Simpson

MIXING VALVES IN A.C./D.C. SETS

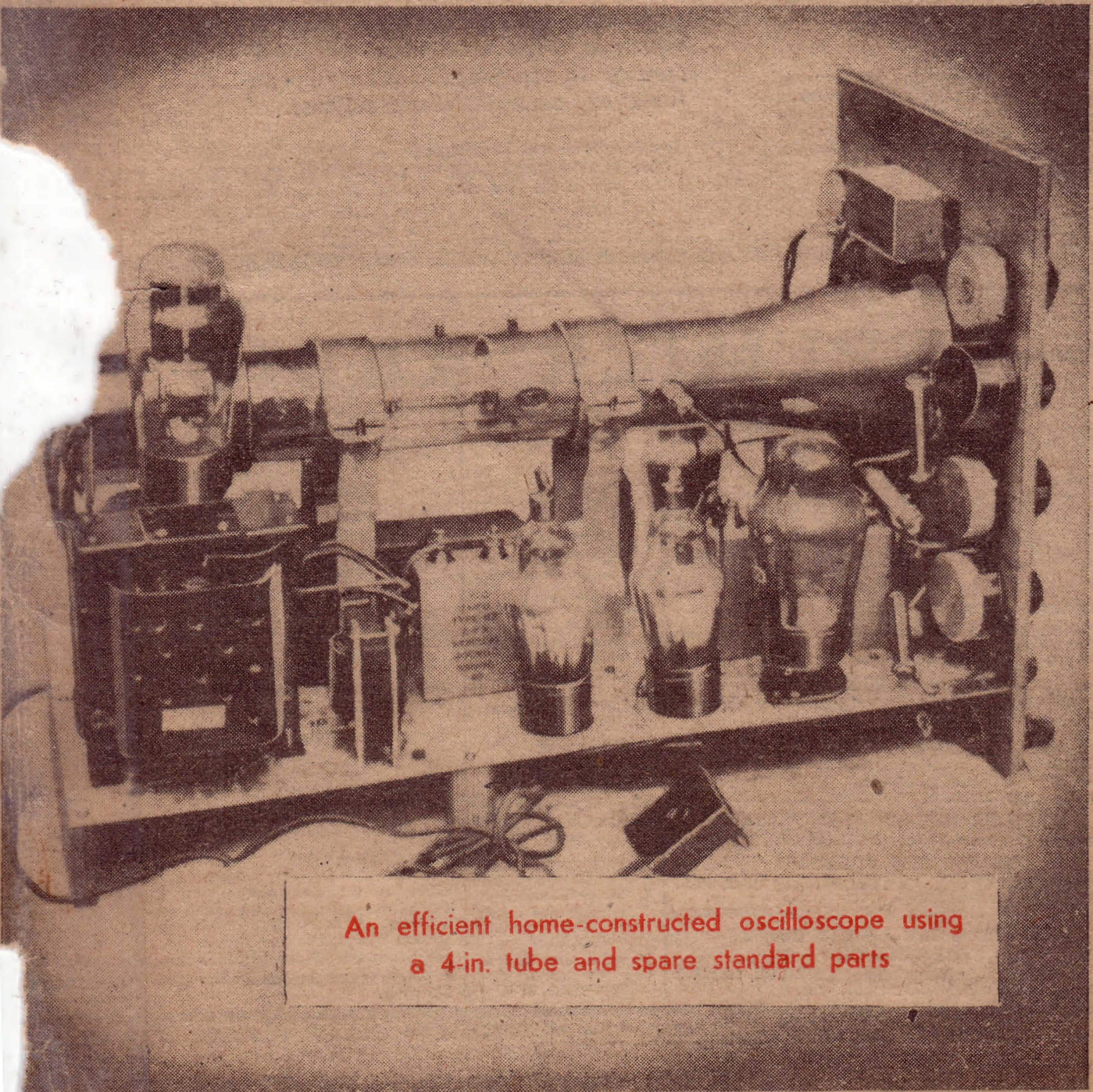
Practical Wireless

9D EVERY MONTH

Editor F. J. CAMM

Vol. 18. No. 436. NEW SERIES. OCTOBER, 1942

TIME BASES FOR OSCILLOSCOPES

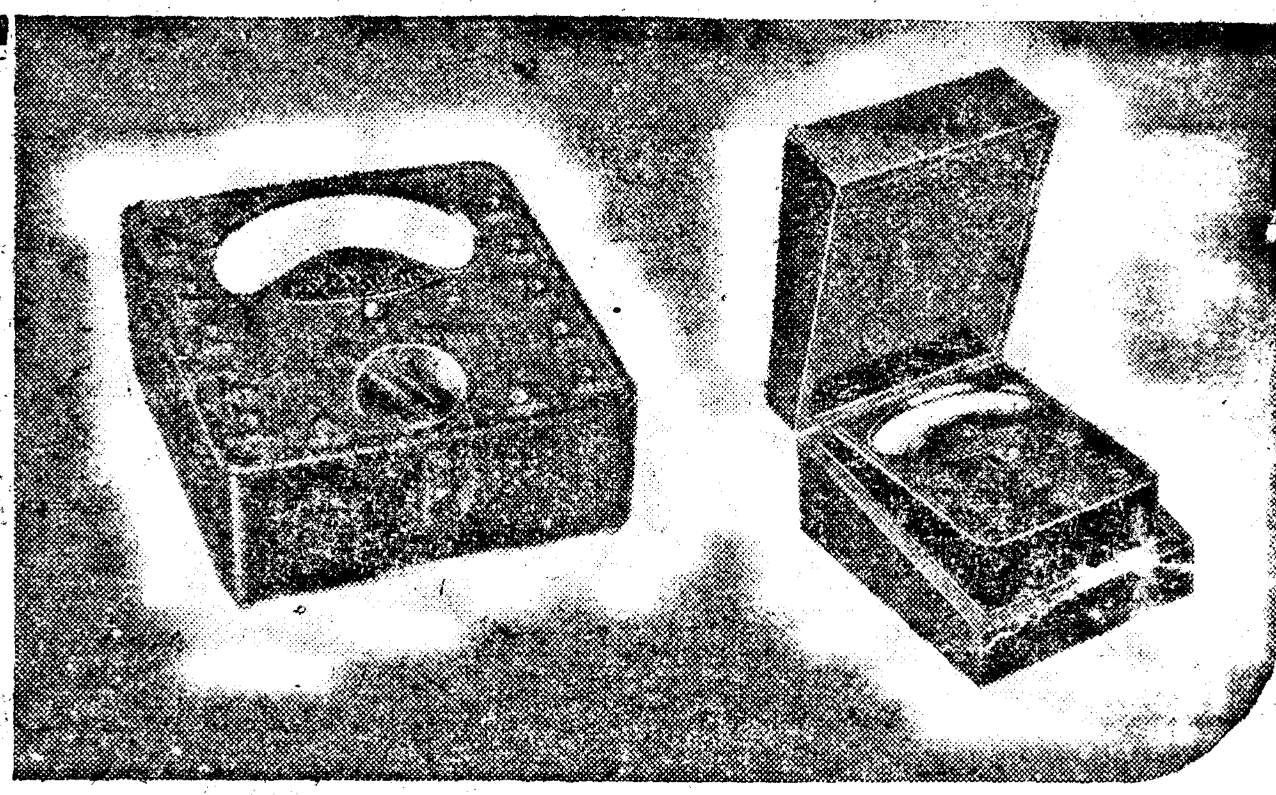


An efficient home-constructed oscilloscope using a 4-in. tube and spare standard parts

AVO

Regd. Trade Mark

ELECTRICAL MEASURING INSTRUMENTS



Universal AvoMinor. *D.C. AvoMinor*

THE world-wide use of "AVO" Instruments is striking testimony to their outstanding versatility, precision and reliability. In every sphere of electrical test work they are appreciated for their dependable accuracy, which is often used as a standard by which other instruments are judged. There is an "AVO" Instrument for every essential electrical test.

Some delay in delivery of Trade Orders is inevitable, but we shall continue to do our best to fulfil your requirements as promptly as possible.

Sole Proprietors and Manufacturers :—
The AUTOMATIC COIL WINDER & ELECTRICAL EQUIP Co., Ltd., Winder House, Douglas Street, London, S.W
'Phone : VICtoria 3404-7.

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			6-pin Type		
Type	Range	Price	Type	Range	Price
04	9-15 m.	... 2/6	06	9-15 m.	... 2/6
04A	12-26 m.	... 2/6	06A	12-26 m.	... 2/6
04B	22-47 m.	... 2/6	06B	22-47 m.	... 2/6
04C	41-94 m.	... 2/6	06C	41-94 m.	... 2/6
04D	76-170 m.	... 2/6	06D	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/-			

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.**

SHORT-WAVE CONDENSERS

Trolitul insulation. Certified superior to ceramic. All-brass construction. Easily ganged.

15 m.mfd.	... 2/4	100 m.mfd.	... 3/-
25 m.mfd.	... 2/6	160 m.mfd.	... 3/7
40 m.mfd.	... 2/6	250 m.mfd.	... 4/-

S.W. H.F. Chokes, 10-000 m., **10½d.** High grade **Pie-wound,** U.S.A. type, 5-200 m., 2/6 each.

PREMIER REPLACEMENT VALVES

4-volt, A.C. types, 5-pin. ACHL, ACSG, 5/6 each.

MOVING COIL SPEAKERS

Goodmans and **Celestion** 8in. P.M. Speaker, **25/-.** 8in. 2,000 ohm Field, **25/-.**
Speakers are complete with output transformer.

MR1 UNIVERSAL 4-WATT OUTPUT TRANSFORMERS

Tapped for Power, Pentode, and Push-Pull, suitable for 2 and 7/9 ohms speech coil, **7/6.**

"SPECIAL OFFER"

Mains Transformers. Primary, 220-230 v.; secondary, 350-0-350 v., 100 ma., 5 v. 2 a. not C.T., 6.3 v. 3 a., C.T., **21/-.**

"LEARNING MORSE?"

Then purchase one of the new practice Oscillators.

Supplied complete with valve, on steel chassis 27/6

Practice Key, 3/3; TX Key, 5/9.

Super Model, on Wooden Base, 10/6.

Browns' Headphones, 17/6 pair.

3 Henry Chokes, 10/-.

PREMIER MAINS TRANSFORMERS, CHOKES and VALVES.
Still available. Send for lists.

MATCHMAKER UNIVERSAL OUTPUT TRANSFORMERS.
Will match any output valves to any speaker impedance.
11 ratios from 13-1 to 80-1, 5-7 watts, 20/-, 10-15 watts, 26/-.

I.F. TRANSFORMERS

Iron-cored 450-470 kc/s. plain and with flying le[ad] **5/6** each.

PREMIER BATTERY CHARGERS FOR A.C. MAINS

Westinghouse rectification complete and ready for use. To charge 6 volts at 1 amp. (also tapped for 2 and 4 v.), **29/6.** 12 v. 1 a. (also tapped for 2 and 6 v.), **37/6.** 6 v. at 2 a. (also tapped to charge 2 and 4 volts), **48/-.**

PREMIER 4-WATT A.C. AMPLIFIERS

Each Amplifier is completely wired and tested. Selected components. Valves and Energised Moving-Coil Speaker, **£5 5s.**

PREMIER MICROPHONES

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

Moving-coil Mike. Permanent magnet model, requiring no energising. Response 90-5,200 cycles. Output .25 volt average. Excellent reproduction of speech and music, **63/-.** Super Model, **£5 5s.**

Microphone Transformers, 10/- each.

Chromium Collapsible Type Microphone Stand, 52/6.

H.T. Eliminators. 150 v. 30 mA. output, **41/6**; ditto, with 2 v. ½ A. charger, **52/6.**

2,000 ohms 25 w. **Resistances** with 5 tapping clips, **2/-.**

Mains Resistances, 660 ohms, .3 A. tapped 360+180+60+60 ohms, **5/6.** 1,000 ohms, .2 A. tapped at 900, 800, 700, 600, 500 ohms, **4/6.**

1,000 ohm Wire Wound **Potentiometers, 3/11 each.**

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

ALL ENQUIRIES MUST BE ACCOMPANIED BY A 2½d. STAMP.

ALL POST ORDERS TO: JUBILEE WORKS, 167, LOWER CLAPTON ROAD, LONDON, E.5. (*Amherst* 4723).

CALLERS TO: Jubilee Works, or 169, Fleet Street, E.C.4 (*Central* 2833).
or 50, High Street, Clapham, S.W.4 (*Macaulay* 2381).

Practical Wireless
and PRACTICAL TELEVISION
EVERY MONTH
Vol. XVIII. No. 436. OCTOBER, 1942.
Editor F. J. CAMM
Staff: L. O. SPARKS, FRANK PRESTON.

COMMENTS OF THE MONTH BY THE EDITOR

Special Note to Home Guards

WE are receiving large numbers of requests from Home Guard units for details of wireless transmitters. This is due to a misunderstanding of a recent Order issued to the Home Guard. It is quite illegal for anyone, members of the Home Guard included, to own or to operate a transmitter. Here is a typical letter: "I have been asked and given permission by the Home Guard, of which I am a member, to construct a small low-powered transceiver for Home Guard use. I enclose a circuit and should be glad if you would let me know if it is in order. In order that you may have assurance that I have permission I have asked one of our officers to countersign." There follows a signature by a second-lieutenant. As we were receiving so many requests couched in somewhat similar terms, we took the matter up with the Post Office and the Home Guard Headquarters in London. Each states in unequivocal terms that no one in the Home Guard units has any authority whatever to grant permission to members of those units to build transmitters, no matter what the powers of them. We were informed that an Order recently issued has been misinterpreted, but a memorandum is being sent to the Headquarters of Home Guard units clarifying the position. Will all readers, including members of the Home Guard, therefore please note that we cannot answer questions dealing with the construction of transmitters, and that their superior officers are quite out of order and acting illegally in signing such requests.

Our Blueprint Service

THERE is a greater demand than ever for our blueprints, the range of which covers nearly every requirement. Most of the blueprints deal with receivers which have been described in this journal, and issues describing the construction are, in many cases, out of print. In such cases the blueprints are supplied with typewritten copies of the instructions, so readers need have no fear that in purchasing the blueprint they will lack the necessary descriptions. We shall in future issues reprint in abbreviated form the instructions relating to receivers which are the subject of blueprints described in issues now out of print. The following blueprints are accompanied by typewritten constructional details:

P.W.31, P.W.35c, P.W.72, P.W.73, P.W.77, P.W.85, P.W.91, P.W. 93, P.W.94, P.W.95, A.W.429, A.W.435, W.M.392, W.M. 395, W.M.396, W.M.398, W.M.399, W.M.402, W.M.404.

The instructions which we shall reprint will, of course, be in abbreviated form, but they will contain the essential details, including the list of components, and the component values—sufficient information for the constructor.

Editorial and Advertisement Offices: "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. 'Phone: Temple Bar 4363. Telegrams: Newnes, Rand, London. Registered at the G.P.O. for transmission by Canadian Magazine Post.

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

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

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

"Screw Thread Manual"

WE have recently published from the offices of this journal an important work entitled the "Screw Thread Manual." This fully indexed 192-page book, crown octavo in size, deals with Screw-thread Terms, Screw-thread Forms, Use of Taps and Dies, the Use of Die-heads and Chasers, Die-heads and Tappers, Screw-cutting in the Lathe, Thread Milling, Thread Grinding, Thread Rolling, Bolt and Screw Manufacture, Measuring Screw Threads, Measurement by Optical Projection, Extracting Broken Taps, Aero Threads, and Tables. The tables include Change-gears for Screw Cutting, British Standard Whitworth Screw-threads, Whitworth Hexagon Nuts and Bolts, British Standard Fine, British Association, British Standard Pipe, American National, Systeme Internationale, British Standard Cycle, Acme, Loewenherz, Model, Royal Microscopical Society, Royal Photographic Society, Watch, Wood-screw, Cordeaux, Edison Type Electric Lamp Caps, Standard Brass, Briggs Pipe, Whitworth Instrument, A.S.M.E., United States Standard, Holtzapffel's, Swiss, American National, Gas, Worm, Metric Fine, Progress, S.F. French, French Metric, and German Metric Screw Thread Standards, Letter Sizes of Drills, British Standard Castle Nuts, Standard Worm, Wing Nuts, Black Nuts, Lock Nuts, Bolt-heads, Whitworth and B.S.F. Screw Threads, Sparking Plug Threads, Heads for B.A. Screws, Tap Drill Sizes, etc.

There are 110 illustrations, and the volume contains a vast amount of matter not hitherto published. It costs 6s., by post 6s. 6d. from the Publisher, The Book Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Radio Sales

ALTHOUGH many are experiencing difficulty in purchasing wireless receivers and components, we are informed on reliable authority that considerable numbers of them are still being made. During the month of June, for example, nearly 12,000 receiving sets, including radio-gramophones, totalling in value £134,000, were sold in this country. Components to the value of over £58,000 were also sold in this country during the same month. Evidently, however, the supply is not equal to the demand, which may possibly account for the revival of interest in crystal receivers. Coils are practically unobtainable, so readers are turning to "Wireless Coils, Chokes and Transformers," which is published from the offices of this journal at 6s. (by post 6s. 6d.). It is comforting to learn also that we are continuing to export considerable quantities of receiving sets and components, and thus helping to pay for the war.

ROUND THE WORLD OF WIRELESS

"Experts in Khaki"

THE men of the Army Laundries who follow the troops into battle, and the Military Police who direct traffic under fire, were vividly described recently in the programmes in this series. Both scripts were written by serving officers in these branches.

Europe is Listening

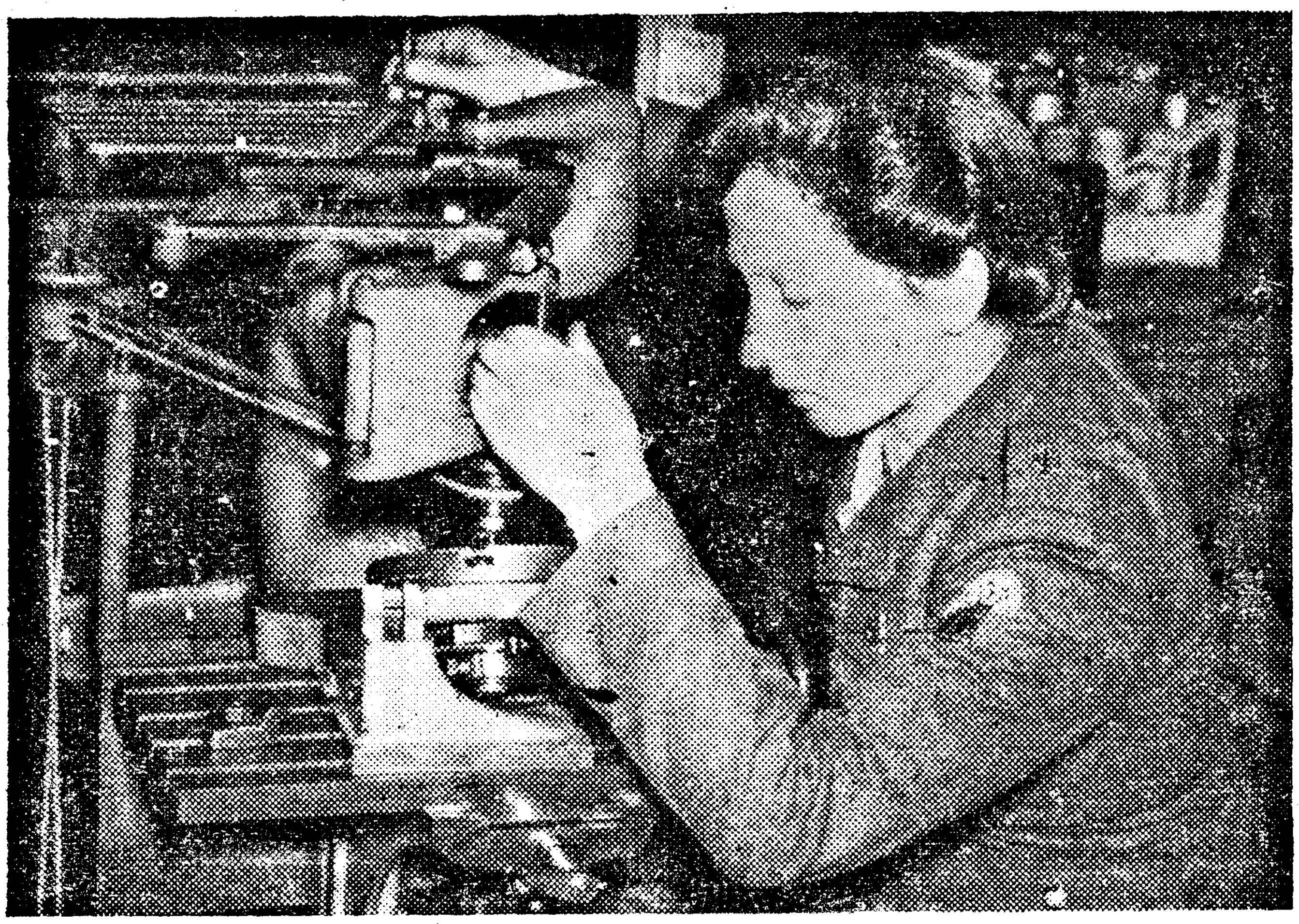
EVIDENCE of European listeners' response to B.B.C. broadcasts continues to reach the B.B.C. The ingenious ways in which it gets to this country will make thrilling reading at such time when it may be disclosed.

"Starvation in Greece"

THOUSANDS of Greeks have died, and thousands more are sick and under-nourished because some of the essentials of life are lacking. Greece has suffered more from starvation than from any other form of Nazi misrule. In a recent broadcast the desperate struggle of the Greeks was constructed from evidence brought by the few refugees who managed to escape. Other material was supplied by nationals of neutral countries. The programme was written by John Dickson-Carr, and was produced by Walter Rilla.

London to Cape Town by Motor-cycle

IN the first of a series of talks "Worth Hearing Again," Sergeant Wallach, of the A.T.S., recently told the story of a strange adventure when she travelled from London to Cape Town by motor-cycle. This talk was originally given in the South African Service on July 17th, 1942.



A.T.S. girls are now receiving instruction in radio work at a school in S.E. command, and our illustration shows a pupil, trained as a wireless mechanic, engraving a dial.

Saying it with Rhythm

TROOPS from the U.S.A. are living up to the American's reputation for originality. A doughboy at the American Eagle Club, London, sent his message home, in the B.B.C.'s weekly broadcast, in this form:

" Hello, family, folks and friends!
Benny here his greeting sends
Far across the water blue,
Radio brings my love to you.
I'm feeling fine; they treat me swell,
There are lots of things I'd like to tell,
But the censors threaten with whip and rack,
So I'll elucidate when I get back."

This effort was applauded by other members of the A.E.F. present.

Holland

A CORRESPONDENT from Holland recently wrote: " We listen regularly to the B.B.C. Dutch News Bulletins. They are a great support for us in the great struggle. . . In spite of the jamming we hear everything, and, as you see, our spirit is undaunted."

Czechoslovakia

A RELIABLE report from Czechoslovakia has reached the B.B.C. The tenor of the report is: " All Czechs listen to the B.B.C. as keenly as ever."

Greece

THE B.B.C.'s " Personal Messages " Service to Greece has evoked a large response and reports received from that country state that " Everyone with a wireless listens to the Greek broadcasts from London and Cairo."

Portugal

THE following is an extract from a letter received by the B.B.C. from Portugal: " Every day at the hour of the broadcast from London, the people of Portugal await your news with anxiety. Even the people in the villages, who have no wireless sets, wait in groups around the shops and other places where the Voice of London can be heard."

No Radio Repairs in Belgium

ACCORDING to a Belgian News Agency, repair work on wireless receivers and the manufacture of spare parts have been banned in Belgium and Northern France.

Music While You Work (at Night)

NIGHT-SHIFT workers in British war factories are to have music while they work at night. The programme, which commenced recently, will be broadcast for half an hour each evening from 10.30 p.m., seven days a week. This time has been chosen as most suitable after consultation with managements, workers, social organisations and the Government Departments concerned. Wynford Reynolds, the producer of these programmes, has had many requests from managements and workers' organisations during the past year for a programme to stimulate night workers upon whom there is special strain and for whom, therefore, special encouragement is needed. The Ministries of Labour, Supply and Aircraft Production have all agreed on the value of the new programme. Over six million people in thousands of factories already benefit from the tonic effect of " Music While You Work " during the day, and the new series will add millions of night workers to their number. More British factories are constantly being wired to take the programmes and the night shift broadcasts will be an extra inducement to managements to introduce music in industry, which is coming to stay.

She Praised the B.B.C.

ACCORDING to a Berne report, a woman cashier in Budapest has been detained for "insulting the Magyars and praising the B.B.C." who, according to her, broadcast true news.

"MacRobert's Reply"

THE story of "MacRobert's Reply," the bomber which Lady MacRobert presented to the R.A.F. in memory of her sons who fought and died in the cause of freedom, was told in a recent broadcast. Some personal recollections by a friend of Lady MacRobert's three sons was included in the broadcast. Two of them were killed in flying operations during the war and the other was killed while flying his own aeroplane in peace-time. Listeners heard about Douneside, Tarland, where they spent their boyhood; and the programme included reminiscences from the lives of the boys and their careers until their deaths. Lady MacRobert's "reply" to the Germans took the form of a Stirling bomber. Two members of the bomber crew described flights in it over Pilsen and Brest and how it stood up to the enemy's "flak" and fighters.

Youth's Own Magazine

THE B.B.C. is planning a Youth Magazine, which will be broadcast weekly and to which it is hoped that many members of youth organisations will contribute. The idea of this Youth Magazine is to show what young people are doing, to give them a chance to say what they are thinking, to provide opportunities for them to hear speakers of whom they have often heard, and to offer advice on many problems and to give authoritative answers to questions. There will be exchange programmes with young people from other countries and the magazine will be used to show youth's place in the world to-day.

"Youth in Action"

A POPULAR weekly feature of the Magazine is to be "Youth in Action," and many activities of both girls and boys will be recorded on the spot by one of the B.B.C.'s eight recording vans which travel up and down the country. During the winter the editors have plans for bringing groups to the microphone to describe what they are doing in their clubs, centres and units. They hope, too, to have contributors from the Dominions, from America, the U.S.S.R. China and the enemy-occupied countries of Europe, who may have stories of exciting experiences to tell.

"Information, Please"

THERE will be a corner in the Magazine for youth's own choice in entertainment and an "Information, Please" section for which members of organisations are invited to contribute questions. The editors of the Youth Magazine hope that organisers and leaders will send to their local B.B.C. Education Officer accounts of original and specially interesting activities, subjects for discussion names and addresses of amateurs who can tell what they have achieved—from swing bands to rabbit breeding — and any other information which they think may be useful.

Danish Service of the B.B.C.

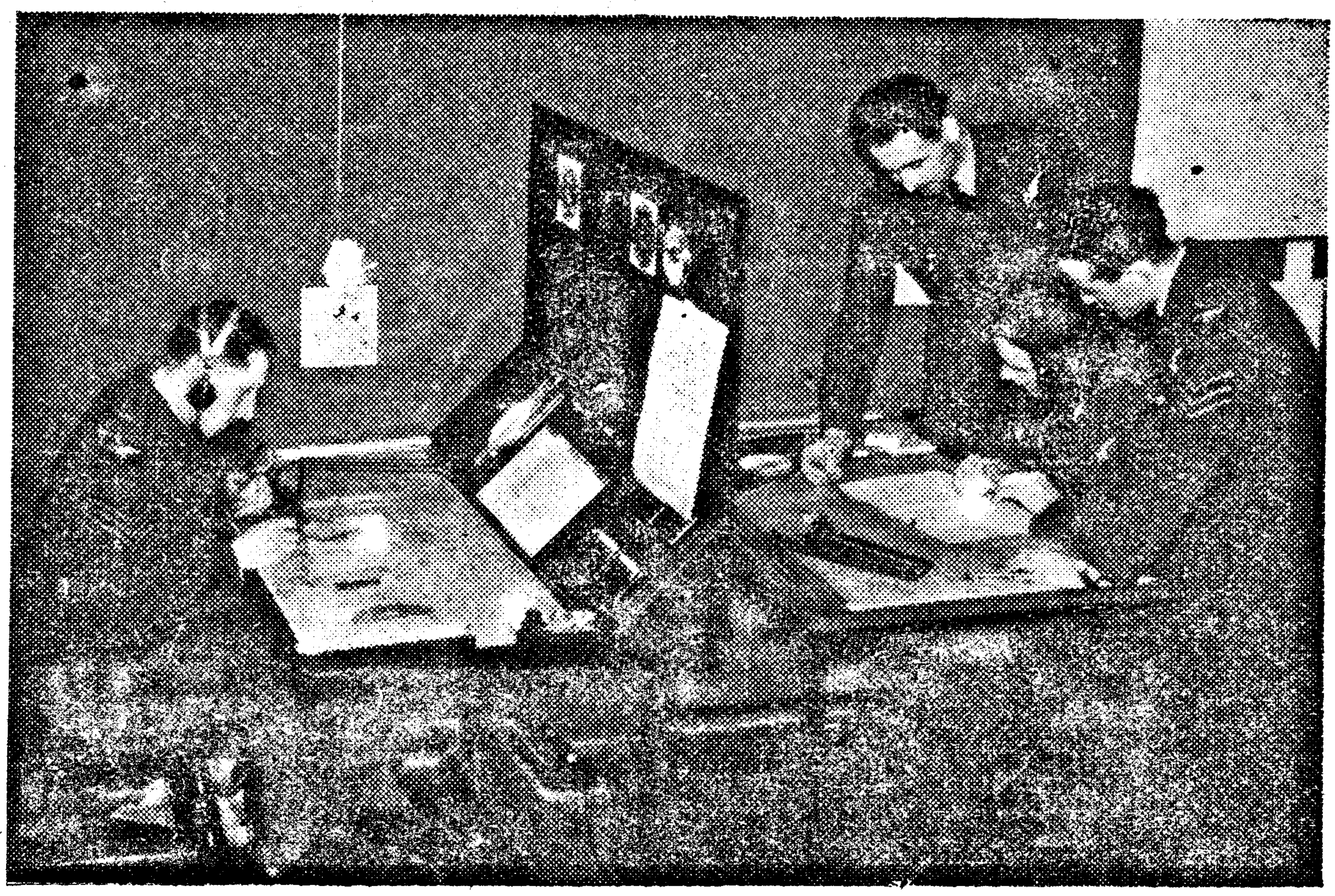
THE first book in English telling the story of Denmark as a State under Germany's protection has recently been published. It shows how much can be done in a German-controlled country to hamper the enemy's war effort without any actual incitement to disaffection. Denmark is a special case because King and Government have been left undisturbed and there is no doubt as to the constitutional legality of the régime. No attempt is made, for instance, to interfere with listening to London and there are, it appears, Churchill Clubs in the principal towns. In the Editor's room of *Politiken*, we are told, there was a large picture of Churchill hanging on the wall which infuriated the various German agents bringing their wares.

Delicate Work

THE job of the Danish Service of the B.B.C. is therefore one of extreme delicacy. It can—and does—condemn any specific act of collaboration such as Denmark's signature of the anti-Comintern Pact or any suggestion of anti-Semitic measures; debunk pretensions of the Danish Nazi elements, and nurse the feelings of national pride in the traditions and achievements of democratic Denmark. But it does not make any attempt to preach open resistance or revolt against the orders of the Danish Government. One of the most useful services performed by the "Voice of London" is in "boosting" the Danish Council as speaking for all patriotic Danes in the gathering of the free nations of the world. Another is to bring to the microphone men who have escaped by sea or by air to fight for the Allied cause. Contrary to the statements by Mr. Sten Gudme, author of the book mentioned above, Danish airmen coming to Britain to serve with the R.A.F. regularly broadcast stories of their experiences.

March of the Movies

ON August 23rd, the first of a new series of film programmes was broadcast on the Forces wavelengths. This "March of the Movies" has been devised and written by Harry Alan Towers, author of a great many variety and record programmes. The series will be a parade in retrospect of some of the better moments in film history, coupled with a survey of the cinema of yesterday, to-day and to-morrow. It is not intended as a history of motion pictures, as each programme will be complete in itself.



The last test before an operational flight. Navigation exercise for observers in Bomber Command; the instructor gives orders from the other side of the board.

All-wave Aerial Systems

Practical Details Concerning the Erection of Suitable Aerials and the Making of Impedance Matching Transformers

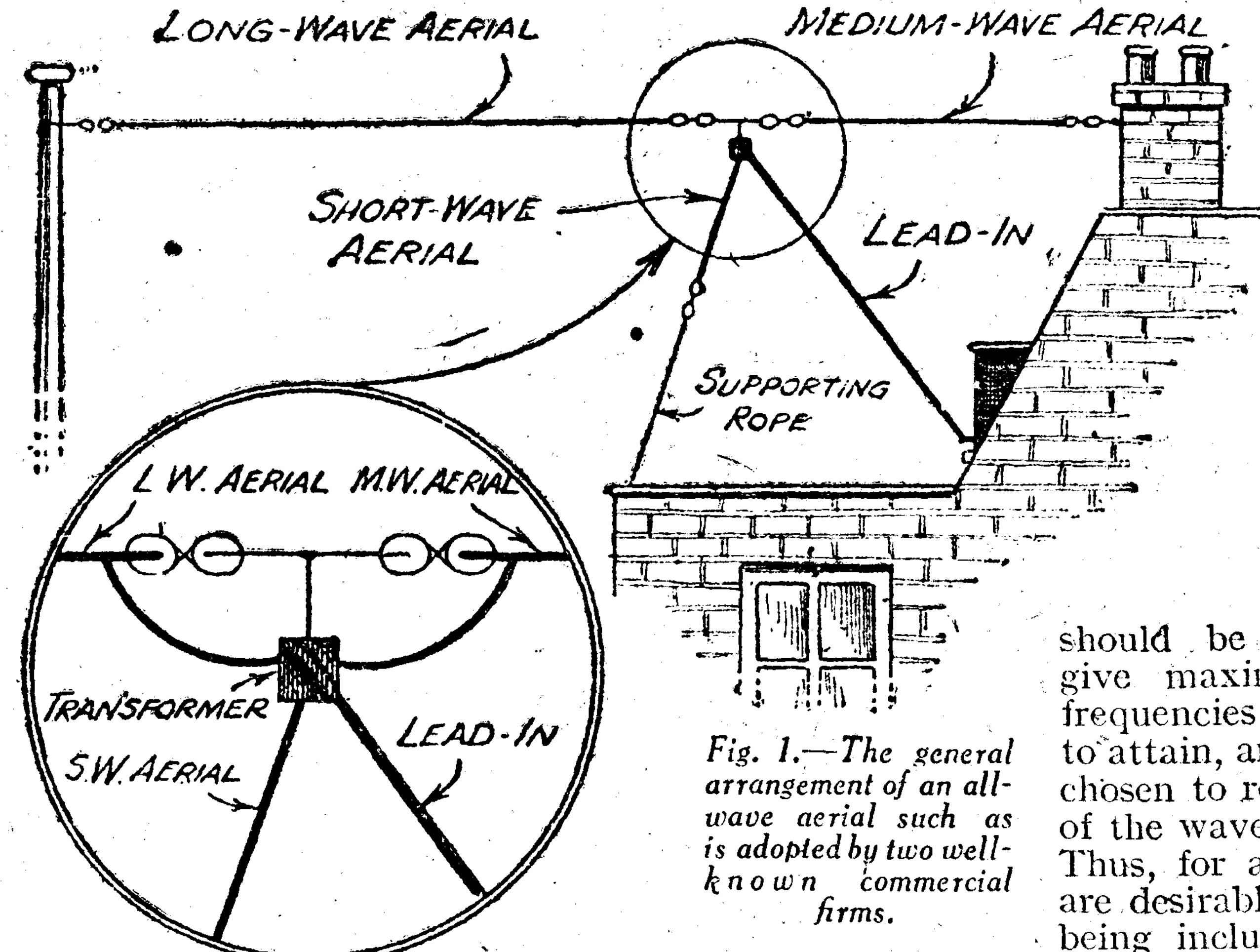


Fig. 1.—The general arrangement of an all-wave aerial such as is adopted by two well-known commercial firms.

THE increasing use of all-wave receivers has resulted in an increase in the interest of aerial design, as it is now found that the standard single-wire aerial does not afford maximum results on all of the wavebands covered by the modern receiver. Even in a modern two-band (medium and long-wave) receiver, a single horizontal wire is necessarily a compromise, and is generally erected to provide maximum resonance on the wavelength which is found to be most difficult to cover with the particular receiver in use. Of course, many listeners simply erect any length of wire which can be accommodated in the garden space which is available, and then devote their energies to designing or modifying the receiver to give the desired results. Where, however, serious interference is experienced, either from passing motor traffic, or from electric signs erected on buildings adjacent to that in which the receiver is installed, the listener is forced to adopt some form of anti-interference aerial.

All-wave Aerials

A modern all-wave receiver may be said to cover one short-wave band in addition to the two normal broadcast bands, and thus a short aerial is found very useful in providing maximum response on the short-wave band. Where two short-wave bands are included, even two short-wave aerials may be found desirable, although not essential. For medium waves an aerial of about 30 feet is generally found most useful, where for long waves from 60 to 100 feet provides maximum results. The longer aerial often only introduces difficulty on the medium waves, due to the fact that it decreases selectivity due to the larger amount of energy which it picks up, as distinct from its resonant frequency. It should be understood, of course, that the aerial system (which includes the aerial, lead-in wire, earth wire, and the coil connected between aerial and earth terminals) will resonate at a particular frequency dependent upon its inductance and capacity. When the grid circuit to which this is coupled is tuned, the aerial is also tuned, due to the coupling between the aerial and grid coils, but the resonance is most pronounced at the natural frequency of the aerial system. At harmonics of that frequency, it will also provide strong resonance, and therefore it should be possible to find a length which will give maximum response at two or three different frequencies or wavelengths. In practice this is not easy to attain, and it is preferable to use separate aerials, each chosen to resonate at a frequency roughly in the centre of the waveband covered by the tuning coil being used. Thus, for a three-band receiver, three separate aerials are desirable, a short wire, say 10 feet or so in length, being included, in addition to the 30 feet and long wire previously mentioned. These may be arranged in many ways, and one of the most convenient for the amateur is depicted in Fig. 1. Here the two broadcast aerials are joined end to end (insulated at the junction) and the short-wave aerial is suspended from the point at which they are joined.

A Complication

If the performance to be obtained from the receiver has to reach a very high level it may be necessary to use even more than these three aerials, including other lengths to resonate at some other part of the wavebands covered. Such an aerial is very popular in America and is known as the spider-web aerial, a diagram of it being given at Fig. 5. It will be seen here, however, that the aerials each consist of a dipole, or half-wave aerial, each built up from two quarter-wave aerials, and this necessitates twin feeder wires from the centre point. The advantage of an aerial of this type is that the feeder wire (or lead-in) will not pick up any energy, as it is either screened or transposed throughout its length. This is the arrangement which has to be adopted if local interference is experienced, as the aerial array may be

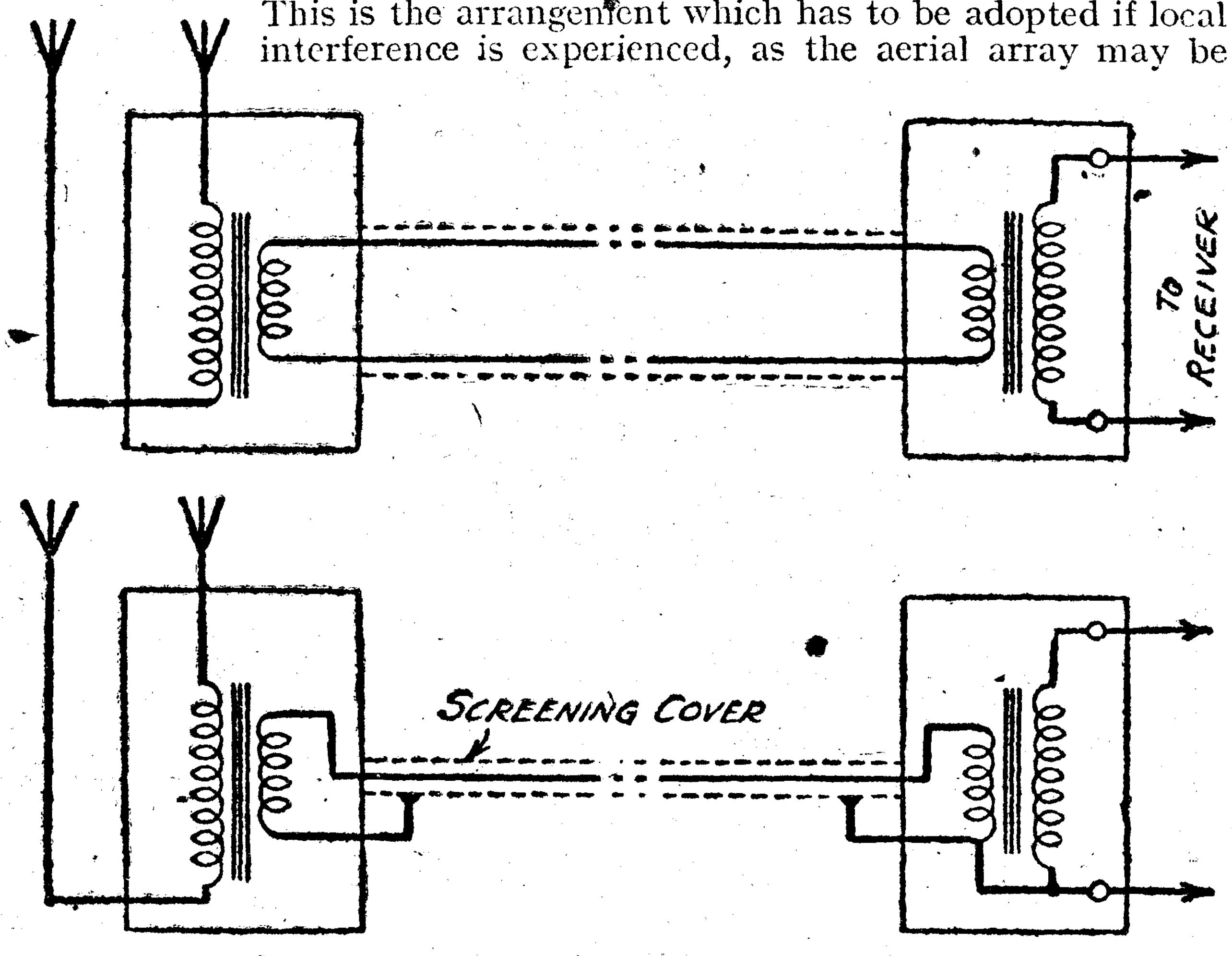


Fig. 2.—Two methods of connecting impedance-matching transformers.

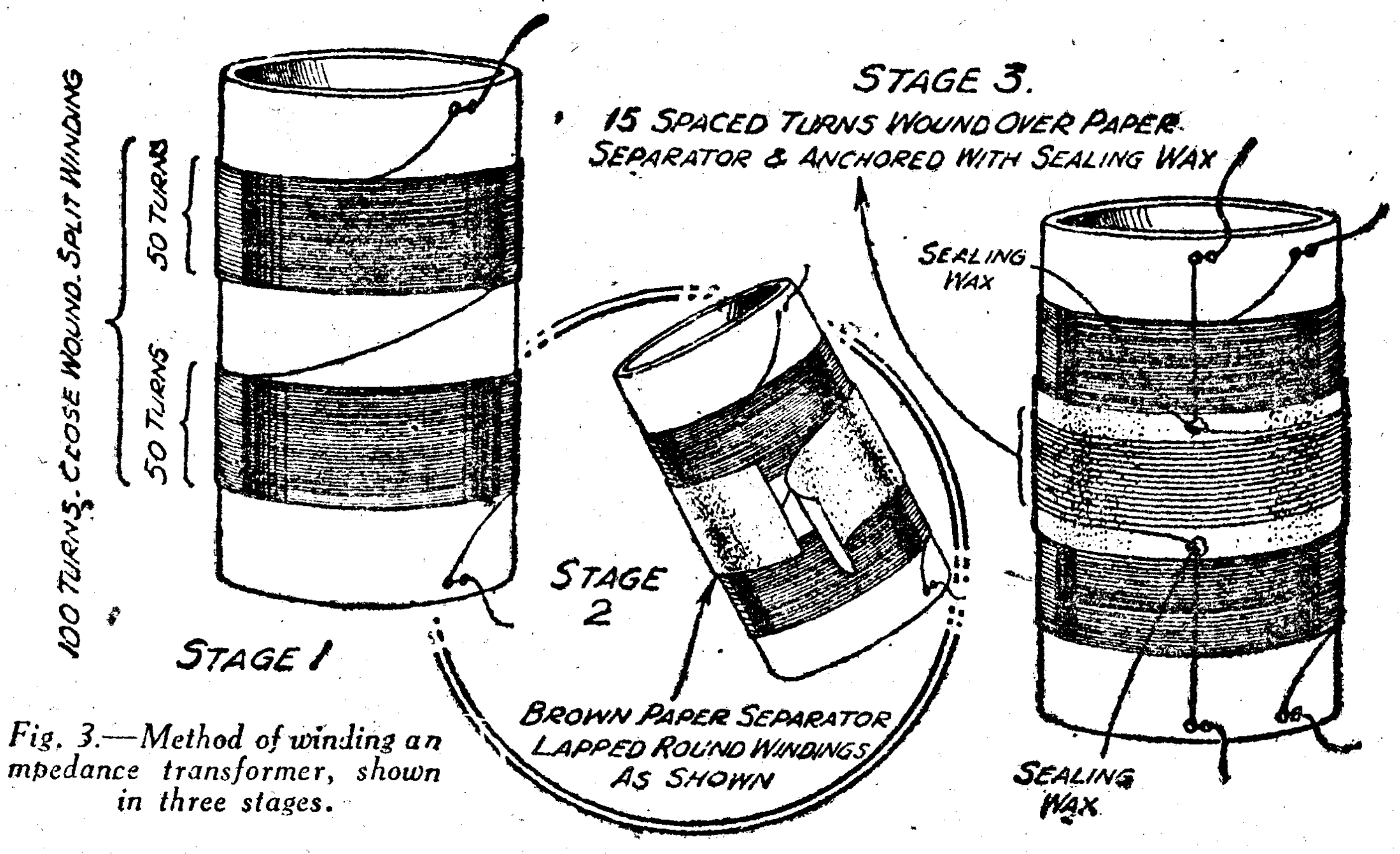


Fig. 3.—Method of winding an mpedance transformer, shown in three stages.

placed well away from the building (out of the area of interference) and the lead-in will play no active part in picking up the signals. If a very long feeder is needed it will be necessary to include two transformers in the aerial system, one at each end of the lead-in, to balance out losses. This is carried out by using a step-down transformer at the aerial end and a step-up transformer at the receiver. The two sections of the transformers which are connected together form a low-impedance circuit and consequently the capacity between the feeders will not have such a marked effect upon the signals which would otherwise be seriously interfered with. Transposed feeders, generally, do not need the inclusion of the transformer, provided the transposition blocks give adequate spacing between the two wires. The twin feeder consisting of two wires will require the transformer, and the usual way of arranging such a feeder is to use parallel-laid insulated wires in a heavy rubber cable. An alternative scheme is to use a single wire laid inside an insulated cable with a braided metal screen surrounding it, and this screen may form one of the feeder wires by being connected to one side of both transformers. The separate schemes are shown in Fig. 2. In place of a simple transformer, an auto-transformer or tapped coil may be used, or a tuned transformer incorporating fixed condensers, such as is used in some commercial units (Fig. 6), may be employed. The capacities will depend upon the coil windings, and it may be desirable for the amateur to experiment to find the most suitable values for his particular aerial and receiver system.

Incorrect Matching

One important point which must not be overlooked is that at the receiver end the tuning circuit may be such that the maximum effect is not obtained from the impedance-matching transformer, and this fact should not be lost sight of when a commercial all-wave anti-interference system is purchased. Generally, these are designed by the makers primarily for use with their receivers, and although they may not necessarily fail to give satisfactory results on other receivers, the aerial circuit may require modification in order to provide the maximum effect. An existing aerial circuit may easily be modified by winding a small coupling coil over the present grid coil (the number of turns and the spacing again having to be found by experiment) and connecting each end of this to the aerial and earth terminals for subsequent connection to the impedance-matching transformer.

Transformer Design

The majority of modern impedance-matching transformers employ iron-cored coils, providing a high inductance-capacity ratio, and are accordingly beyond the scope of the average amateur to build. Alternative designs may be wound on small diameter formers, however, and a small low-loss switch employed on the secondary for wave-change purposes. It will be appreciated, of course, that no switching is required at the aerial end to separate the individual wires, as these automatically resonate to the frequency to which the receiver is tuned, by reason of the tight coupling existing between the aerial and the tuned circuit. A design which has been found to offer good results from an all-round point of view is to wind the aerial transformer (that is the one joined direct to the multi-aerial system) with a primary of 100 turns of 28 D.C.C. wire on a 1in. diameter former, and to split this into two equal sections, separated by ½in. Over the centre space three or four layers of thick brown paper are wound, and in the centre of this 15 turns of a similar gauge of wire are wound for the secondary. The ends of this winding should be anchored with sealing wax or Chatterton's Compound, and taken straight across the primary at right angles before being led through anchoring holes in the former for connecting purposes.

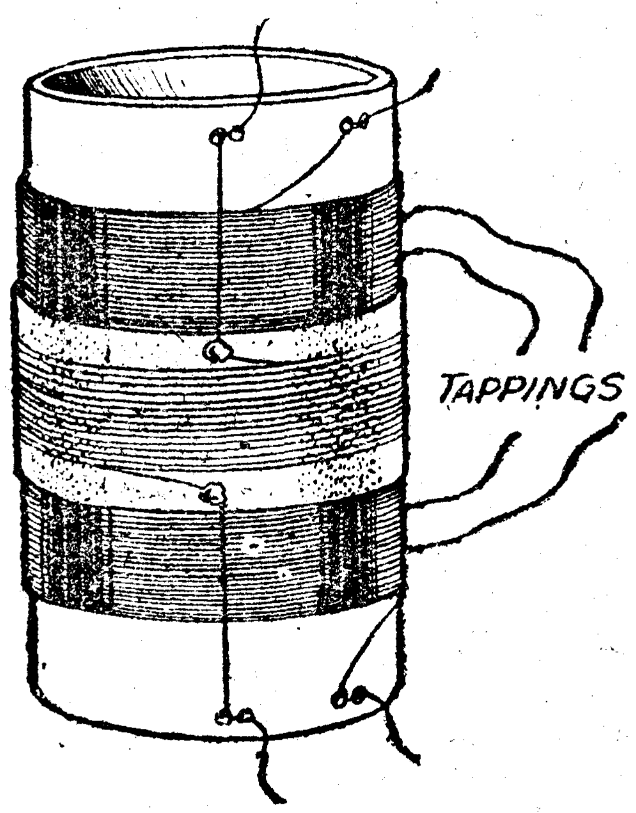


Fig. 4.—The receiver transformer having tappings on secondary.

This coil should be mounted inside a small aluminium screening can, and the bottom of this should be sealed with a disc of waxed wood or ebonite. Chatterton's Compound or some similar wax will make it waterproof, and the holes through which the ends of the aerial and lead-in are passed should also be sealed.

The receiver transformer will be wound in exactly the same manner, but the larger winding (which is

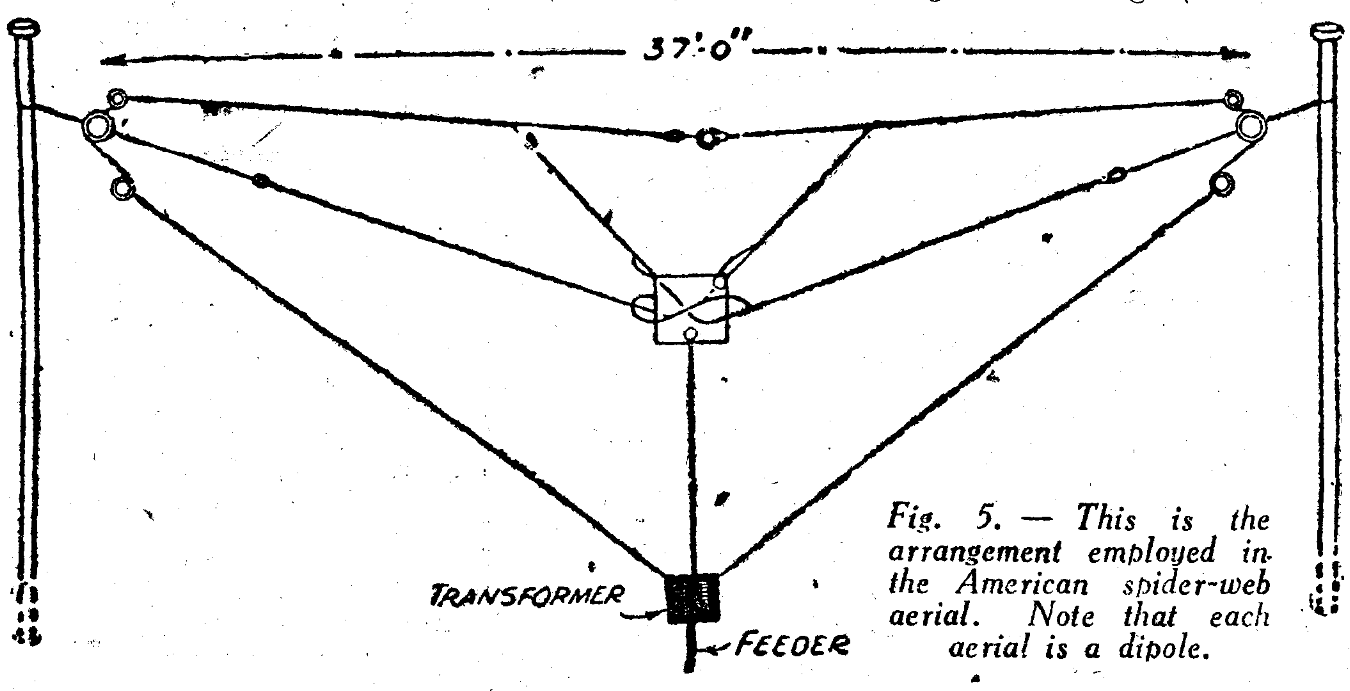


Fig. 5. — This is the arrangement employed in the American spider-web aerial. Note that each aerial is a dipole.

in this case the secondary) must be tapped to provide the necessary wave-change selection points. The ideal system is to use a two-point switch so that equal tappings are selected from each end of the secondary, although in many cases it is quite sufficient simply to transfer one connection by stages down the secondary, leaving the earthed end permanently connected. Figs. 3 and 4 show these arrangements.

The receiver transformer should be mounted as close as possible to the aerial and earth terminals of the receiver, and the leads to these terminals should also be screened.

It must be emphasised that these details will not apply to every set, and therefore the constructor must be prepared to carry out some experiments as previously mentioned.

It is in this direction that the subject is worthy of every constructor's attention; during existing conditions, when normal receiving activities are somewhat limited, more time is available for experimental work, and one could not wish for a more interesting subject than that which is discussed in this article. It possesses the additional attraction of lending itself to the combined work of two or three enthusiasts, as a fair amount of time has to be devoted to the planning and erection of the many aerial arrangements which can and should be explored if one wishes to be to the front when activities resume their normal magnitude on the arrival of peace. One item must be stressed: during all the experimental work and tests, observations should be recorded so that one has accurate details of the result of the various tests in writing.

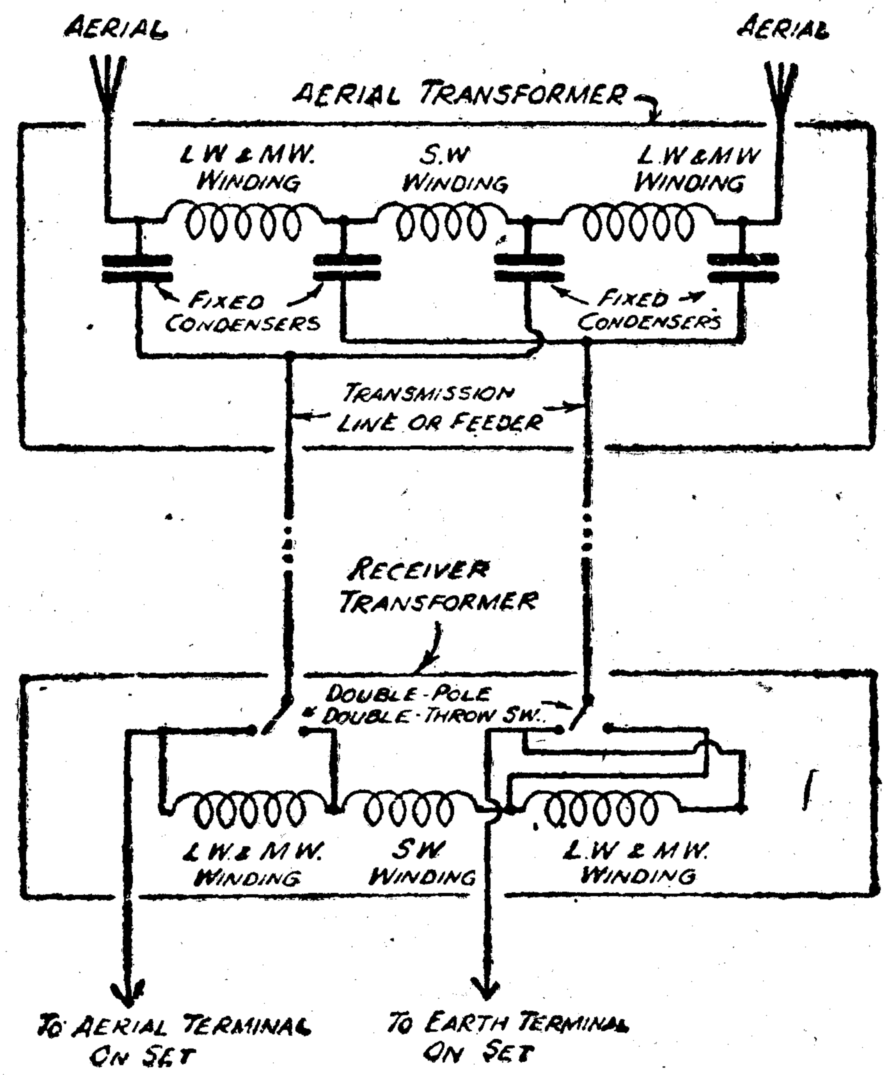


Fig. 6.—The circuit arrangement employed in the B.T.S. anti-interference all-wave aerial system.

Wanted–Old Gramophone Records

Nation-wide "British Legion" Salvage Campaign

ON Saturday, August 15th, a nation-wide campaign was launched for the salvage of ten million old and unwanted gramophone records. They are needed for the recovery of shellac—and the need is urgent! The scheme is operating through all British Legion branches throughout England, Scotland, and Wales, and will continue until September 30th.

Detailed arrangements have been made for prompt and efficient handling and transportation of all records handed in to British Legion branches—and in case you don't know where *your* local Legion branch is, enquire at your post office, and they'll gladly advise you.

Old-fashioned cylinder records, or cracked and broken discs are *not* required, but discs which have the edges chipped are acceptable. Every ten or twelve-inch disc, single or double-sided, of the following brands is urgently needed, provided that it is not broken or cracked:

H.M.V., Columbia, Parlophone, Regal-Zonophone, Zonophone, Brunswick, Decca, Rex, Panachord.

Gramophone record dealers all over the country are giving the scheme enthusiastic support, and are displaying window bills urging the public to take their old and unwanted records to the nearest British Legion depot.

British Legion depots are also displaying posters inviting the public to bring in the much-wanted discs, and the secretaries of the branches are carrying out all kinds of publicity "stunts" to attract more and more records for salvage.

Radio Publicity

Public interest will be sustained throughout the campaign by radio broadcasts, and several stars of the stage and screen have already promised to give up some of their old gramophone records, so that more new ones can be made.

Recorded music is vitally important these days, not only to provide valuable relaxation for the war worker in his "off-duty" hours, but in the Services and industrial canteens; in factories for "Music While You Work," where lively tunes relieve the tedium of monotonous repetition work, and make the working day seem shorter for thousands of men and women.

Recorded instruction for the fighting services, covering every branch—R.A.F. training, Army Commands, how to identify sounds from "upstairs" when submerged many fathoms under the waves in a submarine, sounds which will mean friend or foe aloft. Vital arm in our fight for democracy—the spoken word—is carried to all parts of the world, in dozens of languages and dialects, by means of recorded messages, transmitted through the ether by short-wave broadcast.

Shellac is an essential to gramophone record manufacture, and has to be imported to this country; supplies are short and shipping space is scarce—urgently needed for other vital munitions of war.

To part with old gramophone records may mean a wrench, sentimentally, to some: to many of us it will be a very welcome opportunity to dispose of old accumulations, long unplayed, and taking up room which could be better used.

The British Legion is sharing the income from the salvaged gramophone records "fifty-fifty" with the Hospital for Sick Children, Great Ormond Street, London.

What further inspiration could be needed—you meet an urgent National need, and you benefit two grand institutions at the same time—all by giving up old, unwanted gramophone records.

It is our private guess that the target of "ten million records" will be passed easily, rapidly, and with a desire to break records with records.

Coupling the H.F. Stage

Technical and Practical Considerations of Various H.F. Couplings are Dealt With in This Article

THE effective range of a receiver is governed by the field strength of the transmissions at the receiving aerial, the efficiency of the aerial system, and the overall magnification obtainable from the receiving circuit employed. This is assuming that interference is negligible, and that the signal-to-noise ratio does not have to be considered.

It would appear from the above remarks that with the modern high-powered stations it is only a question of perfecting the detector system in a receiver, and making the aerial as efficient as possible, to enable the more distant transmissions to be consistently received with ease.

Unfortunately, this does not apply in practice. There

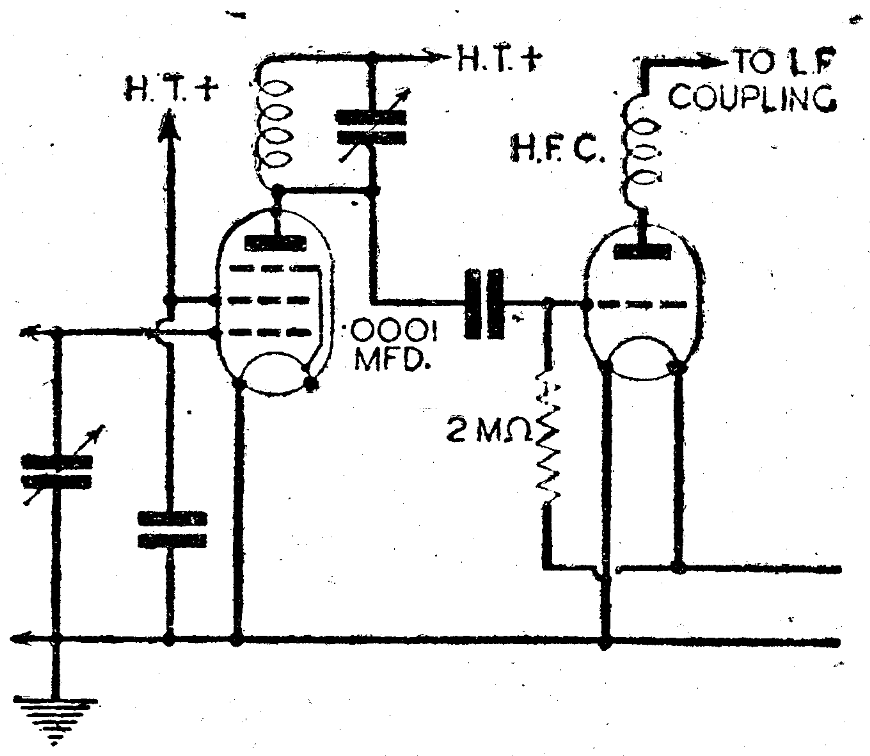


Fig. 1.—The fundamental circuit of tuned anode-coupling, using an H.F. pentode and triode detector.

is no hard and fast rule which allows set designers to determine the field strength of any one transmission over a large area. It is not possible to say that a transmitting station 1,000 miles away, using 25 kilowatts in the aerial, will give a certain field strength in London or Wigan. Too much depends on the characteristics of the radiating system; the atmospheric conditions at any given instant; geographical considerations, and the reception conditions of the area in which is located the receiving aerial.

It is possible, however, for the designers of receivers to specify that a signal of certain strength is required to allow a receiver to give entertainment volume, or fully load the output valve or valves used; therefore, if a receiver is required for long-distance reception they can base their calculations on an average, and provide sufficient stages of amplification to allow a reasonable factor of safety, or reserve.

Detector Valve Limitations

Most constructors will have found that a detector valve has, for practical purposes, a certain operative range. Stations outside that range cannot be considered to be of entertainment value, no matter how the reaction is pushed up, or how much one attempts to improve operating conditions. The output strength of the signal can, of course, be boosted up by means of L.F. stages to provide additional amplification, but there are limits in that direction.

With any detector handling the aerial input, it is useless to provide excessive low-frequency amplification for the purpose of logging distant stations, as one has to consider the question of interference and selectivity. There might be exceptions to the above in areas remote from a powerful station, but with our present broadcasting system it would be rather difficult to find such a spot.

To obtain the desired results, the designers approach the problem from the other side of the detector and, by so doing, they are not only able to obtain an increased signal strength at the detector, but they also improve the overall selectivity of the receiver.

The method they adopt is to amplify the signal before it reaches the detector valve, by what is termed H.F. or high-frequency amplifiers which make use of the modern screened grid or H.F. pentode valves. We are not concerned at this stage with the superheterodyne.

As the H.F. amplifier comes between the aerial and the detector, it becomes necessary to provide some form of coupling to allow the signal to pass from one valve to the other. This is provided by means of one or more tuned circuits, making use of a variable condenser and coil, or coils, which, if properly designed, immediately tend to improve the selectivity of the pre-detector part of the receiver.

Types of H.F. Couplings

There are various forms of H.F. couplings in general use, all serving the same purpose, but each having individual characteristics, the selection depending on designers' requirements and the receiver under consideration.

One of the couplings widely used in the early days of radio and, incidentally, back in favour again now, is that shown in Fig. 1. By virtue of the fact that the tuned circuit is included in the anode circuit of the H.F. valve, it is known as "tuned anode" coupling.

When examining the circuit, it should be noted that the coil is in series with the positive H.T. supply to the valve, and that the fixed and moving vanes of the variable condenser are at H.T. potential. When separate tuning condensers were in use, this did not cause any serious consideration, but now that ganged condensers are so widely used, the arrangement is likely to prove rather awkward in view of the fact that all the moving vanes are common to each other. As the aerial circuit

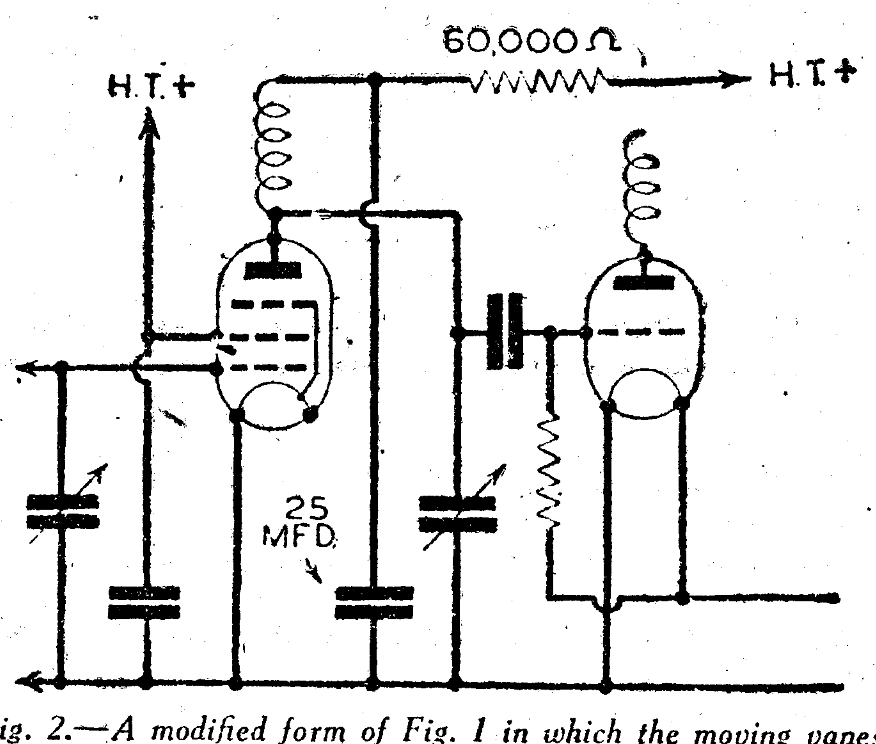


Fig. 2.—A modified form of Fig. 1 in which the moving vanes of the tuning condenser are at earth potential.

has one side at earth potential, it is obvious that a short-circuit of the H.T. would result when a ganged condenser is used in conjunction with the two circuits.

As the method of coupling has certain desirable features, experiments revealed that the circuit shown in Fig. 2 could be used in such circumstances, the moving vanes being at earth potential, thus removing the previous snag.

Good Screening Essential

With a properly designed coil, a high degree of magnification and selectivity can be obtained, but it is essential to see that adequate screening is provided, otherwise unwanted interaction will take place between the anode and aerial coils, or other inductances in close proximity.

The necessity for good screening will be readily appreciated if it is remembered that the anode and the grid circuits of the valve are tuned to the same frequency, thus the slightest feedback between the two circuits will cause the valve to oscillate. For this reason a screened-grid or H.F. pentode is essential, as either offers far less possibility of its inter-electrode capacity providing any feed-back.

The coupling is not to be recommended for circuits embodying more than one stage of H.F. amplification.

H.F. Transformer

The form of coupling is shown in Fig. 3. Two inductances or coils are used, the secondary being tuned in the normal way. The two coils are inductively coupled, and it is possible to control the amount of energy transferred to the detector valve by "a," the degree of coupling provided between the two coils, and "b," by the ratio of the primary turns to the number of turns on the secondary.

The coupling is usually very stable, provided that a high ratio is not used and normal precautions are taken regarding screening. With some makes of transformers it is necessary to provide switching on the primary side and, as it is carrying H.T., this sometimes adds complications. It is possible, however, for the primary to be designed so that its frequency response is fairly flat, thus dispensing with switching, but, unfortunately, reducing the maximum efficiency.

Very interesting experiments can be carried out by constructing transformers of this type and trying various ratios and couplings.

Tuned-grid Coupling

This can be considered as a parallel-fed tuned-anode coupling, though the circuit shown in Fig. 4 reveals that

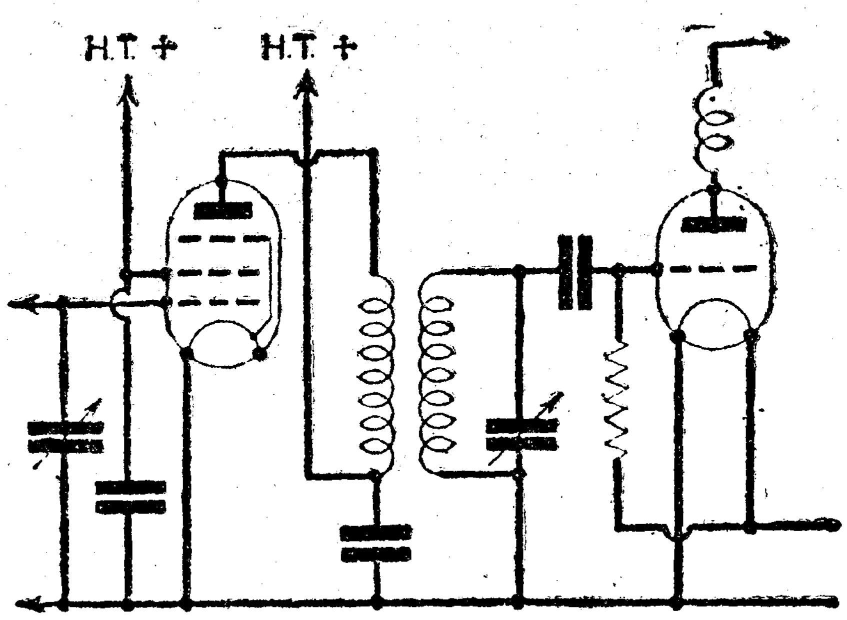


Fig. 3.—A normal H.F. transformer coupling, which is usually very efficient and stable. It is best to provide wave-change switching on primary and secondary.

it is, as the name implies, the grid circuit which is actually tuned. The arrangement possesses the advantage that no high tension is in the tuned circuit, thus allowing ganged condensers and simple switching to be used without any undue consideration. It is very efficient, providing the H.F. choke is, in itself, efficient over the wavebands covered by the receiver. A poor component can account for serious losses; therefore, particular attention must be paid to its choice. One of the screened variety is best.

If more than one stage is used, it is advisable to see that there is no possibility of interaction between the chokes, and if one is also used in the detector anode circuit, it is advisable to select either different makes or types. This procedure is suggested in view of the possibility of an H.F. choke "peaking" or resonating at a certain frequency, apart from the question of interaction. The degree of coupling can be varied by using different capacity coupling condensers, which, by the way, should be of the mica dielectric type, or by tapping the connection from the condenser down the grid coil towards the earth end.

In many circuits, it is advisable to tap the grid condenser connection down the coil, this helping towards improved selectivity and stability, but if one is interested in making coils, experiments should be carried out to determine the best settings. With any of the above

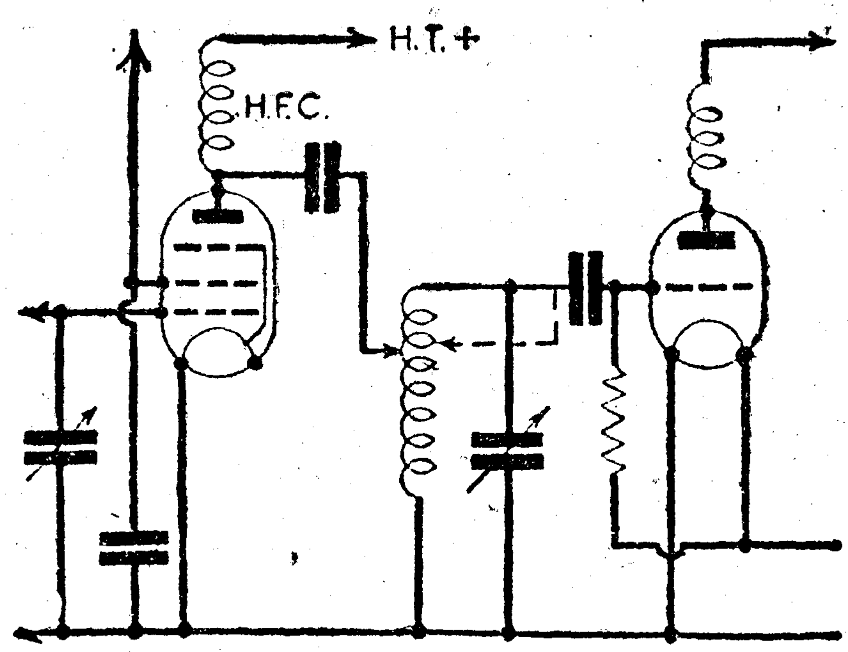


Fig. 4.—A most popular circuit known as tuned-grid. A good H.F. choke is essential.

forms of coupling, it must be remembered that if ganged condensers are to be used, all the coils must be matched as regards inductance values, otherwise satisfactory tuning over their total waveband will not be obtained.

When carrying out any experiments with H.F. stages or couplings to determine their relative efficiency, it is useless tuning in a powerful signal; tests should be made on a weak transmission, as any amplification will then be more readily detected.

Books Received

RADIO SIMPLIFIED. By John Clarricoats. Published by Sir Isaac Pitman and Sons, Ltd. 92 pages. Price 4s. 6d. net.

THIS book follows on the author's popular "Radio Simply Explained," and is written in the same easy and non-technical manner. Explanations of radio principles are simple and lucid. Its primary purpose is to provide beginners with a background of fundamental radio knowledge which will help them considerably in their study of the subject. The text is illustrated with 50 diagrams.

WIRELESS TERMS EXPLAINED. By "Decibel." Published by Sir Isaac Pitman and Son , Ltd. 74 pages. Price 2s. 6d. net.

IN this useful handbook, simple explanations of wireless terms in common use are given, and many of the explanations are amplified by the addition of practical information likely to be of value to the non-technical user of a wireless receiver. The more technical reader will also find the book useful for reference purposes. There are several diagrams to illustrate the text.

REFERENCE DATA FOR RADIO ENGINEERS.

A VALUABLE booklet under the above title has recently been published at 2s. by Standard Telephones and Cables, Ltd., Connaught House, 63, Aldwych, London, W.C.2. It contains 60 pages of formulæ, data, and tables, covering acoustics, aircraft wiring, audio-amplifier design, cables, comparative resistances, conversion tables, copper wire tables, distortion, E.M. and E.S. system of units, mathematical and radio formulæ, logarithms, etc.

Servicing Mains Receivers

A Series of Practical Tests to Assist Those Not Familiar with A.C. and A.C./D.C. Sets

OWING to the absence of the majority of service engineers, many constructors are endeavouring to help their friends when they experience trouble with their receivers.

While the average amateur can cope with the more simple battery-operated sets, many are unable to locate and rectify the faults which appear in receivers of the all-electric types. This is due to three reasons, each of which should be noted by the would-be service man, and remedied as quickly as possible. They are: 1. Inexperience with such sets; 2. Lack of theoretical knowledge of the individual sections of a mains-operated circuit; and 3, the fear of tackling the wiring and layout of an assembly which appears to the untrained eye very complicated.

Essential Practice

If you can read a theoretical diagram—and no one should attempt service work unless they can—devote as much time as possible to the examination of all the theoretical circuits of mains receivers you can lay your hands on. Keep at it, until the various sections of the circuits, such as different biasing arrangements; rectifier and smoothing equipment; methods of feeding the screening-grids with H.T.; energised speakers and heater supplies and wiring are absolutely mastered. At this stage it is well to remember that the remainder of the circuit, or the fundamental circuit, is exactly the same as its battery counterpart, with the exception that the resistors may have a higher wattage rating, and the fixed condensers a greater "working volts" rating. These are necessitated by the fact that the H.T. operating voltages are generally much higher than when a dry battery is used. This point should always be borne in mind when making any replacements; it is dangerous to take chances by using a component of unknown rating.

As regards reason number three, there is, perhaps, some justification for an amateur unfamiliar with mains sets—especially when commercially produced—feeling rather doubtful about probing into extensive wiring and strange-looking components, but all this will not appear so awe-inspiring if the investigator remembers the items stressed above, and has acquired a reasonable theoretical knowledge. If the type of circuit or valve sequence is known, one should know what to expect in the way of coils, tuning condensers, L.F. couplings, and so forth. It is obvious that the anodes of the valves will be connected—perhaps in a roundabout way and through certain components—to the H.T. positive supply line; the same applies to the screening-grids of S.G. and pentode valves. The cathodes of indirectly-heated valves are normally connected to the common negative earth line, which is usually the metal chassis, but, once again, the connection will not always be direct. When the valves require bias, it will be found that the connection is taken through a small fixed or variable resistor, across which is connected a fixed condenser. Speaking of bias, to allow the grid of a valve in a mains set to receive its correct bias, the grid circuit is returned to the negative earth line. This does not apply in the same sense to those valves of the variable-mu type receiving bias from an A.V.C. arrangement, as in the majority of modern superhet sets.

If an energised speaker is included, the field is, in the majority of cases, connected in series with the H.T. supply, i.e., the rectifier, in place of a smoothing choke. The field winding, in conjunction with two large capacity fixed condensers, provides the required smoothing.

Simple Preliminary Tests

Assuming an A.C.-operated set appears to be "dead," here are some simple but informative tests which can be applied without—in most instances—removing the chassis from the cabinet. It is taken for granted that an energised speaker is incorporated in the positive H.T. line, as mentioned above. For the tests, a low-reading milliammeter, a 1,000-ohm resistor, a three-volt dry battery and a 120-volt battery. If a "universal" type of test meter is to hand, it will, of course, render these items unnecessary, as it can be used to carry out all the tests given below.

A receiver undergoing a thorough test, during which the performance of individual components and sections of the circuit is noted, in the Cossor factory.

First of all, place the receiver on a clear bench or table where adequate lighting is available, the testing gear being located in a handy position.

Test number one. Remove cover from adaptor or two-pin plug fitted to the end of the mains lead. See if the two wires are making perfect contacts to the metal parts, and if they are secure. Examine insulation of the wire, replace cover after making any necessary repairs or adjustments. Note, it is not unknown for one of the wires to be fractured and free from its anchorage on the fitting, and in many such cases, making the necessary connection has brought the set back into operation.

Test number two. With the on-off switch in the "on" position, apply the milliammeter and small dry battery—connected in series—across the two contacts on the adaptor or plug, and note if deflection is obtained. No reading will indicate that the primary winding of the mains transformer is broken down or that the on-off switch is not making contact. If a reading is indicated as it should be, test between one side of the adaptor and the chassis of the receiver. No reading should be obtained. If one is, it denotes a leakage between primary winding and the transformer frame, due to a breakdown in the insulation, and this must be rectified.

Valves and Heater Wiring

Test number three. Remove all valves, making a note of their positions, and fixing any top cap connections so that they do not touch any metal parts of the assembly. With the 1,000-ohm resistor in series with the meter and battery, test the heaters for continuity by applying the meter, etc., across the appropriate pins. A reading should be obtained.

Now apply the same meter assembly to the heater sockets of the various valve-holders, remembering that the output valve and valves in push-pull may have separate heater windings. A reading will be obtained if these windings are O.K. The rectifying valve always has, in A.C. sets, a heater winding separate from the other circuits.

H.T. Line

Test number four. With the 1,000-ohm resistor out of circuit, apply meter and battery across the grid and anode sockets of the rectifying valve-holder. This will test the H.T. winding of the transformer and a reading should be obtained. Test between grid socket and chassis, and then anode socket and chassis. This will test each half of the winding and the continuity of the centre tapping point to earth. These tests apply to a full-wave rectifier ; if a half-wave system is employed, the meter must be placed across the anode-grid sockets and the chassis.

Test number five. Test for continuity of speaker field by placing meter across field winding. A reading should be obtained. Now connect meter between one socket of the rectifier valve-holder and each side of the field winding in turn. This will prove, by giving a reading, that the H.T. line to the field is intact. Note that one connection will give a very much lower reading than the other. From that side of the field, connect the meter to the chassis, this giving a test for short circuits—on the set side of the H.T. line—between H.T. positive and earth. Repeat test between other side of field and chassis. No reading should be obtained, but if any short circuit has developed through one or both of the smoothing condensers, or through any other component connected to the H.T. positive line, a reading will be produced. When making the last two tests, it would be advisable to include the 1,000-ohm resistor in circuit, to prevent an excessive reading, which could be produced by a short, from damaging the meter.

It must always be understood that in some circuits a potentiometer is connected across the H.T. supply, often in the case of the H.T. feed to the screen-grid of an S.G. or pentode valve ; therefore, should a higher voltage be used with the meter, it is possible for a low reading to be produced. If any doubt exists, the potentiometer should be disconnected from the H.T. line or chassis, but this is only possible if the chassis is removed. If the theoretical circuit of the receiver is available, it will be possible to see if such a component is wired in the manner mentioned, and the necessary allowances made.

Speaker Transformer

Test number six. Plug one side of the meter circuit into the anode socket of the output valve, and connect the other side to one side of the primary of the speaker transformer. Repeat, using the other side of the primary. As with the field winding, one connection will give a much lower reading than the other, but if the primary is O.K. readings should be obtained in both instances. No reading on one side will denote a broken-down primary winding. With the 1,000-ohm resistor in meter circuit, apply a test across the secondary of the speaker transformer. This will test that winding or the speech coil, but not both at the same time. The only satisfactory way of checking both windings is to disconnect one side of the secondary from the speech coil and apply the test to each winding independently. If the disconnection is not made, it would be possible for a break to exist in the secondary, but a reading would be obtained through the speech coil which is in parallel with the former.

Radio Terms Defined : Inductance

INDUCTANCE plays a very important part in the design and operation of both radio receivers and transmitters. It is present in many forms. Tuning coils. H.F. and L.F. chokes, H.F., L.F. and mains transformers all depend on inductance for their operation.

To define inductance it is best to think of it as that which tends to oppose the flow of alternating current or, in a more general sense, that which resists the value and change of direction of flow of a current.

If a conductor is wound in the form of a coil and a current passed through it, an electro-magnetic field is set up around the conductor.

The strength and direction of the field will depend on the strength of the current. The field will gradually build up to maximum as the current is switched on and then fade away when the circuit is broken.

Self-induction

It is also possible to prove that if an electro-magnetic field cuts a conductor a current will be set up in the conductor, the direction of flow depending on the direction of the field, but it will always be opposite to that of the original current.

The frequency of an alternating current will also affect the inductance : therefore with certain components which carry currents of relatively low frequency, such as L.F. and mains transformers and L.F. chokes, it becomes necessary to insert a metal core inside the coil(s) to increase the inductive value.

The unit of inductance is the henry. This unit, except in the case of L.F. chokes, is too large for general work, therefore it is more usual to use the microhenry, which is one-millionth of a henry.

Transformers

By virtue of self-induction it is possible to arrange two coils so that energy can be transferred from one to the other. If one is connected to a source of alternating current a field will be created around it, and if the other coil is placed close to it, a current will be induced in it having the same frequency as the first.

It is this arrangement of coils which provides the transformers used for H.F., L.F. and mains work, and a step-up or step-down can be obtained by varying the ratio of the primary winding to that of the secondary.

Generally speaking, it is very essential to see that all windings designed for inductance purposes have a low self-capacity.

If an H.F. choke is examined it will be found that it is either wound in the form of a solenoid, or that the winding is split into sections. This is to reduce the self-capacity between the two ends, thus preventing any high-frequency currents from by-passing the winding, by taking the path offered by the capacity.

When considering inductances having iron cores, as in the case of L.F. chokes, transformers, the presence of direct current will tend to reduce the total inductance of the component.

ON YOUR WAVELENGTH

By THERMION

The Reform of Dance Bands

FOR years I have been criticising the aboriginal slush pumped out by a variety of dance bands, criticising the reprehensible practice of song-plugging under which band leaders play tunes in return for a fee from the music publishers; I have attacked the revolting practice of crooning, especially by people who cannot sing, and I have attacked the inordinate amount of time which the B.B.C. devotes to dance band music. This sentimental slush is composed by Als, Eds, and Lews, while the lyrics are by four or five other nonentities. The dance band leader, before his band plays a tune which no one has heard before, will announce it as "that popular number," or "by special request," or "the latest song hit." I do not know why a band should play a number to please one listener, even though such requests were received, which I doubt.

The fact is that these dance tunes come off the assembly line like manufactured goods. They do not require any musical or lyrical ability, and their period of life is at the most a month. What a damning indictment of English composers and English lyric writers that over 75 per cent. of this slushy muck comes from a district appropriately nicknamed by the Americans "Tin-Pan Alley." What is wrong with English composers and writers of lyrics? Is it that they cannot compose or write verse, or is it that the taste of the British public has become so debased that they do not require the higher quality work of British composers?

I take the lion's share of the cred't for the new rules for dance bands recently announced by the B.B.C. The debilitated crooner, the cryners, the peripatetic and palsied creatures who gyrate and contort in front of the microphone are, in future, taboo. No doubt the dance band leaders will organise as a body and (I hope!) withdraw from broadcasting, and place their services with the theatres. Well, the music-halls are welcome to them. It is some time since I have visited a music-hall, so perhaps things have changed. When I did go, half the programme time was occupied by some dance band with its polished array of comic instruments. I have come to the conclusion that members of dance bands, like gipsies, like a bit of brass to polish. We have passed through the stages of ragtime, to jazz and swing. The mixture as before under a different name!

Virile and Robust Music

IT was like a breath of fresh ether to me to read that the cribbing of classical tunes is also banned. The other evening I was playing Mozart's Sonata No. 16, which was written in 1788. A friend remarked that it was based on "The 18th Century Drawing-room"! The B.B.C. in announcing this new policy said that with their many contacts with the public services and factories they knew that the people's mood is for virile and robust music. They have informed music publishers and dance band leaders that the B.B.C.'s policy is designed to improve the standard of dance music in this country. No longer will Haw-Haw be able to sneer at the "Jazz-soaked British." The following will therefore be excluded:

(1) Any form of anæmic or debilitated vocal performance by men singers.
(2) Any insincere and over-sentimental style of performance by women singers.
(3) Numbers which are slushy in sentiment or contain innuendo or other matter considered offensive to good taste and to religious or Allied susceptibilities.
(4) Numbers, with or without lyrics, which are based on tunes borrowed from standard classical works.

Co-operation

THE B.B.C. has invited the co-operation of all concerned, and a committee of representatives of the music and variety departments of the B.B.C. are to see that the new policy is carried out. Their decision will be final. Music publishers are asked to submit in advance any new numbers about which they are doubtful. Thus the selection of broadcast items has wisely been taken out of the hands of music publishers and band leaders. The band leaders will, in future, play what they are told to play. This will undoubtedly spell the end of high salaries for tap-drummers and the players of other alleged musical instruments.

What sort of creature is it that aspires to be a tap-drummer? As was to be expected several dance band leaders have expressed their opinions; they do not think there will be enough music to go round. We should be sufficiently grateful for that. Let us hope that we have heard the last of people going back to Alabam, who are crying out for their mammy's arms, who want to go back to shacks, about wagons whose wheels are broken, rivers staying away from doors, and dancing with beers in your eyes.

Now that the B.B.C. has taken this bold plunge, and exorcised this canker from our radio entertainment, they will possibly receive a spate of letters, inspired and otherwise, from all the relatives of all the members of all the dance bands. I do not believe for one moment that anyone writes to the B.B.C. praising a crooner or jazz music. Such letters as they do receive are from a claque.

Here is a chance for the B.B.C. to encourage English composers and English lyric writers who have been having a pretty thin time of it. They should avoid the song factories where songs and words are turned out at a rate which would put mass production engineering in the shade (except on the matter of precision), and give individual song writers a chance. The B.B.C. could offer a substantial prize each year for the best song of the year. To win it would hall mark a man's work and help to re-establish the principle that work succeeds by merit and not by the plugging of an unworthy composition. Let us become a musical race of poetasters and minnesingers.

The Slush Controllers

[Press Item.—The number of the new B.B.C. "Slush" Controllers has now been increased from three to seven.]

Their S O S was heard—
Three hero's swamped by "slush."
And lest their work's impaired,
Fresh aid to them they rush!

When crooning foul offends,
Now seven will order "shush."
If disobey they dare,
Offenders risk the "push."

When classic music's jazzed—
To syncopated mush,
Band leaders who transgress—
The Mighty Seven will crush!

Yet, sceptical are we
(We say it with a blush!)
We ask:—
WHAT PROGRAMMES WOULD BE LEFT,
IF YOU DELETE *ALL* SLUSH?

"TORCH."

Time Bases

Considerations in Design, and the Action of Single-line Units

By S. A. KNIGHT

PREVIOUS articles have dealt with the cathode-ray oscilloscope as a complete unit. The general function of each part, the tube itself, the time base and the power supplies, was covered as fully as the scope of the articles allowed, and each section had its individual investigation.

It is proposed now to carry the subject a little farther and deal more exhaustively with each section as a whole, and the question of the time base unit naturally comes well to the fore. This unit is the essential part of the whole design, and obviously the one requiring more knowledge of its operation and designing considerations than, say, the various power supplies.

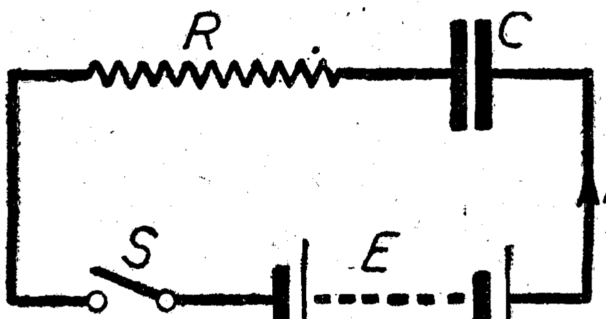


Fig. 1.—The simple circuit used for the condenser charging experiment.

In dealing with a subject of this nature a small amount of mathematical treatment is unavoidable if a true picture is to be given of its functioning, therefore several cases will be found where this has been resorted to. It has, however, been reduced to a minimum as far as possible, and does not affect the reading in any way for those with whom mathematics is not a strong point.

Purpose of a Time Base

The spot on the fluorescent screen of a cathode-ray tube is of little use by itself, apart from the measurement of peak voltage values or as simple indicating device of various potentials, and in order that an actual study of circuit conditions, and the waveforms of voltage and current changes contained therein can be made, a device must be arranged such that the spot can be given a uniform movement across the screen and appear to the observer as a straight line.

When the spot is moved from any part of the screen to the other, two factors enter into the picture and must be taken into consideration—first, there is an afterglow on the screen itself, that is, the spot continues to emit light for a short period after electronic bombardment has ceased, and secondly, there is the perhaps convenient defect of the human eye known as persistence of vision, which means that the eye does not follow instantaneously a movement or variation in intensity of the object it is watching.

These two things, and possibly the latter much more than the former, make a time base possible; without the latter effect, in fact, television and the cinema would still be in the realm of fancy. If the spot, therefore, is made to sweep across the face of the screen with great rapidity, and the movement is repeated at small definite intervals of time, the eye will perceive a steady line drawn on the screen's face.

If this movement is a horizontal one, and during the time of one particular traverse a vertical movement can be superimposed on to it, the spot will now trace out in the form of a graph the form of the applied vertical variations for that period of time representing the horizontal movement of the spot.

Basically this graph is voltage against voltage, since movement of the spot in either the horizontal or the vertical plane is accomplished only by a variation of potential on the appropriate deflector plates. If the voltage applied to one pair of the plates, however, is made to vary in a determined relation to time the graph drawn effectively becomes a voltage against time graph.

Circuits which operate for the purpose of providing voltages varying in a definite manner with time are referred to as Time Bases and produce a base sweep of given duration on which can be represented a potential variation occurring during that period.

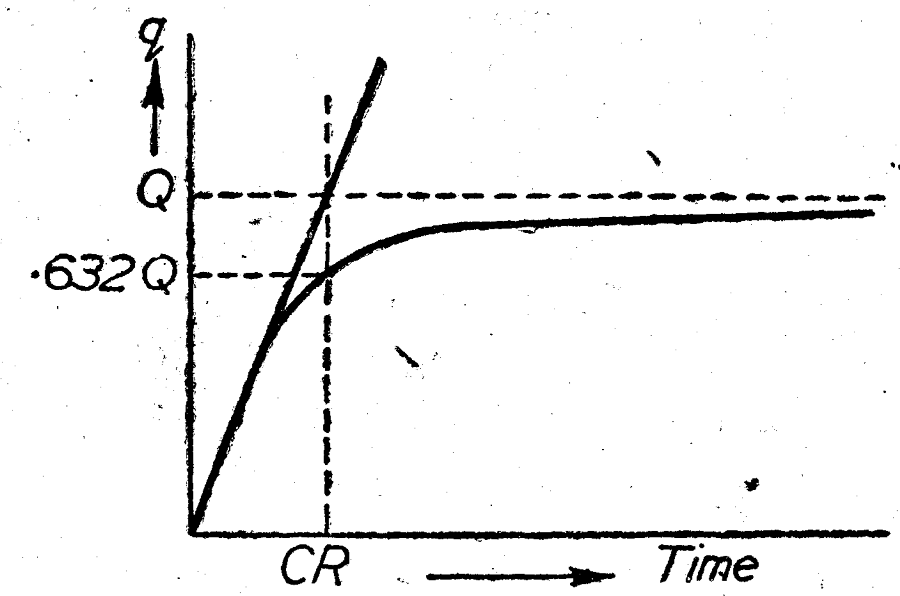


Fig. 2.—The condenser charge curve showing the time constant of the circuit.

Requirements of a Time Base

The basic requirements of a circuit suitable for applying a varying voltage to the horizontal controlling plates of a cathode ray tube is simply a condenser in series with a resistance connected across a source of D.C. supply. The condenser will charge exponentially through the resistance until the voltage across its terminals is equal to the D.C. supply, after which this voltage remains steady and the condenser is said to be fully charged.

If, therefore, the deflecting plates of the tube are connected across the condenser at the onset of its charging period, they will experience a gradually rising potential applied to them and the spot will move across the screen in a certain time and manner depending upon the maximum D.C. voltage, the capacity of the condenser and the value of the resistance used in the circuit.

The Charge of a Condenser

By adding a charge Q to the plates of a condenser the potential across the condenser is altered, i.e., quantity varies as potential. Where the capacity of the condenser is C, and C is a constant, then—

$$Q = CV$$

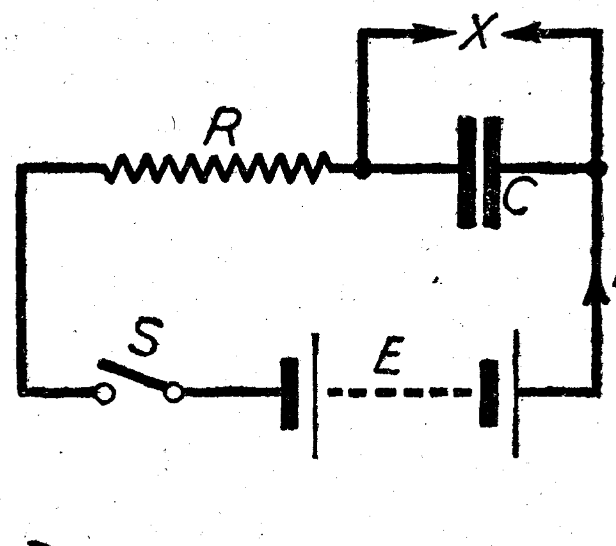
and a condenser has a capacity of one farad if the addition of one coulomb raises its potential by one volt.

When a condenser is charged through a resistance the rise in voltage across its terminals follows a particular law, and the exact type and nature of this law can be determined mathematically. Without entering too deeply into the subject it might yet be as well, especially for those with mathematical tendencies, to examine the type of thing that does actually happen in this kind of circuit.

The circuit in Fig. 1 shows a simple circuit consisting of resistance, condenser and switch connected in series across a battery of potential E. Consider the instant when the switch is closed; the condenser offers no opposition to the flow of current, which therefore is at its Ohm's Law maximum and is equal to E/R.

Consequently the voltage across the resistance is

Fig. 3.—The same circuit as Fig. 1 plus the device X to which the writer refers.



exactly equal to the battery p.d. E, the voltage across the condenser is zero, and the quantity of charge q is also zero.

At some instant later, before the condenser has become fully charged, it is obvious that the current in the circuit is rather less than its E/R value; consequently the battery voltage is divided in some ratio across the condenser and the resistance. In other words, the condenser volts are greater than zero; the resistance volts are less than E and q is greater than zero.

When the condenser is fully charged, current ceases and becomes zero, the volts across the condenser are equal to E, since with zero current there can be no volts drop across the resistance, and the quantity q has become the final quantity Q.

Now let the condenser volts be V_c, the resistance volts be V_r and the battery e.m.f. E, then at any instant during the charge

$$q = V_c C$$
$$\text{But } E = V_r + V_c$$
$$q = (E - V_r)\,C$$
$$= (E - iR)\,C$$

The current at any instant such as the above can be given by dq/dt, where dq is a small element of charge transferred over a small period of time dt. Then from the above

$$CE - q = iRC$$
$$CE - q = RC\,dq/dt$$
$$dq/CE - q = dt/CR$$

Integrating both sides, we have

$$\log (CE - q) = -t/CR + \text{a constant } K$$
$$\therefore CE - q = K_e - t/CR, \text{ where e is equal to } 2.7183.$$

Considering again the initial moment of charging, t equals zero and q equals zero, therefore it is possible to evaluate K in this manner:

$$CE - 0 = K_e{}^{-0} = K$$
$$K = CE$$

Therefore, substituting this value for K in the last equation, we have:

$$CE - q = CE_e - t/CR$$
$$\therefore q = CE - CE_e - t/CR$$
$$= CE\,(1 - {}_e - t/CR)$$
$$q = Q\,(1 - {}_e - t/CR)$$

From this expression the quantity of charge at any given instant of time from zero to infinity can be determined and the relation between time and the growth of voltage across the condenser equally examined.

Taking time equals infinity:

$$q = Q\,(1 - {}_e - \infty)$$
$$= Q\,(1 - {}_e\tfrac{1}{\infty})$$
$$= Q\,(1 - 0)$$

since e is 2.7183 and therefore greater than 1.

$$\therefore q = Q$$

Condenser is therefore never completely charged until after an infinitely long time.

Suppose we now let the time be equal to CR seconds. These dimensions are quite orthodox, since:

$$CR = Q/V \times V/I = Q/I$$

and these latter are expressed in time. Then

$$q = Q\,(1 - {}_e\,CR/CR)$$
$$= Q\,(1 - {}_e{}^{-1})$$
$$= Q\,(1 - \tfrac{1}{e})$$
$$q = Q\,(1 - 0.3679)$$
$$q = .6321\,Q$$

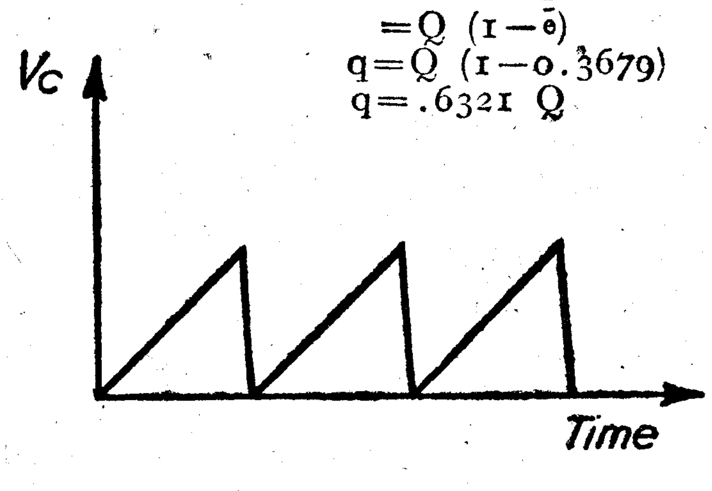


Fig. 6.—Condenser voltage plotted against time to produce a saw-tooth waveform.

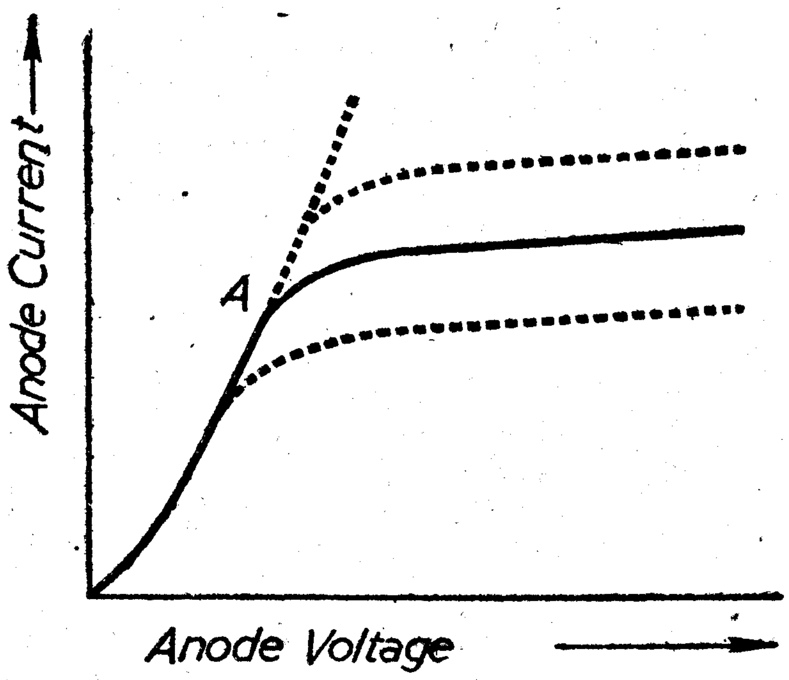


Fig. 5.—The characteristic curve for a diode valve.

This result is a very important one, and the quantity CR corresponding to .6321Q on the condenser charge curve (Fig. 2) is known as the time constant of the circuit. In other words this is the time required in seconds for the circuit to charge the condenser up to .6321 of its maximum possible value.

It should be noted that if the charge curve was not an exponential one—for that is what a curve of this nature is called—but a straight line, the condenser would be completely charged after CR seconds.

Application to a Time Base Action

It will be seen that the exponential charging of a condenser through a resistance is highly suitable as a device to produce a build up of potential across the plates of a cathode ray tube for the purpose of deflecting the spot sideways into a time base traverse.

The problem, therefore, is not one of applying the gradual p.d., but of making the action repetitive, since, in order to be of any value, the traverse of the spot must occur at regular intervals of time such that the persistence of vision of the eye gets the impression of a single, lasting line.

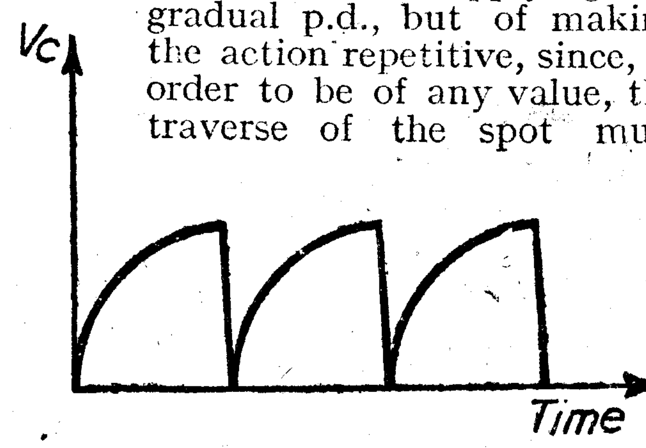


Fig. 4.—The voltage waveform across the condenser when the device X is in operation in Fig 3.

Obviously, if the condenser is allowed to charge only once, the spot will be drawn across the screen in a single sweep, and will remain at the end of its travel indefinitely The impression of the line which the spot created would fade in a few thousandths of a second, leaving again only the spot though in a different position on the screen's face.

The Exponential Time Base

Consider the circuit in Fig. 3, which shows again the condenser resistance arrangement, but this time with a device marked X connected across the condenser terminals. This device may be likened to a kind of automatic switch, in that it operates in the following way:

It has an infinite resistance until the voltage present across its terminals reaches a certain minimum value. It then suddenly changes to a zero resistance and passes current rapidly until once again the potential has fallen to a zero value. Its resistance once more then becomes infinite and the operation is repeated.

In a time base cricuit this device will therefore allow the condenser to charge to a value V_c, after which it will change to a virtual short circuit, and allow the condenser to discharge rapidly until V_c has become zero. At this point it again reverts to an infinite resistance, and the condenser will recommence to charge.

It will be seen, therefore, that the device X is operating exactly as a switch which opens and closes at precise intervals, and the voltage waveform across the condenser will take the form shown in Fig. 4, where a sudden collapse follows each period of exponential charge.

By applying this waveform to the deflection plates of a cathode-ray tube, the spot will be moved from one side of the screen to the other, and at the end of each traverse it will rapidly return to its initial position due to the collapse of V_c. The action is repetitive as long as the waveform is produced and applied, and an exponential time base is consequently created.

Two problems now present themselves to the experimenter in his designing—one, the construction of the automatic switching device X, and two, getting rid of the exponential effect of the produced time base.

Linear Tracing of a Time Base

A time base that is truly linear—that is, a movement of the spot which is exactly proportional to time—is an impossibility and probably always will be, but it is possible to approach extremely near to the ideal state of linearity.

At this stage a lot of people begin asking the question: But why a linear time base? We have an arrangement to give us a good traverse of the screen, albeit exponentially, so why the trouble of seeking ways to make time and movement proportional to each other? Surely this is a case of going out of the way, searching for complications.

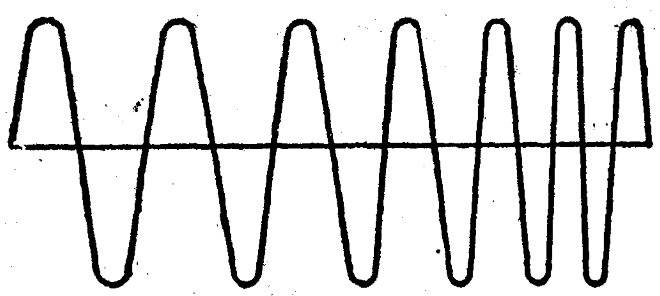


Fig. 7.—The time scale following a logarithmic nature.

But it is not. The spot on the screen moves equal distances for equal change of deflection voltage, thus, since over an exponential charging curve the voltage is changing rapidly at the commencement and slowly towards the end, the time-scale of the time base sweep will follow a logarithmic nature, and will appear something as shown in Fig. 7, with the result that vertically applied sinusoidal voltages are distorted towards the end of the stroke.

Exponential time bases have their uses. If due allowance is made for the "defect," which, for accurate calibration, requires a complete knowledge of exponential functions, the time base can be used as a measuring device for frequency and comparison tests, etc. But a scale which is linear is much more convenient for the ordinary experimenter, and is quite simple to arrange for.

This requires that the graph of condenser voltage against time shall be of the saw-tooth type, i.e., as in Fig. 6.

There are three ways of tackling the problem:

(*a*) An examination of the exponential waveform will show that approximately linear time bases can be obtained by using only the initial portion of the curve, which is substantially linear for some one third of its travel.

(*b*) By increasing the voltage applied to the condenser the amplitude of the waveform would be increased and the initial linear portion would similarly be increased.

(*c*) By making the charging current constant.

The first case—obviously inefficient due to the small voltage amplitude involved and consequently very little deflection of the spot. The entire time base sweep would be reduced to a few centimetres at the most.

The second case—associated with the first and depending on a greatly increased D.C. supply. This has obvious limitations.

The third case is the solution to the problem; for linearity V_c must increase linearly with time. This means that a small element of V_c, dV_c over a small element of time dt must be equal to a constant K.

$$dV_c/dt = K$$

But since $V = Q/C$ this requires that the rate of change of quantity is a constant with respect to time

$$d/dt\ (Q/C) = K$$

But since C is a constant capacity, it follows that:

$$d/dt\ (Q/C) = 1/C.\ dQ/dt.$$

$$\therefore\ 1/C.\ dQ/dt = K$$

$$K = 1/C.\ i\,c.$$

where ic is the condenser current.

Thus, in order to make V_c linear with time, the charging current must be constant.

It follows then that the plain resistance of our simple time base circuit must be replaced by a device capable of delivering a constant current irrespective of other circuit factors.

Constant Current Devices

The saturated diode was a very popular form of constant current device and although not so common nowadays, is nevertheless a simple means for the amateur to obtain a source of constant current for his time base condenser. The characteristic curve for a diode valve is as shown in Fig. 5, and without going into the problem of values it can be seen that the anode current I_a increases fairly rapidly for values of anode voltage V_a up to the point A, when an increase of V_a does not cause a corresponding increase in I_a. The valve is said to be saturated, that is, all the electrons leaving the filament are moving to the anode.

It can be seen, therefore, that if a saturated diode is used to replace the charging resistance in the simple time base circuit, the charging current will be independent of the voltage, provided the voltage is above the point A on the characteristic curve. In this arrangement the only means of adjusting the value of the constant current is by variation of the filament temperature, when the characteristic will either be reduced or increased as is indicated by the dotted lines.

The pentode as a constant current device has become popular in recent years, and for several obvious reasons is more versatile for the job than the saturated diode.

One, for a constant screen and control grid voltage, anode current is practically independent of anode voltage.

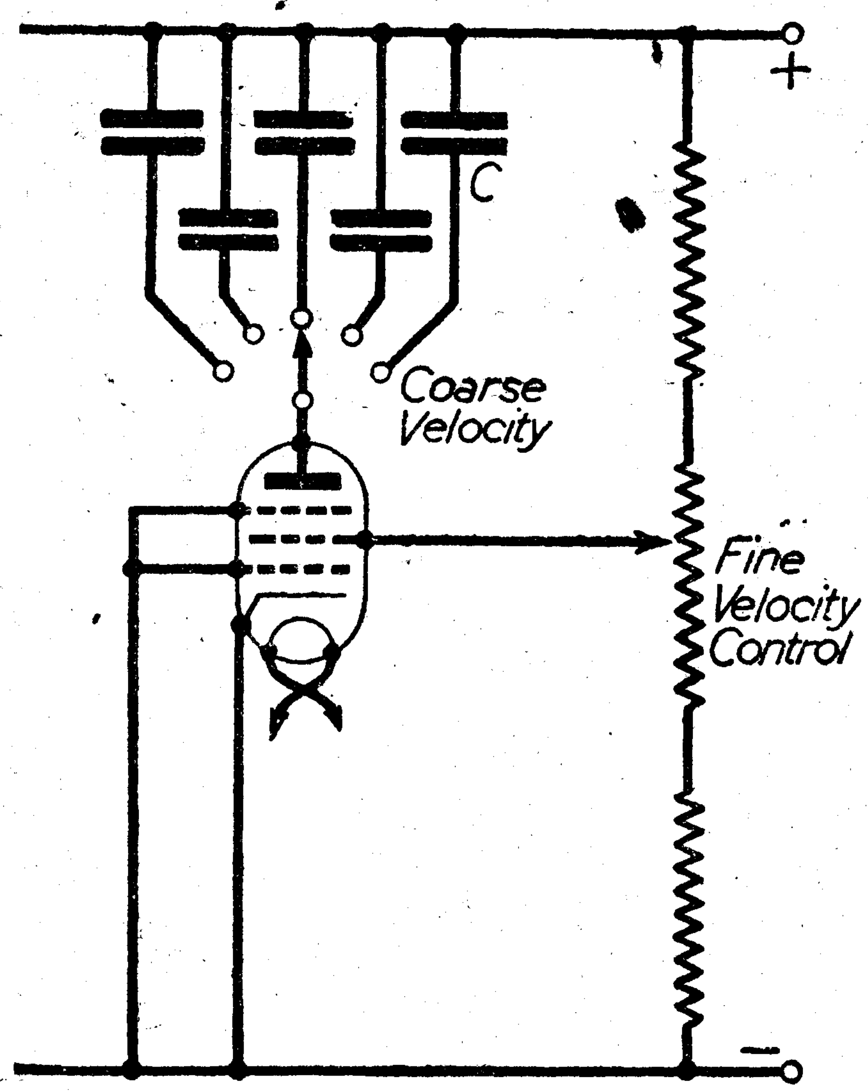


Fig. 8.—The pentode constant current circuit, showing methods of obtaining adjustment.

Two, the obvious limitations imposed on the value of constant current by variations in filament temperature are washed out, as the value of anode current can be widely varied by adjustment of either screen or control grid voltage.

The Pentode Constant Current Valve

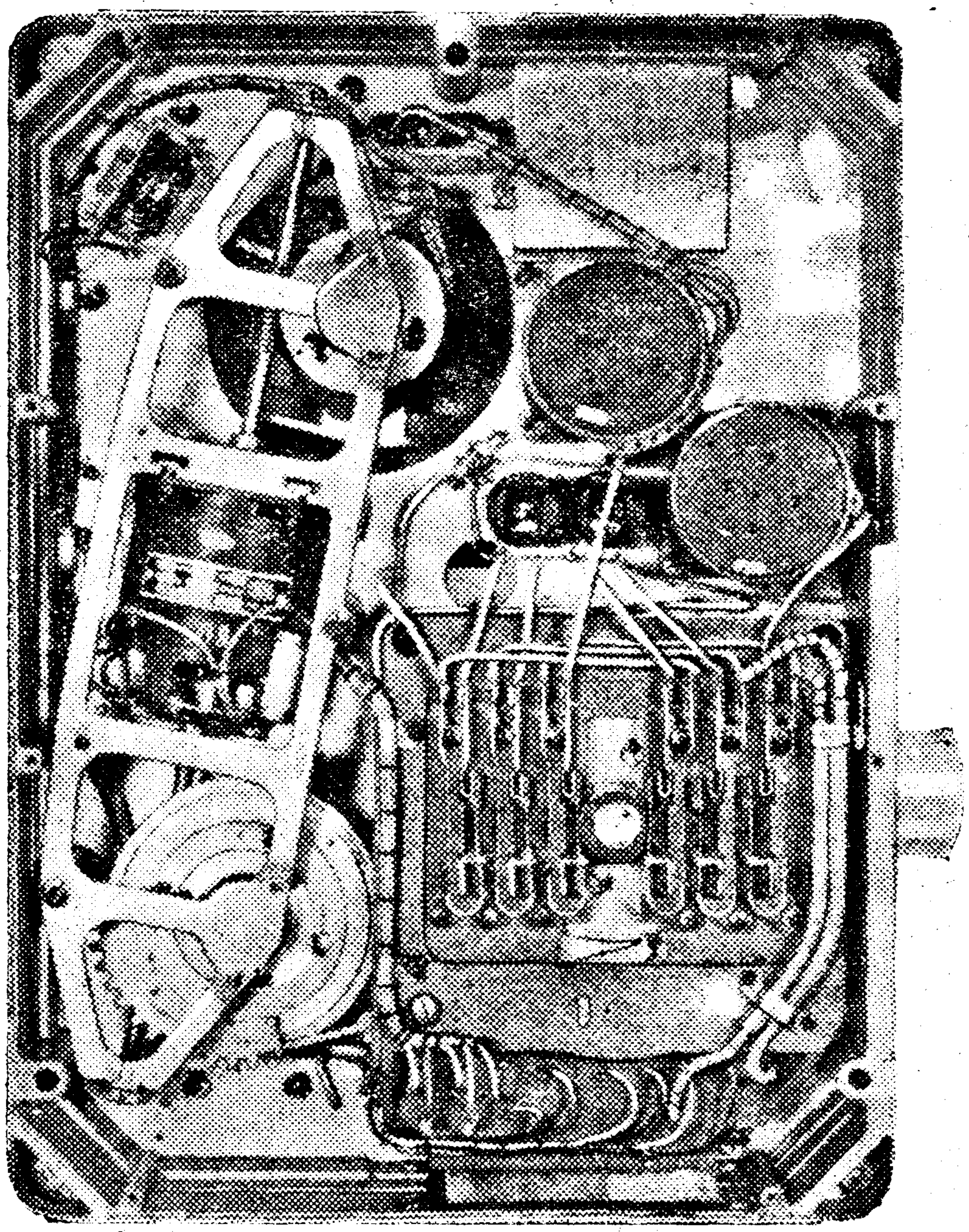
The time for the time base condenser to acquire a desired value depends upon the time constant of CR of the particular circuit, as we have seen earlier on. R in the case of a valve is its D.C. resistance, and C can be of any prearranged capacity. Thus, any variation of C or R will vary the time constant of the circuit, and consequently the rate of charge of the condenser.

(*To be continued.*)

LUFTWAFFE RADIO EQUIPMENT

Further Particulars of the Extensive Installation of the Heinkel HE111H

(Continued from page 421, September issue.)



The underside of the aerial tuning unit.

Intercommunication Amplifier

THIS unit comprises three separate amplifiers in the one unit. These are:

(1) Intercommunication amplifier.
(2) Side tone oscillator and amplifier.
(3) Pulse amplifier.

The complete unit is extremely compact, and is built on a light alloy casting and uses nine valves all of the same type. The wiring is exceptionally well carried out it is cable formed, but where necessary screened single or twisted pair is used in the cable form.

The intercommunication amplifier is a conventional circuit and consists of an amplifier stage driven from the microphone input transformer and an output stage of two valves in parallel.

With normal speech from the laryngophones the amplifier delivers a level adequate for aircraft operation, i.e., approximately 300 mW to four telephones in parallel.

The four laryngophones are in parallel. To prevent changes of level or possible instability a 100 ohms resist tance is switched into the input circuit and a 15,000 ohms resistance in the output circuit when the wireless operator switches to F.T. Side tone and carbon noise from the laryngophones are rather excessive.

Side-tone Circuit

The difficulty of obtaining an audible side tone during C.W. transmission has been overcome in this equipment by providing a separate oscillator and amplifier for this purpose.

The first valve is a conventional Hartley oscillator tuned to approximately 900 cycles.

The output from this valve is attenuated considerably by a preset network before being applied to the grid circuit of the output valve. The grid circuit of this valve is taken out of the audio unit through terminal 47 S.W.1 to the aerial control panel, where it is taken through 30,000 ohms and the aerial, meter to earth. This valve has a high biasing resistance, 7,000 ohms, so that with the key up the gain of the stage is small. On pressing the key the current transformer and rectifier in the aerial tuning unit deliver approximately 7 v. across the aerial meter circuit, thus reducing the bias on the grid and allowing the valve to amplify. The audio output thus follows the rhythm of the keying. The output is taken through the type transmission switch to the intercommunication control panel, where it goes through the receiver switches to the wireless operator's telephones.

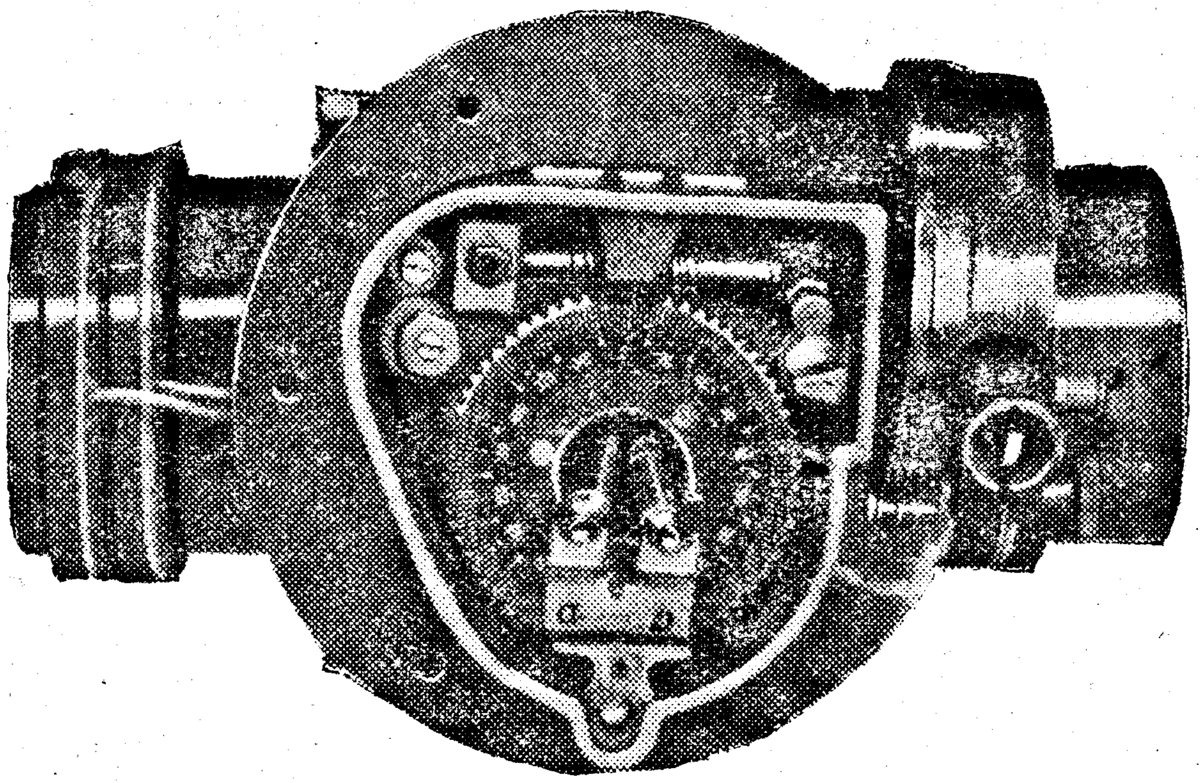
Pulse Amplifier

The pulse amplifier consists of three stages, an oscillator, a class C amplifier and an output stage of two valves in parallel. The circuit is rather unusual.

The first valve is a conventional oscillator circuit tuned to 300 cycles by a variable inductance. This inductance is of very good design consisting of a winding with a cylindrical dust moulding completely surrounding the coil and with a variable air gap in the central core. The second valve is run at reduced anode and screen volts and is overdriven by the oscillator. The values of grid condenser and leak, 10,000 pF and 1 megohm, are chosen so that the valve is automatically biased well back by grid current and passes current only on positive peaks of driving voltage, thus forming the pulses. The third stage of two valves in parallel is normally conducting, with the grids at zero potential; it is, therefore, a low resistance. During pulse the grid is driven negatively beyond the cut off and the valves become a high resistance.

Blind Approach Equipment

The blind approach equipment works with Lorenz ground equipment of the usual type. It gives aural and



The D.F. Loop, which is a military version of the Telefunken Type P.128. A repeater compass is coupled with the bearing indicator and a dust-iron cored solenoid replaces the normal loop.

visual left-right and marker beacon indications to the pilot. The note frequencies used are 1,150 cycles/sec. for the main beacon, 700 cycles/sec. for the inner marker and 1,700 cycles/sec. for the outer marker. The keying rhythm is one dot or dash per second for the main beacon, two dashes per second for the outer marker and six dots per second for the inner marker. The only difference in the indications is that only one neon indicator is used, difference in keying rhythm being the only visual means of distinguishing between outer and inner markers.

Lorenz Type

The equipment in this aircraft is of the Lorenz general type, but apparently not of Lorenz design or manufacture. The main beacon receiver is of the "straight" type and consists of high-frequency amplifier, detector with reaction, two low-frequency amplifier stages and a stage supplying the visual indicator and A.V.C. line. The marker beacon receiver consists of a detector with reaction and a single low-frequency stage which feed into the second low-frequency stage of the main beacon receiver. There are two preset frequencies available in the main beacon receiver; switching from one to the other is by relay remotely controlled.

Construction and Installation

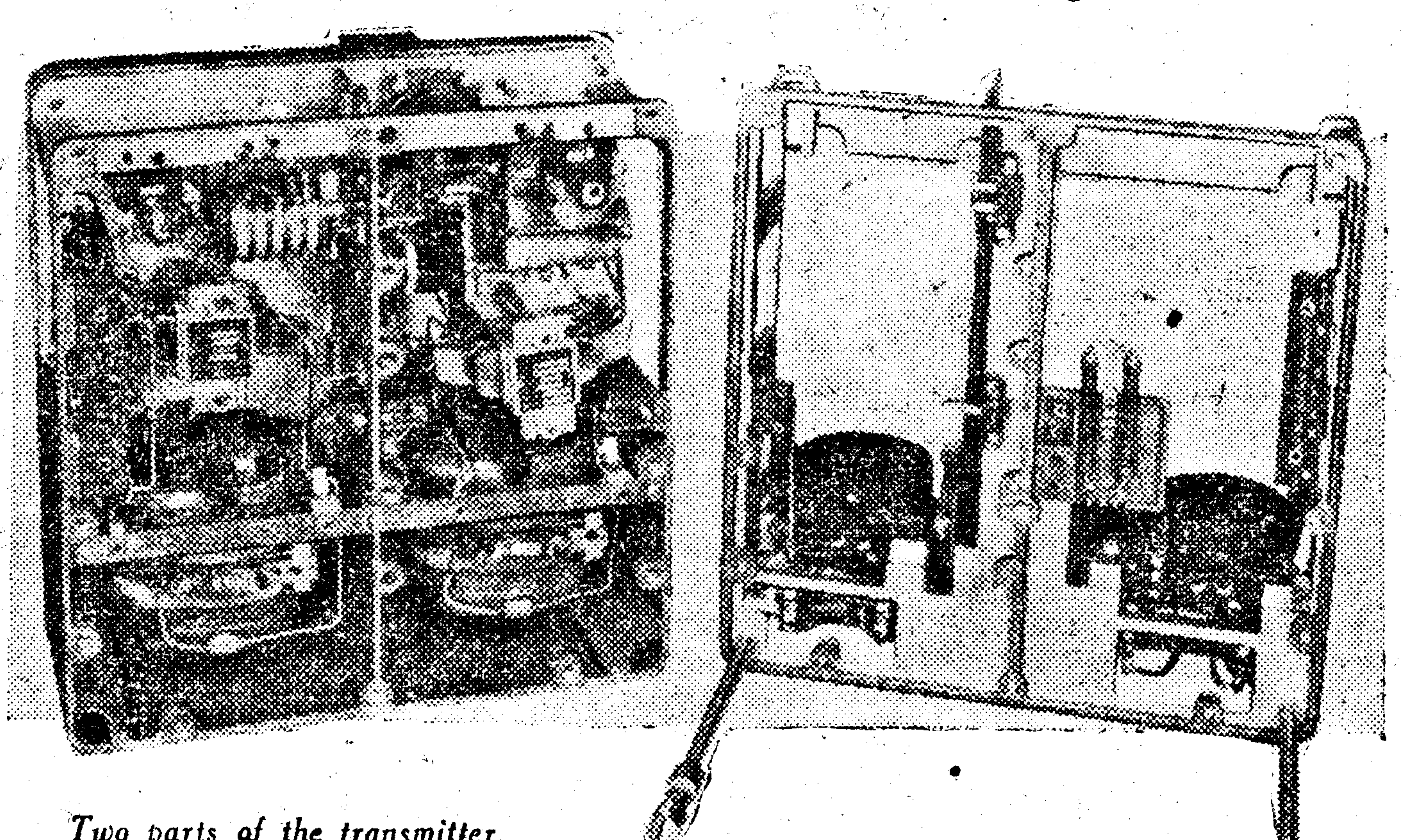
The receivers are made in two parts. One contains the H.F. and detector stages of the main beacon receiver, the other the marker beacon detector and the low-frequency stages for both receivers. Both receivers are held in a single crate by quick release devices, the crate itself being shock mounted.

The receiver unit cases are made of sheet metal and are easily removable, leaving the chassis exposed. Further sheets, however, have to be removed from the chassis to expose all the components. The chassis are constructed of magnesium alloy die cast. In each unit the valves are mounted in line on a shelf on one side of the chassis, the rest of the components on the other sides.

The two matching units were fitted close to their respective aerials.

Component Design and Use

Considerable ingenuity is displayed throughout the equipment in the design of certain components.



Two parts of the transmitter.

Coils

The coils are of bare unplated copper wire, the turns being wound on low-loss bakelite formers which have ample rigidity. The original Lorenz coils were unnecessarily expensive, being gold plated and wound on ceramic formers. Trimmers are of the "piston in cylinder" variety, the adjustment consisting of screwing the piston into or out of the cylinder. The insulation is ceramic, the dielectric being air. They appear to be very well made, have a pleasant "feel" and just the right amount of friction to prevent them shifting under vibration, while not being too stiff to adjust. They are, however, somewhat bulky. The only exception to this type is a circular ceramic trimmer used in the dipole matching unit. The tuned circuits are well designed and laid out. Wherever necessary strip is used to reduce the effective length of leads. The reaction windings are of much thinner wire than the tuned windings and are placed at the low potential ends of the coils.

High-frequency chokes are of conventional design, single layer wound on paxolin tubes, the turns spaced by about the thickness of the wire. They are finished with a covering of oiled silk. Some low-frequency transformers have rather longer winding space in comparison with the depth than in common practice in this country. The laminations when assembled form an oblong shape, the windings being over one limb. Certain transformers have a terminal marked "Sch," which is connected to the chassis and appears to be internally connected to a screen. These are the anode to line and line to grid transformers of the main beacon receiver and the inter-valve transformer coupling the marker beacon detector to the first low-frequency amplifier of that receiver.

Resistances and Potentiometers

The values of the fixed resistances are marked clearly on the resistance, colour coding not being employed. The carbon block resistances in the detector reaction circuits appear to be capable of very fine adjustment at the factory by removing material from the ends. Connection is apparently made by copper plating the ends and soldering to the copper. The potentiometers have a metal track, but the actual resistance element is not externally visible.

Loop Aerial

The loop aerial shows many unusual features differing entirely from the two-turn commercial loops of 43 cms. diameter mounted on the Dornier D.O.17 aircraft. It is intended for mounting under a Perspex housing and is wound on a hollow bakelised fabric former 13in. in length, and of oval section, in which the horizontal cross-section axis is 4in. and the vertical axis 3in. The bakelised fabric is ¼in. thick. Through the centre runs a dust-iron core built up of ring sections placed coaxially, the axis coinciding with that of the loop former.

The windings consist of eight turns of heavy Litz wire approximately 0.08in. in diameter, wound symmetrically over the length of the former. The winding is divided into two halves one on either half of the former, and the halves are connected in parallel giving a resulting inductance of 3.2μH.

The Simple S.W. One-valver

Full Constructional Details of this Popular Set, which is the Subject of Blueprint No. P.W. 88, are Given in This Article

THIS receiver has proved extremely popular, but all copies of the original issue are now out of print. The details are, therefore, reprinted. The receiver is shown in its simplest form and the blueprint which is available for it shows only the bare necessities. In this condition, however, the receiver may be relied upon to furnish a most comprehensive log and under all normal conditions some really good DX work may be accomplished with it. After it has been in use for some time, however, it will be found that various little improvements may be added, and these are described in this article, so that those who wish to build the set in a more advanced form may do so.

The circuit, Fig. 1, is the simplest reacting detector arrangement, rather than a special circuit utilising an S.G. or H.F. pentode valve. Although home-made coils may be used, a standard 6-pin plug-in coil is specified, but the constructor may build for himself a set of such coils, taking for his data the details given in our issue dated January, 1942, or that which will be found in our handbook, "Coils, Chokes and Transformers." It should be noted that a 4-pin coil is not recommended, although it can be used. The reason is that the aerial has a marked effect upon the performance of the receiver, and a 6-pin coil permits of a loose coupled aerial arrangement being employed, with the result that the damping effect of the aerial is removed. A condenser may be connected between the aerial and the grid winding (thus omitting the aerial coupling coil), but the effect is not so good as when the coupling coil is employed, Fig. 2.

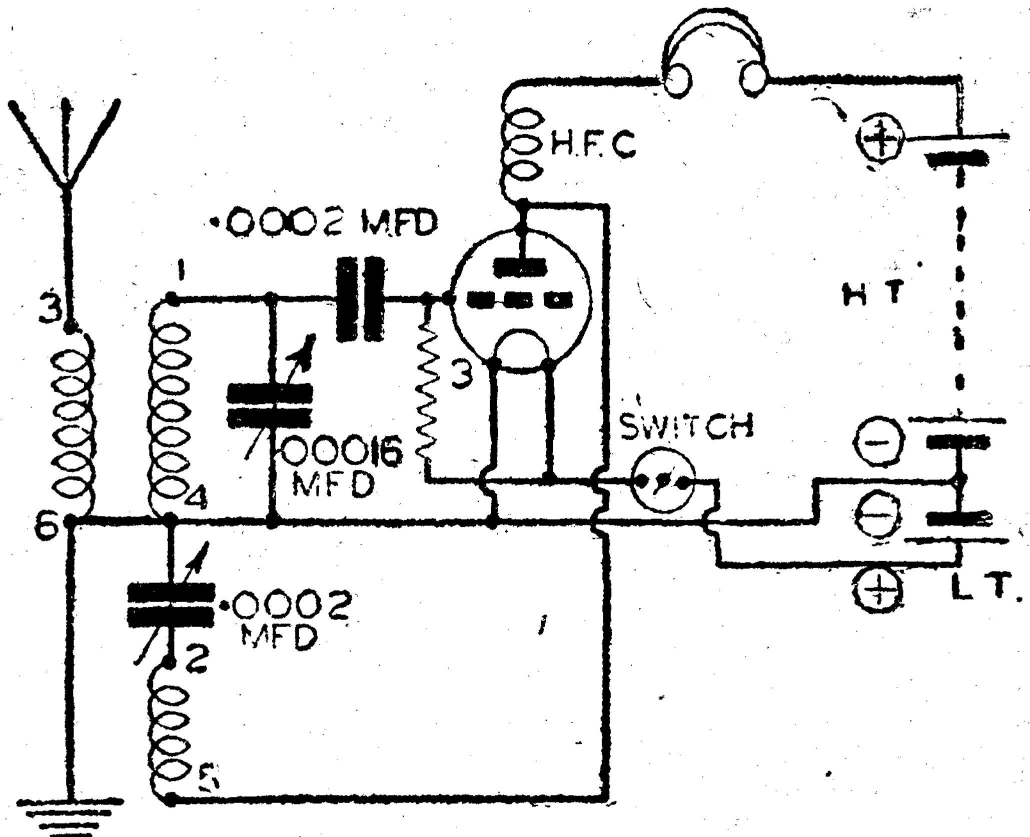


Fig. 1.—The circuit shows the simplicity of this efficient single-valver.

The Circuit

Reaction is obtained by means of a standard reaction condenser and winding on the coil, and a capacity of .0002 mfd. or .0003 mfd. should be employed. In most cases the larger value will be found of most use. A normal tubular or mica fixed condenser is connected in the grid circuit with a fixed grid-leak of 3 megohms, but again, this value may be modified and up to 5 megohms employed. The choke is most important and although it is possible to make a very efficient component at home it is recommended that a really reliable commercial article be employed. This will avoid difficulties due to "dead spots," erratic reaction, etc.

A simple baseboard form of construction is used, as there are only a few components and a chassis is not called for. A good quality coil-holder should be used, and although a metal panel is not a necessity it will be found very useful in assisting in the removal of hand capacity effects. If desired, a wooden or ebonite panel may be employed and a thin sheet of metal or foil fitted behind the panel and connected to earth. It is preferable to cut holes in this so that it does not come into contact with any of the panel components, and then to connect a separate earth lead to it.

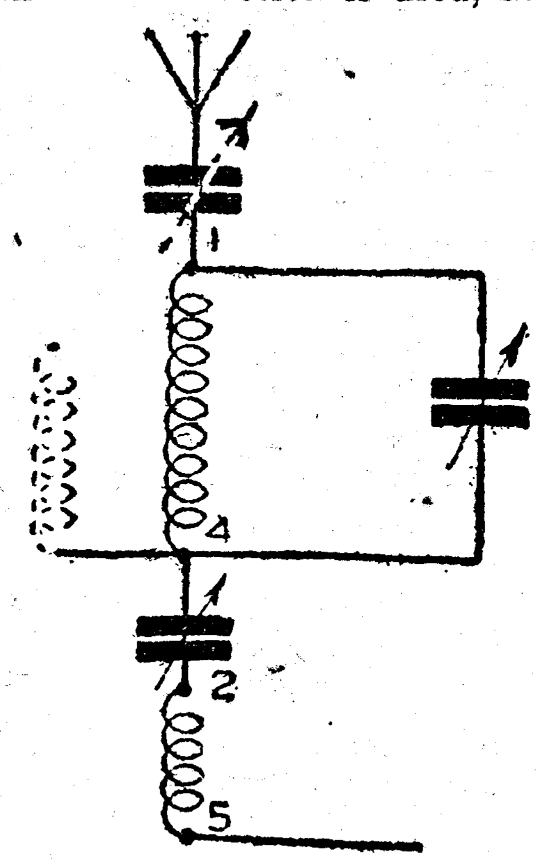


Fig. 2.—An alternative arrangement using a four-pin coil and series aerial condenser.

Construction

The terminals should preferably be mounted on separate mounts, well separated to avoid any loss which might be introduced by a leakage path between them through inferior ebonite or other material. The coil and valveholders should be firmly attached to the baseboard, and the panel components firmly locked to the panel. Remember that any looseness, in either the mounting or in the subsequent wiring, will result in tuning difficulties and perhaps the erratic effects resembling fading. The wiring should be carried out with fairly stiff wire to avoid any subsequent movement, and bare wire may be used and all connections should preferably be soldered. The tuning condenser specified has a maximum capacity of .00016 mfd., but if desired you may use temporarily a .0005 mfd. standard condenser

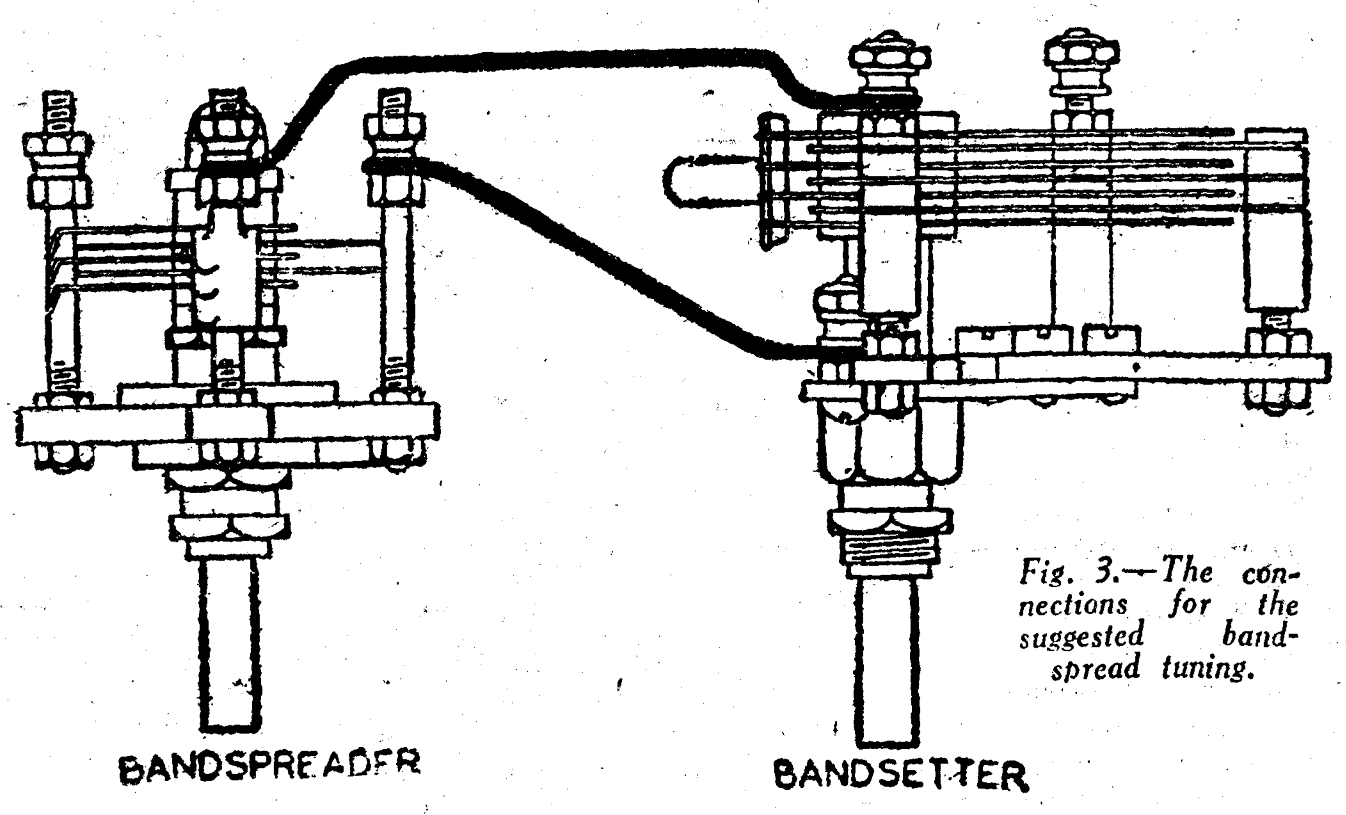


Fig. 3.—The connections for the suggested band-spread tuning.

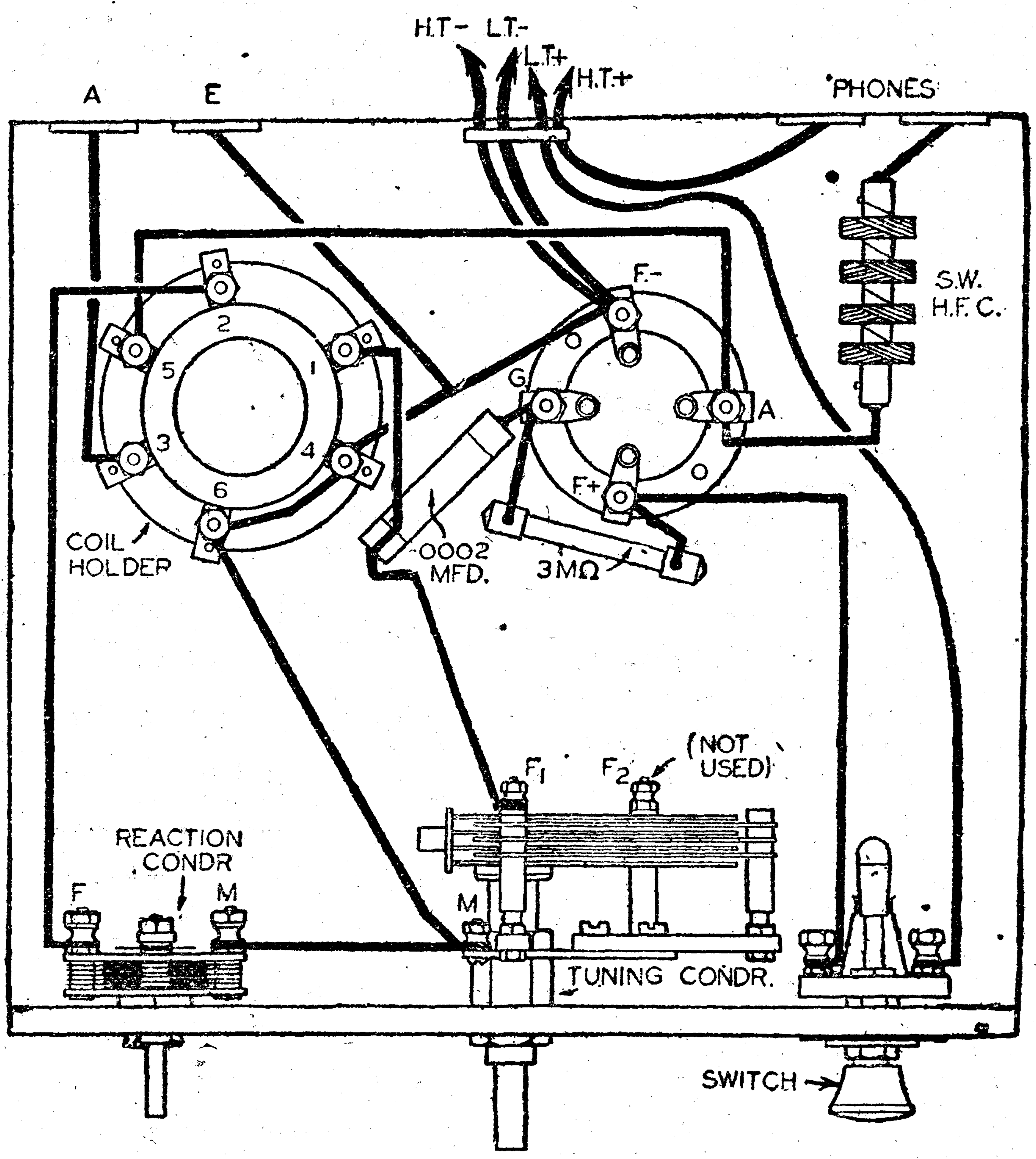
with a .0003 mfd. fixed condenser in series with it. A .00025 mfd. condenser may, of course, be used, but will give rather more difficult tuning due to the wider wave-range covered with that capacity. A set of coils may be bought or made and with these the receiver may be used to cover all wavelengths from 9 to 10 metres up to 2,000. It is not advisable to try to use a set of this type to tune below 10 metres, and therefore, if it is desired to listen on wavelengths below 10 metres an ultra-short-wave set should be made up.

point regarding tuning concerns the minimum wave-length to which each coil may be tuned. This is dependent upon the minimum capacity of the tuning condenser and an inferior condenser will obviously tune to a higher minimum wavelength.

Components

A list of the specified components is given below and, when possible, it is advisable to adhere to it, but rather than hold up the constructional work and undertake a lot of, perhaps, unnecessary correspondence, it is wiser during these days of component shortage to use alternative makes. The circuit is so simple that no difficulty should be experienced with modifying the wiring to suit those parts which ultimately are used. One word of warning, use the best components obtainable, as on these will depend the efficiency of the circuit.

THE LAYOUT AND WIRING PLAN OF P.W. 88



Refinements

The receiver H.T. can be supplied by a 66-volt battery and the voltage should be adjusted to give a smooth reaction control. By way of refinements the first improvement would be the fitting of a bandspreading condenser. This should consist of a small variable condenser having a maximum capacity of about 20 mmfds., and it may be mounted on the panel quite close to the tuning condenser. It is wired in parallel with that condenser, that is, the fixed and the moving vanes of each condenser are connected together, as shown in Fig. 3. When this addition is made tuning will be very much simpler.

The main tuning condenser is simply advanced about one degree at a time, and at each setting the smaller condenser is turning throughout its range, thus spreading out the waveband which each adjustment of the main condenser covers. Good slow-motion dials will be found of the utmost value in a set of this nature, as they enable the smallest movement of the condensers to be made and many stations which would otherwise be missed will thereby be heard. This will be especially noticeable where two or more stations are found very close together on the main tuning condenser. A slight adjustment of this, and the bandspreading condenser will enable quite a large movement to be made with the dial to separate these stations and overlap will be avoided.

Coil Ranges

In the Eddystone range there are 9 coils of the 6-pin type which may be used, and to enable the constructor to obtain some idea of the ranges covered the following are the type numbers and the bands which are covered with a .00016 mfd. condenser :—

6BB	9-14	6P	150-325
6LB	12-26	6G	260-510
6Y	22-47	6BR	490-1,000
6R	41-94	6GY	1,000-2,000
6W	76-170		

If a .00025 mfd. condenser is used, or if the .0005 condenser scheme is adopted, the tuning range will be slightly greater than the above figures, and this will obviously be accompanied by the tuning difficulty already mentioned. It is desirable in a short-wave set to provide as small a tuning band-width as possible, so that difficulties in tuning due to the close proximity of different stations are removed. Another important

LIST OF COMPONENTS

One .00016 mfd. tuning condenser (type 922) (Eddystone).
One .0003 mfd. reaction condenser.
One 6-pin coil-holder (type 969) (Eddystone).
One 4-pin valveholder.
One H.F. choke (type 1010) (Eddystone).
One .0002 mfd. fixed condenser (tubular type) (T.C.C.).
One 3-megohm grid leak (Dubilier).
One on-off switch.
Four terminals.
One wooden baseboard 8in. by 7in.
One ebonite panel 8in. by 8in.
Flex, connecting wire, screws.

Notes from an Amateur's Log-book

2CHW Discusses Hand-capacity, the Bugbear of So Many Amateurs' S.W. Activities

CONSTRUCTIONAL work has not been part of my activities since my last notes were written; I have, however, had some interesting half-hours which were occupied by taking part in those discussions which always seem to arise when a few S.W. enthusiasts get together. From logs and station identification the talks (arguments) invariably drifted towards circuits, and, finally, snags and problems. It is not possible in these notes to cover all the points discussed, but one snag seemed so common that I think it warrants mention. Strange as it may seem, in view of the good circuits and layouts which are about, and the articles which have been published on the subject, the trouble which was worrying so many of my friends was *hand- and body-capacity*.

Nothing is more annoying than when, after tuning in a most elusive transmission, the tuning, which has taken so much patience to achieve, appears to go adrift on the removal of the hand or hands from the control(s). The strength of the transmission fades down; possibly the circuit falls into oscillation, and, so far as the operator is concerned, the signal becomes QSA1.

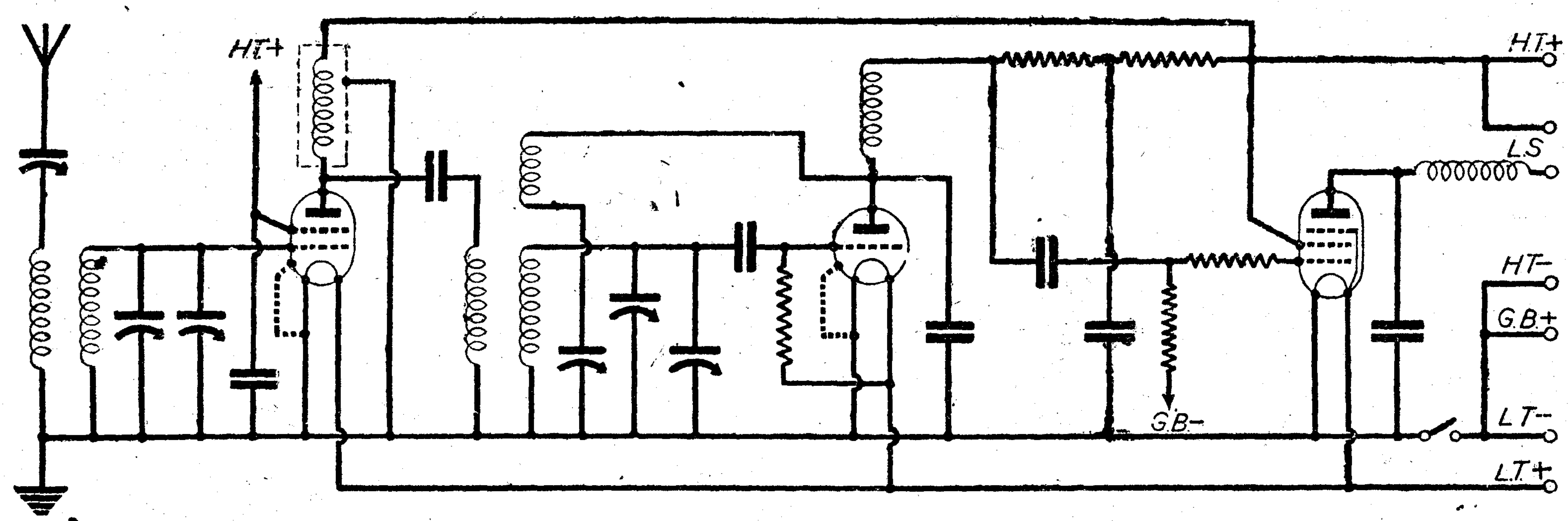


Fig. 1.—A typical 3-valve S.W. circuit showing the number of components connected to earth. The moving vanes of the variable condensers are denoted by the curved arrows.

These patience testing happenings are usually put down—rather too readily at times—to those mysterious phenomena known as *hand- and body-capacity*. Few, if any, amateurs have escaped experiencing them at one time or another, yet, in spite of this and the progress made in S.W. work, etc., they still exist. What then are the causes, and what are the remedies?

Experimental Work

In case any reader thinks that I am about to expose some wonderful remedy that will cure all ills connected with this trouble, I must disillusion him, because—so far as I am aware—the true contributory causes are not known, and, as yet, no one has discovered a specific cure. This all sounds very hopeless, but, in practice, it is not as bad as all that, because, with a certain amount of patience and experimental work, it is usually possible considerably to reduce if not eliminate the trouble.

The peculiar part about hand- and body-capacity is that they do not appear to follow any set rules: for example, it is possible for two identical receivers to be built, one of which will be highly satisfactory, while the other will suffer from the trouble we are considering. At the risk of starting a violent controversy, I think—this is purely a personal opinion—that the causes can be due to any part of the circuit between the aerial and earth, including the last two items.

In the earlier days one used to employ long extension handles to the controls. In the majority of cases these often proved successful, but their use did not eliminate the trouble at its root, they only helped to reduce its effect.

As I see it, the main points to receive careful consideration are given below, and while, in some instances, one alone might affect a cure, there are bound to be other installations which will necessitate experimental work around all of them before the operator finally stumbles, literally, on a combination which provides a solution to his problem.

Layout

Much, indeed, can be done by giving the layout a good deal of thought. I know this statement can be questioned by those who have used a hook-up set without any trouble, but that does not alter the fact that good layout, circuit design and careful wiring of the grid, anode and tuning circuits, forms a first-class insurance against running into the trouble.

We are told to keep certain wiring as short as possible; the advice is perfectly sound, provided it is applied in a reasonable sense. It is of no use keeping connections short if it involves a bad layout, in which, to achieve short connections, the constructor arranges components connected in, say, the tuning, reaction, grid and anode circuits close together, without any thought for the fields which might be created around such parts.

Lay-out and wiring are locked together; before either can be settled the other must be considered; therefore, it is always a wise plan to play about, as it were, with the components like chess men, on the baseboard which is going to be used or on a piece of paper of the same size. By doing this and, at the same time, visualising the wiring, the best assembly should be produced. When deciding on the lay-out of a set, many amateurs seem to think that they must follow some orthodox procedure or line-up: while admitting that experience has proved it advisable to locate certain components or sections of a circuit in certain positions relative to other parts, it does not follow that, say, the valve sequence must conform to a 1, 2, 3, 4 arrangement in a dead straight line along the rear edge of the chassis or baseboard.

Components

Use, whenever possible, the best. This applies in particular, so far as these notes are concerned, to coils, fixed and variable condensers, H.F. chokes, valve-holders and all insulating material. With short waves the frequency of the current is so high, compared with that of the medium and long waves, that components which would be quite satisfactory for the latter might easily introduce serious losses—chiefly through leakage and absorption—that one must bear such points in mind.

It is possible for coils and H.F. chokes to be wound on formers of doubtful value as regards insulation and losses from the H.F. point of view. Similarly, all condensers—both fixed and variable—should be of good quality and design, otherwise they can introduce undesirable features, which, once the set is in operation, might not always be easy to diagnose. A faulty H.F. choke—i.e., one having a high self-capacity and/or unsatisfactory inductance value—will fail in its task of preventing the passage of H.F. currents, and, if it is in the anode circuit of the detector, would probably be responsible for weird reaction results.

Earthing

Too much stress cannot be laid on the importance of good earth connections. Lack of attention to these often contributes greatly to the presence of hand- and body-capacity.

All parts of the circuit which have to be returned to earth should have a direct electrical connection with the earth terminal. Metal chassis are often used to provide the earth return path between the actual terminal and the component. This procedure can be satisfactory, provided the contacts with the metal chassis are above suspicion. The trouble which so often arises is due to imperfect contacts, which, in turn, are due to loose connections and the oxidisation of the metal and the connecting wire. A far better plan is to provide a stout bus-bar of, say, 16 or 18 S.W.G. tinned copper wire, so located across the chassis or baseboard that it forms a handy short connecting point for the various components. At its point nearest the earth terminal it is, of course, connected to it (Fig. 1). Make soldered joints rather than screwed contacts. Use wire of reasonable gauge: 20 or 18 S.W.G. has good rigidity and provides a low resistance path, and it is more efficient to use this than flimsy wire which will sway and dangle all over the place.

A metal panel is a valuable anti-hand-capacity device, provided it is connected to earth, therefore whenever possible it should be used, even for the small sets. In these days of metal shortage, a good substitute will be provided by metal foil or perforated zinc placed at the back of an ordinary panel.

The moving vanes of the tuning condenser are, in the majority of circuits, connected direct to earth, but it is advisable to make quite sure that the connection is of the best, and, when a metal panel is in use, not to rely on the connection provided by the condenser fixing and the panel. Make doubly sure by using a separate earth connection to the spindle itself—using flexible metal braid—or the terminal provided. Certain short-wave variable condensers have separate connections for the moving vanes and the metal work forming the frame of the assembly. In such cases both should be earthed.

The same precautions should be taken as regards keeping the moving vanes on the earth potential side of the circuit, with reaction condensers. If, for example, the condenser comes between the anode of the detector and the reaction coil, connect its fixed vanes to the anode and the moving to earth via the coil.

Screening

Effective screening between tuned circuits is another item which calls for particular attention, as it not only ensures stability between stages but tends to reduce the possibility of hand-capacity by localising its effects. If the screening is around a tuned circuit, see that the metal is, at least, three-quarters the diameter of the coil away from the winding. If two adjacent stages have to be screened, don't use a dividing screen common to both sections. It is far better to make each screening box or case a separate unit, and allow ½in. or ¾in. between those adjacent to each other. Give particular attention to the earth lead and the earth plate or connection. These points are too often skipped. The use of a thin single uninsulated wire for the earth lead is inviting trouble. Stranded wire—something in the region of 7/22's—well insulated, is approaching the ideal, but even with this gauge, the lead should be kept as short as possible.

Take trouble to make the actual earth plate or connection as efficient as possible. The larger the metal area in the ground, and the deeper it is buried, add to its effectiveness, provided the surrounding earth is such that it keeps in a damp condition as against dry hard clay or gravel-like soil. If a water pipe has to be used, select the rising main and clean the pipe well before the earthing band is strapped in position. When a really sound electrical connection has been made, bind it well with insulating tape to reduce possibility of corrosion.

Aeria

A poorly designed and erected aerial can be responsible for much trouble. It is possible for an aerial to have a

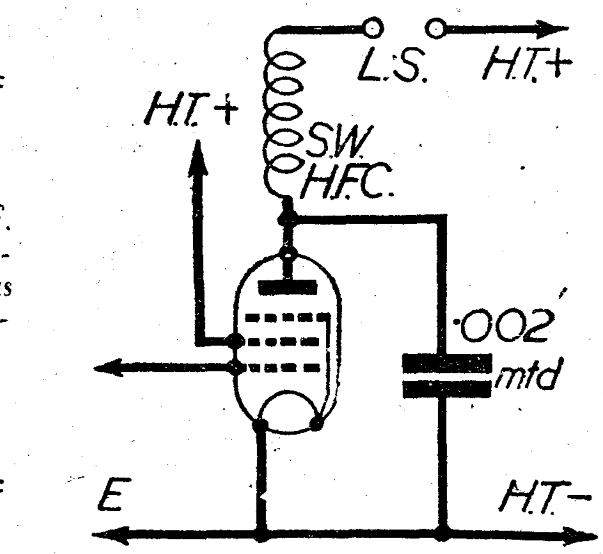
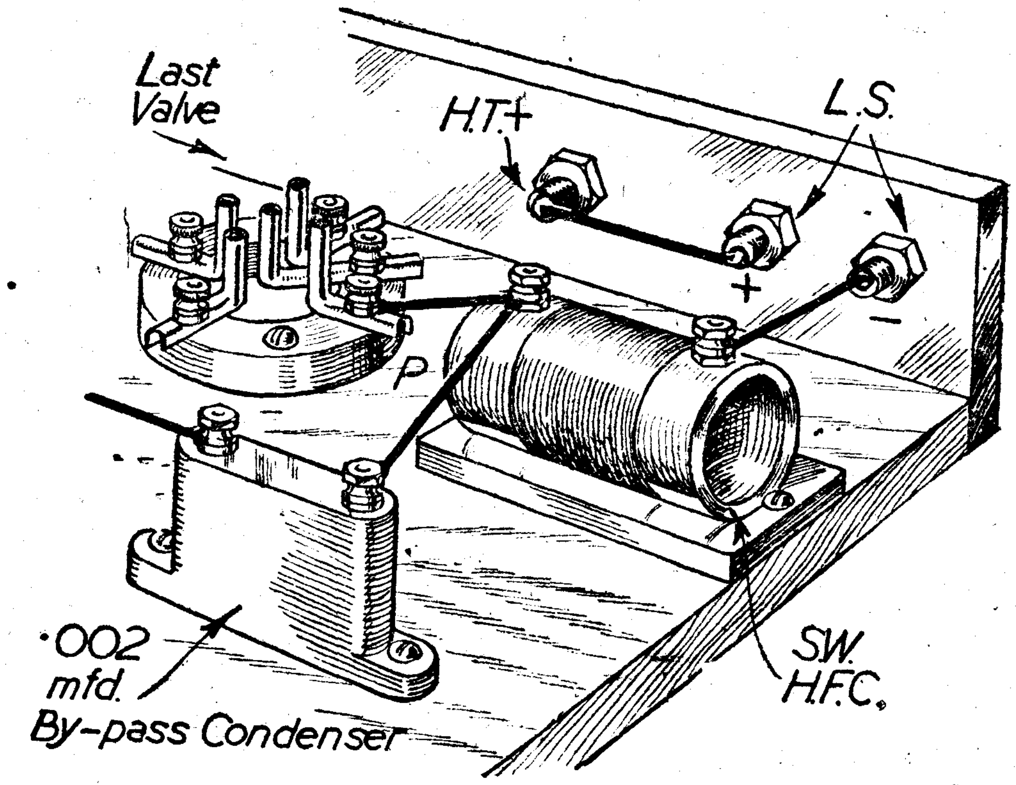


Fig. 2.—A simple H.F. filter always worth incorporating in a S.W. set as it forms a good anti-body-capacity device.



high capacity to earth, and this is one of the items to be avoided when considering S.W. sets and reception.

Use a reasonable number of good insulators at each point of suspension; keep the horizontal and the down-lead portions well away from surrounding earthed objects, and see that the whole aerial erection is such that the wire is kept reasonably taut. Don't have a long lead-in wire roaming through the house, and never tack it neatly to the wall or picture rail.

Hand- or Body-capacity

Hand-capacity can be experienced whether 'phones or a speaker is in use, whereas, body-capacity seems to be the more correct term to use when 'phones are being worn, as this particular form of the trouble does not appear to be so pronounced if a loudspeaker handles the output. When the operator is wearing 'phones, and any movement of his body, or even hands, relative to the set causes the tuning and/or the reaction to vary, it is obvious that body-capacity is present. One of the simplest remedies to try is the inclusion of a good S.W. H.F. choke in the anode circuit of the output valve, together with a small by-pass condenser between anode and earth. The idea is shown in Fig. 2.

Mixing Valves i

Making and Adjusting Shunts. Details of N

IN selecting the valves for a universal receiver, one would, normally, see that every one was of a similar heater current rating.

Since, however, valves are in short supply, it is by no means always possible to do this, and some way of accommodating an odd set of valves has to be provided for. In view also of the number of different types of universal valves one could obtain, it is inevitable that the average radio man has collected quite a varied assortment.

Let it be assumed, then, that four valves are available for use consisting of an H.F. pentode with a heater rating of 13 volts at .18 amp., another of the same voltage but consuming .2 amp., an output pentode

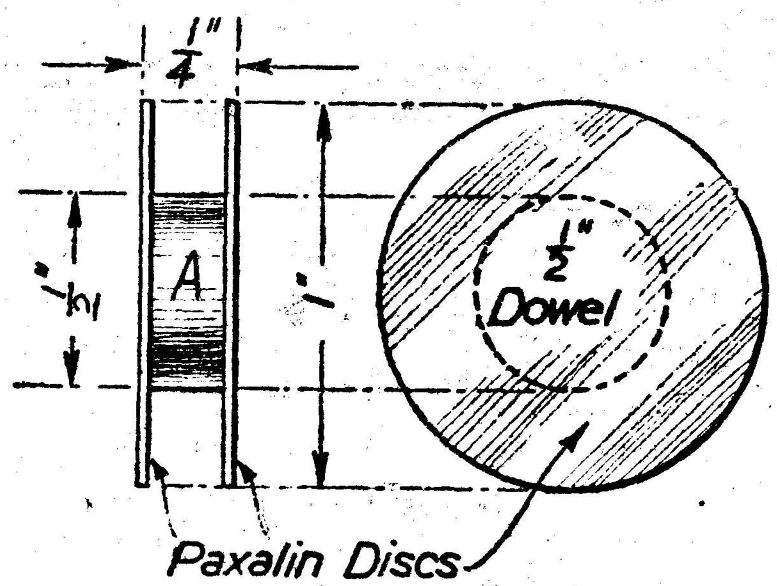


Fig. 1—A simple method of making bobbins for shunts.

taking 40 volts at .2 amp., and a rectifier needing .3 amp. at 20 volts.

Since the rectifier (in this case) consumes the highest current, it is obvious that this current—.3 amp.—must be provided for in the heater chain. It would, however, be too great for the remaining valves, so that it becomes necessary to by-pass the excess current at each of the other valveholders.

The skeleton diagram in Fig. 3 shows how this may be effected. As V1 consumes only .18 amp., the difference between this and the standing current of .3 amp. must be absorbed by the shunt resistance R1, and its value calculated from $R=\frac{E}{C}$, where E=the valve heater voltage and C=the current difference—in this case .3−.18=.12 amp. The shunt value, therefore, would be $\frac{13}{.12}$ =108.33 ohms. Actually, 108 ohms would be near enough for the purpose.

An important consideration is with regard to the wattage of the shunt. Obviously, if the resistance overheats and breaks down the whole of the current passes through the heater of the valve it is by-passing—possibly with disastrous results to its life. It is wise, therefore, to see that the shunt is of ample size. The wattage may easily be calculated from $W=I^2\times R$, so that in the example above it would become $.12\times.12\times108=1.5$ watts. The same method of calculation may be applied to all the remaining valves in Fig. 3, where it will be seen that the various shunt values and currents are shown.

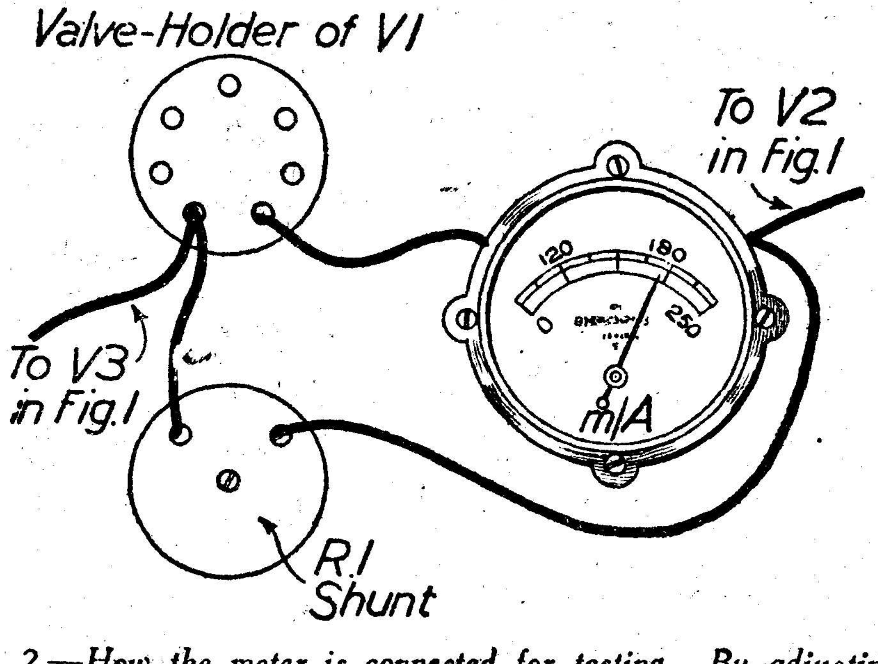


Fig. 2.—How the meter is connected for testing. By adjusting R1 until 180 m/A is shown on the meter, the exact current for V1 is ensured.

Shunt Details

Turning now to more practical considerations, the shunts may, of course, be purchased provided the correct values are obtainable. They are very simple to make, however, although some form of meter is necessary for adjustment.

A bobbin similar to that shown in Fig. 1 may be constructed from a section cut from a piece of ½in. dowelling A, and two circular discs of paxolin glued or screwed to either side. Resistance wire *is* obtainable, but if any difficulty is experienced in this direction, it is usually possible to obtain some from second-hand mains resistances, power resistances, etc., which can be purchased from surplus stores.

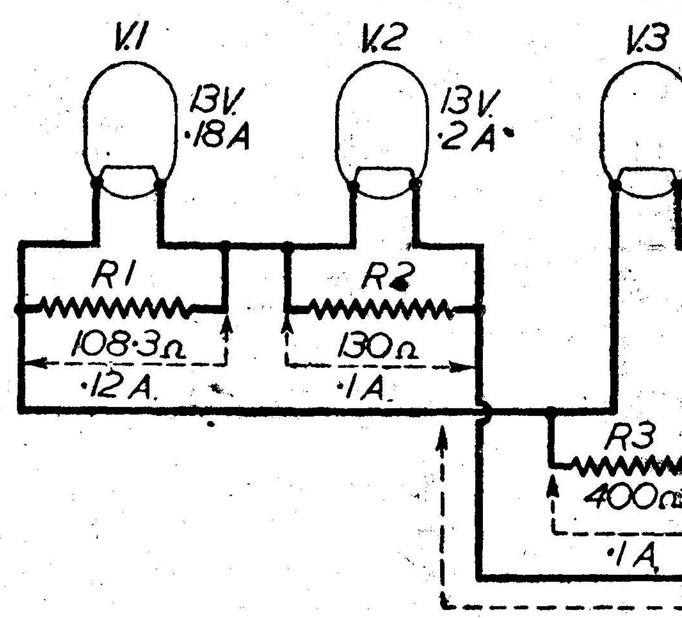


Fig. 3.—Skeleton circuit of the heater ch... the current divides between th...

The wire should be of a gauge capable of amply carrying the required current, so that no possibility of electrical breakdown exists. For the benefit of readers who are not familiar with the current carrying capacity of resistance wire, a short list of the most useful sizes, together with ohms per yard is given in the accompanying table.

In order to obtain a rough idea of the length of wire required, it is best to assess this from the ohms per yard table, estimating it rather more than less. Before winding it on to the bobbin the wire should be doubled in half, and then wound on from the doubled end. This procedure makes it, as far as possible, a non-inductive winding. For the exact adjustment of the shunt value, it is obviously best to measure it with the aid of an ohm-meter, but if such an instrument is not available, a milliammeter reading up to 250 will be suitable. For this test it will be necessary to connect the meter as in Fig. 2, where it will be seen that the part of the circuit of Fig. 3 under consideration is shown pictorially.

With the milliammeter in this position it will read the actual current taken by the heater of V1, and if the ohmic value of the shunt was provisionally made a little higher than necessary, then this reading will be under .18 amp. This is desirable, as by gradually shortening the shunt winding the exact consumption of the heater (.18 amp.) can be provided for. It is important to note that the set must be switched off every time before disconnecting the shunt for adjustment.

If more than one valve is being shunted, as in Fig. 3, it is advisable, before adjusting any shunt exactly, to see that they are all reasonably accurate by means of the ohms per yard method.

Mains Dropping Resistances

In this connection the mains dropping resistance

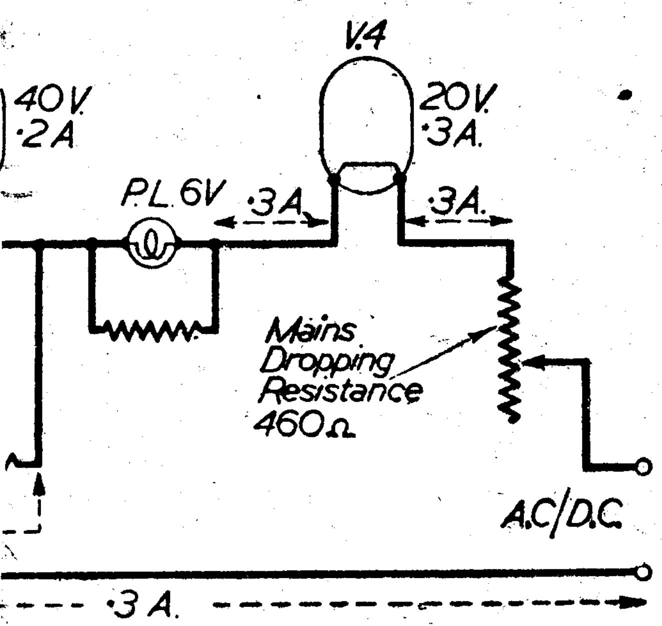
n A.C./D.C. Sets

Iains Dropping Resistances. By S. BRASIER

calls for some comment because it must be of such value that it provides the correct voltage drop at the highest current taken by any valve. In the case of Fig. 3, it would be .3 amp.—required by the rectifier.

For the calculation of this resistance it is necessary to add together the heater voltages, which would be $13+13+40+20=86$. It is usual to include a pilot lamp, however, so allowing another 6 volts, the total would become 92. This figure is subtracted from the mains voltage—say 230 volts, which leaves 138 volts to be dropped at .3 amp. Applying the formula $R=\frac{E}{C}$, the value of the resistance becomes 460 ohms.

The usual type of mains dropper takes the form of a high wattage resistance wound on a porcelain tube and tapped for mains voltages of 200-250 volts. Where space and ventilation permit this type is very reliable. Another means of achieving the same object is to employ a barretter, which is a special lamp that maintains a constant current for wide mains voltage variations.



ain of an A.C./D.C. set, indicating how valves and shunts respectively.

An alternative to the examples given above consists of what is known as a linecord. It is fitted externally and combines the duties of the mains lead and mains dropping resistance. For this reason it is ideal for midget receivers, and is invariably used for them.

A length of special asbestos-covered resistance wire is interwoven with the two mains leads, one of which (black) goes to one pin of the mains connecting plug, the other lead (red) is joined, together with one end of the resistance, to the remaining pin. At the receiver end of the lead the black wire would go to the earth line (chassis), the red wire to the rectifier anode, and the resistance to one side of the rectifier heater.

In some American midget sets a two-way linecord is employed. In this case a rectifier taking a low anode voltage is utilised, and the resistance wire is joined to the rectifier anode as well as to the valve heater.

Linecords can be bought complete, having various resistance values or "by the yard" at so many ohms per foot. In this way any non-standard resistance can be made up.

An idea that may interest some readers is illustrated in Fig. 4. The lead from a table-lamp is connected to the valve heaters, and the ordinary electric lamp—of a suitable size—used as the dropping resistance, so that the normally wasted power is used to good purpose. This novel system was employed on a receiver which was only used after dark, and the lamp provided enough illumination to "listen" in. If the lamp is not of the correct resistance it is a simple matter to include a short length of linecord in the lead of the table lamp.

The power normally wasted in a small two-valve universal set amounts to some 50 watts, so that the idea explained above has other applications which could be exploited, such as miniature electric heaters, bed warmers (using resistance mats) for a bedside receiver, etc.

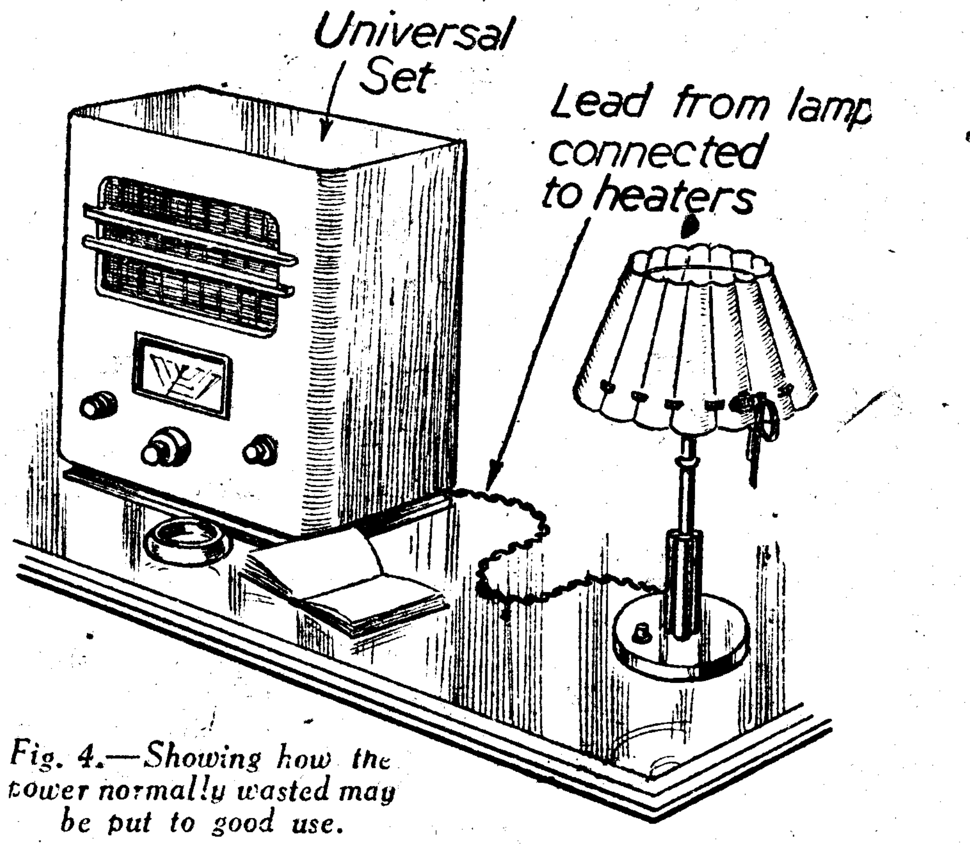


Fig. 4.—Showing how the power normally wasted may be put to good use.

RESISTANCE WIRE DATA (EUREKA)		
S.W.G.	Ohms per yard	Current cap.
28	3.91 Ω	.25 amp.
30	5.58 Ω	.2 amp.
32	7.35 Ω	.15 amp.
34	10.13 Ω	.1 amp.
36	14.84 Ω	.05 amp.

Live Chassis

When working on a universal receiver—particularly on D.C. mains—it is most important to remember that the chassis is often live, and, although the voltages are not often above that of the mains, one can, nevertheless, receive quite a nasty shock. It is for this reason also that a condenser of high working voltage is always connected in series with the aerial and earth leads.

Another condenser that is of vital importance is that used for smoothing immediately following the rectifier. The quality of this component should be of the highest obtainable, and the working voltage double or even treble that of the rectifiers' peak output voltage. One cannot stress too much the necessity for this procedure.

Hum

A trouble which is not unusual in the type of set under consideration is modulation hum. Fortunately, it may be generally eliminated by connecting a condenser of .01 mfd. between the mains input positive and chassis. A more elaborate scheme which also smooths out any roughness in the mains supply is that shown in Fig. 5. Mains H.F. chokes are used in series with the supply together with condensers connected so that their centre point is earthed. Disused plug-in coils may be employed quite successfully for mains H.F. chokes, provided the wire is thick enough to stand the current passed. Anything up to 28 S.W.G. would be suitable, and two coils of about No. 250 would be required. Should the space in the receiver not allow of their inclusion, the complete unit could be mounted externally.

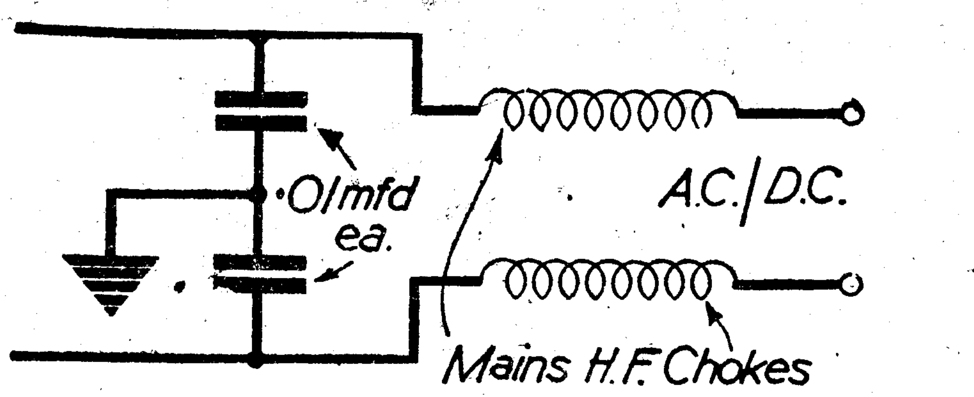


Fig. 5.—Plug-in coils may be used as mains H.F. chokes, as described in the text.

"SIGNALS" IN THE R.A.F.

How "Signals" Linked a Thousand Bombers

AIR MARSHAL SIR ARTHUR HARRIS, Commander-in-Chief of Bomber Command, has congratulated the Signals Branch of his command on their excellent work during the heavy attacks on Cologne and the Ruhr by over a thousand bombers. His message was sent to every group and station.

The word "signals" is mysterious. Just what this department of the R.A.F. does is carefully kept dark; what messages they send may not be revealed; and how they send them is secret. But without this department it would be next to impossible to send one, let alone a thousand, bombers over Germany.

"Signals" was working its hardest for many days before the first thousand went to Cologne. They saw that all preparations and orders for the raid went through swiftly, but without giving any warning to the enemy. They saw that each of the thousand bombers was linked, even while in the air, to its base. They saved many lives and many aircraft.

The nerve centre of an R.A.F. station. The controller, surrounded by telephones and maps, gives the pilots permission to take off and land. Through a hand "mike" he can talk to the aircraft while they are in flight.

Navigational Aid

A navigator may wish to fix his position without disclosing it to the enemy. The Signals Branch has a method by which this can be done in any number of aircraft at the same moment. Or the navigator may have been killed or injured and his captain have the job of making a safe return without his navigator's aid. The wireless operator can get a series of homing bearings which will bring the aircraft right overhead at any of the hundred or so aerodromes; and once there the pilot can speak directly by radio telephony to the aerodrome control officer, who will guide the aircraft safely down. A group commander may wish to divert some of his aircraft to another aerodrome, perhaps because the weather has suddenly changed. Signals has provided a channel of radio-communication for that very purpose.

But if the badly disabled aircraft, labouring home on one engine, is forced to come down in the sea, can Signals do anything about it? Almost certainly the position of the aircraft will have been fixed by radio before it crashed, and so the Air Sea Rescue people will be able to get on the job at once.

"Signals" to the Rescue

When on "ops" the navigator must know the time to a second, and if necessary Signals can give it, as a telephone exchange does when you dial "TIM," but with rather more difficulty.

Many times during the raid on Cologne Signals helped our crews. A Wellington, for example, had its wireless set shot away, but the captain got back to England and then tracked his way back to base by radio telephony; he spoke to about six stations, one after another, as he came to them; they gave his exact position, and told him what weather to expect on the way.

From the Chief Signals Office at Command to the W.A.A.F. telephone, teleprinter and ground radio operator Signals is a great and intricate organisation, on whom the men in the air depend for their lives. An Order of the Day to the Signals Branch said: "The safety of aircraft and of their crews is found to depend again and again upon the methodical efficiency, care, intelligence and devotion to duty of the Signals Service. Captains of aircraft should know that, when the safety of their aircraft is endangered by fog or other conditions of bad visibility, they can rely absolutely on the Signals Service to bring the aircraft home safely.

"The tradition of the Signals Service is that the safety of aircraft overrides every other interest; the personnel of the Signals Service spare no effort to bring every aircraft safely to base. The Signals Service aspires never to lose an aircraft."

R. A. F. Day Bombers.

The accompanying illustration was taken at one of the R.A.F.'s day bomber stations. The squadrons there are equipped with the Douglas Boston III. The Douglas Boston III is a half-brother to the Douglas Havoc, which we have been using for some time as a night fighter-bomber, chiefly for "stooging" about over enemy aerodromes, waiting for the return of their raiders over this country.

Speed is an essential quality for daylight bombing and for working with fighter escorts, but the Boston can also look after itself very well.

Radio Examination Papers—11

Another Set of Random Questions, with Suitable Answers by THE EXPERIMENTERS

1. Beam Tetrodes

BOTH beam tetrodes and screen-grid valves have four electrodes. These are: filament or cathode, control grid, screen grid and anode. In both cases they are arranged in that order, with the filament or cathode in the centre, and the anode surrounding the other three electrodes.

But in the screen-grid valve the spiral wires forming the two grids are not necessarily arranged in any particular order in respect of each other. With the beam tetrode, on the other hand, the wires are in mechanical alignment; that is, each turn of the control-grid spiral is in the same horizontal plane as the corresponding turn of the screen grid which surrounds it. This is simply illustrated in Fig. 1, which also explains diagrammatically the reason for the name "beam tetrode." It will be seen that the electron stream from the cathode takes the form of a number of beams or rays to the anode.

Without giving a full explanation, it can be stated that the effect of this construction is to remove the "kink" which is found in the anode current-anode voltage characteristic curve of the screen-grid valve. The result of this is to give the beam tetrode characteristics which resemble in all major respects those of a pentode.

SPECIMEN QUESTIONS

1. *In what essential particular does a beam tetrode differ in construction from a screen-grid valve?*
2. *What symptoms would you expect to find if an output valve: (a) were "soft"; (b) had lost its emission; (c) had a broken heater connection inside its base?*
3. *How would you test an L.F. transformer (of which no technical details were available) if it were suspected of being faulty?*
4. *Explain the principle of a vibrator-type H.T. supply unit.*
5. *What are the advantages of a barretter over a tapped resistance for voltage regulation in an A.C./D.C. receiver?*
6. *Find the inductance necessary for an L.F. choke required to present an impedance of approximately 40,000 ohms at 600 cycles per second.*

2. Faulty Output Valve

(a) A "soft" valve is one in which there is a certain amount of air or other gases inside the glass envelope. By contrast, a "hard" valve is one which is highly evacuated.

When gas is present, this tends to ionise due to the voltage between the cathode and anode. And when ionisation takes place the internal anode-cathode resistance of the valve decreases. Thus, a "soft" valve would tend to pass a higher anode current than would a normal valve in good condition. This would generally cause excessive heating of the valve. Additionally, the characteristics of the valve would undergo a change as "softening" took place, and distortion would occur. Also, if the anode voltage were above a certain value, the valve would be seen to "blue-glow"—that is, a bluish glow would be seen around the electrode system—due to ionisation of the gases.

(b) If the valve had lost its emission there would be no flow of electrons from the cathode to the anode, and therefore the valve would be completely inoperative. In practice, it is customary to say that a valve has lost its emission when the emission has fallen below normal, although some electrons are thrown off by the cathode when it is heated and an anode voltage is applied.

It is clear that a valve having the fault described in the question would pass a lower anode current than normal, and, because of this, that it would easily be overloaded. A simple test for reduced emission is to reduce the grid-bias voltage; if the volume of reproduction then increases and quality improves it is a sign that the fault is present.

(c) If a heater connection were broken the cathode would not be raised to a dull red heat, and therefore there would not be any electron emission from it. The valve would therefore be completely inoperative, and there may be a complete absence of signals from the speaker. On the other hand, the inter-electrode capacity may allow some audio-frequency voltages to be applied to the speaker, when reproduction would be extremely faint, and "thin" in character. The valve would also be cold to the touch after the set had been switched on for some time; the other valves would by then be warm.

3. L.F. Transformer Tests

The first step would be to find which pairs of the four terminals were connected together through the windings. This test could best be made by means of a high-reading ohmmeter, or even by means of a megger; in using a megger the handle should be turned very slowly so that the full voltage is not applied to the windings. An alternative method of test would be by means of a 0-5 mA milliammeter wired in series with a 4.5 volt battery and a 1,000-ohm resistor.

Having found that there were two pairs of terminals, each connected to one of the windings, the terminals could be marked with coloured chalk or strips of coloured paper. Each terminal of a pair would be similarly marked.

Next it would be necessary to find which of the pairs was connected to the primary, and which to the secondary winding. The same test equipment would be used as before, the object being to find which winding had the higher D.C. resistance; that would be the secondary.

It would also be a good plan to check that there is

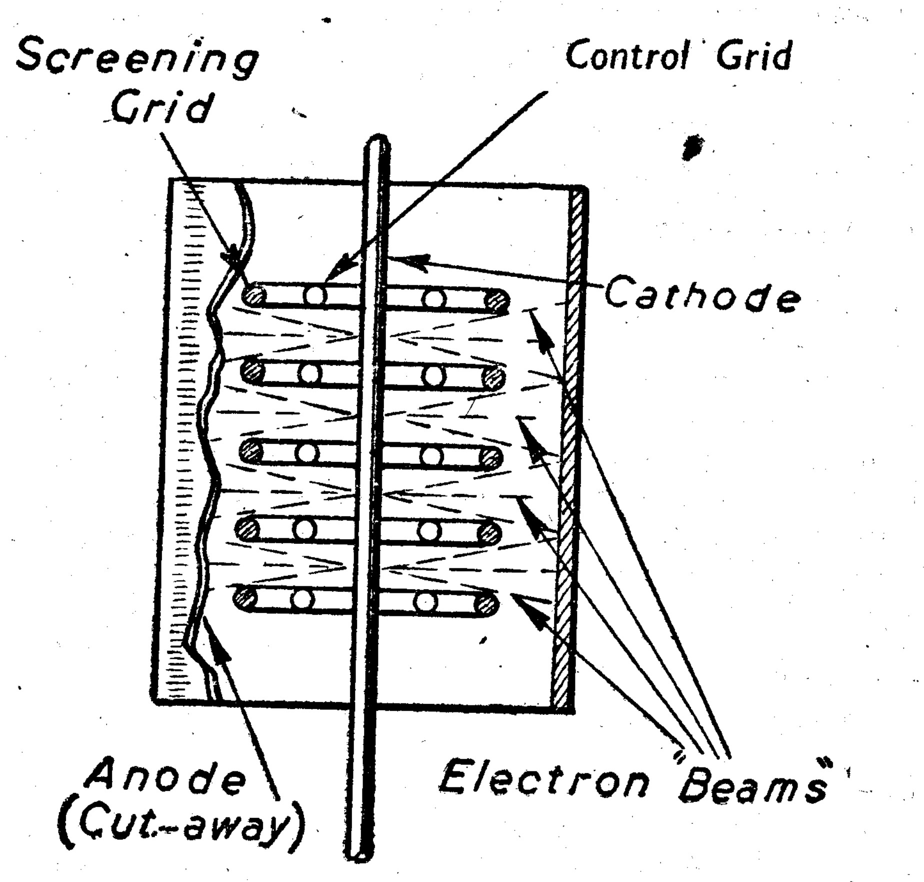


Fig. 1.—This section through a beam tetrode (not to scale) shows the alignment of the wires forming the control grid and screening grid, and the "beaming" of the electron stream from cathode to anode.

a high resistance between each winding and the core, and between the two windings. Such a test is best made by using a megger, but a high-reading ohmmeter, or the milliammeter-battery-resistor arrangement, could be used. When using either of the two last-mentioned devices the reading should be infinity; when using a megger, the resistance should be in terms of megohms.

4. Vibrator H.T. Units

There are two main types of vibrator H.T. unit: one is described as self-rectifying, while the other must be used in conjunction with a separate rectifier. In both types a high-ratio step-up transformer is used, and there is a vibrating contact between one end of the primary and the supply accumulator. The vibrator is similar in principle to an electric bell or induction coil, and serves to make and break the L.T. supply to the primary at high speed.

Due to mutual induction a high voltage (proportional to the step-up ratio of the transformer) appears across the secondary winding each time the primary circuit is made and broken. And since the current through the secondary flows in one direction when the circuit is made, and in the opposite direction when the circuit is broken, it will be seen that the output from the secondary is A.C. Before it can be used for H.T. supply, it must be rectified.

One means of carrying out rectification is by means of a valve or metal rectifier. But as this adds to the bulk and cost of the unit, a different system is generally employed when compactness is of importance. This consists of having a second make-and-break "ganged" to that in the transformer primary circuit. Both contacts vibrate at the same speed, and the secondary one is arranged to make contact with the two ends of the secondary winding in turn. The D.C. output is taken from this vibrating contact and from a centre-tapping on the secondary of the transformer, as shown in the simplified diagram in Fig. 2.

If, at any instant, one end of the transformer secondary is negative, the other is positive in respect of it. Moreover, the ends bear the same polarity in respect of the centre tap, which may be described as "neutral." It has been stated that this reversal of polarity is due to the making and breaking of the primary circuit, so it will be seen that if the secondary and primary contacts vibrate in sympathy, the polarity "picked-up" by the secondary vibrator will remain constant. That is why a D.C. output is obtained. Naturally, the output will be rather unsteady, and therefore smoothing is necessary before applying the voltage to the receiver.

5. Barretters

Some form of voltage regulator is necessary with A.C./D.C. sets, in which the valve heaters are wired in series and fed from the mains supply. If, for example, the voltage required for the series-connected valve heaters should be 65 and the mains voltage were 230, it would be necessary to "drop" 165 volts. This could be done by using a fixed resistor, the value of which would be found by applying Ohm's Law (R=E/I). But if the set were to be used on 250-volt mains an extra 20 volts would have to be dropped, while if it were used on 200-volt mains only 135 volts would have to be dropped.

Obviously, a tapped resistance could be used, tappings being provided to suit the usual mains-supply voltages. But, as mains voltages do not always remain absolutely steady, the result would be only a compromise. That is one reason why a barretter is nearly always to be preferred.

A barretter consists of a special form of filament lamp having certain properties. Chief of these is that should the current through the filament tend to rise, the resistance of the filament rises proportionately, so opposing the rise in current. Thus, a barretter designed and made to pass a certain current will allow just that current to flow through it over a wide range of applied voltages. In other words, the voltage drop across the filament will rise at the same rate as any rise in applied mains voltage.

Thus, it will be seen that a barretter gives the advantages that it is not necessary to move any tappings when using the set in which it is fitted on different mains voltages, and that it will compensate for any appreciable fluctuations in mains voltage, so keeping the voltage fed to the heaters steady in all conditions.

6. Choke Impedance

Since the question calls for only an approximate value (and that is all that is necessary in practice) we can consider the terms "impedance" and "reactance" as synonymous. It may be pointed out in passing that in determining impedance we take into consideration self-capacity and D.C. resistance, whereas in finding reactance it is only the inductance which is considered. A good L.F. choke has a low self-capacity and also a low D.C. resistance, so these factors should not affect our results very seriously.

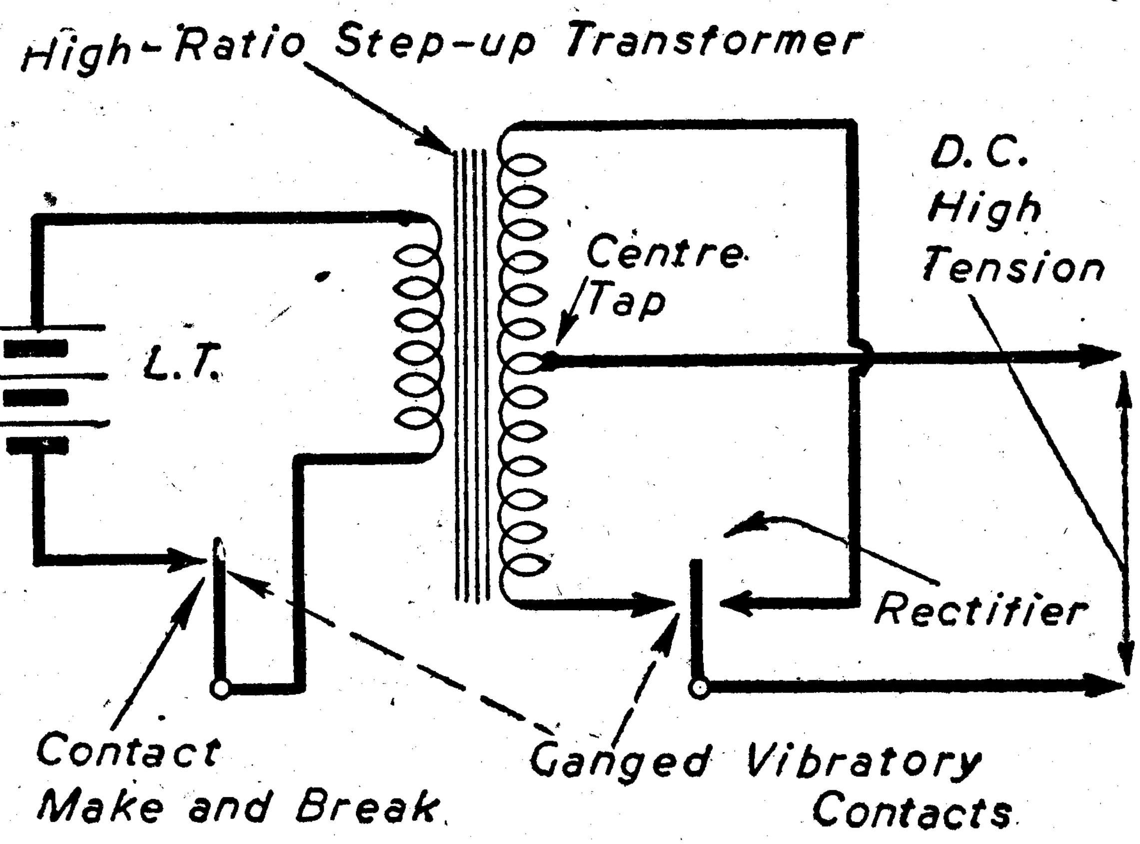


Fig. 2.—This simplified diagram illustrates the underlying principle of the vibrator-type H.T. unit. Two vibratory contacts are ganged together; one serves as an L.T. make-and-break, the other as a rectifier.

The reactance of a choke is found from the formula:

$$X_L \text{ (inductive reactance, in ohms)} = 2\pi f L,$$

where π is 3.14, f is the frequency of the L.F. in cycles per second, and L is the required inductance in henries.

If we substitute the figures given in the question in this equation we get:

$$40{,}000 = 6.28 \times 600 \times L, \text{ or}$$

$$L = \frac{40{,}000}{6.28 \times 600}$$

which is approximately 10.7 henries. That, therefore, is the value of choke required. In practice, we should choose one rated at 10 henries, making sure that this figure was maintained when the choke was passing the anode current of the valve with which it was used.

It is evident that it is not important to regard the D.C. resistance and self-capacity, when we remember that the resistance would be effectively in series with the reactance, and that the capacitative reactance (very high) would be effectively in parallel with the inductive reactance.

More About Baffles

WE have received several letters from readers interested in the articles in the August and September issues on "Why the Baffle?" by L. O. Sparks, and two of the letters we give below. K. T. Hardman, of Birkenhead, writes:

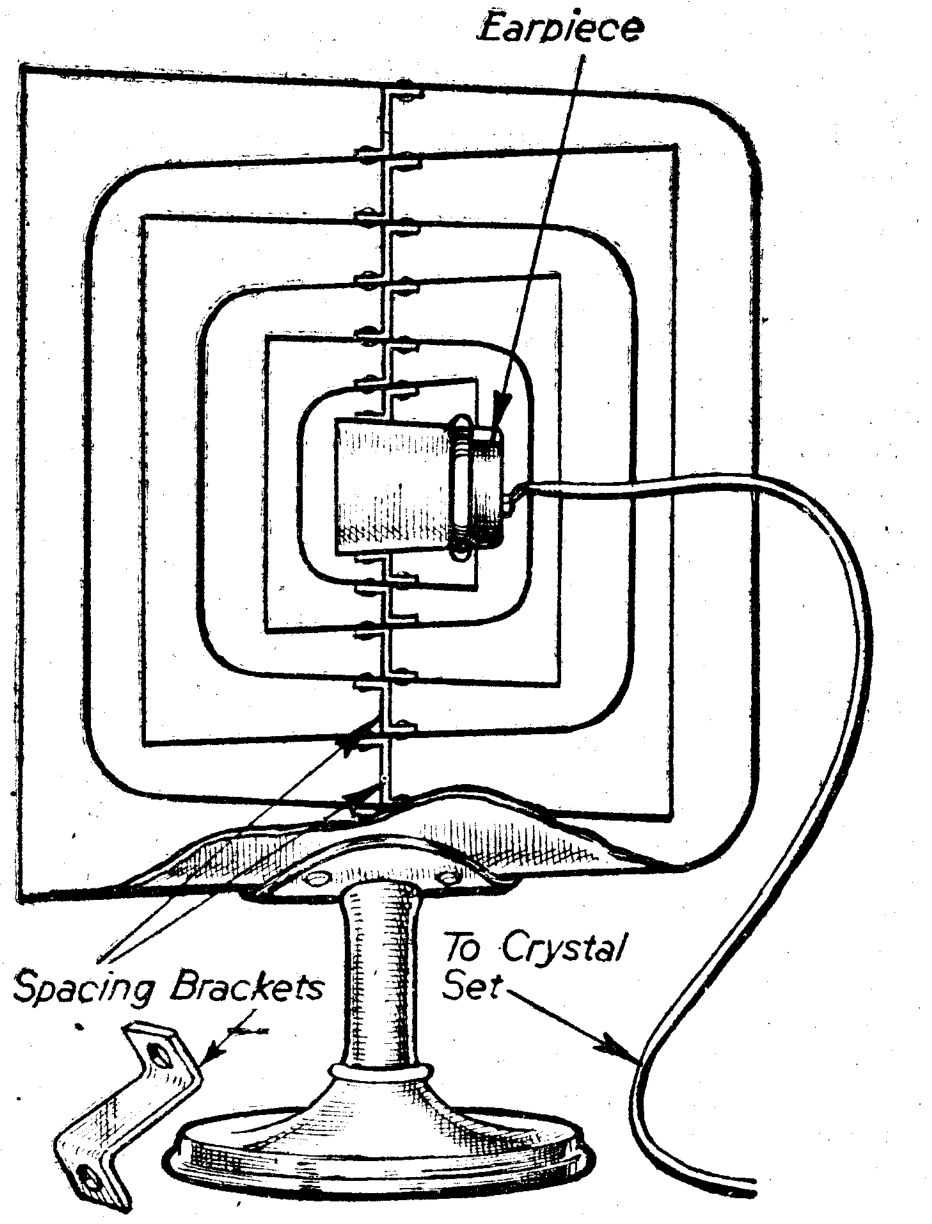
"The articles on 'Why the Baffle?' have been very interesting to myself, as they have reminded me of some little experiments of my own—which outbreak of war stopped.

"Stimulated by my memories of the legend of 'The Ear of Dionysius' from the early history of the Island of Crete, I began to wonder if it would not be possible to design a loudspeaker crystal set (by means of a suitable speaker unit) which without being too large in overall size would sufficiently magnify the small input from the crystal itself to be comfortably audible in a fair-sized room.

"I thought it quite possible that there might be a fair market for such a set amongst listeners who are not interested in foreign broadcasts, on account of low cost and freedom from batteries, accumulators and electric supplies.

"I got a number of aluminium dishes or basins made, of growing increase in size, and with their openings (or rims) placed in reverse in the next size larger; I had quite a number of these dishes so fixed up one inside the other that their final overall size was reasonably compact. In the centre of the smaller and innermost dish I mounted an earpiece as speaker unit—and that was as far as I got. I could not get hold of a crystal suitable to complete the experiment.

"Transmission after the war will probably be much more powerful and I think such a set as I visualised would pick up, and reproduce at comfortable volume for small rooms, quite a lot of programmes with very little outlay and upkeep. The reception would be much purer and free from mush in general, which many listeners would much prefer to getting a big number of mushy foreign programmes."

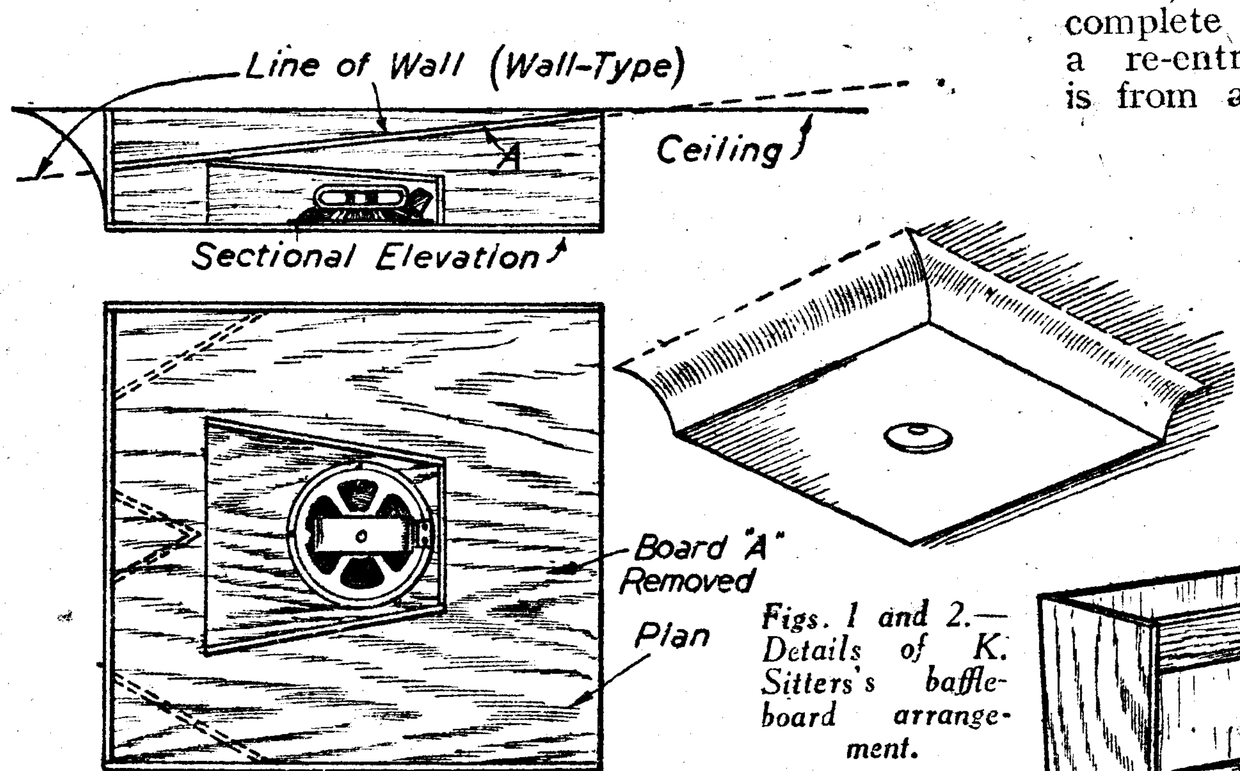


K. T. Hardman's idea for a loudspeaker for a crystal set.

Streamline Effect

K. Sitters (Signaller, R.A.) writes as follows:

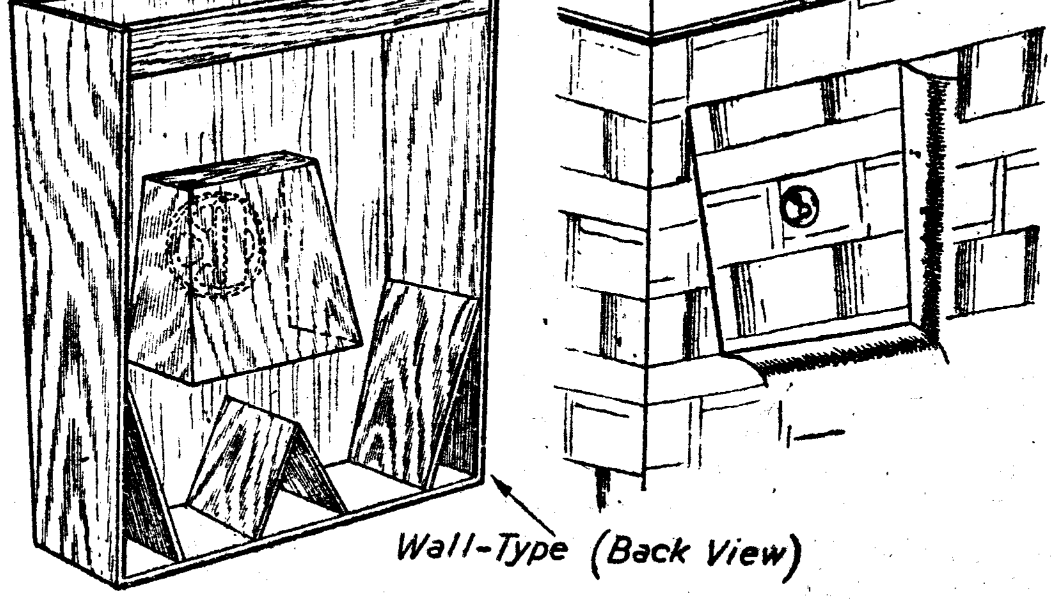
"Readers of the article on L.S. Baffles may be interested in my own arrangement, which has been in use successfully for several years. It consists of an elaboration of the simple baffle board, and in view of its size the most convenient place for it is in or on the ceiling in the middle of the room. Fitting is by four long thin screws into the joists above, and the lead from the set is concealed behind the plaster. For purely decorative purposes the sides of the baffle are 'faired' into the ceiling by means of the wide curved strips of thick card glued to baffle and ceiling after fitting, and the whole outside whitewashed, producing a streamline, built-in effect.



Figs. 1 and 2.—Details of K. Sitters's baffle-board arrangement.

"As will be seen from Fig. 1, the loudspeaker is in the centre of the board, which is boxed in on three sides; the fourth side is open but may be covered with fabric to exclude dust. The 'roof' consists of another thick board, not parallel to the baffle but sloping up to the open side. A smaller, similarly shaped assembly fits inside, over the loudspeaker unit, facing inwards, the complete arrangement resembling in general form a re-entrant horn. Where the room lighting system is from a pendant fitting, of course, some modification would have to be made to this design; a very interesting fitting could be evolved incorporating an indirect lighting unit, or the wall model could be adopted (See Fig. 2.).

"Here the wall itself is utilised to replace the sloping top board, and to achieve this the entire baffle slopes outwards from the wall; the open side is at the top, where the depth of the 'horn' is greatest.



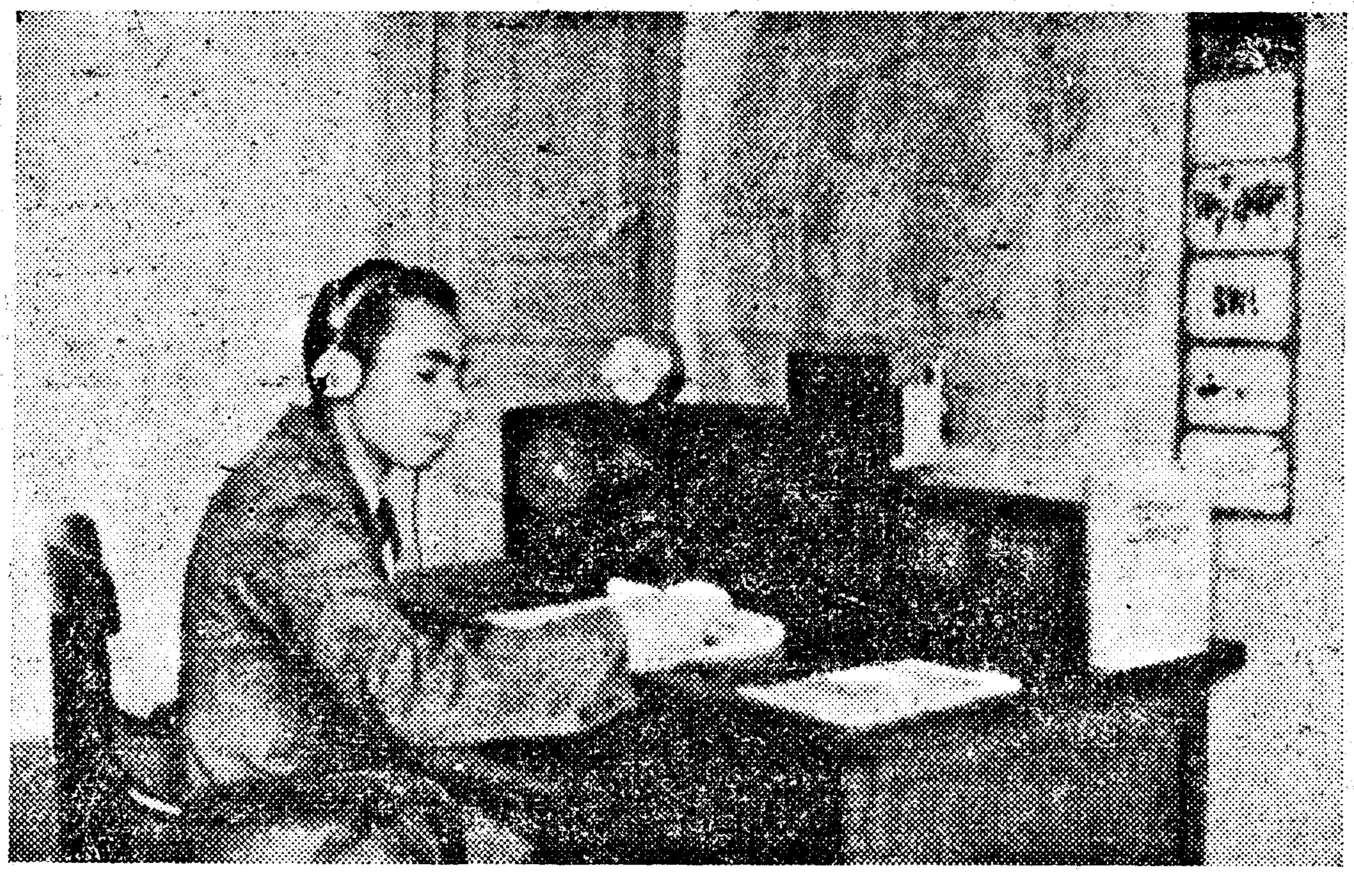
BRITISH LONG DISTANCE LISTENERS' CLUB

THIS month we have received sufficient letters from members to show that in spite of war-time difficulties and restricted hours of leisure, the keenest interest in S.W. activities still prevails. We are particularly pleased to note that many of the earlier members are now dropping us a line, and we hope that we shall hear from many more of those who might be termed "pioneer members." Below is reproduced a letter from one whose name is already familiar to S.W. enthusiasts, through his contributions to the S.W. section of PRACTICAL WIRELESS, and we look forward to his co-operation with B.L.D.L.C. activities.

Middlesbrough

HERE is the letter to which we refer, it is from Member No. 3,350, A. W. Mann.

"I read with interest the constructional details as given by Member No. 8,027, relative to six-pin type S.W. coils. In his letter he says: 'Some experiment was necessary to eliminate aerial series condensers, but this I finally achieved.' I am of opinion that in 99 per cent. of instances, where commercial type six-pin coils are used, as for example, in o-v-1, o-v-2 type receivers, a small capacity semi-variable series aerial condenser is necessary, apart from 80 metres and 160 metres ranges, when used in conjunction with average amateur type aerials of more or less restricted height. I have long held the opinion that while admitting all the advantages modern six-pin coils offer, and there are several, this type of coil fails when compared with the older types in which separate coils were used for aperiodic coupling, which allowed adjustment in relation to grid and aperiodic windings to suit individual circumstances. If, when under peaceful conditions component manufacture can again be undertaken, one or more manufacturers turn their attention to the design and manufacture of six-pin coils with an adjustable aperiodic coupler, I think they will find a ready market, and the extra cost of such coils would be justified. While on the subject of S.W. coils, just a few remarks concerning pin and socket contact. In common use we have split sockets and resilient pins. I find that when coils and holders of identical make are purchased, quite a lot of time is necessary to assure that perfect contact is made by all pins and all coils. If, however, solid type sockets are used, as in home-made coil holders, a considerable improvement is noticeable. I have never experienced these defects with the four-pin type of various makes. It would appear from my experience, and that of others of which I am aware, that the most satisfactory method would be for the manufacturers to sell S.W. coils in complete sets to cover all S.W. ranges, and include a coil holder which has been tested for perfect contact in the electrical and mechanical sense at the factory. Here again, any extra charge would be justified and worth while. The minimum range using a .0001 mfd. tuning condenser is given approximately as 9 metres. With circuit losses reduced to the minimum and receivers of o-v-1, o-v-2 types built on U.S.W. lines, with shortest possible wiring, I have never yet been able to cover the 10 metres band using triode detectors. This is, no doubt, due to grid circuit capacity defects, apart from other considerations of which I am aware, and my point in mentioning this is that as most amateurs either remove one turn from a standard 9 metres coil as listed, or wind a suitable coil on a standard former, most of us would sooner pay the manufacturer to do the job in a first-class commercial manner. In dealing with the subjects outlined, I do not wish to be misunderstood; my object is not to question the design of commercial type S.W. coils and coil holders, or the policy of designers and manufacturers in their production, but in detailing my own experiences and views, perhaps contribute in some measure to further improvement. The most perfect non-trouble six-pin coils, together with a set of standard four-pin type, I have ever used, as to electrical and mechanical contact, were of American design. Solid coil pins were used in conjunction with spring-type sockets in the coil holders. In a 2 H.F., S.G., Det., 3 L.F. receiver it was possible to interchange individual coils and sets of coils without trouble as to contact. My remarks in this letter, however, apply only to six-pin coils as used in conjunction with triode detector circuits o-v-1—2 and aerials of proved efficiency of various types. The experiences of others would, no doubt, interest fellow members as well as myself."



Member No. 5,871 adding to his log in his neat and well-arranged receiving station.

Egypt

MEMBER No. 5,871, Mahmoud Hosni, has followed up his airgraph, details of which were given in the August issue, with a letter enclosing a new photo of his den. His enthusiasm prompts him to suggest the formation of a Group in his area, but, unfortunately, this is not a practical proposition at the moment. When peace returns, we shall be only too pleased to encourage every co-operation between overseas members, but, until then, such ideas must remain in abeyance. Here are extracts from 5,871's letter.

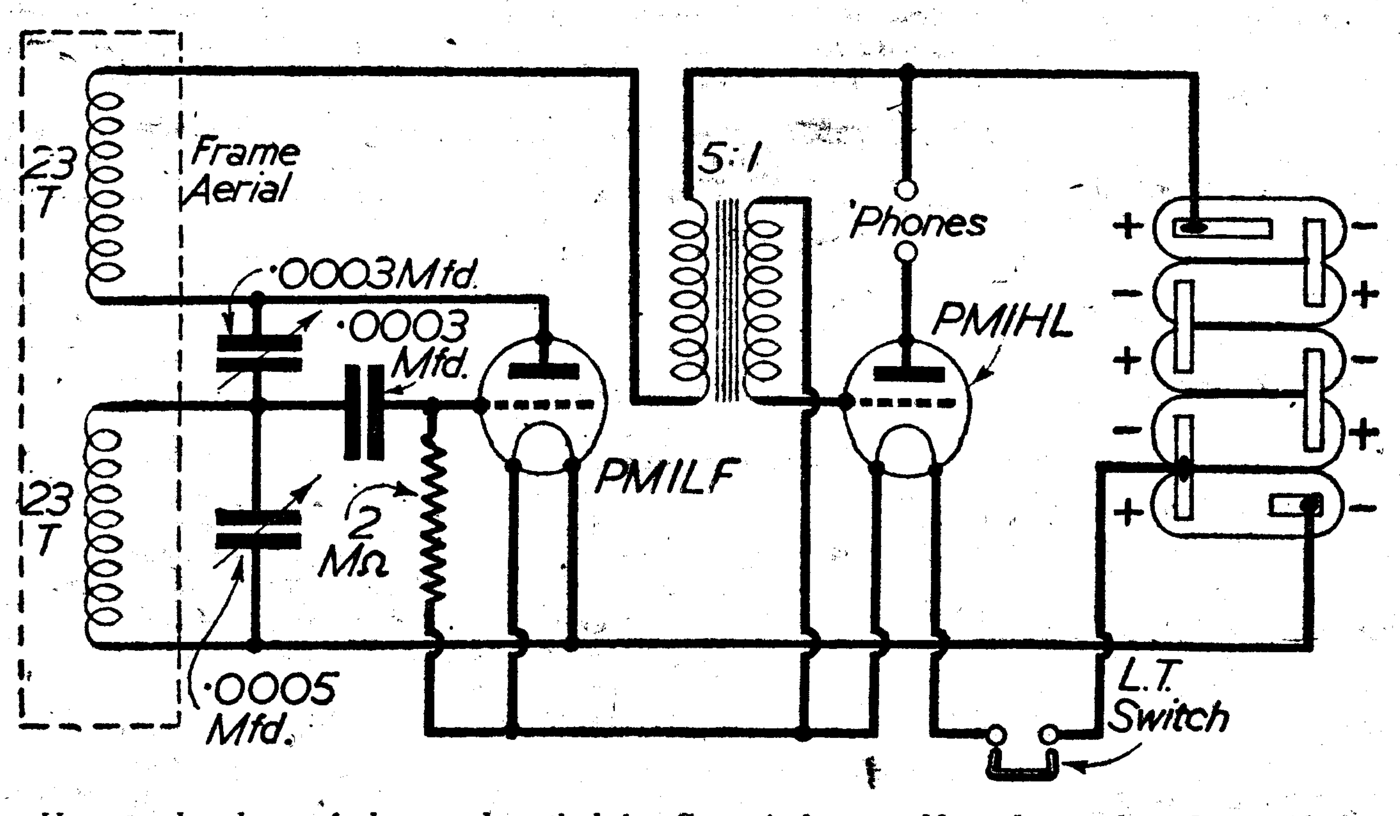
"This time, I enclose new photo of the receiving corner in my den, which I hope will be of some interest to other members. The gear consists (from left to right) of a 'Sky Buddy,' a 1-v-1 S.W. battery operated set, over which a combined one valver and L.F. oscillator for morse practice is located, and the last, a four valve A.C./D.C. medium-wave receiver of American design. All the apparatus is home-built except, of course, the 'Sky Buddy.'

"In the meantime, I am going to construct the small portable receiver described in the February issue, and I hope to inform you about the results obtained in the near future.

"Before closing, I would like to thank the Editor and the staff for carrying on so that we might still get our much appreciated copy of PRACTICAL WIRELESS."

R.A.F. Member

WE are pleased to hear that Member No. 5,560, Sgt. R. S. Andrews, R.A.F., is still keeping his interest alive and in spite of his many other activities is able to carry out a little constructional work. We hope that the details contained in his letter and the two diagrams will assist other members in the Forces and the civil defence services to construct a neat compact receiver. This is what he says:



Here is the theo. of the set described by Sgt. Andrews. Note the winding data and the reaction circuit.

"When on leave last March I constructed the Midget two-valve portable, details of which were given in your issue of a few months ago. The results obtained were very satisfactory, British stations being received at a comfortable strength on headphones. Selectivity was effective through the D/F properties of the set. A few Continentals were picked up in this way, at a readable strength.

"Since I came back I have constructed, in my off duty hours, a modified version of this receiver, which I consider an improvement of the original.

"The details of the circuit and layout are apparent from the diagrams. The detector circuit used enables reaction with reduced H.T., also that the reaction point does not drop or disappear when the set is put in the case. The filament circuit remains unaltered, L.T. being obtained from one three-cell flashlamp battery of 4½ volts. H.T. is derived from three or more of these in series, placed as shown. The output stage is unaltered and works one headphone.

"The case, of wood ¼in. thick, is 5in. by 6in. by 3½in. internally, with a 3-ply back and ebonite panel 6in. by 7in. The baseboard, ½in. thick, is 5in. by 3½in., and screwed on to the panel.

"The coil (frame aerial) is wound in an *odd* number of slots on a cardboard former 5in. by 6in., and consists of two separate windings of 23 turns each, of 26 D.C.C. wire.

"The leads in this set from the coil, to anode and to grid condenser, are the ones which in the original set formed the centre-tap loop.

"I hope that this information will be of use to readers, in the civil defence services and forces who may wish to build a compact receiver."

Rossendale

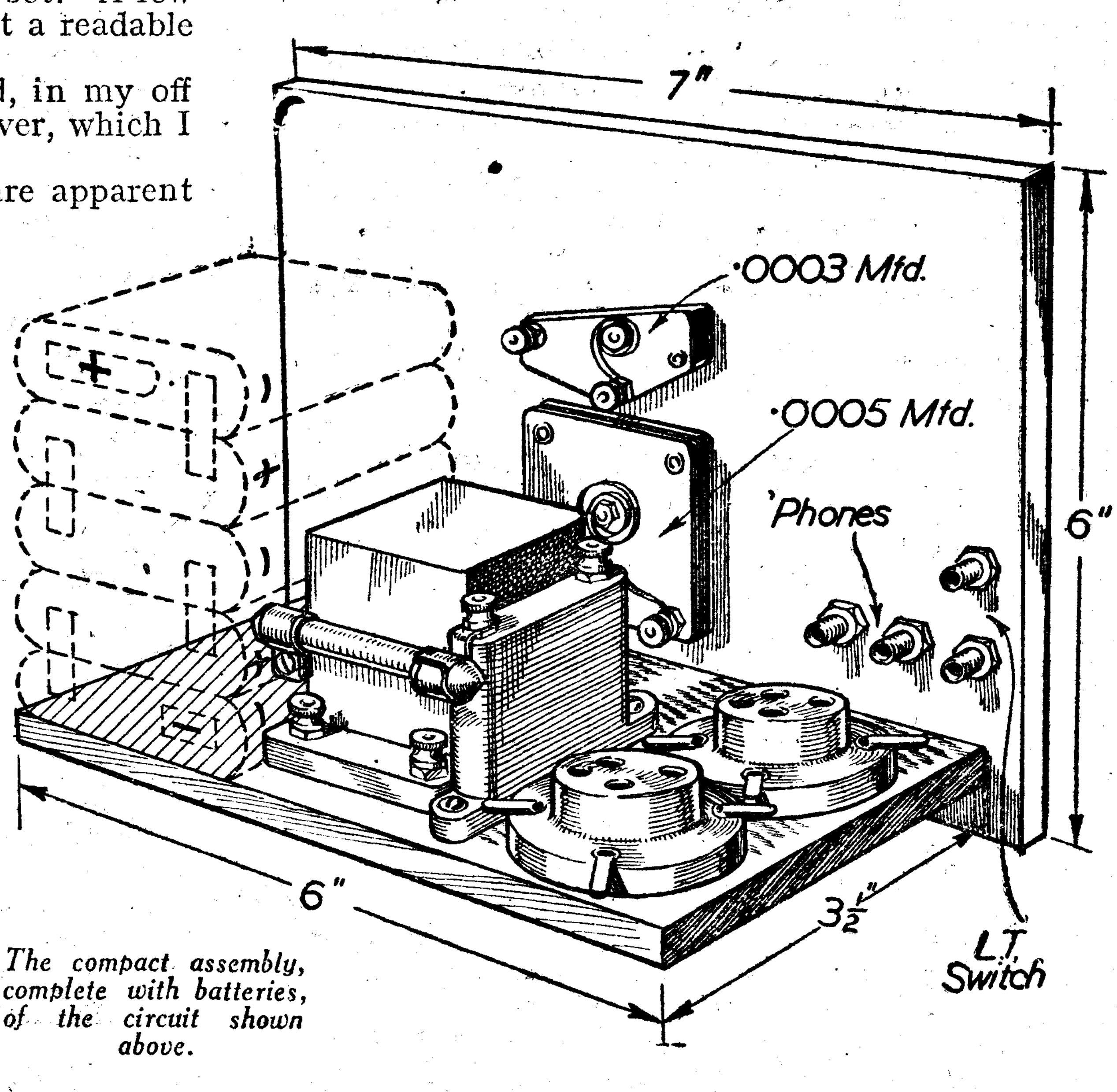
DETAILS of his experiments are given in a letter from Member No. 6,313, C. A. Hooley, who has been experiencing a little trouble with a Class B arrangement.

"Short-wave listening here is a thing of the past, so I cannot send you any logs, but I can send you details of experiments carried out and apparatus built ready for after the war.

"I have three short-wave sets. A 1-v-2, which is just an untuned H.F. stage, condenser coupled to the det. stage, followed by two L.F. stages. The second set is an 0-v-1, also a straightforward set without any trimmings. The third set is an 0-v-pen. This set may be of interest to you as it is built round two Hivac miniature valves, types XD and XY. The size of this set is 6in. by 5in. by 5¼in. and weighs 2¼lb. The Eddystone bandspread tuning outfit and one of their reaction condensers—.0002 mfd.—are used, together with plug-in coils which allow the circuit to be tuned from 20-170 metres. Current taken is approximately 6 m/A. The transformer is a midget Bulgin LF.33.

"Experiments have been tried with a class B valve, to try and use it as an 0-v-1 on the S.W., but so far there is nothing doing as I cannot get the reaction control to work. Different values of grid leaks and condensers have been tried, the H.F.C. has been tested, decoupling added and H.T. varied, but all with no effect. I would, therefore, like to hear from anyone who is using a class B valve as det.-L.F. stage.

"I would like to express my appreciation of PRACTICAL WIRELESS as a whole, and to several features in particular, namely, 2CHW articles, Radio Examination Papers, Mathematics Course, and On Your Wavelength."

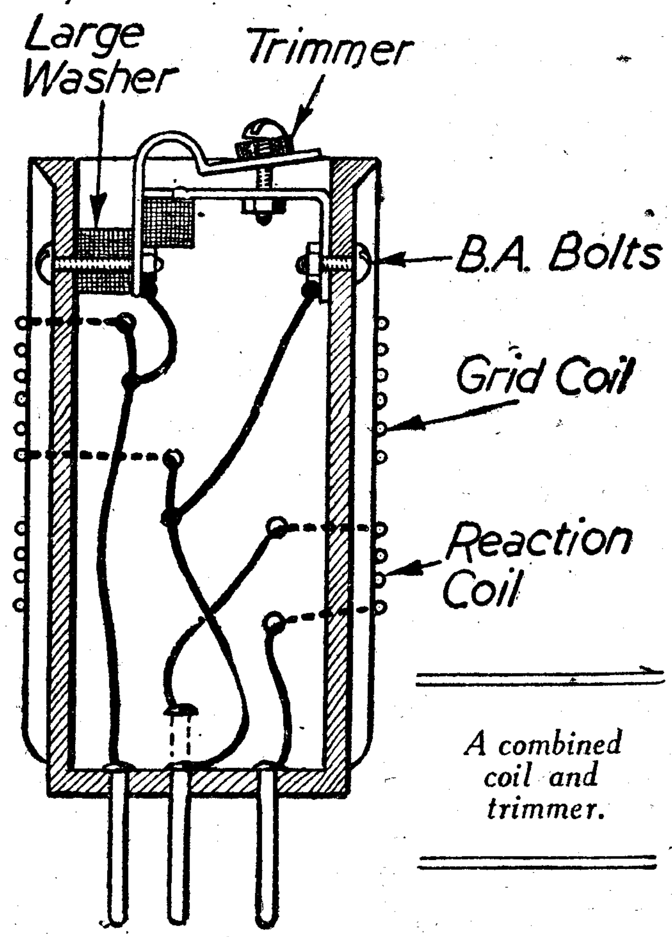


The compact assembly, complete with batteries, of the circuit shown above.

Practical Hints

Coil Trimming

RECENTLY I built a 3-valve R.F.T. receiver with a trimmer on the H.F. stage. As the set had plug-in coils I found that the trimmer required a different setting for each coil, and the best that I could do



A combined coil and trimmer.

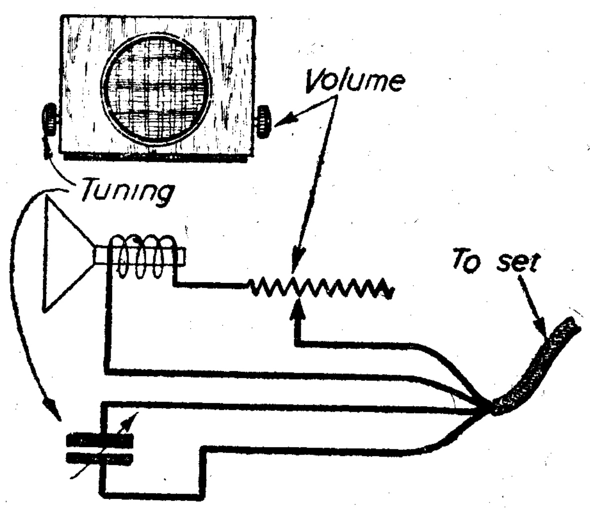
was to make a compromise setting with a great deal of loss in efficiency.

My solution was to have a trimmer accurately adjusted for each coil. To do this I obtained a separate trimmer for each coil and mounted it in the top of the coil. The trimmer was mounted, as shown in the sketch, with two bolts and a large washer to fill up the gap, as it was not quite so long as the internal diameter of the coil.

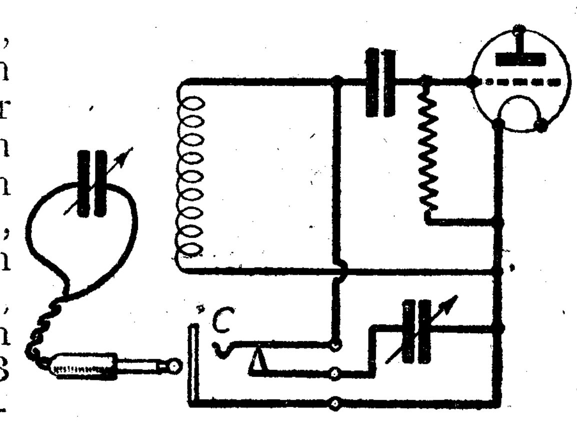
This method of trimming increased the performance of the receiver considerably, and it also made accurate calibration possible which could not be done when the trimmer was continually varied.—G. PICKWORTH (Tamworth).

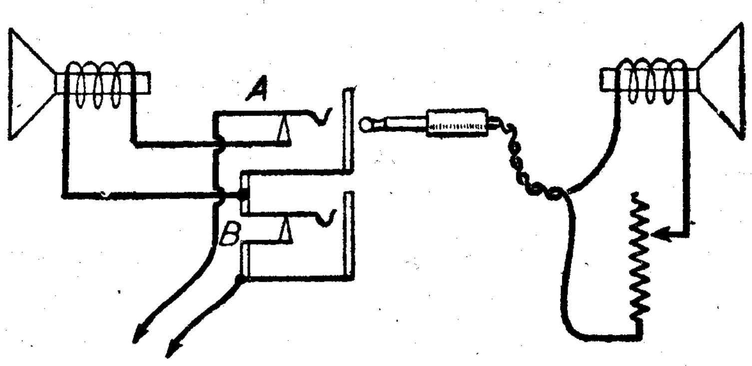
Remote Control Switching

I HAVE evolved the following method of remote control for my receiver. It incorporates four-core cable and three plugs and jacks. Actual switching on and off is not



employed in the unit, as it is used from room to room. If the speaker plug is inserted in jack A, the speaker in the set is disconnected, and only the extension used. If plugged in B, both speakers are in action. I do not use B plug much, as it overloads the set. The plug and socket C is for the extension tuning condenser. When plugged in, the tuner on the set is cut out. Thus the usual arrangements are: plugs in A and C or only in B.—H. C. PARTEN (Exeter).

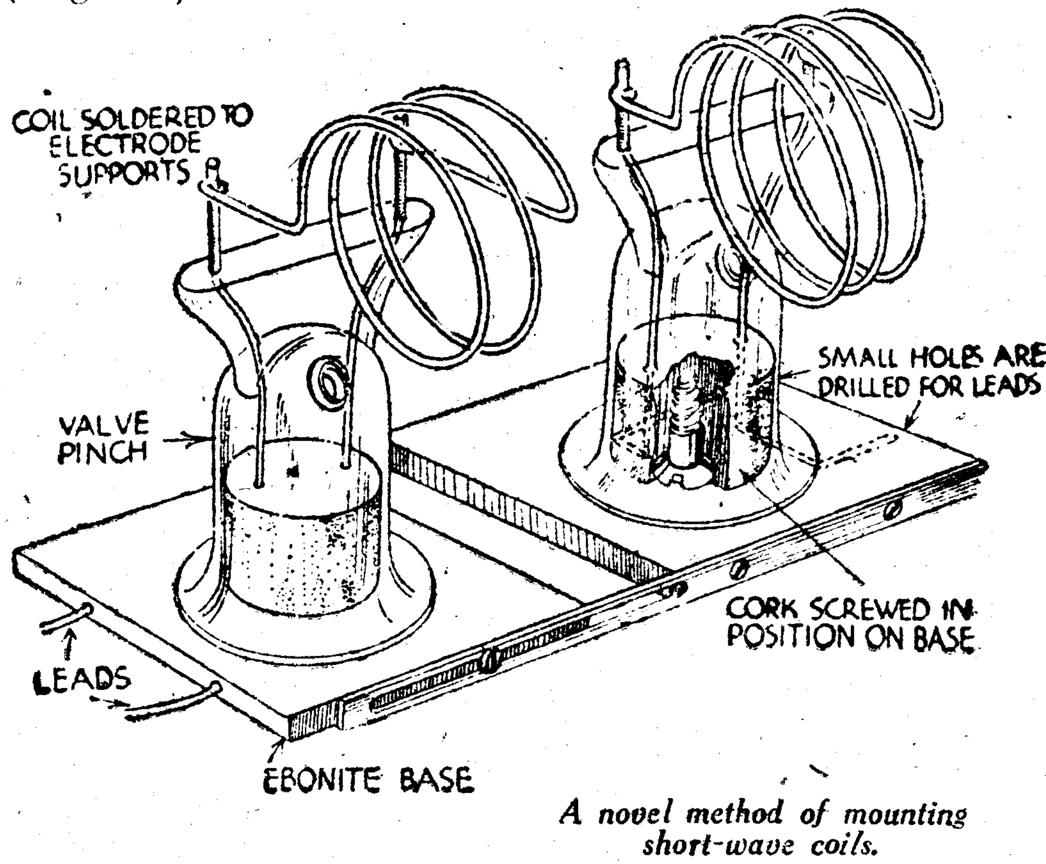




Remote control switching with plugs and jacks.

Mounting S.W. Coils

I HAVE found that losses in efficiency of S.W. coils can be minimised by mounting them on the glass pinch of an old valve, which in its turn is mounted on a cork screwed to a baseboard. The pinch is pushed over the cork and mounted on a small ebonite square. The whole assembly looks very attractive. A slider can be fitted to the side of the ebonite to vary the coupling, and small holes are made through the ebonite for the connecting leads, as shown in the sketch.—A. T. WARD (Edgware).



A novel method of mounting short-wave coils.

Simplified Fault Finding

MY receiver recently developed a fault which stopped all signals. I could not even get the local. To add to my misfortune my only meter had been damaged, so I proceeded to locate the fault in the following way. First I took an old pick-up adapter from the junk box and fitted a pick-up to this. When inserted in the detector stage (the set was not employed as a radiogram) I could get some kind of noise by plucking the needle point. This indicated that detector and L.F. stages were in order. I next transferred it to the I.F. stage and again could hear a noise when the needle was plucked. In the frequency-charger stage I could not obtain results and suspected this stage. As the coils may have made some difference I tested the anode circuit by placing an ordinary compass near the I.F. transformer, after removing the screening cover, and found that when switched on the needle was deflected. This indicated that anode current was flowing, and thus, for my purpose I was driven to suspect the tuning circuits. An external examination showed that all connections were in order, and before modifying the setting of the trimmers I removed the ganged condenser screening cover to inspect the trimmers in case the mica had become broken. I then found that the condenser vanes were "all in" or at maximum, whilst I noted that the tuning pointer was at minimum. A further test showed that the trouble was that the grub screw holding the dial to the condenser spindle had become loose and the condenser was not turning with the dial.—G. T. WALDE (Hendon).

A Refresher Course in Mathematics

By F. J. CAMM

(*Continued from page 452, September issue*)

Quadratic and Cubic Equations—Graphs

CLEARING the brackets from the right-hand side of the quadratic equation given last month:

$$y^2+\frac{b}{a}y+\left(\frac{b}{2a}\right)^2=\frac{b^2}{4a^2}-\frac{c}{a}$$

By using the common denominator $4a^2$ the left-hand side becomes:

$$\left(y+\frac{b}{2a}\right)^2$$

and we have: $\frac{b^2-4ac}{4a^2}=\frac{b^2}{4a^2}-\frac{c}{a}$

Extract the square root of both sides:

$$y+\frac{b}{2a}=\pm\sqrt{\frac{b^2-4ac}{4a^2}}.$$

Now transfer $\frac{b}{2a}$ to the other side:

$$y=-\frac{b}{2a}\pm\sqrt{\frac{b^2-4ac}{4a^2}}$$

From which $y=-\frac{b}{2a}\pm\frac{1}{2a}\sqrt{b^2-4ac}$

Here it will be seen that the square root of the denominator $4a^2$ has been placed outside the square-root sign, and:

$$y=-\frac{b\pm\sqrt{b^2-4ac}}{2a}.$$

This formula may be generally applied in the solution of quadratic equations. The $\pm$ sign gives two possible solutions:

$$y=\frac{-b-\sqrt{b^2-4ac}}{2a}$$

$$\text{and } y=\frac{-b+\sqrt{b^2-4ac}}{2a}$$

The solutions are, of course, imaginary if the quantities embraced by the square root sign evolve as negative quantities.

Although two roots are obtained from a quadratic equation only one of them is feasible in relation to practical examples, and the other is ignored.

Examples.—Solve the following quadratic equations:

$3a^2-3b=16$

Answer: 2.863 or −1.863.

$\frac{3}{x}-4a=1$

Answer: $x=.75$, or -1.

$9x-20=x^2$

Answer: $x=4$ or 5.

Quadratic and cubic equations are, of course, more easily solved by means of graphs, which will be dealt with later.

Cubic Equations

The solution of cubic equations takes on a different form to the solution of quadratics.

A cubic equation must be expressed in its standard form of:

$$y^3+3ay^2+3by+c=0$$

By assuming that $y=x-a$ the equation then becomes:

$$x^3-3(a^2-b)x+(2a^3-3ab+c)=0$$

It is obvious that this can be expressed in the form:

$$x^3-3px+q=0$$

Therefore, any cubic equation can be expressed in the form $x^3-3px+q=0$, having no term containing x^2.

Now let us solve the equation $x^3-3px+q=0$.

Let $x=\frac{z}{n}$.

Then $z^3-3pn^2z+qn^3=0$

We shall see, when we deal with trigonometry, that:

$$\text{Cos } 3\theta=4\cos^3\theta-3\cos\theta,$$

and hence:

$$\text{Cos}^3\theta-\tfrac{3}{4}\cos\theta-\tfrac{1}{4}\cos 3\theta=0$$

These last two equations are equal if

$$z=\cos\theta$$

$$3pn^2=\tfrac{3}{4}$$

$$\text{and} -\tfrac{1}{4}\cos 3\theta=qn^3$$

Therefore: $\text{Cos } 3\theta=-4q\left(\frac{1}{4p}\right)^{\frac{3}{2}}$

This equation can always be solved (using tables), when p is positive and $4q\left(\frac{1}{4p}\right)^{\frac{3}{2}}<1$ or if $q^2<4p^3$.

The roots of the equation:

$$x^3-3px+q=0$$

are $\frac{1}{n}\cos\theta$,

$\frac{1}{n}\cos\left(\theta+\frac{2\pi}{3}\right)$, and $\frac{1}{n}\cos\left(\theta+\frac{4\pi}{3}\right)$

More generally, a cubic equation is expressed in the standard form:

$$ax^3+bx^2+cx+d=0$$

This is volved in the following manner:

$$x=-\frac{b}{3a}+\left[-\frac{B}{2}+\sqrt{\frac{A^3}{27}+\frac{B^2}{4}}\right]^{\frac{1}{3}}+\left[-\frac{B}{2}-\sqrt{\frac{A^3}{27}+\frac{B^2}{4}}\right]^{\frac{1}{3}}$$

where $A=-\frac{1}{3}\frac{b^2}{a^2}+\frac{c}{a}$

and $B=\frac{2}{27}\frac{b^3}{a^3}-\frac{bc}{3a^2}+\frac{d}{a}$

Examples

Solve: $x^3+3x^2-1=0$

Answer: $-1+2\cos 40°$, $-1+2\cos 160°$, and $-1+2\cos 280°$

$2x^3-3x-1=0$

Answer $\frac{1 \pm \sqrt{3},}{2}$ and -1.

$$x^3-6x^2+6x+8=0$$

Answer: 4, and $1 \pm \sqrt{3}$

$$x^3-24x-32=0$$

Answer: -4, and $2 \pm 2\sqrt{3}$

As already indicated, cubic equations are best solved graphically.

Graphs

If two quantities bear such a relation to one another that a change in one brings about a corresponding change in the other, they are best represented by means of a *graph*. A graph is drawn on *squared paper*. Squared paper, according to the purpose for which it is to be used, can be obtained with equi-spaced vertical and horizontal lines, of almost any desired spacing. Usually the lines (for convenience in *plotting* decimal quantities) are 1/10th in., or 1mm., apart. Sometimes the spaces are 1/16in., ⅛in., or ¼in. apart. A typical piece of graph paper is reproduced in Fig. 1, showing that the intersecting equi-spaced lines divide the paper into *squares*. The horizontal line *OX* is the axis of *abscissæ*. The vertical line *OY* is called the axis of *ordinates*. Every vertical line is an ordinate, and every horizontal line is an abscissa.

The space between two ordinates along the line *OX* may be taken to represent one unit of measurement of one of the quantities, and the space between two abscissæ on the line *OY* may be taken to represent the unit of the other quantity; or two or more squares, or a fraction of a square, may represent the unit. It is not necessary to employ the same number of squares to represent a unit of each of the quantities. For example, one square may represent a unit of one of the quantities, and 1½ squares, or two or more squares, may represent a unit of the other. We soon learn how to decide the number of squares to allocate as a unit in each case, in order that the graph may be plotted in the required space.

If we mark along the line *OX* a distance equal to seven spaces, and along the line *OY* a distance equal to five spaces, we obtain two points. If we erect a line vertically from the point *OX* and draw another line horizontally from the point on *OY* the two lines will intersect. If we deal with a number of observations in the same way we shall obtain a series of such points. These are usually marked with a small x or circle at the points of intersection. It is not, of course, necessary to draw these intersecting lines, as the lines already on the paper act as guides. If these points are connected together by means of a thin piece of wood or celluloid bent to lie along the various points a *curve* is obtained. It may be impossible for the curve to touch all of the points because the line would be irregular or broken. In this case a line which *averages* the points, that is to say, a line which lies evenly among them, may be drawn, and such a line represents the average value of the results plotted. It also serves to indicate errors of plotting or observation. Sometimes a straight line will connect the points, but in graphs such a straight line is still referred to as a curve.

The great advantage of a graph in plotting experimental results is that it enables the relation between two quantities or any change in the relation between those quantities to be seen at once, whereas such changes may not be discerned by ordinary methods of calculation. A simple example will illustrate the great advantage of graphs.

We know that 240 pence make one pound. We can plot a graph of the relation 240 = 1, and so be able to ascertain how many pence there are in any number of shillings, or any fraction of a pound. In such a case we should take 20 squares to represent the pound along the lines *OY*, and 24 squares (each square representing ten pennies) along the line *OX*. Connecting the two points to the *origin O*, we obtain a curve of the relation between pence and pounds. If, therefore, we desire to know what fraction 180 pence are of one pound we should count 18 spaces along the line *OX* and note the point where it cuts one of the ordinates.

Equivalent values of relations can be read off direct. The vertical distance along a graph is called the y co-ordinate, and the horizontal distance the x co-ordinate. Suppose, therefore, that we plot two values, say, four spaces along the x co-ordinate and five spaces along the y co-ordinate. By joining the point of intersection to the origin in *O*, a straight line is obtained. When the relation between two variables results in a straight line we are enabled to find what is known as the *equation of the line*. The equation of such a line takes the form:

$$y=ax+b$$

Now a and b are constants and if the values of x and y are inserted values of a and b can be ascertained. Fig. 2 gives an example. It will be seen that the y co-ordinate and the x co-ordinate intersect at 24 spaces and 40 spaces respectively. Thus, from this graph we can compile values of x and y.

When $x=40$, $y=24$
$x=24$, $y=14.4$
$x=16$, $y=9.6$

Similarly, we can obtain by direct measurement on the graph any other value of x in relation to y.

Let us insert a pair of these values in the equations.

$$y=ax+b$$
$$24=40a+b$$
Subtract
$$14.4=24a+b$$
$$9.6=16a$$
$$\therefore\ a=\frac{9.6}{16}=.6$$

Now incorporate this value of a in the equation (given above)

$$24=40a+b$$
$$24=40x\ .6+b$$
$$24=24+b$$

from which it is apparent that b is *O*. Thus the equation of the line is:

$$y=.6x$$

From this it is obvious that when the equation of a line is of the form $y=ax+b$, then by giving to x the values of 1, 2, 3, 4, . . . the corresponding values of y may be found and the line obtained by plotting.

From a group of values of any two quantities which vary with each other we are able by plotting those values on square paper to draw a line which *averages the points*. Once the line is drawn we can find its equation, and when the lines of the equation are obtained, then for any value of one of the quantities we are able to obtain the corresponding values for the other, either by calculation from the equation, or by inspection of the graph.

Also, if we are given the equation of a line we can assume values for one of the variables, and by calculation find the values of the other. It is always advisable to give definite numerical values to a and b, and to plot the line from them. Next, give a different set of values for a and b, and plot the line again. It will then be noted that the *inclination or slope* of the line depends upon the point at which the line cuts the axis of y on b. In other words, the slope depends upon the term a. Although the terms x and y have been used, other letters can, of course, be used—in fact are used in some standard equations from which graphs are plotted.

Ohms Law is a good example, where

$$I=\frac{E}{R}$$

Let us take the simple equation.

$$y=x+3$$

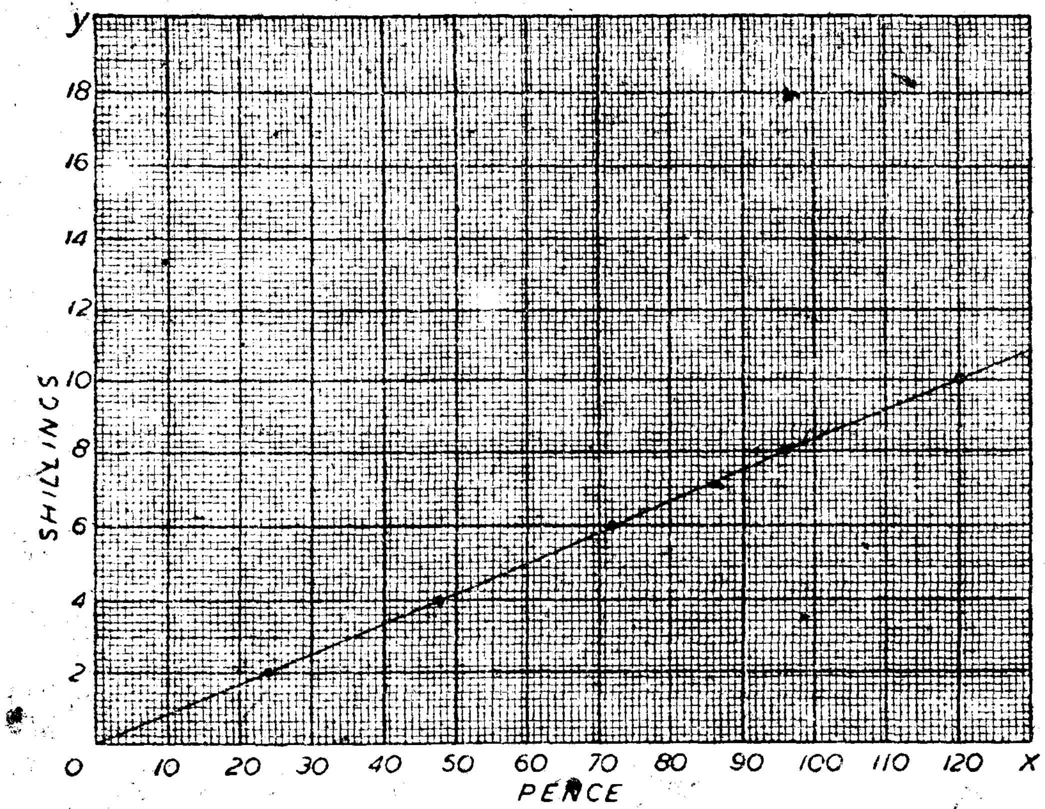


Fig. 1.—Simple graph.

Then $x=0,\ y=3$
$x=1,\ y=4$
$x=2,\ y=5$
$x=3,\ y=6$

Now let us plot a graph from these values, as in Fig. 3. It will be seen that starting from O the first dot is placed at 2 on the y co-ordinate.

Now taking succeeding values a dot is made at the intersection of 1 on the x co-ordinate with 3 on the y co-ordinate; at the intersection of 2 with 4; and 3 with 5. Connect the points with a line. The line should be drawn as fine as possible, so that the graph may be accurately read.

Now let us assume that this line represents the relation of 2 variables A and B. We substitute these in the equation previously given. Thus:

$$A=aB+b$$

and in this we substitute the known values of two points in the line. This will yield two equations from which we calculate a and b.

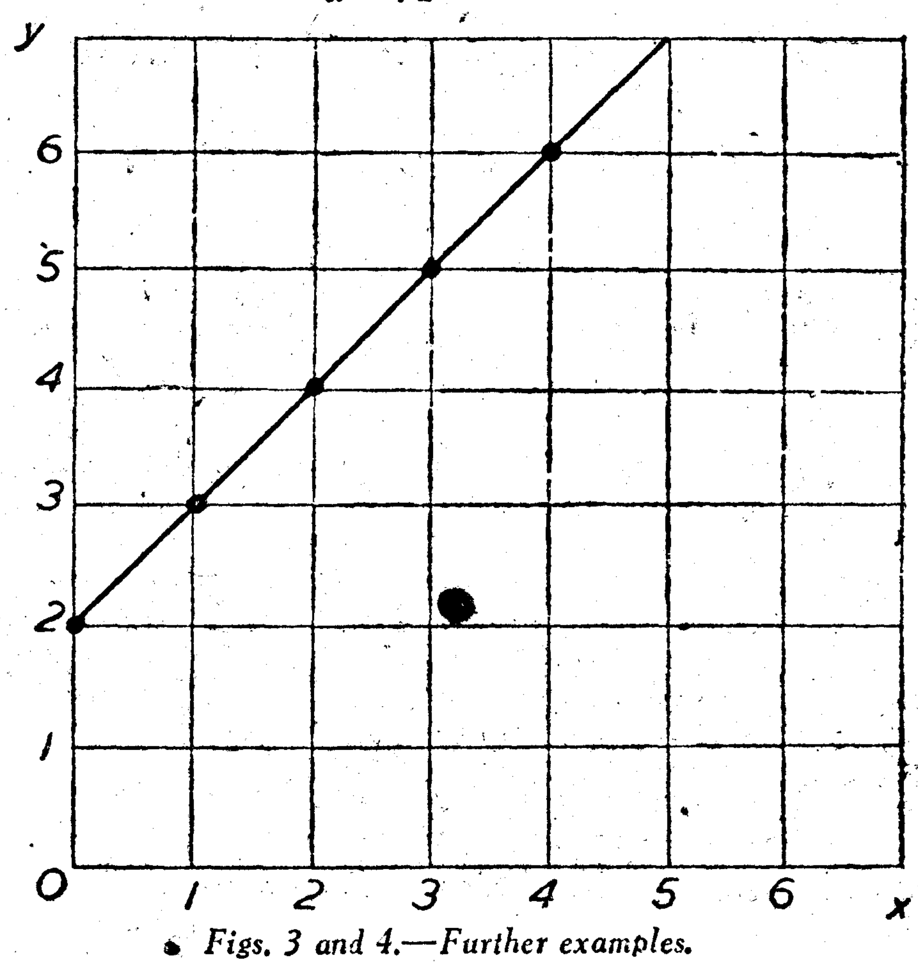
For example, the values along oY may represent values of A, and along oX values of B.

In the graph Fig. 4, when A is 5, B is 3.

When A is 4, B is 2.

We can now substitute these values in the equation:

$$5=a\times 3+b$$
$$4=a\times 2+b$$
$$1=a$$
$$a=.1$$



Figs. 3 and 4.—Further examples.

Substituting this value in the equation $4=2a+b$, $b=2$.

Now further substitute these values in the equation

$$A=aB+b$$

We obtain

$$A=B+2$$

From which

$$A=B+2$$

The term b decides the point in the axis of y from which the line is drawn, and by altering its value (letting the value of a remain constant) parallel lines will be obtained.

When the magnitude of a is changed, with b remaining unaltered, a series of lines is obtained which are drawn from the same point, although the slope of each in relation to the axis x will be different.

Now revert to the equation $y=ax+b$, and let $a=1$ and $b=2$, producing $y=x+2$. When plotted this produces the line xx (Fig. 4). If a is equated to 0 ($a=0$), $y=2$. When this line is plotted it will be parallel to line xx, but two squares above it, as yy.

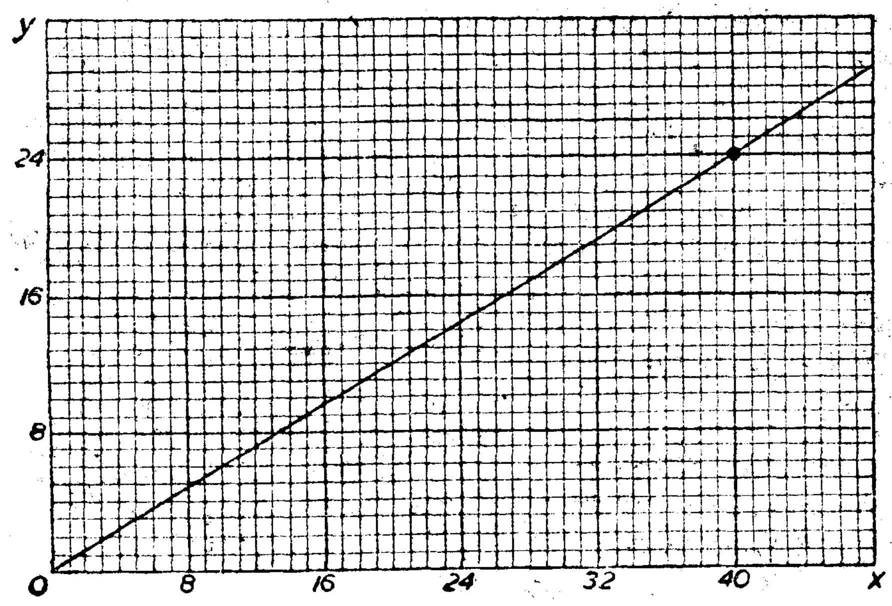
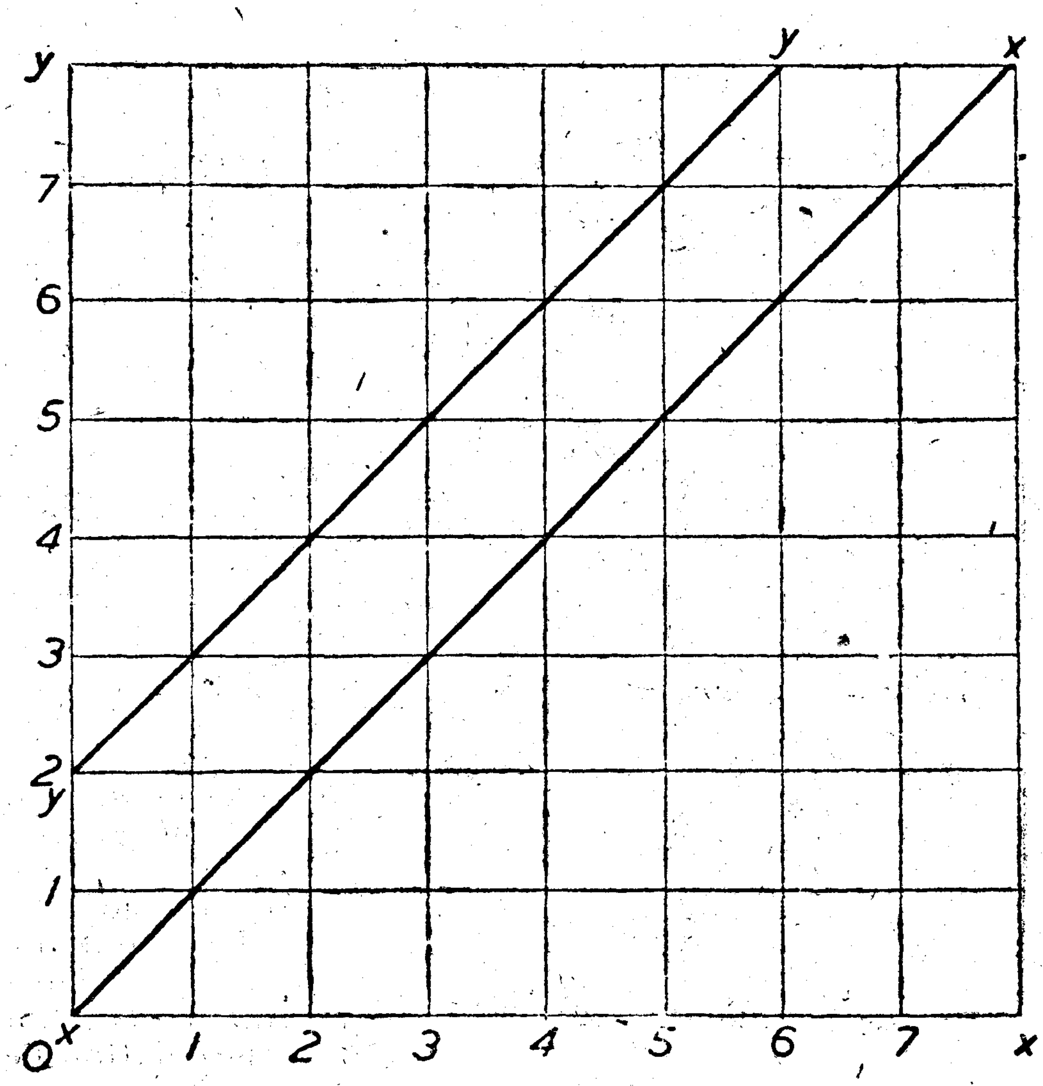


Fig. 2.—Another simple graph.

If we make $a=4$ we shall obtain $y=4x+2$, and this should be plotted.

These are straight line graphs, but all graphs are not straight lines. After plotting the various points and connecting a line through them, a curved line is often obtained, and it is almost impossible to find a law or equation which will express the relation between the two variables. So we may resort to the artifice of plotting one of the variables, and quantities which are



derived from the other, such as the squares, the reciprocals, or the logarithms, to produce a straight line.

Here is a table showing values of x and corresponding values of y.

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0
y	1.5	2.0	2.3	2.7	3.0	3.4	3.7	3.9	4.1	4.4

Fig. 5 is a graph plotted from these values, and it will be seen that the graph produced is a curved line.

It is important, before plotting a graph, to choose a value for each space which will enable the graph to be plotted accurately. The greater the number of squares assigned to each unit of the values to be plotted, the more accurate will be the result. At the same time, the number of values to be plotted will to some extent decide the value of each space, so that the graph can be kept within reasonable proportions. Generally, if a small number of values are to be plotted, the number of spaces allotted to each unit may be as large as the graph paper will allow, especially if the values contain decimals, when a space may be given the value of .1, or 10 spaces may equal .5. The values or quantities to be plotted will decide the exact value.

From what has been said, it will be clear that, having plotted a graph from a series of related quantities, intermediate values of each can be read off.

If we plotted a graph of the squares or the cubes of all numbers from 1 to 10, for example, we could read off the squares or cubes, or the square roots or cube roots of any number within those limits.

It is often convenient to plot the logarithms of one series of quantities. This is the case when plotting the results of a formula which would produce an irregular curve, as already noted. By plotting the logarithms of one series, the resulting graph is approximately a straight line. I shall return to this point later.

Simultaneous equations can conveniently be solved by means of graphs, the algebraic methods having already been given. For example, solve the simultaneous equations by means of a graph

$$2x+3y=12\ldots\ldots(1)$$
$$6x-3y=12\ldots\ldots(2)$$

Taking (1) it is obvious that

$$y=\frac{12-2x}{3}\ldots\ldots\ldots(3)$$

and (2) $\quad y=2x-4\ldots\ldots\ldots\ldots(4)$

Taking (3), when $x=0$, then $y=4$, and when $x=6$, $y=2$. Plot these two values. Treat equation (4) in a similar way. It will be noted that the two lines intersect, and it is said that this point of intersection is *common to both lines*, and the values of x and y which it indicates are the solution to the two equations (1) and (2). The reader should practise solving some of the simultaneous equations given earlier by means of graphs; and also plotting curves from any series of related values.

We have seen that, by giving values to x in an equation which expresses the relation between two variables, the corresponding values of y can be found.

When a curve is of the form $y=ax^2$ it is known as a *parabola*, and such a curve can be plotted from the equation:

From which $\quad 4y=x^2 \quad$ or $\quad y=\frac{x^2}{4}$

Giving values of 1, 2, 3, 4, . . . to x, we shall obtain corresponding values of y. Make a list of the related values:

x	0	1	2	3	4	5
y	0	$\frac{1}{4}$	1	$2\frac{1}{4}$	4	$6\frac{1}{4}$

The curve must thus pass through the origin O of the graph (O being the point of intersection of the two axes).

Now in the chapter on Algebra we saw that when a number, either positive or negative, is squared, the product is positive. Hence for each value of y there

Fig. 5.—Plotting a curve

will be *two* values of x, equal in magnitude, but one positive and the other negative, and when plotted these will give two identical curves in reverse, making a combined curve (a parabola) of which half an egg forms a rough example.

It has been assumed that the constant a is positive and $=\frac{1}{4}$; if a is negative and of the same magnitude the equation would be: $y=-\frac{1}{4}x^2$ and this will produce another parabola, but inverse to the first and symmetrical to it.

It will be found that the equation $x^2+y^2=20$ (or $x^2+y^2=$ any number other than 0) will produce a circle when plotted. Proceed thus:

$$x^2+y^2=20$$
$$y^2=20-x^2$$
$$y=\pm\sqrt{20-x^2}$$

Give values of 0, 1, 2, 3, 4, 5, etc., to x, and calculate the corresponding values of y:

x	0	1	2	3	4	4.47
y	4.47	4.36	4	3.32	2	0

Remember that there will be *two* values of y equal in magnitude, but of opposite sign, and the values of x will similarly be positive and negative. When plotted, the curve produced will be a circle of radius 4.47.

(To be continued.)

YOU MUST KNOW

"MATHS"

WE have already trained hundreds of men for radio duties with the R.A.F. and other vital war-time services. Now, in response to many requests, we have introduced new Mathematical Courses.

If you wish to join the R.A.F., or increase your efficiency in other war-work, you must know Mathematics. By our simplified method of Home Studying, you can at last learn this fascinating subject really thoroughly, in your spare time. Waste no time, but post coupon now for free details of our Home-Study Courses in Mathematics, Radio Calculations, Radio Servicing, Radiolocation, Television and Transmission.

T. & C. RADIO COLLEGE
29, Market Place, READING

(Post in unsealed envelope, 1d. stamp.)

Please send me free details of your Home-Study Mathematics and Radio Courses.

NAME ....

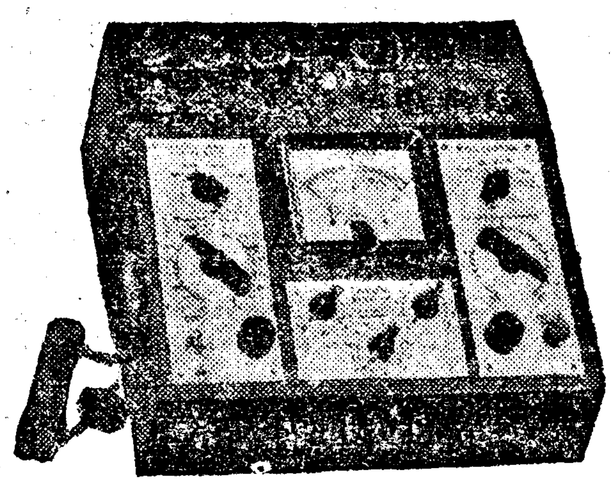
ADDRESS ....

P.32. ....

TAYLOR

MUTUAL CONDUCTANCE

VALVE TESTERS



Robust, compact and accurate test instruments.

This instrument provides a quick and accurate measurement of Mutual Conductance of practically every type of British and American valve. Tests are also provided for Cathode Leakage, Electrode Shorts, Filament Continuity and Diode and Rectifier Emission.

MODEL 45
£15:15:0

Taylor Valve Testers are supplied with a book of instructions, including wiring diagram, a valve chart covering over 1,000 types of valves, and a grid connecting lead.

Taylor Electrical Instruments Ltd.
419/422, Montrose Avenue, Slough, Bucks.
Telephone : Slough 21381.

Stocktaking Bargains

WE ARE ANXIOUS TO CLEAR OUR STOCKS TO MAKE ROOM FOR NEW AND ATTRACTIVE LINES WHICH WE HAVE SECURED

PHILIPS HIGH VOLTAGE TRANSFORMERS

These transformers are robust in construction and weigh approximately 13lbs. Dimensions : 5¾ by 5¼ by 4¼in. Specification : 350-0-350 v., 70 m.a. Four tappings giving 4 v. 3 amps., 6.3 v. 4 amps., 4 v. .65 amp. and 4,000 v. at 3 m.a. Input 100/250. Carriage forward. Free Wiring diagram. Price **32/6.**

PHILIPS SMOOTHING CHOKES

Brand new, well-built chokes, 60 ohms D.C. resistance 100/120 m.a. Size : 2½in. by 2¼in. by 1¼in., **5/6** each. Also 400 ohms D.C. resistance 60 m.a. Size; 1½in. by 1½in. by ⅞in., **3/6** each.

PHILIPS 3 GANG CONCENTRIC SPIRAL VANE VARIABLE CONDENSER

.0005 mfd. without trimmers. As used in Philips well-known Push Button receivers. Price **4/6.**

PHILIPS TRIMMER CONDENSERS

Non-drift air di-electric, 60 m.mfds. suitable for S.W. work, **1/3** each.

SPEAKER GRILLES

Solid chromium-plated decorativ speaker grilles. Beautifully made' **3/6** each. Similar, lighter weight, nickel-plated, **2/6.** Each 14in. long, 4-bar, 1½in. wide.

VARIABLE POTENTIOMETERS

380 ohms 10 watt. Low price to clear, **7/6** each.

PLUGS AND JACKS

These ex-Govt. Jacks have powerful phosphor-bronze springs ensuring a perfect contact. Overall length, including ½in. threaded shank, 3½in. Supplied with nut for panel mounting. Price complete with best quality Plug (as illustrated), **5/6.**

ROLA SPEAKERS

Brand new Rola 8in. P.M. moving coil, with transformer for super power or pentode valve. Fine cadmium plated chassis, **27/6.**
CELESTION 8in. P.M. moving coil, pentode output. New, **25/6.**
GOODMANS 8in. P.M. moving coil Universal transformer, suitable for all output valves, **27/6.**

G.P.O. MORSE KEY AND BUZZER UNIT

We have only a small number of these instruments left. Made for professional use. All parts of heavy solid brass mounted on mahogany base. The Key is fitted with platinum contacts. An excellent opportunity for those requiring a robust unit which will give years of service. Price **45/-.**

BIG CONDENSER PURCHASE

We are able to offer the following at prices much below to-day's value.
ELECTROLYTICS.—25 mfd. 25 volt, 25 mfd. 12 volt, 50 mfd. 12 volt, 25 mfd. 50 volt. All sizes, **2/-** each.
TUBULARS.—.0003 mfd., .005 mfd., **7d.** each. .01 mfd., **10d.** each. 0.1 mfd., **1/-** each.
METAL CASED PAPER.—1 mfd. x 1 mfd. 300 volt, **2/-** each. 1 mfd. 300 volt, **2/-** each.
SPECIAL TUBULARS.—0.1 mfd. 6,000 volts D.C., **9/6** each.

SEE ALSO OUR ADVERTISEMENT ON PAGE 503.
ALSO SEPTEMBER ISSUE *PRACTICAL WIRELESS.*

LONDON CENTRAL RADIO STORES

23, LISLE STREET, LONDON, W.C.2.
GERRARD 2969.

Impressions on the Wax

Review of the Latest Gramophone Records

H.M.V.

A GREAT friendship existed between Johannes Brahms and the noted virtuoso of the violin, Joseph Joachim, and, apart from one brief and unfortunate lapse, the friendship, which was so mutually beneficial, existed from the day they first met until the death of Brahms.

The Double Concerto was written for Joachim and his 'cellist friend, Hausmann, and the first two movements possess a wealth of sombre, passionate lyricism. The finale is predominated by the Hungarian gypsy atmosphere which is created in several of Brahms' compositions.

The new recording—the only previous one of this work was made many years ago by Thibaud and Casals, with Cortot conducting—is magnificent. Heifetz and Feuermann form a superbly matched pair, while the orchestral performance under Ormandy's baton is distinctly outstanding. Brahms' Double Concerto for Violin and 'Cello and Orchestra in A minor (Op. 102), four records in album (No. 374), *H.M.V. DB*6120-3.

I recommend to all those who like the beautiful waltz melodies of Johann Strauss a particularly fine recording by Eugene Ormondy and the Philadelphia Orchestra, on *H.M.V. DB*5963. It is of two waltzes, "Vienna Blood" and "Voices of Spring," and they form most welcome listening during these days when we hear too little of melodious tunes.

From the dance records I have selected *H.M.V. BD* 5768, "Beethoven's Moonlight Sonata," played as a foxtrot by Glen Miller and his Orchestra. On the other side the same combination records "The Story of a Starry Night"—adapted from Tchaikovsky's "Pathétique"—and played as a fox-trot. The fact that I have selected this record does not mean that I agree with the practice of adapting works of the great composers to modern dance band requirements and orchestration.

Joe Loss and his Orchestra have used "Somebody Else is Taking My Place" and "One More Kiss" for their latest record which is *H.M.V. BD*5754.

For a vocal, "Hutch" offers "If You Haven't Got Dreams" and "Moonlight Cocktail," on *H.M.V. BD*1010.

Columbia

THE "Ballade No. 1 in G Minor" (Op. 23) is the first of four ballades composed by Chopin, and it is said that it tells a story, but, if that is so, it is left to the imagination of the hearers to form their own conclusions. The Ballade is a great work, composed of a mixture of grandeur and feeling in a perfectly balanced construction. Eileen Joyce—on *Columbia DX* 1084—records a perfect pianoforte performance of the work.

Dr. Malcolm Sargent conducted the Hallé Orchestra when they recorded the "L'Arlesienne Suite," No. 1, by Georges Bizet. It is in five parts—*Columbia* 1805-1807—the third record recording "Greensleeves"—fantasia—performed by the same orchestra, in addition to the fifth part of the Suite.

Part one and two—the Prelude—is a striking example of Bizet's mastery of orchestral resources; the Minuetto (No. 2) on part three portrays the affections and dreams of Mother Renaud and Balthazar, the shepherd. This theme is further developed in part four—Adagietto No. 3—by the strings only, which are used to such good effect to convey the emotions of Mother Renaud who, through the death of her husband, can now express what she had always cherished in her heart. The Carillon—part five—provides the betrothal music; the whole performance, under Dr. Malcolm Sargent, is a wonderful tone picture of sorrow, sentiment and joy, and a most striking example of the skill of Bizet.

Henry Wendon (tenor) with Gerald Moore at the piano, gives a fine rendering of "Love Went a-Riding" and "Eleanore" on *Columbia DB*2083.

For dance music, I recommend Victor Silvester and his Ballroom Orchestra, playing "Demande et Réponse"—waltz—and "One Dozen Roses"—quickstep—on *Columbia FB*2834. These I would follow with "Two Pair of Shoes"—foxtrot—and "The Lamplighter's Serenade"—also a foxtrot, on *Columbia FB*2831. Felix Mendelssohn's Serenaders have recorded "Hawaiian Memories" on *Columbia FB*2828, and, personally, I was disappointed by their performance as I expected much more from the Hawaiian guitar section.

Parlophone

ONE artist I always watch the Parlophone list for is Richard Tauber, and this month his name appears over *Parlophone RO*20513, a number which denotes a record containing two fine recordings by that very popular artist. He sings "Jealousy" and "Love's Last Word"—both with orchestral accompaniment. Harry James and his Orchestra—on *Parlophone R*2848—give a good performance of "The Carnival of Venice" and "The Flight of the Bumble Bee," two pieces of nice armchair music.

"Humpty Dumpty Heart" and "Skylark"—both foxtrots—are the two items selected by Geraldo and his Orchestra this month. They are on *Parlophone F*1933. Harry Parry and his Radio Rhythm Club Sextet offer in superb rhythm style "Rose Room" and "My Blue Heaven," *Parlophone R*2846. To conclude the light section, there is "Tin Pan Alley Medley"—No. 47—Ivor Moreton and Dave Kaye on two pianos, with string bass and drums, on *Parlophone F*1936.

Decca

TO start the Decca selections, I have chosen *Decca F*8166, which has two fine recordings by the Royal Air Force Dance Orchestra, of "Me and My Melinda" and "Pennsylvania Polka." Next comes a record by "The Street Singer" (Arthur Tracey) singing in his own inimitable style, "Shepherd Serenade" and "The White Cliffs of Dover." He is provided with a pipe organ and accordion accompaniment.

Here is another of Vera Lynn's, on which she records "Someone Rocking my Dreamboat" and "One More Kiss," *Decca F*8169. She is accompanied by Mantovani and his Orchestra.

Oscar Rabin and his Band—with vocals by Diane and Benny Lee—offers "One Dozen Roses" and "I'm in Love With the Girl I Left Behind Me," on *Decca F*8156.

Rex

BIG BILL CAMPBELL and his Rocky Mountain Rhythm—on both sides of *Rex* 10138—have recorded "Log Cabin Medley," which introduces many of those songs so closely associated with the West.

Brunswick

THE Brunswick highlight this month, to my idea, is their record *O*3351*B*, on which Alec Templeton has recorded the first movement—Andantino—of "Tchaikovsky's Symphony No. 6 in B Minor, Op. 74," and, on the other side, the first movement—Allegro—of "Concerto in A Minor," Op. 16, by Grieg. The rendering—pianoforte solos—of these works, gives the artist full scope to demonstrate his skill and technique.

Judy Garland has two numbers on *Brunswick O*3352*A*, "Blues in the Night" and "Stompin' at the Savoy." Two more vocals are provided by Irene Dunne, who sings "Smoke Gets in Your Eyes" and "I've Told Ev'ry Little Star," on *Brunswick O*3340. To conclude this list, there is Woody Herman and his Orchestra playing "Even Steven" and "The Lamplighter's Serenade," on *Brunswick O*3342*A*.

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).

Cathode-ray Oscilloscope

SIR,—Readers may be interested in the accompanying photograph, which goes hand in hand with the articles I have written on the Cathode-ray Oscilloscope and Time Bases; it shows what can be done in the way of home-constructed oscilloscopes.

The photograph on this page shows a 4in. tube job I constructed recently from spare standard parts and which functions on a par with any commercial product.

The power supplies are obtained from two mains transformers, one conventionally connected to supply 400 volts full-wave rectified to the time base circuit (which occupies the entire side nearest the camera, in the large photograph reproduced on the cover of this issue), while 1,000 volts for the tube is obtained from a 500-0-500 transformer used right across and half-wave rectified.

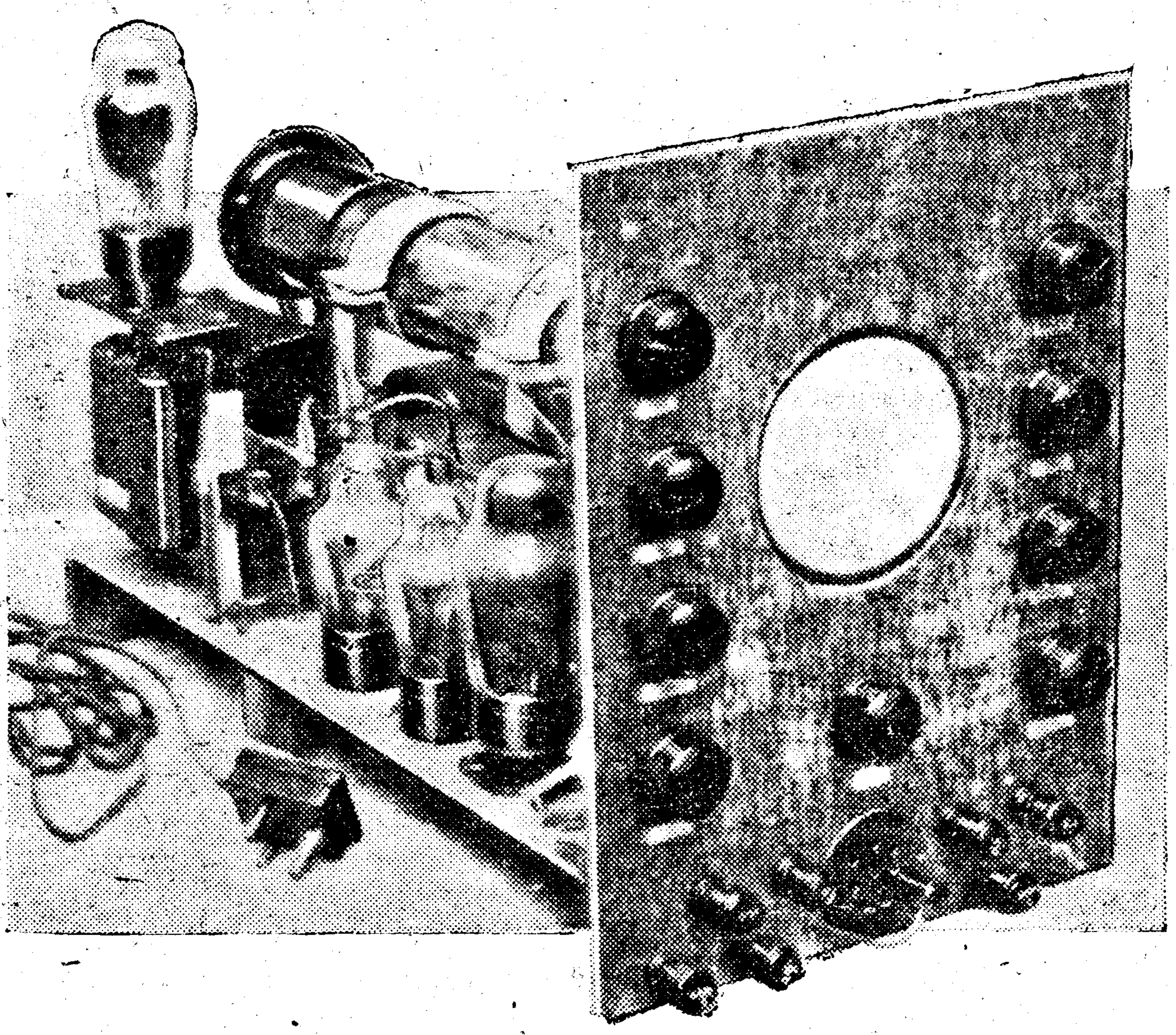
The time base is a Puckle circuit, employing three valves, condenser selection being made from the panel by means of plug and seven-pin socket, giving a frequency range from below 10 c.p.s. to over 50,000 c.p.s. The system is conventional and has velocity, trigger and synchronised controls mounted on the panel.

A single amplifier is employed for amplification of small work inputs and has a comparatively wide frequency range of 30 to 100,000 c.p.s. with a gain of 50. In order to preserve response negative feedback gain control is employed.

The usual brilliance and focus controls are used, together with X and Y shifts, and terminals give access to the amplifier and deflector plates input.

An external electronic switching arrangement (not shown) can be connected to give switching of the trace such that the tube virtually becomes a "double beam type," each of two inputs being automatically switched to its corresponding trace.

The tube has a 4in. screen with blue fluorescence and medium persistence, electrostatically focused and deflected. In view of its excellent performance, compact size (15in. by 9in. by 12in.) and portability the complete job makes an extremely useful piece of service apparatus, as apart from large fixed designs, used only in workshops and laboratories.—S. A. KNIGHT (Bury, Lancs).



Front view of a 4in. tube oscilloscope, constructed by S. A. Knight.

Back Numbers: Colour Coding

SIR,—It has been a puzzle to me for a long time who the people are who write asking for "back numbers." Do they sign themselves as regular readers? It is usually more than one copy they ask for, and if they were regular readers, like myself, they would not want back numbers, they would have them. I am not sending my copy to people who won't give an order to their newsagent, but who only want to look at a copy now and then.

I heartily agree with Thermion's remarks in the July issue regarding the marking of resistances, and I disagree with the remarks made by Mr. Goode of York. I have several kinds of resistors, but I prefer those that have the number of ohms stamped on them; for instance, how many constructors have a code book, and again who wants to pick up a resistor with a lot of different colours on it? I have resistors here with various shades of yellow and various shades of orange, and it is very hard to know which is orange and which is yellow. I want to know the number of ohms quickly and not have to waste three or four minutes de-coding. I consider it a waste of material and time, besides, let's be modern and not use old-fashioned methods that are out of date.

By the way the numbers on my resistors don't rub off, they stay put.—J. T. PORTMAN (Warsop, Notts).

Short-wave Transmissions

SIR,—I have noticed with interest in the July issue of PRACTICAL WIRELESS an invitation for readers to send in reports about the "Voice of Free India," which also calls itself the "Voice of Azad Hind." Its present schedule is as follows, on 26.16 m. and 20.34 m.:

14.00 G.M.T., programme in Persian; 14.15 G.M.T., Pashdo; 14.30 G.M.T., Tamil; 14.45 G.M.T., Bengali; 15.00 G.M.T., Hindustani; 15.30 G.M.T., English; to 16.00 G.M.T.

On Mondays, Wednesdays and Fridays, News Bulletins are given in the less common languages from 15.25 to 15.35, the time of Hindustani and English transmissions being shortened for these transmissions. The same programme is repeated from 01.30 to 03.30 the following morning on 20.34 m. only.

Batavia, under Japanese control, now transmits a long schedule on 16.6 m.

Station WGO, New York, broadcasts the same programme as WCW from 13.00 to 16.15. Its frequency is 14.47 mc/s. Station WCB, Press Wireless New York

(15.58 mc/s) transmits programmes in English during the evening. I have also received WQJ, WQD and W.K.O. on point to point transmission.

Besides receiving news in English from Berlin, Rome, Finland, Rumania, Bratislava (Slovakia) and Holland I have also received the same from Ankara, Sweden, Spain, Vatican City and Vichy, France (the last of which gives three programmes in English each day).

Of the Asiatic stations that I listen to, I regularly receive news in English from Beirut, Chungking, Tokyo, Shanghai, Saigon, and New Delhi. I have also received Sydney and Melbourne in Australia. In addition to these I listen fairly regularly to FZI, CR7BE (30.15 m.), Cairo, HCJB, VONF and CJCX. I have also received ZOY. I very regularly listen to the usual American stations. These are: WNBI (16 m. and 25 m.), WRCA (19 m. and 31.02 m.), WBOS (19 m. and 25 m.), WLWO (19 m.), WGEA (19 m. and 31 m.), WGEO (31 m.) WCBX (19 m.), WCBA (16 m. and 25 m.), WCRC (16 m. and 25 m.) and Boston (16 m., 19 m., 25 m., 31 m., and 49 m.).

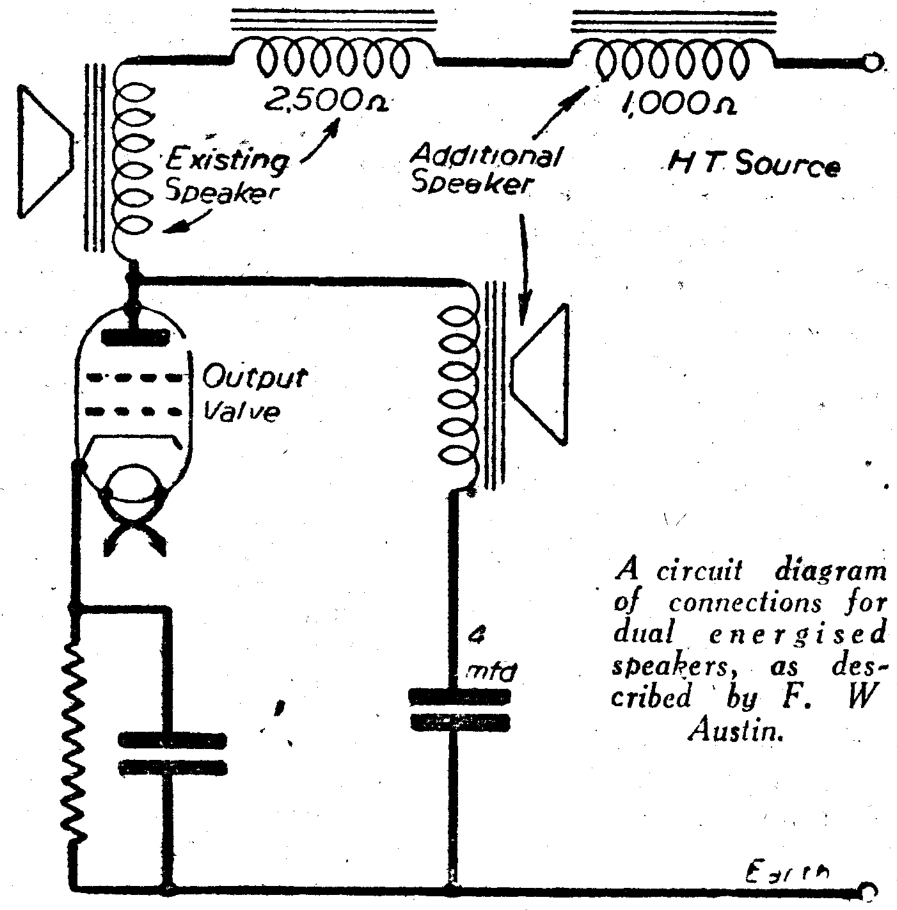
Besides the Free Indian Station there are also stations of the same type (namely the New British Broadcasting Station, The Christian Peace Movement Station, Radio Caledonia, Teleradio and Radio Metropole) broadcasting news in English.—A. G. LANGLEY (Worcester).

Dual Energised Speakers

SIR,—I had a 2,500 ohm energised speaker connected to my set in the usual manner (series) and coming across a 1,000 ohm energised speaker I decided to employ them both. The 1,000 ohm speaker had a separate field winding, common to American types, and this field winding was inserted between the output of the rectifier and the energised coil of the other speaker, making a field of 3,500 ohms (see sketch). The speech transformer was connected via the plate of the output valve, the other side being connected through a 4 mfd. condenser to earth. As the 1,000 ohm speaker was of 6in. diameter the musical register of the two speakers combined was very uniform, high notes and low notes both having perfect clarity. I recommend this method of connecting dual speakers as giving excellent results.—F. W. AUSTIN (Paddington).

A Photographic Range-finder

SIR,—In reply to several readers, the distance between the ½in. hole and the end of the case is ⅜in. in the range-finder described in the August issue.—A. L. GODIER (London, N.8).



A circuit diagram of connections for dual energised speakers, as described by F. W. Austin.

Station WCW

SIR,—In reply to J. W. MacVey's letter in the July issue of PRACTICAL WIRELESS, the station he heard was WCW, but the dialogue is "This is the Voice of America." I heard it recently (August 8th, 1942) at 11.03 p.m. B.S.T., when signal strength was R6, with slight fading, *and no static*, on 18.9 metres. It is from New York City, and owned by Press Wireless. The station with the dialogue "News Every Hour on the Hour" is WLWO (Cincinatti, Ohio).—A. J. NEWMAN (London).

TECHNICAL NOTES

Bias Circuit

IT should be remembered that when using indirectly-heated valves the cathode circuit is essential to complete the H.T. circuit. A case of a fault recently arose where no results could be obtained in the output stage. The reader had checked the H.T. voltage and various other points, but had failed to ascertain that the cathode circuit was complete. Owing to an open-circuited bias resistance, H.T. current was not flowing through the output valve, and thus all his tests had been useless. A milliammeter in the anode circuit would, of course, have indicated the trouble, but he only had a voltmeter and thought that the presence of H.T. voltage at the anode was sufficient indication that the valve was working.

Choice of Detector

A READER wrote to us the other day asking whether his reception would be improved by replacing his power-grid detector by a double-diode-triode valve. An examination of the diagram of his set revealed that there was only one H.F. stage incorporated, and therefore we advised him to retain his power-grid detector if distant station reception was desired, but that the substitution would be worth while if quality reception of nearby stations was the main requirement. Our advice was based on the fact that the diode detector is liable to distort if the input voltage is very low, but will not suffer from overloading. The power-grid detector, on the other hand, can usefully be employed to receive distant stations, as reaction can effectively be used, and reasonably good quality can be obtained from a lower input voltage than that required by the diode.

PRIZE PROBLEMS

Problem No. 436

THOMPSON'S set had been in operation for a good while, giving every satisfaction, when, one evening, it ceased to function. He examined the H.T. and L.T. batteries and found them in quite reasonable condition: he applied tests to the G.B. battery, but that also was above suspicion. To test the anode current consumption, he inserted a milliammeter in series with the anode of each valve and the H.T. positive line, and found that the figures for the first two valves were in order but the consumption of the output valve was high. He, naturally, suspected the valve, but before changing it he tried various values of G.B. and was surprised to find that this had no effect on the high anode current. What was wrong?

Three books will be awarded for the first three correct solutions opened. Entries should be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 436 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, September 14th, 1942.

Solution to Problem No. 435

The speaker sold to Williams was of very low impedance and did not, therefore, match up with the output valve in his receiver. When he took it back to the dealer, it operated quite well when put on test, as the set used by the dealer was fitted with connections for low-impedance windings. What Williams should have done was to buy a suitable matching transformer.

The following three readers successfully solved Problem No. 434 and books have accordingly been forwarded to them: J. W. Davison, Roosebeck, Red Row, Morpeth; H. N. Barraclough, "Myrtles," Cherry Lane, Lymm, Cheshire; R. Staniforth, 365, Queen Street, Withernsea, E. Yorks.

Replies to Queries

Measuring Eliminator Output

"I bought a small eliminator a while ago and on test it only measures 15 volts instead of 80, 45 instead of 90, and 130 instead of 150. Could I alter it with changing the resistances, and if so what should I get for each tapping ?"—P. J. (Bournemouth).

THE readings you give tend to show that you tested the output from your eliminator with an ordinary type of voltmeter. The two low outputs are intended for the screen of an S.G. valve, and the detector anode voltage, and the current in each case is only a few milliamps. The highest output is intended to supply up to 25mA or so, and this is the current which will be taken by a small "pocket" type voltmeter. Consequently, as the low voltages are obtained by means of the voltage drop through series resistances, the additional current taken by your meter will result in a much greater voltage drop than is intended and would give the readings you mention. The output tapping would be more or less correct. Thus, to test this type of unit you must use a meter having a resistance of at least 1,000 ohms per volt—at which the current taken will only be 1mA or so.

Electric-light Wiring

"I am going to make up a trickle charger and want to fit it to the mains. When I unscrewed a cover of a switch, however, I found three wires running to it, two joined to one connector and one to the other. Is this a standard three-wire system, and if not, how is it that there are three wires and not two ? Perhaps you could tell me the best way to fit my charger ?"—S. T. (Thornton).

THE switch is not a three-wire circuit, and the fact that there are two wires on one connector merely indicates that the wiring is looped in. That is, the wire is brought down from the ceiling in a loop and the end of the loop cut and attached to avoid making a joint above the ceiling. You should not tamper with the wiring at the switch, but if you need an additional point for your charger, you should use an adapter in a convenient socket, with a switch on the adapter to enable either the charger or the other socket to be used. If you are not familiar with the mains we recommend that you get a good electrician to carry out the work for you.

Meter Conversion

"I wish to convert a meter I have to read higher currents and am not quite clear of the formula for this. I believe you have published the details, but I have been through all my back numbers and cannot find it."—F. C. (Swansea).

THE meter has to be shunted to read a higher current and therefore the value of the shunt will be equal to the resistance of the meter divided by the multiplication factor less one. Expressed mathematically, this equals—

$$\text{Value of shunt} = \frac{\text{Resistance of meter}}{N-1}$$

where N is the multiplication factor or number of times the full scale has to be increased.

Faulty Smoothing Condenser

"I have a small Universal mains set which has developed a fault in the form of very rough music and speech, the latter, in fact, being almost indistinguishable. I wonder if you can, from this, tell what is wrong with the set and how to cure it. I am using it on A.C. supply, 240 volts."—L. M. (Greenwich).

THE trouble sounds very much like a raw A.C. supply getting through to the set—that is, ineffective smoothing. We imagine that the receiver is one of the "Midgets" with a field-speaker winding used as a smoothing choke, and think that the most likely cause of the trouble is an open-circuited smoothing condenser. This is, no doubt, an electrolytic, and we suggest that you try the effect of connecting a new electrolytic condenser between each side of the field and earth. This will no doubt cure the trouble.

Electro-musical Instruments

"Can you tell me how the electric piano or organ works ? I have seen an advertisement in an American paper for one of these things which is supposed to give a remarkable tone, and I should like to know the principles upon which it works. I forget the trade name of the job, but perhaps you know the thing I refer to."—W. H. C. (York).

THERE are now several different types of electrical-musical instrument. In one the vibration of strings is picked up by electro-magnets and then amplified ; in another microphones are used to pick up the sounds, whilst in yet another the musical sounds are reproduced electrically by means of oscillating valves or toothed metallic discs rotating near electro-magnets. It is claimed that the oscillating valve circuit produces the best tone, and by special tone circuits various effects may be produced. The question of harmonics is receiving special attention.

Radiator Interference

"I was troubled with an intermittent crackling on my set at various intervals, and in an endeavour to locate the trouble I made a large number of tests. Eventually I found that the trouble seemed to come from an ordinary electric radiator, but only when this was first switched on. The noise appears in the set for about three minutes after the fire has been switched on and then ceases. I fail to see, however, how this can cause trouble, as there are no moving parts in the fire and nothing which on the face of it can give trouble. Is it possible for you to help me to find exactly what is making the noise ?"—B. G. (Reading).

ALTHOUGH in theory there is nothing in an ordinary electric fire which can cause trouble there are two possible sources of radiated electrical interference. In the first case a partially fractured element might arc when the fire is first switched on, and as the element heats up the expansion of the wires may close the fracture and thus the arcing would cease. On the other hand, the turns of the wire element may be touching and as the element warms up the turns may open, again giving rise to the small arcs which would cause crackles to be heard on a receiver in the locality.

Switch Noises

"There are a lot of crackles on my set, and I have found that they come from the on/off switch. If I turn this, the noises are sometimes worse, and I can set it so that it stops entirely. I have bent the springs to try and get over it, but it does not seem to work. Is it due to any chemical action due to the electricity flowing through it ?"—D. E. (Bristol).

THERE is insufficient current in the ordinary battery receiver to affect the switch as you suggest. The trouble is generally due to the fact that the metal becomes corroded and dirty and this makes poor contact. The remedy is to keep it scrupulously clean and shielded from the dust. A good modern switch should not prove faulty, and the trouble you mention was generally experienced only with the older patterns of this component.

Gramophone Motor Speed

"I have a synchronous gramophone motor and turntable of the one-hole fixing type and this runs at a definite speed without any speed control. Is there any way in which I could fit a speed regulator to this so that I can run records at various speeds, or must it be left as it is ?"—C. R. H. (Blackpool).

THE type of motor in question runs at a speed dependent upon the frequency of the supply and the number of teeth on rotor and stator. Accordingly the only way of modifying the speed is to modify the frequency of the supply or the number of teeth—both of which are impracticable. Although you could fit up a friction brake to operate against the edge of the turntable this is inadvisable as it will cause the motor to heat up and you may burn out the windings. By using a friction device when starting the turntable you can, however, make the rotor turn at exactly half speed and keep in step at that speed but other speeds are out of the question.

Classified Advertisements

ADVERTISEMENTS are accepted at 2s. per line or part of a line. Minimum 4s. Advertisements must be prepaid and addressed to Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

LOUDSPEAKER REPAIRS

LOUDSPEAKER repairs, British, American, any make, moderate prices.—Sinclair Speakers, 12, Pembroke Street, Copenhagen Street, N.1.

LITERATURE, MAPS, etc.

AMATEUR Radio Handbook. Second edition now on sale. 328 pages, price 4s. —Radio Society of Great Britain, 16, Ashridge Gardens, London, N.13.

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

RADIO SOCIETY OF GREAT BRITAIN invites all keen amateurs to join. Reduced war-time subscriptions. Send 1s. for latest "T. & R. Bulletin" and details.—16, Ashridge Gardens, London, N.13.

NEW LOUDSPEAKERS

3,000 Speakers, P.M. and energised, 5in. to 14in., including several Epoch 18in.—Sinclair Speakers, 12, Pembroke Street, Copenhagen Street, N.1.

MORSE & S.W. EQUIPMENT

"H.A.C." Short-wave Receivers.—Famous for over 8 years. Improved one-valve model now available. Complete kit of precision components, accessories, with full instructions, requiring no soldering, only 16/-, postage 6d. Immediate despatch. Illustrated catalogue free.—A. L. Bacchus, 109, Hartington Road, S.W.8.

FULL range of Transmitting Keys, practice sets and other equipment for Morse training.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: GERrard 2089.

RECEIVERS AND COMPONENTS

SOUTHERN Radio's Wireless Bargains: **7/6.**—Assorted Components contained in attractive permanent box. 9 Assorted Valve Holders, 2 Volume Controls, 12 Assorted Condensers, 6 Resistances, Choke, Wire, Plugs, Circuits, etc. 7/6, postage 7d.

ORMOND Loud Speaker Units, Balanced Armature Types. Unshrouded, 3/-; largest 4-pole type, 6/6.

ACE P.O. Microphones ready for use on any receiver, 6/6.

TELSEN Radio Magazines, complete with 4 circuits, 9d. post free; Wireless Crystals, 6d. each, 5/- per dozen. Permanent Magnet Speakers, 8in., complete with multi-ratio transformer, 22/6. Many other bargains for callers. All goods guaranteed. Please add extra for postage.

SOUTHERN Radio Supply Co., 46, Lisle Street, London, W.C. Gerrard 6653.

ELECTRADIX BARGAINS

PERISCOPES, folding trench Mark III, with spare mirror. Opens to 25in. high x 4½in. x 3in. In canvas case with strap, **12/6.** Post. 1/-.

SPEAKERS, 5¼in. mov. coil, P.M. damaged cone, home repair easy; unused salvage, 7/6.

FOOT SWITCHES, 5 amp. on-off, quick acting, for motor or machine control, **5/-.**

COUPLINGS, vernier tooth for motor or magneto drive, ½in. shaft, brass, pair, **6/-.**

CHARGING DYNAMOS, suit any drive, Wind Aero Rotax 6/12 volts, ball bearing, 8½ amps., weight 11lbs., unused; cost £10. Surplus bargain, **17/6,** del. free England and Wales.

D.C. MOTOR GENERATORS. 100 volts to 17 volts, 6 amps., **£4 7 6.** Ditto, 220 volts to 16 volts, 5 amps., **£5 8/-.**

3 K.W. D.C. shunt wound "Maudslay" dynamo, 110 volts, 28 amps., 950 revs., on extended bedplate, with coupling, **£22.** Lister engine to match, available shortly.

12 VOLT LIGHTING SET, Stuart Turner type, 120 watts, with accumulator, second hand, **£15.**

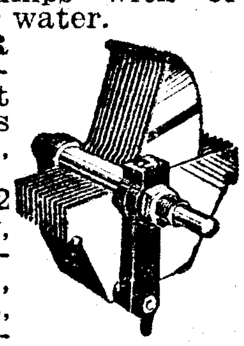
PLUGS. Radio coupling, 2-pin Belling type, 5/- doz. Socket panel pairs on paxolin, **8d.** pair, or 5 pairs on panel, **3/-.**

TESTERS, AMPLIFIERS OR PORTABLES. We offer a very fine job in mahogany, canvas covered, 9in. x 9in. x 6½in. with double doors, metal bound handle. Removable chassis has ebonite panel, 4 transformers, 5-tap switch, rheostat, etc. Most suitable for builders of Test Set, Mike Amplifier, Oscillator or any portable electric set. Unused, **45/-.**

VALVES. 1-volt "Weco," new, **3/6.** Osram AT40, 6-volt, **4/6.**

FULTOGRAPH PARTS. Spare parts, new. Chart Drum and clips, **5/6.** Magnetic Clutch, 6-volt, complete, **25/-.** 9in. Traverse Shaft, 4in. threaded 120 to inch, with bearings, **12/6.** Stylus, with carriage rods and brackets, **7/6.** 5-pin plugs, with panel socket and cords, midget type, **4/6** pair. 14-way Plug and Socket, with cord, **7/6.** ⅛in. Aluminium Panel, drilled 13in. x 6⅝in., **3/-.** Bakelite ditto, 7⅞in. x 6¼in., **2/3.**

PUMPS. Stuart motor pumps, centrifugal, C.D. Shelter, 12 volts D.C. or 230 volts A.C. in stock. Twin-piston pumps with or without motors, for suds or water.



SOLO VARIABLE AIR CONDENSERS for Wavemeters and Single Circuit Tuning, logarithmic blades .0005 mfd., new. Type F., boxed, **3/6.**

CONDENSERS, Fixed, 2 mfd. G.P.O. for smoothing, **2/6.** H.T. Mica Fixed Condensers, 1-4 mfd., 4,000 volts, **10/-.** Large 1 mfd., 2,000 volts, **10/6.** 1 mfd., 6,000 volts, oil-filled B1 condensers, **35/-.** 2 mfd., 4,000 volts, cased, **45/-.**

INSULATORS. All shapes and sizes from aerial egg or shell at 2d. to big Navy 6in. type. Cleats and pedestal insulators. No list ready. Please specify wants.

8-WAY Lucas-Rotax Switch Boxes, 8 levers and fuses for charging, etc., **3/6.** 6-way Push Button, R.A.F. switches, **2/9.**

MICROPHONES. Armoured type, metal clad, for heavy duty, **5/-.** G.P.O. sensitive Button type, **2/6.** Studio mikes, **£3.** Mike Transformers, **4/6** to **15/-.**

HOME GUARD. Field telephone cable, single or twin in ¼ mile reels. Ceiling Roses, porcelain, with 2 "scruit" couplers for connect boxes, **6/6** doz. Old bayonets, make 2 daggers, **3/6.** Relays and Drop Indicators, Portable Field Telephones, etc.

THE CAMBRIDGE TOWNSEND BUZZER, is the highest note and smallest Buzzer made, used by Government on wave-meters, and has ample platinum contacts. Ideal for key work. **10/-.**

Other Buzzers: Practice, bakelite-cased, **2/-** and **3/6.** Square brass-cased Buzzer **4/6.** Heavy type bakelite-cased, **5/6.** Few D111 Buzzers, multi windings, no contacts, **5/6.**

DICTAPHONE SOUND AMPLIFIERS and horn for loud use with buzzers, **7/6.**

Please add postage for all mail orders. Send stamped envelopes for replies to all enquiries.

ELECTRADIX RADIOS,
19, Broughton Street,
Queenstown Road, London, S.W.8
Telephone: Macaulay 2159.

RECEIVERS AND COMPONENTS

GALPIN'S ELECTRICAL STORES.

SHEET EBONITE, size 12in. by 11in. by 1/32in., best quality. Price **4/-** per doz., post free.

ELECTRIC LIGHT CHECK METERS, well-known makers, first-class condition, electrically guaranteed, for A.C. Mains 200/250 volts 50 cy. 1 phase 5 amp. load, **10/-** each; 10 amp. load, **12/6**; carriage 1/-.

AUTO TRANSFORMER, 1,500 watts, tappings 0-110-200-220 and 240 volts for step-up or step-down. Price **£5,** carriage paid.

LARGE TRANSFORMERS for re-winding, size 2 kW. auto, rating unknown. Price **30/-,** carriage forward.

HIGH FREQUENCY TRANSFORMERS, 75 v. A.C. input at 300 cycles; output 5,000-0-5,000 v. at 500 watts. Price **45/-,** carriage forward.

110 v. D.C. MOTORS, maker **KLAXON,** precision built, approx. 1/10 h.p., ball bearing variable speed, laminated fields, in new condition. Price **20/-,** post free.

ROTARY CONVERTOR, D.C. to D.C.; Input 220 volts D.C.; Output 12 volts at 50 amps. D.C., ball-bearing, condition as new. Price **£10** carriage forward, or **17/6** passenger train.

DOUBLE OUTPUT GENERATOR, shunt wound, ball-bearing, maker "Crypto," outputs 60 volts at 5 amps. and 10 volts at 50 amps., condition as new. Price **£10** carriage forward, or **20/-** passenger train.

ALTERNATOR, output 220 volts, 50 cycles, 1 p.h. at 180 watts, will give 1 amp. easily, speed 3,000 r.p.m., self-exciting, condition as new. Price **£8** carriage forward, or **15/-** passenger train.

TRANSFORMER, input 230 volts, 50 cycles, 1 p.h.; output 1,100-0-1,100 volts at 220 milliamps, and 6 volts C.T. three times, earth screen, wound to B.S.R., weight 32 lbs. Price **£6**; carriage passenger train **7/6.**

MILLIAMP METER, by Ernest Turner, 2½in. dia., panel mounting, moving coil, reading 0-100 milliamps. Price **50/-.**

ELECTROSTATIC VOLTMETER, 12in. dia., switchboard type, reading 0 to 15,000 volts. Price **£12,** carriage paid.

CABLE, V.I.R. and braided, heavy duty, as new, size 37/13 s.w.g., carry 200 amps., lengths 30 to 40 yards. Price **8/-** per yard, carriage paid.

ROTARY CONVERTOR, D.C. to A.C., input 35 volts at 16 amps.; output 24 volts, 100 cycles, single phase, condition as new. Price **£5.**

BELLS, LOUD RINGING, 20 volts D.C. working, 8in. dia. metal gong, for outdoor use, new, price **30/-.**

PORTABLE AMPMETER in teak case, size 8in. by 8in. by 3½in.; 5in. scale reading 0-20 amps. A.C., condition new. Price **£5.**

MOTOR BLOWER, 110 volt D.C., as new, 6in. dia. Inlet and Outlet, speed 2,800 r.p.m. Lightweight, portable. Price **£7 10s.**

SEARCH or **FLOODLIGHT,** 18in. dia., on swivel stand, fitted G.E.S. lampholder, also 16in. dia. Mangin Mirror, in first-class condition. Price **£8 10s.,** carriage paid.

GALPIN'S ELECTRICAL STORES, 21, WILLIAM STREET, SLOUGH, BUCKS.
Telephone: Slough 20855.
Terms: Cash with order.

A.C. Adaptor for D.C. Avominor, 4 range, 12, 120, 300, 600 v. A.C. Plugs in without alteration. **42/-** each.—Longford, 30, Carrington Street, Derby.

RECEIVERS AND COMPONENTS

LONDON CENTRAL RADIO STORES

Grand Stocktaking Clearance to Make Room for Further New Lines of Interest and Importance.

AMERICAN Octal base valve-holders, Mazda type, brand new, **1/3** each.
PHILIPS 0.1 mfd. 5,000 v. working condensers, metal-cased, brand new, **10/6** each.
FLEXIBLE DRIVES. Well-made shielded cable drives for remote control. Ideal for radiogramophones. Approx. 2ft. long. To clear, **4/-** each.
ELECTRO-MAGNETIC COUNTERS. Resistance 500 ohms. From 1-12,999, size 4½" x 2" x 1¼". Ex-G.P.O. Invaluable for countless purposes, **9/6** each. A smaller type, 1-1,999, size 4½" x 1½" x 1⅜", **5/6.**
VARIABLE CONDENSERS. 2 and 3-gang. Die cast frames in first-class condition, **5/6** each.
YAXLEY type switches, 2-way, **1/6**; 2 bank 3-way, **3/9.**
OUTPUT TRANSFORMERS. Primary 300 ohms D.C., Secondary .5 ohm D.C., Brand new, **6/6.** Also new chokes, 30 henry, 150 ohms, **5/6** each.
RELAYS. Small relays for operation on 2 v. D.C., with 6-way make and break switches. Brand new, **5/-** each.
TRIMMERS. Twin trimmers on ceramic base, new, to clear, **6d.** each, **5/-** doz.
COIL FORMERS. Cardboard and Paxolin. Assorted sizes, **2/9** doz.
CHARGERS. Trickle chargers, metal rectification. Input 200/220 v. A.C. Output 2 v. ½ amp. Shockproof, **17/6.**
VALVES are in short supply. Stock of Mullard TSP 4's and HVR 2's to be cleared at **17/6** each. First come, first served.
TELEVISION diode valves. Unused Mullard EA50, 69 mm. x 12 mm. overall, 6.3 v. heater at .15 amp., **10/6** each.
CHASSIS. Heavy gauge metal chassis, battleship grey, 12" x 5½" x 2½", **1/6** each. Also 10" x 5¼" x 3", brand new cadmium plated, **1/3** each. Special line of beautifully polished chassis, 12" x 8½" x 3", a really super job, **4/-** each. All drilled for valves, etc.
PUSH-BACK Wire Flex, ideal for wiring receivers, etc., **1/6** 8-yard coil.
VOLUME CONTROLS. Wire wound, 1 ohm, 800 ohms, 2,000 ohms, **3/6** each. Carbon type, 100,000 ohms, 250,000 ohms, 500,000 ohms, 1 megohm, **4/6** each. Midget type, 5,000 ohms, **3/6** each.
AERIAL WIRE, 3 strand, best quality, enamelled, copper, 50ft., **2/6.**
VALVEHOLDERS. Chassis mounting, 7-pin. **8d.** each; **6/-** doz.
PHILIPS Mica-di-electric .0003 mfd. Reaction condensers. Brand new, **2/-** each.
SISTOFLEX. Big purchase of this fine insulated sleeving. 3 mm., 4 mm., 5 mm., **3d.** each per yd. length, **2/6** doz. yards. 8 mm., **5d.** yd. length, **4/6** doz. yds. 16 mm., **7d.** yd. length, **6/6** doz. yds. Special price for quantities.
MINIATURE Rotary switch on porcelain base, **1/3** each.
DOUBLE-THROW Panel knife switches, new, **1/9** each.
G.E.C. Fractional H.P. Motors, 225 volts, single phase, 50 cycles, 1/100 h.p., 1,400 r.p.m. To clear, **47/6** each.
PAXOLIN PANELS. Thin panels, **5/6** doz.
ACCUMULATORS. Ediswan 2 v. 60 amp., brand new, in ebonite cases, size 8" x 4¼" x 2½", **17/6** each.
PUSH-PULL INPUT TRANSFORMERS by well-known maker, nickel iron core, in metal case, size 2" x 1⅜" x 1½" high, ratio 6 : 1. Price **6/6.**

(Continued top of column 3.)

WEBB'S Radio

Special List of

RADIO COMPONENTS

Webb's war-time service still affords unique facilities for the radio-man. The following items are part of a large range of components in stock NOW! Call at our showrooms or post your enquiries to-day.

SHORT-WAVE VARIABLE CONDENSERS

Cyldon Midget 20 mmf., ceramic end ... 3/6
Eddystone Microdenser, 18 mmf., 4/6; 40 mmf., 5/-; 60 mmf., 5/6; 100 mmf., 5/9
Wavemaster 250 mmf., 150 mmf. and 100 mmf. ... 3/6
Ceramic Trimmers, compression type, 250 mmf., 450 mmf. and 750 mmf. ... 1/-
U.I.C. Trimmers and Fixed Condensers, all values in stock.

FIXED CONDENSERS

Aerovox 40 mfd. 200-volt Condensers, for Midget Receiver, at ... 6/6
Aerovox 30 mfd. + 32 mfd. 175 volts Condenser for Midget Receiver, at ... 6/6
Dubilier .1 mfd. 6,000 volt working condenser at ... 6/-
First grade N.S.F. Tubular Condensers, .1 and .01 mfd., each ... 6d.

INTERVALVE TRANSFORMERS

I.F. 465 Kc. square can type ... 6/-
I.F. 465 Kc. small cylindrical ... 4/-
Low Frequency small shrouded, 3 : 1 ratio, 3/6; heavier type... ... 5/-

VALVE HOLDERS

American Octal chassis mounting (Paxolin) ... 4d.
Ceramic (Amphenol) 5-pin, U.S.A. ... 2/-
Ceramic 4 and 5, British ... 1/-
Side Contact Valve Holder, for E series valves ... 6d.

MISCELLANEOUS ITEMS

Push Back Insulated Flex (single) doz. yds. ... 1/-
Resistance Cord for A.C./D.C. Receivers, 100 ohms, per ft. ... per ft. 2/-
Flexible Couplers for ¼in. shaft, rubber insulation, each ... 4d
80 ohm Concentric Cable (½in. diam.), maximum length 150ft., per ft. ... 8d.
Collapsible Microphone Stands ... 42/-
Highest quality Moving Coil Microphone, with transformer ... £5/5/-
Potentiometers and volume controls—all usual values from stock at... 4/6
Midget type Centralab at ... 5/6
Phillips Loudspeaker, 8½in. P.M., 3.5 ohms speech coil at ... 17/6
45-volt Burgess High Tension Batteries, heavy duty ... 14/8

Additional charge of 1/- for postage and packing on orders below 10/-

WEBB'S RADIO, 14 Soho St., Oxford St., London, W.1 *Telephone : Gerrard 2089*

Open 9 a.m. to 5 p.m. Sats., 9 a.m. to 12 noon

RECEIVERS AND COMPONENTS

T.C.C. Tubular Electrolytic 2 mfd. 50 v. working, **3/6** each.
B.I. 50 mfd.+50 mfd.+2 mfd. Block electrolytics, **5/6** each.
TRANSFORMERS. Made by Standard Telephones. Beautiful job, weight 12lb., 5¾" x 4¼" 350-0-350 v., 120 m.a. Four tappings giving 4 v. 2 amps., 4 v. 8 amps., 3 v. 3 amps., and 20 v. 1 amp. Brand new, **25/-** each, carriage forward.
EX-TELEVISION manufacturer. Heavy duty mains transformer. Input 240 v. A.C. tappings at 5,000 v. 5-8 milliamps., and for supplying filament of Mullard HVR 2 (6.3 v. at .65 amps.). Shrouded in metal box, **10/6** each, carriage forward.
VARIABLE RESISTANCES. Well-made resistances with wiping contact. Will carry about 10 watts. Brand new, first quality. Price **6/6** each.

SEE ADVT. PAGE 497. ADD POSTAGE. NO C.O.D. ORDERS.

LONDON CENTRAL RADIO STORES 23, LISLE STREET, LONDON, W.C.2.
'Phone: Gerrard 2969.

COULPHONE Radio, New Longton, Nr. Preston. Brand new goods only. P.M. Speakers with transformer, 8in. Rola and Plessey, **24/6.** 6½in. Celestion, **21/-.** Electrolytics, 500 v. 8 mfd., **5/6**, 8+8 mfd., **9/6.** 50 mfd. 50 v., **3/3.** Erie 1 watt resistors, all value **9d.**, each. Push-back wire, 100ft. coils, **6/-.** Barreter resistors, **6/-.** Parafeed L.F. Transformers, 4 : 1, **5/9.** Tinned copper wire, ½lb. reel, **2/3.** S.A.E. for stock list.

GEE GEE GEE GEE GEE GEE 15, LITTLE NEWPORT STREET, W.C.2. THE HOUSE FOR QUALITY COMPONENTS AT LOW PRICES.

AMERICAN & B.V.A. VALVES. Many types available. Send requirements for quotation.
MAINS TRANSFORMERS. Brand new, 300-0-300, 120 m.a. 4 v. and 4 v., also similar giving 6.3 v. and 5 v. output. **£1** each. Include 9d. extra for carriage.
MAINS DROPPERS. .2 amp., suitable for Lissen, Pye, etc., brand new, **3/9** each, also .3 amp. for Decca, Ferranti, Maestro, brand new, **5/6** each.
TUBULAR CONDENSERS. 50 mfd. 12 v. working, brand new, **1/-** each.
PENTODE Output speaker transformers, brand new, reduced price, **5/-** each.
FOR SERVICE ENGINEERS. Replacement for U.R.1C. or 1.D.5 valve, approximately 45 m.a. Guaranteed to work, or cash refunded. **12/6** each.
T.C.C. TUBULAR CONDENSERS. .1 mfd., **9d.** each, **8/-** dozen.
ROLA Super P.M. Type Speakers. 4in. diameter, pentode output, a really wonderful job, brand, new, **25/-** each. STAMPED Envelope must accompany all enquiries.

GEE ELECTRIC, 15, LITTLE NEWPORT STREET, W.C.2. GERRARD 6794.

MAKE and Sell your own Torch Battery Cigarette, Pipe, Gas Lighter. No wheels, wicks, flints, springs. Lasts 5-6 months. Diagram, full instructions for easy home construction, **4/-.** Element included FREE.—P. W. Barham, "Hilltop," Bradmore Green, Coulsdon, Surrey.

VALVES. Hundreds in stock at list prices. Include U50, 5Z4G, 1D6, KT41, U14, KT63, PM24M. All 1.4 volt types. Postage extra.—L. W. Lawrence, Station Street, S. Walden, Essex.

RECEIVERS AND COMPONENTS

FRED'S RADIO CABIN,
75, Newington Butts, S.E.11. Rodney 2180
REMARKABLE PURCHASE ENABLES US TO OFFER THE FOLLOWING GOODS AT LESS THAN PRE-WAR PRICE.
FUSES, glass, 1¼ inches long, 2 amp. and 1½ amp., **3/-** doz.
RESISTORS, 1 watt, various useful sizes, **2/6** doz.
MAINS DROPPERS, 0.2 amp., **3/6** each; also EKCO type, **2/6** each.
VARIABLE CONDENSERS, mica dielectric .0003 mfd., brand new, **6d.** each, **5/-** dozen.
MICROPHONES. Complete with transformer. Solid ebonite job, full instructions included. New line, **6/-** each.
TRIMMERS. 100 m.mfd. small type on paxolin base, **4d.** each, **3/9** dozen. New.
PUSH BUTTON, 6-way, complete with knobs—a really fine job. **2/6** each. New.
TRIMMERS, straight line type, capacity 3.35 m.mfd., **6d.** each.
SPEAKER GRILLES, 7in. x 3¾in. Chromium plated, cheap to clear, **1/6** each.
GRID LEAKS, 1½ meg. wire ends. **4d.** each.
SUPERHET CONDENSERS. Three-gang, .0005 mfd. **1/3** each.
EKCO mains twin filter chokes. **1/6** each.
CRYSTAL and Catswhisker in metal box. New stock at low price of **6d.** each.
SLEEVING. First-class quality, **3½d.** per yard length. 1 doz. lengths **3/-**. Braided sleeving **8d.** per yard length, **7/-** doz. lengths.
MAINS CHOKES, Smoothing. 350 ohms 60 m.a., **3/-** each.
GOODMANS Speakers, 8in., suitable all output valves. Universal transformer. **27/6** each.
T.C.C. wire-end Tubulars, 0.1 mfd., **7d.** each, **6/6** dozen, also .01 mfd. at **6d.** each, **5/-** dozen.
CONNECTING WIRE. Heat resisting, tinned copper, as used by Government. **6d.** coil of 12ft.
TRIMMERS. 50 m.mfd., **3d. each.** Also 250 m.mfd., **3d.** each.
MICROPHONE Inserts, ex G.P.O. **2/3** each.
5-WAY BATTERY CORDS, 4d. each.
T.C.C. TUBULAR Electrolytic Condensers. 75 mfd., 12v. working, **1/6** each. 20 mfd., 50v. working, **1/9** each. 2 mfd., 300v. working, **1/6** each.
MORSE KEYS on polished solid oak base, exactly as supplied to the Air Training Corps, etc., **4/6** each.
CRYSTAL Detectors, permanent type, **1/6** each. New.
DR. CECIL'S Radio Crystals, as advertised, special price, **9d.** each.
BAYONET Plugs for mains, British made, **6d.** each.
STANELCO Electric Soldering Irons. Made by Standard Telephones, with special bit for radio service work. **21/-** each. Resin-cored solder, **4/-** lb. reel.
Postage must be included. No C.O.D.
FRED'S RADIO CABIN FOR BARGAINS, 75, Newington Butts, S.E.11. Rodney 2180.
New branch at 17, Hamilton Parade, London Road, North Cheam, Surrey.

WANTED

LONDON CENTRAL RADIO STORES Will Pay good prices for Receivers, Radiograms, Amplifiers, Dynamos, Converters, Test Equipment, Electric Gramophone Motors, and all Radio and Electrical Accessories.—London Central Radio Stores, 23, Lisle Street, London, W.C.2. Gerrard 2969.

MORSE CODE TRAINING!

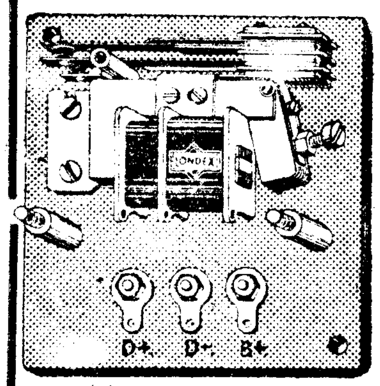
The Candler System of Scientific Code Training is carried out in your own home. It is definitely the quickest, easiest way of becoming a skilled wireless telegraphy operator. Numerous Candler trained operators are serving in the Army, Navy and Royal Air Force. Why not write now for a copy of the

FREE "BOOK OF FACTS"

it gives full details of the courses for Beginners and Operators.

CANDLER SYSTEM CO.
(5.L.O), 121 Kingsway, London, W.C.2
Candler System Co., Denver, Colorado, U.S.A.

BATTERY CUT-OUT



TYPE LF/C

Simple, robust and sensitive. Works in any position.

Ask for leaflet 98/PEW.

LONDEX LTD.

Anerley Works, 207, Anerley Road, London, S.E.20. 'Phone : SYD 6258/9.

WANTED

WANTED, 18 S.W.G. Enamelled Copper Wire; sample, price, quantity available to Bain, 15, Dragon Road, London, S.E.15.

WANTED, urgently, April issue PRACTICAL WIRELESS in good condition, state price, all postages returned. Also "Class B" Output Choke.—Kennedy, 260, High Street, Arbroath.

WANTED, Mullard Valve PMIDG, good working condition.—Walker, 2, George Place, Gourock.

TUITION

LEARN MORSE CODE the Candler way. See advertisement on this page.

"RADIOLOCATION."—Students of both sexes trained for important war-time Radio Appointments. Also for peace-time careers in all branches of Radio and Television. Boarders accepted. Low inclusive fees. College in ideal peaceful surroundings. 2d. stamp for Prospectus. —Wireless College, Colwyn Bay.

PRACTICAL Postal Radio Courses; coaching for I.P.R.E. exams.; qualifying for R.A.F. and A.I.D. posts; booklet free.—Secretary, I.P.R.E., Bush House, Walton Avenue, Henley-on-Thames.

A COMPLETE LIBRARY OF STANDARD WORKS

By F. J. CAMM

MASTERING MORSE 1/-, by post 1/2.
GEARS AND GEAR CUTTING 6/-, by post 6/6.
WATCHES: ADJUSTMENT AND REPAIR 6/-, by post 6/6.
NEWNES' ENGINEERS' MANUAL, 10/6, by post 11/-.
PRACTICAL MOTORISTS' ENCYCLOPÆDIA 10/6, by post 11/-.
MOTOR CAR PRINCIPLES and PRACTICE 6/-, by post 6/6.
PRACTICAL WIRELESS ENCYCLOPÆDIA 10/6, by post 11/-.
RADIO TRAINING MANUAL 6/-, by post 6/6.
EVERYMAN'S WIRELESS BOOK, 6/-, by post 6/6.
PRACTICAL WIRELESS CIRCUITS 6/-, by post 6/6.
COILS, CHOKES and TRANSFORMERS 6/-, by post 6/6.
PRACTICAL WIRELESS SERVICE MANUAL 8/6, by post 9/-.
WORKSHOP CALCULATIONS, TABLES AND FORMULAE 6/-, by post 6/6.
NEWNES' SHORT-WAVE MANUAL, 6/-, by post 6/6.
WIRELESS TRANSMISSION 6/-, by post 6/6.
DICTIONARY OF METALS AND ALLOYS 7/6, by post 8/-.
THE SUPERHET MANUAL 6/-, by post 6/6.
PRACTICAL MECHANICS' HANDBOOK 12/6, by post 13/-.
RADIO ENGINEERS' VEST-POCKET BOOK 3/6, by post 3/9.
WIRE AND WIRE GAUGES (Vest-Pocket Book) 3/6, by post 3/9.
DIESEL VEHICLES: OPERATION, MAINTENANCE AND REPAIR 5/-, by post 5/6.
NEWNES' ENGINEERS' VEST POCKET BOOK 7/6, by post 8/-.

All obtainable from or through Newsagents or from Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Practical Wireless

BLUEPRINT SERVICE

PRACTICAL WIRELESS	Date of Issue.	No. of Blueprint.
CRYSTAL SETS		
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" crystal Set		PW94
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver		PW85
The "Pyramid" One-valver (HF Pen)		PW93
Two-valve : Blueprint, 1s.		
The Signet Two (D & L F)	27.4.?	PW76
Three-valve : Blueprints, 1s. each		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	—	PW39
Hall Mark Cadet (D, LF, Pen (RC))	—	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	—	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	—	PW62
The Centaur Three (SG, D, P)	—	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	—	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))		PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	—	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det, Pen)	—	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	—	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)		PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	—	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	—	PW92
Four-valve : Blueprints, 1s. each.		
Beta Universal Four (SG, D, LF, Cl.B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	—	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	—	PW90
Mains Operated		
Two-valve : Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen)	—	PW18
A.C.-D.C. Two (SG, Pow)	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve : Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow)	—	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW36A
Armada Mains Three (HF Pen, D (Pen))	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve : Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47
SUPERHETS.		
Battery Sets : Blueprints, 1s. each.		
£5 Superhet (Three-valve)	—	PW40
F. J. Camm's 2-valve Superhet	—	PW52
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve)	—	PW43
D.C. £5 Superhet (Three-valve)	—	PW42
F. J. Camm's A.C. Superhet 4	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four	—	PW73
Four-valve : Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model / Push Button 4, A.C. Mains Model	22.10.38	PW95
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
Simple S.W. One-valver		PW88
Two-valve : Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)		PW91
Three-valve : Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)		PW68
PORTABLES		
Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen)	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)		PW77
Four-valve : Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86
MISCELLANEOUS		
Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE		
CRYSTAL SETS.		
Blueprints, 6d. each.		
Four-station Crystal Set	—	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans)	—	AW388
Full-volume Two (SG det, Pen)	—	AW392
A Modern Two-valver	—	WM409
Three-valve : Blueprints, 1s. each.		
£5 5s. S.G. 3 (SG, D, Trans)	—	AW412
Lucerne Ranger (SG, D, Trans)	—	AW422
£5 5s. Three : De Luxe Version (SG, D, Trans)	—	AW435
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	—	WM327
Economy Pentode Three (SG, D Pen)	—	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	—	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen)	—	WM389
Certainty Three (SG, D, Pen)	—	WM393
Minitube Three (SG, D, Trans)	—	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC. Trans)	—	AW370
Self-contained Four (SG, D, LF, Cl. B)	—	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2LF)	—	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF, Pen. HF Pen, DDT, Pen)	—	WM404
Five-valve : Blueprints, 1s. 6d. each		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF Class B)	—	WM344
New Class B Five (2 SG, D, LF. Class B)	—	WM340
Mains Operated.		
Two-valve : Blueprints, 1s. each		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C.	—	AW383
Mantovani A.C. Three (H.F. Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	—	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	—	WM329
Harris' Jubilee Radiogram (HF, Pen D, LF, P)	—	WM386
SUPERHETS.		
Battery Sets : Blueprints, 1s. 6d. each.		
'Varsity Four	—	WM395
The Request All-Waver	—	WM407
Mains Sets : Blueprints, 1s. each.		
Heptode Super Three A.C.		WM359
PORTABLES		
Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Tyers Portable (SG, D, 2 Trans)	—	WM367
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
S.W. One-valver for America	P.W.15.10.38	AW429
Roma Short-Waver	—	AW452
Two-valve : Blueprints, 1s. each.		
Ultra-short Battery Two (SG, det, Pen)		WM402
Home-made Coil Two (D, Pen)	—	AW440
Three-valve : Blueprints, 1s. each.		
Experimenter's 5-metre Set (D, Trans, Super-regen)	—	AW438
The Carrier Short-waver (SG, D, P)	—	WM390
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF, Pen, D, RC, Trans)	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valver Short-waver (SG, D, LF, P)	—	WM383
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super	—	WM397
Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.		AW453
Three-valve : Blueprints, 1s.		
Emigrator (SG, D, Pen) A.C.	—	WM352
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans)	—	WM391
MISCELLANEOUS		
S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM 392 (1/-)	—	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	—	WM403
New Style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-)	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	—	WM405
Wilson Tone Master (1/-)	—	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM408

These Blueprints are drawn full size.

Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices *which are additional to the cost of the Blueprint.* A dash before the Blueprint Number indicates that the issue is out of print.

Practical Wireless (issues dated prior to June 1st, 1940) .. .. **4d. Post Paid**
(Issues dated June 1st to July 27th, 1940) .. .. **5d. Post Paid**
(Issues dated September, 1940, to November, 1941) .. .. **7d. Post Paid**
(Issues dated December, 1941, and after) **10d. Post Paid**
Amateur Wireless .. **4d.** ,, ,,
Wireless Magazine .. **1/4** ,, ,,

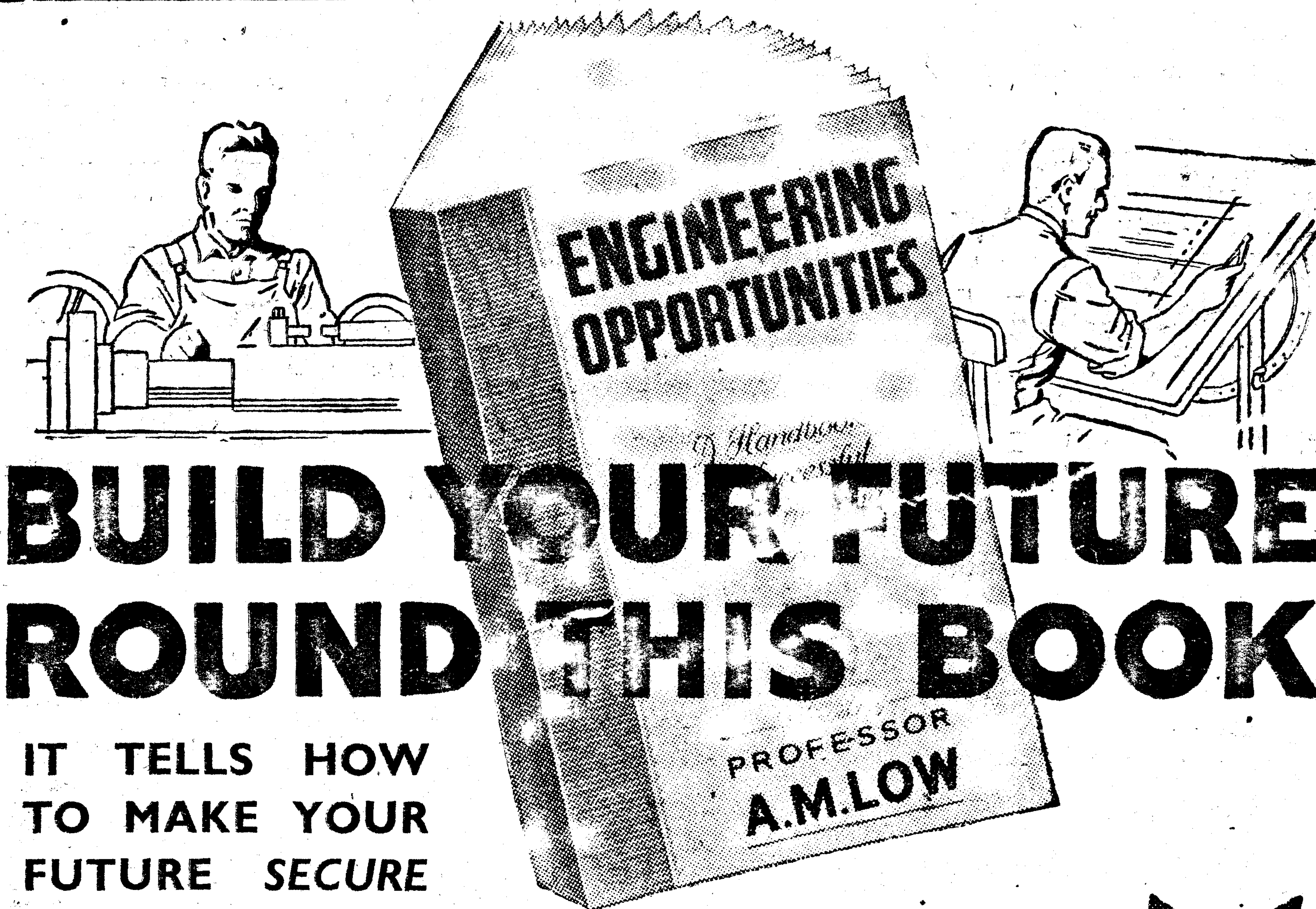
The index letters which precede the Blueprint Number indicate the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine.*

Send (preferably) a postal order to cover the cost of the Blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

FREE ADVICE BUREAU COUPON

This coupon is available until October 3rd, 1942, and must accompany all Queries and Hints.

PRACTICAL WIRELESS, OCT., 1942.



BUILD YOUR FUTURE ROUND THIS BOOK

IT TELLS HOW TO MAKE YOUR FUTURE *SECURE*

In the more competitive days of peace, technical training will be a vital necessity to the Engineer who wishes to safeguard his position and make advancement. "ENGINEERING OPPORTUNITIES" will show you how to secure this all-important technical training quickly and easily in your spare time. This 112-page book is full of valuable information and explains the simplest way of preparing for recognised Examinations. Among the courses described are:

A.M.I.Mech.E.
- Inst. of Production Engineers.
- Mechanical Engineering.
- Draughtsmanship.
- Tracing.
- Works Management.
- Jig and Tool Design.
- Maintenance Engineering.
- Diesels.
- Inspection.

A.M.I.E.E.
- City and Guilds.
- Electrical Engineering.
- Installations.
- Electricity Supply.

A.M.I.C.E.
- Civil Engineering.
- Structural Design.

L.I.O.B.
- Building Construction.
- Clerk of Works.

A.F.R.Ae.S.
- Air Ministry Licences.
- Aeronautical Engineering.

A.M.I.A.E.
- Repair Certificates.
- Automobile Engineering.
- Garage Management.

A.M.Brit.I.R.E.
- Wireless.
- Radio Servicing.
- Television, etc., etc.

POST THIS COUPON NOW

Special Courses for London Matriculation and R.A.F. Mathematics.

You cannot afford to miss reading "ENGINEERING OPPORTUNITIES." Write (or forward the coupon) for your copy, and subsequent matter, immediately. Sent (post free) on receipt of 2½d. in stamps.

WE DEFINITELY GUARANTEE "NO PASS —NO FEE"

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

409a, SHAKESPEARE HOUSE, STRATFORD PLACE, LONDON, W.1

Please forward (post free) your 112-page handbook, "ENGINEERING OPPORTUNITIES," and subsequent matter relating to the Institute, for which I enclose 2½d. in stamps.

Name.................................... Address..

....

THE B.I.E.T. IS THE LEADING INSTITUTE OF ITS KIND IN THE WORLD

Published on the 7th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and printed in England by THE NEWNES & PEARSON PRINTING CO., LTD., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand: GORDON & GOTCH, LTD. South Africa: CENTRAL NEWS AGENCY, LTD. Subscription rates including postage: Inland 10s. 6d. per annum; Abroad 10s. per annum. Registered at the General Post Office for the Canadian Magazine Post.