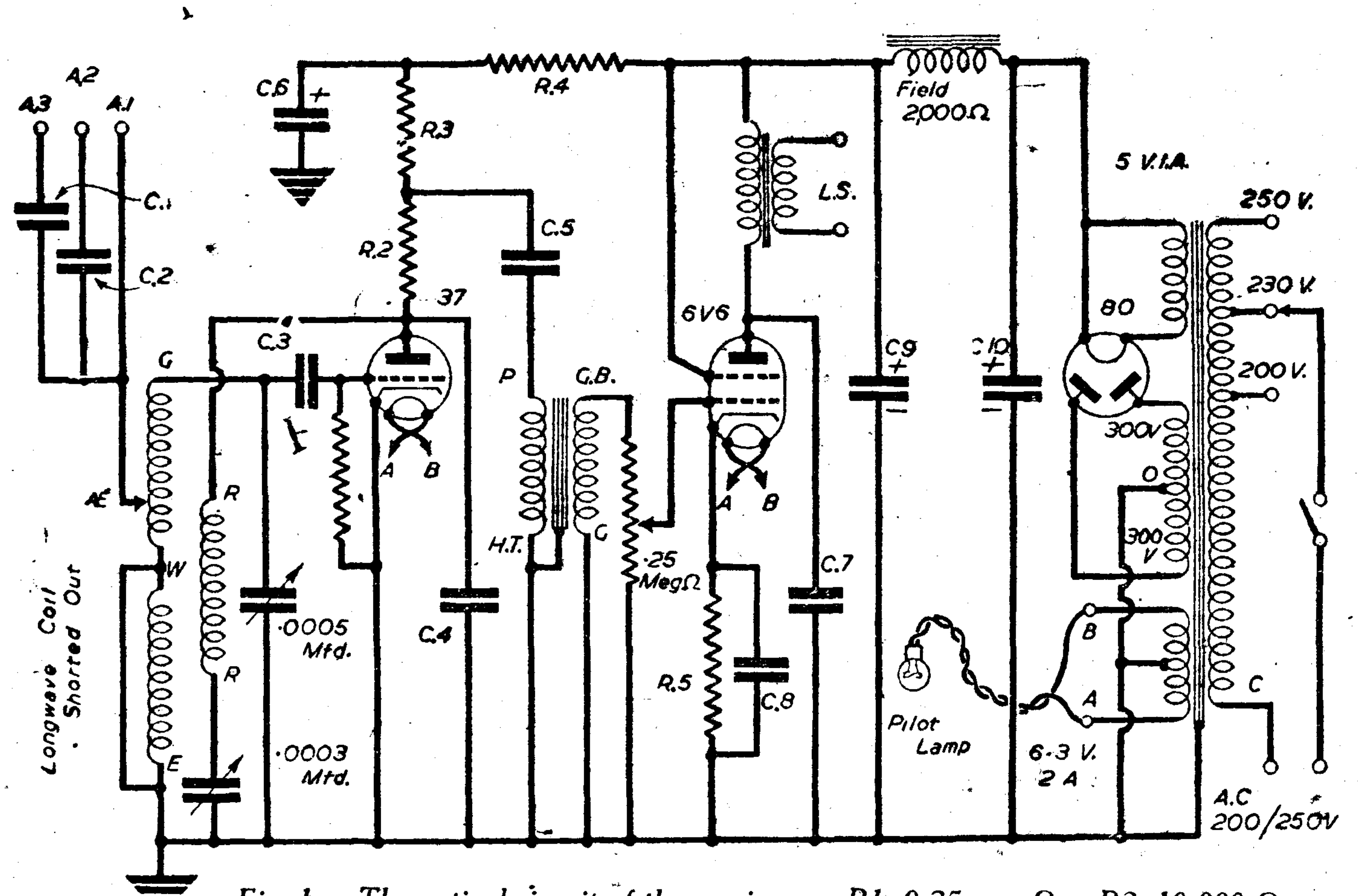


Fig. 1.—Theoretical circuit of the receiver. R1, 0.25 meg Ω ; R2, 10,000 Ω ; R3, 50,000 Ω ; R4, 25,000 Ω ; R5, 250 Ω ; 1 Potentiometer 0.25 megΩ. C1, .00005 mfd. ; C2, .0001 mfd. ; C3, .0001 mfd. ; C4, .0003 mfd. ; C5, .5 mfd. ; C6, 1 mfd. ; C7, .002 mfd. ; C8, 25 mfd. ; C9, C10, 8 mfd. each. 1 variable condenser .0005 mfd. 1 .0003 mfd.

With regard to the tuning arrangements, a screened coil was used of the type which provides for an aerial tapping on the grid winding. Varying degrees of selectivity are obtained by the use of terminals A1, A2 or A3. If preferred, a coil having an aerial coupling winding may be used, in which case the tapping on the grid winding will not be necessary.

Owing to the design of the cabinet used, the set was built on a shallow aluminium chassis 1½in. deep, but in spite of this all fixed condensers and resistors were accommodated underneath. The mains transformer is of the "drop-through" type which also helps to provide a clean layout. The reaction condenser and volume control (with on-off switch) are mounted on angle brackets fixed to the front edge of the chassis so that the spindles register with the holes in the cabinet. The tuning condenser is a solo 0.0005 mfd. of any good type, and this is supported by a slow-motion dial assembly bolted to the chassis and eventually screwed to the inside of the cabinet.

The wiring of the receiver is simple and no screened leads were used, although heater wires should be twisted in order to minimise the possibility of hum.

It will be noted from the chassis layout, Fig. 2, that the L.F. transformer is mounted at rather an odd angle. This is so that interaction between it and the mains transformer is at a minimum. The exact position is best found by trial and error after having temporarily connected flexible leads to the transformer. Another point concerning this component is that although its high-tension and grid terminals are earthed in the design shown, it may be advisable to reverse either or both of the windings in another model.

No difficulty should be encountered in obtaining satisfactory results on first tests, and, providing the set *is* in order, the volume will be found to be ample for normal listening, assuming the use of a reasonably good aerial. An earth connection improved results on the original model.

Use is made, of course, of the reaction control (but not to the extent that it causes interference) and it was found convenient to adjust it so that the volume is adequate when the volume control is at maximum. Then, control of the set, for local station listening, may be effected by the tuning and volume controls only. The use of reaction has the effect of cutting the higher frequencies slightly, therefore the comparatively low value of 0.001 or 0.002 mfd. is more suitable for C7, but apart from this the condenser should not be omitted, for other reasons.

An 8in. diameter mains energised speaker having a

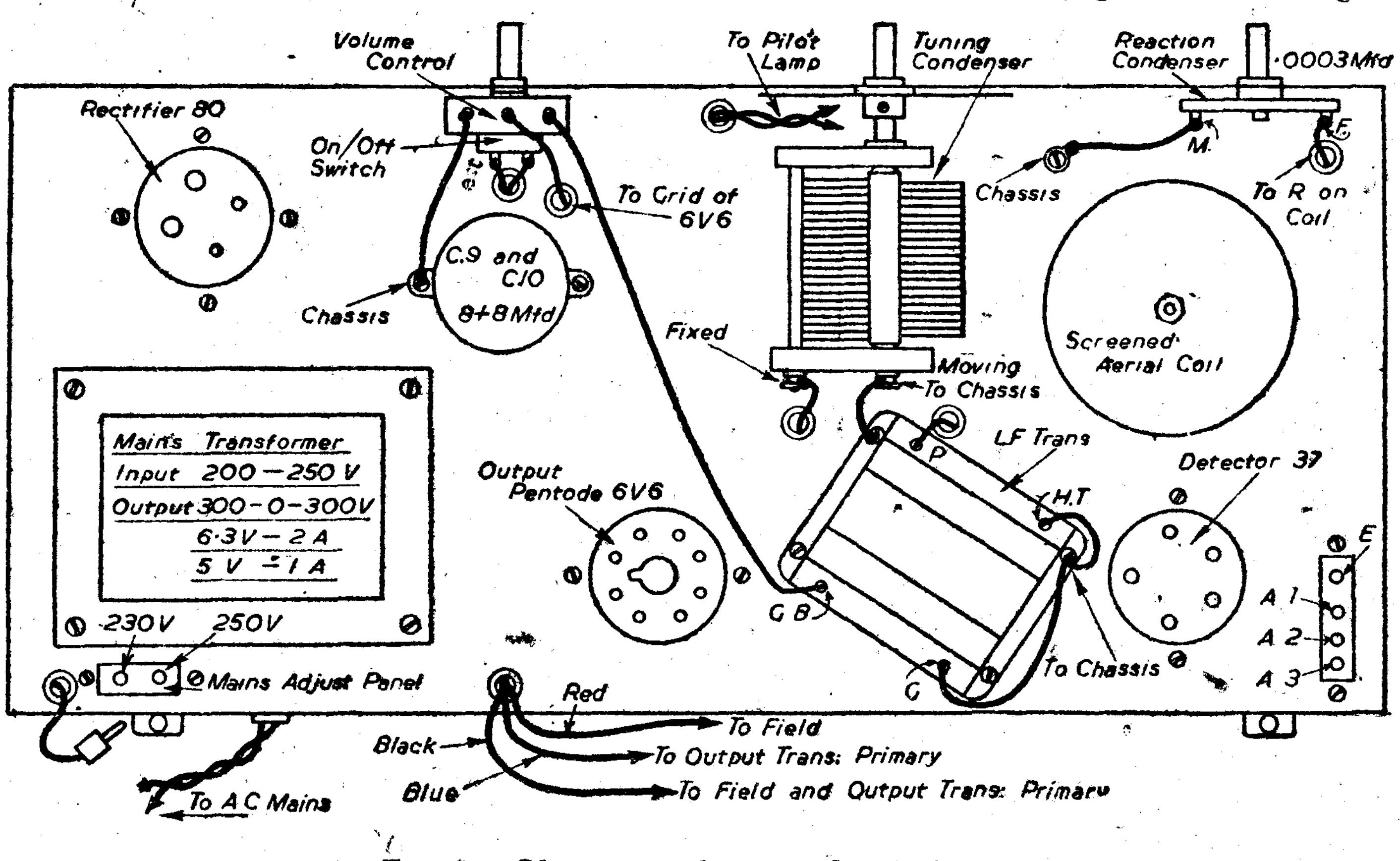


Fig. 2.—Plan view of upperside of chassis.

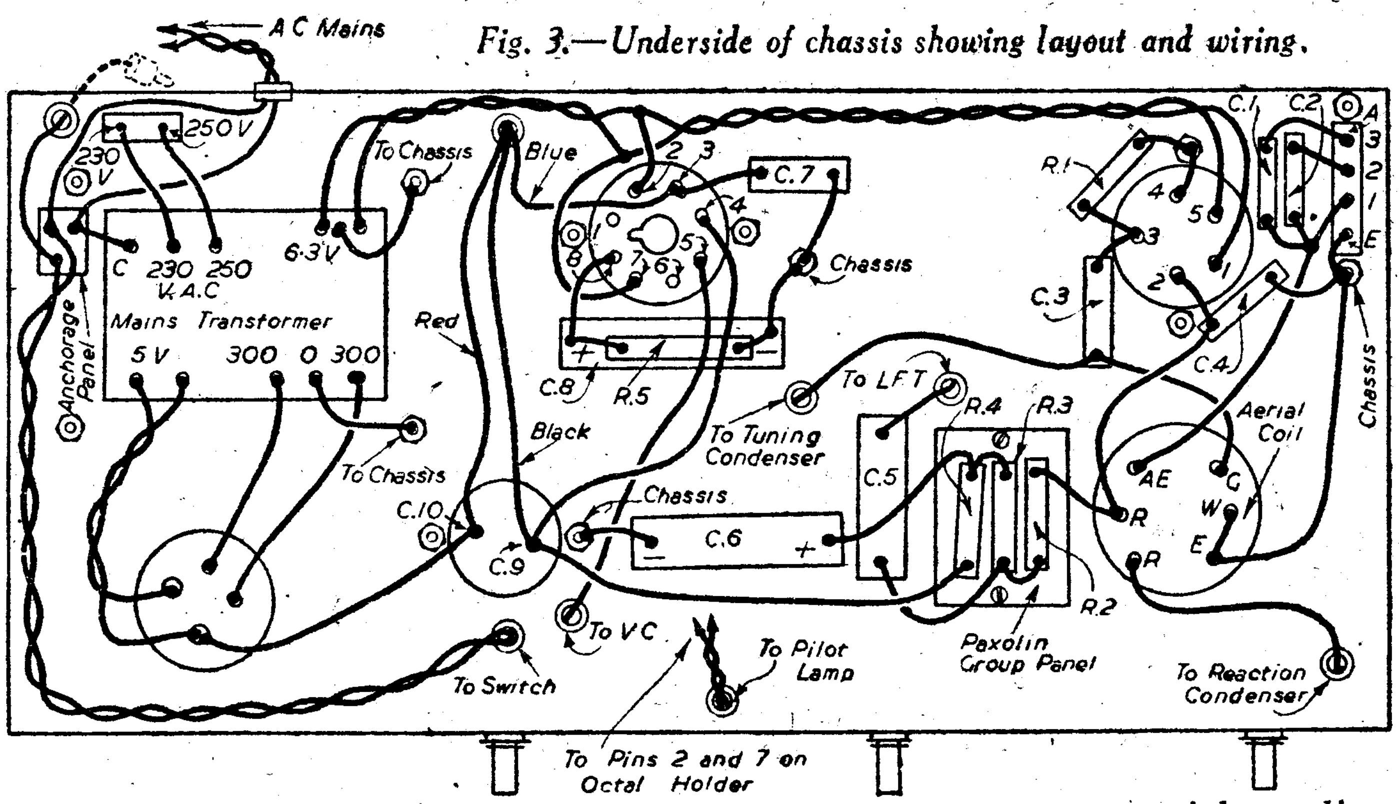


Fig. 3.—Underside of chassis showing layout and wiring.

field resistance of 2,000 ohms was used and mains hum was almost inaudible.

American type valves were used because they were the most convenient ones on hand, but a receiver of this design fitted with English valves would, no doubt, be just as efficient. It would then be necessary to use a mains transformer having 4-volt secondary windings. Also, it may be advisable to increase the value of the load resistor R3 if the detector valve is of high impedance. The type 37 shown in the diagram is a low impedance valve, therefore the value of 50,000 ohms for R3 is sufficient. General efficiency might be still further improved by the use of an H.F. pentode as detector.

One of the biggest problems to overcome with a receiver of this simple type, having only one tuned circuit, is that of selectivity, and naturally it is more apparent in some localities than others. In view of this, some tests were carried out with a wave-trap designed to either eliminate or considerably reduce the signal from the European News station. Although it was eventually decided not to incorporate the device in the original receiver, the results were quite successful, so for those in a locality where this station swamps the Forces programme Fig. 4 shows three alternative methods of connection. A is the rejector method, B an acceptor circuit, and C a rather unorthodox method whereby an aerial coupling coil is tuned to reduce the unwanted signal. It also has the effect of "spreading" the three local stations more equally over the dial. In A and B the wave-trap consists of a separate coil tuned by a condenser. A practical form may consist of a coil tuned by a fixed capacity and a small trimmer.

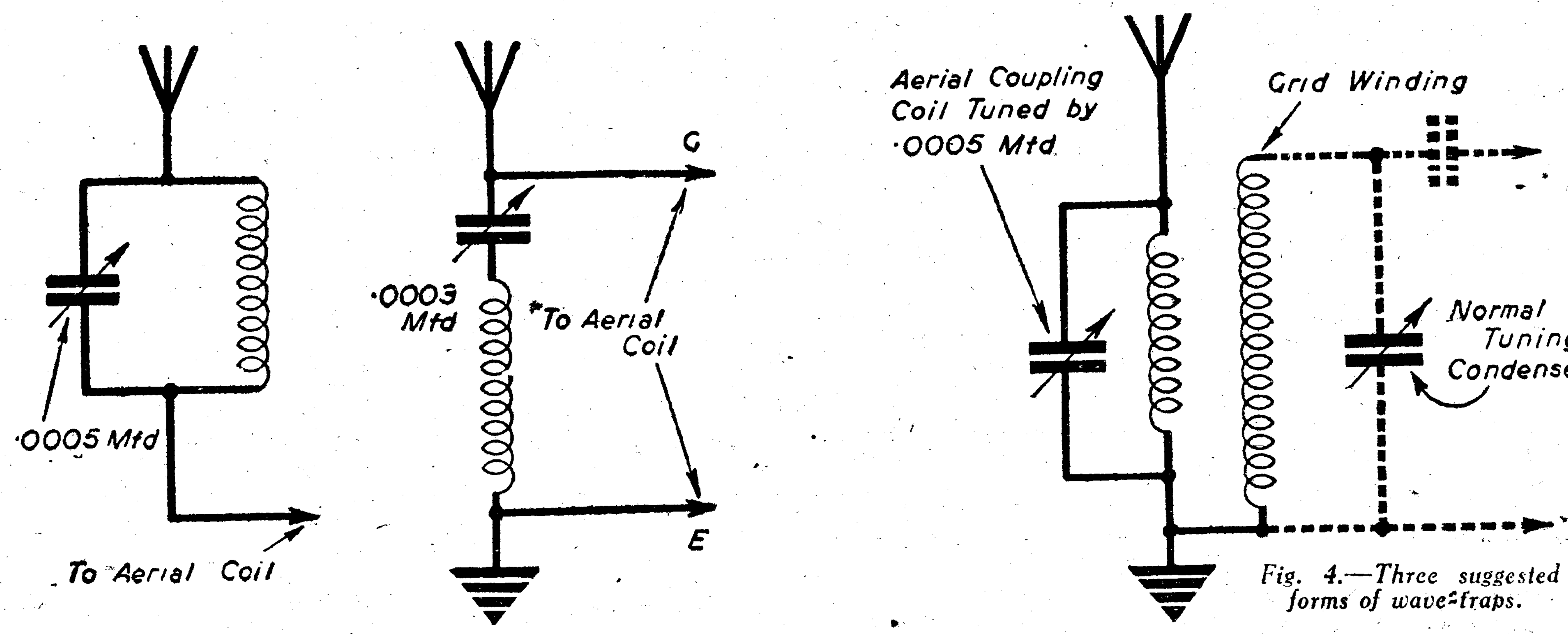


Fig. 4.—Three suggested forms of wave-traps.

LIST OF COMPONENTS

Cabinet.
One chassis approx. 13in. x 7in. x 1½in.
One .0005 mfd. solo tuning condenser with slow-motion dial assembly.
One ·0003 mfd. reaction condenser.
One .25 megohm volume control with switch.
One tuning coil (see text).
One L.F. transformer, ratio 3 : 1.
Three valveholders to suit valves used.
One mains transformer to suit valves used.
Two 8 mfd. electrolytic smoothing condensers (see text).
Fixed Condensers: One .00005 mfd., two .0001 mfd., one .0003 mfd., one .002 mfd., one .5 mfd., one 1.0 mfd.
One 25 mfd. 25 v.w. (electrolytic).
Resistors: One 10,000 Ω, one 25,000 Ω, one 50,000 Ω, one .25 mΩ, one 250 Ω (for 6v6 only).
Three valves, triode detector, output pentode, and rectifier.
One 8in. mains energised loudspeaker, 2,000-ohm field.
One Pilot lamp, 6.3 volts.

S.W. COILS

It is only natural for many constructors to wish to make their own S.W. coils, especially during existing conditions, and numerous requests are received by our Query Service for details of the number of turns required on formers of various sizes. Such information should be available in every constructor's den, together with, of course, neatly compiled tables covering the formulæ and data so often required during experimental and constructional work. The "Radio Engineer's Vest Pocket Book," price 3s. 6d., or 3s. 9d. by post, contains such essential information in a compact and handy size, and it forms a work which will prove itself invaluable in every constructor's workroom.

As very few turns are needed for most S.W. coils, the beginner might be led to believe that short-wave coil construction is a very simple problem. This is not so, however, as a number of important details have to be considered when designing coils for wavelengths below 100 metres. In the first place the turns of the tuned (grid) winding must be spaced in order to reduce the capacity to a minimum. For wavelengths below 50 metres this space should be ⅛in. or more, and for the ultra-short wavelengths a space of about ¼in. is recommended. It must also be borne in mind that the spacing affects the inductance—the greater the space between adjacent turns the lower the inductance. The other factor governing the inductance of the winding is, of course, the number of turns of wire used.

Detection

Anode Bend, Cumulative Grid and Super Regenerative Detection. By S. A. KNIGHT

IF a potential difference of varying magnitude is applied to the ends of a conductor and a curve is drawn to show how the current varies with the magnitude of the applied p.d., the graph is a straight line where the conductance of the conductor is represented by the slope of the line. This is known as a linear characteristic.

In simple crystal receivers the combination of the crystal and the steel whisker acted as a conductor, but in this case a conductor with a non-linear current-voltage characteristic, i.e., the resulting curve was not a straight line. Various groups of dissimilar substances were found to act as conductors whose characteristics were non-linear, and any such arrangement could be employed for the detection of radio frequencies. Although the valve has almost entirely replaced the simple crystal detector, this principle of detection by a conductor whose current-voltage characteristic is not a straight line applies basically to the theory of the valve as a detecting device.

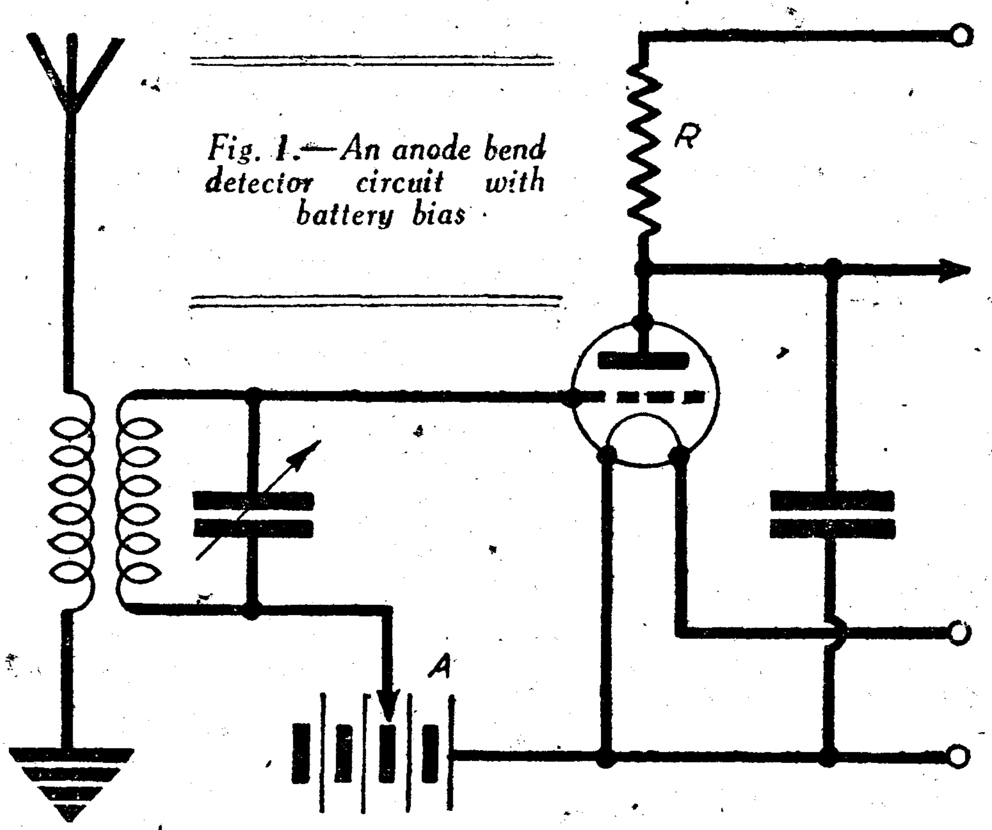


Fig. 1.—An anode bend detector circuit with battery bias

Anode Bend

The characteristic curve of a crystal detector just discussed is very similar to the mutual characteristic of a triode valve, the current portion of the valve's characteristic being used for R.F. detection in much the same way as the curved portion of the crystal combination is employed. The system of detection depending on the curved part of the mutual characteristic is known as anode bend, a circuit arrangement for carrying this method out being depicted in Fig. 1.

Suppose that the anode current-grid volts (Ia.Vg) curve of the valve concerned is as shown in Fig. 2, where the anode potential is assumed to be 90 volts. A steady bias of, say, minus 1 volt is applied to the valve grid by the battery A, and a steady current of 0.25 mA. flows through the anode resistance R.

A signal now arrives at the aerial and an R.F. current modulated by L.F. flows in the grid tuned circuit. This fluctuating p.d. is therefore applied between the grid and filament of the valve and is shown by the curve (a) of Fig. 2. When the signal swings negative the anode current of the valve increases, likewise when the signal swings negative the anode current of the valve decreases. Due to the curvature of the valve characteristic, therefore, the anode current varies in a manner indicated by the curve (b) of the figure in question. This curve is an asymmetrical R.F. current superimposed on the steady direct current applied to the valve anode, and can be split into three main components:

(i) the R.F. component, which is by-passed to earth via various condensers;

(ii) the D.C. component, supplied by the H.T. battery in order for the valve to operate, and which is of no importance as far as an audible output is concerned;

(iii) An A.C. component representing the modulation envelope, this being an audio frequency, and either directly operating the phones or passed to the L.F. stages for single amplification.

It can be shown that if the p.d. applied to the grid and filament of an anode-bend rectifier is e volts, where e is quite small in value, the signal input being unheterodyned, then the current output of a useful valve is generally proportional to e^2. If the input is so large that the grid swings beyond the point of cut off to the left of the characteristic and well on to the linear portion to the right of the characteristic, then the useful current output becomes proportional to e rather than e^2.

The anode bend detector, like the crystal, is generally insensitive to weak signals.

Damping of the tuned circuit is quite small with this form of rectification since the valve can be brassed well back on its characteristic and the applied p.d. causes no grid current to flow. The resistance between grid and filament is therefore very high and damping becomes negligible.

Grid Detection

Grid current will begin to flow in the grid circuit of a valve as soon as the grid becomes sufficiently positive to collect electrons from the filament and provided, of course, that a full conducting path is connected between the two electrodes. By arranging a simple circuit where a micrometer is connected in the grid circuit and a varying p.d. positive in sign is applied to the grid electrode, a curve may be plotted showing the variation of grid current with grid potential (Fig. 3).

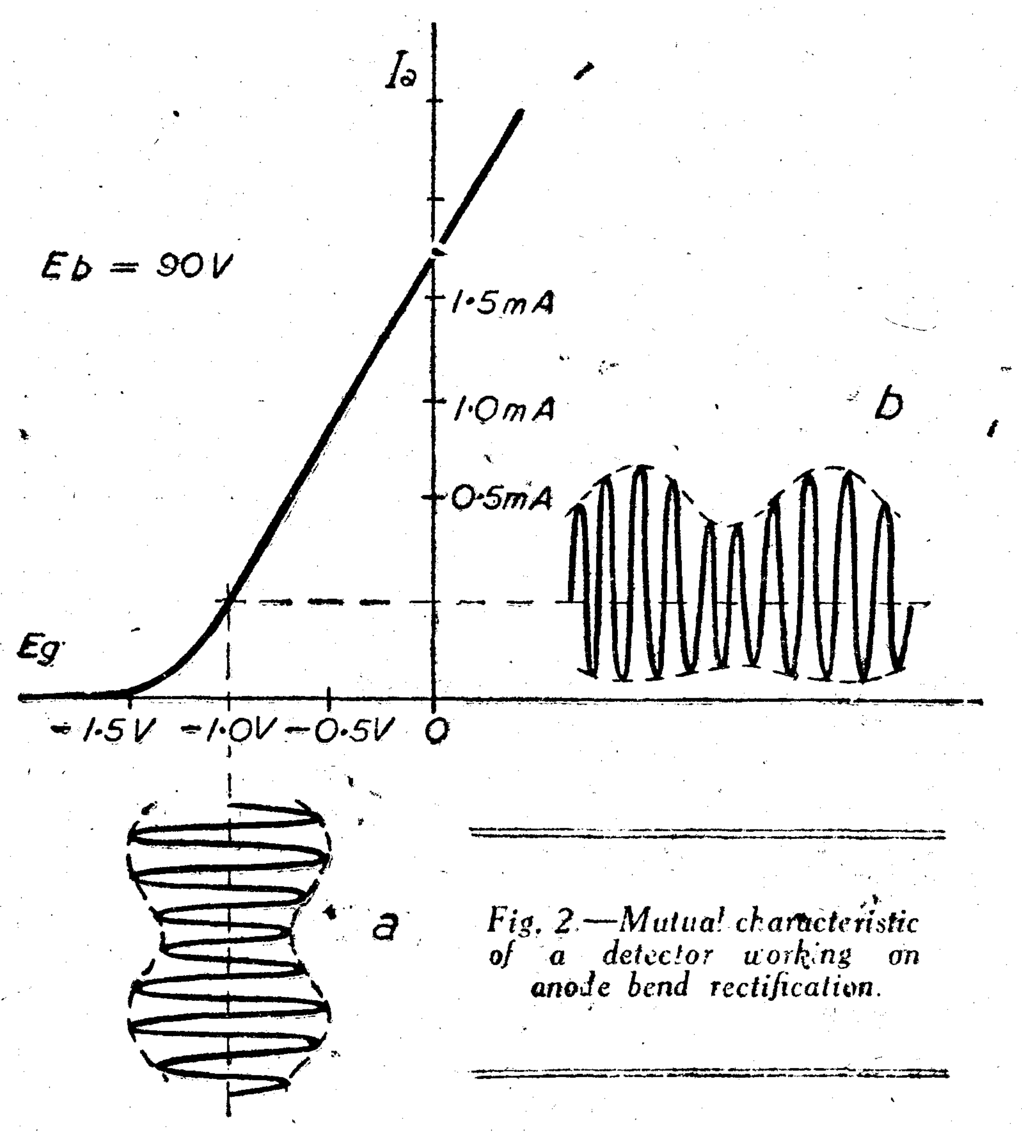


Fig. 2.—Mutual characteristic of a detector working on anode bend rectification.

This curve will be seen to have something in common with the anode bend characteristic, where, in this case, if the grid is adjusted to a value of, say, 0.75 volts positive, and an alternating p.d. is applied by an incoming signal between the filament and the grid, positive swings of the signal will cause an increase in grid current greater than the decrease in grid current caused by the negative swings. The principle of employing the grid characteristic for rectification is the basis of grid detection known fully as cumulative grid detection (C.G.D.).

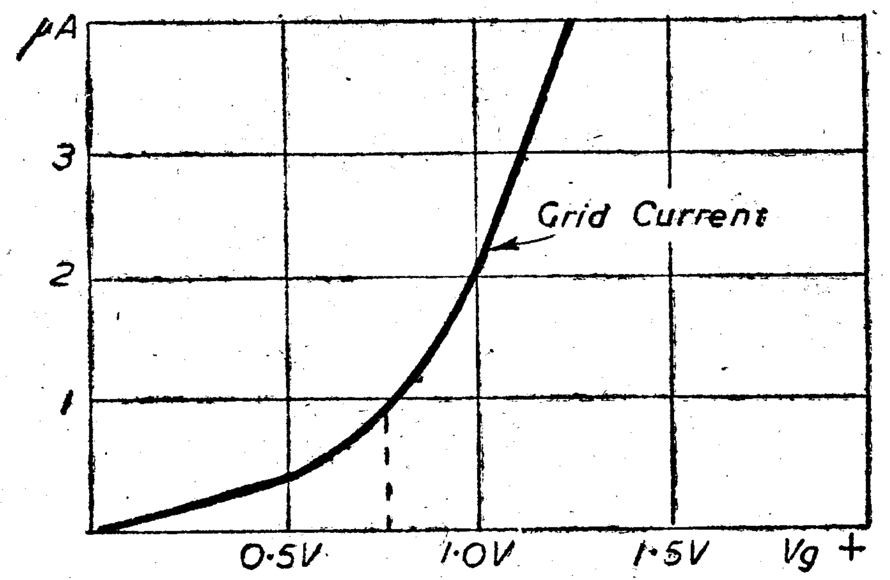


Fig. 3.—How grid current varies for a change in grid potential.

Actually, when used as a grid detector, the triode valve performs a double job, the grid filament circuit performing the actual detection while the grid anode combination becomes in effect an amplifier of the rectified signal. We shall discuss first, however, the grid circuit only and see how detection is effected.

In Fig. 4 a triode valve is wired for grid detection, where the grid condenser and the grid leak are shown respectively by C and R. The condenser is small in value while the leak is fairly high. A bias battery B is connected as shown, this making the grid positive by an amount such that detection can occur at a point where the slope of the grid characteristic is most rapidly changing. The potential on the grid is actually less than the voltage applied by the battery because the steady current flowing through the grid leak produces a p.d. across it which is in opposite sign to that applied. The actual grid potential is given by V where

$$V = e - IR$$

e being the battery p.d., I the grid current and R the resistance of the leak. It is general in nearly all receivers employing grid detection, however, to return the grid leak to the positive end of the filament and dispense with the bias battery, the resulting positive grid p.d. thus obtained being sufficient for the efficient operation of the arrangement.

When a signal arrives at the aerial, a R.F. current begins to flow in the tuned circuit and an R.F. voltage is applied between the grid and filament of the valve. As we have seen, positive signal swings cause an increase in grid current, while negative signal swings cause a decrease in grid current, but due to the curve of the characteristic the increases are greater than the decreases. Thus the mean value of the grid current increases to a value greater than I, and consequently the grid potential drops to a value lower than V.

The grid current consists as before of an R.F. component, a D.C. component and an audio A.C. component. The latter two pass through the grid leak and the effect of them is that the potential of the grid falls and fluctuates at the audio frequency about the new mean value.

During the period of an arriving signal when the p.d. across the leak is higher than the normal no-signal p.d. the charge on the grid condenser must obviously be greater than the charge it normally contains by an amount sufficient to raise the p.d. across it from IR to (I+i)R, where i is the mean and fluctuating increase in grid current caused by the arrival of the modulated signal. Therefore, as the audio signal fluctuates the charge on the condenser follows the fluctuation, excess charges draining away through the grid leak, the grid at all times tending to return to its no-signal potential of $V = e - IR$.

Second Stage

Thus the first stage of grid detection is covered, and the second part will now be considered. It should be noted that there is nothing new in the section so far discussed; detection is merely carried out by utilising the curvature of the characteristic in very much the same way as anode bend and crystal detection is carried out. Whereas in a crystal the current output from the detector is made to operate the phones or amplifier, in the grid detector it is used to produce a p.d. across a high-resistance leak.

The ordinary operation of a triode should be familiar to most readers, and the remainder of the operation of the detector depends simply on these principles. The anode current of the valve is dependent upon the grid potential, and the fall of grid p.d. which occurs when a signal is applied causes a fall in anode current. The audio frequency fluctuations of grid potential then produce an audio frequency fluctuation of anode current.

The swings of the grid p.d. should never extend far enough to reach the lower limits of the characteristic curve, otherwise anode bend detection will begin to occur. As we saw earlier, in anode bend, the A.C. applied to the grid of the valve causes a *rise* in the mean anode current, while in grid detection it causes a *fall* in the mean anode current. Since these two effects are opposite and conflicting it is essential that the anode voltage of a cumulative grid detector should be high enough to ensure straight mutual characteristic over the range of grid voltage to be worked, thus eliminating any tendency to anode bend.

As for anode bend, the useful current output from the grid detector, when the applied p.d. is small, is proportional to e^2, while if the input is large the output

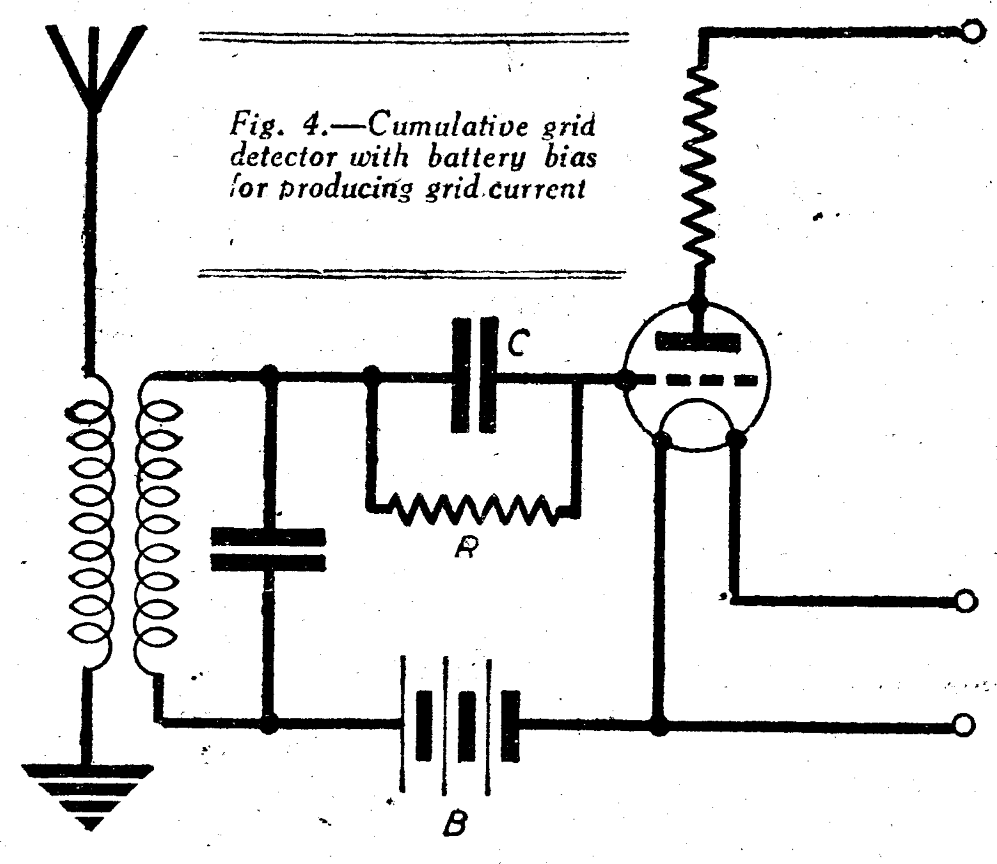


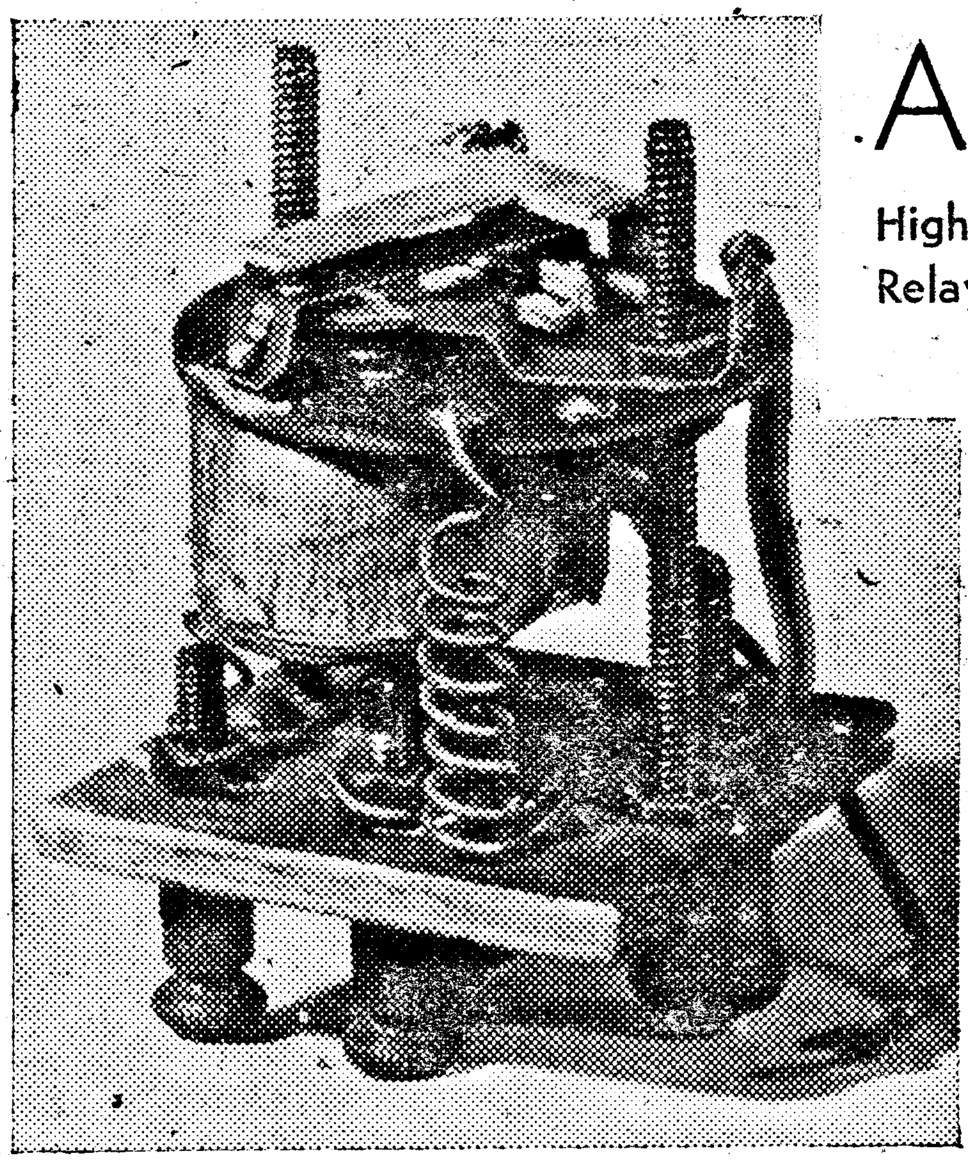
Fig. 4.—Cumulative grid detector with battery bias for producing grid current

becomes proportional to e. (This applies to an unheterodyned signal.) In the case of an heterodyned signal the current output is proportional to e, irrespective of how small the input may be.

Due to the fact that the output from the grid detection process is employed to vary the grid potential which in turn varies the anode current, the C.G.D. is very much more sensitive to weak signals than the anode bend detector.

Damping in the C.G.D. is greater than in the other detector, since grid current is flowing and consequently an effective resistance is connected in parallel with the grid-tuned circuit. This has the effect of increasing the effective resistance of the tuned circuit.

(*To be continued.*)



The additional contact strip is shown on the right of the top of the relay.

A Low-current Relay

High Current Consumption Often Restricts the Use of Relays. The One Described Below, by F. G. RAYER, Consumes Only a Few Milliamps.

THIS relay unit will be found easy to construct, and it was made up originally to use with an extension speaker which was at some considerable distance from the receiver which operated it. So long were the extension lines that it was found that a normal relay which requires a momentary current of fairly large value to operate it would not work. This might have been overcome by using very heavy gauge wire for the extension wiring, but the necessary material was not to hand and would have cost a great deal to buy. It was decided, therefore, that a type of relay was needed which would function satisfactorily with a very small current, so that the length of the extension lines would not prevent it from operating. The current taken by one relay is approximately 20 ma., it will be seen, therefore, that the two relays used in the circuit described require only 40 ma. (.04 amps.), and, as this current is taken from the two volt accumulator which is used to operate the receiver, it may be disregarded for all practical purposes, it being only one-tenth the current used by an average three-valve receiver.

The magnetic switch used is advertised in the pages of PRACTICAL WIRELESS. It will be necessary to modify the unit by adding another contact which will close when the relay is energised (Fig. 1). It will be found that a piece of brass about 1¼ins. long by ¼in. wide can easily be bolted to one of the fixing holes of the unit to provide the additional contact; it should be arranged so that when the armature is attracted to the core of the electro-magnet the small contact attached to the armature presses against it. These details will become apparent when the actual component is to hand. If a small piece of silver is soldered to the strip of brass it will assure good electrical contact being made. There is a resistor built into the unit, but this should be disregarded, and the connections for energising the coil taken from the soldering pips which are connected directly to the winding, and the unit enclosed in a small box to keep it free from dust.

Application

One of the units may be used to switch on the filament supply of the receiver which operates the remote speaker; if the receiver is of the type having a single tuned stage another unit will enable either one of two pre-determined stations to be selected from the remote point.

The circuit, Fig. 2, shows two of the units used with a receiver which was especially made for the purpose; it had only one tuned stage, the aerial circuit being untuned. The H.F. transformer, used for coupling the screen-grid valve to the detector should be of the selective type, and in this respect an iron-cored component would be an advantage. The H.F. stage, which provides some measure of amplification, is followed by a power-grid detector which, in turn, is transformer coupled to a small power valve. The circuit provides a fair measure of selectivity and sufficient volume to operate satisfactorily the speaker in the receiver and an extension speaker. It will be seen that the lead from the speech-coil to the secondary of the transformer in the receiver is disconnected and taken to one point of the 3-point on/off switch, while the free terminal of the secondary is connected to earth on the receiver. This automatically switches on the speaker in the receiver when the latter is switched on at the local point, but leaves it silenced if the receiver is operated from the extension point. The extension speaker is silenced when not required in a similar manner. It will be seen, therefore, that either of the speakers, or both together, may be used as the listeners desire.

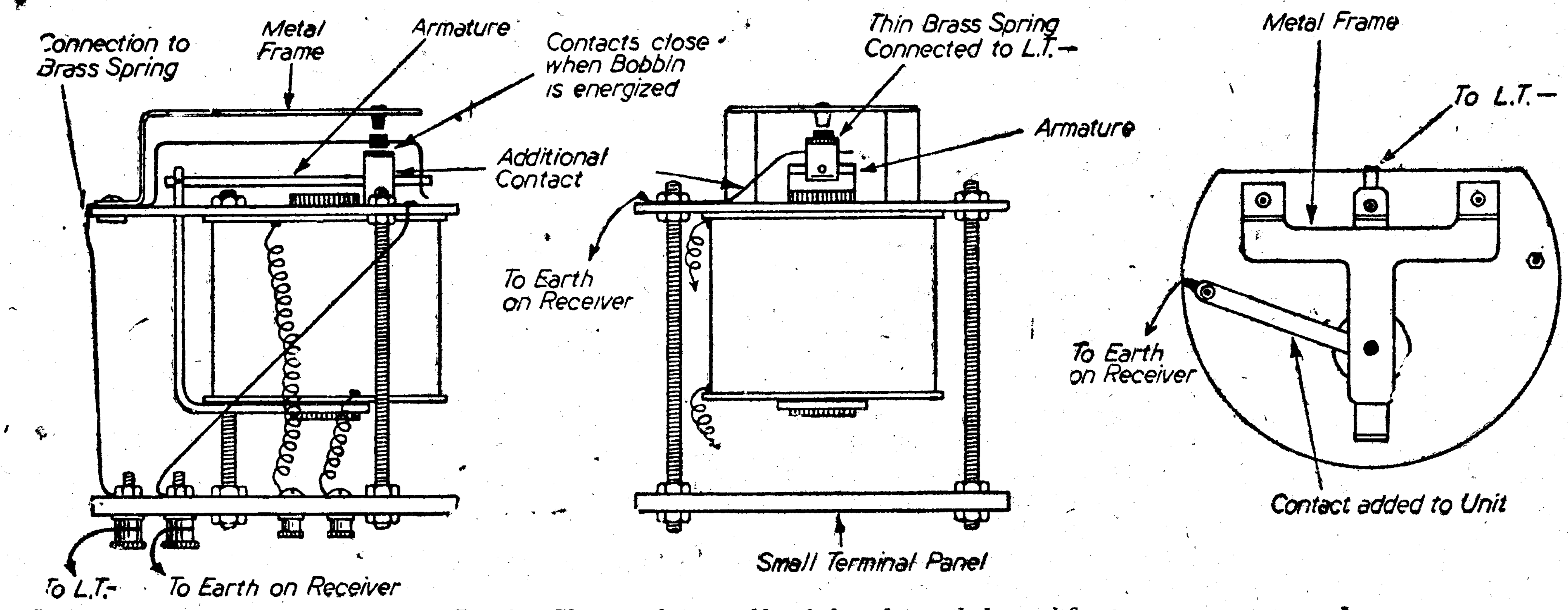


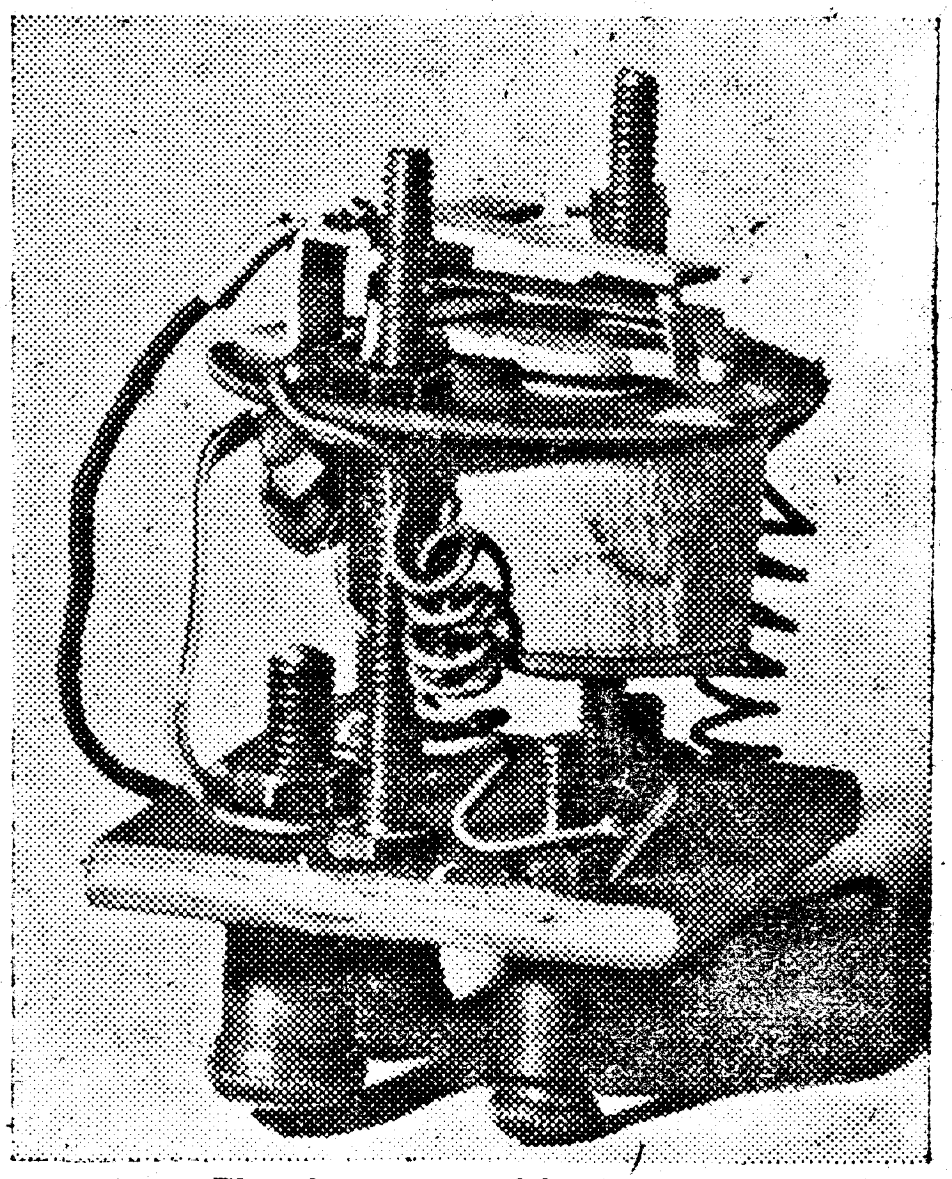
Fig. 1.—Showing the assembly of the relay and the modifications.

Station Selector

Station selection is carried out in much the same way, a single-pole switch being provided both at the receiver and at the extension point. Here, however, the operator who closes his switch first, thus energising the station selection unit, "wins the day." The two preset condensers should be tuned to receive the Home and Forces programme (the .0005 capacity being used for the former) and then securely locked; it is not very likely that any reaction will be necessary, unless the aerial or reception conditions are poor.

The speaker used at the extension point must be of the high-resistance type. It should for preference be a model with an attached volume control, although this is not absolutely necessary. The two switches at the extension point may be mounted in the cabinet of the speaker or attached to a small separate panel as desired. It is best to use single wires for the extension leads, and to keep the lead which comes from the 1 mfd. condenser away from the other wires; if this is not done the capacity between the leads will tend to make reproduction "woofy."

The units may be used with circuits other than that just described, of course. But it should be noted that they are *not* suitable for switching on the power supply of a mains receiver. Relays which depend upon a large momentary current for their operation have the disadvantage that if the battery runs down during a period of listening—as it sometimes does—they cannot be switched off from the remote point; with the units described, the receiver will automatically be switched off when the voltage of the accumulator falls too low to operate the relay.



The relay as mounted by the writer.

The Relay Unit

The relay is mounted upon a small piece of ebonite or wood by means of two screwed rods passed through the two holes punched in the paxolin top of the unit. This small panel carries four terminals, two of which are used for the connections to the bobbin and two for the connections to the relay contacts. In the unit which is used for station selection a fifth connection is required, so that the relay acts as a single-pole-double-throw electrically-operated switch. The fifth connection is made by soldering a lead to the metal frame which is fixed to the top of the unit. It will be seen, therefore, that when the relay is not energised the spring which pulls the armature from the core of the magnet makes contact with this metal part and leaves the one preset condenser switched into circuit; while when the relay is energised the spring is drawn down with the armature and makes contact with the springy brass strip which is fixed below it, this switches the one condenser out of circuit and brings the other in, thus selecting the desired station. In the unit which is used to switch the receiver on and off this fifth connection is not required, the necessary contact being made when the armature is drawn towards the core of the bobbin.

The station selection relay unit should be mounted close to its associated preset condensers so that fairly short connections can be made in the tuned circuit.

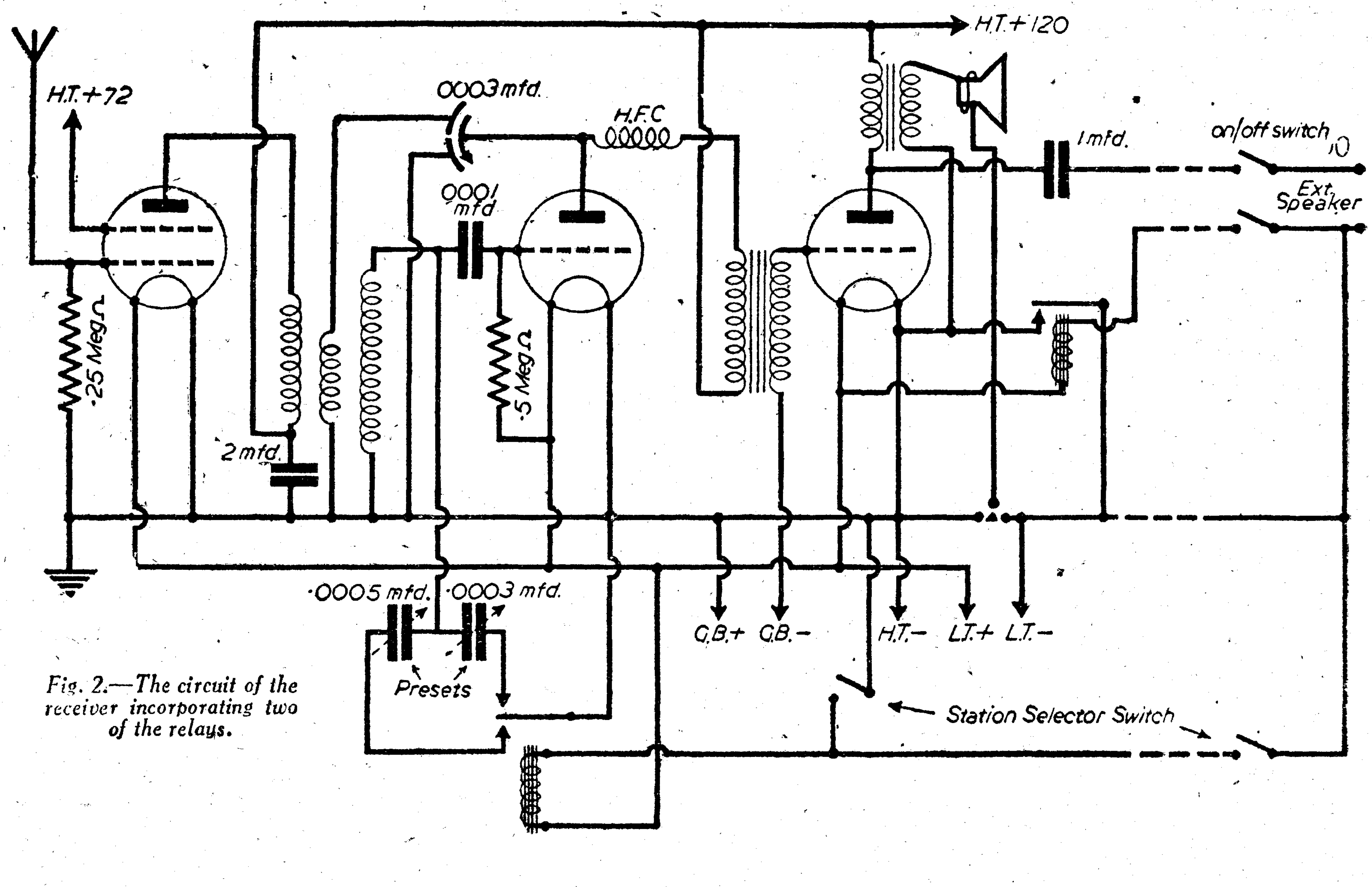


Fig. 2.—The circuit of the receiver incorporating two of the relays.

Checking Shorting Coils

Details of a Process Widely Used in Coil Production Shops to Detect, Visually, Shorting Turns

By L. G. W. KNOTT

As coil winding is done by machinery, it is quite possible to have coils delivered to a production bench either partially or wholly short circuited, due to the insulation mediums being chafed or rubbed on bobbins or guides during the winding process. A shorting coil may not altogether unbalance a tuned circuit with one variable condenser shunting it, but if

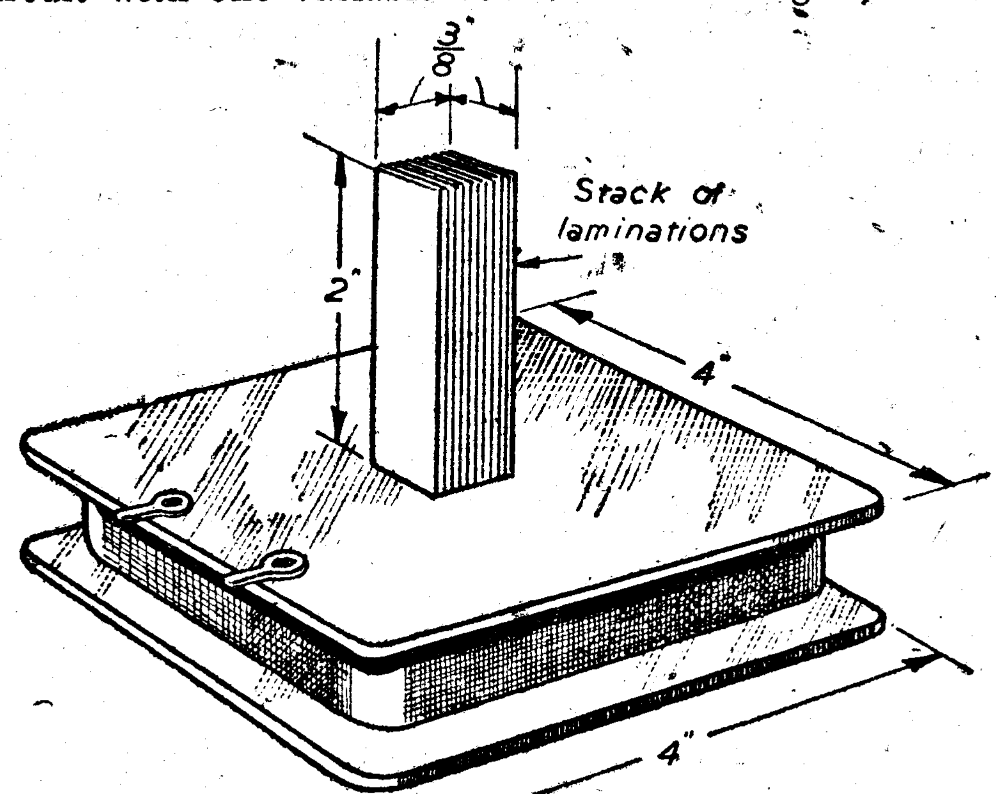


Fig. 1.—The laminated stack over which the coil to be tested is placed. The bobbin shown carries 5,000 turns of 30 S.W.G. wire which, with the core, provides an inductance of 1.3 henries.

it were in a network incorporating two other coils and a three-gang condenser, instability of operation would be in evidence.

Various forms of test equipment have been devised to check against good or bad coils, ranging from low-valve ohmmeters to electron-ray apparatus designed to show variations in amplitude, the application of which made quite obvious that what was wanted was an instrument which was absolute and instantaneous in action, extremely sensitive, compact, robust, and not costing too much to produce, the requirements of which, it is believed, are satisfied in the test equipment described below.

A New Method

For instantaneously and visually checking coils for shorting turns, a method has been resolved around an oscillatory circuit, so designed that it will stop oscillating when a defective coil is coupled to it magnetically. The set-up comprises a negative-resistance oscillator of the dynatron type, the inductance of which is representative of the positive resistance in the circuit, and to which is incorporated an explorer testing stack or pillar of iron stampings over which the coil to be checked is placed. Doing so changes the circuit constants of the network, and not only stops it from oscillating but causes a small flashlight bulb to be extinguished as an indication of a coil with partial or wholly shorting turns. If the coil under test is without this fault, the lamp remains alight. Fig. 1 depicts the exploring coil and stack, together with dimensions and winding data for construction.

Circuit Considerations

An ordinary transition circuit of oscillation could have been used, though without advantage, as no consideration had to be given to either waveform or frequency stability; the dynatron circuit was, however the more simple of the two for general design and was thus decided on. Nevertheless, some consideration was necessary relative to the tuned circuit controlling the frequency at which oscillation had to take place. Requirements were:

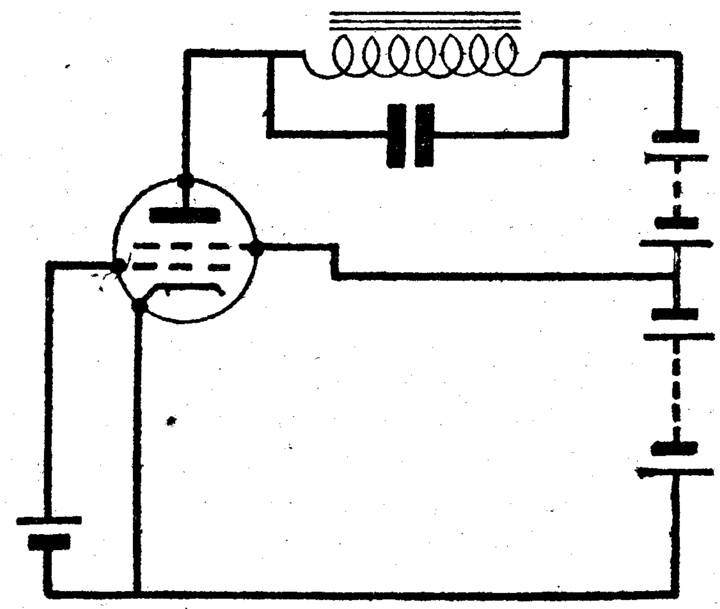


Fig. 2.—The basic circuit of the dynatron oscillator.

(a) That the highest workable frequency be of a sufficiency to permit the tuned-circuit capacity across the coil to be always the predominant tuning-capacity "component"; that is, the action of the coil under test, when over the stack, must be such that any mutual capacity present should have little or no effect on frequency.

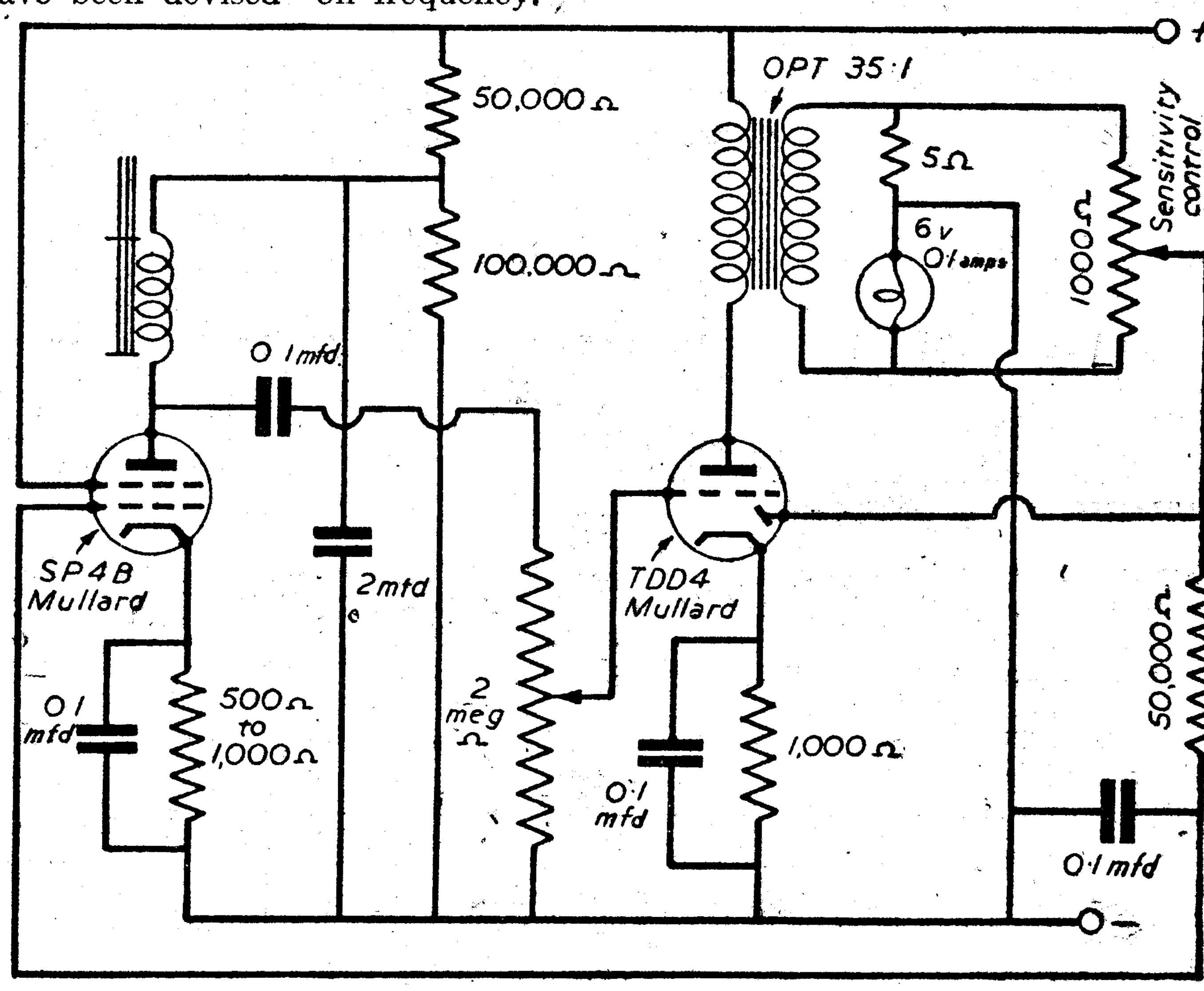


Fig. 3.—The complete circuit, including the amplifier. The exploring stack of laminations is shown in the anode circuit of the SP4B Mullard valve. Circuit constants should be adhered to. If, however, other valves are used, cathode bias resistors must be correspondingly changed in values. Operating potentials are dependent upon the types of valves employed and as recommended by the makers.

(b) That the lowest workable frequency be of a sufficiency to permit the single tuned-circuit—made up as an iron-cored inductance with capacitance—to have a reasonably high Q or sensitivity factor.

2-megohm potentiometer having to be calibrated from coils of known turn numbers and the switch thrown for the second set of readings which are multiples of ten of the first or calibrated set of readings.

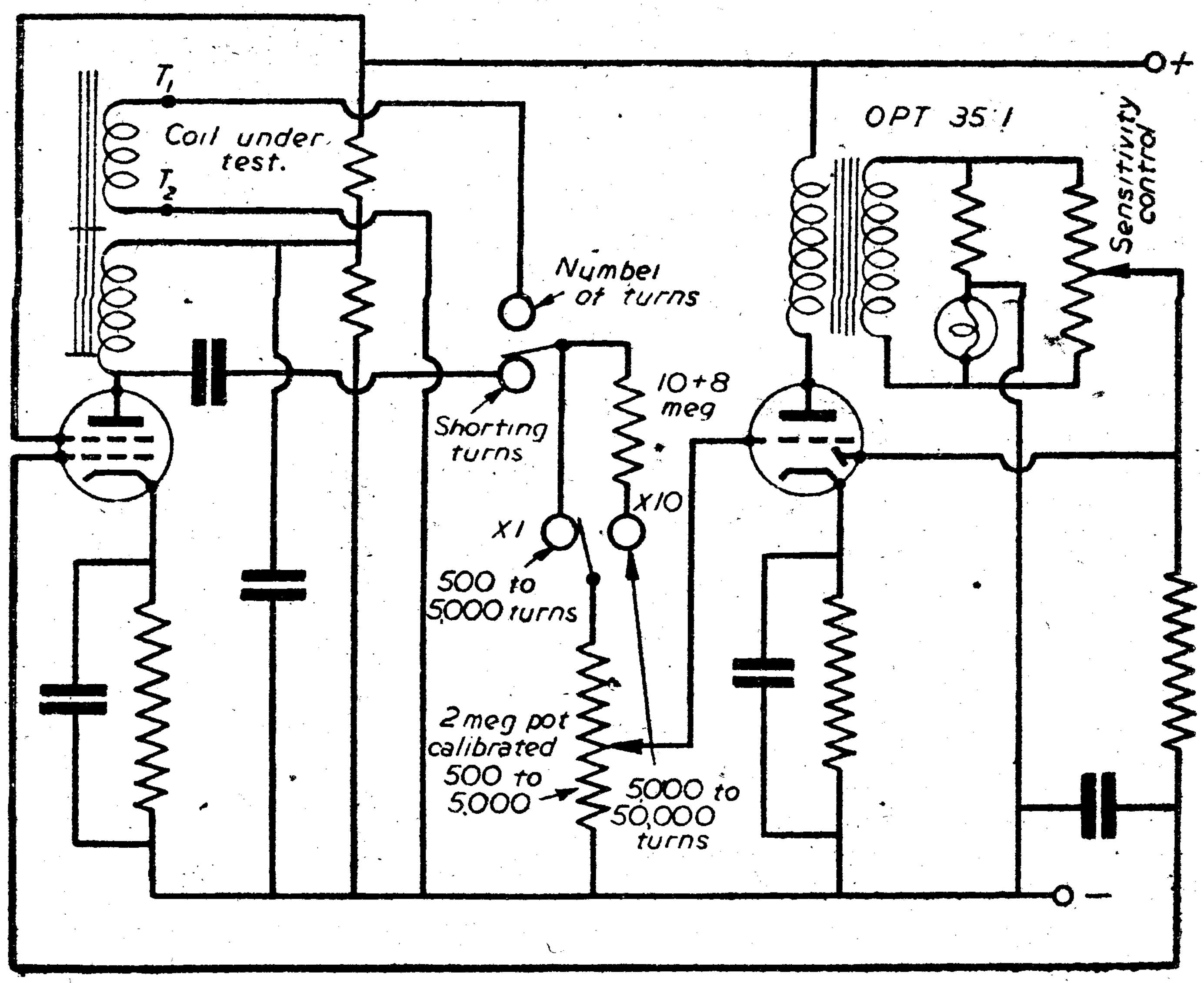


Fig. 4.—The simple circuit modifications necessary for approximating the position of the shorting turns. Constant values, not shown, are as for Fig. 3.

To Operate

Warm up the tester for 15 minutes previous to use, making sure that all coils are well away from the vicinity; then adjust the sensitivity control until the lamp lights and place the coils to be tested one at a time over the stack of laminations, watching at the same time to see if the lamp extinguishes itself as indication of a partial or entirely short-circuiting set of turns. To check the apparatus before testing coils, place over the stack a 2in. diameter ring made from No. 20 S.W.G. tinned copper wire; if in working order the lamp will automatically go out.

Servicing Application

This instrument will prove extremely useful to service engineers, as an aid to checking against intermittent signals, suspected as being due to short-circuiting coils expanding and contracting under operating conditions—especially oscillator coils in superhet receivers. Any coil whose former allows it to be placed over the stack can be thus tested, though when replacing, resoldering end connections to tags should be done so that some slackness of wire is present, otherwise, when coils are operationally heated, the connecting ends may tighten up and snap off.

(By courtesy of the Institute of Practical Radio Engineers.)

Operational Frequencies

These can approximately range from 1,000 to 5,000 c.p.s., the final design, shown in Fig. 2, having an operating frequency of 2,000 c/s, dynatron controlled. Fig. 3, on which values can be noted illustrates that the signal frequency is fed through a condenser to a single valve amplifier designed to serve two purposes: (1) To amplify the signal to such power that it is sufficient to light the flashlight bulb. (2) To supply automatic bias of such sufficiency in limiting action that it will prevent the lamp from burning out; additionally, this also acts as a sensitivity factor to prevent excessive oscillation and prevent the circuit becoming insensitive to minute changes in induction or positive resistance.

Design Sensitivity

That of the circuit shown (Fig. 3) is such that it will indicate two shorting turns on a coil wound with No. 44 S.W.G. wire, or similarly, one wound with No. 38 S.W.G. having but one shorting turn. This, converted to values of parallel resistance across an inductance, is in the neighbourhood of 3 megohms in shunt with an impedance of 25,000 ohms. As an example, a coil placed over the stack had an inductance value of 2 henries; then a 3-meg. resistor was shunted across the turns—the indicating lamp went out, this stressing the fact that the instrument can be made less sensitive by shunting resistance across the circuit inductance.

Approximating Turn Numbers

By modifying the circuit to Fig. 4, it is possible to approximate the number of turns in a coil under test with windings ranging from 400 to 50,000 in number.

Although it is not possible definitely to indicate the number of turns on a faulty coil, there is, in most instances, a similar coil used as a standard in a receiver from which a ration of good to bad may be found, comparison more or less indicating the number or location of the shorting turns. The method of switching from a range of coils, 500 to 5,000 turns, and 5,000 to 50,000 turns is clearly shown on the drawing the

PRIZE PROBLEMS

Problem No. 453.

MATTHEWS had an A.C./D.C. receiver which gave very good results and which he used on his A.C. supply. He changed his address to a district which was supplied with D.C. and when he connected his receiver to the supply he could obtain no signals. He thought that it had been damaged in transit and returned it to the makers, but it was sent back marked O.K. He tried it again but could still obtain nothing on it. What was wrong?

Three books will be awarded for the first three correct solutions opened. Address your solutions to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 452 in the top left-hand corner, and must be posted to reach these offices not later than the first post on Friday, February 11th, 1944.

Solution to Problem 452

Williams did not alter the circuit—electrically—by changing over the connections to the reaction condenser; what he should have tried was reversing the leads to the reaction coil.

The three following readers successfully solved Problem 451, and books have accordingly been forwarded to them. D. Heath, 29, Summerhouse Drive, Bexley, Kent; F. Kitt, "Oakhurst," Dousland, Yelverton, S. Devon; D. G. Hobbs, 19, Springfield Park, S.W.20.

BOOKS RECEIVED

SERVICE MANUAL, MAJESTIC RECEIVERS. By International Majestic Radio Corporation, Ltd., 6, Angel House, Pentonville Road, London, N.1. 14 pages. Price £2 2s. nett.

THIS is a Service folder, containing the schematic diagrams and details of the most popular Majestic receivers and units in circulation from 1930 to 1940, and it should prove of great assistance to those connected with the Servicing industry.

An Inexpensive Multi-range Meter

A Useful Moving-coil Instrument Which can be Built for £1.

AT the present time meters are very expensive to purchase, and the following details, which deal with the construction of a moving-coil instrument which has five current readings and six voltage readings, may be of interest. The meter is not difficult to make, and is reasonably accurate—depending upon the selection of suitable resistors and upon the careful construction of the shunts used.

The Moving-coil Movement

This is the most expensive part of the instrument. The movement used was purchased from an advertiser whose announcements regularly appear in PRACTICAL WIRELESS. The meter costs 15s., and is stated to "need slight repair." With the instrument purchased, the only "repair" necessary was the removing of a shunt within the case which was included to give a maximum current reading of .5 amp. This detail is one which would probably vary in different instruments, but, having regard to the very low price of the meter, this is to be expected. Whatever the fault, it is worth while carrying out the repair in a careful and workmanlike manner. The other points of construction are all perfectly straightforward.

When the shunt was removed from the movement under consideration, it was found that the full-scale deflection was 10 mA's. This was considered rather too high, so the meter was dismantled and the moving-coil re-wound with twice the number of turns which it originally had (34 turns increased to 68). This requires a little care, but is well worth while, as it enables a higher ohms per volt operation on voltage measurements. The re-wound coil was given a coating of thin shellac to prevent the winding moving or becoming loose. The scale of the instrument could have been altered, but it was considered better to leave it as it was. If the constructor feels that the re-winding of the moving-coil is rather beyond his abilities it can be left in its original form; a list of the different resistance values required for meters of different full-scale deflections is given, together with the method of arriving at the desired values, so that the constructor may choose values to suit the meter used.

When the meter is in order the rest of the construction may be commenced.

The Case

This was made from thin wood and painted black. The size was 1½in. deep by 3¼in. wide by 5¼in. from back to front; the top is made of ebonite, and is drilled to hold the terminals used for connections. The plan view, Fig. 1, shows the layout of the panel. A flexible lead is taken through a small hole in the panel, and is fitted with a tag—which is used to bring the various shunts in circuit when connected to one of the four large terminals to the right of the meter. If a plug and a number of sockets are available, it would probably be better to use them, provided that they make perfect contact.

The Shunts and Resistors

The shunts for obtaining the 10 and 20 mA readings were made by winding the wire taken from an old rheostat on a small piece of wood, the whole being well

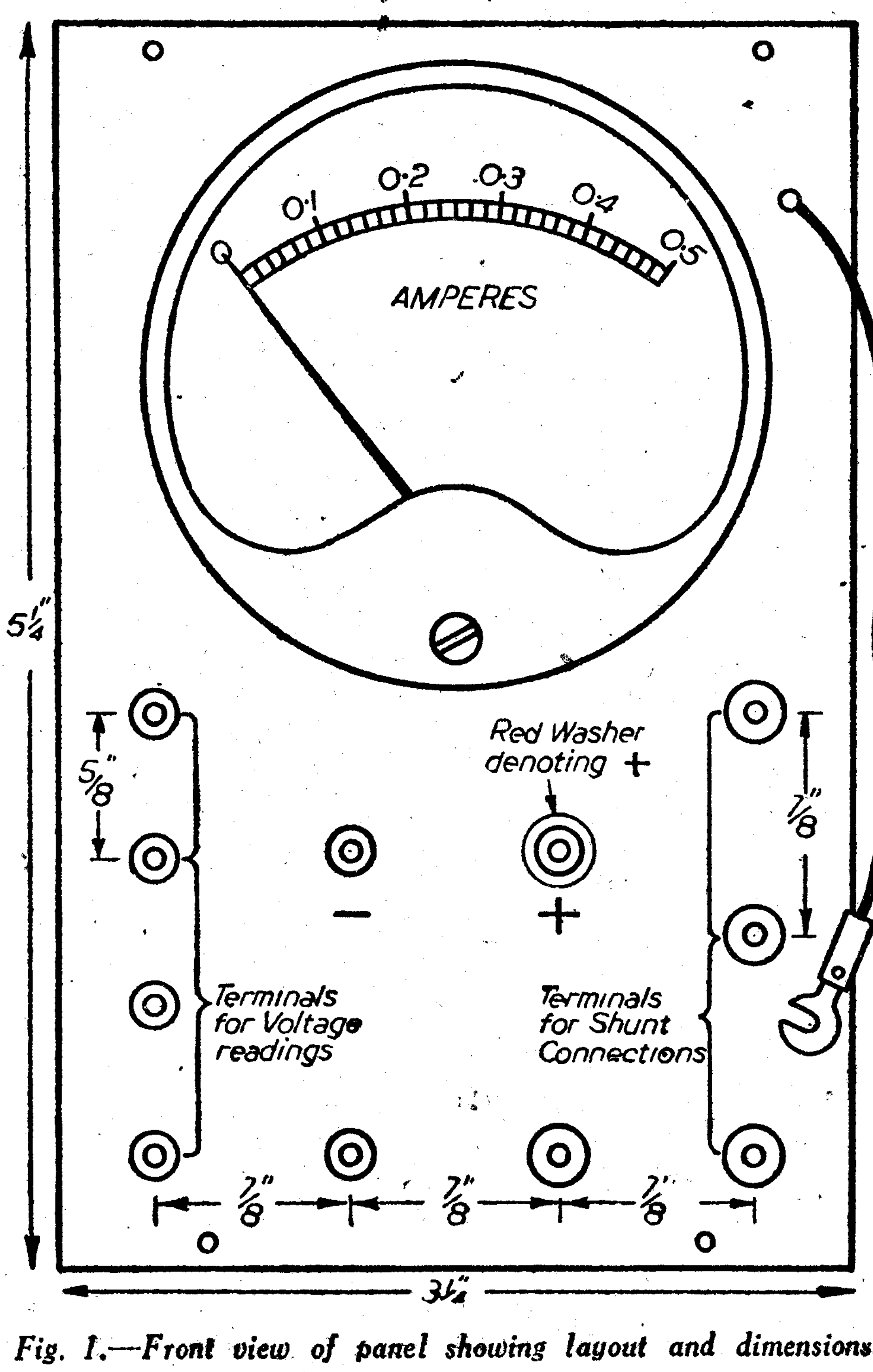


Fig. 1.—Front view of panel showing layout and dimensions.

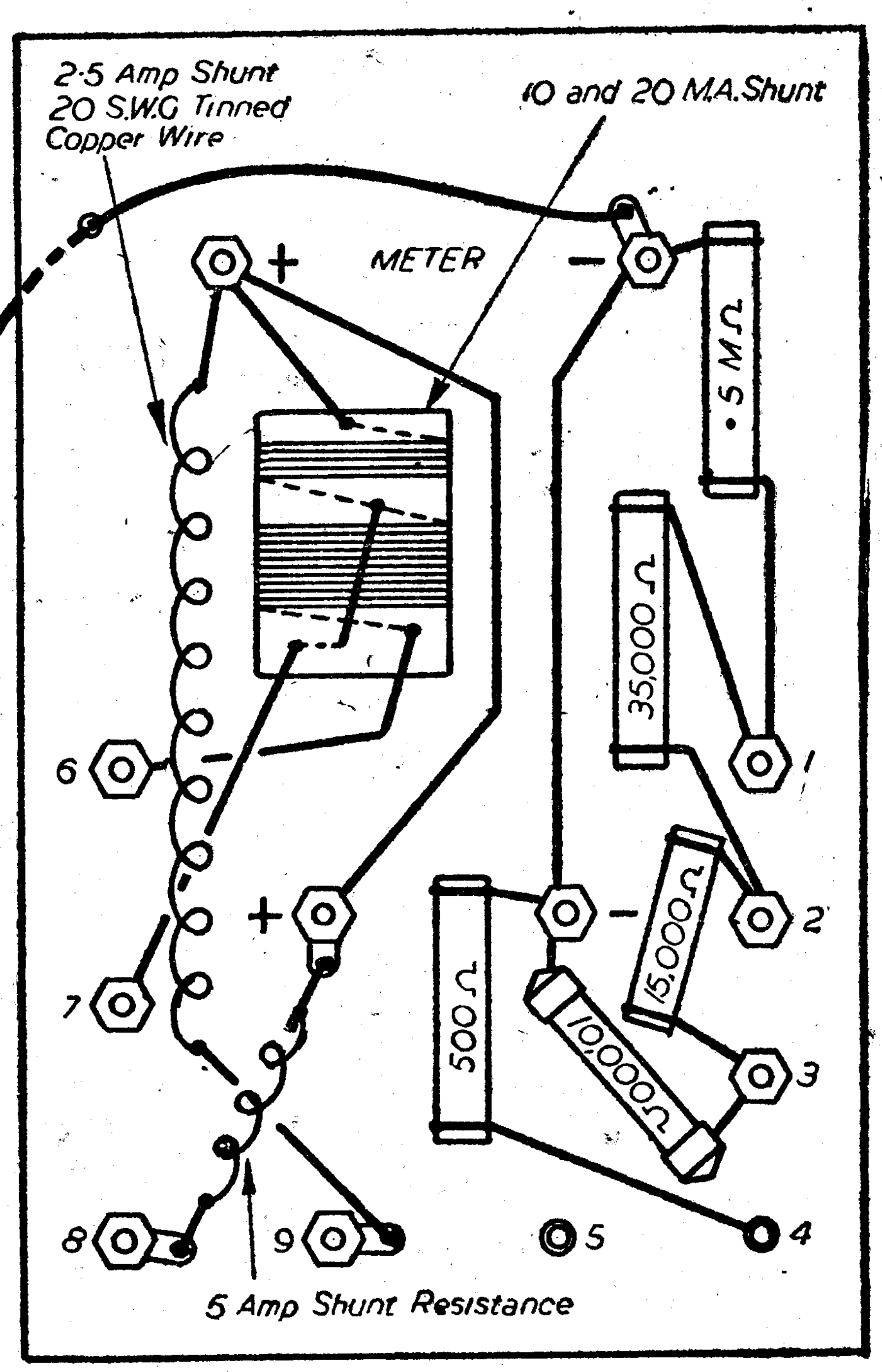


Fig. 2.—Rear of panel and wiring diagram.

shellaced when finished. The appropriate resistance is arrived at as follows: A variable resistance of about 5,000 ohms is connected in series with a G.B. battery, and the two are connected to the meter. The resistance is then adjusted until the meter shows the full-scale reading. A length of resistance wire is then connected in parallel with the meter, and the change in reading noted—the less resistance wire in circuit the farther towards zero the meter pointer will move, and it will

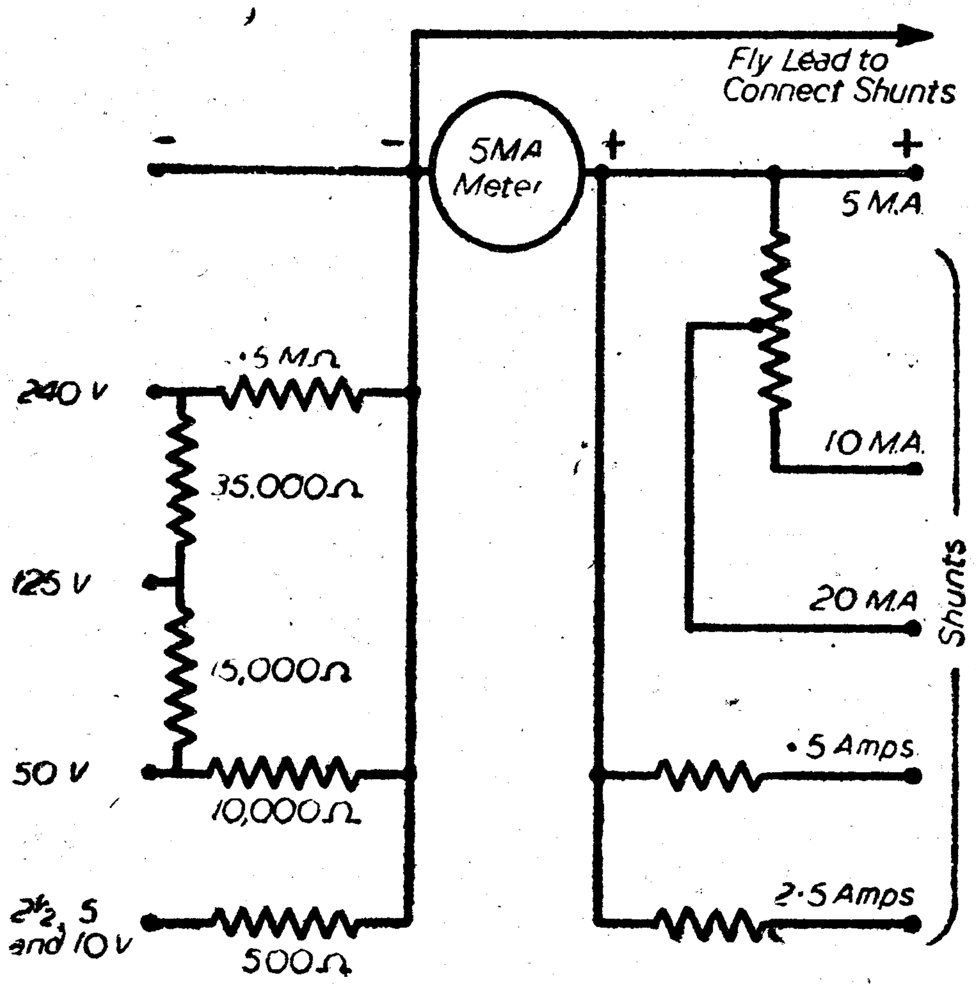


Fig. 3.—The theoretical circuit of the complete meter assembly.

thus be possible to arrive at a length of wire which reduces the reading of the meter to half. This is the 10 mA shunt, and a length of copper wire should be soldered to the resistance wire at the appropriate point. The resistor thus formed is connected in parallel with the meter, and the variable resistance again adjusted to give a full-scale reading; about one-third of the 10 mA shunt will need to be connected across the meter to again reduce the reading by one-half. Another length of copper wire is soldered to the resistance wire when the point has been found, and the whole is then wound upon a strip of wood or paxolin. The drawing of the underside of the meter, Fig. 2, shows the position of this shunt—it is supported in the wiring.

The .5 amp shunt was made with the wire originally found in the meter, it being wound in a small coil and fixed between two terminals. The necessary value being found by connecting the meter in series with circuits which were passing known currents, i.e., a two-volt accumulator and a .1 amp valve, accumulator and .2 amp valve; both the valves together, etc. As the deflection obtained with a moving-coil meter is proportionate throughout the scale an accurate shunt may be made by taking the average of all the readings. The 2.5 amp shunt was made in the same manner, the length of tinned-copper wire afterwards being coiled in a long spiral.

Voltage Readings

If possible it is best to select the resistors, as ordinary components vary much in their actual values. Some of the resistors are connected in series so that they are added together—this was done because the values happened to be to hand. It will be seen that the 500 ohm resistor provides for the 2.5, 5 and 10-volt readings by connecting the 10 and 20 mA shunts in circuit. It is not advisable to obtain the higher voltage readings in this manner as a large current would need to flow; e.g., connecting the 10 mA shunt will increase the 50-volt reading to 100 volts, but 10 mA will need to flow in the circuit for full-scale deflection. The .5 megohm resistor helps to compensate for the resistance of the meter (which, it must be remembered, is always in circuit) by reducing the resistance between the voltage points and the meter. The wattage of the components can be seen from the table, although higher wattages can be used. The theoretical circuit of the complete meter is shown in Fig. 3.

Operation

It is best to leave the scale of the meter unaltered and to prepare a table showing the various voltages and currents. In this instrument the readings are logically arranged and when the meter has been in use for a short time, it will be found that it is not necessary to refer to the table to find the reading in question.

VOLTAGES

Meter Scale ..	0						.1						.2						.3						.4						.5
Plus and 1 ..		12	24		36	48	60	72	84		96	108	120	132	144		156	168	180	192	204		216	228	240						
Plus and 2 ..	0						25						50						75						100						125
Plus and 3 ..	0						10						20						30						40						50
Plus and 4 ..	0						.5						1						1.5						2						2.5
Plus and 4 with lead on 6 ..	0						1						2						3						4						5
Plus and 4 with lead on 7 ..	0			1			2			3			4			5			6			7			8			9			10
CURRENTS.																															
milliamps																															
Plus and Minus	0						1						2						3						4						5
Ditto, lead on 6	0			1			2			3			4			5			6			7			8			9			10
Ditto, lead on 7	0			2			4			6			8			10			12			14			16			18			20
amps																															
Ditto, lead on 8	0						.1						.2						.3						.4						.5
Ditto, lead on 9	0						.5						1						1.5						2						2.5
Meter Scale ..	0						.1						.2						.3						.4						.5

Test Prods

The test prods were made by inserting two lengths of thick wire in some small diameter rubber tubing, the wire "prods" being soldered to two lengths of flex fitted with spade ends and the joint covered. A length of twin flex fitted with two spades at one end and a plug and socket at the other is also useful as it enables the meter to be connected into a H.T. battery circuit in a moment, the plug being inserted in the battery while the plug from the receiver is inserted in the socket connected to the meter. The details are shown in Fig. 4.

When using a meter of this type for voltage readings it will be seen that it is merely necessary to choose a resistance value which will pass the current taken by the meter for full-scale deflection when connected to the voltage desired. *Bearing in mind Ohm's law, the value* may easily be found. A simple way to write the law is as follows:

$$\frac{\text{Voltage across circuit in volts}}{\text{Current in amps.} \times \text{Resistance in ohms.}}$$

where it is only necessary to cover up the wanted value to see what to do with the known factors. Supposing a meter having a full-scale deflection of 2 mA is to be used and a voltage-reading of 50 is needed, then the calculation:

$$\frac{50}{.002} = \text{resistance required} = 25{,}000 \text{ ohms.}$$

The following small table shows the various resistance values needed for various voltage readings when using the most popular types of meter.

It will be seen that one terminal (No. 5) is left blank in the meter—this was originally intended to provide a high voltage reading of 750 volts. This high reading would be an advantage as it would pass less current for a given voltage; however, the 300 volt reading passes little current *and should therefore be used when measuring the voltages of the anode and screen supplies of receivers.*

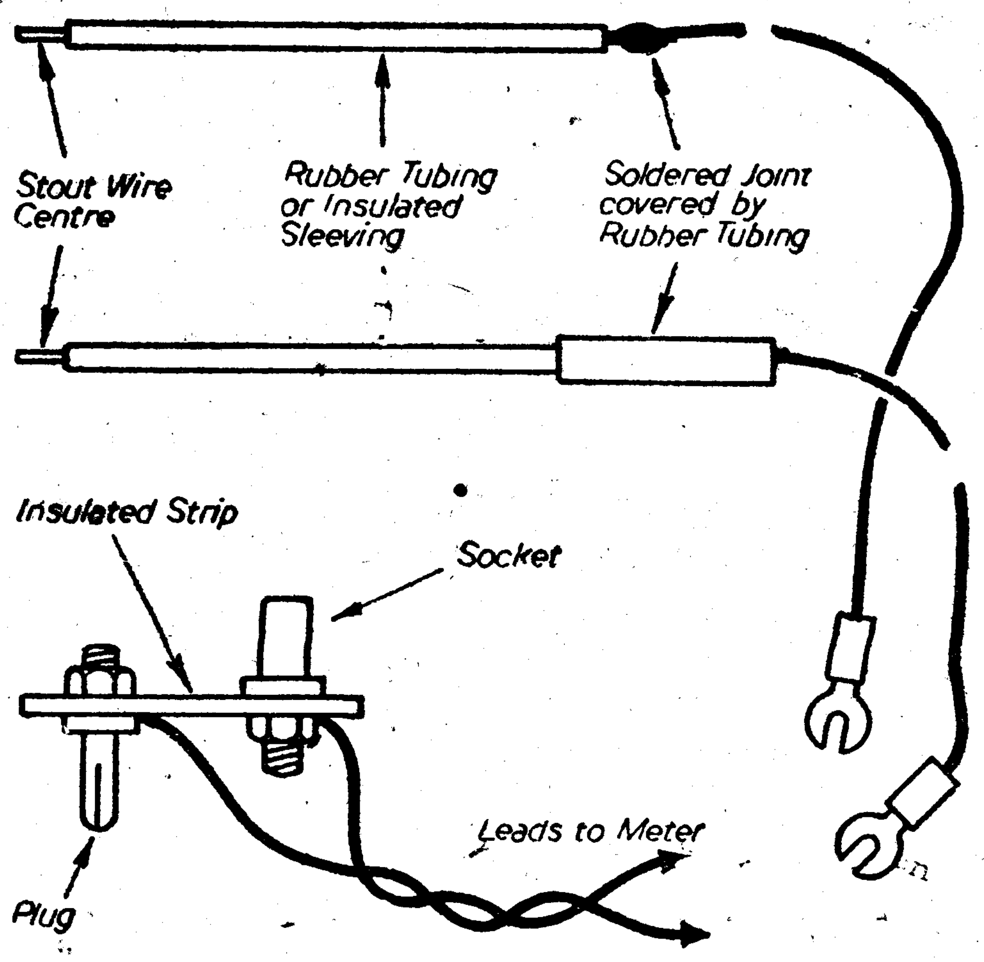


Fig. 4.—Test-prods and H.T. battery connector.

Current for full deflection.	Voltage readings required				300
	2.5	10	50	125	
1mA.	2,500	10,000	50,000	125,000	.3 MΩ
5mA.	500	2,000	10,000	25,000	60,000
		½ watt.		1 watt.	
10mA.	250	1,000	5,000	12,500	30,000
		½ watt.		2 watt.	3 watt.

Making Jelly Electrolyte

How to Prepare the Solution to Make an Accumulator Unspillable

THE usual instructions for making jelly electrolyte tell one to mix certain proportions of sodium silicate (water-glass) and sulphuric acid, and leave it at that. Now there is a snag in this: when the two are mixed together the solution immediately precipitates large crystals, and the watery portion will not jellify.

The making of jelly electrolyte is a trade secret and the instructions which follow may not be the same as those employed by the battery manufacturers when sending out their products. But it completely overcomes the trouble of crystallisation, and is a neat and effective solution to the problem. With the jelly thus formed, one can make any accumulator unspillable, which is particularly desirable in a portable receiver.

Measure the amount of acid the accumulator needs in the first place. Then allow one-quarter of this volume of waterglass and three-quarters of sulphuric acid. The waterglass sold in tins for preserving eggs is suitable. The density of the sulphuric acid depends upon whether the accumulator is charged or uncharged when the solution is poured in. If it is already charged, sulphuric acid of 1.400 sp. gr. should be used; if there is difficulty about getting this unusual gravity, then the accumulator should be uncharged and acid of the normal 1.250 sp. gr. used. The added water brings down the gravity, but this will go up again when the cell is charged.

Put the measured quantity of waterglass into a lipped vessel for ease of pouring, and add an equal quantity of *boiling* water. Mix well together by stirring. Then add the cold sulphuric acid whilst still stirring. A piece of ebonite or wood should be used to stir with, *not* metal. There should be very few crystals in the solution, and any that there are can be strained out.

The solution is now ready to pour into the accumulator, taking care that the level comes to about a quarter of an inch above the top of the plates. If the instructions have been carried out there should be a little solution left over; this forms an excellent check on jellification, as in some cells it is difficult to tell when this has occurred. Simply pour the surplus into a vessel and when it has jellified the solution in the accumulator will have jellified too. Jellification will take place in from one to two hours. The first sign is that the mixture becomes cloudy, and when this stage is reached jellification proceeds rapidly.

The accumulator to be filled should be emptied out and allowed to drain for a few minutes, but prolonged exposure to the air should be avoided as this is apt to decrease the efficiency of the plates. The jelly, when in use, should always be kept moist with a little distilled water.—W. N.

Radio Examination Papers—27

Another Set of These Popular Questions, With Answers, by THE EXPERIMENTERS

1. Parasitic Oscillation

IN general, parasitic oscillation is more likely to be observed when using a power amplifier with a valve designed for a maximum undistorted output of upwards of three watts. This is largely because an amplifier of this type is normally intended for "quality" reproduction, and therefore faults are more apparent.

There are three principal methods of tackling the problem when it occurs in a new amplifier; the same methods are, of course, better applied during the construction. Two methods consist of inserting a stopper resistance in either the grid or anode circuit. When the stopper is placed in the grid circuit, its value should be in the region of 10,000 ohms, but is seldom critical. The anode circuit stopper resistor should have a value up to about 200 ohms. In choosing a resistor the fact that it carries an appreciable current should not be overlooked.

Since the resistor is in series with the output transformer, it will reduce the available output to a certain extent, and should therefore have as low a value as possible consistent with its efficacy in eliminating the oscillation.

The third method referred to above consists of providing a measure of negative feedback. Methods of doing this have been described in the series of articles entitled "Low-frequency-amplifier Design" appearing in these pages (February issue), so it is not necessary to enter into full details here. It should be mentioned, however, that the degree of feedback employed should not be greater than that required to prevent the unwanted oscillation, unless it is proposed to take advantage of the other benefits conferred by the system.

The three methods described are illustrated in simple form in Fig. 1.

QUESTIONS

1. *How would you attempt to stop parasitic oscillation in a power output triode or tetrode?*
2. *Explain, and illustrate by means of diagram, a method of variable-mu volume control which does not affect the sharpness of tuning.*
3. *What is meant by the "dead space" which is noticed when tuning to a C.W. signal? How is it caused?*
4. *How would you arrange for the energising supply for a 2,500-ohm speaker field if the speaker were to be used with an A.C. receiver taking only 35 mA, and fed from a 250-volt rectifier? It should be assumed that an energising current of not less than 60 mA is necessary.*
5. *What steps should be taken to find the reason for marked overheating of a mains power transformer?*

2. Variable-mu Volume Control

The use of variable-mu control generally has the effect of varying the sharpness of tuning. This is because the load applied by the valve to the preceding tuning circuit is reduced as the negative bias voltage is increased; that is, when the volume level is lowered. This is the reverse of what is generally wanted, because reproduction suffers if tuning is sharpened to a marked degree. The reason is that the "peakiness" of the tuning results in cutting of the higher frequencies. Additionally, of course, accurate tuning becomes increasingly difficult when it is excessively sharp. In turn, any slight inaccuracy of tuning has the effect of causing additional distortion.

To overcome the disadvantages referred to, a method of control is required which will tend to flatten the tuning curve of the tuned circuit at the same time as the increased loading due to the valve tends to sharpen the tuning.

Fig. 2 shows a simple method of achieving the result required. It will be seen that the variable-mu bias control in the cathode circuit of the H.F. valve also acts as a variable damping resistor across the aerial coil. As the resistance between the cathode and earth is increased, the resistance across the aerial coil is reduced, and vice versa. The value of volume-control potentiometer shown is suitable for most types of long-grid-bias V.M. mains-fed valves, but would be too high to provide smooth control with valves of other patterns.

3. The "Dead Space"

The reception of C.W. signals depends upon the production of an audible beat note. This is produced by beating the oscillation of the incoming signals with a locally generated oscillation. The latter must differ from the frequency of the signal by an audible frequency; a difference of 1,000 cycles or 1 kc is generally most suitable, because a 1,000-cycle note is most pleasing to the average ear.

In the case of a regenerative receiver the detector

(Continued on page 151)

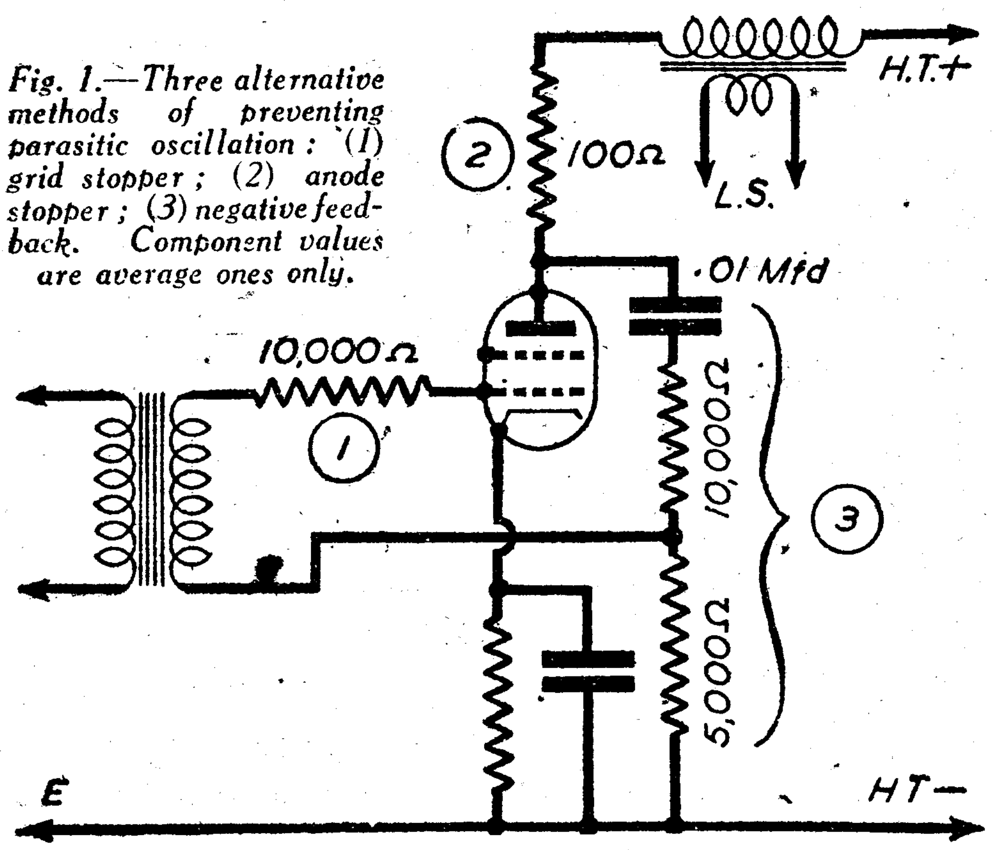


Fig. 1.—Three alternative methods of preventing parasitic oscillation: (1) grid stopper; (2) anode stopper; (3) negative feed-back. Component values are average ones only.

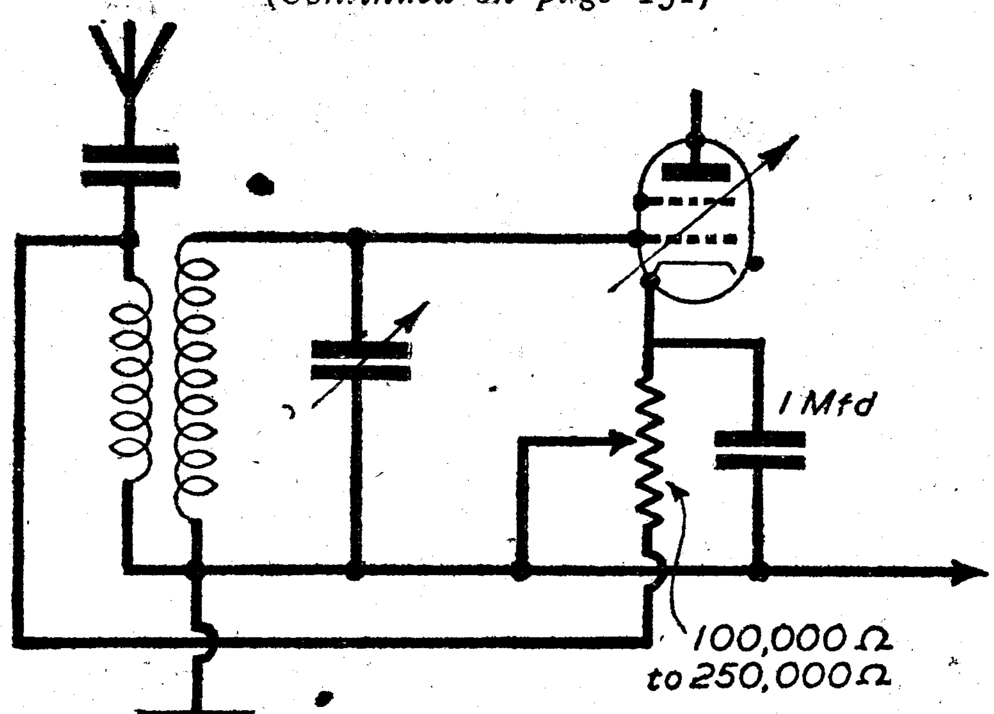


Fig. 2.—A method of variable-mu volume control which does not affect the sharpness of tuning. As the bias voltage is incresaed additional damping is applied to the aerial circuit.

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valve is caused to oscillate at a frequency different from that of the incoming signal. This means that the input circuit is not actually tuned to the required transmission, but to a frequency separated from it by about 1 kc. When using a superhet with separate oscillator coupled to the second detector there may be a separate tuning control for the beat-frequency oscillator. This is necessary, due to the fact that the frequency of the I.F. amplifier is fixed, and, therefore, that the input tuning circuits must be tuned to the transmission. In some instances, however, the frequency of the B.F.O. is fixed at a value about 1 kc above or below the intermediate frequency.

The pitch of the audible note can then be varied, as it can with the regenerative receiver, by altering the setting of the main tuning condenser.

It will now be seen that the pitch of the C.W. note heard in the 'phones or speaker is governed entirely by the difference between the frequency of the signal or I.F. amplifier and the local oscillator. Clearly, then, if the two frequencies are made identical the "audible note" will be of zero frequency. In other words, it ceases to exist. It is the point at which the two frequencies are made identical—no matter by what means—that we have the "dead space."

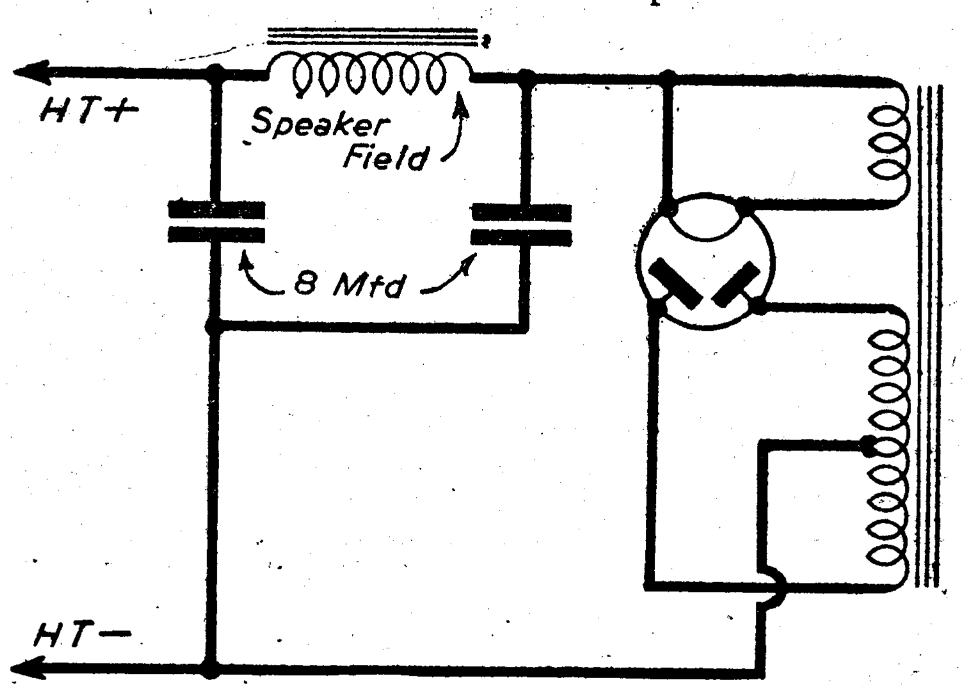


Fig. 3.—The normal method of energising the speaker field.

4. Energising a M.C. Speaker

The usual method of energising the speaker field when using an A.C. receiver is by inserting the field winding in series with the H.T. positive supply line from the rectifier to the set. In that case, the field winding also acts as an excellent smoothing choke. Fig. 3 shows the method of connection; it will be observed that the usual smoothing condensers are used, and that the field in every way replaces the smoothing choke.

This system of energising is excellent when the H.T. current consumption of the set is upwards of 60 mA, and when the D.C. voltage available from the rectifier is sufficiently high to ensure an adequate H.T. voltage to the set after allowing for the very appreciable voltage drop through the field winding. At 60 mA this drop is 150 when using a 2,500 ohm speaker.

In the case under consideration the H.T. current is insufficient for energising. Additionally, assuming the use of 250 volt H.T. valves, the voltage drop entailed cannot be tolerated. Provided that the rectifier and transformer were capable of providing between 100 and 120 mA, the simplest and most economical method of obtaining the energising power would be as shown in Fig. 4. The normal smoothing system is retained, and the speaker field is wired (in series with a limiting resistor) in parallel with the rectified H.T. voltage before smoothing. It would be easy enough to determine the correct value of the resistor when the rectified voltage, at full load, was known. The resistor would need to have a wattage rating of at least 5 watts.

If the rectified output current were insufficient to provide H.T. and also the energising power for the speaker field an entirely different system of supply would be required. That shown in Fig. 5 is sometimes used, but it is not one to be strongly recommended, because the field coil is connected directly to the

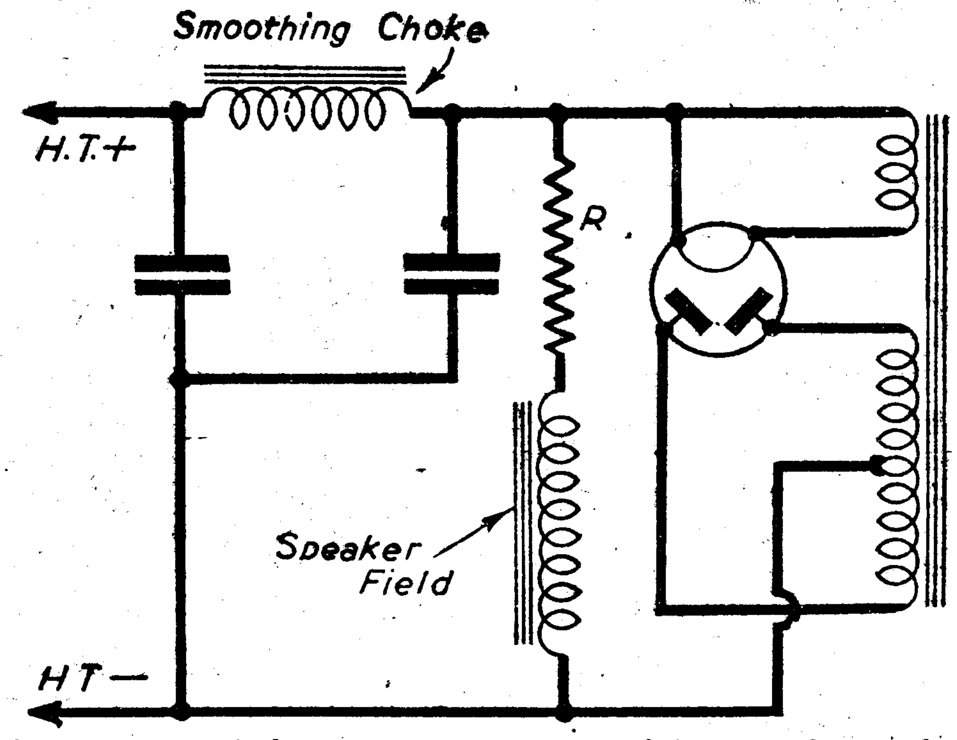


Fig. 4.—A method of energising a speaker field when the rectifier output greatly exceeds the H.T. requirements of the receiver.

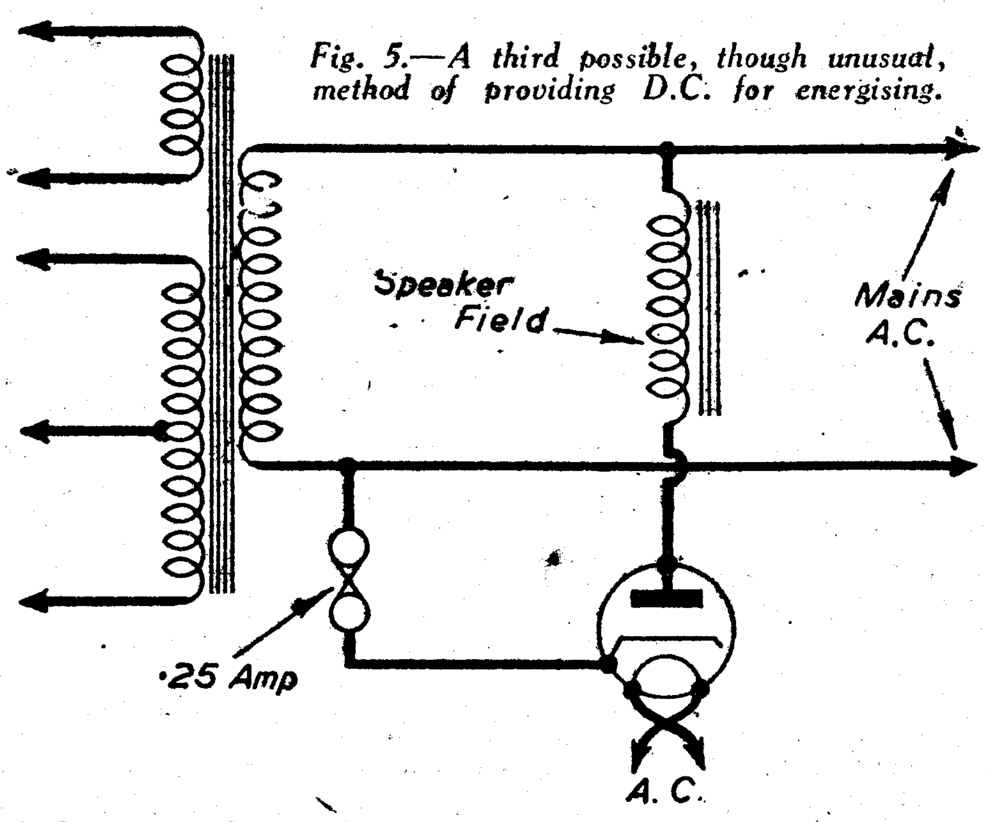
mains; that is why the .25A fuse is included. With this system use is made of an additional half-wave rectifying valve, this being operated directly from the mains A.C. supply. The arrangement should certainly not be used for a speaker mounted away from the set, and even for a built-in speaker care should be taken to ensure adequate insulation.

5. Transformer Overheating

As might be expected, overheating of a transformer indicates the passage of an excess current. This could be due to the fact that the component was being used in conditions other than those for which it was designed, or to a partial short-circuit somewhere in the circuit.

It will be assumed that the transformer is correctly used. A short-circuited, or partially short-circuited, smoothing condenser would first be suspected, and a check could be made by disconnecting one side of each

Fig. 5.—A third possible, though unusual, method of providing D.C. for energising.



of the smoothing condensers in turn. Another possible cause is unsatisfactory insulation of the smoothing choke with the result that there is leakage between the H.T.+ supply passing through the choke and earth.

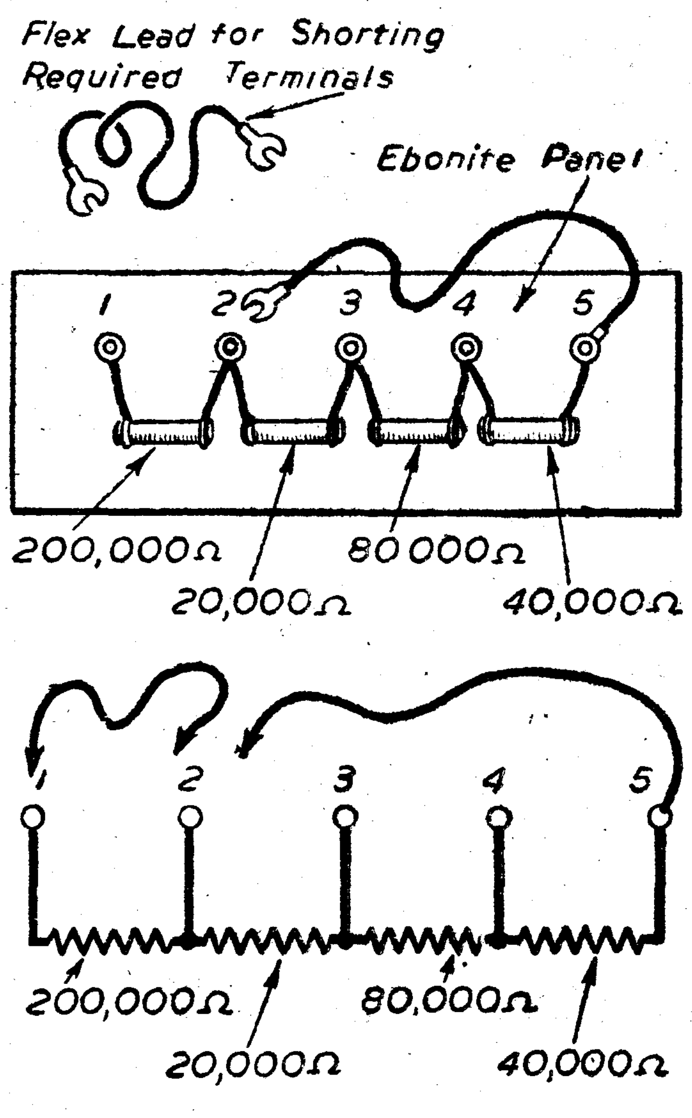
Yet another possible cause of the trouble is the presence of a number of short-circuited turns on one of the windings of the transformer itself. If that were the cause of trouble it could be detected by disconnecting the transformer secondary windings. Overheating would continue, although perhaps not to the same extent, despite the absence of load. Another possible transformer fault is that of short-circuit of a winding to the core, which is no doubt earthed.

In some transformers a screening ring is fitted between two adjacent windings; this is used to minimise hum due to induction. This ring is gapped, so that it does not constitute a "closed loop." If the two sides of the gap were bridged due to their contact with the chassis, for example, marked overheating would result.

Practical Hints

Multiple Resistance Board

EXPERIMENTERS often require resistors of various values, and if they have not a component of the necessary value to hand probably do not realise how easily other resistance values can be connected together to make up the desired value. In the small resistance board shown in the accompanying drawing only four resistors are used, yet it is possible, by the selecting of various combinations, to obtain almost any desired resistance value within the limits normally required in radio work. The resistors—which are 20,000, 40,000, 80,000 and 200,000 ohms — were chosen with this end in view; other values could be used, of course, provided that the various combinations of resistance are calculated.



A simple multiple resistance board arrangement.

The resistors are connected to five terminals mounted on a small piece of ebonite. A flexible lead is attached to the fifth terminal, and another flexible lead is used for short-circuiting various terminals when this is necessary. If plugs and sockets were available they could be used with advantage instead of the terminals. The following table shows the necessary connections for some of the more useful resistance values available.

Resistance value in Ohms	Terminals	Connections	
12,660	2 and 4	Flexible lead on 2	3 and 4 shorted
16,000	3 and 2	,, ,, ,, 1	2 and 4 ,,
17,140	3 and 2	,, ,, ,, 1	1 and 2 ,,
18,810	3 and 2	,, ,, ,, 1	—
20,000	3 and 2	—	—
34,280	3 and 4	,, ,, ,, 1	2 and 1 ,,
35,260	1 and 4	,, ,, ,, 1	—
40,000	4 and 5	—	—
60,000	2 and 5	—	3 and 4 ,,
61,110	3 and 4	,, ,, ,, 1	—
80,000	3 and 4	—	—
82,350	1 and 2	,, ,, ,, 1	—
100,000	2 and 4	—	—
120,000	3 and 5	—	—
140,000	2 and 5	—	—
200,000	1 and 2	—	—
220,000	1 and 3	—	—
240,000	1 and 5	—	2 and 4 ,,
260,000	1 and 5	—	3 and 4 ,,
280,000	1 and 4	—	2 and 3 ,,
300,000	1 and 4	—	—
340,000	1 and 5	—	—

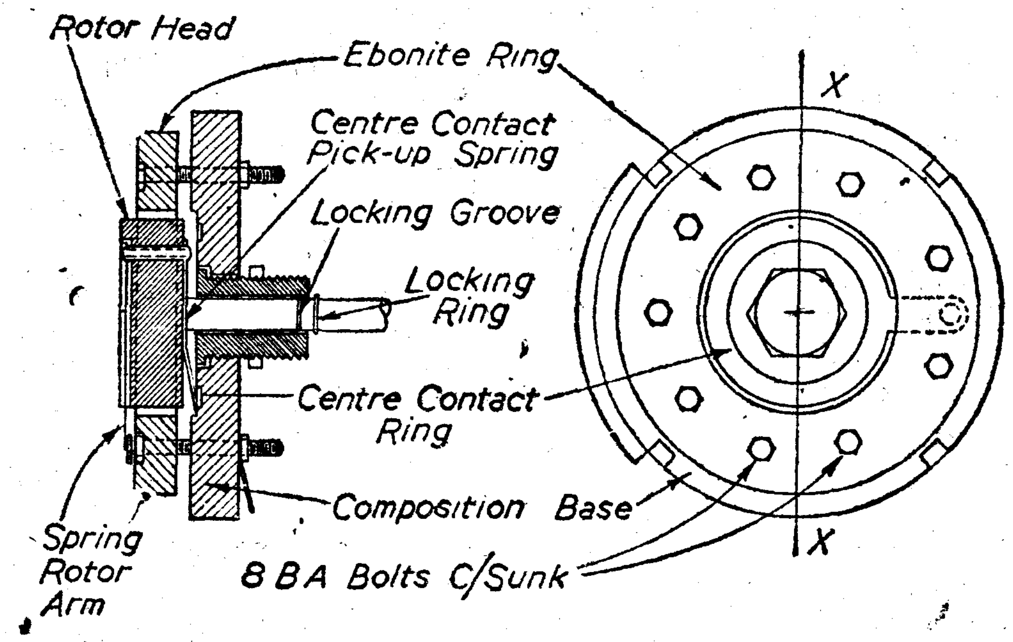
The values obtained by parallel connection are worked out to the nearest hundred ohms, which is a degree of accuracy quite high enough for components used in normal sets.—F. G. RAYER (Longdon).

A Multi-way Stud Type Switch

REQUIRING a multi-contact stud type switch of compact size for use in a home-made test meter, it was eventually decided to make up a suitable unit from a surplus volume control of the carbon type. The volume control chosen was a "Morganite-Stackpole," without the mains switch attachment, and this proved ideal for the job, since its construction, using a carbon coated ring with a spring-loaded moving contact, provided, without alteration, the moving contact for the switch.

First of all the metal cover and the nut securing the rotor and shaft sleeve were removed, and the whole rotor and sleeve were withdrawn as a unit. The carbon-coated ring was secured to the base by two 8 B.A. bolts, which also provided the contacts for the wiring tags at each end of the resistance. This ring was removed and used as a template for a new ring cut out of scrap ebonite. The two fixing holes were drilled and the new ring was bolted in place on the base. When securely fixed a further seven equally spaced holes were drilled 8 B.A. clearance right through the ring and the base.

These seven holes, together with the two securing bolt holes in the ring, were then countersunk sufficiently deep with a $^5/_{32}$ in. drill to allow for the thickness of an 8 B.A. hexagon bolt head. The bolts were then inserted in the ring and tapped home flush with the ring surface with a light hammer. The ebonite was found to be sufficiently soft to accommodate the hexagon bolt heads, which, cutting into the "countersink," locked themselves. Tightening up the nuts, a file was applied to the ring surface until the bolt heads and ring were perfectly smooth. The rotor assembly was then replaced complete, and tags were fitted to each of the nine protruding bolts on the outside of the base ready for wiring up. It was found, on completion, that the action was perfectly smooth, and gave a good positive contact without any further adjustment.—J. SANER (Blackheath).



Section and front view of a multi-stud type switch.

ON YOUR WAVELENGTH

By THERMION

Who Did Invent It?

PRESUMING that we can apply a term representing the highest degree of mental creative ability—invention—to a broadcast feature it will be interesting to know who did "invent" the Brains Trust? I ask the question because there seems to be a dispute about it between the B.B.C. and one who claims that signal honour. But does it really matter? It is an ordinary sort of feature employing some well-known names and I fail to see the possibility of reflected glory. As a matter of fact, I have some decided views about the Brains Trust, as I have about crooners and jazz, and what the B.B.C. has itself described as debilitated slush. I have not noticed any marked improvement since the B.B.C. delivered its exordium on jazz. In fact, matters are getting worse. The air is being used for blatant publicity. If it is not a show which is being advertised the artists advertise themselves.

Now if any reader cares to take the trouble to check the answers given by the Brains Trust (excluding, of course, questions which merely demand an opinion as an answer) and award marks much as say Joad would to his scholars, some of those taking part in the Brains Trust will be found to come out very much at the bottom of the form. I know that these questions are shot at the members of the Brains Trust without previous opportunity for looking the matter up (is this really so?), but then I would remind Joad that he would not excuse his pupils on that score if they gave wrong answers to his questions. After all, the schoolmaster is supposed to know the answers, and pupils are not allowed to carry books of reference around with them at examination time. Nor when Joad asks them a question does he give them 10 minutes to look it up. I am afraid the point, therefore, that the answers are spontaneous goes by the board, and adds point to my criticism that answers on matter of fact are quite often wrong. For example, taking a list of questions of the factual kind answered by the Brains Trust the other day I awarded only 17 marks out of 100 to the Brains Trust, which means that individual members of the Trust scored less than five each.

American System

NOW the American system in which listeners get a money prize every time they floor their particular version of the Brains Trust is a much better system, but perhaps the B.B.C. would find that rather too expensive.

Whoever devised the Brains Trust, however, it is still a popular feature, although it is my view that it is not vastly different from the American style of quiz. In other respects the American system is better; not only do they give money prizes when the Trust is floored, but they also give the prizewinners a complete set of the *Encyclopædia Britannica*, by the aid of which, no doubt, the prizewinner could easily devise some further prizewinning questions. The Brains Trust is altogether over-rated, and its importance as a broadcast feature quite exaggerated. As an entertainment it may occasionally be amusing. It is to me, but not in the sense in which it is intended to be amusing. I am amused at the fencing which goes on, the subtle methods of angling for time to think up a good answer, the "it all depends what the questioner means" sort of reply, and the assumed erudition of the Brains Trust in general. Sometimes they drop unholy bricks. However, it is from the point of view of amusement that it has succeeded and not as an ethereal alma mater exuding omniscient profundity. I leave my readers to judge how far they are amused by it.

Radio Sets in Cars

DURING the summer of 1940, when there seemed every likelihood of this country being invaded, the use of wireless sets in cars was banned. That risk appears now to have receded considerably and accordingly the R.A.C. and A.A. have asked the Postmaster-General for the ban to be lifted. The reply received is that the Government has under consideration the question of allowing some relaxation of the restriction on wireless receiving apparatus in motor-cars, and that a further announcement will be made when a decision has been reached. This approach is a part of the policy of the two organisations to press for the removal of wartime restrictions on motoring as and when they appear redundant.

WHERE PRESS (AND LICENCE HOLDERS) GET OFF

[Press Item.—The Director-General of the B.B.C., Mr. Robert Foot, lecturing the Variety Department producers, said: "Don't be worried by Press criticism that always cancels itself out. And in future credits will not be given at the microphone to B.B.C. staff for the Brains Trust programme."]

Now, take no notice of the Press;
Itself it cancels out.
So carry on the way you are,
And entertain no doubt;
They've got to take our programmes.
Who cares if many scoff?
And if they do not care for them,
They can blinking well switch off!

The Press is very powerful,
But let it rave and shout;
Though kings and Governments at times
The Press has tumbled out,
It cannot take that course with us,
From danger we are free,
Immune! Above all human powers—
Immortal B.B.C.!

The greatest gas works ever known,
Are at Broadcasting House.
We rule the roost. Care not one hoot
How our "consumers" grouse.
And if the "fumes" which we emit
At times prove suffocating,
Ignore the Press. It cuts no ice
That's what we're annotating!

Just one thing more we would remark.
To fond ambition's spike,
Our staff anonymous shall be
When it's before the mike.
Precautionary measure this;
Protect their lives we must,
Lest they invent some further stunt,
More boring than Brains Trust!

"TORCH."

Our Roll of Merit

Readers on Active Service—Thirty-ninth List.

G. Biggin (Bdsm., Y. & L. Regt.).
C. Watson (L.A.C., R.A.F.).
J. Docherty (Spr., R.E.).
L. Smith (F.O., R.A.F.).
N. Picay (Bdr., R.A.F.).
B. Gregory (Fus., R.I.F.).
L. Green (Gnr., Home-Forces).
C. Hodgetts (Sgt., R.A.F.).

YOUR SERVICE WORKSHOP—11

A Standard Cap

Constructional Details of an Important, yet Sir

By STANL

BEFORE describing the next piece of apparatus for your service workshop, it is necessary to deal with the final points and calibration of the Resistance and Capacity Bridge which was described in the January issue.

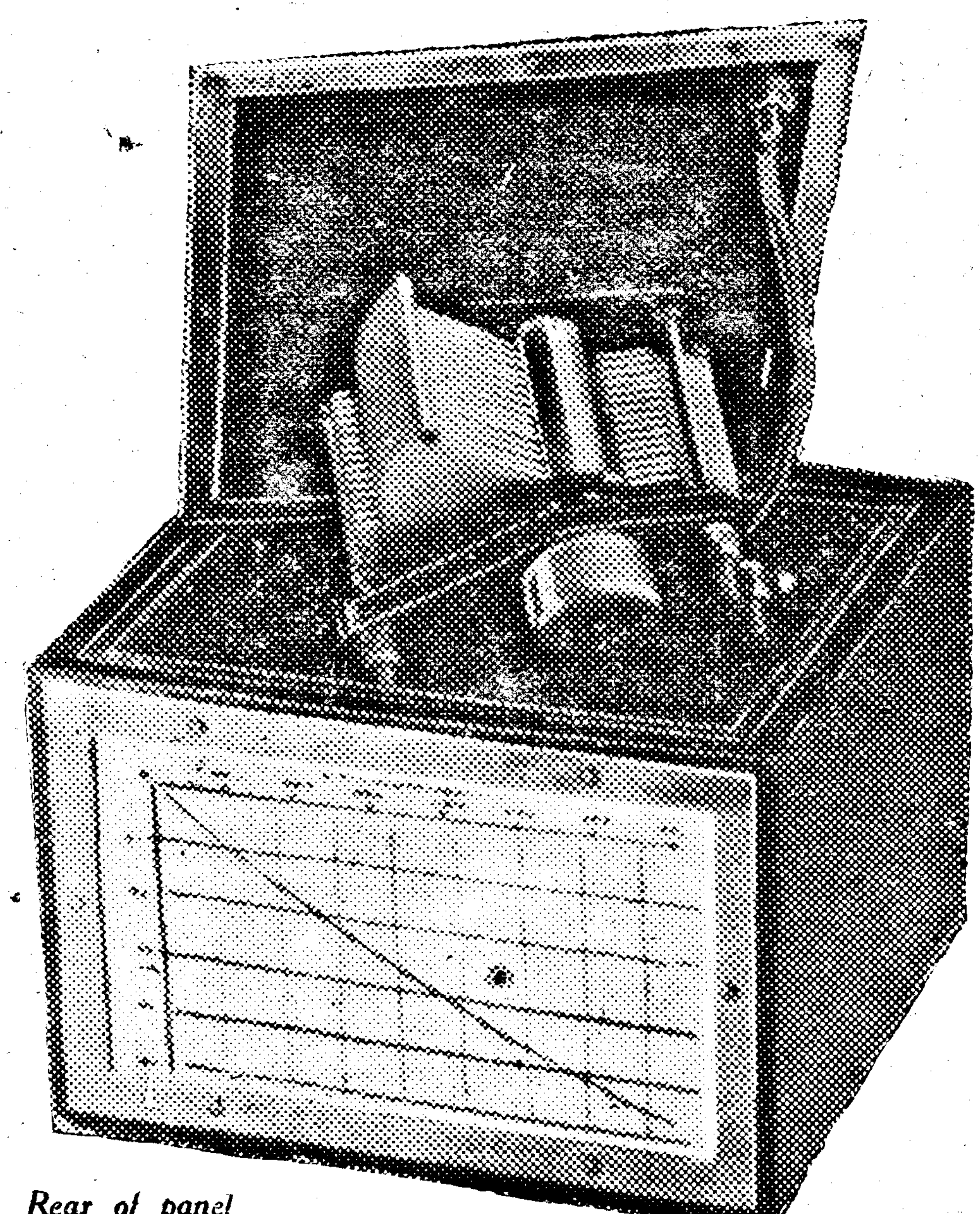
It was stated previously that VR2, the filament resistor, had a further use; this is also in connection with the pitch of the note, which may be varied within certain limits by reducing the voltage below the normal two volts, and may prove useful if the characteristics of the L.F.T. are such that only a low note may be obtained.

When satisfactory oscillations are being generated the bridge circuit may be given a rough check, and for this various values of condensers are connected to the "test" terminals and VR1 adjusted to the silent or weakest point. The range switch must, of course, be set appropriately.

It will be seen from the illustration that circular pieces of ivorine are fitted under the various controls and the large one associated with the potentiometer forms a convenient dial upon which calibration may be registered, balance being indicated by a "pointer" made from clear celluloid and fixed to the large control knob.

Calibration

There are two methods which may be employed in order to calibrate the instrument and it is dependent upon the accuracy of the fixed standards as to which one is adopted. The first method, which is the easiest, applies when these standards are of no particular accuracy, as, for instance, when they are selected from normal components. The procedure then is to find the balance point when various values of condenser are joined to the "test" terminals and mark these points directly on the dial. Range 1 covers 0.1 megohm to 10 megohms, range 2, 0.00001 mfd. to .001 mfd.; range 3, 0.001 mfd. to 0.1 mfd.; and range 4, 0.1 mfd. to 10 mfd. It may be stated that these values are based on the assumption of a maximum ratio of 10–1 and 1–10 either side of the slider of V.R.1, but it will be found that values above and below these given for each range will be measurable. However, this only results in overlapping of the ranges when dealing with capacity, but in the case of the resistance range, lower and higher readings might prove useful. At the low end of the capacity range it would be unwise to rely too much upon calibrations below 50 m.mfd. (0.00005 mfd.) as then the self capacity of the components and wiring undoubtedly affects accuracy; nevertheless, fair indications down to 10 m.mfd. are given.



Rear of panel showing robust variable condenser.

The other method of calibration is applicable where the fixed standards are accurate to say ±1 per cent. Two ways are available here, the first necessitating a collection of condensers of various capacities which must be of the same order of accuracy as the standards; the procedure is then the same as before, i.e., that of marking in the various values as they are tested. One range only need be calibrated and it will then be correct

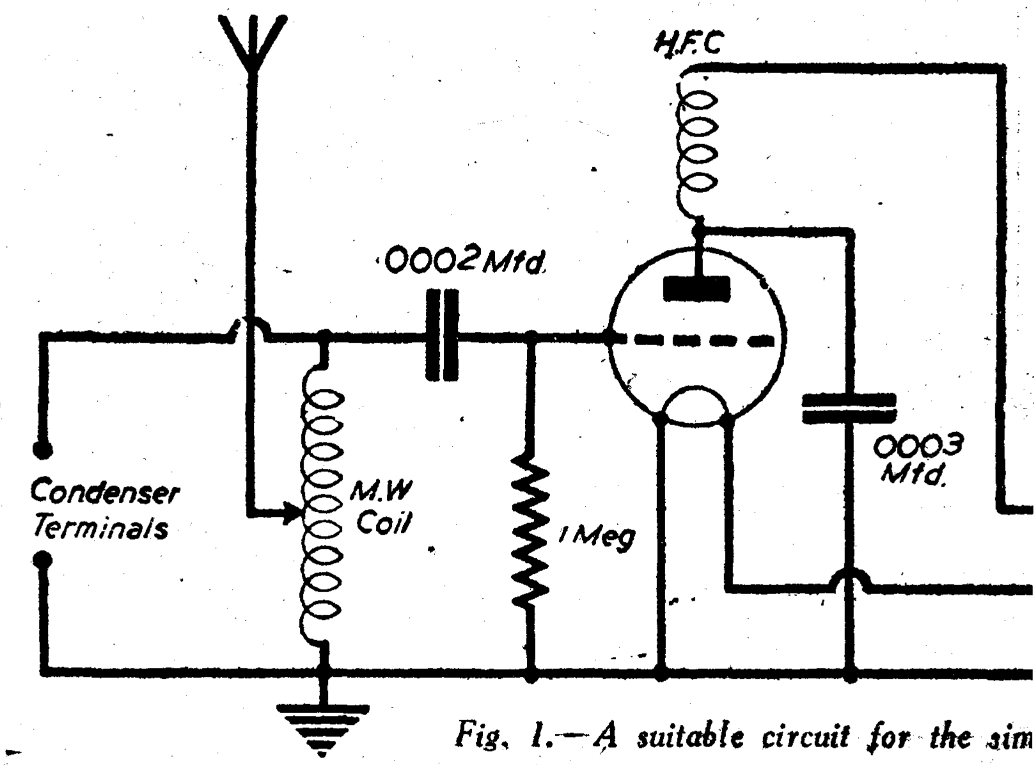


Fig. 1.—A suitable circuit for the sim

for all four, the accuracy throughout being that of the fixed standards. However, it is unlikely that the constructor will possess or have access to, many condensers of accurately known value, in which case it becomes necessary to adopt another method and one which is probably as accurate as any if carried out with care. It consists of dividing the potentiometer element into parts (electrically) so that any ratio up to 10–1 or 1–10 may be available. For instance, if, by means of an ohm-meter, the element is divided into two equal parts, the resistance arms on either side will be equal. Then, if the standards can be relied upon for their accuracy, it will be appreciated that the bridge will be balanced when a condenser or resistor is joined to "test" having a value similar to the standard component switched in. This midway point on the scale, therefore, is marked 1. If now a point is found to the right of the central figure where the resistance is one-third of the whole, it will be apparent that the resistance of the left arm is twice that of the right. This point is marked 2. The position for a quarter of the element is marked 3, and so on until one eleventh is reached, which of course, is 10–1. Having calibrated the right hand side of the scale, it is safe to assume that that of the left will be similar and it is only necessary to duplicate these points by means of dividers. When measuring capacity the right hand side of the scale becomes a

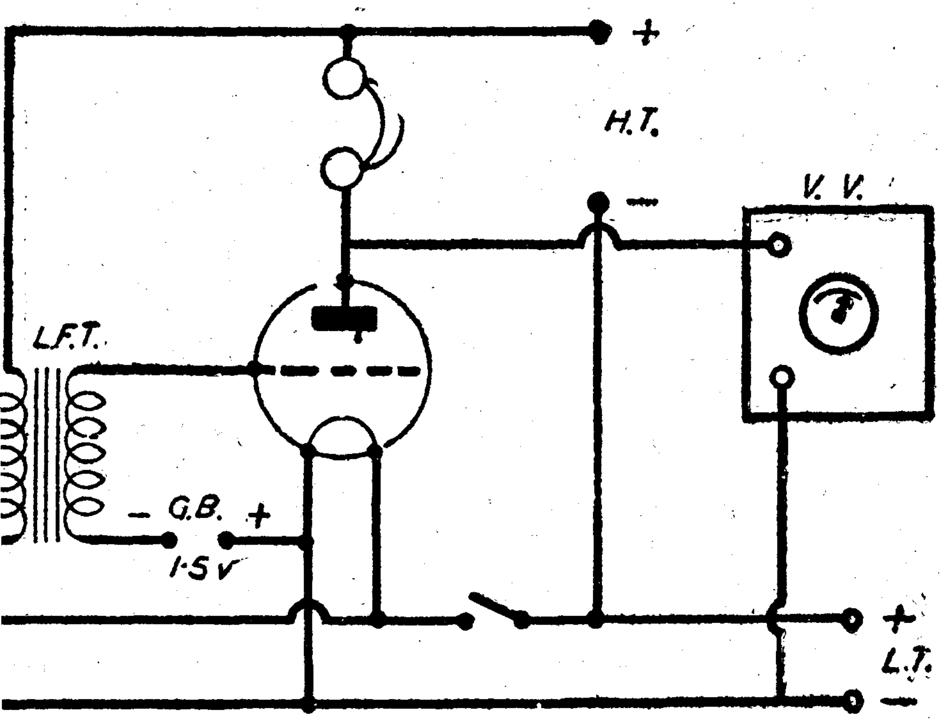
acity Condenser

e, Piece of Apparatus for the Service Man

BRASIER

multiplier and the left hand side a divider. For example if on range 2, balance is obtained when the pointer indicates figure 3 on the right, the value of the unknown is clearly 300 m.mfd. or 0.0003 mfd., while figure 2 to the left would prove that the condenser has a value of 50 m.mfd., or 0.00005 mfd. The same method is adopted on ranges 3 and 4, but in the case of range 1, where resistance is dealt with, the scale becomes reversed and the left hand side is the multiplier, so that when checking say a 7 megohm resistor, the nullpoint would be indicated at figure 7 to the left, while for a 100,000 ohm component the pointer would come to rest at figure 10 to the right.

The scale marked out for the original instrument is shown clearly in the panel layout, where it will be seen that a 0–100 degree scale embracing the whole resistance element has been included. This is useful if it is desired



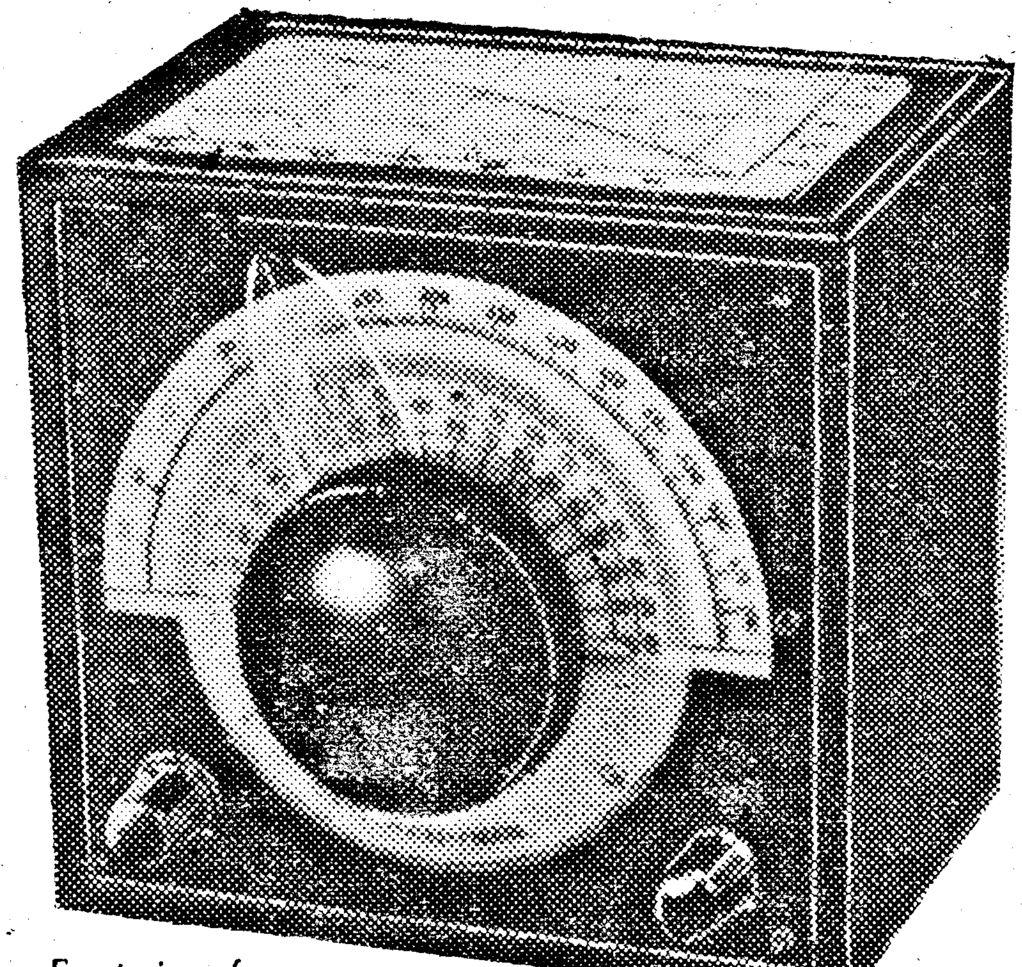
two-valve receiver to which the writer refers.

to prepare a graph which would give readings of intermediate values and also give calibration points to the ends not included by the ratio scale. Quite a neat and professional job may be made of the scale if, after pencil calibration points have been marked, a little time is spent marking out the circles and divisions with dividers and ruler, so that neat lines are scored in the ivorine. These may then be filled in with indian ink, afterwards adding the figures.

To those readers who have no facilities at all for measuring resistance and who find it difficult to get hold of meters for the purpose, it is suggested that extra resistance ranges be added to the bridge. This would entail only the inclusion of a 6-way switch instead of the 4-way shown and two more standard resistors of values that would provide the required ranges of measurements.

Economical In Use.

The instrument is very economical as its periods of actual use are short, but it is nevertheless important to switch off at every opportunity since the L.T. is derived from a dry battery. The current drain on this (assuming the use of a modern 2-volt battery valve) is approximately 100 milliamps and that on the 9-volt high-tension battery roughly 0.5 milliamp. When using the bridge it will be noted that sharp balance and a silent point is usually



Front view of the completed instrument.

obtainable on ranges 3 and 4, while on ranges 1 and 2 the effect is not quite so definite, although the minimum point is always discernible. This is quite in order and is usual with the type of bridge described.

Readers who have difficulty in procuring a 2,000 ohm potentiometer of a suitable type may like to know that this value is not at all critical and it is therefore possible to use components having a value up to even 20,000 ohms. The thing that matters in conjunction with bridge measurements is the ratio and providing the foregoing remarks on calibration have been understood, this will be readily appreciated.

Standard Condenser

THE usefulness of the Test Oscillator, output meter, valve voltmeter, etc., is usually fully appreciated in service work, but there is another instrument—for such it may well be called, although extremely simple—that is often forgotten. Reference is made to the standard condenser, which is a well-made variable condenser capable of accurate adjustment, mounted in a screening box, and calibrated throughout its capacity range. The little work involved in making up such apparatus is well worth the extra facilities it offers in experiments and general testing.

The component selected should be of sturdy and strong construction and preferably one having a maximum capacity of .00075 or .001 mfd. This gives rather more scope than the normal .0005 mfd. but if the highest value is unobtainable one of .0005 mfd. can be used. Regarding vane shape, the old semi-circular pattern is actually the best to use because then a more even calibration is obtained, but failing this the logarithmic design is perhaps the best. In this case the moving vanes should, for preference, be braced at their extremities, and a pig-tail rotor connection is essential.

It is interesting to note that a precision laboratory standard condenser may cost anything in the region of £50-£75, and while it is not suggested that the service man should equip his workshop with such apparatus, it shows that, under more humble circumstances, the component selected cannot be too good. The instrument shown was constructed for a few shillings, the actual condenser being a " Pye " logarithmic model of sturdy construction having a capacity of .00075 mfd. The type to look for is one made some time ago by a well-known manufacturer, with either reduction gear drive or integral slow-motion which must be free from back-lash and capable of very fine adjustment.

The condenser should be mounted on a metal panel of a size which, when fitted into a metal or metal-lined box, provides a clearance of about 1¼in. all round the condenser assembly. It is important to ensure that the panel makes perfect contact with the box; if a wooden metal-lined box is employed a lining of copper foil is very convenient. After fitting and soldering joints, etc., the metal is left high all round the top edge of the box to the extent of about ½in. or so. After

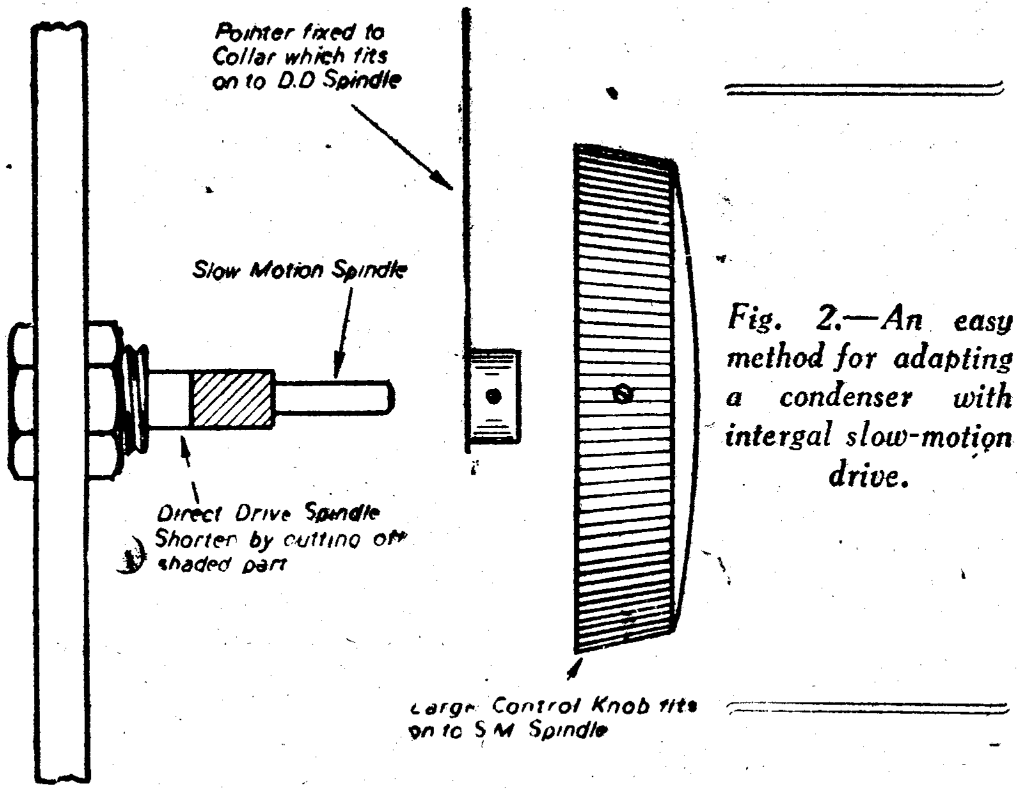


Fig. 2.—An easy method for adapting a condenser with intergal slow-motion drive.

screwing in little strips of wood which will support the panel the foil is bent inwards to provide adequate metallic surface on to which the metal panel is screwed.

If the condenser is of the type with integral slow-motion having the usual knob and graduated dial, this is not very convenient for calibration purposes. A suitable method of adapting it is shown in Fig. 2 where it will be seen that a pointer or celluloid curser is fixed to a brass collar which fits on to the direct drive spindle of the condenser. This spindle will probably need shortening (being careful not to cut through the slow-motion spindle) so that a suitable control knob of large diameter may be fitted to the slow-motion spindle, its lower edge being just clear of the pointer. This simple adaptation makes it possible for the pointer to traverse a suitably marked out scale of aluminium or ivorine. Two terminals are fitted to the metal panel, one making contact with it and also connecting to the moving vanes. The other, joined to the fixed vanes must, of course, be insulated by bushing. Ample clearance between the terminal post and panel must be allowed if the minimum capacity of the condenser is to be unaffected.

Calibration

There are **various methods of calibrating a variable** condenser, the most usual and perhaps the most accurate being by the substitution method, and the apparatus employed is such that should be available in the Service Workshop, namely: A test oscillator and valve voltmeter. Suitable designs for these instruments were given in this series in the issues for June and July respectively. Other gear required for calibration purposes consists of a one or two valve receiver minus the tuning condenser, but with two terminals to provide for its connection. Nothing elaborate is required and the gear can be put together in an hour or so on a miniature baseboard, using a couple of grid-bias batteries for the H.T. supply. The apparatus is then set up in accordance with the diagram of Fig. 3 while a suitable circuit for the receiver is suggested in Fig. 1.

The oscillator is adjusted to radiate from a small aerial a modulated signal on the medium waveband. The "aerial" may consist of about 2 ft. of wire lying in close proximity to a similar wire joined to the coil in the receiver, which should be of the medium-wave type (see Fig. 1). The valve voltmeter or, of course, a sensitive output meter is connected to the receiver's output to indicate accurately when resonance is obtained between the oscillator and the receiver. The last requirement is a small fixed condenser of accurately known value. A convenient size is 50 or 100 m.mfd. (.00005 or .0001 mfd.) and the accuracy should be of the order of ± per cent. if the standard variable condenser is to be considered worthy of the name. Although the values given above provide for easy calibration, it is not essential to have any particular capacity so long as its value is accurately known. For instance, if a condenser is on hand having a value of, say, 75 m.mfd. ± 1 per cent. then this will be suitable, only the mental arithmetic involved when calibrating will be slightly greater. Some notes in the last article dealing with the condensers for a capacity bridge may be referred to in regard to acquiring suitable small condensers.

With the apparatus arranged as in Fig. 3 and everything switched on, the test fixed condenser is connected to the "condenser" terminals on the receiver, using thick leads. The coil in the receiver will then be fixed-tuned by the test condenser, the value of which is assumed to be 100 m.mfd.

It will be obvious now that a setting of the test oscillator will be found where the wavelength is the same as that to which the receiver is tuned. This will be evidenced by a reading on the V.V. and also from sound in the headphones, if in use. Having tuned the oscillator to the exact resonance point, leave all adjustments as they are and disconnect the test condenser from the terminals on the receiver joining in its place the standard condenser, which we will call S.C., the earth terminal of which is connected to the earth side of the coil in the receiver. In order to obtain resonance once again a capacity of 100 m.mfd. is required across the coil, and this is achieved by adjusting the S.C. until resonance is again shown on the V.V., and the point indicated on the dial is equivalent to 100 m.mfd. In order to obtain the next calibration point it will be necessary to connect the fixed test condenser in parallel with the standard condenser so that the capacity across the coil becomes 200 m.mfd. If the wavelength emitted by the T.O. is increased, resonance between it and the receiver may again be obtained, and at this point the test condenser is disconnected. The circuit will then be out of tune, but by slowly increasing the capacity of the S.C. the second calibration point of 200 m.mfd. may be obtained when a deflection of the V.V. is seen to indicate resonance. The test condenser is again joined in parallel with the S.C., the wavelength of the oscillator increased, the test condenser disconnected and the capacity of the S.C. increased. At this point its value is 300 m.mfd. and the procedure is repeated so that eventually the whole scale is calibrated in steps of 100 m.mfd.

(To be continued.)

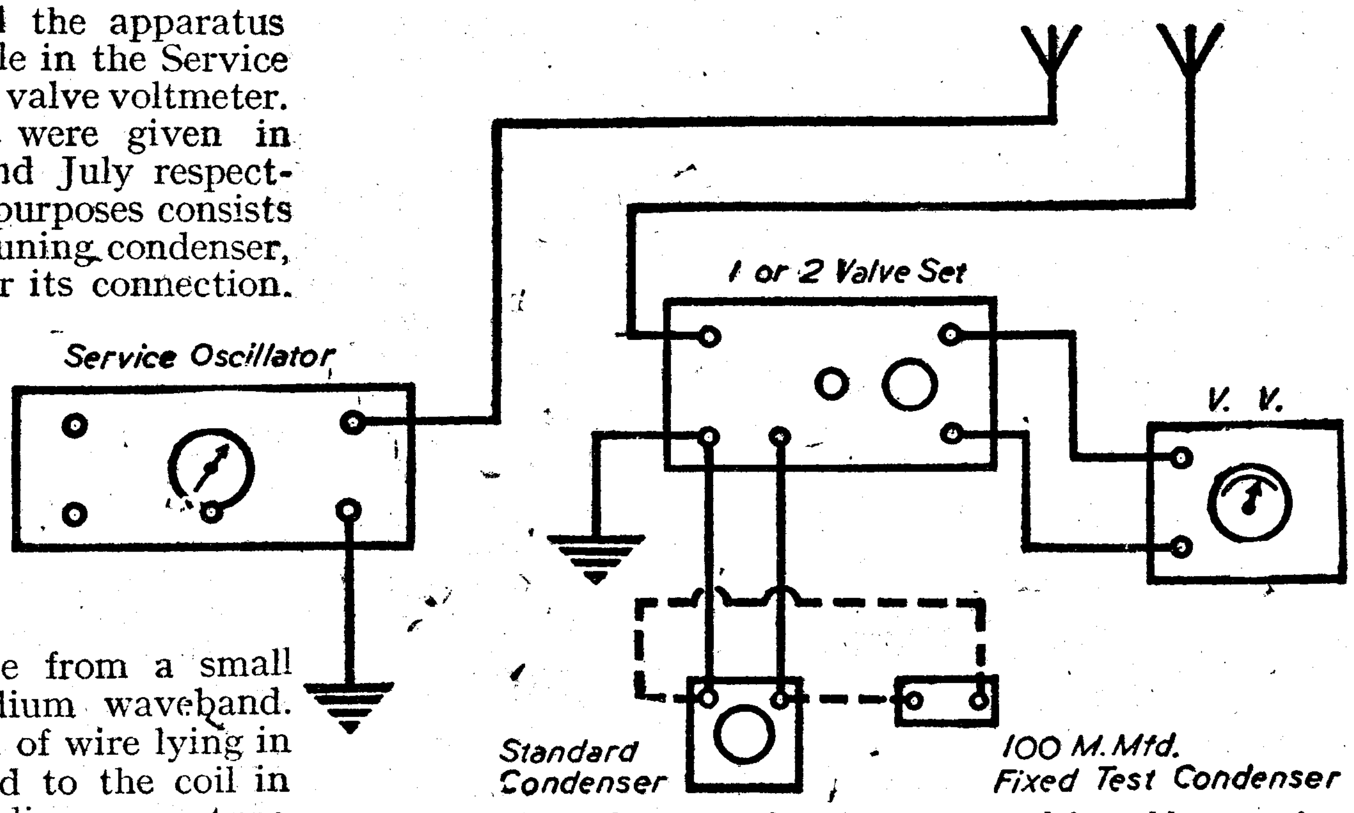


Fig. 3.—Shows the set-up of apparatus required for calibration of standard condenser.

Secondary Batteries—7

This Article Deals With the Economics of Charging, Constant Current and Constant Potential Methods.

By G. A. T. BURDETT, A.M.I.I.A.

(Continued from page 99, February issue.)

IN the formula under consideration on page 99 of the February issue, it was stated that the required current was 6 amps.

$\therefore$ Required resistance $= \frac{75-36}{6} = 6.5$ ohms.

$\because$ Value of external resistance = Total resis. — external resistance of cells $= 6.5 - 0.4 = 6.1$ ohms.

This will give us $\frac{75-36}{0.4+6.1} = 6$ amps charging current.

The above figures are in respect of the commencement of the charge. Towards the end of the charging period the P.D. or back E.M.F. of each cell will rise to 2.8 volts, making a total of $2.8 \times 20 = 56$ volts. To maintain a current of 6 amps, the required resistance will be:

$\frac{76-56}{6} = 3.3$ ohms, or approximately half the original resistance.

To enable the current to be maintained at 6 amps the external resistance is cut out as required.

Under working conditions rarely is it possible to maintain, say, 20 cells in circuit from the commencement to the end of the charge of each cell. In one circuit the cells may vary in size or will be in varying states of charge when put on charge, which results in frequent interruptions of the charging circuit to enable cells to be removed and connected up as necessary. At other times one cell only may be in circuit, though this arrangement is not an economic one. Were this the case in the above installation the maximum resistance would then be:

Assuming the cell was a small one with a charging rate of ½ amp, $= \frac{75-1.8}{0.5} = 146.4$.

Since the internal resistance of the cell would account for only 0.02 ohms (which can be ignored) a comparatively high external resistance would be required. In practice, for the above installation a variable resistance giving a range of 0—150 ohms is suitable. When choosing such a resistance care must be taken to ensure that the wire chosen will carry the desired current, e.g., say up to a charging current of 10 amps. Most electrical pocket books and year books give tables of suitable resistance for a range of values of current which should be consulted when purchasing or constructing a resistance for charging purposes.

As illustrated above the P.D. or back E.M.F. of cells rises during charge with a result that with a constant resistance the current will drop in inverse proportion to such rises. The most rapid rise of back E.M.F. of each cell is during the first half-hour of charging when the back E.M.F. of each cell should rise to about 2.3 volts. After this period the rise is gradual and the variable resistance requires very little attention on the part of the operator.

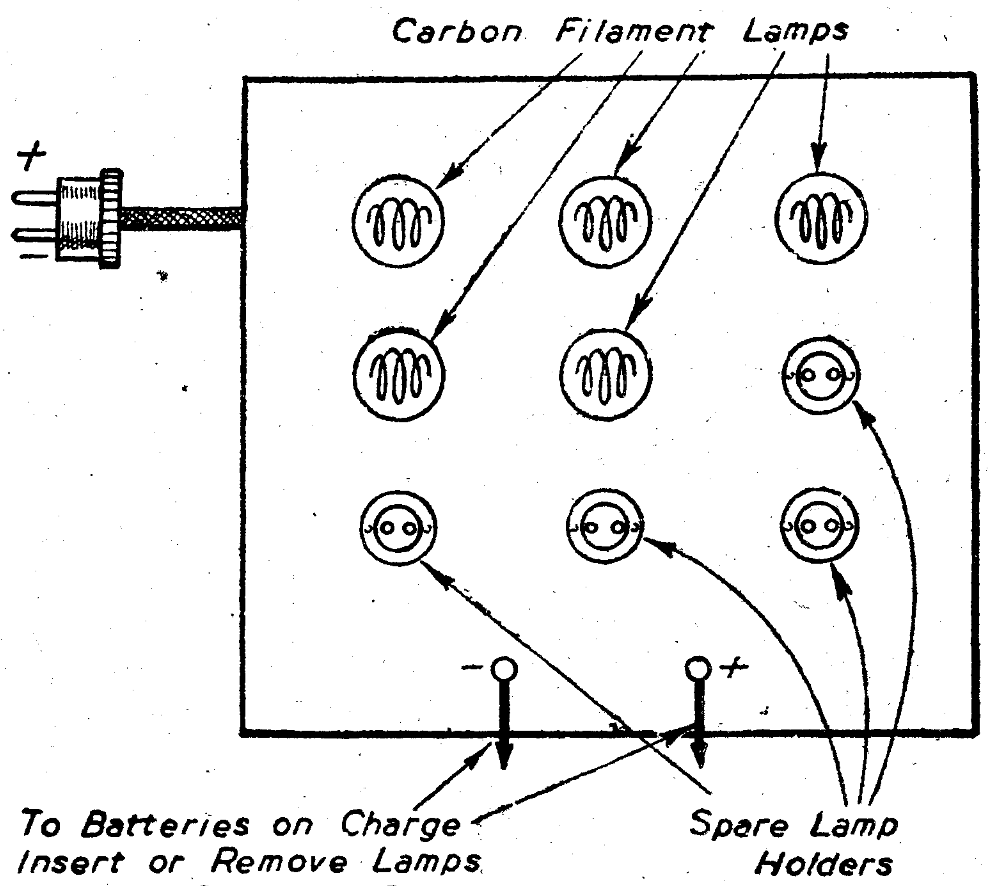


Fig. 1.—Lamp board for current control.

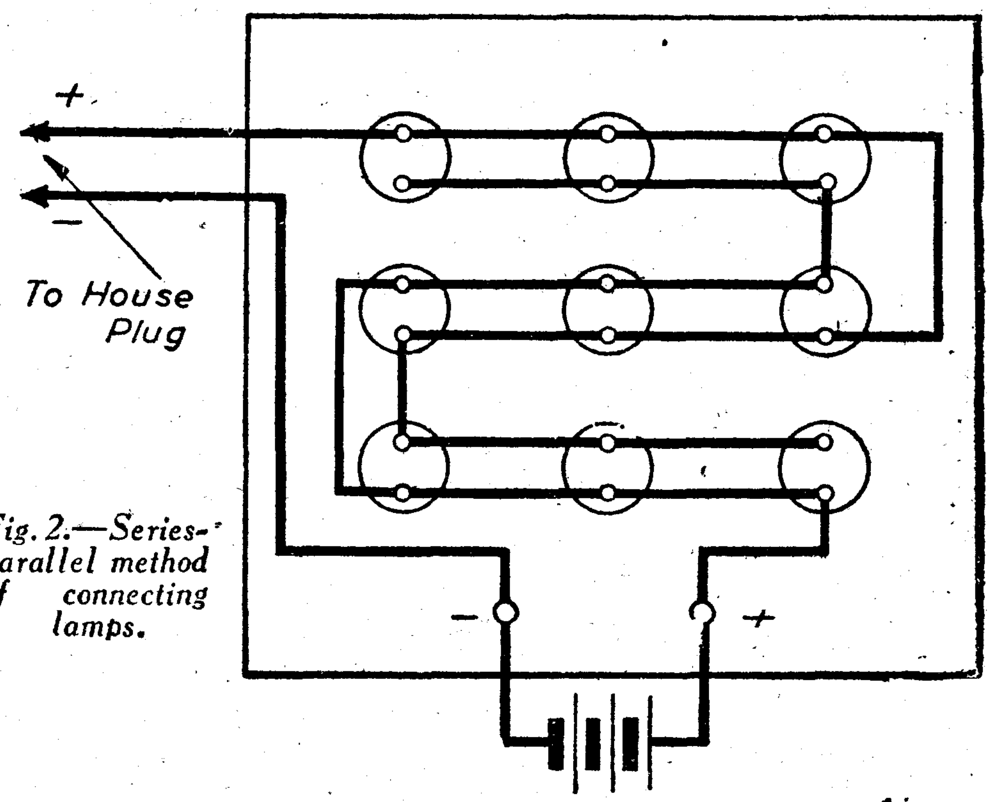


Fig. 2.—Series-parallel method of connecting lamps.

Lamp Resistance

A suitable yet simple charging board comprises the lamp resistance circuit, particularly adaptable for operation on D.C. mains at mains voltage, e.g., 200 volts, 100 volts, etc., where no cut-out is required to protect the equipment should the supply fail. The simplest circuit of all for use on a D.C. mains supply consists of a bank of lamps connected to the ordinary house-heating plug, see Figs. 1 and 2. Variation in charging current is obtained by inserting or removing lamps from the circuit, so reducing the current passing through the lamp circuit, and therefore the battery circuit. In view of the great mechanical strength of its filament and its higher current consumption per candle power of light output, the carbon type lamps should be used in preference to the usual gas-filled or vacuum lamps. Where a specific current (non-variable) is required, and of a comparatively high value, a small electric heater, e.g., the bowl fire, may be employed instead of lamps. For instance on a 200 volt D.C. supply the 1,000 watt (1 kW) electric fire takes a current of 5 amps. Such a system may be further usefully employed for heating purposes when in effect the charging current is obtained for no cost. See Figs. 3 and 4.

Economics of Charging

Within certain definite limits any number of cells may be charged at the same cost as a single cell. That

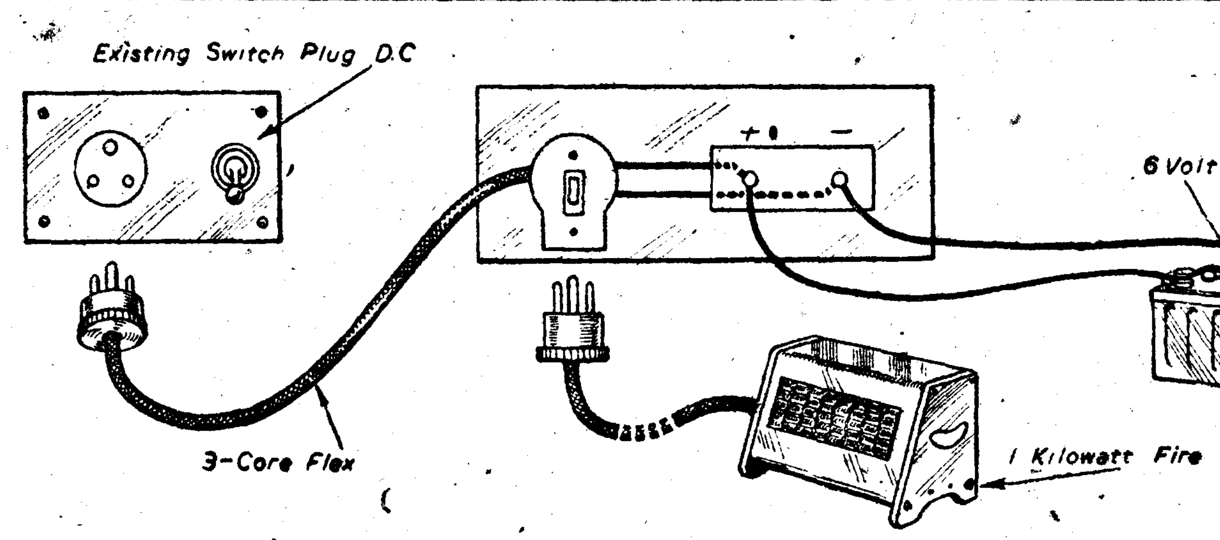


Fig. 3.—Using an electric fire as current regulator. For D.C. only

is, where the voltage of the system cannot be varied except through the normal wire ohmic resistance. For instance, one 2.0 volt cell is charged at 2.0 amps on a 75 volt circuit.

Period of charge = 12 hours.

$\therefore$ Energy consumed $= E \times I \times t =$ watt hours, where E = voltage of supply; I = charging current t = duration of charge in hours.

$= 75 \times 2 \times 12 = 1{,}800$ watt hours $= 1.8$ kW/s or B.O.T. units.

Approximate useful energy utilised for charging cell $= 2.8 \times 2 \times 12 = 67$ watt hours, or 0.067 B.O.T. units.

Wasted energy = total energy − useful energy $= 1{,}800 - 67 = 1{,}733$ watt hours.

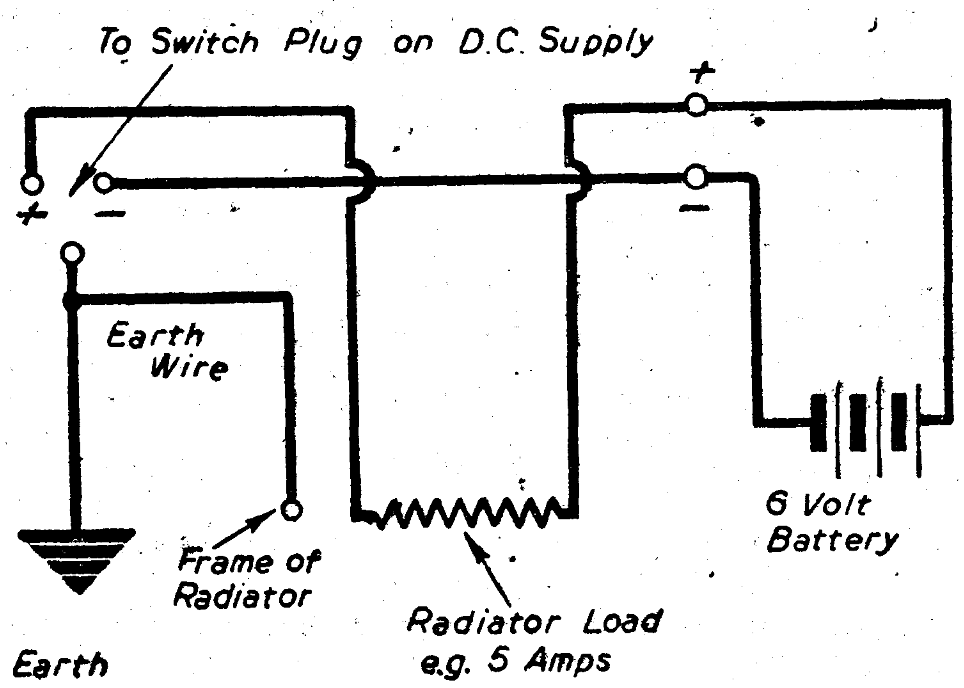


Fig. 4.—The theoretical circuit of Fig. 3, showing how battery and radiator are connected.

This wasted energy has been dissipated in the heat from the lamps or from the electric radiator. The normal wire wound ohmic resistance also dissipates heat in this manner, although the temperature rise of the wire is not so high as where a conventional bowl fire is employed. Such resistances only reduce the voltage, and therefore the currents to the actual battery circuit. Conversely, should 20 cells be connected in series to the 75 volt supply and the charging rate remains at 2 amps

The useful energy employed $= 2.8 \times 2 \times 12 \times 20 = 1{,}344$ watt hours.

Wasted energy $= 1{,}800 - 1{,}344 = 456$ watt hours, which is appreciably lower for the same cost given in the former example.

Constant Potential Method

Since, with a given resistance and a constant charging voltage, the charging current reduces or tapers off as the back E.M.F. of a cell increases as it reaches a fully charged condition, it has been possible to exploit commercially this characteristic. The system is known as the constant potential method, and allows batteries to be charged quickly. The voltage of the supply, usually provided by special constant potential generators or rotary converters, is constant, and no variable resistances are employed. The charging rate is automatic, the value of which is dependent upon the state of charge of the cells in the charging circuit. Fig. 5 gives a diagrammatic layout of this method. Constant potential sets normally have voltages of $7\frac{1}{2}$ and 15. That is, some sets (two-wire single circuit) supply only $7\frac{1}{2}$ volts, while others (three-wire three circuit) provide supplies of $7\frac{1}{2}$ volts and 15 volts, as in Fig. 5. The latter arrangement enables both 12 volt batteries and 6 volt batteries (or combinations of cells to these voltages) to be charged simultaneously from one set.

The voltage thus selected is based on a maximum of 2.5 volts per cell, e.g.,

One 12 volt battery at 2.5 volts per cell $= 2.5 \times 6 = 15$ volts.

One 6 volt battery at 2.5 volts per cell $= 2.5 \times 3 = 7\frac{1}{2}$ volts.

The maximum charging current occurs when a discharged battery is first put into circuit.

For instance, assuming the 6 volt battery had an internal resistance of 0.02 volts per cell $= 0.02 \times 3 = 0.06$ ohms = internal resistance of battery. With a "discharged" P.D. of 1.8 volts per cell, or $1.8 \times 3 = 5.4$ volts for the battery the initial charging current would be:

$$\frac{\text{Voltage of supply} - \text{Back E.M.F. of battery}}{\text{Internal resistance of battery}}$$

$$= \frac{7.5 - 5.4}{0.06} = 35 \text{ amps.,}$$ since there is no external resistance in circuit.

As the back E.M.F. of the battery rises to a maximum of 2.5 volts per cell the current will decrease until no current flows through the circuit, e.g.

$$\frac{7.5 - (2.5 \times 3)}{0.06} = 0$$

The voltage of cells when charged by this method cannot, of course, reach 2.8 volts per cell, but as the voltage of a fully charged cell drops below this figure almost immediately after it is removed from charge its advantage in these instances are outweighed by the convenience of the system employed. The employment of this method of charging is limited to certain types of battery, and cannot be employed for batteries requiring a long steady low charging current.

Batteries requiring an initial charge should not be charged by the constant potential method for obvious reasons. In order to limit the initial heavy charging currents and so increase the utility of constant potential sets special resistance leads of known resistance are provided. These leads are used as external resistances as required. Such leads may be later removed (when the battery is reaching full charge) and replaced by ordinary leads having negligible resistance. Fig. 5 illustrates the use of these leads.

(To be continued)

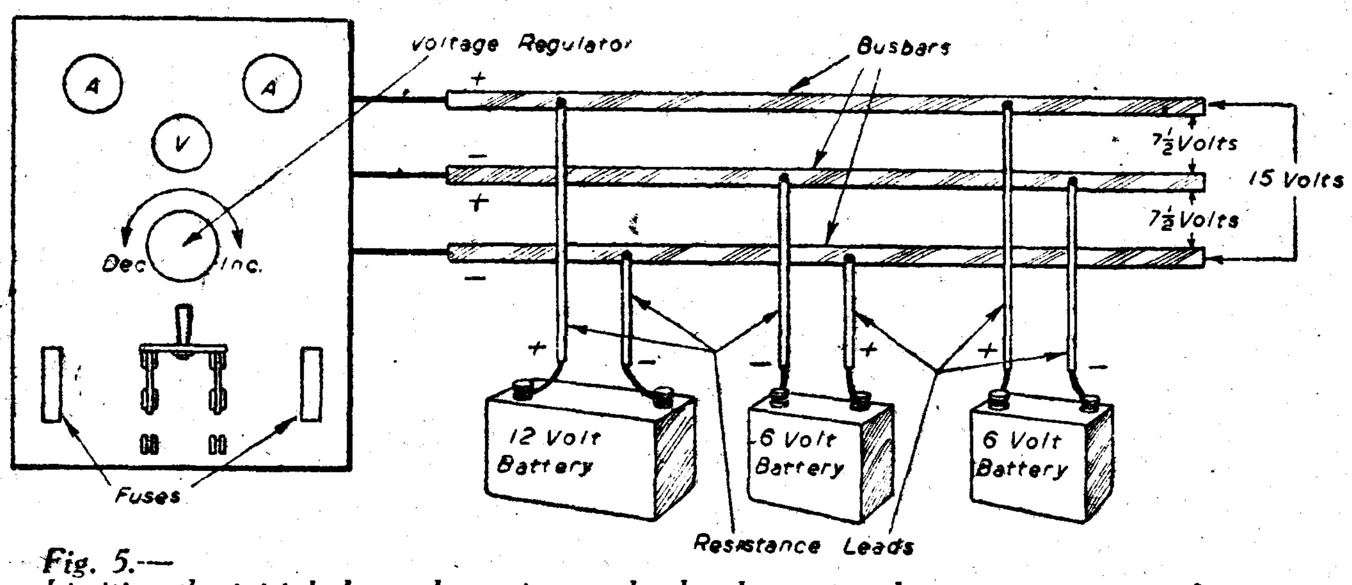


Fig. 5.—Limiting the initial charge by resistance leads when using the constant potential system.

Elementary Electricity and Radio—14

Sky-wave Propagation. Attenuation. Echo Signals. By J. J. WILLIAMSON

(*Continued from page 107, February issue.*)

Selective Fading

THIS type of fading causes severe distortion, often making broadcast programmes (radio-telephony) completely unintelligible. It is caused by the fact that the side-bands of a radio-telephonic signal penetrate to varying degrees into the ionosphere, thus having different path lengths.

Sky-wave Propagation Characteristics

For frequencies below 300 kc/s refraction of the wave occurs at the *E* layer, and distance up to 4,000 miles may be covered satisfactorily, practically all signals received at this distance being due to the sky-wave. If the path of the wave is in daylight the signal strength over long distances will be relatively weak, but constant; where the transmission path is in darkness strong signals will be received. If the sunset line falls across the transmission path the signal strength falls.

If the frequency is increased to 500 kc/s long-distance communication becomes impossible in daylight, night transmission suffering from very bad fluctuations of signal strength.

The 600 to 1,500 kc/s band is used for broadcast purposes, sky-wave reception is only of use during the night, due to the very great attenuation that occurs during the day.

Frequencies between 1,500 kc/s and 30,000 kc/s give transmission that is almost completely dependent upon the sky-wave for long-distance communication. Refraction occurs from the F, F_1 or F_2 layers according to transmission conditions, i.e., frequency, etc., the E layer being completely penetrated. Fig. 92(a), (b), (c) and (d) show transmission paths for different frequencies in this band at different angles of propagation. Notice that for every frequency used there is a critical angle, which, if exceeded, causes penetration of the layer, with the result that either complete refraction occurs at a higher layer or the wave does not return to earth.

When 30,000 kc/s (approximately) is reached complete penetration of all layers occurs, and the signa is lost into space.

Attenuation of Sky-waves

Attenuation is greatest where atmospheric pressure is greatest, i.e., for the lower frequencies, where complete refraction is due to the E layer, at the E layer's lower edge, or within the E layer for complete refraction from other layers. Also, the greater the electron density, other things being equal, the greater is the attenuation. Attenuation is inversely proportional to the square of the frequency, i.e., the higher the frequency the less the attenuation.

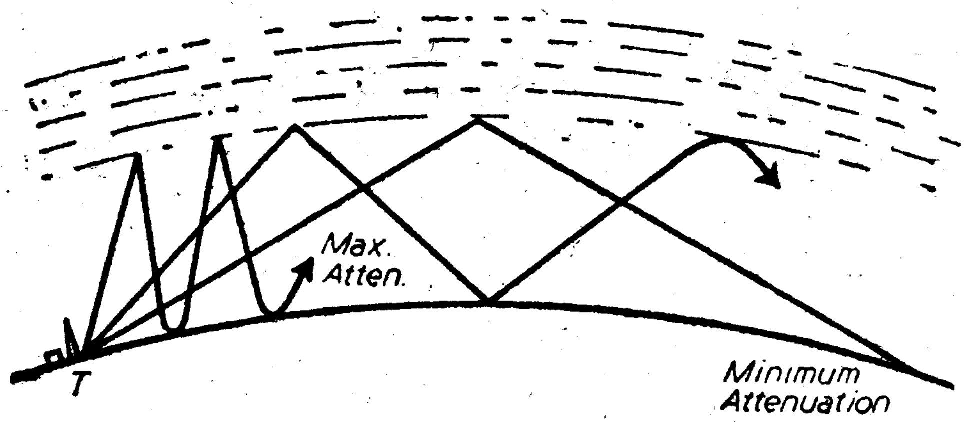


Fig. 93.—Propagation angle and attenuation.

As shown in Fig. 93, if waves are propagated at all angles, then those with the greatest angle of propagation will suffer the greatest attenuation for a given distance because of the greater number of reflections that occur. Thus, the lower the angle of propagation the less the number of reflections, and hence the less the attenuation for a given distance. The sharper the angle of propagation the greater is the attenuation for a completely refracted wave, but the opposite is true for waves that pass *through* a layer.

From the foregoing observations it can be seen that there is an optimum frequency and transmission angle for every set of transmission conditions. The optimum

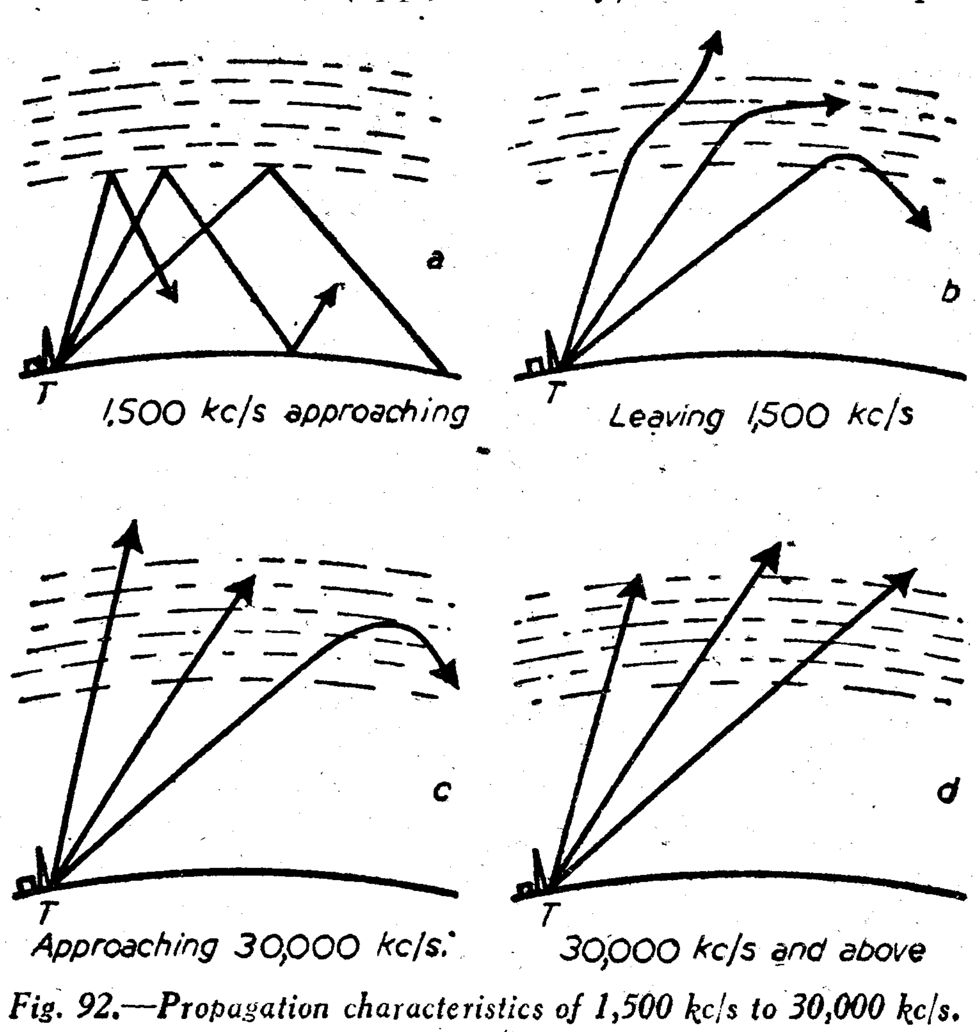


Fig. 92.—Propagation characteristics of 1,500 kc/s to 30,000 kc/s.

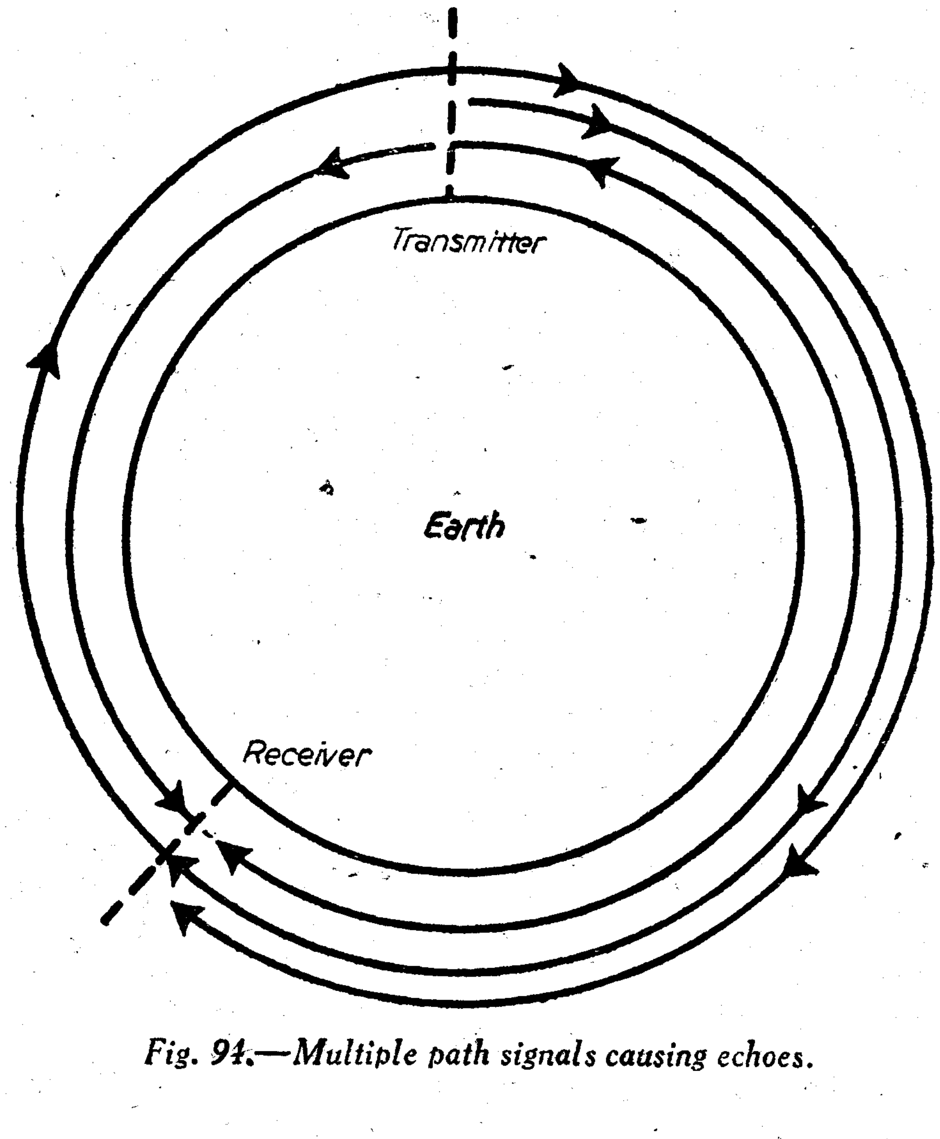


Fig. 94.—Multiple path signals causing echoes.

frequency being the highest possible, i.e., just lower than that frequency which would have complete penetration;

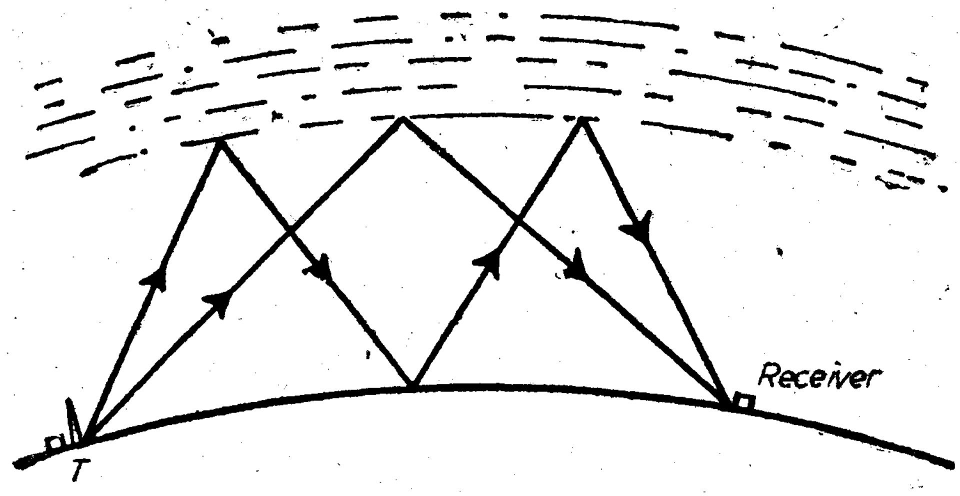


Fig. 95.—Echoes caused by different angles of radiation.

whilst the optimum angle of propagation would be the lowest possible.

At 1,400 kc/s extreme attenuation occurs; this phenomenon is due to the frequency of the wave corresponding to the frequency at which electron resonance occurs, i.e., when the effect of the earth's magnetic field and the wave's fields cause the free electrons of the ionised layer to follow an increasing spiral path resulting in many more collisions of the electrons concerned, with other particles and consequent extraction of energy from the wave.

Echo Signals

It has been observed that as many as five echoes occur in radio transmission, compelling wireless telegraphic morse speeds to be reduced, etc. These echoes appear to be due to the wave taking different paths to the receiver, i.e., both ways around the world, or several rotations around the earth. (See Fig. 94.) Echoes of short intervals may be explained as shown in Fig. 95, where the receiver receives the signals from the transmitter over several paths of different length at different propagation angles.

(*To be continued.*)

Cathode-ray Tubes—3

Sealing-in. Exhausting the Tubes. Bases. By LAURENCE ARTHUR

(*Continued from page 98, February issue.*)

Fluorescence and Phosphorescence

THE production of a bright spot on the screen of a cathode-ray tube by means of an electron beam is a phenomenon known as luminescence. This consists of two effects—fluorescence, which is the light visible instantly the beam strikes the screen; and phosphorescence, which is the light created after the original excitation, and which persists for an appreciable time after the excitation has ceased. This latter effect, also called afterglow, may be as short as 10 microseconds where instantaneous indications only are required. In practice when an appreciable afterglow is required for the visual investigation of slowly varying effects the period may be 10 to 20 seconds. Experimentally, afterglow has been prolonged for one hour or more after excitation had stopped. The colour of the spot and the degree of afterglow are controlled entirely by the composition of the materials used for screening.

Screen Colours

In general use are screens showing green, blue-green, light blue, red and sepia responses with and without appreciable afterglow. The most brilliant screens for television work give a substantially black and white picture. The mixtures used for screening by the various manufacturers are secret, but zinc sulphide and zinc silicate, activated with copper, silver or manganese are frequently used for screens having a green or blue response. The green colour is probably the best for visual use (other than television), because it is restful to the eye, but for photographic recordings the light blue shade has the best actinic value.

There are at least three methods used for applying screens. In one the bulb is put screen end downwards on a revolving turntable. A coating of phosphoric acid is carefully brushed internally on to the part requiring screening, and then the finely divided screen powder is "puffed" on to the acid (which acts as an adhesive) by an instrument resembling a scent spray with a long adjustable nozzle. When sufficient powder has been deposited the bulb is removed from the turntable and baked in a gas-heated oven. The second method employs the screen powder embodied in a solution of cellulose. A definite quantity of the liquid is poured into the bulb, which is rotated until the material is spread evenly over the area required to be covered. With small tubes this may be done successfully by rotating the bulb rapidly between the hands, but for large tubes a turntable is required, the speed and time of rotation being determined by the size of the bulb and the viscosity of the liquid. Here again the bulb must be baked before use. The third method is described as "settling." The screen powder is mixed with distilled water, and a predetermined quantity poured into the bulb, which is left to stand in a room kept at an even temperature and free from vibration. After 12 hours' standing the water may be poured away, leaving an even coating of the screen powder firmly adhering in the required position. Considerable skill is required for this pouring operation, but the resultant settled screen is an improvement in many respects over those obtained by the other two methods.

The wall coating serves to dissipate the charges induced by the electron beam striking the screen, and originally it was thought necessary for one to begin where the other finished. Nowadays it is more usual to leave a gap, from 2 to 5 millimetres wide, between the two coatings.

Certain tubes have the connections to the deflector plates and the final accelerating anode brought out through glass arms on the side of the neck, as shown in Fig. 20. These arms are fixed on the bulb before it is processed in any way.

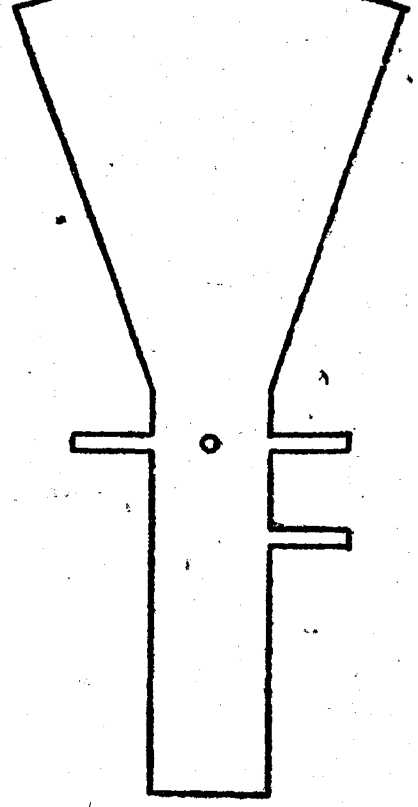


Fig. 20.—Side arms for connections to deflector plates and final accelerating anode.

Sealing-in consists of fusing the flange of the foot—on which the mount is built—to the neck of the bulb. The bulbs are always supplied over length and the excess later serves a useful purpose. The stem on the foot is held vertically in a collar and the bulb slipped over the mount. The bulb is held by an adjustable ring clamp. It is essential that the deflector plates should be exactly at the predetermined distance from the screen and that means that the seal must be accurately positioned. As the deflector plates are obscured by the wall coating some lower point, say the top of the grid, is taken as a guide and a gauge resting on the top of the bulb is marked where the guide point must come. The bulb may be raised or lowered until it is set correctly. The mount and the bulb are now rotated together and gas jets slowly heat up the glass at the appropriate place. The glass soon becomes molten and the weight of the excess length of neck, called the cullet, draws the lower part down until it is in intimate contact with the rim of the flange. At the time the flange and bulb run together the cullet drops clear. The glass is allowed to cool very slowly so that strain in the seal may be avoided. A seal-in of a small cathode-ray tube is shown in Fig. 21.

When connections to deflector plates are brought out to side arms instead of being taken to the foot, the deflector plates have circular nuts welded on their backs, and care is taken when sealing-in that these nuts come directly opposite to the arms. A stainless steel rod, threaded at one end and having a short length of platinum wire welded at the other end, is carefully screwed into each nut by using a pair of fine pliers. The end of the glass arm is heated in a gas flame and closed up with the end of the platinum wire protruding. A nickel plated cap is subsequently cemented on the arm and the platinum wire soldered to it.

Exhausting

The tube is now ready for pumping or exhausting. Small tubes are pumped on rotary machines which take up to 64 at one time. Medium sized tubes are exhausted on stand pumps, three at a time, and the large tubes are pumped singly. The principles are the same in each case, and it will be simpler to describe the operation as being applied to one tube. Mercury vapour pumps were at one time the only satisfactory method of obtaining a high vacuum, but nowadays double stage oil pumps have reached such a stage of perfection that they are the type almost universally used. There are several makes of oil pump on the market, but it will suffice to describe the operation of one type. As will be seen from Fig. 22 it consists of an iron box, full of oil, inside of which is a cylindrical chamber. Inside the chamber a thick disc revolves eccentrically, driven at 400 revolutions per minute by an external electric motor. The inlet and outlet ports to the chamber are near together, but between them there is a single scraper arm held down by a spring loaded plunger. Two of these units are mounted on the same shaft 90 deg. apart. The inlet port is connected to the tube being pumped, while the outlet port is closed by a leather valve or spring-loaded ball valve. As the eccentric disc rotates in the direction shown, it revolves round the interior of the chamber. Air drawn down from the cathode-ray tube is pushed round until it escapes at the outlet, the scraper vane ensuring that the inlet and outlet ports are isolated from one another.

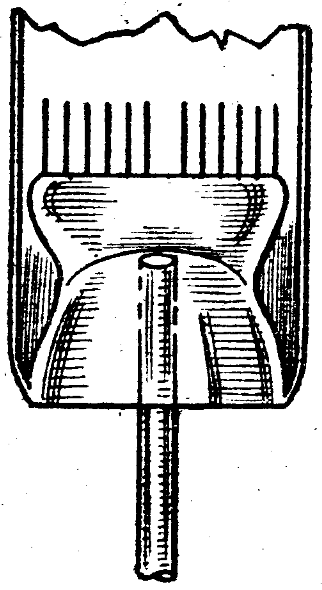


Fig. 21. — Seal in of small cathode-ray tube.

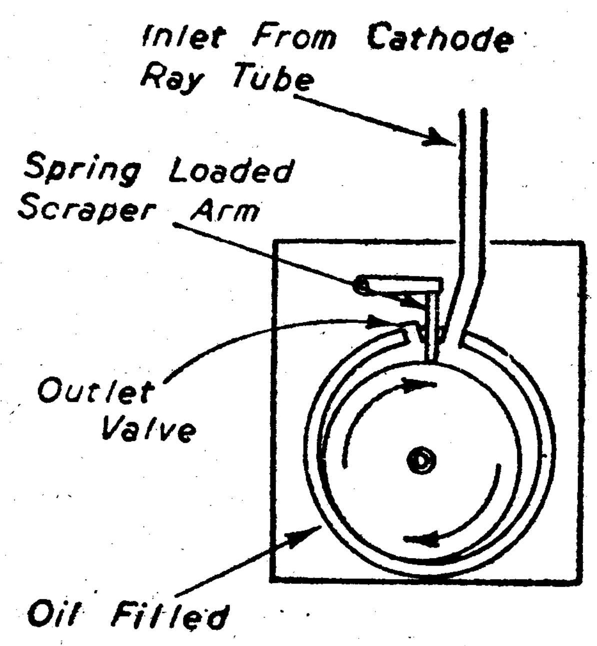


Fig. 22.—Rotary oil pump for producing vacuum.

It is necessary to prevent oil vapour working back, and a liquid air trap to condense it is inserted in the glass circuit between the pump and the tube. Liquid air is intensely cold—lower than minus 183 deg. C.—and it rapidly boils away at normal temperatures. It resembles water in appearance, and it is stored in vacuum containers which must have a narrow unstoppered opening at the top. Liquid air traps are frequently made from Thermos flasks, the vacuum between the two glass walls retarding temperature gain. Fig. 23 shows a typical liquid air trap. The pressure to which cathode ray tubes are evacuated is between .0001 and .00001 millimetres of mercury (compare normal atmospheric pressure of 30ins., equivalent to 760 millimetres). The effectiveness of the pumps may be checked with a McLeod gauge which shows on a scale the exact pressure being achieved.

To start pumping the stem of the cathode-ray tube is joined by glass tubing to the inlet of the oil pump and the driving motor switched on. The time of evacuation ranges from one hour for the small tubes up to three hours for the large ones used in television. Several other operations are carried out during the period the tube is on the pump. To obtain a lasting high vacuum in a glass bulb, it is necessary during pumping to bake the tube at the highest temperature it will stand without the walls collapsing. This is done in a gas or electrically heated oven and the temperature reached is 450 deg. C. After a few minutes' pumping a check on its effectiveness is made by applying to the outside of the tube a lead from one side of a Tesla high frequency coil, the other side being earthed. If the H.F. discharge produces a purple glow inside the tube there is an air leak somewhere and there is no purpose in continuing pumping until it has been found and rectified. The purpose of the prolonged baking is to drive off gases from the glass and metal, from the former water vapour and carbon dioxide and from the latter mainly hydrogen and carbon monoxide. After about three-quarters of the total period of pumping has elapsed the heater wires of the tube are connected to a source of supply at a voltage approximately 50 per cent. higher than the rated voltage.

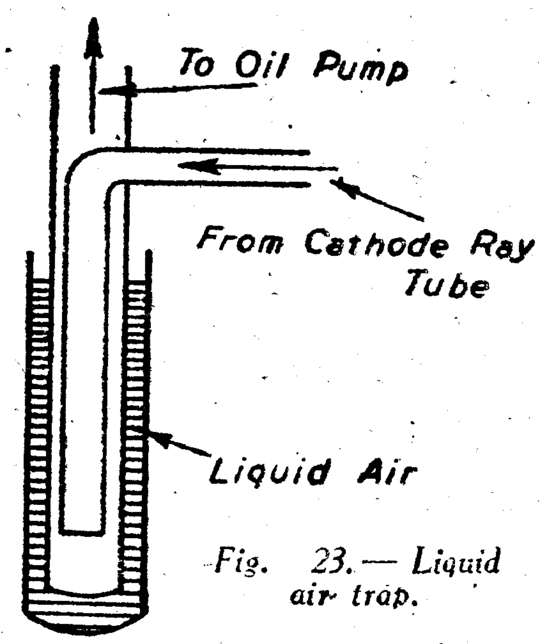


Fig. 23.— Liquid air trap.

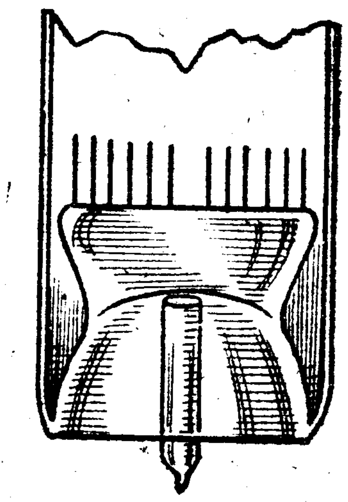


Fig. 24.—Sealing off stem after pumping.

For the final clearing up of the gases inside the tube great reliance is placed on the use of "getters" which produce the well-known silver or black localised patches frequently seen on valves. Most of the gettering of cathode-ray tubes is done with powdered magnesium and barium in small copper pellets, which are held in nickel getter pans by a thin covering of nickel sheet or gauze. There are usually two getters on each tube. The getter material is volatilised by bringing close to the neck of the tube opposite to the getter pans a small water-cooled coil of copper tubing which is fed with a heavy high frequency current (70 or 80 amps.) from a powerful oscillator. The high frequency current induces eddy currents in the getter pans, quickly making them red hot, and the getter is fired. This operation is done at the end of the pumping period when the heater supply is also switched off. The stem is heated with a gas blowpipe and sealed off as shown in Fig. 24.

(*To be continued.*)

Low-frequency Amplifier Design—6

The Concluding Article of This Series Deals With the Question of Power Supplies

ALTHOUGH not always regarded as coming within the design of the amplifier itself, the power-supply unit must be planned along with the amplifier. The reason for this is that the low-frequency-amplifying system of any receiver consumes far more high- and low-tension power than does the rest of the set. In fact, in most cases a power-supply unit designed simply to feed a power amplifier of any pretensions would have sufficient "reserve" output to supply another couple of valves at least.

Considering first an amplifier for operation from A.C., we must decide on the requirements of the mains transformer, and then of the rectifier. For L.T., one secondary winding will be required to provide an A.C. output at a voltage suitable for the valves employed. These will probably have 6.3-volt heaters, and the

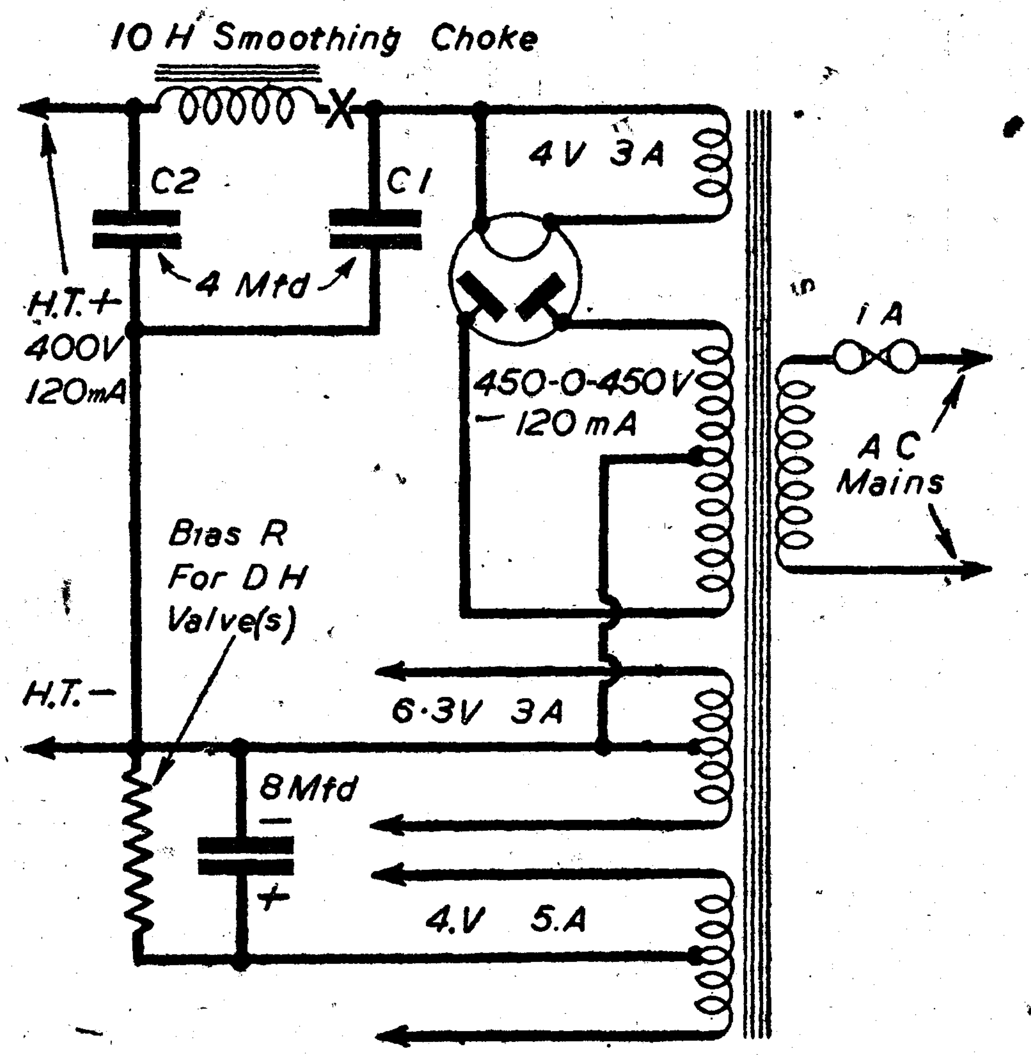


Fig. 1.—A representative circuit for an A.C. power supply unit for a large amplifier and receiver having a valve such as the PP5/400 in the output stage.

total current consumption will normally be in the region of 5 amps. If the consumption is less than this, it should not matter. This is because the "regulation" of a worth-while power transformer is so good that the variation in voltage will be extremely slight on current loads between, say, 2 and 5 amps.

A Second L.T. Secondary

If directly-heated output valves are used, they will probably have a filament rated at 4 volts, 1 amp., which means that a second L.T. winding will be required. The current load will generally be between 1 and 2 amps., depending upon whether a single-valve or push-pull output stage is employed. Again, the exact current rating of the winding is not critical, provided that it is not less than the load to be applied. This winding must be centre-tapped, unless an "artificial" centre-tap is provided by means of a potentiometer having a resistance of about 15 ohms. The separate winding should be provided for directly-heated valves, even if they are of the same voltage rating as the indirectly-heated valves used elsewhere in the set.

Low-resistance Rectifier

Next, consideration must be given to the rectifier, and the winding or windings to feed it. In any amplifier designed for an undistorted output in excess of, say, 2 watts it is now standard practice to employ valve rectification. There are two chief reasons for this, one of which is that a valve is considerably more compact than is a rectifier of other types, such as a metal-oxide one. Another reason is that, in general, the internal resistance of a rectifying valve is considerably lower than that of a metal-oxide or similar type of rectifier. As a matter of interest, the internal resistance between cathode and one anode normally lies between 50 and 100 ohms.

This low resistance is of especial importance when using class B or class AB amplification, because the anode current fluctuates according to the applied audio grid voltage. At the same time, the anode voltage should remain sensibly constant; if there were a high resistance in the rectifier there would be greater variation of applied voltage for any variation in anode current.

For nearly every purpose, where an A.C. set is concerned, a full-wave rectifier is to be preferred. Not only is it rather more efficient than a half-wave rectifier, but smoothing is easier due to the fact that the "ripple frequency" is twice as high with a full-wave as it is with a half-wave rectifier. In consequence, a smaller smoothing choke can be employed. There is another incidental advantage in this, which is that the smaller choke can be made to have a much lower D.C. resistance.

Choice of Rectifier

Having agreed on a full-wave rectifier, the choice of type can be made. This will be dependent upon the requisite H.T. voltage—making due allowance for the voltage drop through the smoothing choke and primary winding of the output transformer—and upon the total current required. In computing the current, allowance should be made for any consumption by a potentiometer, if fitted. When these details have been ascertained, it is best to have a complete valve list available. The PRACTICAL WIRELESS Valve Data Sheets will be useful here. In addition, however, it may be a good plan to have a list of American types in addition, since these will increase the range of choice.

By way of example, suppose the voltage required to feed the amplifier to be 400, and the total H.T. current 120 mA. It will be assumed that a 10-henry choke having a D.C. resistance of 200 ohms is to be used. (See Fig. 1.) The voltage drop across the choke would be approximately 25, and therefore our H.T. output from the rectifier should be at a voltage of 425. A rectifier such as the Osram U 12/14 (directly-heated) or MU 12/14 (indirectly-heated) would serve our purpose if the transformer supplied 425 volts A.C. to each anode, assuming the use of a 4 mfd. smoothing condenser in position C.1 in Fig. 1. This means that our mains transformer should have a centre-tapped secondary giving 425 volts, 120 mA on each side of the centre tapping. Should the only available transformer of otherwise suitable type have a voltage output in excess of this it would be necessary to use a smoothing choke of higher resistance, or to insert a fixed resistor at the point marked X in Fig. 1.

If it be assumed that the valve mentioned is to be used, we can find from our tables that the filament or heater, according to the pattern employed, requires a supply of 4 volts 2.5 amps. The transformer should therefore have yet another low-tension secondary winding to supply this; a winding rated at, say, 4 volts 3 amps. would be right. A centre-tapping is not required for this winding, since the H.T. positive supply can be taken from one end of it; a variation of plus or minus 4 volts is of no consequence in relation to the total H.T. voltage.

Directly- and Indirectly-heated Rectifiers

Reference has been made to the use of directly-heated and indirectly-heated rectifiers. The reason for the two patterns, and the method of choice between them, can now be explained. If a directly-heated rectifier were used in conjunction with indirectly-heated valves there would be a danger of an excessive voltage being applied to the smoothing condensers throughout the set. This is because the rectifier would become fully operative almost immediately upon switching on. But the indirectly-heated valves would not. There would therefore be no load on the rectifier for about 30 seconds after switching on. And the no-load output voltage may well be at least twice the voltage under normal load. As an example, it may be stated that the D.C. voltage from the rectifiers mentioned, and with the plate A.C. decided upon, is about 560 for a 30 mA load.

It should now be clear that an indirectly-heated rectifier should be used when indirectly-heated valves are used throughout the amplifier. But if directly-heated valves are responsible for more than about 50 per cent. of the total current load, directly-heated rectifiers are to be preferred. The directly-heated valves will at least ensure that at least half load is applied to the rectifier from the moment of switching on.

Heater Voltages

The one example quoted will show the general procedure which should be adopted in choosing a rectifier. It should be pointed out, however that different types of rectifier have filaments or heaters rated at 2.5, 4, 5 and 6.3 volts; there are, in fact, other ratings, but they are hardly likely to be used with the type of amplifier which has been dealt with in this series of articles. The filament current requirements also vary from about .6 to 3 amps., and therefore the winding used to supply the L.T. current should be rated at between about 1 and 5 amps. If the current rating were at least twice the consumption and the "regulation" of the transformer were not very good, it would be desirable to "load" the L.T. secondary by placing a fixed resistor in parallel with it to "absorb" the surplus current. In practice, it is seldom necessary to take this step. If in doubt, the voltage applied to the filament should be measured with an A.C. meter with the amplifier switched on; it should not exceed the rating of the filament by more than about 10 per cent. Incidentally, it is equally important that the voltage should not be less than the filament rating by more than the same percentage. Too low a voltage is dangerous because it means that the cathode will be "strained" due to the drawing off of electrons while it is below the correct operating temperature.

Speaker Field as Choke

It is often a convenience to use the field winding of an energised moving-coil loudspeaker for smoothing. This is a very satisfactory system when the rectifier gives a sufficiently high voltage output to allow the correct H.T. voltage to the output valves, after making allowance for the necessarily high voltage-drop across the field winding. When the H.T. current consumption of the amplifier does not exceed about 50 mA, it is possible to use a speaker field for smoothing by employing a rectifying valve which will give a maximum current of 120 mA. In the absence of accurate data in the form of characteristic curves, it would be reasonable to expect that the rated output voltage for any given plate voltage would be up by about 25 per cent.

This method of under-running a rectifier shows some advantage in the way of increased "life," besides being a convenience. In estimating output voltage it must always be borne in mind that makers' ratings are nearly always given on the assumption that a 4 mfd. smoothing condenser is used immediately after the rectifier. A lower capacity would result in reduced voltage, while the voltage would be slightly increased if the capacity were higher than the basic figure.

Another method of energising the speaker field when the available voltage will not permit of a high drop is to use a rectifier which will give the necessary H.T. voltage, but a current in excess of normal requirements. If the H.T. output is not in excess of about 250 volts, the field can then be wired in parallel with the rectifier supply to the smoothing choke. It should not be wired on the "output" side of the choke, because that would increase the voltage drop through the choke, and might even cause choke "saturation" and consequent inefficient smoothing.

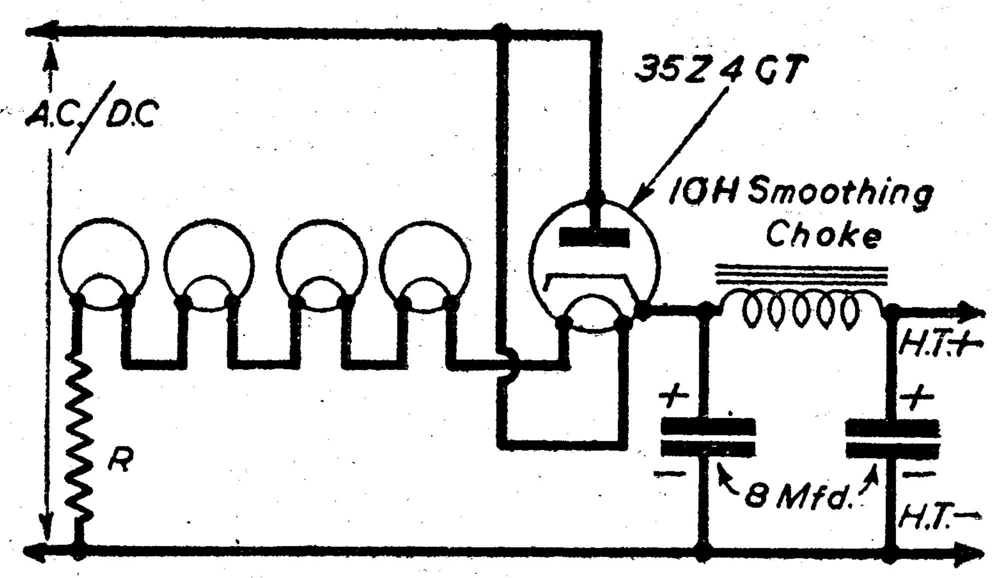


Fig. 2.—Connections to a half-wave rectifier used in an A.C./D.C. amplifier. The resistance marked R is used to limit the mains voltage to the sum of the valve heater voltages.

Half-wave Rectifiers

In the case of an A.C./D.C. receiver or amplifier, a half-wave rectifier has the advantage of simplicity, but will, in general, provide a comparatively small output. Valves such as the American 35Z5GT will, however, give an output of 100 mA at 250 volts, whilst the 40Z5GT will give 100 mA at 125 volts. The method of connecting a valve such as that first mentioned is shown in Fig. 2. It should be noted that the heater of this valve is deliberately connected at the positive end of the chain of heaters to reduce to a minimum the voltage between the heater and cathode; if this voltage were excessive there would be a danger of insulation breakdown between the two.

Smoothing Component

No mention has yet been made of the choice of smoothing choke and condensers. It is more important to choose a choke of liberal current rating than simply of high nominal inductance, and in most cases a good component of 10 henries will give adequate smoothing provided that this inductance is maintained under working conditions; in other words, that the inductance really *is* 10 henries when the choke is passing the full H.T. current. The question of D.C. resistance has already been mentioned. Values between 100 and 200 ohms should be used wherever possible, although it will be found that the lower the resistance, the more expensive will the component be. This is because heavier-gauge wire and/or a more massive core is required.

The smoothing condensers should have a rated *working* voltage (test voltage is not a satisfactory criterion) of not less than 50 per cent. in excess of the rectifier output voltage. Electrolytic condensers are to be preferred on the grounds of compactness when condensers of this type are available in working voltages complying with the condition laid down above. For rectified outputs of 500 or more it will normally be necessary to employ non-electrolytic condensers.

The B.B.C.'s Twenty-first Birthday

Important Dates in the progress of the B.B.C. Between 1933 and 1936

(*Continued from page 123, February, issue.*)

January, 1933
—. Leeds premises opened.

March, 1933
6. Broadcast from top of Table Mountain relayed from Africa.

May, 1933
28. Opening of West Regional station at Washford.

June, 1933
12. Speech by H.M. King George V at World Economic Conference broadcast to the world.
16. New organ in Concert Hall officially taken into use.

July, 1933
12. First broadcast by Mr. Rudyard Kipling (from Royal Society of Literature luncheon.
28. First broadcast by a woman announcer.

November, 1933
18. First broadcast of "In Town To-night."

December, 1933
11. "Scrapbook of 1913" broadcast (First of series.) —. Radio Exhibition at Olympia.

January, 1934
15. Lucerne Plan, drawn up by the European Broadcasting Convention, put into operation. The B.B.C. retained its one long wavelength and was allotted one more exclusive medium wavelength (making 11).

April, 1934
14. Talk on Rear-Admiral Byrd's Antarctic Expedition. from his base camp, Bay of Whales.
22. Twenty-four-hour clock experiment started.

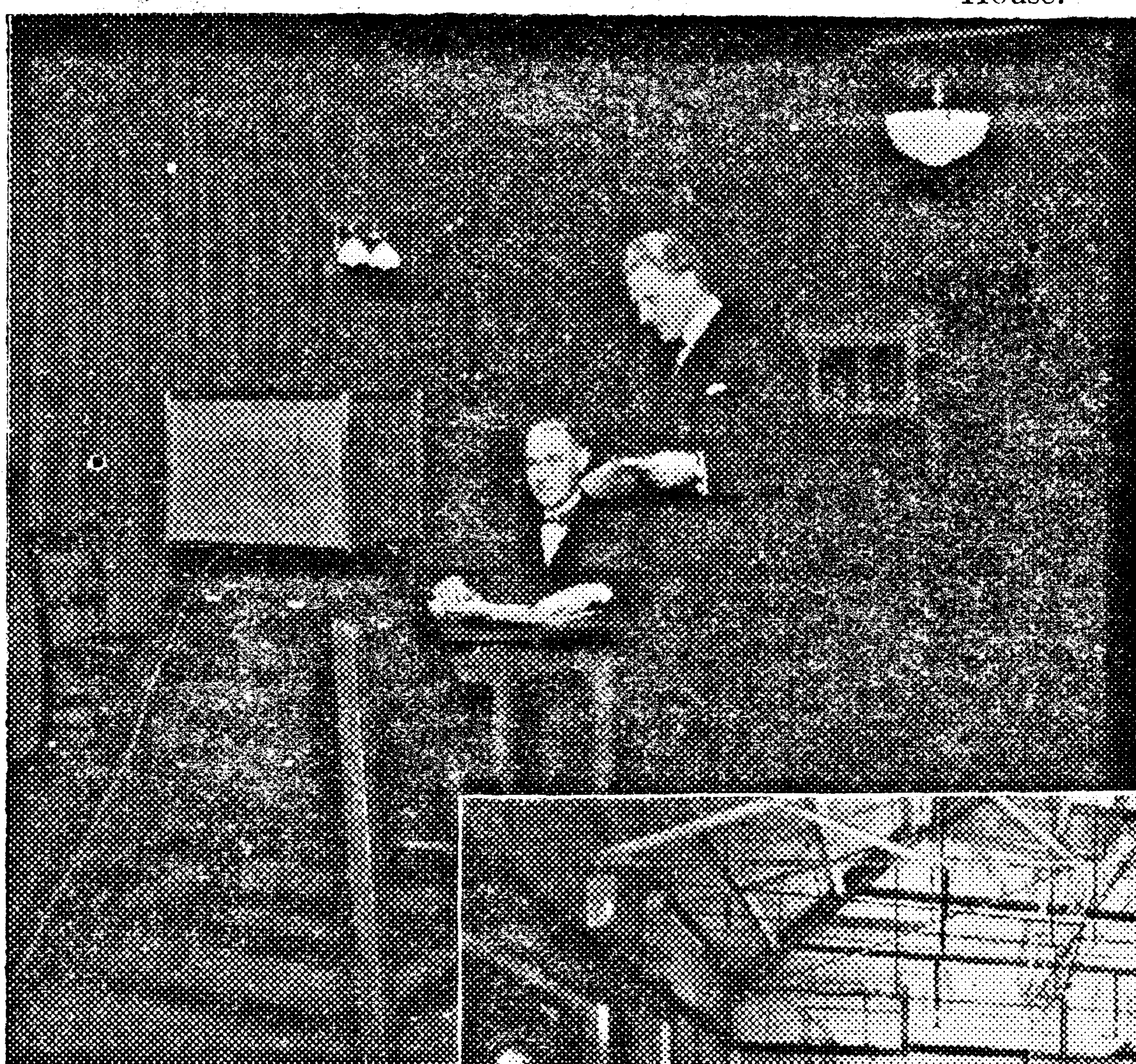
June, 1934
14. Visit of King and Queen of Siam to Broadcasting House.
—. Empire News Service separated from Home News Service.

September, 1934
6. Opening of National long-wave station at Droitwich.
17. A variant of the original "Foundations of Music" series of programmes was introduced.
Opening of new Bristol studios.

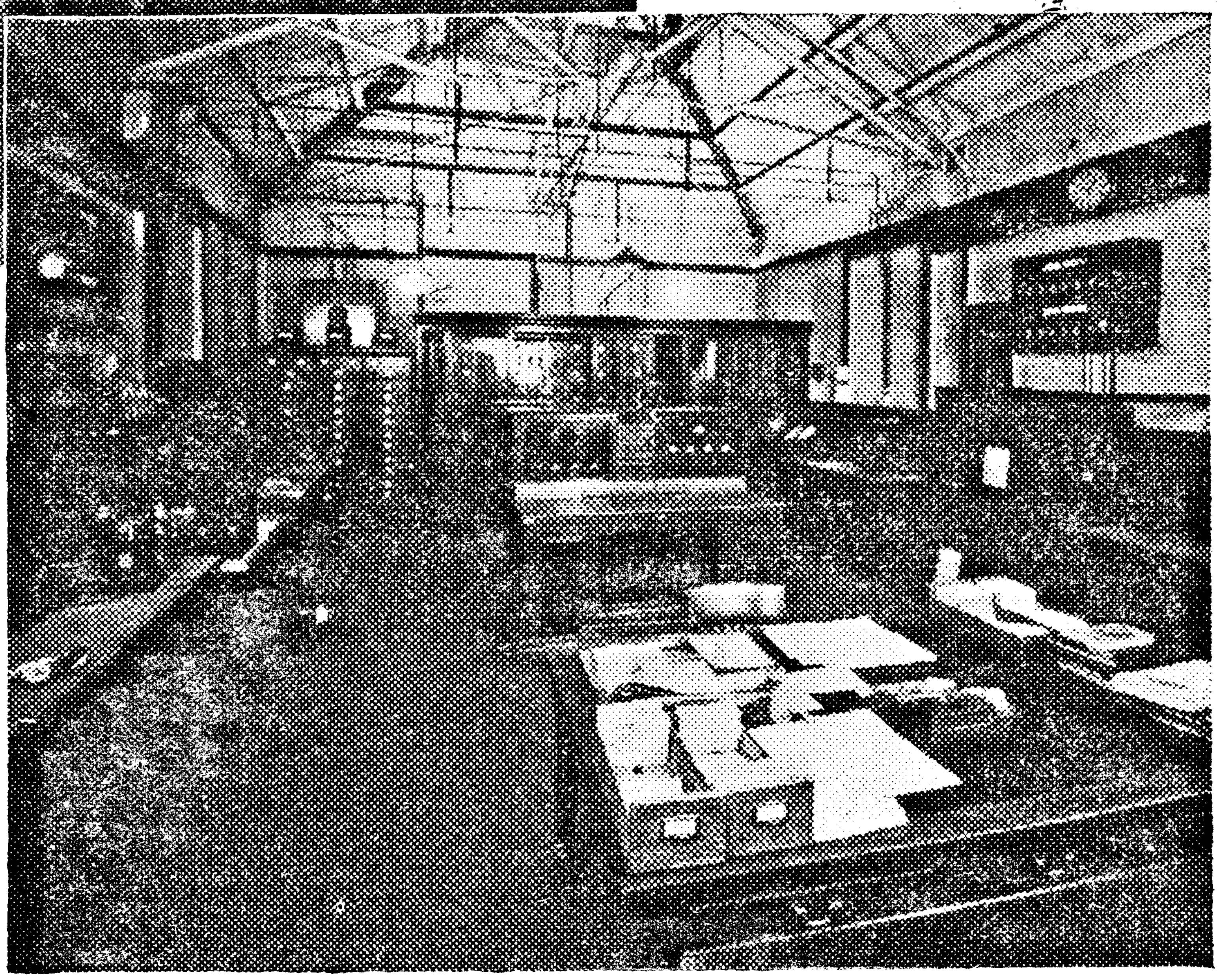
October, 1934
7. Daventry 5XX superseded by Droitwich high-power transmitter.
23. World broadcast of the arrival at Melbourne of the winners of the England-Australia air race.

January, 1935
—. Report of the Selsdon Committee on Television.
3. First English broadcast by Eddie Cantor.

(*Continued on page 167.*)



M. Stephan—noted for his French Talks—being announced by Stuart Hibberd.



Control room of 2LO during the Savoy Hill period.

May, 1935
6. H.M. King George V's Silver Jubilee celebrations.

September, 1935
11. Last low definition television programme by Baird Process was broadcast.
—. Committee appointed with Lord Ullswater as Chairman to report on the broadcasting service.

January, 1936
—. Opening of New York Office.
1. First broadcast by Mark Hambourg.
20. Announcement of death of King George V.
21. Until after the funeral ordinary programmes were cancelled and special ones were substituted.
22. Proclamation of accession of H.M. King Edward VIII in London.
28. Broadcast of funeral of His late Majesty King George V.

February, 1936
1. King Boris of Bulgaria visits Broadcasting House.
—. Report of the Ullswater Committee on Broadcasting.
8. First running commentary on the Winter Olympic Games at Garmisch.

July, 1936
6. Broadcast ceremony of unveiling of Canadian Memorial at Vimy Ridge by H.M. the King

August, 1936
26. First experimental transmission for Radio Olympia of television from Alexandra Palace.

October, 1936
1. Staff Training School started.
5. *New Every Morning.* New Daily Service book brought into use.
20. First recital given on the B.B.C. Cinema Organ.

November, 1936
2. Official inauguration of television took place at Alexandra Palace. (Baird and Marconi E.M.I. used in alternate weeks until 6.2.37, after which Marconi E.M.I. was used exclusively.)

December, 1936
—. Royal Charter for the continuance of the British Broadcasting Corporation, and Licence and Agreement between the Postmaster-General and the British Broadcasting Corporation.
10. Announcement of the abdication of King Edward VIII.
11. Broadcast by the Duke of Windsor.
19. First woman to give running commentary. (Thelma Carpenter on snooker match.)
—. Specialised unit set up for carrying out Listener Research.

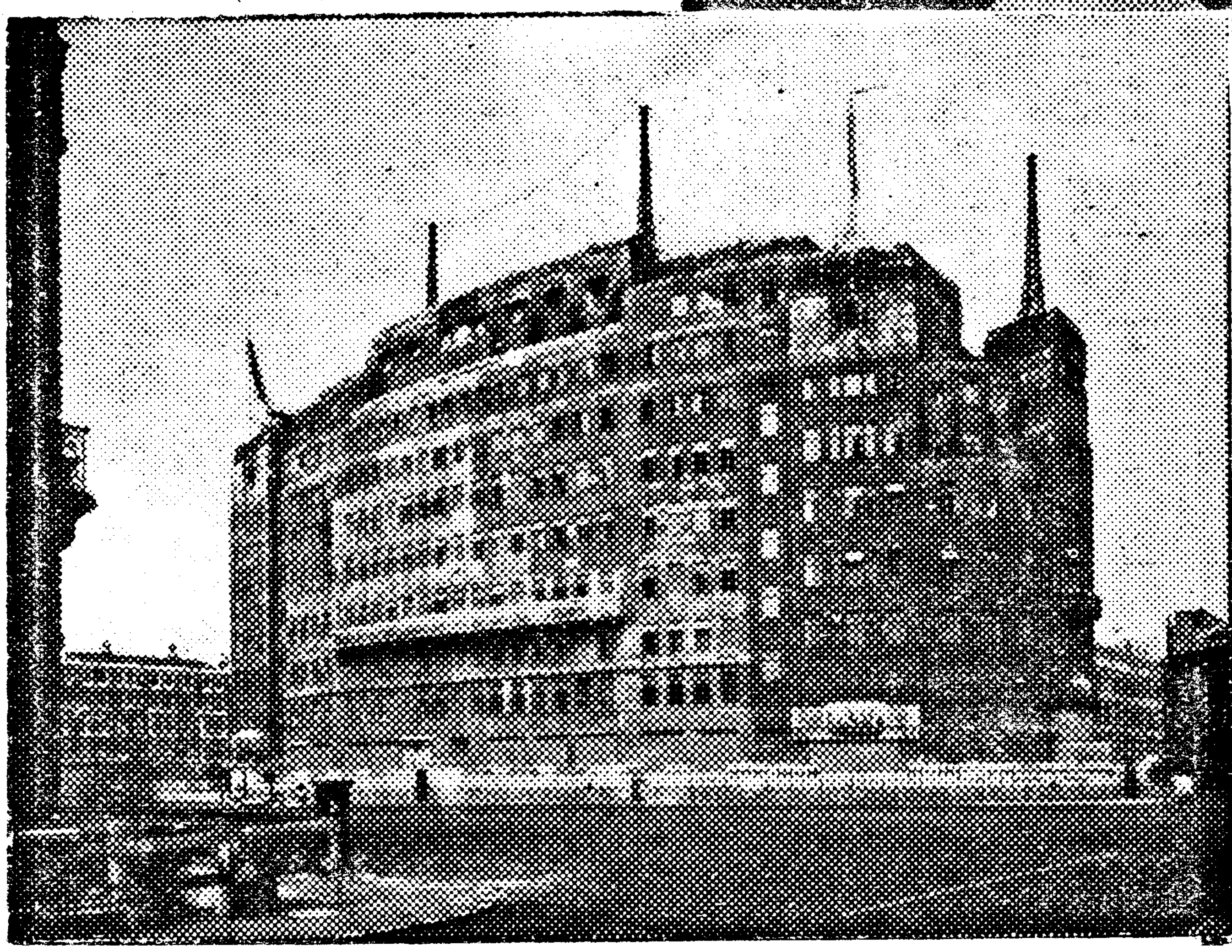
March, 1936
1. Empire broadcast by King Edward VIII.
20. Opening of Lisnagarvey transmitting station.

April, 1936
—. Continental tour by B.B.C. Symphony Orchestra.

May, 1936
29. First broadcast from Glyndebourne Festival.
Proclamation of the date of the coronation of H.M. King Edward VIII.

June, 1936
—. Memorandum by the Postmaster-General on the Ullswater Report.
7. First broadcast service from Iona Abbey (Isle of Iona).

Studio 4c at Broadcasting House. Compare this with the illustration showing M. Stephan at the microphone.



The present home of the B.B.C. Broadcasting House, London.

(*To be continued.*)

Valve Data Sheets

OSRAM

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TRIODES

Type	Filament. Volts	Filament. Current amps.	D (directly) or I (indirectly heated)	Type of Base	Anode Volts max.	Amplification Factor	Impedance Ohms	Mutu'l Conduc'ce mA/volt	As amplifier under conditions of max. anode volts. Appr'x Grid Bias Volts	Bias Resist. Ohms	Aver'e Anode Current mA	Optimum Load Ohms	Power output (single valve) watts
ML4	4	1.0	I	5-pin	250	12	2,860	4.2	—16	1,000	14.0	7,000	—
H63	6.3	0.3	I	Octal	250	100	66,000	1.5	—2	2,000	1.0	200,000	—
L63	6.3	0.3	I	Octal	250	20	7,700	2.6	—8	800	9.0	50,000	—
PX4	4	1.0	D	4-pin	300	5	830	6.0	—42	900	50.0	4,000	3.5
PX25	4	2.0	D	4-pin	400	9.5	1,265	8.0	—31	530	62.5	3,200	5.5
DA30	4	2.0	D	4-pin	500	4	580	6.9	—134	—	60.0	6,000	11*
DA100	6	2.7	D	Special	1,000	5.5	1,410	3.9	—150	—	100	6,800	30

* Normally used in push-pull. Total output Class AB1, 45 watts.

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OUTPUT PENTODES AND TETRODES WITH PENTODE CHARACTERISTICS

Type	Filament V'lts	Filament Current amp	D (directly) or I (indirectly) heated	Type of Base	An'de Volts max.	Screen Volts max.	Mu'al Conductance mA/volt	Av'age Anode C'rent mA.	Av'age Screen C'rent mA.	Approx. Grid Bias Volts	Bias Resist. ohm	Optimum Load (single valve) ohms	Apprx. Power output (single valve) watts
KT2	2	0.2	D	5-pin	150	150	2.5	7.5	1.7	—4.5	—	17,000	0.5
Two KT2 Valves in quiescent push-pull					150	Code V&W132-139 X 147	—	3.2 (total quiescent)		—7.5	—	25,000*	1.0 (Total)
KT21(o)	2	0.3	D	5-pin	150	150	5.3	5.0	1.2	—2.5	—	19,000	0.75
KT24	2	0.2	D	5-pin	150	150	3.2	10.0	2.0	—3.2	250	10,000	0.8
					120	120		5.0	1.0	—2.7	450	20,000	0.39
QP21†	2	0.4	D	7-pin	150	150	2.3	3.5	0.9	Code V&W—9.8 to —9.5 X —8.8	—	25,000*	1.0
MKT4	4	1.0	I	7-pin	250	225	3.0	32	5.0	—13.5	300	8,000	2.5
KT41	4	2.0	I	7-pin	250	250	10.5	40	8.5	—4.4	90	6,000	4.2

† Double Pentode. (o) Obsolete. * Anode to Anode.

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OUTPUT PENTODES AND TETRODES WITH PENTODE CHARACTERISTICS—(*Continued*).

Type	Filament V'lts	Filament Current amps.	D (directly) or I (indirectly) h'ted	Type of Base	An'de Volts max.	Screen Volts max.	Mutu'l Conductance mA/volt	Av'age Anode C'rent mA	Av'age Screen C'rent mA	Approx. Grid Bias Volts	Bias Resist. ohm	Optimum Load (single valve) ohms	Apprx. Power output (single valve) watts
KT61	6.3	0.95	I	Octal	250	250	10.0	40	7.5	—4.4	90	6,000	4.3
KT63	6.3	0.7	I	Octal	250	250	2.5	34	5.5	—16.5	420	7,000	3.0
KT66	6.3	1.27	I	Octal	250	250	6.3	85	6.3	—15	170	2,200	7.25
KT32	26	0.3	I	Octal	135	135	9.0	75	5.0	—7.6	95	1,300	3.5
KT33C	{13 26	0.6 0.3}	I	Octal	200	200	10.0	60	10.0	—13.2	188	3,000	5.0
KT72(N)	15	0.16	I	Octal	175	175	2.5	30	6.0	—12.5	300	6,000	2.0
KT73(N)	6†	0.4	I	Octal	175	175	2.5	33	6.0	—12.5	300	6,000	2.0

† Suitable for use with 6.3 v. transformer, or 6 volt accumulator. (N) Not available.

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RECTIFYING VALVES

Type	Description	Type of Rectification	Type of Base	Filament Volts	Filament Current amps.	Max. Anode Volts R.M.S.	Max. D.C. Output Volts at Max. Current	Max. D.C. Output Current mA	D.C. Output at Half Current Volts	D.C. Output at Half Current mA
U10	Directly Heated	Bi-phase	4-pin	4.0	1.0	250	260	60	300	30
U12/14	Directly Heated	Bi-phase	4-pin	4.0	2.5	500	540	120	620	60
MU12/14	Indirectly Heated	Bi-phase	4-pin	4.0	2.5	500	540	120	600	60
U16 (o)	Directly Heated	Single phase	4-pin	2.0	1.0	5,000	6,400	5.0	—	—
U17	Directly Heated	Single phase	4-pin	4.0	1.0	2,500	2,950	30	—	—
U18/20	Directly Heated	Bi-phase	4-pin	4.0	3.75	850	1,050	125	1,100	62.5
U31	Indirectly Heated	Single phase	Octal	26	0.3	250	280	100	D.C. volts drop 20v. at 120 mA	
U50	Directly Heated	Bi-phase	Octal	5.0	2.0	350	325	120	380	60
U52	Directly Heated	Bi-phase	Octal	5.0	3.0	500	500	250	565	150
GU50	Mercury Vapour	Single phase	4-pin	4.0	3.0	1,500	1,270	250*	1,300	125*

† Suitable for use with 6 v. car battery in service. (o) Obsolete. * Delayed switching of anode volts.

TUNING INDICATORS (TUNERAY)

Type	Filament Volts	Filament Current amps.	Type of Base	Anode Voltage (through 1 megohm) max.	Anode Voltage (through 1 megohm) min.	Target Voltage max.	Target Current mA.	Triode Current	Triode Grid Voltage for 0° Shadow angle
Y63	6.3	0.3	Octal	250	180	250	4.5	0.25	—22

Valve Data Sheets

OSRAM

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SMALL TRANSMITTING VALVES

Type	Description	Filament Volts	Filament Current Amps.	Type of Filament†	Type of Base	Anode Volts max.	Screen Volts max.	Anode Dissipation Watts max.	Permissible Mean Input mA.	Output Class C unmodulated Watts	Wavelength (min.) for max. Output Metres
DET5	Triode	4	2.0	O. D.	4-pin	600	—	25	100	35	100
DET12	Triode	7.5	3.2	Th. D.	4-pin	1,250	—	50	100	70	5*
DET14	Triode (as T55)	7.5	3.0	Th. D.	Am. 4-pin	1,500	—	55	150	80	5
DET19	Double Triode (as RK34)	6.3	0.8	O. I.	Am. 7-pin	300	—	10	80	16	1.25
KT66	Beam Tetrode ..	6.3	1.27	O. I.	Octal	400	250	21	100	20	25
KT8	Beam Tetrode ..	6.3	1.27	O. I.	5-pin	600	300	25	95	38	20
PT5	Pentode	4	1.8	O. D.	5-pin	1,250	300	40	100	80	15
PT7	Pentode	2	0.3	O. D.	7-pin	240	150	3.0	13	1.5	100
PT11	Pentode	4	1.8	O. D.	5-pin	750	250	25	100	50	15
PT10 / PT14	Pentode	4	1.25	O. I.	PT10 5-pin / PT14 7-pin	500	250	15	80	20	15

† O = Oxide Coated. D = Directly Heated. Th = Thoriated Tungsten. I = Indirectly Heated. * 30% efficiency at 1.3 metres.

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OSRAM BARRETTERS (CURRENT REGULATORS)

OSRAM Barretter Type	Mean Current Rating (amps.)	Voltage Range	Type of Base
202	0.2	120—200	4-pin
301	0.3	138—221	E.S. cap
302	0.3	112—195	E.S. cap
303	0.3	86—129	E.S. cap
304	0.3	95—165	E.S. cap

OSRAM PILOT OR DIAL LAMPS

Cat. No. of Lamp	Description	Type of Receiver for which suitable
O.S.17	2v 0.6A 15 m.m. flat	2v. Battery Sets
O.S.33	3.5v. 0.15A 15 m.m. flat	Fuse Lamp
O.S.35	3.5 v. 0.3A 15 m.m. flat	—
O.S.36	As O.S.35 but half opal	—
O.S.45	2.5v. 0.3A 12 m.m. round	2v. Battery Sets
O.S.50	3.5v. 0.15A 12 m.m. round	2v. Battery Sets
O.S.55	3.5v. 0.3A 12 m.m. round	A.C. sets with 4v. transformer*
O.S.70	6.2v. 0.3A 15 m.m. round	A.C. sets with 4v. transformer; DC/AC sets with 0.2A valves
O.S.74	6.5v. 0.16A 12 m.m. round	DC/AC sets with 0.16A valves
O.S.75	6.5v. 0.3A 12 m.m. round	DC/AC sets with 0.3A valves; A.C sets with 6.3v. transformer
O.S.7588	8v. 1.6 watt M.E.S. Indicator	A.C. sets

* Between centre cap and one side ; or two lamps in series across 4 volt winding.

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LOW FREQUENCY AMPLIFYING (MODULATING) VALVES

Type	Description	Filament Volts	Filament Current Amps	Type of Base	Amplification Factor	Impedance Ohms	Mutual Conductance mA/volt	Anode Volts	Scn. Volts	Grid Volts	Anode Current per valve mA.	Peak Input Volt. Grid to Grid	Anode to Anode Load Ohms	Total Power Output Watts
								Operating data for push-pull stage (Class AB2)*						
B21 (o)	Double Triode	2.0	0.2	7-pin	—	—	—	150	—	—6	2.2	L21 Driver	12,000	1.25
B63 (N)	Double Triode (as 6A6)	6.3	0.8	American 7-pin	—	—	—	300	—	0	17.5	70	10,000	10
KT66	Beam Tetrode	6.3	1.27	Octal	—	—	6.3	400	300	—30	60	76	2,800	50
KT66 connected as Triode					8	1,450	5.5	400	—	—38	62.5	84†	4,000	14.5
DA41	Triode (as TZ40)	7.5	2.5	American 4-pin	62	17500	3.6	1,000	—	0	22	220	6,900	175
DET19	Double Triode (as RK34)	6.3	0.8	American 7-pin	—	—	3.4	300	—	—15	30	100	10,000	13.0
DA100	Triode	6.0	2.7	Spec. 4-pin	5.5	1,410	3.9	1,000	—	—145	100	500	8,000	200
DA250 (N)	Triode	10.0	2.0	Large 4-pin	16	2,290	7.0	2,500	—	—130	80	360	12,000	800

(N) Not available. (o) Obsolete. † Grid not driven positive. * One Valve in case of Double Triodes

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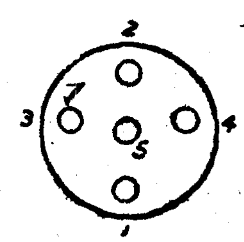
BASE CONNECTIONS

Valve Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Top Cap
S23 S24 VS24	G2	Gc	F	F	X	A
W21 Z21	G2	Gc	F G3 M	F	X	A
HD22 HD23 HD24	A	D1	F M	F	D2	Gc
KT2 KT21 KT24	A	Gc	F	F	G2	—
MH4 MHL4 ML4 MH41	A	Gc	H	H	C	—
D41	D1	D2	H	H	C	—
D42	A	C	H	H	X	—
D43	—	C	H	H	X	A
KT8	G2	Gc	H	H	C	A

Key :
- F Filament
- H Heater
- C Cathode
- Gc Control Grid
- G2 Screen Grid
- G3 Suppressor Grid
- M Metallising
- D1 AVC Diode
- D2 Signal Diode
- A Anode
- X Omitted



View from underside of base. 4 and 5-pin base.

Impressions on the Wax

Review of the Latest Gramophone Records

H.M.V.

AN outstanding record, from the point of view of performance and the quality of recording, is included in the list of latest H.M.V. releases. I refer to *H.M.V. DB*6151, on which the N.B.C. Symphony Orchestra, conducted by Leopold Stokowski, have recorded "Love Of The Three Oranges," Op. 33a, by Prokofieff. The work includes Scène Infernale and March, and, on the other side of the record, The Prince and the Princess. The composition is particularly noteworthy and the performance given by the N.B.C. Symphony Orchestra deserves a special word of praise.

To those who appreciate the true magnificence of the "Organ Prelude and Fugue in A Minor"—Bach-Liszt—I recommend *H.M.V. C*3376. This is the latest record by the famous pianist Solomon, who gives a solo performance of exceptional merit.

Another record which I am including in my H.M.V. selection is one of the Boston Promenade Orchestra under the conductorship of Arthur Fielder. It is *H.M.V. C*3375 which consists of Part 1 and Conclusion of the "Overture Der Freischutz," by Weber. This is a fine recording in all respects.

Mary Ellis, soprano, and Peter Graves, baritone, sing for us, in a most pleasing manner, a duet "Easy To Live With," on one side of *H.M.V. B*9357. On the other side, Elizabeth Welch, comedienne, makes a fine recording of "Dark Music." Both of these numbers are from the latest Ivor Novello show "Arc de Triomphe." "Hutch" tells us, on *H.M.V. BD*1067, that "It Can't Be Wrong" and "I Have A Vision."

Eric Winstone and his Band have made a good record —*H.M.V. BD*5828—by playing "I Never Mention Your Name (Oh No)" and "Baby, Please Stop and Think About Me," both foxtrots. "How Sweet You Are" and "It Can't Be Wrong"—two foxtrots—are played in fine style by Ivy Benson and her Girls' Band on *H.M.V. BD*1069. Swing Music 1944 Series, Nos. 557 and 558, are on *H.M.V. B*9360, the two numbers being "Casey Jones" (The Brave Engineer) and "In The Barrel," both played by Wingie Manone and his Orchestra.

Columbia

MOZART'S opera the "Marriage of Figaro" is ever popular and Joan Hammond, soprano, has selected from it "Grant O Love" and "Ah 'Tis Gone" for her Columbia recording this month. She is accompanied by the Hallé Orchestra under the baton of Leslie Heward, and her performance is superb. The record is *Columbia DX*1141, and I recommend it to all who enjoy this particular work of Mozart and a voice of great beauty.

The Liverpool Philharmonic Orchestra, conducted by Constant Lambert, have recorded "Ivan The Terrible—Overture Part 1 and 2" on *Columbia DX*1140. This is a most striking composition of Rimsky-Korsakov, and Constant Lambert shows a deep and thorough understanding of it, in which he is most ably supported by the orchestra.

A delightful 10in. record is *Columbia DB*2132 on which those two talented pianists Rawicz and Landauer have recorded "Suite Espagnole" (Spanish Suite) by Albeniz, arranged by the two artists mentioned above, who give an exceptional performance of the work on two pianos.

David Lloyd, tenor, with Gerald Moore at the piano, sings with perfect understanding and a most pleasing style "Songs My Mother Taught Me" and "I Love Thee." The recordings are on *Columbia DB*2131.

Carroll Gibbons' name appears on two Columbia records this month, *FB*2984, on which he has recorded at the piano "Carroll Calls the Tunes, No. 27"—two parts—which consists of a very tuneful medley of popular numbers, and *FB*2985, which is of Carroll with the Savoy Hotel Orpheans playing "For the First Time (I've Fallen in Love)" and "Pedro, the Fisherman," both foxtrots. Both of these records are good.

Victor Silvester and his Ballroom Orchestra have recorded two good numbers on *Columbia FB*2988, one a waltz, "There She Was," and the other a quickstep, "My Heart Tells Me." "Pony Express," linked with "Bells of St. Mary's," form the selection of Jimmy Leach and the New "Organolians," on *Columbia FB*2982. Another good record.

Parlophone

RICHARD TAUBER, tenor, has recorded a delightful rendering of "Without a Song" and "Don't Ask Me Why," on *Parlophone RO*20526, which I recommend to all who enjoy a robust tenor voice combined with the skill and artistry of Richard Tauber.

The other Parlophone records I have selected for this month are all for the dance enthusiasts, and I will open the ball with Joe Daniels and his Hot Shots in "Drumsticks" playing "South Rampart Street Parade," a quickstep, and "Bond Street Ballyhoo," a foxtrot. These are on *Parlophone F*2004.

These are followed by two foxtrots played by the No. 1 Balloon Centre Dance Orchestra, "I'm Mad At Myself" and "Hold Back the Dawn"—*Parlophone F*2004.

Geraldo and his Orchestra tempt us with a slow foxtrot, "Walkin' by the River" and "The Dancer at the Fair"—foxtrot, on *Parlophone F*2003.

For something "hotter," there is *Parlophone R*2925, on which Duke Ellington and his Orchestra have recorded Nos. 3 and 4 of The 1944 Super Rhythm-Style Series. The two pieces are "Blue Harlem" and "Slippery Horn."

Finally, Ivor Moreton and Dave Kaye, on two pianos, with string base and drums, play "Tin Pan Alley Medley, No. 59," on *Parlophone F*2002.

Regal

I HAVE only two Regals, but both are good in their class. In particular I like *Regal MR*3720 on which George Formby has recorded "If I Had a Girl Like You" and "Bell Bottom George," both from the film of that name.

Harry Roy and his Band shine on the other one, *Regal MR*3721, with "This is the Army Mister Jones" and "Pistol Packin' Mama," a comedy foxtrot.

New Records for Old

THIS must not be taken too literally, but it is nearer the truth than many people think. The most important ingredient used in the making of new records is shellac, and in spite of the large stocks of this material which had been accumulated, the supply is rapidly diminishing.

Shellac is needed for war purposes, and it has to be imported, which, in turn, means ships and transport, two very important factors in our war effort.

If new records are to be made, shellac must be provided without imposing an additional drain on the stocks wanted for war purposes. This is where you can help. Old records can be treated so that they yield this important substance, therefore, always make a point of handing in to your dealer one old record at least for every new one you purchase; and thus help the manufacturers to keep up the supply. It doesn't matter how old the records are, provided they are unbroken.

There are still hundreds of thousands of old and unwanted records in the country, and as long as they stay in cabinets, albums, or on the shelf, they represent a terrific waste of vital material. Turn them out, and hand them to your local dealer.

Open to Discussion

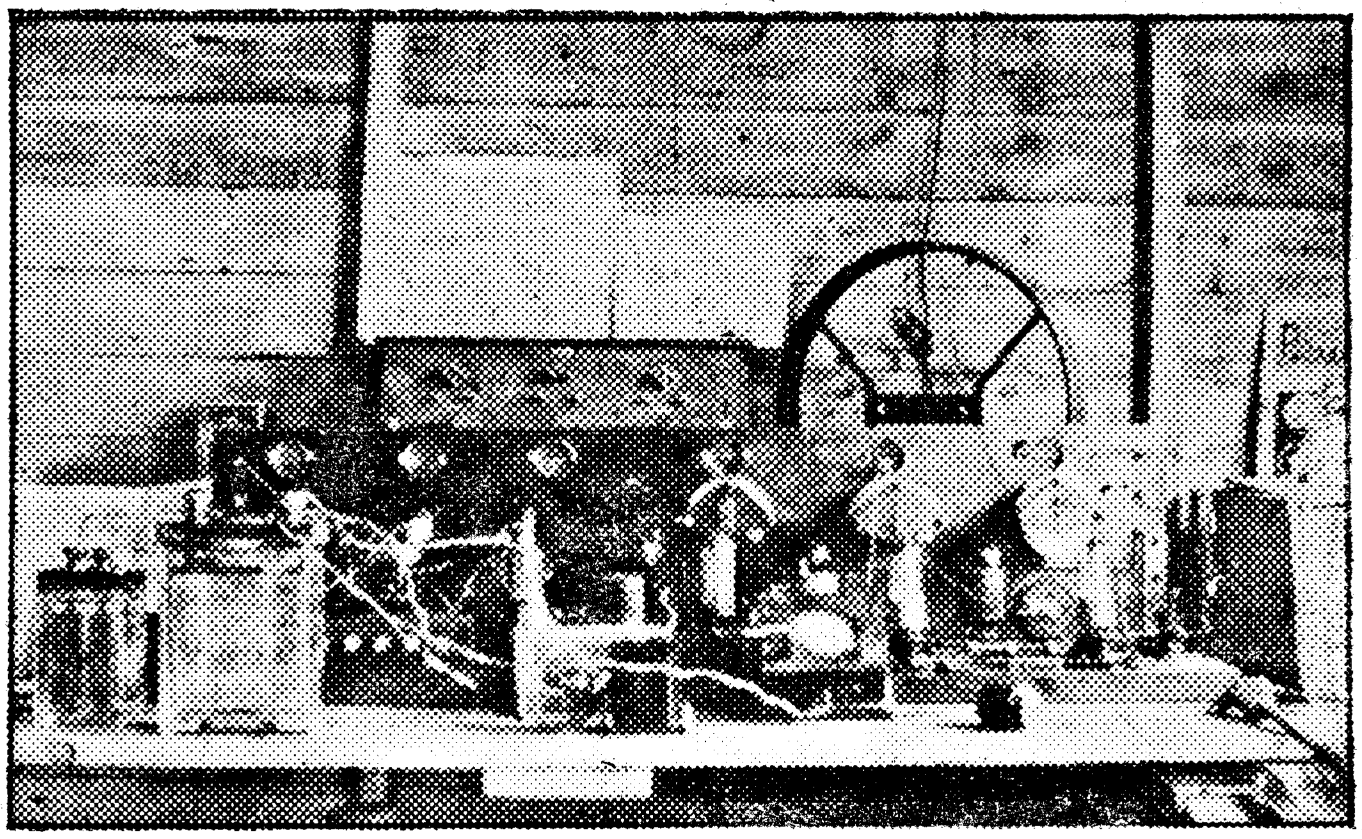
The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Battery versus Mains

SIR,—I was involved recently in a discussion on battery or mains, and I would like to know what PRACTICAL WIRELESS readers think of the question. My opinion is that most battery sets of 12 years ago are far superior to the mains set of to-day. Apart from batteries (which, in normal times, are no trouble whatsoever), a battery set will last a lifetime without one breakdown. A friend of mine has a battery set which has been in use without a break since 1929, and it has never required attention once. Can the same be said of the mains set of to-day? From what I understand, if your mains set goes for three years without repairs you must be regarded as very lucky. Any interference to be had will be received on a mains set, and should the current be off, what then? I can visualise radio in the form of a modern crystal set in the years to come.—I. H. WOODWARD (Stoke-on-Trent).

An Old Reader's Activities

SIR,—As a reader of PRACTICAL WIRELESS since No. 1, and still a regular reader, your article "Twenty-One Years" also brought pleasant memories to me. I can recall almost the exact words I wrote in a letter to the Editor on the first issue of PRACTICAL WIRELESS. They were: "Wishing your new periodical the greatest success, and may your new book reach enormous sales." I have been interested in radio since 1922, built my first crystal set with a very large coil and carborundum detector, have listened to the old Writtle Station 2MT, and later used the types of valves you mentioned—Dutch, oblong "Telefunkens," and all types of British valves, including the "Dull Emitter" Xtrandion and Dextrandion. I have also built scores of circuits, from the single valve "Reinartz," "Hartley," etc., to the advent of the superhet. Owing to overstudy of this fascinating hobby, I had to gap a few years in watching the trend of all mains design, but just prior to this war took to radio again. I have constructed most of my service equipment from articles published from time to time in PRACTICAL WIRELESS, and now possess almost everything that is needed for present-day repairs, although through lack of time available I am unable to do all that I should like to do in this respect, partly through shortage of components and the numerous types of valves that are almost impossible to obtain. I think that the Board of Trade should issue a certificate to all persons like myself who are interested to get people's sets going. I shall be interested to note the new Utility set, especially the layout. Personally, I think that the receiver, detector and pentode "transformer coupled," and well smoothed and decoupled, should meet the demand; and that in future the valves should be known as No. 1 rectifier, No. 2 detector, No. 3 pentode, No. 4 D.D.T., No. 5 frequency changer, etc.; and that all rectifiers, whatever the voltage and make, should be on a British Standard base (4-pin), because *directly* and indirectly *heated heaters* can replace each other provided the characteristics are as near as possible with output; of course, the 5-pin H.W. receiver could stand. In conclusion, I have just completed what I call my Utility set (receiver, one detector, 1 pentode): the power is there on the Home and Forces wavelengths, but I am troubled with the *powerful transmitter* of London Regional European Service. I am trying a new coil to cut this out, and hope to be successful in a few days.—F. R. PARKER (Rainham).



A corner of F. R. Parker's wireless shack several years ago, showing his 3 H.F., Det. and 2 L.F. receiver.

Selling and Servicing

SIR,—With reference to your article on "Selling and Servicing" in the December issue of PRACTICAL WIRELESS, I wish to place my case before you.

When we applied for the licence we were instructed to give the address of the premises desired to open. We rented a shop which we had to take for a year, and informed the Board of Trade, who wrote back saying our application would receive consideration, and telling us not to take premises until we were given the O.K. How, in the name of goodness, can we give the address of the premises we wished to open without taking those premises? In due course we were told that our application had been turned down. We then requested a personal interview, this was refused. In the meantime we had opened for radio service. I might mention that neither I nor my partner are gate crashers. I have been in the trade 14 years, and my partner 20 years. We are both ex-Servicemen from the present war. My partner was wounded at Dunkirk, and has recently returned from hospital, where he had another operation for his war wounds. We were given to understand that special consideration would be shown to us on these grounds, but apparently our war service counts for nil.

I would also point out that in this town no radio shop has had to close down through the owner having to go into the Services, so there will be no Servicemen to come back to reopen their premises. Mr. Dalton cannot make that an excuse in our case.—V. BAILEY (and partner) (Dumfries).

SIR,—I have been following the letters on "Selling and Servicing" since your November, 1943, issue with great interest, and would like to remark as follows

In the first place, the people who complain opened with the *sole idea* of servicing, and, no doubt, catered for same, and, after a while, thought they would also like to sell spares, etc.

Surely, it would be more convenient for the serviceman to call upon the customer to insert a valve which could be carried in the pocket, for a small service charge, and avoid expensive taxis.

I also note that the licensed shops have no stock, and cannot repair sets, but suggest that the customer takes them to one of these repair depots, and such repair establishments may then supply any parts required, and this, in my opinion helps these people considerably.

In the December issue Mr. L. E. Healey states that he worked for a large firm in Colchester as their service engineer for a period of 14 months, then started on his own account at Clacton, *no doubt* as a *service engineer*, and had no intention of retail trade at the time, and was quite content (had not dealt with any authorised wholesalers before, or was not established in any way, except by his private work from home). Surely these people should be satisfied, and not expect to take the retailers' trade, as most retailers have lost their service men. Further, in my opinion, the reason the retailers are short of stock is because it is going to these service men.

I think I know Mr. F. E. Smith, if his business address was London Road, Chelmsford, and cannot quite make out if he has a retail licence (I conclude he has), but if not, my experience may help him and others.

Regarding Mr. J. Pidgeon (Melton Mowbray). If he has carried out so much repair work why is he not satisfied, especially as he is *not at all interested in money*.

Now for my own experience. I have been a radio dealer and service engineer for the past 18 years on my own account. At the outbreak of war I closed down, owing to the evacuation of the district, and went on war work. I have always had bad health (Grade 4), and could not do the work, was released, and thought I would open up again a mile away from my old shop, as there were no people in my old district.

I did not know about the Price Regulation Committee or Board of Trade Regulations at the time, so opened up, dressed the windows, etc. After being open one week a gentleman called upon me, and pointed out that I had no licence to sell retail so would have to clear my windows and shelves. This I did, and I must add that he showed me *every courtesy and respect*.

I then went round to my various customers that I had previously had in the district and asked them if they would be willing to sign a letter saying they considered my opening necessary and of benefit to the district. I proved that the population of the district had increased, and that my business was required.

Within seven days my licences were granted, and I feel sure if people went the correct way to work, and gave facts, they would get a square deal. I am speaking from my own experience.—R. H. PETTITT (Hadleigh).

Distorted B.B.C. Transmissions

SIR,—I was very pleased to read in the December issue the letter from Mr. Field, of St. Asaph.

In Hampshire reception of any of the B.B.C. transmissions after dark cannot be relied upon.

I service domestic receivers in a widely scattered agricultural area, and if the people responsible at the B.B.C. could hear some of the outspoken remarks they would blush with shame.

It is useless me telling my customers that the B.B.C. distort their signals in order that enemy aircraft shall not use them as beacons, for they point out that it does not appear to be very effective.

But here is another aspect of the case. People have only to turn their controls a fraction and in comes a good musical programme from a Nazi controlled station, and without a sign of fading. They listen to this and also Nazi propaganda which interrupts the music at intervals, with the result that listeners hear items of news which our M.O.I. would not publish and which on some occasions it is not good they should hear.

The B.B.C. officials appear to think that all homes are now equipped with modern sets, complete with A.V.C., etc. They would be surprised at the number of two valve and three valve sets in our farms and village homes.

To conclude, will the B.B.C. try and give us a good signal the next time the Prime Minister addresses the country in order that there shall be no guessing at some of his words?—H. H. BULLOCK (Alton).

SIR,—Being a member of the engineering department of the B.B.C. I should like to reply to Mr. Field's letter in the December issue of PRACTICAL WIRELESS.

Firstly, I can assure him that a great deal of notice is taken of listeners' queries and complaints by the so-called "highbrows of Broadcasting House."

Secondly, Mr. Field lives in what is technically known in the B.B.C. as a "mush area," which is caused solely by the method of transmission necessitated by the war. The engineer division could cure this unfortunate defect, but only at the expense of considerably worse reception for a greater number of listeners.

Thirdly, to effect an improvement in reception I suggest Mr. Field tries a vertical aerial with one or more reflectors, the whole array being pointed in the direction of his nearest station.

In conclusion, I should like to add that the people of the occupied countries are only too glad to be able to listen to the B.B.C., even though their reception is by no means perfect as regards quality.—D. J. BURTON (Penrith).

Station Identification

SIR,—In reply to the request of L. H. Cox, in the November issue, CSW is the call sign of the radio station situated at Lisbon, Portugal. It operates on the following frequencies: 7,260 mc/s as CSW8, 9,740 mc/s as CSW7, 11,040 mc/s as CSW6, 11,840 mc/s as CSW5, 14,600 mc/s (20.55 m.) and CSW, 15,215 mc/s as CSW4.

I received CSW6 on June 2nd at 18.10 hrs. B.D.S.T.

Other extracts from my log may be of interest to some readers: PRL8, 31.56 m. and 25.64 m.; FZI, 25.06 m.; GBC6, station testing in London; Batavia, 16.8 m.; Tokio, JZK, 15,160 mc/s; JLS2, 17,845 mc/s; JLG4, 15.105 mc/s. The above mentioned Japanese stations operate on 50 kW.

Moscow calling B.B.C. with despatches, 19 m.b. Voice of Free India, 26.93; Finland, 31 m.b. Radio Metropole, 25.16; Allied H.Q., N. Africa, 19 m.b.; SBT, Sweden, 19.76 m.; ZTJ, Johannesburg, 49.94 m.; HVJ, Vatican City, 19.84, 50.25, 25.55 m.; Rome, 19.20 m.; Moscow, 25.00 m., 25.36 m.; B.B.C. calling, Cairo; C.B., Leopoldville, 25.7; HER5, Schwarzenburg, 25.2 m.

Chungking calling San Francisco; New York to London with instructions; United Nations, Radio Tunis; EAQ, National Radio, Spain; HER3, Schwarzenburg, 48,866 m.; Godfrey Talbot calling B.B.C. recording room from Alexandria; Free Yugoslavia Radio, 25 m.b.; Berlin calling Ireland, 31 m.b.; and of course the American stations WGEO, WGEA, WRUL, WBOS, WCBX, WCDA, WNBI, WKRD, WCRC, WLWO, WJRB, WDO, WKRX, WHL6.—A. G. C. WILSON (Letchworth).

Morse Code Practice Partner Wanted

SIR,—I am keen to contact any amateur in, or near, Dawlish, who would like to learn the Morse code the Candler way. I have started and am keen to find a practice partner.—A. C. L. JOTEHAM (2FUB), 207, Henty Avenue, Dawlish, S. Devon.

"BERMUDA"

A TUNEFUL tango under the title of "Bermuda" has just been published at 1s. with lyrics by Frances V. Morris, and music by Arthur Vandeau. Copies are available from Frances V. Morris, 310, Chelsea Cloisters, S.W.3.

It is a number which should become popular.

Replies to Queries

H.F. Circuit Arrangement

"I enclose a diagram of the H.F. side of my receiver which I cannot stabilise. The coils are home-made and the details are given on the sketch, together with details of the rest of the circuit values, etc. Can you offer any suggestion? On the back I have shown the exact layout with the actual distances between valves, etc."—P. R. (Bridgend).

THE coil arrangements are very efficient, and it is no doubt this high efficiency which is causing your trouble. You will undoubtedly get better results if you tap the coils about one-third of the way down from the high potential end, and you could then experiment with various connections to this point. For instance, you could connect the tuning condenser across the entire coil, with the grid connection for the detector valve taken from the H.P. end. The lead from the H.F. anode could be taken to the tapping point. Alternatively, you could connect the anode to the H.P. end and take the grid connection from the tap. Yet another arrangement would be to take both anode and grid leads from the tap. The layout should not give rise to any trouble, and the values of resistances, etc., appear quite in order. We think the tapping of the coil will produce the desired stability.

Tapping a Coil

"I am building an experimental short-wave set but am doubtful regarding the method of using a coil. I want to experiment with different degrees of aerial coupling, for which I understand it is in order to use a tapping clip on the grid coil. As, however, I also wish to experiment with the reaction circuit in the same manner with a clip on the grid coil I wonder if the coil will work in three separate sections in this way."—A. K. (Blackheath).

IT is quite in order to use the idea proposed, and this is, in fact, quite a common method of using experimental apparatus. Care must, of course, be taken to make certain that the tapping clips do not short adjacent turns, and remember that the clips should fit tightly or background noises will be produced if the coil is subjected to vibration.

A Matching Problem

"A 3-valve set has been brought to me, viz., S.G., det., and pentode. The receiver is quite intact, but the speaker was originally meant for Class B or Q.P.P., and requires approximately 3 watts. The pentode valve has an output of 1 watt. Will a 3 to 1 step-up L.F. transformer be necessary in the output to match the valve and speaker?"—J. B. (Tooting).

THE question of matching is not concerned with the strength of the input signal, but with the impedance. The fact that the speaker will handle 3 watts simply means that a signal greater than that value should not be passed to it. The pentode, which only delivers 1 watt, may be coupled to it (through a suitable impedance matching device) and will work satisfactorily. You will probably find that by using the two outside terminals on the speaker, and connecting these direct in the anode circuit of your pentode valve, the matching will be approximately correct, as the usual load of a Class B stage is in the neighbourhood of 8,000 to 12,000 ohms, and this is also the normal load of pentode. You should, therefore, ignore the centre terminal on the speaker and use it in the ordinary way.

Unusual Fault

"I recently made up a set in which I used two English variable condensers made up from aluminium. I was not very pleased with the results, and I saw some American variables in a junk shop one day, and as they looked rather good, being made from brass, I bought them and put them in my set. I got much louder results and many more stations. Is this due to the fact that brass is a better conductor?"—H. R. J. (Hull).

SOME theories were once advanced concerning the chemical aspects of wireless components, but nothing was proved regarding the differences in performance between aluminium and brass plates. What you will probably find is that the old condensers which you had at first relied for their contact with the moving vanes on a friction disc which had probably got dirty, or had been oiled. The new brass condensers no doubt had soldered pigtails for connection, and thus gave a lower resistance and a much better contact, thus giving better results.

Performance, Not Appearance

"Will you inform me what is the good or the use of the .1 x .1 condensers and the four resistances (1 watt) in the Fury Four? Do they really do anything important? Can they be substituted? Is there any alternative to them, because the set never looks neat with those parts wired up?"—G. N. (Brockley).

COMPONENTS are never put into a wireless receiver unless they are required. With regard to the particular resistances and components you refer to, these act as decoupling circuits for the anodes and screening grids of the first two valves, and the .1 x .1 condensers incorporate two condensers in one case, thus reducing space and simplifying construction. You cannot remove these parts without incurring the risk of instability.

Earth Return Required

"I have built the Leader 3, but cannot get any medium-wave stations. I have mounted the wave-change switch on a panel instead of the chassis, and wonder if this is the cause of the trouble."—W. A. C. (Poole).

IF you examine the circuit of the Leader you will find that a three-point switch is required for wave-change purposes. Two arms are joined to the two coils, and the third arm is connected to earth, so that in the medium-wave position the tappings on the coils and the earthed end of the coils are joined together. An ordinary two-point switch was, however, used for this purpose, and third, or earth contact, was obtained through the medium of the arm of the switch and the mounting bracket, which was mounted direct on the metallised chassis. You must, therefore, in your case, obtain a three-point switch and join the third arm to earth in order to enable the switch to function.

Combined Volume Control

"My set is a battery straight three, using two L.F. transformers. The detector is an S.G. valve. How can I fit a pick-up and also a volume control to have effect on both radio and gramophone? I have one with three terminals (.5 megohm). Would this do?"—F. P. (Preston).

THE volume control should be quite suitable if joined across the secondary of the first L.F. transformer. Join the two outside terminals on the control to G. and G.B. terminals, and disconnect the lead at present joined from the grid of the L.F. valve to the G. terminal on transformer. This lead must then be joined to the arm (centre terminal) on the volume control. The pick-up should be joined between the grid and earth line of the detector valve, and the volume control will then function on both radio and gram.

Using a Frame Aeria

"Could you give me the general rule for substituting a frame aerial for aerial and earth in a wireless circuit provided with coils for long and medium waves. To which points, for example, does one join the beginning and end of the frame?"—F. H. (Liverpool).

THE frame aerial takes the place of the aerial-tuning coil. The latter must therefore be removed from the receiver. One end of the frame is then joined to the grid of the first valve (or to the fixed vanes of the first tuning condenser), and the other end of the frame is then joined to the original earth line, or the H.T. — terminal. If the frame is designed to cover medium and long waves, the short-circuited portion should be on the earth side in the same manner as with ordinary coils.

Classified Advertisements

LITERATURE, MAPS, etc.

RADIO SOCIETY OF GREAT BRITAIN invites all keen experimenters to apply for membership. Current issue "R.S.G.B. Bulletin" and details, **1/-** below:

AMATEUR RADIO HANDBOOK (300 pages), paper cover, **4/-**; cloth, **6/6**. Radio Handbook Supplement (140 pages), paper cover, **2/9**; cloth, **5/-**.—R.S.G.B., 28-30, Little Russell Street, London, W.C.1.

WEBB'S Radio Map of the World. Locates any station heard. Size 40in. by 30in., **4/6**, post **6d.** On linen, **10/6**, post **6d.**—Webb's Radio, 14, Soho Street, London, W.1. GERrard 2089.

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MORSE Practice Equipment for class-room or individual tuition. Keys, audio oscillators for both battery or mains operation.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

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CLARION slow motion dial, illuminated disc drives, useful for short waves, **2/6** complete.

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AMPLION twin H.F. binocular chokes, **1/9**.

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SOLDER, 1lb. reels, fine all-tin instrument solder, **3/6** lb., or ½lb. reel **1/-**.

MIXED RESISTORS. Each packet contains same selection, **2/6** doz.

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T.C.C. BLOCK CONDENSERS, 100 mfd. 50v. wkg., **3/9** each.

MAINS DROPPERS, with variable sliders, total 1,000 ohms, .2 amp., **4/6** each, .3 amp., **5/6** each.

WIRE. Silk covered, 38 and 40 gauge, **1/3** 2oz. reel; enamelled, 26 and 28 gauge, **2/3** 4oz. reel; 32, 34 and 36 gauge, **2/9** 4oz. reel. Litz wire, 9/45 and 7/45, **1/6** 2oz reel.

RESISTORS. 150,000 ohms and 20,000 ohms 2 watt, **10d.** each.

Postage must be included. No C.O.D.
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SCREWS and Nuts, assorted gross of each (2 gross in all), **10/-**.

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CIRCULAR Magnets, very powerful, 1½in. diameter by ⅜in. thick, **1/6** each, **15/-** per doz.

ERIE Resistances. Brand new, wire ends. All low value from .8 ohms upwards. A few higher value are included in each parcel, ¼, ½, 1 and 2 Watt. 100 resistances for **30/-**.

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SPECIAL ASSORTED PARCEL FOR SERVICE MEN

100 ERIE resistances (description above), 24 assorted Tubular Condensers; 6 Reaction Condensers, .0001; 12 lengths Insulated Sleeving; 75ft. Push-back Connecting wire; Soldering Tags, Screws, Wire, etc., **65/-**. All brand new.

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LOUD Speaker Units, unshrouded, Midget type, **4/-**; Metal case condensers, .1+.1+.1, **2/6**.

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ERIE RESISTORS. ¼ and ½ watt all useful values. Our selection. **3/6** doz.

MICA CONDENSERS. Wire ends. .0001 mfd., .001 mfd. etc. Our selection. **4/-** doz.

FLEX. Twin 14/36, best quality, **6d.** per yard

ELECTROLYTICS. 6 mfd. 200v. wkg., **3/6** each. 50 mfd. 12v. wkg. **1/9** each. 12 mfd. 50v. wkg, **1/9**. 50 mfd. 25v. wkg, **2/-** each. We have a few 8s and 16s 450v. wkg. Please send s.a.e.

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COULPHONE Radio New Longton, Nr. Preston. New goods only. Tungsram valves, English and American Rectifiers **10/6**. Mains Transformers: 350 v. 100 m.a., 4 v. 6 a., 4 v. 2½ a., **32/6**; 350 v. 120 m.a., 6.3 v. 3 a., 5 v. 3 a., **33/6**. Mains Transf. bobbins, std. rep. Eng. and Amer., **18/8**. Rola P.M., less transformer, 5in., **21/6**; 6½in., **22/6**; 8in., **24/-**; 8in. Celestion P.M. with Transformer, **30/-**; 10in. Heavy Duty with Transf., **45/-**. Cored solder, **4/6** lb. Tinned copper wire, **2/3** ½lb., 2 mm. systoflex, **3d.** yd. Line cord replacement resistors, 800 ohm. 2 adjustable tappings, **6/9**. Parafeed L.F. Transformer 4 : 1, **5/-**; 50 mfd. 12 v., **2/-**; 25 mfd. 25 v., **2/-**. Erie resistors, 1 watt, **9d.**; ½ watt, **6d.**; ¼ watt **4d.** Pushback wire, 100ft., **6/-** Switch cleaner, **2/3** bottle. Power Pentode Output transformer, **7/6**. Bell transformer **6/6**. Valveholders, **1d.** per pin. Stanelco electric soldering irons, **21/-**. Tubular and silver mica condensers, all sizes. Volume controls with switch, **5/9**. Less switch, **4/9**. 450 watt iron elements, **2/3**. S.A.E. for stock list.

WANTED.—Loan, hire, purchase P.W. for October, November, 1940.—Box 105, "Practical Wireless," Tower House, Southampton Street, W.C.2.

AMPLIFIER (U.S.) 4-v. A.C. 8 watt push-pull output, new, with energised speaker. AvoMinor (new) Sale or exchange old meter(s). Numerous spares and cabinets. Pick-up wanted.—Kennedy, 260, High Street, Arbroath, Scotland.

MIDGET COILS. Midget aerial and H.F. medium and long wave, T.R.F. coils, ideal for T.R.F. midget receivers. **11/-** pair.

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The index letters which precede the Blueprint Number indicates the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.

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