MAINS-OPERATED MORSE OSCILLATOR

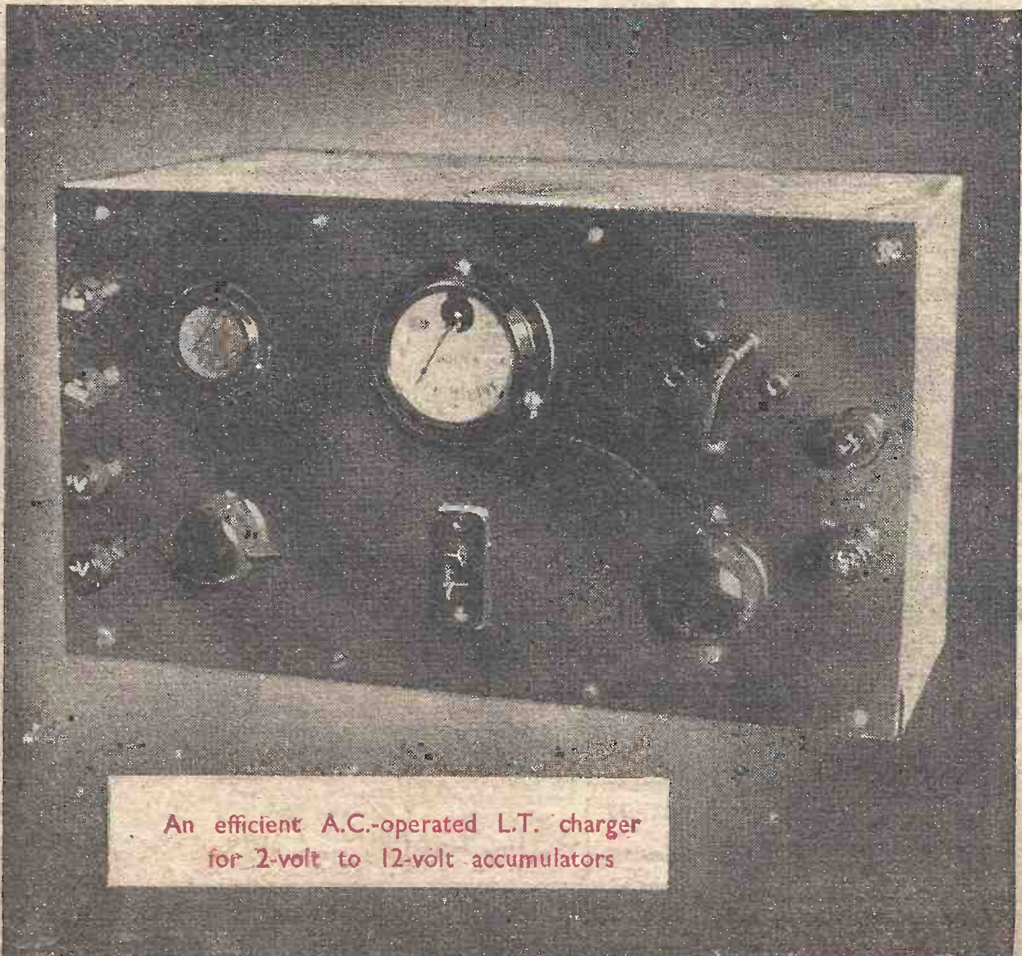
Practical Wireless

9D EVERY MONTH

Editor F. J. CAMM

Vol. 18. No. 435. NEW SERIES. SEPTEMBER, 1942

AN ACCUMULATOR CHARGER



An efficient A.C.-operated L.T. charger for 2-volt to 12-volt accumulators

Practical Wireless
and PRACTICAL TELEVISION
EVERY MONTH
Vol. XVIII. No. 435. SEPTEMBER, 1942
Editor F. J. CAMM
Staff: L. O. SPARKS. FRANK PRESTON.

COMMENTS OF THE MONTH BY THE EDITOR

After the War

"POST-WAR Planning in Radio Communication" was the subject of a discussion which concluded the 1942 session of the I.E.E. The debate was opened by Colonel Sir A. S. Angwin, who said that after the war, when normal services return, there will be great opportunities for broadcasting, and the cessation of hostilities will provide the opportunity for removing some of the anomalies of broadcasting.

One of the reforms which we hope will be brought about is the standardisation of components, and particularly valves. There are far too many types of the latter, and wireless receiver design as we knew it in 1939 had developed to the stage where more attention was given to the design of the cabinet than to the design of the receiver. The inside of a wireless set revealed in some cases that those responsible for its production could not have had previous experience of factory methods, nor of design. A wireless receiver was still an assembled product. Not one factory made the receiver from beginning to end, and thus design was restricted and stultified by the components which were bought in. A somewhat similar state of affairs existed in the bicycle trade for nearly 40 years. In that industry when the safety bicycle had been invented and Dunlop had produced the pneumatic tyre, there was the usual crop of inventions, the inevitable formation of clubs, and the marketing of fanciful gadgets which were the *dernier cri*. Then it developed into specialism. One firm supplied lugs, another handlebars, whilst others contributed the saddles, the hubs, the spokes, the nipples, the chain, wheels and cranks, the tyres and the lamps. When, therefore, you started as a bicycle manufacturer you were limited in your design to some suitable permutation of the components available, if you were to compete on a price basis with your competitors. The wireless trade, largely an unskilled business, has followed somewhat similar lines, with, perhaps, the exception that it has taken a leaf out of the book of car manufacturers, and endeavoured to make each year's models obsolete, by producing new models each year.

Post-war Planning

THE inside of a wireless set still looks like a passable imitation of a Heath Robinson cartoon. Odd-shaped screening cans, odd-shaped condensers and resistances all proclaim the assembled, as distinct from the designed, product. Large numbers of firms not knowing the first thing about radio saw in it a good thing, and made fortunes. When we speak therefore of post-war planning in connection with radio we prefer to think of it in the sense in which engineers use the term.

During the war fewer valve types have been made, and still fewer are available to the public. We are managing reasonably well despite those restrictions, and this should give a lead to valve manufacturers to concentrate on fewer types.

The day of the portmanteau valve is surely past. Of course, when we speak of post-war planning in connection with radio we are apt to think in terms of broadcasting as we now know it. It is certain, however, that television, which is being developed during the war, will open up, and may thus change the whole ambit of broadcasting. Our present system is somewhat analogous to silent films. There are good reasons for believing that after the war television will be simplified and cheapened to the point where it will become popular.

Problems Being Solved

THE intricacies of the ultra-short-waves, and the disadvantage of the somewhat limited reception area of the transmission, are already on the way to being overcome. We think that in the early days of post-war television the amateurs will be able to play, as they have done in wireless telephony, a most useful part. They constitute a vast body of energetic, enthusiastic and unpaid experimenters, and the results of their efforts will help in the perfection of television as they have in other branches of radio. Television, as we knew it before the war, was somewhat outside the field of experiment for all except a highly technical few who could afford the somewhat expensive apparatus necessary. Whether some optical system of projection from a small tube (this has, of course, been successfully demonstrated) will replace the large cathode-ray tube, remains to be seen. It is possible that the velocity modulation system will replace that used by the B.B.C. before the war. It certainly should be given a chance. It also seems reasonably certain that a higher line frequency will be adopted.

Queries

WILL readers please note that during the war we are unable to undertake alterations of circuit diagrams, nor the redesign of receivers to incorporate particular components. This involves far more work and time than is possible under war conditions. We also note that readers are not obeying the Query Rules. Will they please turn to page 456 of this issue, and make quite sure before submitting a query that they comply with those rules? A stamped and addressed envelope, and the coupon from the current issue must be enclosed. Queries must be limited to two. We do not answer questions relating to commercial receivers, nor do we reply to questions which may arise out of the publication of articles in contemporaries. We do not answer questions over the telephone.

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

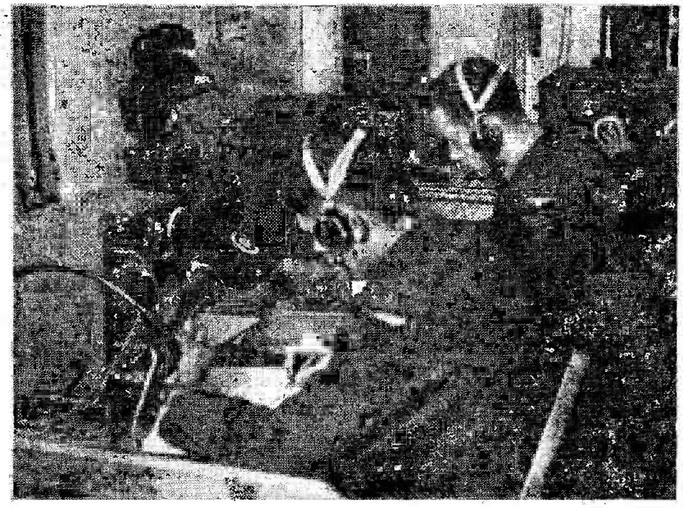
ROUND THE WORLD OF WIRELESS

Cycling to Radio

BECAUSE of the petrol shortage a worker of Hull (Quebec) cycles to work. He does it to music from a small radio set carried in a basket on the handlebars.

A Link with Home

EVERY Saturday night the B.B.C. sends out a short-wave broadcast from the American Eagle Club in London, and this is re-broadcast throughout the United States. Relatives of men who are going to speak are notified in good time, and after every broadcast letters from the cities and the small towns of America flow into the B.B.C. offices in New York.



The radio watch. These wireless operators are constantly in touch with operators on each aircraft. Bombers keep radio silence till they are over the target, but these men are ready if needed to send new instructions.

Radio in Schools

SEVERAL head teachers in Devon having expressed their opinion on the desirability of having wireless in their schools, the Plymstock Junior School Managers sent a resolution on the matter to the Devon Education Committee, which has replied that it is prepared to make a grant of up to 50 per cent. of the cost of providing and installing a wireless set in any school in Devon under the jurisdiction of the county authority.

American Valves

ACCORDING to a report from the U.S.A. the long-standing problem of the radio industry in that country, that of too many valve types, with many duplicates, has been solved by the War Production Board order to valve manufacturers to discontinue manufacture of 350 out of 710 valve types now on the American market. Many of the discontinued valves are in small demand or obsolete.

B.B.C. as Enemy of Axis Powers

MR. BRENDAN BRACKEN, Minister of Information, told the House of Commons recently that the B.B.C., the world's largest and most trusted broadcasting instrument, was regarded by the Axis Powers as a mighty enemy. Its audience was estimated at about 200,000,000 people every week.

Orchestra's New Leader

IT is announced that Mr. Jean Pougnet, former leader of the B.B.C. Salon Orchestra, has become leader of the London Philharmonic Orchestra.

Radio Entertainment by Prison Inmates

TO the signature tune of "Time on My Hands" radio listeners in America are entertained once a week by the inmates of San Quentin Prison.

Radio Licences in Eire

DURING the past twelve months there has been a drop of 8,144 in the number of people holding wireless licences in Eire, chiefly owing to the fact that listeners cannot obtain dry batteries for their sets. In spite of this, people who retain their sets but are unable to use them are still expected to pay their licences.

Scottish University and Radio

IT is interesting to note that Glasgow University has recently made a notable addition to its list of recognised subjects for the M.A. and B.Sc. degrees. Officially styled the "study of thermionics and radio communications," classes for this subject were inaugurated last October, and considerable success has attended these classes. It is hoped that as a result of the war other universities will in future recognise the importance of radio communication to a much greater extent than in pre-war days.

Factory Workers Broadcast to U.S.A.

A "WORKS WONDERS" programme broadcast from a North Country factory to America in the early hours of one morning recently brought a cablegram to the managing director of a British firm from the president of an American firm with which they have business dealings. The head of this American manufacturing firm, who heard the broadcast from this North Country factory, cabled:

"Your many friends join me in sending congratulations to you and your employees on successful broadcast. Your Government must be proud of the fine spirit of your workers and the contribution they are making in the war effort. Stop. It must be great satisfaction to have such an organisation. Stop. Had advised your many friends and they were all listening."

B.B.C. Allotment

THE team of enthusiastic amateur gardeners from the B.B.C. Outside Broadcasting Department, who cultivate an allotment in a London residential square, are now reaping the fruits of six months' "hard" labour. They are eating lettuce, spinach, cabbages, radishes, spring onions and other vegetables which they have grown themselves. When they finish their day's work these gardeners often visit the allotment, and one or other of them may be seen later in the evening walking proudly away with a large cabbage or some lettuce tucked under his arm! Raymond Glendenning, the all-round sports commentator, cooks the vegetables as well and is said to be as skilful as a housewife at the business.

Beam Approach

IT is interesting to note that beam approach, the R.A.F. name for the method of landing an aircraft by the aid of a radio beam, was the subject of an outside broadcast early in March, from an aerodrome of Flying Training Command. The broadcast was recorded by the B.B.C., and the records are now being used at a number of Flying Training Command schools as part of the preliminary training of pilots before they try out beam approach for themselves.

"Calling Gibraltar"

JOAN GILBERT, commère of the B.B.C. "Calling Gibraltar" programme, gets a large fan mail from listeners in other parts of the world who hear her broadcasts. She devotes a fraction of time in her programmes to answering these letters. This makes the men who garrison the Rock very jealous, and recently they wrote to her to tell her they were timing her replies to correspondents *not* in Gibraltar with a stop-watch. But after she had "replied" to one officer in the Western Desert who said that he was "five hundred miles from the nearest pub," the Rocky hearts melted. A cable came to Joan from Gibraltar this week, saying, "Have thrown away stop-watch."

Good-bye to "Slushy" Songs

THE B.B.C. have at last realised that there is a very strong desire among the public and members of the Services for more virile and robust dance music, and it has drawn up a four-point policy on dance band broadcasts.

1. To exclude any form of anæmic or debilitated vocal performance by male singers.
2. To exclude an insincere and over-sentimental style of performance by women singers.
3. To exclude numbers which are slushy in sentiment or contain innuendo or other matter considered to be offensive from the point of view of good taste and of religious or allied susceptibilities.
4. To exclude numbers, with or without lyrics, which are based on tunes from standard classical works

Signature Tune Password

ANNE SHELTON, who broadcasts in the Overseas programme "Calling British Forces in Malta," has a signature tune, "Only Forever," that has now become a catchword among British troops half the world over. It has even been used as a password of the night on the North-West Frontier of India. Anne Shelton receives hundreds of letters a week from troops in all parts of the world.

Gramophone Record Sales

A RECENT report from America states that in 1941 more than 110 million gramophone records were sold, and the final figures for sales of discs in this country during last year may also prove to be a record. To-day, however, in England the demand is greater than the supply, which has been curtailed by the scarcity of raw materials (shellac is imported mainly from India and Burma), and factory labour.

Decreasing Licences

THE Postmaster-General, Mr. W. S. Morrison, quoted the following figures recently in the House of Commons, showing the number of receiving licences issued during the past few years, which reveal a sudden drop in the previously maintained steady increase. The figures are: 1939, 8,947,570; 1940, 8,904,177; 1941, 8,625,579. There have been many contributory causes to this decline, including the breaking up of many homes as a result of the war.

Station WLW's New Home

THE various broadcasting departments of the Crosley Station WLW, Cincinnati, recently moved to more commodious premises, consisting of six floors with over-all dimensions of 58ft. by 110ft. The new building, which is admirably adapted to the needs and requirements for which it is intended, is designed to house some 400 employees grouped under twenty different departments. The first floor will contain six smaller studios, the master control room, recording laboratories, spacious newsrooms, engineers' department, recreation room and a glass enclosed foyer.

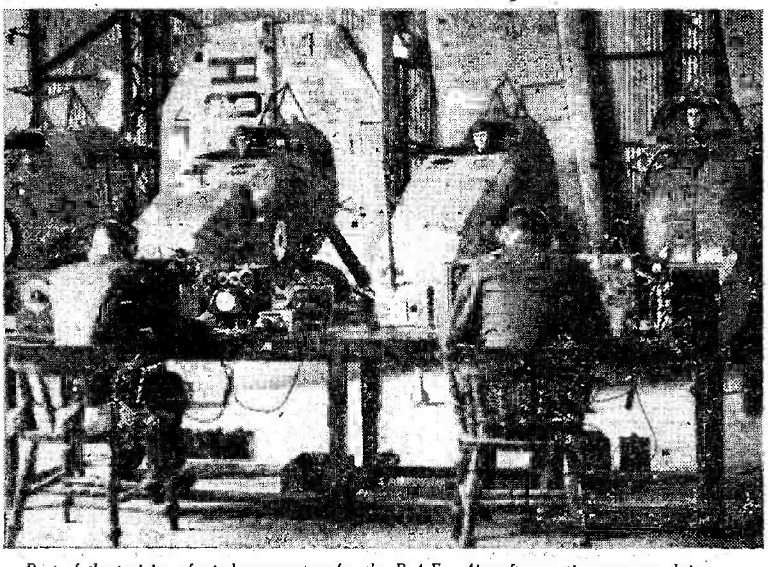
The second floor, on which is the reception hall, also has 16 administrative and executive offices, while the third floor will be arranged to provide accommodation for two additional studios and offices for writers.

Studios and Offices

THE studios on this floor will allow for audiences, the larger one being two stories high, 43 by 58 feet, with a new theatre stage and dressing rooms for artistes. The seating capacity of this studio will be approximately 500.

The fourth floor will be taken up by the organ loft for the studio below; a client's room so arranged that parties may watch the broadcast being made on the third floor from a glass-enclosed balcony; production rooms; sound department offices.

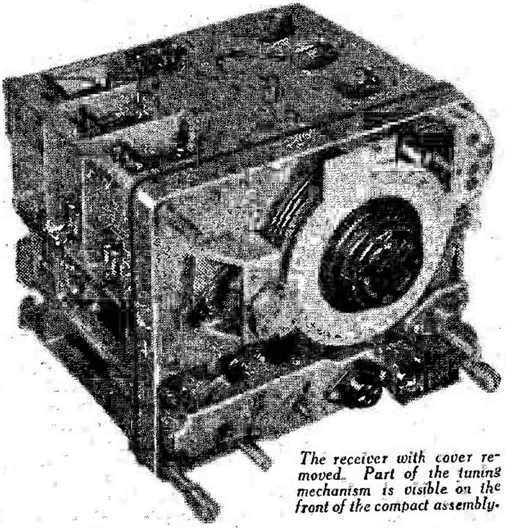
Studio "A," or the station's largest broadcasting theatre, will take over practically the entire 5th floor. This large room of approximately 50 by 110 feet will have a new stage 25 feet deep and 30 feet wide with a seating capacity for about 900 persons. A small dining-room and a musicians' lounge is also located on this floor. A balcony, three rooms for the engineering department, and the organ loft will encompass the sixth or top floor.



Part of the training of wireless operators for the R.A.F. Aircraft operating messages being sent from the instructors' table to the wireless operators in aeroplane cockpits.

LUFTWAFFE RADIO EQUIPMENT

Details of Part of the Extensive Installation of the Heinkel HE111H



The receiver with cover removed. Part of the tuning mechanism is visible on the front of the compact assembly.

ON the receiver side of the installation separate units are provided for short and long waves.

The receivers are similar in design, both being continuously tuned superheterodynes having four spot frequencies which are determined by a cam click device on the main condenser. All tuning controls are ganged, the main knob being large and occupying most of the front panel. The tuning scale is visible behind a magnifying window, very accurate setting being possible. The overall dimensions are approximately 8in. by 8½in. by 7in. The chassis is built up of die-castings. The receivers are mainly for C.W. reception, but R.T. or N.C.W. can also be received on the short-wave receiver. The frequency ranges are 300-600 kc/s and 3-6 mc/s. The performance of the receivers is of a very high order both for selectivity and sensitivity. The construction is, however, expensive and rather complicated.

Mechanical Construction

The chassis is constructed in three main die-castings of magnesium alloy. The valves and associated components of individual stages are mounted in screened compartments formed in the die-castings. The compartments are arranged round four sides of a central three-gang variable condenser of die-cast alloy construction. This condenser has earthed stator plates and live rotor plates mounted on a ceramic spindle which runs in ball bearings, one of which is spring mounted to give freedom of motion in a lateral direction. Connection is made to the rotor sections through double spring wiping connectors. Behind the dial are mounted four discs, each having a notch which engages a projection on a hinged lever for the purpose of locating the tuning control at any one of the four spot frequency settings. The common hinge pin of the levers is eccentrically mounted in its bearings and connected to a knob for the purpose of adjusting all four spot frequencies simultaneously over a small range. The four discs can be released independently by screws accessible from the front of the receiver. An indicating system is provided to show which spot frequency is in use. The transmitters have a similar control system.

Circuit Arrangements

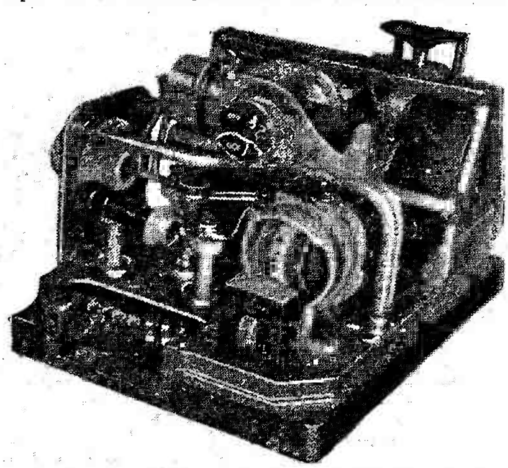
The circuit has eight valves, arranged as follows:

R.F. amplifier. Frequency changer with separate oscillator coupled into the grid. The anode is coupled by a double circuit I.F. transformer to an I.F. amplifier coupled by a second double circuit transformer to a second I.F. amplifier. This is coupled by a single circuit I.F. transformer to an anode bend detector. The grid circuit of this detector is coupled to a heterodyne oscillator, while its anode circuit is resistance-capacity coupled to the output valve. The heterodyne oscillator is adjustable to beat at intermediate frequency and 1,000 cycles above or below it. The oscillator is switched on when the panel is set to A1 for C.W. reception. A note filter is also switched in under these circumstances. The long-wave receiver has both these features switched on all the time. The sensitivity of the receiver is adjusted by varying the bias applied to the grids of the R.F. amplifier and the first I.F. amplifier. No A.V.C. is fitted. A resistance is connected to the H.T. negative circuit which can be short-circuited for full gain or left open for low gain. The receivers are put on low gain by this means when the type transmission and reception switch is in either the "transmit" or "whistling in" position.

Design and Use of Components

Valves are perhaps the outstanding feature of the receiver. They are all of the Telefunken Type R.V. 12 P.2000 and are H.F. pentodes. The dimensions are very small, a ring seal being used. The base connections are by a series of brass pins which project radially. The valveholder is moulded and entirely encloses the valve, carrying also the top contact. The valve is removed by inserting a screw in the base and pulling. The valve size is slightly greater than the acorn type. The suppressor and screening grids are connected to the anode when the valve is used as a triode. The oscillator for the frequency changer is temperature-compensated by means of positive and negative temperature co-efficient ceramic condensers.

All radio-frequency coils have dust iron cores with closed iron circuits. The inductance of these coils can be varied by an adjustable end portion which is carried in a threaded part of the bakelite mounting. This adjustment is used to set up the I.F. circuits, which are coupled by a variable condenser connected between taps on the coils, being tuned by fixed ceramic condensers.



Top view of aerial tuning unit, showing one of the variometers and the sturdy method of construction.

Each receiver is supplied with L.T. power direct from the aircraft battery at 24 volts; the heaters in series parallel take 0.3 amperes, each valve taking 68 mA. at 12 v. The H.T. supply is from a motor generator, being 40 mA. at 200 volts.

Long- and Short-wave Transmitters

The wireless equipment contained two transmitters, one covering the band 300-600 kc/s and the other 3,000-6,000 kc/s. These transmitters are of the same mechanical design and in many respects resemble the Lorenz commercial transmitter, but on a smaller scale.

The transmitters each consist of a master oscillator valve driving two amplifier valves in parallel. Only one type of valve is used throughout, this is a Telefunken valve, Type R.L.12 P35, thus the problem of replacements is simplified considerably.

Iron-cored Variometers

The essentials of the two transmitter circuits are common to each other. In each case the tuning of the oscillator and amplifier tank circuits is carried out by iron-cored variometers, which are ganged together and controlled by a single knob tuning on the top of the transmitter. This knob is attached to a metal scale beneath the top cover, which is engraved directly in frequencies and is viewed at the point where it passes the vernier by a small magnifying glass. The tuning mechanism is fitted with a fine adjustment control, and is so arranged that four frequencies can be preset to lock in position consecutively as the dial is rotated. The locking arrangements have been described in the receiver section.

Both transmitters are fitted with testing sockets on the top panel, and eight pin plugs on the bottom panel by which they obtain supplies from the main deck.

The power supplies for the anode and screens of the valves are obtained from a rotary transformer operating from the main aircraft battery. Also, in the case of the long-wave transmitter sending impulses, the grid bias supply is obtained from rectified A.C. from this rotary transformer. The heater supply for these valves is obtained directly from the aircraft battery.

The total power consumption of the transmitter, including the heater wattage, is approximately 120 watts for approximately 45 watts H.F. output. The anode efficiency of the amplifier valves measured at 4.5 mc/s is approximately 65 per cent.

A noteworthy feature of the design is the use of iron-cored variometers to obtain the frequency coverage. The variometers are constructed to give an approximate frequency scale.

The mechanical construction consists mainly of two light aluminium castings, one of which carried the valves and valveholders, the other the variometers, condensers and tuning mechanism.

The electrical performance is reasonably good, but the construction would appear to be costly.

Long-wave Transmitter

This transmitter can be used to send pulse transmission as well as C.W., the pulses being applied to the amplifier grids from the audio amplifier unit through the aerial controller by means of the type transmission switch.

The general performance of the transmitter is very similar to that of the S.W. transmitter.

The power output obtainable from this transmitter in the pulse position is approximately the same as that under C.W. operation.

Aerial Circuits and Controls

Both the fixed and trailing aerials are located at points remote from the radio equipment so that tuning units have to be provided at the base of each aerial.

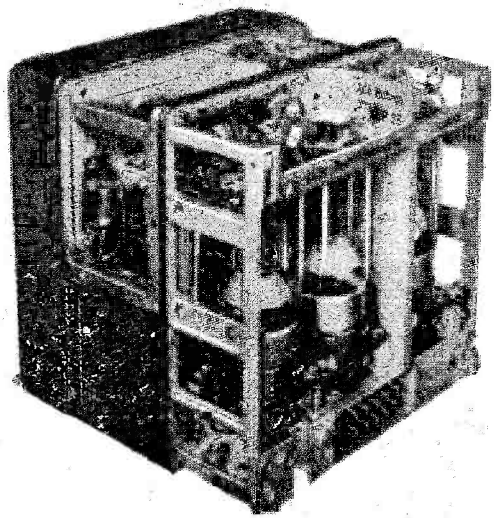
Remote tuning of the units is performed by electrical remote control from the aerial controller.

The aerials are switched from send to receive by means of a magnetically-operated vacuum relay controlled from the keying circuit.

The aerial winch is electrically controlled from the aerial controller and provides alternatives of either of two lengths of trailing aerial.

Remote Tuning Controls

The remote tuning is operated from alternating current of frequency approximately 250 cycles derived from the transmitter power unit. The control is effected by repeater motors more familiarly known in this country as Selsyn motors. Each motor has a single phase wound rotor and a three phase stator. The stator windings of the controller motor and the controlled motor are connected together phase to phase. The rotor windings of each motor are connected in parallel and energised from the 250 cycle 110 volt supply. By transformer action due to the phase of the currents induced in the stator windings the rotors take up similar angular positions and any rotation of one rotor is followed by the other. Two control motors are fitted in the aerial controller, one to drive each remote aerial unit. The motors are rotated by the controls marked Schlepp and Fest. The position of the variometers is indicated on the scales seen through the windows in these controls. The motor and tuning dials are driven through an electro-magnetic clutch, so that in the event of the control knobs being turned with the A.C. supply not on, the dial calibrations will not come out of alignment with the remote aerial units. The dial is driven through an epicyclic gear.



The transmitting unit with valves in position and protecting cover removed.

Different lengths of aerial are used on the two frequency bands. The aerial is capacitative at its working frequency, and it is tuned by the variometer.

Operation of Electric Aerial Winch

The electric winch is remotely operated from the main control panel. Either of two lengths of trailing aerial may be used depending upon which frequency band is in operation, and the length of aerial wire which is run out is determined by the position of the type transmission switch. A switch is provided on the main control panel to "reel in" and to "reel out" the aerial, and the winch stops automatically and locks when the appropriate length of aerial has been run out. Indication that the winch is "reeling in" or "reeling out" is shown on the main control panel by two electro-magnetic shutter indicators. The indicators absorb 0.8 watts from the 24-volt aircraft supply and, due to their small dimensions and simple construction, they are of particular interest.

(To be continued.)

Why the Baffle?

Folded Air Columns and Suitable Designs Are Discussed in this Concluding Article. By L. O. SPARKS

THE idea of the short flare incorporated in the cabinet can be developed along simple lines when larger cabinets are under consideration or when more adequate loading of the cone is desired. Many designs have been produced, the majority utilising the basic principle of the horn in one form or another, and while some have not been adopted generally, others—usually the simpler types—can be seen in use in sound amplifying installations and public address equipment.

Folded-back Horns

This system—so far as the amateur is concerned—is best utilised when a large cabinet of the gramophone or radiogram type is available, and when it is desired to provide an air column of sufficient cubic volume to fully load the speaker cone. As the name implies, the system consists of an enclosed space which, by means of suitable internal structures, is formed into a winding channel, the actual length of which depends on the size of the space (cabinet) and the form of construction used for the internal partitions. The fundamental idea is shown in Fig. 7, and it will be seen that if the channel was opened out into a straight line, a tube would be formed. Conversely, the diagram could be considered as a long tube folded up until it just occupies the enclosed space. The tube would have a constant diameter, but by a slight modification of the partitions, it is possible to obtain a shape which, if not true to line, approaches more nearly the shape of a normal horn. While this method of obtaining a suitable air column is feasible when a cabinet of reasonable dimensions is available, a simplified form can be used when space or portability is a consideration. In this direction, Fig 8 shows an arrangement which the writer has used successfully; it is similar, so far as basic principles are concerned, to the many types of folded-back flares often used for P.A. work.

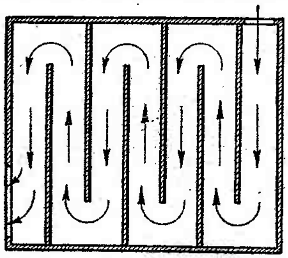


Fig. 7.—The fundamental arrangement to secure a folded back air column.

The idea shown in the diagram (Fig. 8) can be likened to the 'phones in a basin, a method often used in the early days of radio in lieu of a speaker. With a small diameter modern moving-coil speaker a very satisfactory assembly can be made by using a short horn—metal, stout cardboard or wood—in conjunction with a large enamelled washing basin, the component parts being arranged as shown in the diagram.

For Large Cabinets.

The design shown in Fig. 9 is a practical development of Fig. 7, and forms a folded-back system which is capable of giving most pleasing results. The construction may appear to be rather complicated, but in practice it is not so difficult as it looks. A little patience is required, and care should be exercised when making measurements and marking off the partitions and their fixing points. No dimensions are given, as these will depend on the diameter of the speaker and the size of the cabinet, but here are the main features which, if observed, will simplify matters.

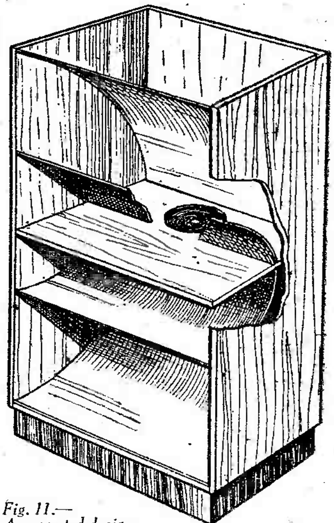


Fig. 11.—A suggested design which should prove satisfactory.

To start with, the cabinet should be constructed from wood of reasonable thickness; I would not advise the use of anything thinner than, say, $\frac{3}{8}$in. plywood, and with this damper struts or battens should be fixed to eliminate any possibility of boom or resonance. (See previous article.) The interior constructional work can be carried out with the same material, although—as with the cabinet—thicker wood will be better. After using 5-ply wood for the partitions, I experimented with one of the many thick composite boards which decorators often use for ceilings, etc. This was found to be easy to work with, good from the point of view of sound absorption and freedom from resonances, and light in weight.

Forming the Conduit

To fix the various pieces in position, use was made of $\frac{3}{8}$in. square planed wood which was cut to the desired lengths and then glued to the cabinet in the positions previously determined by measurement. A word is necessary here to draw attention to two points on the diagram (Fig. 9). It will be seen that the two vertical partitions are not the same length; the rear one is longer than the other. Similarly, the distance between the rear partition and the back of the cabinet is slightly less than that between the two partitions, while the distance between the front of the cabinet and the front partition is greater still. The object of these variations is to try and create an air column of conical shape, i.e., roughly the same as an ordinary horn. This can be visualised more clearly if one imagines the tube formed by the internal structure opened out to lay along a straight line.

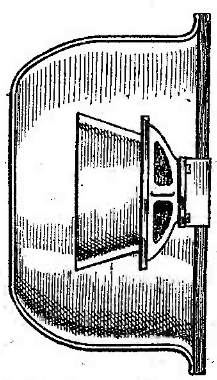


Fig. 8.—A simple and effective design when space and portability are the chief considerations.

Bearing the above in mind, the material can be marked out and cut then, when the fillets are *really* secure, the various sections can be located and fixed to the fillets by means of glue and screws. It may, of course, now be necessary to dispense with glue, therefore additional precaution should be taken to ensure every part is secured in a rattle-free manner.

Assuming the fret openings to be cut in the front of the cabinet, and the back to be removable, it is advisable to start these operations by working from the front to the back.

The upper, or speaker shelf, should be the first to be fixed; follow this with the two front sloping portions—these have a slope of 45 deg., the same as the others—then secure the front vertical partition. Now fix the remaining three sloping pieces in the section below the shelf, and follow these with the rear vertical partition.

The speaker is fitted to its own baffle-board, which has previously been cut to the desired size, and it is fitted to the inside of the front of the cabinet in the normal manner. The final fitting—the sloping piece at the top rear corner of the speaker chamber—completes the assembly.

The cabinet the writer used had originally been designed for use as a large radiogram, and the upper portion was also removable. This simplified all the internal work considerably, including removal of speaker, etc., therefore, if one considers making a cabinet (when material is more plentiful) in which to incorporate this or some similar sound system, it would be advisable to bear this point in mind.

To approach more nearly the true fold between vertical sections of the column, the sloping pieces could be replaced by curved portions, but this was not adopted in the assembly under discussion, as suitable material was not to hand. Thin ply or metal could be used to form such reflectors, provided the space to the rear of them was filled with kapok, plaster of Paris, or even cement, to kill any possible vibration, etc.

Alternative Arrangements

The design shown in Fig. 10 is an experimental variation of Fig. 9. The speaker is fitted on the floor level of the cabinet, and the sound conduit formed by the partitions is used in the more normal sense of a horn, the fret or opening being at the top of the front of the cabinet. The arrangement lends itself to many interesting modifications, for example, the rear of the speaker chamber (actually the front of the cabinet) can be left open, a suitable silk covered fret covering the aperture, or it can be filled with kapok or similar material as shown in the speaker cabinet illustrated in the August issue (Fig. 4).

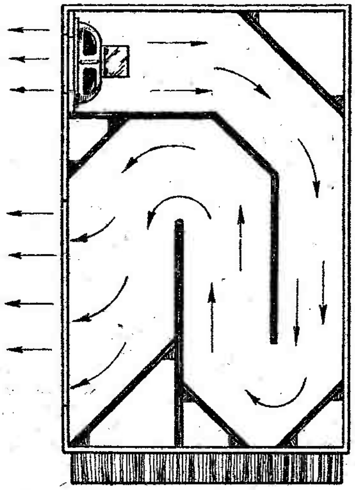


Fig. 9.—The system applied to a large cabinet. Note the gradual increase in width of the air column.

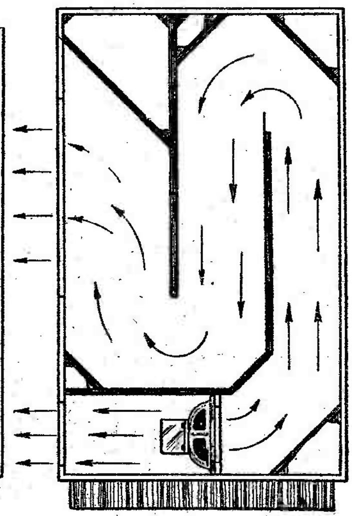


Fig. 10.—An alternative arrangement, which, in the writer's opinion, gave the most satisfactory results.

To simplify construction and removal of the speaker, the latter could be placed in the bottom-rear corner of the cabinet, so that it is facing the front, provided that the vertical partitions were altered accordingly.

A system which in many ways is more simple to construct than those already described is shown in Fig. 11. This is put forward not as a tested design, but as a suggestion, as the writer has not yet been able to undertake the constructional work. It appears to offer possibilities, and it would seem ideal for use in a corner-fitting cabinet. The originator of the idea suggested that a high-note tweeter might be fitted to the front panel just below the upper opening, with the object of increasing the overall response. The only likely objection to this is the fact that the radiations from a tweeter are inclined to be beam-like and very directional. However, it would certainly be well worth trying.

An Analysis of the B.B.C. Forces Programme

In the recent debate on the Ministry and Broadcasting in the House of Commons a Member spoke of programmes of "sentimental, sloppy muck that go out hour after hour on the Forces programme."

An analysis of the Forces programme between 5.15—10.15 p.m., the hours when the Forces have most opportunity of listening, shows that for a recent and typical week, just over 50 per cent. of the time was taken up by the spoken word (news, newsletters, talks, feature and magazine programmes, plays and religion).

This figure is sufficient in itself to rebut the charge of continuous "sentimental, sloppy muck," but further percentages are equally revealing. Dance music took 6.5 per cent. of the time, as against 5.7 per cent. for serious music. The figure for light music was 7.4, and for variety 20.3. These are percentages which vary very little either way from week to week, though the amount of time given to talks and serious music tends to be slightly on the increase.

Evolutionary Stages

The Forces programme has gone through several evolutionary stages since it was originally planned for the B.E.F. in France. At first the demand was almost exclusively for entertainment. After Dunkirk the emphasis changed, and more serious material was gradually introduced. The arrival of contingents of Empire troops created the need for programmes of special interest to them, and Dominion newsletters and sports commentaries were introduced. The coming of United States troops to this country has meant that once again the scope of the Forces programme is being extended ("Command Performance," "Let's Get Acquainted," etc.). Moreover, the co-partnership of the Services and workers in industry is increasingly reflected in the programmes ("Award for Industry," "I am an Aircraft Designer," etc.).

Educational Items

In addition, the Forces programme includes such regular features as "The World at War," "Radio Reconnaissance," "Marching On" and the Weekly Newsletter, which are educational in the widest sense of the word.

The recent broadcasts also include three orchestral concerts, two instrumental recitals, two choral programmes and seven gramophone programmes of classical music.

Experimenting with Reflex Circuits

Circuits Which Still Offer Scope for the Experimenter are Discussed in This Article

REFLEX circuits were extremely popular between 1922 and 1924, and in spite of their enforced retirement by the rapid progress of receiver design, there are doubtless many readers who would like to experiment with some of the arrangements which were in favour in the earlier days of wireless. It is no exaggeration to say that reflex circuits, if carefully designed, can even now be used with commendable success, and that they are worthy of consideration quite apart from their rather historic associations

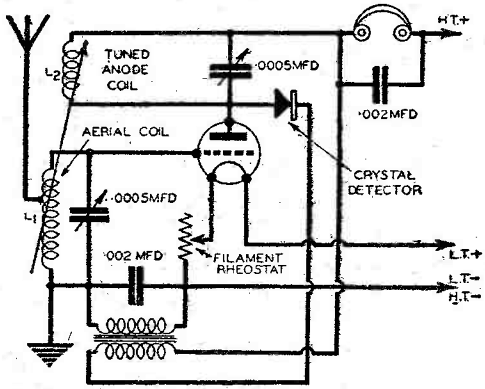


Fig. 1.—An early type of reflex circuit, in which use was made of a crystal as the detector.

One Valve as Two

Before going on to describe one or two reflex arrangements, it might be as well, for the benefit of newer experimenters and constructors, to explain exactly what a so-called reflex circuit is. The name is fairly explanatory, for it is defined in the dictionary as "bent or turned back; directed backwards." Thus, a reflex circuit is one in which the signal voltages are "turned back." In other words, after the signals have been rectified by their passage through the detector, they are passed back to the high-frequency amplifying valve, in which they are then amplified at low frequency. It will be understood from this somewhat bald statement that one valve is made to function as both a high-frequency and low-frequency amplifier. Theoretically, then, it is possible to obtain the same output from two valves wired in a reflex arrangement as from three valves connected in a more conventional circuit. In practice such a wonderful result is not quite achieved, although an appreciable amount of extra amplification can be secured, particularly in a receiver of the simpler type.

The Detector

At this point it is worthy of note that the first reflex circuits to be used actually employed a crystal detector, with the result that "three-valve" reception was to be obtained by using only one valve. This was an advantage not to be overlooked in the days when valves, and all other components, were very expensive, and when the average valve filament (there were only battery-operated valves then, of course) consumed something like 4 watts, as compared with the .2 watt required by modern 210-type valves. To-day the particular advantages mentioned do not weigh so heavily, although the saving of one valve is worth considering. For purposes of comparison an early type of reflex circuit of the kind just referred to is given in Fig. 1, where the simplicity of the arrangement is clearly to be seen. If the course of the signal voltages is followed it will be seen to go from the aerial-tuning circuit to the grid of the valve, from there to the (tuned-) anode circuit, to the crystal detector, back to the grid-filament circuit of the valve by way of an L.F. transformer and, finally, to the phones or speaker joined between the tuned-anode circuit and H.T. positive.

The arrangement is simple enough and the principle perfectly obvious. As to the practical details, it should be observed that the secondary winding of the L.F. transformer is at the earth end of the aerial circuit, and also that it is by-passed by means of a .002-mfd. fixed condenser. Due to the method of connecting the low-tension battery and filament rheostat (this component was always used with the earlier types of bright-emitter valve) a small value of grid bias is applied to the valve.

Quality of Reproduction

The principal fault with the reflex circuit was that reproduction was not so good as with the "straight" arrangement, because the same valve could not function efficiently at both high-and low-frequencies. In spite of this difficulty, however, really good results were frequently obtained, and the actual arrangement shown can be tried out with modern components. One point to observe is that reaction is provided by coupling together the tuned-anode and aerial coils; this means that one coil must be movable in respect of the other. For this reason the circuit is most easily tried out by making use of solenoid-wound coils having a variable coupling in the form of one winding sliding in or over the other. Appropriate windings for medium waves are 44 turns of 22 s.w.g. enamelled wire on a 3in

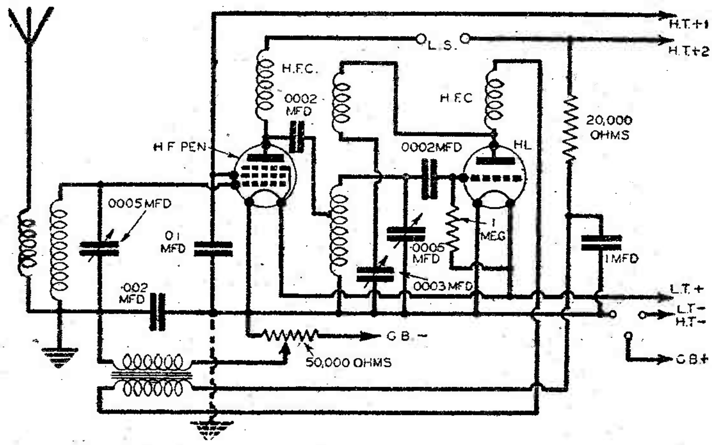


Fig. 2.—The above circuit is a suggestion for a reflex circuit employing modern components. Broken line shows an alternative earth connection, which should be tried.

diameter former L1, and 52 turns of the same wire on a 2½in. diameter former for L2, respectively.

A More Modern Circuit

It is not anticipated that there will be very many readers who will wish to go to the trouble of rigging up the circuit shown in Fig. 1, since better results can be obtained with a more up-to-date arrangement using modern components and a valve (instead of the crystal) as rectifier, with reaction. A suitable circuit for such an arrangement is shown in Fig. 2, where the first valve is a variable-mu H.F. pentode, and the second a normal type of three-electrode detector. All components are of standard type, and the two tuned circuits may, if desired, be tuned by means of a two-gang condenser, provided that two coils of similar type be employed.

The circuit now in question is an efficient one which is capable of good reception and reasonably good quality so long as no attempt is made to obtain great volume. A variable bias voltage is applied to the first valve by means of a potentiometer in parallel with a 4½-volt G.B. battery. By this means it is not a difficult matter to find a setting at which the valve will function fairly well in both high- and low-frequency capacities. To avoid overloading, the L.F. transformer is of only 2 : 1 step-up ratio, whilst a ratio of even 1 : 1 might prove better in many cases. No matter which transformer ratio is employed it is important that the component should be of good quality, and having a high secondary impedance. The other constants of the circuit conform to present-day standards, whilst the anode circuit of the detector valve is suitably decoupled so that only one main H.T. positive tapping is required. For convenience and simplicity, a second tapping is used to supply the screening grid of the high-frequency pentode.

If an H.F. pentode is not available there is no reason why an ordinary screen-grid or variable-mu valve should not be used, and although this will not prove quite so effective, it will certainly function quite well.

There are various modifications of the two general circuits dealt with, and, provided that the principles are understood, the experimenter is quite at liberty to try a number of alternative arrangements. It is by no means unlikely that some new phenomena will be discovered, and, at least, the fact of having tried the circuits will add to the enjoyment of wireless experimentation.

A Mains Operated Oscillator

An Efficient Unit for Morse Class Instruction.

By A. E. IRWIN.

THE meagre performance of a battery operated oscillator which depends upon the condition of two sources of supply, namely L.T. and H.T. batteries, makes the necessity of providing a mains operated oscillator obvious to those who have undertaken morse instruction.

The usual scheme of using a L.F. transformer for the oscillator circuit was tried, but was discarded for the following reasons: Firstly, the output level varies considerably when the note is changed; a variation of 4 to 1 in output level was measured over the complete range of note frequencies provided in this particular model.

Secondly, no means could be found of obtaining a satisfactory system of volume control; various arrangements were tried but all suffered from the same defect, the note changed when the volume control was altered. Thirdly, a pure note which does not vary audibly with keying could not be obtained.

The circuit described in this article was designed to overcome the disadvantages enumerated above, and it is claimed that the note is much purer, quite steady during keying, the volume control definite, and the output level constant over a wide range of frequencies. The wide range frequency control (0 to 5 kc/s), combined with the volume control, provide a desirable feature if several oscillators are used in the same room to assimilate the interference met with in practice.

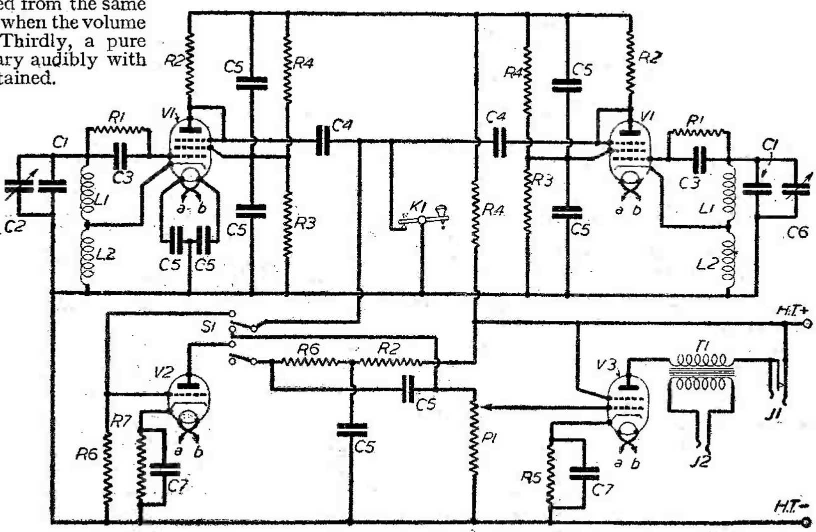


Fig. 1.—The theoretical circuit of the unit in which V1 and V1 are the two electron-coupled oscillators responsible for the audible note.

Circuit Details

The H.T. and L.T. transformer T2 has the following windings. 4 volt 4 amps, 4 volt 3 amps and 250 volt 50 milliamps. Half-wave rectification is obtained by the valve V4. The smoothing circuit consisting of an L.F. choke and two 4 mfd. condensers, is of the conventional type, Fig. 3.

The basic part of the circuit, Fig. 1, makes common the output of two identical electron-coupled oscillators of 100 kc/s, approximately, the beat note or difference frequency being obtained by altering the capacity of a small variable condenser across the tuned circuit of one of the oscillators. One oscillator is fixed at 100 kc/s, the other, by means of the variable condenser, can be varied between 100 kc/s to 95 kc/s, thus giving a range of beat notes from 0 to 5 kc/s. Supposing the variable oscillator is adjusted to 99 kc/s, the beat note or difference frequency will be 100—99 kc/s, or 1 kc/s.

The oscillator components are all of standard type with the exception of the coils, these were wound on wooden formers about ½in. diameter and 2½ins. in length. A circular top and bottom about 1½ins. diameter are fixed to these formers, so that they resemble large cotton reels. Four hundred turns of 30 S.W.G. copper cotton-covered wire is wound on the former (L1), and then the wire brought out for several inches and back again for winding a further 100 turns (L2), the loop thus formed being the tapping point shown connected to the cathode of V1. The oscillators were built up on a small piece of wood forming a sub-baseboard 8ins. by 6ins., and tested initially as a separate unit. The output level was low, but could be heard quite well on headphones connected across the junction of the condensers C4 and negative H.T. Lining-up was done by putting the plates of C6 all in (maximum capacity) then adjusting C2 until no note is heard. The frequency of the oscillators is identical when this condition is obtained. It will be found after this adjustment has been made that, varying C6 from maximum to minimum capacity, a note from 0 to 5 kc/s is obtained. C6 is finally brought through the front panel and provided with a knob for the variable frequency control. Keying is effected by short-circuiting the output from the oscillators, by means of a morse key with a back contact connection: when the key is depressed the short-circuit is removed. Two stages of L.F. amplification follow, the first a triode and the second an output tetrode. By means of S1 the first amplifier can be cut out, the removal of the loudspeaker plug from jack J1 closes the circuit by means of a contact incorporated in the jack. The output transformer should be a 7 to 1 ratio if possible, if one is not available an ordinary L.F. transformer will suffice, but must be connected as a step-down transformer, that is, the secondary (marked grid/grid-bias or IS/OS) joined in the anode circuit of V3 and the primary to the telephone jack.

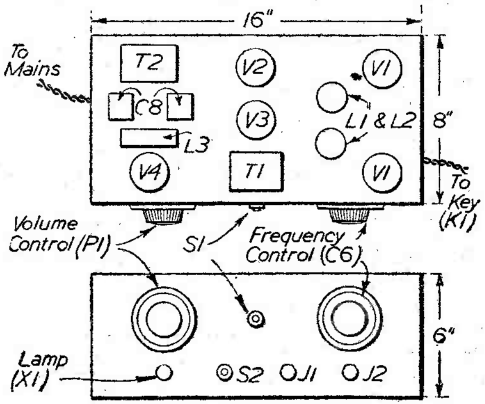


Fig. 2.—The actual layout, as used by the writer of the article. Note positions of V1 and V1.

Practical Layout.

From Fig. 2, it can be seen that the two oscillators are on the extreme right of the main baseboard, which is 16ins. by 8ins. wide. The sub-baseboard on which they are mounted can be fixed to the main baseboard by means of wood screws. The H.T. equipment is assembled on the extreme left, the centre portion being occupied by the two amplifiers and the output transformer. The sides and back are 6ins. in height and the layout of the front panel is arranged as shown in Fig. 2. The flex for the mains supply is taken through the left-hand side close to the transformer T2. The keying leads are brought out from the right-hand side near the oscillators V1.

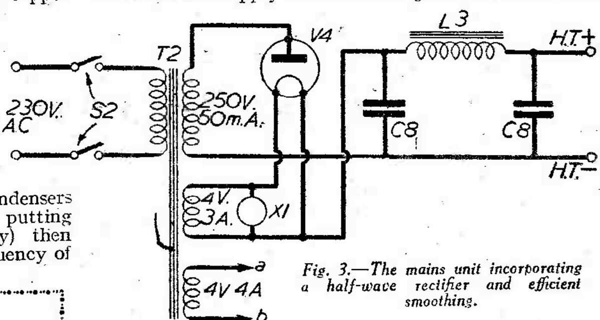


Fig. 3.—The mains unit incorporating a half-wave rectifier and efficient smoothing.

Performance

With the first stage of L.F. amplification out of circuit, an output of ½ watt was measured, or ample loudspeaker strength for a small room. With the two L.F. stages in circuit, the final amplifier gave an output of the order of 1.5 watts, providing a volume level sufficient for the largest of assembly halls or, as an alternative, enough power to operate an almost unlimited number of pairs of headphones.

The total power consumption from the mains is 35 watts.

LIST OF COMPONENTS

The bracketed numbers denote quantities required.

- C1 .0005 μf Condenser (2).
- C2 50 μμf Trimmer Condenser (1).
- C3 .0003 μf Condenser (2).
- C4 .002 μf Condenser (2).
- C5 .01 μf Condenser (8).
- C6 50 μμf Variable Condenser (1).
- C7 25 μf Electrolytic Condenser (2).
- C8 4 μf Condenser (2).
- J1 Jack, with contact (Bulgin) (1).
- J2 Jack (1).
- K1 Morse key (1).
- L1 400 turns 30 S.W.G.
- L2 100 turns 30 S.W.G.
- L3 L.F. Choke (Ferranti B2) (1).
- P1 .5 megohm Potentiometer.
- R1 50,000 ohm Resistor (2).
- R2 100,000 ohm Resistor (3).
- R3 10,000 ohm Resistor (2).
- R4 20,000 ohm Resistor (3).
- R5 300 ohm Resistor (1).
- R6 250,000 ohm Resistor (2).
- R7 800 ohm Resistor (1).
- S1 Switch, D.P. change-over (1).
- S2 Switch, D.P., on off (1).
- T1 Output Transformer 7 : 1 ratio (1).
- T2 Mains Transformer (1).
- V1 H.F. Pentode, Mazda SP.41 (2).
- V2 Triode, Osram MH41 (1).
- V3 Output, Tetrode MKT4 (1).
- V4 Half-wave Rectifier (1).
- X1 4-volt Lamp (1).

Radio Examination Papers—10

A Further Selection of Questions, with Appropriate Answers, by The Experimenters

SPECIMEN QUESTIONS

1.—*Draw an outline circuit of a second detector designed also to provide delayed A.V.C. Explain how the delay is obtained.*

2.—*Explain briefly the function of the choke and condensers in an H.T.-supply smoothing circuit of the type shown in Fig. 2.*

3.—*In a typical battery superhet, what symptoms would you expect of the following faults:*

(*a*) *Open-circuited grid leak in the oscillator circuit of the frequency-changer?*

(*b*) *Burnt-out filament in the I.F.-amplifier valve?*

(*c*) *Low resistance leak across the secondary winding of the second I.F. transformer?*

4.—*What is the difference between electrostatic and electro-magnetic screening?*

5.—*Explain the reason for frequency-doubling in the exciter stages of an ultra-high-frequency transmitter.*

6.—*What would be the correct resistance and wattage rating for the bias resistor shown in Fig. 4 if the valve passed 35 mA anode current and 7.5 mA screen current at the correct H.T. voltage and with the correct working bias of —4 volts?*

1.—Delayed A.V.C.

THE circuit for a double-diode second detector is given in Fig. 1. Detection is provided by the common cathode and the diode anode marked D.1, in conjunction with the load resistance R.1. Anode D.2 provides A.V.C., and resistance R.2 is the load across which the rectified A.V.C. voltage is developed; the end of R.2 which is connected to the diode anode becomes negative in respect of the cathode, and also of the earth line.

If the cathode were returned directly to the earth line, in the usual manner, an A.V.C. voltage would be applied to the controlled valves immediately a signal was rectified. Consequently, some negative bias would be fed back as A.V.C. on even the weakest of signals. This would mean that sensitivity would be reduced on all signals.

By means of the potentiometer composed of resistors R.3 and R.4, however, a certain initial positive bias is applied to the cathode of the double-diode valve. As long as the cathode is positive in respect of D.2 there can be no electron flow from the cathode to the anode, and therefore no rectified voltage across R.2. But when the anode D.2 reaches a higher positive potential than the cathode, electrons will flow and rectification will occur.

This gives the required delay, and means that A.V.C. cannot be applied until the positive half-cycles reaching D.2 are of higher potential than the cathode. In other words, A.V.C. will not be applied until signals of certain amplitude are applied to the diode.

If the value of R.4 be fixed, the extent of the delay can be governed by variation of R.3. The latter can be set so that A.V.C. is not applied to the controlled valves until the amplitude of the signal reaching the second detector exceeds any desired figure.

The delay voltage does not have any effect on detection, because the load resistor (R.1) of the detector diode is returned directly to the cathode. It may be added that R.5 is a decoupling resistor and, along with C.1, it provides smoothing of the A.V.C. voltage.

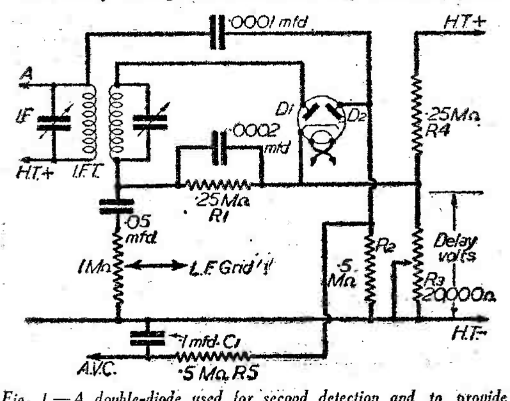


Fig. 1.—A double-diode used for second detection and to provide delayed A.V.C. for the preceding H.F. and I.F. stages.

2.—H.T. Smoothing

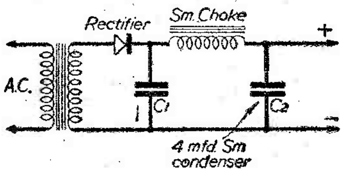
Fig. 2 shows a simple smoothing circuit of the type that may be used in conjunction with a rectifier when drawing H.T. from A.C. mains. A half-wave rectifier is shown for simplicity, but the principle would be the same if any other type of rectifier were employed.

The output from the rectifier is D.C., but it is pulsating; that is, the voltage is constantly rising from zero to a maximum and then falling back again to zero. In that form it would obviously be unsuitable for use as high-tension with a receiver. It is therefore necessary to "iron out" the pulsations and to obtain a reasonably steady D.C. voltage supply. The "ironing out" or smoothing is performed by the iron-cored choke and the two large capacity condensers. That marked C.1 becomes charged as the voltage rises, and then starts to discharge as the voltage falls, thus "absorbing" the shocks of the pulsations. In that way a certain amount of smoothing is effected, the sharp "peaks" and deep "troughs" of the pulsating voltage being flattened out to a certain extent.

Despite the action of the condenser, the voltage still pulsates, although to a less marked extent. When the voltage rises and the current through the choke tends to increase, a so-called back E.M.F. or reverse voltage occurs, due to the self-induction of the choke. As the current starts to fall so does the back E.M.F. The result is a tendency for the current through the choke to remain steady, and therefore for the output voltage to remain steady.

Condenser C.2 has a similar effect to that of C.1,

Fig. 2.—A simple rectifier and smoothing system. Question 2 asks for an explanation of the function of the choke and the condenser.



on the slight irregularities in voltage appearing between the negative output lead and the right-hand end of the choke, so that an almost perfectly steady D.C. voltage may be applied to the receiver.

3.—Superhet Faults and Symptoms

(a) The oscillator grid leak, in conjunction with the grid condenser, provides a small amount of "self-bias" to the oscillator grid, so preventing the amplitude of oscillation from rising to the point at which the grid would be so heavily biased negatively that oscillation would cease.

Therefore, if the leak were not connected, or if it were open-circuited, the oscillator would (theoretically) go out of operation after the first few cycles of oscillation. In practice, there would generally be sufficient "leakage resistance" between filament and grid—either at the

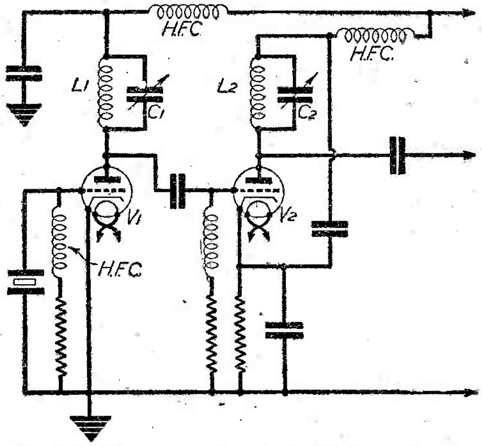


Fig. 3.—A simple frequency-doubling circuit. V.1 is a crystal oscillator, the anode circuit of which is tuned to the crystal frequency by L.1 and C.1. V.2 is the doubler, and L.2 and C.2 tune to twice the crystal frequency.

valve base or valve holder—for the high negative bias to leak away at intervals. As a result, the oscillator would intermittently fall into and out of oscillation. Reception would, therefore, be obtained in a series of "pulses," the duration of these being governed by the resistance of the leakage path.

(b) If the filament of the I.F. valve were burnt out, the valve would obviously cease to operate as an amplifier, but there would probably be sufficient capacity in the valve and the wiring for strong signals to pass through to the second detector. Reception would thus be obtained on very strong signals, but signal strength would be poor. At the same time, tuning would probably be very critical.

(c) Leakage across the I.F. transformer would clearly result in a marked loss of signal strength, and if the resistance were sufficiently low, reception would not be obtained at all, provided that the stages were well screened. In other circumstances, in addition to weak signals, it would be found that tuning was unduly flat and that adjustment of the trimming condenser across the secondary of the faulty I.F. transformer would not have any effect.

4.—Screening

Electrostatic screening is used in H.F. circuits, and normally consists of placing aluminium or copper plates, connected to earth, between circuits at different H.F. potential. In pentode and tetrode valves the screening grid provides an electrostatic screen between the grid and the anode, and prevents feed-back through the capacity which would otherwise exist between the electrodes. Expressed rather crudely, the screen neutralises the capacity.

Electro-magnetic screening is different in that a screen of magnetic (ferrous) material is employed. This is placed in the field of such components as iron-cored chokes and transformers carrying low-frequency or A.C. currents. Eddy-currents are developed in the iron screening, and so the magnetic field is virtually prevented from extending beyond the screen. Sheet iron is generally used for electro-magnetic screening, and often forms the case or container of the choke or transformer itself. Aluminium and copper are useless as magnetic screens, being non-magnetic, while iron would cause serious losses if placed in H.F. fields.

5.—Frequency-doubling

Crystal control is desirable in all transmitters, so that the generated frequency may be maintained at a steady figure. The frequency of oscillation of a quartz crystal is inversely proportional to its thickness, and a crystal for, say, 20 megacycles is extremely thin; one for 40 megacycles is so thin that it is not only delicate, but very costly to produce.

So that a thicker and more robust (lower-frequency) crystal may be used, frequency-doubling was introduced. By using a series of frequency-doubling stages it is possible to multiply the crystal frequency by eight, sixteen or even thirty-two.

Fig. 3 shows a crystal oscillator (V.1) followed by a triode frequency-doubler (V.2). The anode circuit of V.1 is tuned, by coil L.1 and condenser C.1, to the crystal frequency, so that V.1 becomes, in effect, a tuned-anode-tuned-grid oscillator. The output from V.1 at, say, 20 megacycles, is applied to the grid of V.2, the anode circuit of which is tuned by means of L.2 and C.2 to 40 megacycles. This circuit receives "kicks" at every half-cycle and therefore oscillates at twice the frequency of the previous tuned circuit.

In practice, it is often found desirable slightly to over-bias V.2 so that the wave-form is distorted. By this means, more effective "kicks" are applied to L.2 and C.2 with the result that the frequency-doubling is carried out more efficiently.

6.—Bias-resistor Value

The bias resistor shown in Fig. 4 carried the total cathode current of the valve. And this current is the sum of anode and screen currents. In the case in question this amounts to 42.5 mA.

We know from Ohm's Law that resistance in ohms is equal to the voltage divided by the current in amps., or that R=E/I. If we substitute in this equation we get:

$$R = \frac{4}{42.5} \times 1{,}000$$

the fraction being multiplied by 1,000 to convert the current in mA. to the current in amps. If the equation is worked out it will be found that R=94.1 ohms. That, therefore, is the value of bias resistor required. The figure is not very critical in practice, and we should use a resistor of 90 or 95 ohms, whichever were the more convenient; it might even be permissible to use a value of 100 ohms, but that would cause the valve to be slightly over-biased and would therefore reduce the output to a certain extent.

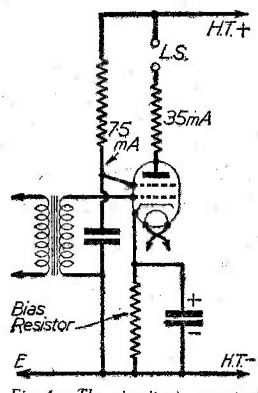


Fig. 4.—The circuit of an output tetrode using cathode biasing. It is required to find the correct value for the bias resistor.

The necessary wattage rating can be found either by multiplying the bias voltage developed, by the current passing through the resistance; or by multiplying the resistance in ohms by the square of the current in amps. The former is the simpler, and we have

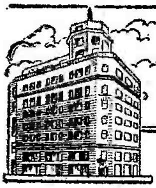
$$W = \frac{4 \times 42.5}{1{,}000}, \text{ which gives us .17 watt.}$$

Using the second method we have:

$$W = I^2R = \frac{42.5}{1{,}000} \times \frac{42.5}{1{,}000} \times 94.1$$

which also gives the answer as .17 watt.

In practice we should use the nearest higher wattage rating, which is .25, or $\frac{1}{4}$ watt.



ON YOUR WAVELENGTH

By THERMION

B.B.C. or C.B.C.?

A CORRESPONDENT thinks I am not quite right in my remarks about political speakers and their abuse of the ether. I said that I admitted that some of them were interesting, although I implied at the same time that they might have been inane. He thinks that at the B.B.C. we want a C.B.C.—presumably a Cochran. Perhaps there is a need for someone with a wide knowledge of the entertainment profession, although the technique of broadcasting and the technique of the theatre are dissimilar things. Perhaps when television is with us in the not-too-distant future the B.B.C. will employ someone who is used to producing stage effects for the eye as well as the ear. At present, however, our broadcasts are sightless. We are absolutely dependent upon the spoken word and the realism of the noises off for the theatrical effects. The scene must be built up in the mind and mentally, not optically visualised. That, of course, is all a matter of presentation. I was referring rather to the subject matter, which brings me to a point I have raised so many times: Are we sated with broadcasting: Do we have too much of it? Are we becoming inured to it? We should soon become bored with the theatre if we went to a show every night, and we should become even more quickly bored if we went two or three times a day. It would not matter who put on a show, Cochran or anyone else, we should still be bored with it, for as Shakespeare says, "they are as sick who surfeit with too much as they who starve with nothing." If we only had two or three broadcasts a week apart from the news, we should *look forward* to it, as we did in the days of Writtle, and the early days of 2LO. There is pleasure in anticipation. It is more pleasant to travel than to arrive. As it is, we do not look forward to broadcasting. For 16 hours a day it is always there, and so we have become perhaps a little over-critical. Think back upon the early days of Writtle and 2LO. Frightful as were some of the programmes, and blurred as were most of the transmissions, they provided mental exhilaration to the *n*th degree. We were not over-critical about the poor transmissions, nor about the well-worn gramophone records which were played by Eckersley.

Familiarity has bred contempt and made us over critical, perhaps.

Criticism

BUT that is no excuse for the B.B.C. If critics continue to criticise particular broadcasts, the B.B.C. should drop them. They must remember that once a man has broadcast his views they sail around the world, and often are thus given a cachet out of all proportion to their importance. By inference they become standard views. But then, again, many will write and congratulate the B.B.C., which is suitably impressed and continues to book up the speaker for further dates. They are unmindful of the fact that disappointed listeners seldom write letters of criticism, adopting the principle that if they cannot praise, they will not damn. They may even apply to the spoken word the principle of "de mortuis nil nisi bonum," for as Barry said in one of his plays, the three things which cannot be recalled are the past life, the *spoken word*, and the neglected opportunity. Praise, on the other hand, is a particularly harmless thing; it can be handed out even where it is not deserved, for it does not wound. Even so, it is wrong to praise that which quite rightly should be severely criticised. It is not the man who praises of whom notice should be taken; it is the man who says nothing whose opinion is often most worth while.

Entertainment and Not Education

AT the same time, I suppose we should be grateful for the fact that, whereas the cost of most things has doubled, and the income tax appropriately enough has followed suit, we still only have to pay ten shillings a year.

The laws of mathematics are therefore justified, because if the unit value is now only 50 per cent. of what it was pre-war, you can only expect half the quality. I make this remark in the absence of precise information as to what the B.B.C. does pay its speakers and its entertainers.

I have no reason to suppose that they have doubled their fees. In general terms I agree with the criticisms that the main function of the B.B.C. is entertainment and not education. It must give the public what it wants and not what the B.B.C. thinks it ought to have. It must keep abreast of the times and not stereotype its forms of entertainment. Its recent decision not to permit the mild and popular expletives and execrations is a move back towards the hypocritical days of the last century, and if there is one thing which this war has illumined it is that our post-war period will be shorn of the hypocrisy, the mock-modesty, the dandyism, the vanities, the false Puritanism of the Victorian era. The B.B.C. must not endeavour to bolster that up.

B.B.C. Pundits Prohibit Laughter.

[The B.B.C. has officially stated that its Brains Trust is a serious item of its programmes and should not be laughed at.]

A grave announcement on the air
We feel constrained to make
When hearing our Professors speak—
Don't laugh, for pity's sake.

If Joad and Huxley, splitting hairs,
With rage should make you wriggle,
Remember this injunction, please:
Rage on, but do not giggle.

When into abstruse arguments
Our Brains Trust takes a ramble,
Remember what respect you owe
To our Commander Campbell.

We beg you take them seriously,
Derision is a sin,
We're really most perturbed to think
They often make you grin.

For this is very far indeed
From our sincere intent,
Or why such liberal weekly sums
On them in fees are spent.

Let this suffice, be sober-faced,
No longer at them scoff. . . .
"We won't," the listeners make reply,
"WE'LL DARNED WELL SWITCH 'EM OFF."

"TORCH."

Our Roll of Merit

Readers on Active Service—Twenty-sixth List.

W. Gall (Gnr., R.A., Home Forces).
R. P. Munn (Lieut., R.N.V.R.)
J. E. Jackson (Lieut., R.E.)
A. Rossi (Pte., R.A.)
D. Giddens (Spr., R.E.)

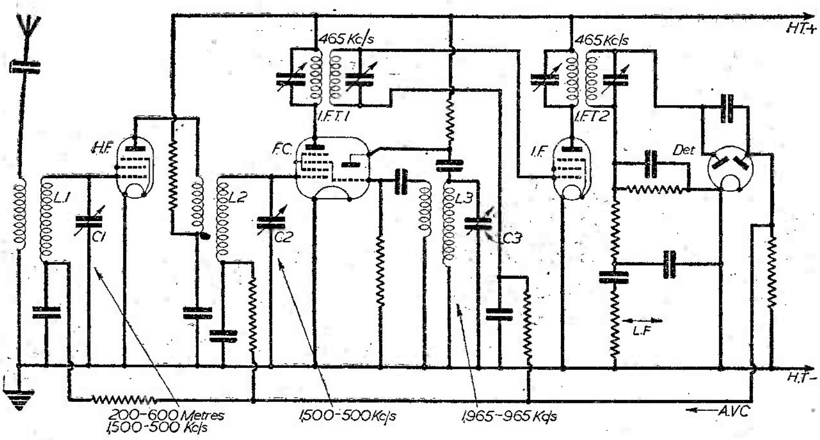
SUPERHET TUNING CIRCUITS

How Inductance and Capacity Values are Calculated

THE tuning arrangements in a superhet are so much different from those in a "straight" receiver that difficulty is often experienced in understanding their functions. A start can best be made by revising one's knowledge of the action of the frequency-changer. This valve—or sometimes pair of valves—acts as a first detector and also as a high-frequency oscillator. The oscillator is tuned to a frequency which always differs by the same amount from the frequency of the signal it is wished to receive. In most modern superhets this difference frequency is approximately 500 kilocycles per second; 465 kc/s is a widely used frequency.

In theory, the oscillator may be tuned to a frequency either higher or lower than the signal frequency by 465 kc/s, but in practice it is the higher frequency that is used. The reason for this will become fairly obvious a little later when it is seen, for example, that for a 600-metre signal the oscillator frequency would be only 35 kc/s if it were 465 kc/s lower than the signal frequency.

The intermediate frequency is fixed at 465 kc/s. At least, it is fixed at a frequency quite close to this figure, although the actual frequency in kc/s varies according to the setting of the pre-set controls on the intermediate-frequency transformers.



This skeleton circuit of the first four valves of a typical good-class superhet shows the frequency ranges of the tuning circuits. L1 and C1, and L2 and C2 cover the signal-frequency range, while L3 and C3 cover the corresponding oscillator frequency range. The two 465 kc/s I.F. transformers are marked I.F.T.1 and I.F.T.2.

Signal-Frequency

The accompanying diagram shows the skeleton circuit of the first four stages of a modern superhet. There is an H.F. amplifier prior to the triode-hexode frequency changer, and that is followed by a single stage of intermediate-frequency amplification and then by the second detector, which is a double-diode in nearly all cases. The aerial is tuned by the oscillatory circuit made up of the coil L.1 and the tuning condenser C.1. On the usual medium-frequency band this circuit has to cover a range of about 200 to 600 metres, this corresponding to a frequency range of 1,500 to 500 kc/s. For those who have forgotten, it may be mentioned that the formula for converting wavelength to frequency is:—

$$f = \frac{300,000,000}{\lambda}$$

where f is the frequency in cycles per second, and the Greek letter λ is the wavelength in metres.

For convenience, it is generally better to take f in terms of kilocycles per second, and to alter the numerator to 300,000; or in megacycles per second, when the numerator should be 300. The reason for this is simply that one kilocycle is 1,000 cycles, and one megacycle is 1,000,000 cycles.

Referring again to Fig. 1, it will be clear that the tuning circuit made up of L.2 and C.2 must also cover the same frequency range as do L.1 and C.1. This is because there is a simple H.F. transformer used to couple the H.F. amplifier to the first detector.

Inductance and Capacitance Values

In designing these two tuning circuits, the correct inductance and capacity can be determined from the standard tuning-circuit formula, which is:

$$f = \frac{1}{2\pi\sqrt{LC}}$$

where f is the frequency in cycles per second, L is the inductance of the coil in henries, and C is the capacity of the condenser in farads. But as inductance of tuning coils is more often stated in terms of micro-henries and the capacity of condensers is almost invariably in terms of microfarads, it is convenient to modify the formula for the practical units. This is equivalent to multiplying both L and C by 1,000,000, or 10^6 (a more convenient way of expressing the same thing). And since the two are multiplied together, this means that the denominator is multiplied by the square root of 10^{12}; this is, of course, 10^6. And those readers who have been following the series entitled "A Refresher Course in Mathematics," will know that, if the result is to remain unchanged in value, the numerator and denominator of the fraction must be multiplied by the same figure.

Thus, we can re-write our formula as:

$$f = \frac{10^6}{2\pi\sqrt{LC}}$$

where L and C are in microhenries and microfarads respectively. Now let us see how this can be used. We start by taking f as 500,000, π as the usual 3.14 and C as .0005 mfd., which is the standard capacity for tuning purposes on medium waves. From this we could find the value of L in microhenries. Those who work out this little sum will find that the answer comes out at around 200, which is an average inductance for medium-wave coils.

Alteration of Capacity

The inductance will remain unaltered, so it remains to find whether or not the frequency can be raised to the required 1,500 kc/s by reducing the capacity of the tuning condenser to its minimum. That minimum value is not zero, as may at first be thought, but is appreciable. In addition, it must be remembered that incidental wiring capacities are of greater consequence at the minimum

(Continued on page 432.)

Stocks definitely Limited

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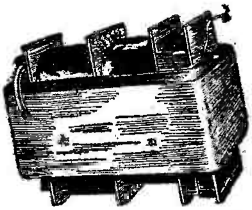
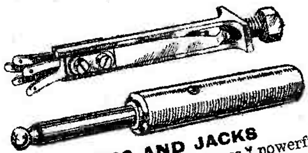


PHILIPS HIGH VOLTAGE TRANSFORMERS

These transformers are robust in construction and weigh approximately 13lbs. Dimensions : 5¼ by 5¼ by 4½in. 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.**



PLUGS AND JACKS

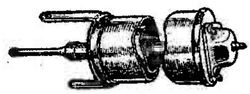
These ex-Govt. Jacks have powerful phosphor-bronze springs ensuring a perfect contact. Overall length, including ¼in. threaded shank, 3½in. Supplied with nut for panel mounting. Price complete with best quality Plug (as illustrated), **5/6.** Plugs only, **2/-.**

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.

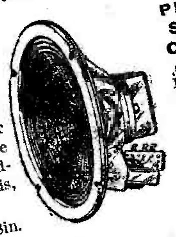
PHILIPS 3 GANG CONCENTRIC SPIRAL VANE VARIABLE CONDENSER

.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.

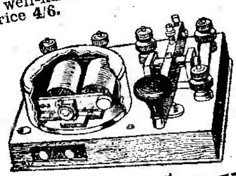


ROLA SPEAKERS

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 & 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/-.**

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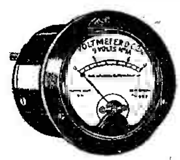
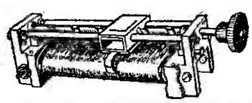


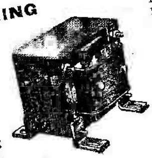
A good quality panel mounting meter with clear - reading 2½in. dial. Voltage measurement 0-9v. Fitted with terminals at back. Brand new. Price **20/-.**



VARIABLE POTENTIOMETERS

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

PHILIPS SMOOTHING CHOKES



Brand new, well-built chokes, 60 ohms D.C. resistance 100/120 m.a. Core size : 2½in. by 2¼in. by 1½in., 5/6 each. Also 400 ohms D.C. resistance 60 m.a. Core size : 1½in. by 1¼in. by ¾in., **3/6 each.**

SPEAKER GRILLES. Solid chronium-plated decorative speaker grilles. Beautifully made, **3/6** each. Similar, lighter weight, nickel-plated, **2/6.** Each 14in. long, 4-bar, 1½in. wide.

Cash with order. No C.O.D. No orders accepted from Eire or N. Ireland. Postage must be included.

LONDON CENTRAL RADIO STORES

See also our classified advertisement on page 459

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of the tuning condenser. Assuming the use of a high-grade condenser, and that care is to be exercised in building the receiver, it is reasonable to take the minimum capacity as one-tenth of the maximum. If this is done and the figure substituted in the formula given above, it will be found that the answer obtained is approximately 1,500 kc/s, as anticipated.

Oscillator Frequency

Now when we turn to the oscillator circuit, bearing in mind the considerations already explained, it will be seen that the frequency range to be covered is that of the signal-frequency circuits, plus 465 kc/s. In other words, the range is 1,965 kc/s to 965 kc/s. It is at once evident that a smaller coil or a smaller condenser, or both, will be required for tuning. A condenser of lower maximum capacity is certainly desirable because the ratio of maximum to minimum frequency in the range is smaller than before; whereas it was three to one for the signal-frequency circuits, it is little more than two to one for the oscillator circuit.

Suitable inductance and capacity values could be found by means of trial in the formula previously employed. But we know that the condenser may be of fairly low maximum capacity, so we should start by trying a value of, say, .0002 mfd. If this capacity is substituted in the formula it will be found that an inductance of about 125 microhenries will suit our purpose. The method of working is as follows:

$$965{,}000=\frac{10^6}{6.28\sqrt{L\times.0002}}$$

The only convenient method of working this out is by squaring throughout. This will be made easier if we write our 965,000 as 10^6, which is approximately correct.

The formula, after squaring throughout, can then be written:

$$10^{12}=\frac{10^{12}}{40\times.0002L}$$

(It should be mentioned that 40 is only approximately correct for "two pi all squared" or "four pi squared," but it is sufficiently near for present purposes. At this point it may be mentioned that pi squared approximates fairly closely to 10, and that this is useful for quick estimation.)

By cross-multiplication we can see that the above equation may be written in the form:

$$10^{12}\times40\times.0002L=10^{12}$$

Simplifying, we get:

$$10^9\times8L=10^{12}$$

or $8L=10^3$

or $L=125$ (microhenries).

Maximum Oscillator Frequency

Assuming that an inductance of this value would be used, the next step would be to try substituting it in the formula, allowing the value of C to be .00002 mfd., one-tenth the maximum value, plus .00002 mfd. for stray capacities.

The working is as follows:

$$f=\frac{10^6}{2\pi\sqrt{125\times.00004}}$$

It will be found that this comes to about 2,200 kc/s, which means that the frequency coverage should be adequate.

If the self-capacity of the coils was known, and if an average figure were taken for incidental capacities it would be possible to calculate the exact capacity required for the oscillator condenser at any setting of the signal-frequency tuning condensers and so to design a ganged condenser with which the tuning could be kept in line throughout the frequency range. In some cases the end plates of the condenser sections are split radially so that they can be bent toward or away from the adjacent fixed vanes and the tuning thereby "trimmed" at a number of settings of the tuning condenser.

Padding

When a number of frequency ranges have to be covered the position is rather more complex. The method often adopted for ensuring correct alignment in these circumstances is to use separate oscillator coils for the different ranges and to wire small fixed or pre-set condensers in series with them; these are known as padding condensers. When the coils are switched into the circuit one of these condensers is virtually in series with the oscillator tuning condenser, and it may be so adjusted that correct alignment is maintained. It is not proposed to work out the results of connecting condensers in this manner, but readers who are interested may do so, remembering that when condensers are wired in series the overall capacity is equal to the reciprocal of the sum of the reciprocals. Expressed mathematically, this means that:

$$C=\frac{1}{\frac{1}{c_1}+\frac{1}{c_2}}$$

where C is the overall capacity, and c_1 and c_2 are the capacities of the two condensers that are in series.

We have not dealt with the calculation for the inductance of the windings of the I.F. transformers, but readers may find suitable values for these by adopting the formula used above and assuming a maximum capacity of about .0005 mfd. for the trimmers. The required I.F. should be obtained when these are set to half their maximum capacity.

S.G. SNAGS

Screened Sleeving

SOME troubles seem to crop up in periods; at the time of writing, the chief delight of many constructors appears to be the lack of attention to the ends of metallised sleeving and, believe it or not, actually connecting the sleeving to the conductor which normally passes through the centre of the insulating tubing inside the outer metal covering.

Such little pranks can prove quite expensive, apart from the fact that the circuit is likely to be struck dumb, while the tester or constructor will give vent to his feelings in a more expressive manner.

When metallised sleeving is used, and in a modern high-gain receiver it is employed quite a lot, do make sure that the ends are at least ⅜in. away from the ends of the insulating sleeving and that they are securely bound with thread, folded back on itself and soldered neatly, and covered with insulating tape or, better still, a short length of systoflex or valve rubber tubing such as used on most cycle tyres.

Unless you are asking for trouble, don't leave frayed ends on metallised sleeving.

S.G. Detectors

When many constructors switch over for the first time from an ordinary triode to a screened-grid detector, they are often very disappointed with the results. Under correct operating conditions an S.G. or H.F. pentode valve will give increased gain when used in the detector position, but where so many constructors slip up is in the value of applied H.T. voltage to the screen.

In the majority of cases quite a low voltage will give the best results, an average value being in the neighbourhood of 30 to 36 volts.

Valve Curves—Static or Dynamic?

Their Meaning. The Difference Between Static and Dynamic Figures. Practical Effects

IF you examine any page of a valve manufacturer's catalogue you will observe a table giving the "characteristics" of the valve; that is, anode impedance, amplification factor, and mutual conductance. This table will be prefaced by a statement that these are the published characteristics of the valve, taken under some special operating conditions—usually anode volts 100, and grid volts zero. Further, there will be "characteristic curves"—usually one or two showing the relation between anode current and grid voltage for various values of anode voltage.

It is generally understood that these characteristics and curves are what are known as "static" characteristics, that is to say, they are derived from test figures taken

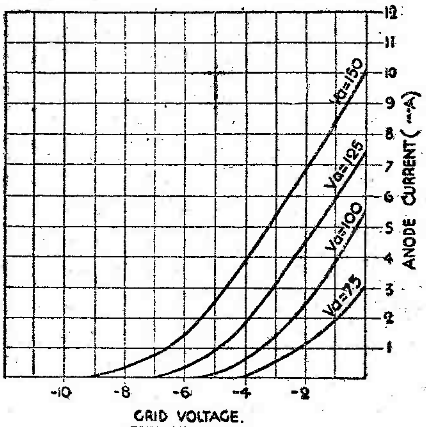

Fig. 1.—Static characteristics of a typical general purpose battery-operated valve.

in the laboratory, and not as a result of measurements made while the valve is operated under reception conditions with a signal applied to the grid and a "load" connected in the anode circuit. On the other hand, it is not commonly known that, under practical working conditions, the values of the characteristics are not so high as the "static" figures.

Why not Dynamic?

The reader may, therefore, quite reasonably ask why "static" characteristics and curves are published by valve makers instead of the more practical "dynamic" characteristics. There are two very good reasons. In the first place, the static characteristics are published merely as an indication of the qualities of various valves, and since all the valve makers publish characteristics taken under the same voltage conditions, these figures serve perfectly well as a standard of comparison between various types and makes of valves.

The second reason requires a rather extended explanation. It is that the "dynamic" characteristics are not constant, but depend upon the actual operating conditions, and more particularly upon the nature and impedance of the "load," that is, the type of apparatus connected in the anode circuit of the valve.

An Example

This will be made clear by taking a typical example. Fig. 1 shows the published (static) grid volts/anode current characteristic curves of a typical 2-volt general-purpose valve—the type of valve used as a detector or first low-frequency amplifier. Separate curves are given for anode voltages of 75, 100, 125, and 150 volts. Taking the 125-volt curve—the top curve but one—it shows that if a pressure of 125 volts was applied to the anode of this valve, and the voltage applied to the grid was varied from zero to 7 volts negative, the anode current would vary from about 7.4 milliamps down to zero, the corresponding values of grid voltage and anode current being represented by points on the curve. It is necessary to realise, however, that *this curve presupposes that the anode voltage remains constant at 125 volts all the time.*

In Practice

Now see what happens in actual practice. To begin with, some piece of apparatus, such as a resistance or a transformer, will be connected in the anode circuit, and if the valve is being employed as a low-frequency amplifier, a negative bias voltage will be applied to the grid. Suppose this negative bias is 3 volts, and that with no signal applied to the grid the actual voltage on the anode is 125. When a signal is applied to the grid, the grid voltage varies above and below the bias voltage of 3 volts negative. When the grid voltage increases (that is, becomes less negative) the anode current will rise, and when the grid voltage becomes more negative the anode current will decrease.

But when the anode current rises, the voltage drop in the anode load will increase and the actual voltage at the anode will be less than 125. Similarly, during negative half-cycles when the anode current decreases, the voltage drop in the anode load will also decrease, and the actual voltage at the anode will be greater than the nominal figure. Thus, the *true* values of anode current during positive half-cycles will not be those indicated by the static curve, but will be lower; and the true values of anode current during negative half-cycles will be greater than those found from the curve.

Practical Effects

In other words, the "dynamic" curve of the valve will be "flatter" than the static curve, as though it has been moved round bodily with the point corresponding to the working grid-bias as the pivot, as indicated in Fig. 2. It is easy to understand from this graph, which shows that the dynamic curve has a less steep slope than the static curve, that the practical effect of using a valve under reception conditions results in a reduction of its mutual conductance below the "static" figure.

Another and still more interesting way of showing the difference between static and dynamic conditions is to derive a dynamic curve from the anode volts/anode current curves of the valve. This method will appeal to those listeners who like to study radio from the theoretical angle, and should

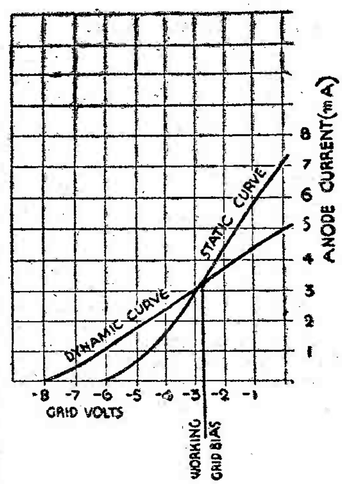

Fig. 2.—Static and dynamic curve forms.

also interest those who, so far, have not come across anode volts/anode current curves.

Deriving Other Curves

Referring again to Fig. 1, we can take readings rom the curve, showing the anode currents for various grid voltages, as for example 0, −1, −2, −3, and so on. The following table has been compiled from the curves in Fig. 1.

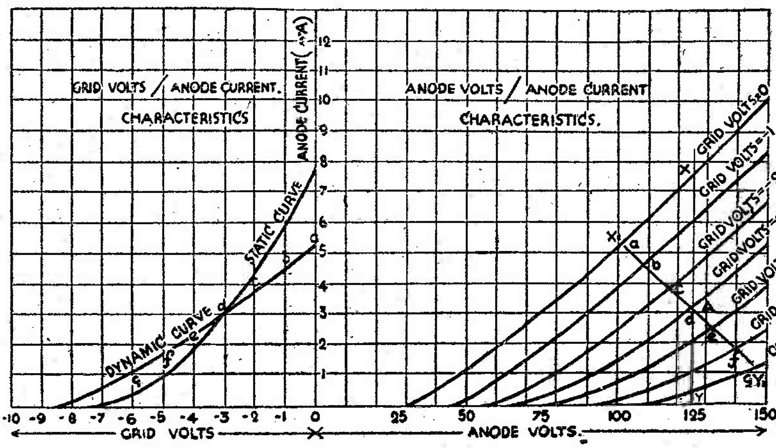

Fig. 3.—Anode volts/anode current curves and derived dynamic curves.

Negative Grid Volts.	Anode Current.			
	75 Volts.	100 Volts.	125 Volts.	150 Volts.
0	3.1	5.25	7.4	10.0
1	1.8	3.9	5.9	8.4
2	0.95	2.4	4.3	6.7
3	0.4	1.4	3.0	5.2
4	0.1	0.65	1.85	3.8
5	0	0.25	1.0	2.4
6		0.05	0.4	1.35
7		0	0.15	0.7
8			0	0.35
9				0.1
10				0

Now take a sheet of graph paper and plot the different values of anode current at zero grid volts against the corresponding anode voltages. You will then obtain a curve similar to that shown at the top in the right-hand half of Fig. 3. Similarly, by plotting the various anode currents for −1 grid volts (second horizontal line of the table) against the respective anode voltages, a second anode volts/anode current curve for grid volts −1 can be plotted. To complete the work a whole "family" of such curves must be drawn.

Now we have considered in our example that at −3 volts grid bias the anode voltage is 125. If the anode voltage remains constant (which, of course, it does not for reasons already explained) a 3-volt (peak) signal on the grid would cause the anode current to vary between the points X and Y, for the grid voltage would vary by 3 volts above and below the bias of −3 volts. Thus, the instantaneous grid voltage will range from zero to −6 volts.

The Effect of Impedance

These conditions would only exist, however, if the "load" in the anode circuit of the valve had no impedance and therefore produced no voltage drop. But the anode load does possess impedance—must, in fact, possess impedance in order that an amplified reflection of the grid input signal shall be developed across it. And because the load possesses impedance, and produces a voltage drop which depends upon the current flowing through it at any instant, the fluctuations in anode current will not be so great as those indicated by the intersections of the line XY with the various anode volts/anode current curves.

Operating Conditions

The operating conditions of the valve will still slide from one curve to another, but along another line, such as $X_1 Y_1$, which represents a load of just over 10,000 ohms, being given by "resistance equals volts divided by amps." The greater the impedance of the load, the less steep will be the slope of $X_1 Y_1$. For the present we will assume that the line so marked in Fig. 3 represents the actual working conditions.

The Dynamic Curve

The working values of anode current at various instantaneous values of grid voltage will therefore be shown by the points at which the line $X_1 Y_1$ cuts the various anode volts/anode current curves, and are marked a, b, c, d, etc., on $X_1 Y_1$ (Fig. 3).

From these values we can now construct a dynamic characteristic curve, as shown at the left-hand side of Fig. 3. In this way the true variations taking place in the valve under actual working conditions can be studied with accuracy.

PRIZE PROBLEMS

Problem No. 435

WILLIAMS wished to fit up a simple battery-operated set in his local A.R.P. post; he found in his den an old three-valver complete with one of the early horn type loudspeakers. After overhauling, the outfit gave quite good results, although the tone was not all one would desire. Seeing a moving-coil speaker marked at a very reasonable price, he decided to purchase it to replace the horn model. On connecting the new speaker, he was very surprised to find that the results were weak and poor in quality. Thinking that the speaker might be faulty, he took it back to the dealer, who connected it to a test receiver and proved that it was in perfect condition. Again Williams tried it on his set, but results were still hopeless. 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. 435 in the top left-hand corner, and must be posted to reach this office not later than the first post on Monday, August 17th, 1942.

Solution to Problem No. 434

The A.C./D.C. receiver Pte. Askwell was using did not include a condenser in series with the throw-out aerial, therefore, the latter was in direct contact with the chassis—through the aerial coil—and, as one side of the mains is connected to the chassis, a short circuit could be produced across the mains if the aerial touched the ground. It will be remembered that one side of the mains is always earthed. When the first test was carried out, no defect was present, but, owing to the poor insulation on the wire used for the aerial, a short circuit was caused by the pouring rain.

The three following readers successfully solved Problem No. 433, and books have accordingly been forwarded to them: H. Wiener, 243, Willesden Lane, N.W.2; Bdr. E. P. Andrews, R.A.; N. D. Twiddy, 54, Woodbridge Road East, Ipswich, Suffolk.

The Cathode-ray Oscilloscope

The Puckle Circuit. Fly-back Eliminator. Synchronisation

(Continued from page 390, August issue)

THE limit of this build-up is reached when the grid of V_1 is driven so negative that the valve is completely cut off, and anode current ceases. As soon as this happens, condenser C_1 begins to discharge through resistance R, the time of discharge being determined as before by the product of C_1R. When the discharge is complete the current through V_1 commences to increase, and the action is reversed. A study of the condenser current waveform during a full cycle will show the saw-tooth effect which obtained from this circuit, and which can, of course, be used for the production of time-base potentials. It will be seen from Fig. 18 that the time interval between successive waves depends on the values of each alternate condenser and grid leak, C_1R and CR_1, and can be adjusted by varying any one of the pairs. For equal values of CC_1 and RR_1 the waveform will approximate that drawn in the figure, where interval time = wave duration.

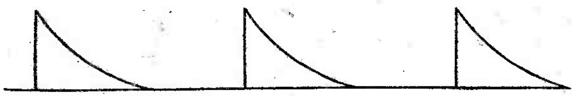

Fig. 18. Wave forms produced when interval time equals time of wave duration.

Other Time Bases and Constant Current Devices

It is by no means essential to use the principle of coil coupling and oscillation in hard valve time-base generators. A valve is required for the charge and discharge of the condenser as we have seen in the previous circuit arrangements, and this valve must be provided with adequate feedback to make its working constantly repetitive. In generators where this feedback is obtained by coil coupling it is possible to make one valve perform the complete function—apart, that is, from separate waveform amplifiers, which will be dealt with later on. In the case of circuits, however, which depend on resistance capacity coupling between the anode and the grid, it is necessary to use another valve in the line of the feed-back in order to obtain the necessary reversal of phase.

One of the most popular and efficient of these latter circuits is due to Puckle, and is drawn in full in Fig. 21. It consists essentially of the discharger valve V_1, phase reverser V_3, and a constant current pentode V_2. A brief note on the latter would be preferable before attention is paid to the rest of the circuit.

As already explained, when a condenser is charged through a resistance the voltage across it rises, exponentially, and as the charge on the condenser more nearly reaches potential of the applied e.m.f., so does the exponential characteristic of the charging curve become more pronounced. When it is not convenient to employ a high value of charging voltage for the time base in use, i.e., when it is necessary to use practically the whole of the waveform amplitude and not depend on the initial linear section of the curve, a device must be found whereby the charging current will be constant irrespective of the applied potential. With a supply voltage that is constant, therefore, the resistance must not be constant, but a varying function of the current. This condition can be fulfilled by replacing the series resistance by a saturated valve. Early methods employed a diode for the purpose, as the potential curve across the condenser went up the voltage drop across the diode went down, the sum of the two potentials being equal to the applied H.T. The charging current remained, however, unaltered, due to the characteristics of the diode, and thus the rate of charge of the condenser was more or less constant.

An alternative to the diode was found in a valve of the pentode class. With such valves the anode current is practically independent of the anode voltage, provided that the latter exceeds a certain value. (See Fig. 19b.) In modern pentodes this value is usually in the order of 40-70 volts, and provided the anode voltage is not allowed to fall below this figure the anode current remains substantially constant. Referring to Fig. 19a, which shows a pentode used as a constant current device, it will be seen that a variation of screen potential by means of a potentiometer can become a means of varying the anode current and therefore the rate of charger of condenser C. As this component is the actual producer of the saw-tooth time-base waveform it is obvious that the speed of the sweep can smoothly be controlled by means of this potentiometer in the same way that variation of a charging series resistance will control the time-base speed. This device can be used to replace any of the R resistances in the previous circuits, and will ensure a practically linear output of only some 50 volts less than the full H.T. to be obtained from the generators.

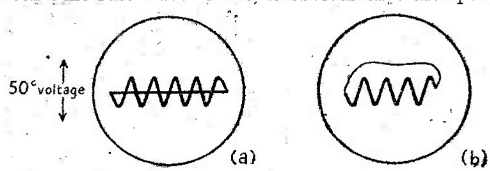

Fig. 20.—The effect produced if steps are not taken to suppress the cathode beam during discharge.

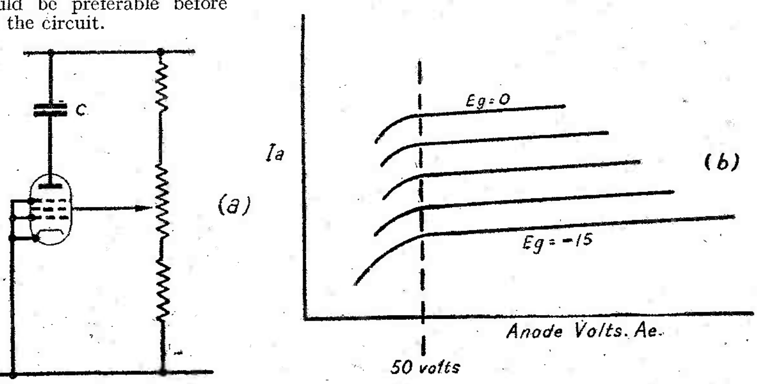

Fig. 19. (a) A pentode used as a constant current device; (b) Showing how the anode current remains reasonably constant independent of voltage.

Puckle Circuit

The circuit due to Puckle (Fig. 21) is an ingenious and popular hard-valve time-base circuit, which is capable of providing stable operation over a very wide frequency range.

The operation of the arrangement is as follows: the time-base condenser C charges linearly through the constant current pentode V_2, thus carrying the cathode of the discharge valve V_1 more and more negative relative to its anode. The control grid of this valve is, however, connected to the H.T. positive line through the comparatively high anode load resistance R_2 of valve V_3, and is appreciably negative with respect to its anode due to the voltage drop produced in R_2 by the anode current of V_3.

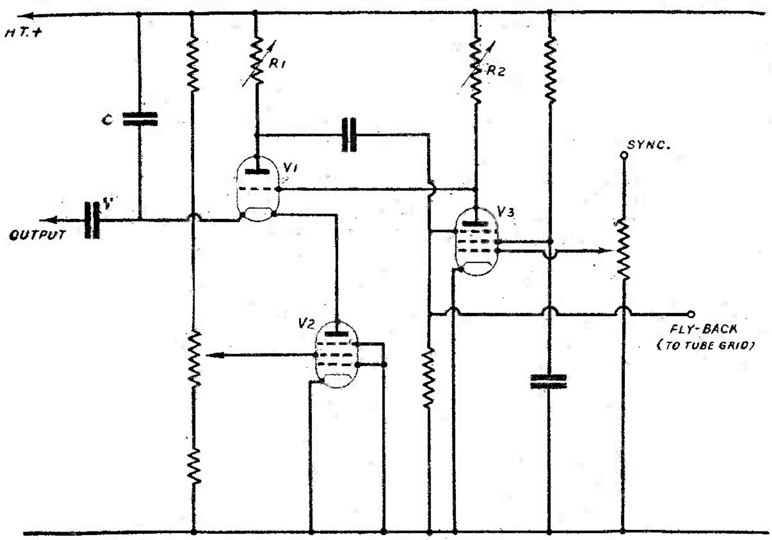

Fig. 21.—The Puckle hard-valve time-base circuit capable of providing stable operation over a very wide frequency range.

As soon as the cathode of V_1 has travelled sufficiently negative to approach the potential on its control grid, this valve will commence to pass current and a voltage drop will be present across R_1. This will swing the suppressor grid of V_3 negative, causing the anode of V_3 and also the grid of V_1 to travel positive. The action is cumulative and condenser C rapidly discharges through the saturation of V_1, until, when it is completely discharged, no further current flows through R_1 and the cycle repeats.

It will be seen that the resistance R_1, which is in the discharge path, will affect the amplitude of the triggering impulse present in the grid circuit of V_3, and also modify the period of the fly-back, and by being a variable can be used as a triggering control. The voltage developed across C before each successive discharge is equal to the amplitude of the produced waveform, and is dependent upon the extent by which the grid of V_1 is maintained negative relative to its anode by the voltage drop across R_1. The greater the value of this resistance the greater the time C must charge before V_1 becomes conductive and, therefore, by making R_2 a variable, the amplitude may be easily controlled.

The rate at which C charges depends on its capacity and the current through V_2. A rough control can be obtained by a selection of capacities between .0001 and 1 μF, while a progressive control, ensuring frequency overlap between the ranges covered by the condensers, is obtained by varying the screen volts of V_2. This is generally called a velocity control, and as the slider approaches the positive end of the potentiometer the current of the charging valve will increase, as will the speed of the time base.

It will be noticed that there are two sections of the circuit which have not yet been mentioned anywhere in this article; they are the leads synchronisation and fly-back eliminator.

The Fly-back Eliminator

Unless precautions are taken to suppress the cathode beam during the discharge or fly-back period, this latter stroke can often be seen either as a light kind of time-base sweep cutting through the observed waveform or as an irregular arc joining up both ends of the trace proper. This at times can prove confusing and cause some annoyance, as turning down the brightness control to reduce the fly-back will also reduce the observed waveform in the same ratio (Fig. 20.)

A method of overcoming this fault is generally used in oscilloscope circuits, and consists of applying a negative pulse to the grid of the cathode-ray tube during the period of fly-back, thus cutting off the beam during this time.

In the circuit (Fig. 21) it will be seen that a lead is taken from the grid of V_3 through a small condenser and applied to the grid of the tube. If the brightness control of the latter is now adjusted just to the required brightness, the negative kick which occurs on the grid of V_3 during the period of discharge of the condenser C, will be applied to the grid of the tube and the beam will be suppressed for that time.

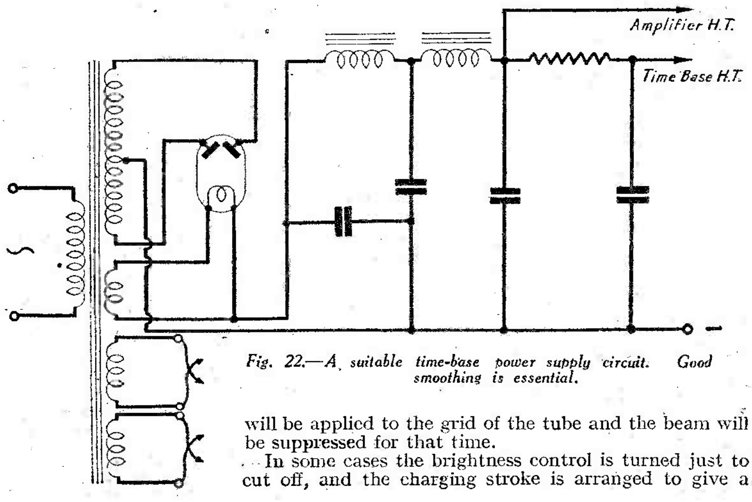

Fig. 22.—A suitable time-base power supply circuit. Good smoothing is essential.

In some cases the brightness control is turned just to cut off, and the charging stroke is arranged to give a positive pulse to the tube's grid. This method is sometimes called the forward stroke release.

Synchronisation

Synchronisation is not a subject which can be fully dealt with in the present article, and is therefore only described briefly. What is meant by synchronisation is the locking of the time base to the potential being examined so that the time base is only triggered off at certain periods of the work voltage.

Consider a frequency of 50 cycles applied to a time base running at a speed which is not a factor of that frequency; obviously the time base will be commencing each stroke at a different part of the 50 waveform, with the result that detailed study is impossible. By varying the velocity control the waveform can be brought to rest, but drift is difficult to eliminate, and unless the velocity is continuously adjusted the picture will not remain stationary.

By injecting a small portion of the work voltage into the discharging network it can be arranged that the time-base sweep is not released until a certain amplitude is reached in the work voltage.

Synchronism, or stable figures, occur when the ratio of the time base and work frequency can be expressed as an integer, that is, a whole number or a ratio of two whole numbers. The resultant traces need not be confined to a single pattern, in fact an intricate pattern might be obtained which at first sight might appear difficult to understand.

These cases are known as Lissajous effects, and their pattern depends on the relative ratio of the time base and work frequencies. Again, this subject can only be dealt with in later articles.

In most cases excessive sync. potentials are liable to cause a shortening of the time-base traverse and destroy linearity. The sync. control should always be kept at its minimum value, i.e., with zero work potential applied, and after steadying the trace by means of the velocity control a slight advancement of the sync. control usually suffices to lock the time base.

Time-base Power Supplies.

The power supplies for the time-base circuits are quite conventional, the total output supplied depending on the arrangement in use. Generally good smoothing is essential and voltage regulation should be constant over a wide current range. The pack can be used to supply the heater volts for the cathode-ray tube (only advisable when the tube pack negative is earthed), as well as H.T. for any amplifying stages which might be used between the work input and the Y plates. At all times the tube must be kept away or screened from the A.C. fields surrounding the transformers, chokes and heater leads (Fig. 22).

Time-base Amplification Stages

Owing to insufficient amplitude of the generated saw-tooth waveform, and also due to the defocusing effect of the deflector plates in high vacuum tubes which causes a blurring of focus at the extremities of the time base sweep, it is sometimes necessary to introduce an amplifier between the time-base output and the horizontal controlling or X plates of the tube to overcome either or both of these difficulties (Fig. 23).

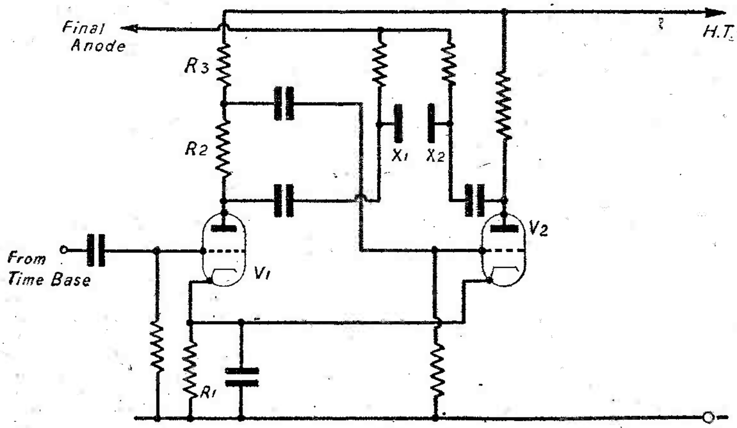

Fig. 23.—An amplifier circuit which can be introduced between the time base output and the X plates of the tube.

The defocusing effect can only be avoided by the use of symmetrical deflecting circuit in which the plates are connected with their electrical centre point at final anode potential. (See earlier.)

The circuit shown uses two valves of similar characteristics, and these are biased by R_1 in their cathode circuits. The anode resistors of V_1 are together equal to the anode resistor of V_2, and in order to obtain equal output from the valves their inputs also must be equal. The input to V_2, therefore, is only a proportion of the output of V_1, depending on the values R_2 and R_3. For optimum results $\frac{(R_2+R_3)}{R_3}$ = amplification of V_2, assuming that the grid leak of V_2 is much greater in value than R_3.

There is a reversal of phase in each valve, therefore the potential applied at any instant to either X plate is equal and opposite to the potential on the other.

METER READINGS

A PROBLEM was recently put forward by a reader who was testing a receiver with a multi-purpose meter and who could not decide upon the reading obtained. It appeared that the meter had a series of voltage ranges, obtained with a selector switch, and when on a high voltage range he obtained a reading of just over 100 volts. To make quite certain what the reading was, he used the next lower range which read slightly more than 100 volts, and he then found that the reading was only slightly above 60 volts. He thought the meter was out of order, but this was not so. On the high voltage range the total current flowing through the meter would be less than on the lower range, owing to the higher resistance of the meter, and thus this would be the more accurate reading. The voltage being tested was probably the screen voltage, where the additional drain of the low resistance meter would considerably modify the voltage actually applied to the circuit.

* * *

INEFFECTIVE SCREENING

WHEN metal screens are employed between stages in a receiver it may be found that screening appears to be ineffective. This may be due to several reasons, but it is important to bear in mind that the screening will not act in the desired manner unless it is complete. This means that the separate pieces of a complete screen must be bolted together so that no gaps or air spaces are left, and it may also be found that it must be made in such a manner that it forms a complete box—with top and bottom. An obstinate superhet was recently tested where oscillation could not be avoided until the chassis (which was of metal) was placed upon a sheet of metal so that it was closed in entirely. The underside screens had been made exactly to the depth of the chassis and this enabled each section to be enclosed by the bottom plate.

Battery to A.

How to Convert a Battery-opera

IT is generally known that an A.C. mains receiver is appreciably more efficient than a battery receiver of similar type and having the same number of valves, but there are many constructors who prefer to build the latter type of set because they believe that the construction is easier and that the receiver is "safer." In many respects this is a fallacy, since a mains set is no more difficult to build than a battery one, although there is a little more work involved, principally due to the fact that a power unit has to be made in addition to the receiver proper. But this does not lead to complications of any sort, and the final result, provided that reasonable care is taken, is just as "safe" in every respect. The essential point is that the components which are in connection with the mains supply should be beyond reproach, and should be insulated in the best possible manner.

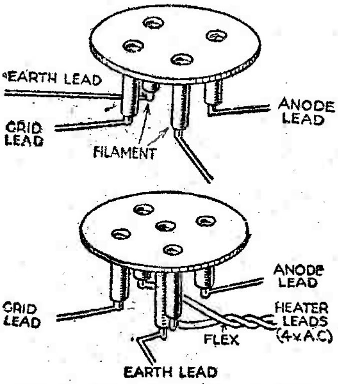

Fig. 1.—Shows how the valve-holder connections have to be altered to suit A.C. mains valves.

All-mains or Eliminator?

When the above points are fully realised there may be many constructors who would like to convert their battery sets for mains operation, and the following practical advice will prove useful. It is, of course, a simple matter to construct an eliminator to replace the H.T. battery as well as to provide a source of power for charging the accumulator, but this is only a compromise, and does not give an improvement in reception. We will therefore disregard that aspect of the question and deal, instead, with the alterations required when the set is to be entirely modified for use with the more efficient indirectly-heated mains valves. In the first place the connections to the valve-holders require to be modified, whilst if the holders originally fitted are of the four-pin type, they must be replaced by others suitable for five-pin valves.

The grid and anode connections remain as before, but all earth-return leads have to be made to the cathode terminals (see Fig. 1), whilst the original filament terminals become heater terminals, and must be connected to a 4-volt supply of A.C. As it will generally be desirable to build the mains portion as a separate unit, the heater terminals should be re-wired with twisted double flex, as indicated. The object in using twisted flex is to prevent hum, which may be caused due to the magnetic field set up round wires carrying alternating current; the fields are neutralised to a large degree when the wires are twisted together. The flex should be stout material of good quality, so that its resistance, and hence the voltage-drop across it, is reduced to a minimum.

Simple Wiring Alterations

We may first of all consider the simple modifications in wiring required in the case of a two-valve (det.-pentode) battery receiver employing a circuit such as that shown in Fig. 2. The few alterations are indicated in the new circuit (Fig. 3), from which it will be seen that in the case of the cathode lead to each valve a bias resistance is included, this being by-passed by a 25-mfd. electrolytic condenser, of which the positive terminal is joined to the cathode of the valve. The value of the resistance is, in each case, governed by the type of valve employed, but the values indicated apply to two well-known types of Cossor valve—the 41 H.L. and the M.P./Pen. When other valves are used the resistance values must be changed accordingly.

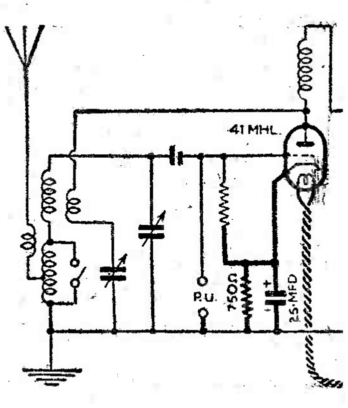

Fig. 3.—The circuit shown in Fig. 2 now ... cathode

The altered connections for the pick-up should also be noted, whilst it will be seen that additional decoupling has been added in the detector anode circuit in the form of a second 25,000 ohm resistance. Actually this second resistance may not always be required, but it is generally necessary in order to ensure smooth reaction, and to keep down to a reasonably low value the current passing through the primary winding of the L.F. transformer.

Another point which should be borne in mind is that the H.T. voltage employed after altering the set will be a good deal higher than before, so that the decoupling condenser marked C may have to be changed. The condenser should have a rated working voltage of not less than 250 when an indirectly-heated valve rectifier is used in the mains unit, or of 350 when a directly-heated valve or a metal rectifier is employed. The rest of the circuit may remain unchanged.

A Three-valver Example

In modifying a receiver having a variable-mu or a screened-grid stage rather greater precautions must be taken if the

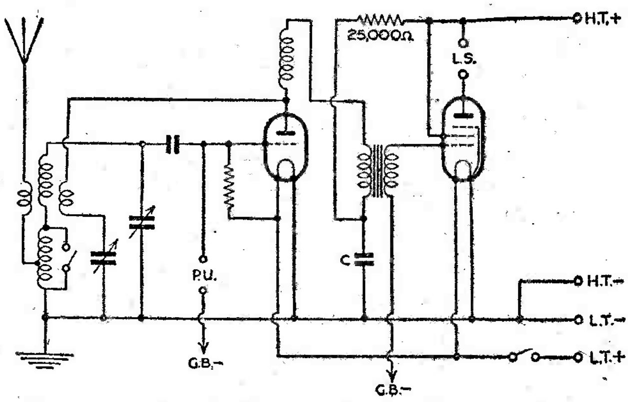

Fig. 2.—A typical 2-valve battery-operated circuit which lends itself to easy conversion.

Battery to A.C. Operation

CENTRE PAGE CIRCUIT

How to Convert a Battery-operated Set to an All-mains Model

to a 4-volt supply of A.C. As it will generally be desirable to build the mains portion as a separate unit, the heater terminals should be re-wired with twisted double flex, as indicated. The object in using twisted flex is to prevent hum, which may be caused due to the magnetic field set up round wires carrying alternating current; the fields are neutralised to a large degree when the wires are twisted together. The flex should be stout material of good quality, so that its resistance, and hence the voltage-drop across it, is reduced to a minimum.

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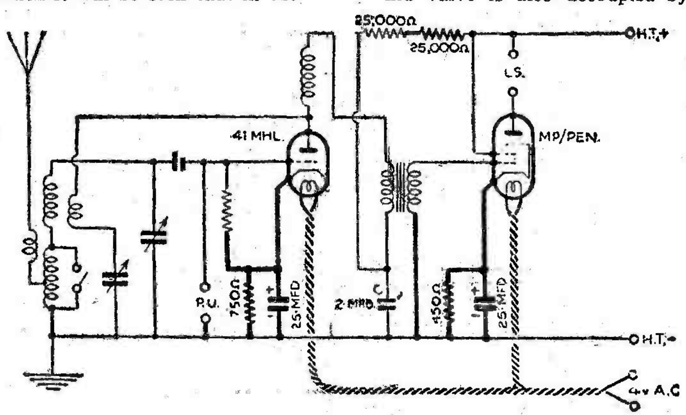

Fig. 3.—The circuit shown in Fig. 2 now altered to suit A.C. mains valves. Note cathode circuits.

The altered connections for the pick-up should also be noted, whilst it will be seen that additional decoupling has been added in the detector anode circuit in the form of a second 25,000 ohm resistance. Actually this second resistance may not always be required, but it is generally necessary in order to ensure smooth reaction, and to keep down to a reasonably low value the current passing through the primary winding of the L.F. transformer.

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A Three-valver Example

In modifying a receiver having a variable-mu or a screened-grid stage rather greater precautions must be taken if the possibility of instability and self-oscillation is to be avoided. As an example, we may compare the circuits represented by Figs. 5 and 6, of which the first is a standard battery-operated arrangement and Fig. 6 is its A.C. counterpart. In Fig. 6 the variable-bias voltage for the first valve is provided by means of a 2,000-ohm graded potentiometer included in the cathode lead, whilst the voltage for the screening grid of this valve is obtained by means of a potentiometer comprising two fixed resistances joined in series between H.T.+ and the cathode (equivalent to H.T.−).

Increased Decoupling

Additional decoupling is provided for the detector valve, and the anode of the variable-mu valve is also decoupled by means of a 2,000-ohm resistance and a 1 mfd. fixed condenser. Although not always necessary, the auxiliary grid of the pentode is decoupled instead of being connected directly to the positive high-tension lead. As the modified circuit is likely to prove rather "critical" because of the much higher degree of amplification provided, the grid circuit of the pentode is also decoupled by inserting a 100,000-ohm fixed resistance between the G.B.− terminal on the L.F. transformer and the earth line, the cathode by-pass condenser being connected between one end of the decoupling resistance and the cathode of the valve.

Just as in the case of the two-valve circuit discussed above, the decoupling condensers C, C1 and C2 should have rated working voltages of at least 250 and 350 in the conditions referred to; condenser C3 should be rated at not less than 200 volts working, while the by-pass condensers C4 and C5 may be standard electrolytic condensers, designed for a working voltage of not less than 10 and 20, respectively. In the case of both circuit arrangements considered, the fixed resistances may all be of the 1 watt type, since the current which they have to carry is comparatively low.

Despite the fact that the general modifications required when converting receivers of other types than those mentioned are the same as have been described, readers are recommended

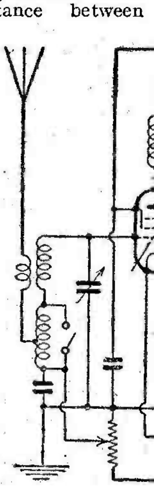


Fig. 5.—This is r

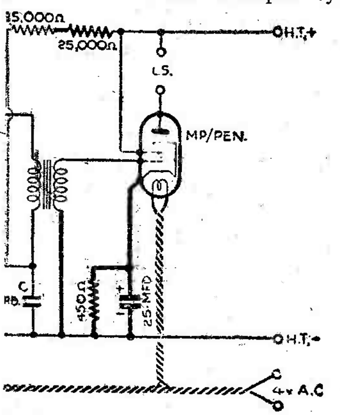
C. Operation

ed Set to an All-mains Model

possibility of instability and self-oscillation is to be avoided. As an example, we may compare the circuits represented by Figs. 5 and 6, of which the first is a standard battery-operated arrangement and Fig. 6 is its A.C. counterpart. In Fig. 6 the variable-bias voltage for the first valve is provided by means of a 2,000-ohm graded potentiometer included in the cathode lead, whilst the voltage for the screening grid of this valve is obtained by means of a potentiometer comprising two fixed resistances joined in series between H.T.+ and the cathode (equivalent to H.T.–).

Increased Decoupling

Additional decoupling is provided for the detector valve, and the anode of the variable-mu valve is also decoupled by means of a 2,000-ohm resistance and a 1 mfd. fixed condenser. Although not always necessary, the auxiliary grid of the pentode is decoupled instead of being connected directly to the positive high-tension lead. As the modified circuit is likely to prove rather "critical" because of the much higher degree of amplification provided, the grid circuit of the pentode is also decoupled by inserting a 100,000-ohm fixed resistance between the G.B.– terminal on the L.F. transformer and the earth line, the cathode by-pass condenser being connected between one end of the decoupling resistance and the cathode of the valve.



...tered to suit A.C. mains valves. Note ...nuits...

Just as in the case of the two-valve circuit discussed above, the decoupling condensers C, C1 and C2 should have rated working voltages of at least 250 and 350 in the conditions referred to; condenser C3 should be rated at not less than 200 volts working, while the by-pass condensers C4 and C5 may be standard electrolytic condensers, designed for a working voltage of not less than 10 and 20, respectively. In the case of both circuit arrangements considered, the fixed resistances may all be of the 1 watt type, since the current which they have to carry is comparatively low.

Despite the fact that the general modifications required when converting receivers of other types than those mentioned are the same as have been described, readers are recommended not to attempt the modification of receivers having two H.F. stages, or of the super-heterodyne type unless they have a fairly wide experience or are prepared to carry out a certain amount of experimental work. The reason for this is that stable operation is not always easy to obtain with more sensitive receivers, and it is not possible to treat the subject of their alteration in general terms, since each individual circuit must be considered on its merits.

The Power Unit

It remains now to consider the battery eliminator, or power unit, and the connections are given in Fig. 4, for a circuit which employs an indirectly-heated valve rectifier. A satisfactory unit of either type can be assembled on a simple flat baseboard, and may be housed in the same cabinet as the set, or in a separate container.

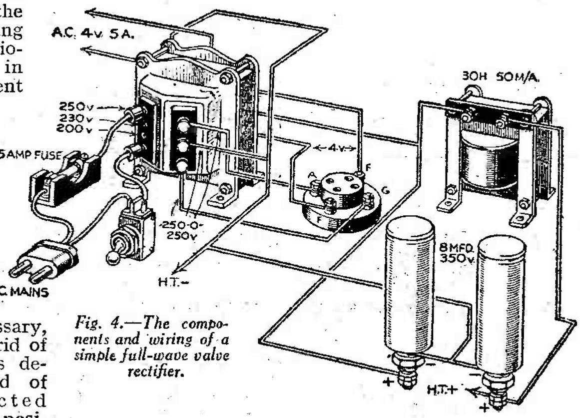


Fig. 4.—The components and wiring of a simple full-wave valve rectifier.

For the purpose under consideration it is generally better to use the indirectly-heated valve type of rectifier, since the "peak" voltage when first switching on is not so great, and the condensers in the set do not require to be of so high a working voltage. The circuit is self-explanatory, and the output from the unit is approximately 250 volts at 60 m.a. and 4 volts at 3 amps.;

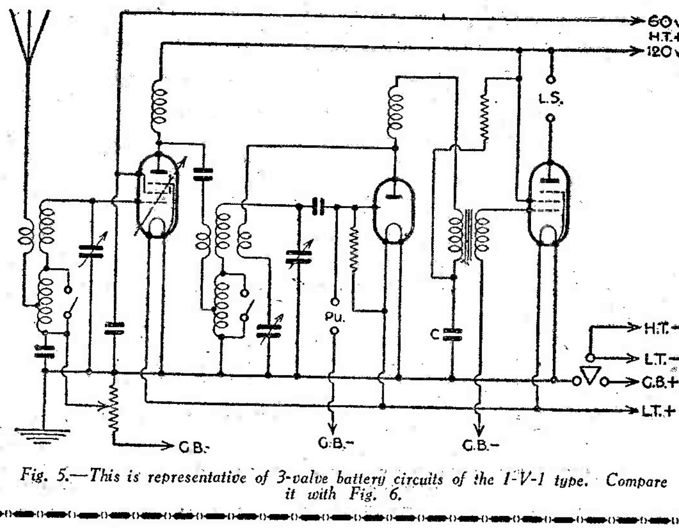


Fig. 5.—This is representative of 3-valve battery circuits of the 1-V-1 type. Compare it with Fig. 6.

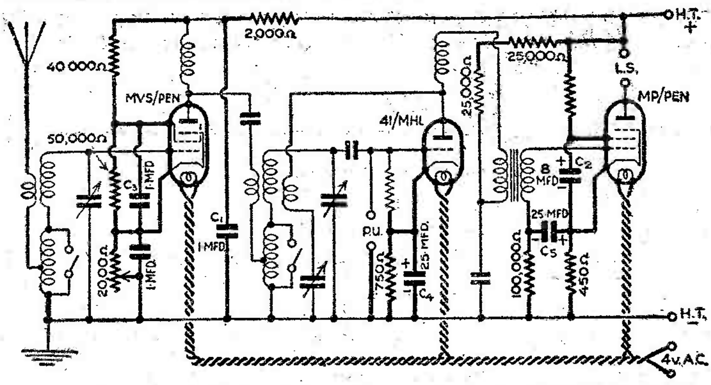


Fig. 6.—The circuit modified for A.C. supplies, variable bias being provided for the H.F. valve.

provision is, however, made for reducing the H.T. current to about 40 m.a., when only two valves are employed in the receiver.

There is no necessity for fitting terminals to the mains unit, and it is generally more convenient to provide suitable flexible connecting leads as shown, these being joined to the appropriate terminals on the receiver. Particular makes of smoothing chokes are not given, since any good component rated at 30 henries when carrying 50 m.a. is suitable, provided that the D.C. resistance does not exceed 1,500 ohms. The same remarks apply to the electrolytic smoothing condensers, fuse, and Q.M.B. on-off switch, but all components must be of reputable make and unimpeachable quality.

Improved Flat-cell Type Dry Battery

A Constructional System to Eliminate Electrolyte Leakage

OWING to the demand for a dry battery of reduced volume for a given output, the flat-cell type of battery has recently come into prominence. An important point in the manufacture of this kind of battery is the provision of an effective seal between adjacent cells of the battery, so that internal leakage of the electrolyte does not occur, and the accompanying diagrams illustrate a satisfactory construction that accomplishes this in a simple manner.

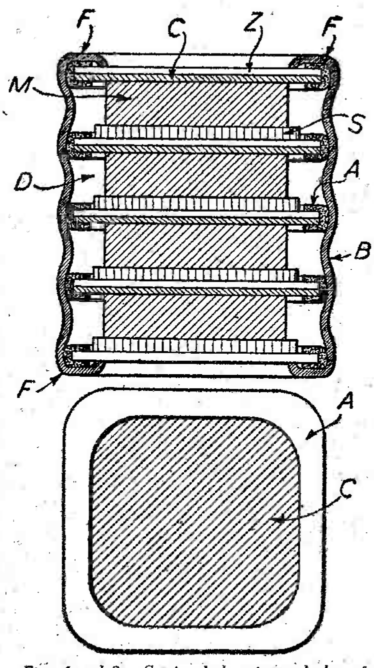
As shown in Fig. 1, each cell comprises zinc and carbon elements Z and C, an electrolyte S, and a depolariser M, and a number of cells (four are shown in the illustration) are stacked together to form a battery. The carbon element C preferably comprises a coating of carbon on one surface of the zinc plate or element Z. The feature of the construction shown is that the zinc or zinc-carbon elements are made somewhat larger in area than the electrolyte and depolariser elements, so that marginal portions of the zinc plates project beyond the main body of the cells, and a sleeve B of suitable electrolyte-resisting material is placed over the stack of cells and then shrunk on to them so that it embraces the edges of the zinc elements tightly and forms an effective seal between adjacent cells. Preferably a ring A of suitable electrolyte-resisting material is arranged round the marginal portion of each zinc element Z, and suitable adhesive may be used to cause adherence both of the rings A to the zinc elements Z, and the outer sheath B to the edges of the rings A. The sleeve B assumes the corrugated form shown when shrunk on, and will permit some expansion of the air spaces D round the cells to accommodate gases generated in the battery.

Constructional Details

In the preferred construction the outer sheath comprises a tube of plastic material, such as polyvinyl chloro-acetate, celluloid or cellulose acetate plastic, which can be swollen by immersion in a suitable liquid, such as acetone; the tube is cut slightly longer than the assembled stack of battery cells and its cross-sectional area is somewhat less than the area of a zinc plate. During manufacture of the battery the tube is swollen by immersing it in a mixture of acetone and water, so that it can be fitted over the stack; it is then dried to cause shrinkage, so that it adheres tightly to the edge of the zinc plates. Contraction of the sheath produces the corrugations shown in Figure 1, and causes the ends of the sheath to turn inwardly, as shown at F, thus holding the cells together. The tension within the sheath produces the end pressure necessary to maintain the cell elements in good electrical contact.

As shown in Figs. 1 and 2, it is preferred to place a ring or band A of suitable material, which may also be a plastic material, round the margin of each zinc to form a cushion between the outer sheath and the edge of the zinc plates and also to protect the margins from the electrolyte. The ring or bands A may be cut from a tube of plastic material and expanded, and then shrunk on to the zinc in the manner already described. The ring A may, as already stated, be coated with adhesive to cause adherence to the zinc plate and to the outer sheath. Suitable adhesives are: A suitable grade of chlorinated diphenyl, a soft sticky cumar resin, or a mixture of beeswax, resin and linseed oil.

The battery is completed by the attachment of terminal leads (not shown), and it may, if desired, be coated with bitumen, pitch or other suitable material before being placed in a container.



Figs. 1 and 2.—Sectional elevation and plan of an improved dry battery, showing how effective inter-cell sealing is obtained.

BRITISH LONG DISTANCE LISTENERS' CLUB

The Month's News of Members' Activities

Natal, S. Africa

"I WAS interested to observe in an earlier issue of PRACTICAL WIRELESS a statement to the effect that the B.L.D.L.C. was not a club established for the benefit of those enthusiasts who merely wish to hang a certificate on the wall, so consequently I thought that I had better get busy and attempt to show that my interest is really genuine. To this end, therefore, I enclose a photograph of my 'den.'

"The cabinet on the left contains an 11in. M.C. speaker. On its right is part of an 8-valve superhet all-wave receiver chassis of Atwater Kent manufacture. Being of 1936 or 1937 vintage, it does not possess really adequate bandspread, but pulls in the more powerful stations quite well. Next to it is a home-made 4-valve H.F.-Det.-L.F. regenerative set, which, with change-over coils, performs really well on the higher frequencies (10-40 metres). It is with this Rx that I am trying to form a respectable log of 'stations received,' but, as I have not long been in the S.W. listening game, my present log is not worth mentioning. Although I have heard such stations as Daventry, Sydney, Tokyo, and all South African transmitters, they are so commonly heard that they are not unusual. As I take in PRACTICAL WIRELESS regularly, I derive great interest from articles, etc., published about S.W. work, and heartily approve of its new and handier size. Also, the descriptions of P.A. amplifiers and sound systems have been of great use to me and my wireless friends who have lately been busy on that work. PRACTICAL WIRELESS is an excellent all-round publication, and, incidentally, to the best of my knowledge, it enjoys a wide sale in this country.

"In conclusion, therefore, let me say that I hope that PRACTICAL WIRELESS continues to appear every month."—J. Hotchkiss, Member 6,994.

[*Many thanks, No. 6,994, for your interesting letter and photograph. We hope you will make good progress with your S.W. work, and soon compile a fine log of Dx transmissions. We are pleased to note that you get your copy of* PRACTICAL WIRELESS *regularly: many readers in this country would like to be able to say the same.*—HON. SEC.]

Belper, Derby

"WITH reference to the article in the July issue of PRACTICAL WIRELESS, 'Who Can Help?' I think that my log may help. On April 21st, 1942, at 15.30-16.00 hrs. G.M.T., I received a station which said, 'This is Asad Hin calling over Free India Radio.' (This was spelt out.) The wavelengths were 31.92 and 26.16 metres. The 31.92 m. station has since been replaced by one on the 24 m. band. Later, in May, another member of the club told me that he had had conclusive proof that this station was not India at all, but Germany. Asad Hin signed off for the day at 16.00 hrs. G.M.T. and left his carrier wave on. A few minutes later came the words, 'This is Germany calling in her Indian transmission.' I hope this log will help out those members who sent in a query about Asad Hin. I should like help over a station which I received on June 7th at 19.30 hrs. G.M.T. on a wavelength just above WCW, 18.9 m. and yet below 19 metres. It said, 'This is WSH calling HET7.' WSH would be an American, but I cannot trace the origin of the call-sign HET7. Perhaps you could tell me the country."—R. Braithwaite, No. 7,176.

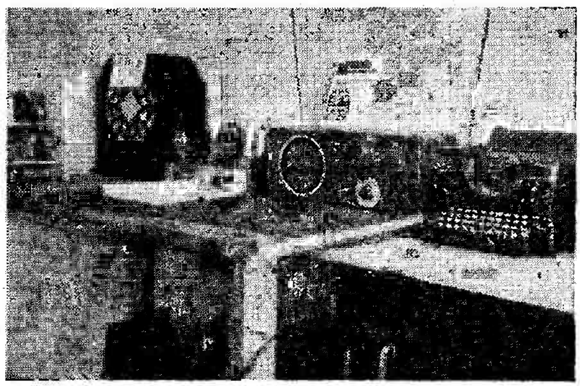
Romsey, Hants

"A FEW lines to report reception of the following stations during June: 16/6/42—Chungking, China, XGOY, 25.21 metres; news in English from 23.30-23.55 hrs. R. 6, QSA. 4, T. 8, very bad QRM. 18/6/42—WDO, New York City, U.S.A., 20.7 metres, 14,770 kc/s; close down 24.00 hrs.; 22.30-24.00 hrs. programme in Portuguese. This station appears to have the same schedule as WCW. R. 6, QSA. 4, T. 8. Also logged during June: WCW, WLWO, WRUL, WCBK, WCRC, WGEA, FZI."—T. Hyder, No. 7,089.

Lurgan

"I HAVE also been experimenting with several S.W. circuits for an 0-v-1, using an output pentode with separate oscillator and a pre-selector which I intend to build shortly.

"On May 31st, between 03.30 and 09.00, I had a S.W. DX competition with a friend. The following are a few of the best catches: Moscow, RWG, 19 m., R.S.T. 550; Chungking, XGOY, 16 m., R.S.T. 446; Cincinnati, WLWO, 19 m., R.S.T. 568; Bound Brook, WRCA, 14 m., R.S.T. 557; Vatican City, HVJ, 19.8 m., R.S.T. 588, and Hull, WBOS, 19.2 m., R.S.T. 344.



A section of the receiving station owned and operated by a Natal member, Mr. J. Hotchkiss. A neat and businesslike layout.

"Incidentally, my friend received WSI on 16 metre band, answering RWG.

"These loggings were received on an 0-v-1, bandspread tuning with a short indoor aerial.

"A few days ago I picked up a small transverse current mike, for which I built a 2-valve R.C. coupled amplifier for phone work.

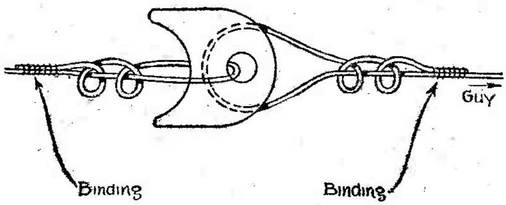
"I would like to make contact with any S.W. enthusiast who builds his own equipment."—M. Posner, No. 7,224.

Walthamstow

"I NOTE with regret the lack of any notice regarding a club being formed in Walthamstow yet. Surely a district of this size can muster at least six members even in these times. If a club was formed it could be of benefit to all who join, as radio needs co-operation at all times.

"I am going to rebuild my 0-v-1 with the addition of an R.F. stage, also I am going to modify the detector circuit. I don't know whether to use suppressor grid or electron coupled reaction. Could you advise me which is the best for short-wave work?"—K. C. Hawkes, No. 6,736.

[*Well, it is up to the other members in Walthamstow. If they will respond and write to us, we will see about forming a group. Regarding reaction, we would advise No. 6,736 to try the electron-coupled system, as it is certainly most effective.*—Hon. Sec.]



This shows the correct method of connecting the halyard and aerial to a shell-type insulator

Exeter

"HERE are details of some of the alterations I have made to my three-valve receiver. Finding that the .0001 mfd. grid condenser leaked through its casing, so much that the set would work without a grid-leak, I made a more efficient one from two pennies, a small piece of mica, and some amyl-acetate cement.

"I also erected a 40ft. outdoor aerial, about 20ft. of which is vertical. Lately automatic grid-bias has been added, and the .01 mfd. condenser parallel-feeding the transformer changed for a .1 mfd. The value of the condenser feeding the 'phones was changed from .02 mfd. to 1 mfd. These latter changes appear to make static less troublesome, and definitely improve quality.

"The best reaction arrangement I have tried is that in which the condenser is connected between the junction of coil and choke and earth. This arrangement does not affect tuning nearly as much as the proper throttle-control method.

"To close, I give the list of stations which I have lately received: FZI, WRUL, WGEA, WCW, WCBX, WNBI, WCDA, WCRC, WLWO, Radio Metropol, Moscow, PMA, WBOS, HVJ and others.

"If anyone could supply me with details of Radio Metropol I should be very pleased. Its wavelength is 19.69 metres. A news in English and musical programme is given daily at 12 a.m. D.B.S.T. No location was given.

"Also, instead of a resistance in the grid circuit of an untuned R.F. valve, I find a good wave-wound R.F. choke much better. It gives more volume, and, in my case, better selectivity and freedom from local station break-through."—W. A. Jubb, No 7,168.

Egypt

WITHIN a day or two of receiving the letter from Member 6,994, of S. Africa, an "airgraph" letter arrived from Mahmoud Hosni—No. 5,871—of Daher, Cairo, on which he says: "I am very pleased to send you this first letter by the 'airgraph' system, which I think will be of great use in correspondence between amateurs in Egypt and England, due to its speed when compared with the normal postal system."

Reproduced on the airgraph is a photo of his equipment, which includes a "Sky Buddy," an A.C./D.C. four-valver; a 1-v-1 S.W. receiver and a combined one-valver and L.F. oscillator for morse practice. Unfortunately, owing to the size of the airgraph, it is not feasible for us to reproduce it to show the actual layout of the gear. Mahmoud Hosni ends his letter by "Wishing the club and Practical Wireless every success."

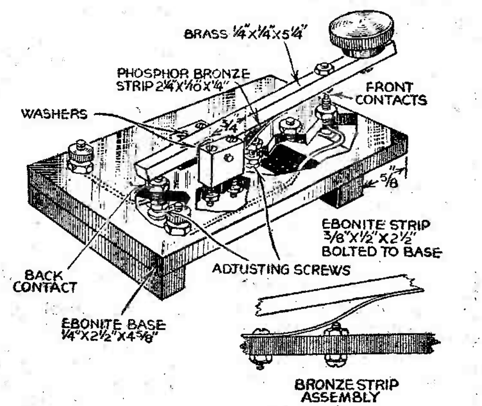
[*We thank Member 5,871 for the interest shown and his kind wishes, and we feel sure that the airgraph system will, undoubtedly, speed up communications between amateurs all the world over, when we return to normal activities. Although the airgraph was the first we have received from a civilian member, it was not the first to be delivered to Headquarters, as several members in the Forces serving overseas have already taken advantage of the system to send us greetings.*]

Aerial Insulators

WHEN giving the aerial its annual summer overhaul, particular attention should be paid to the state of the insulators and the halyards. The former should thoroughly be cleaned, all sooty deposit being removed and the surface of the insulator polished. Halyards should be examined for fractures, rust and brittleness. If in doubt about any part, it is always advisable to replace it with more serviceable material. If ropes are used, they should be subjected to a thorough test to determine whether they are still in a condition to withstand their load. This can be done by fastening one end to a convenient spot, and then exerting a reasonable pull on the whole length of the rope. Appearances are often deceptive; a rope might look sound and yet be rotted in parts. Any frayed portions should be cut out as they are liable to foul the pulley and, during the high winds of the winter, break and let the whole aerial down.

If fresh fixings have to be made to the insulators, make quite sure that you use the correct method of fastening them to the wire or rope. The illustration (left) shows how it should be done. It is only a small point, but it is a very important one, and it is surprising the number of constructors who do not use the correct method. If the diagram is examined, it will be seen that the two loops actually pass through each; therefore, if by any mischance the insulator breaks, the aerial will still be held by the guy. In addition to this, the system makes the greatest use of the insulator by ensuring the longest path for any leakage between the two ropes or wires.

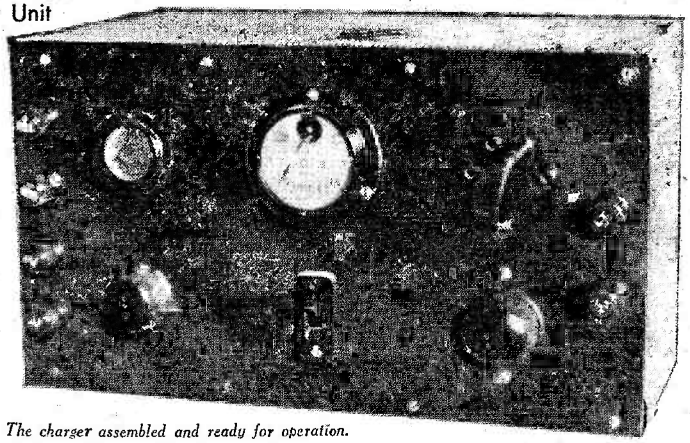
Note the simple, neat and effective way in which the aerial and halyard are made secure. There is no need to use several unsightly knots of doubtful value; use the method shown, finishing off the loose ends by binding neatly with waxed thread.



Here are the constructional details of a handy Morse key for those who wish to practise the code.

An A.C. Accumulator Charger

Constructional Details of a Unit Suitable for One to Six Two-volt Cells



The charger assembled and ready for operation.

THE design of this unit provides for the charging of 2, 4, 6 or 12 volt accumulators at a maximum current of $1\frac{1}{2}$ amps., therefore, it is suitable for use with radio cells and trickle-charging car batteries. Under present conditions when so many cars are laid up, this is of definite value, as one is able to keep the battery in trim throughout the period.

The circuit diagram is shown in Fig. 1. The mains transformer is wound to give A.C. voltages of 10, 13, 15 and 20 volts, at 2 amps., and all the essential details are shown in the data panel, given below.

For more complete details of the actual winding operations, readers are asked to refer to the article on "A Universal Filament Transformer" in the issue dated August, 1942, where the method of construction is equally applicable to this component.

The L.T. rectifier employed is of the selenium type, made by Standard Telephones, Ltd., and is rated at 12 volts, 1 amp. This seems to be a rather conservative estimate, as the writer has found that even at 2 amps. over a long period, it functions quite satisfactorily without any undue heating up. The *makers do not*, however, *advocate* so much *overload*, therefore, the highest rate of charge for this instrument should not exceed $1\frac{1}{2}$ amps.

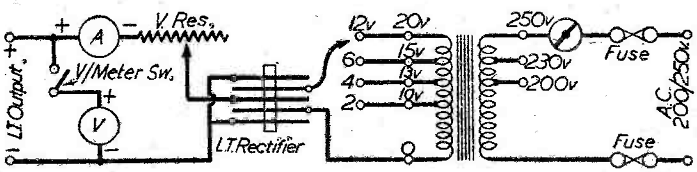


Fig. 1.—The complete circuit of the charger, showing the secondary voltages for accumulators of various voltages.

When the construction of the original charger was contemplated the writer had on hand a cheap grade of moving-iron voltmeter reading 0–8 volts. As it proved to be fairly accurate it was incorporated in order to facilitate some sort of check on the batteries before and after charging. It is connected across the output terminals, when required, by the rotary on–off switch in the bottom right-hand corner, readings being taken, in all cases, with the charger switched off, otherwise misleading indications will result.

From the foregoing it will be realised that the voltmeter is by no means essential, but if one is available it will certainly prove most useful.

In view of the fact that a variable charging rate is provided for, an ammeter is necessary, and an instrument reading up to 1.5 or 2 amps. is suitable. An ordinary moving-iron type of meter will be quite satisfactory for this purpose.

In the original model a "Bulgin miniature meter" reading 0–1 amp. was utilised, and shunted by a resistance equal in value to the resistance of the meter. By adopting this procedure the effective range of the meter is doubled.

For the benefit of readers who wish to use a meter of lower value than that required, the formula for meter shunts s: R of shunt$=\frac{\text{R of meter}}{\text{N}-1}$, where N is the number of times the full scale reading is to be increased. A practical method of doing this would be to arrange for full scale deflection of the meter, and then, by trial and error, find the correct value of shunt by connecting a short length of resistance wire across its terminals. By gradually shortening the wire, the reading may be adjusted to any point on the scale. Thus, half-scale deflection would double the effective range and a quarter-sale reading would increase the range by four.

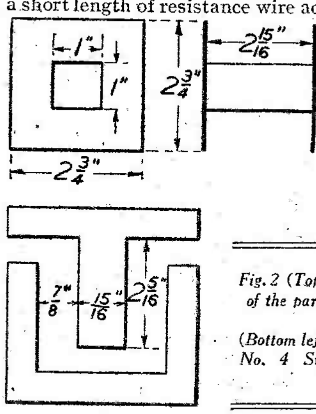


Fig. 2 (Top left).—The measurements of the parts required for the bobbin.

(Bottom left).—The dimensions of the No. 4 Stalloy stampings used for the transformer.

MAINS TRANSFORMER DATA PANEL

Primary 200/250v.	8 turns per volt=2,000 turns for 250v., tapped at 1,840 for 230v. and 1,600 for 200v. Gauge 30 S.W.G. enam.
Secondary 10, 13, 15, 20 volts	8 turns per volt=160 turns for 20v., tapped at 120 for 15v., 104 for 13v., 80 for 10v. Gauge 20 S.W.G. enam.
Wattage	20v. × 2 amps.=40 (+25 per cent. losses)=50 watts ∴ Core consists of 6 dozen pairs No. 4 Stalloy stampings.

Construction

When the mains transformer has been completed the assembly of the charger may be commenced.

The original measures 12in. × 7in. × 5½in. deep, but if the voltmeter and its switch—mentioned previously—are omitted, this size may be reduced considerably. A suggested panel layout for this requirement is shown in Fig. 4, but whatever the size is, a panel and baseboard will be required. They can both be of wood, although ebonite is preferable for the panel.

Panel Layout

The layout of the parts is not at all critical, and an approximation may be secured from the illustration and back-of-panel diagram. Looking at the former the meter on the left is the ammeter, below this is the variable resistance for adjustment of the charging rate. In the centre is the volt-meter and below it the main on–off switch, with the volt-meter switch on its right. The remaining control is for the adjustment of the charging voltage, and consists of four sockets, to either one of which is connected a plug. This plug is joined to a short length of flex which passes through a small hole in the panel and wired up as shown on the diagram. The sockets (reading from left to right) are for 2, 4, 6 and 12 volts respectively.

The two terminals on the right of the instrument are the L.T. output for connection to the battery, whilst those on the left are merely joined to the voltmeter and ammeter, respectively, for external application should they at any time be needed.

After drilling the panel for the necessary components it should be fixed at its lower edge to the baseboard by four screws. Panel brackets may be used if desired, but if the baseboard is ½in. thick or over the screw fixing alone will be quite rigid.

The panel components should be mounted first, then only the transformer and rectifier remain to be screwed to the baseboard. It may be advisable to wire up some points on the panel before the transformer is mounted.

The metal rectifier is quite small and a simple right-angle bracket fixed to one side of it will suffice for mounting.

Note should be made of the two 1 amp. fuses inserted in the mains lead. These were incorporated on the transformer assembly, but a separate fuse holder and fuses can, of course, be screwed to the baseboard.

The variable resistor calls for some comment. Its alue is 6 ohms, and one of the old type of filament resistors will serve the purpose admirably. It has to carry a fair current, however, so that one of the more robust types—with a porcelain body, for example—should be selected if possible.

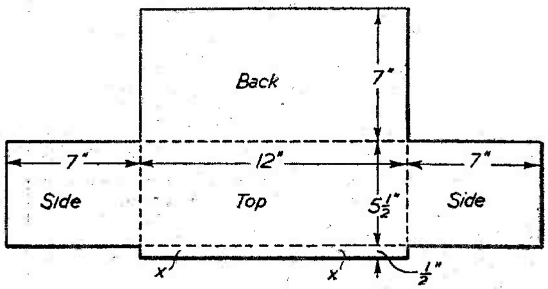
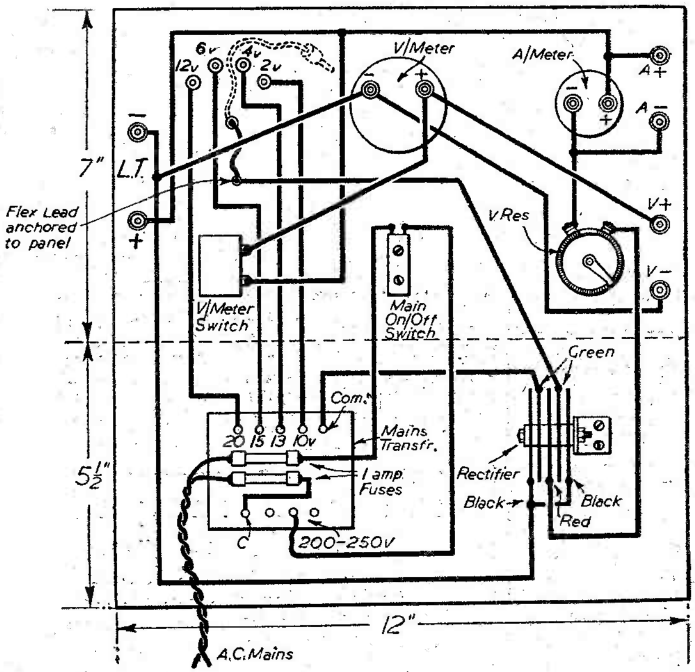


Fig. 3.—The perforated zinc used for the cover should be marked out as shown here.

The inclusion of a resistor is of the utmost importance, and, if by any chance a variable one is not obtainable, a fixed resistor of 2 ohms must be included in the circuit.

Wiring should be carried out with thick wire, well insulated, and care must be taken to see that the rectifier is connected according to the diagram. Be sure, also, that the transformer secondary tappings go to the correct sockets on the panel.



The detailed wiring diagram of the charger, showing the location of the component parts.

Making the Cover

When the wiring of the unit has been completed it will become necessary to provide some form of cover that will provide ample ventilation, and prevent the possibility of receiving shocks from the instrument. This was accomplished in the original unit by the use of perforated zinc.

It is cut in one piece to a shape similar to that shown in Fig. 3, the back and sides being bent down at right angles to the top, and the joins soldered up. The cover should be of such dimensions that it reaches down to the bottom edge of the baseboard, thus a good fixing is afforded by passing screws through the metal and into the edges of the wood. The front piece of the cover marked X in Fig. 3, is bent down at right angles to the top. Into this angle fits a strip of wood of ½in. square section, and the length of the cover, and is held in place by one or two brads. The next procedure is to drill four small holes along the top edge of the panel, ¼in. down.

After "registering" these holes in the wood strip, screws are passed through the panel into it, and together with the bottom fixing, and the whole will then be quite rigid.

Operation

Before switching on, the voltage selector plug must be adjusted for the voltage of the accumulator or accumulators being charged. If you have, say, six 2-volt cells, then all these may be charged at once—by wiring them in series—on the 12-volt adjustment. The charging rate is then adjusted to the specified figure by the variable resistance.

This would probably be 1 amp., if all the cells were of the 40 ampere-hour type.

On the other hand, the rate may be dropped to ½ amp. for lower capacity batteries of the same voltage. Again, if you have, say, two 2-volt 40 A.H. and two 2-volt 20 A.H. cells to charge, connect the two smaller ones in parallel, but in series with the larger cells. In this way they can be charged at 6 volts at the rate of the large batteries, whilst the small ones will still be receiving their correct lower charging current. A car battery should be charged at the highest rate, that is, 1½ amps., for the circuit in question. Even under these conditions,

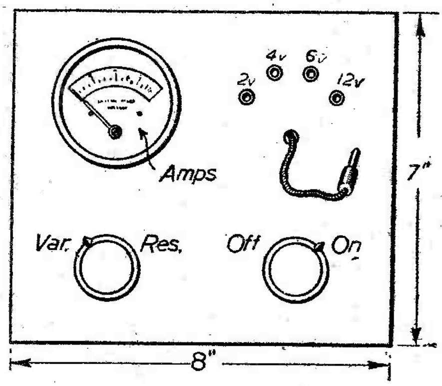


Fig. 4.—Dimensions and layout of the panel if the voltmeter is not used.

it is only what is termed a "trickle-charge," although over a period of about four or five days it could probably be rejuvenated to full capacity.

Safety Resistance

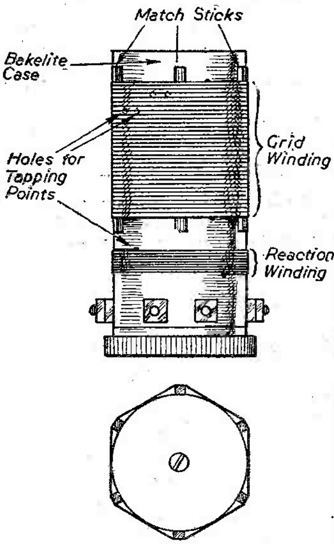
It is important to remember that a portion of the resistance element should always be left in circuit; the control knobs should never be turned to the extreme clockwise position. Provided that the value of the resistance is as specified, this requirement is met, as at 1½ amps. on the meter the knob has still about a quarter of its travel to spare.

Finally, if difficulty is experienced in obtaining the specified ammeter, do not forget that even a voltmeter may be pressed into service. A voltmeter consists of a milliammeter with a resistance in series with it. By removing the resistance, it may be treated as a milliammeter, and the shunt formula applied, as described earlier.

Practical Hints

A Three-band S.W. Coil

HERE is a dodge for making a three-band S.W. coil. Take a bakelite shaving soap case and stick six matchsticks equally round the outside. Wind over the matches 24 turns of 22 S.W.G. d.c.c. wire. Anchor the ends under brass bolts at



Method of making a S.W. coil.

the base and bring up through the holes. Make tappings at the fourth and ninth turns, and space the wire one diameter during winding.

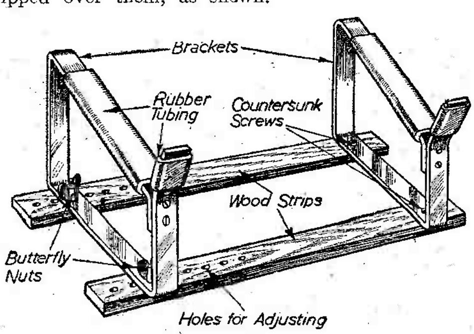
Below the matches place the reaction winding which consists of nine turns of the same wire, close wound. Both windings are in the same direction—anti-clockwise.

A countersunk hole in the centre of the base facilitates fixing.—G. H. WHALEN (Warrington).

A Radio-chassis Cradle

THE sketch below shows a simple chassis-holder which I recently devised. Radio or amplifier chassis often have to be placed upside down when repairs and tests are being made. But often this cannot be done without the possibility of damaging the valves or coils. With the aid of this chassis-holder, which is adjustable, these dangers can be avoided.

The construction can be followed from the sketch. The two supporting brackets can be made out of any fairly strong metal, which can be bent into shape. These are supported on two wooden strips. Before the metal strips are bent into shape pieces of rubber tubing are slipped over them, as shown.



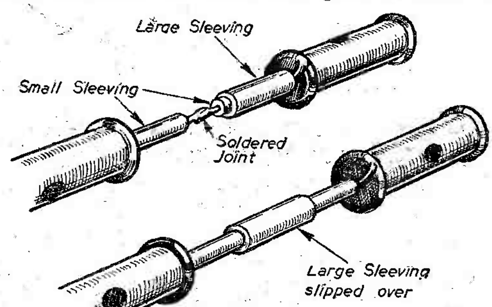
A radio-chassis cradle of simple construction.

One bracket is fixed at one end of the two wooden strips by screws. The other bracket can be adjusted to suit the length of the chassis under test, by removing the butterfly nuts, and fitting their bolts in other holes in the two strips at the required distance from the fixed bracket. The removable bracket is then placed back on the bolts, and the nuts tightened up. This stand is also useful for "wiring-up."

Dimensions can be judged to suit individual requirements and the materials at hand.—G. T. EDWARDS (Halifax, Yorks).

A Wiring Hint

NOW that components are so difficult to obtain, it is often necessary to connect two resistances in series to produce the required value. For example, two 10,000 ohm resistances in series will give a value of



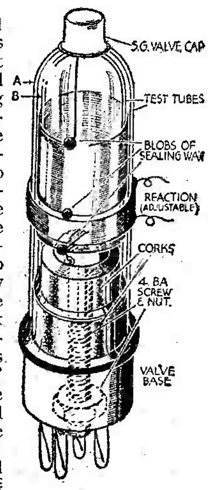
Simple dodge for protecting soldered joints.

20,000 ohms. When doing this a neat finish to the joint can be obtained by using two sizes of insulating sleeving and sliding the larger piece along over the soldered connection. The sketch clearly shows the method.—R. L. GRAPER (Chelmsford).

An Efficient Coil Assembly

THE percentage efficiency and degree of low loss of this coil former design are such that it is only superseded by air-spaced wound coils. The following material is required for its construction (this, irrespective of the type of wire and type of coil required): Two test tubes, one to fit into the other with approximately ⅛in. air gap between the inner surface of "A" and the outer surface of "B"; this measurement will vary according to the size of the particular coil, how wound, and the valve base to be used. Small blobs of sealing-wax are applied in the manner indicated to prevent the windings from slipping before "painting" with "pure" amyl acetate. The 4B.A. screw and nut, corks and S.G. valve cap are taken from the junk-box.

Reference to the illustration will make apparent the method of assembly.—R. A. FENTON (Cambridge).



A novel coil assembly, using test tubes.

A Refresher Course in Mathematics

By F. J. CAMM

(*Continued from page 399, August issue*

Interest and Discount—Indices and Factors—Quadratic Equations

Compound Interest

THE interest due at the end of each year is added to the principal in compound interest, and thus the principal increases from year to year as the interest is added.

Let A = *Amount.*
P = *Principal.*
r = *Interest* on £1 per year, or stated period.
Then:

$$n=\frac{\text{Log } A-\text{Log } P}{\text{Log } (1+r)}$$

$$A=P\ (1+r)^n$$

$$P=\frac{A}{(1+r)^n}$$

Discount and Present Value

Discount represents the difference between the *Amount* and its *present value.* Expressed in another way, it is the interest on the present value for a given period.

Banker's discount, or *commercial discount* is the interest charged on the amount of the debt, and it is hence greater than the true discount.

The present value of a sum of money which is due at some future date is that amount of money which, plus its interest from the present moment to the time when the payment is due will equal the given amount.

The present value of £500, for example, due 12 months hence at 5 per cent., is £475, because the interest amounts to £25.

Let P = the Present value.
$D1$ = Banker's discount.
A = Amount of Debt.
r = Interest on £1 for one year.
n = Number of years.

$$A=P(1+nr)$$

$$A=\frac{D(1+nr)}{nr}$$

$$D=A-P=A-\frac{A}{1+nr}=\frac{Anr}{1+nr}$$

$$P=\frac{A}{1+nr}$$

$$D1=Anr$$

$$n=\frac{A-P}{Pr}$$

Factors

I have dealt in earlier articles with the elementary algebraic processes of addition, subtraction, multiplication and division, and it is now necessary for the reader to acquire a knowledge of factors and indices. In any algebraic expression which is the product of two or more quantities, its *factors* are those quantities.

The factors of $x^2+10x+21$ are $x+3$ and $x+7$, because when multiplied together they produce that expression. The process of finding the factors of an expression is known as *resolution*, or the *resolving* of the expression into its factors. It is a process reverse to that of multiplication. Now in algebra there are many expressions, or *identities*, which occur frequently, and because their factors may easily be recognised they must be memorised. When memorised, the factors of expressions having similar form may be extracted on sight and without calculation. Here they are:

(1) $(a+b)\ (a+b)$, or $(a+b)^2=a^2+2ab+b^2$
(2) $(a-b)\ (a-b)$, or $(a-b)^2=a^2-2ab+b^2$
(3) $(a+b)\ (a-b)=a^2-b^2$
(4) $a^3+b^3=(a+b)\ (a^2-ab+b^2)$
(5) $a^3-b^3=(a-b)\ (a^2+ab+b^2)$
(6) $(a+b)^3=a^3+3a^2b+3ab^2+b^3$
(7) $(a-b)^3=a^3-3a^2b+3ab^2-b^3$
$a^3+b^3+c^3-3abc=(a+b+c)\ (a^2+b^2+c^2-bc-ca-ab)$

If we meet the expression $x^2+2xy+y^2$, we know at once that the factors are $(x+y)\ (x+y)$, from the 1st of the algebraic identities given above; because these hold true no matter what letters are employed.

From this 1st identity $(a+b)^2=a^2+2ab+b^2$ we deduce the rule: *The square of the sum of two numbers or quantities is equal to the sum of the squares of the quantities plus twice their product.*

From the 2nd identity $(a-b)^2$ we deduce the rule: *The square of the difference of two numbers or quantities is equal to the sum of the squares of the quantities minus twice their product.*

From the 3rd identity $(a+b)\ (a-b)$ we deduce the rule: *The product of the sum and the difference of two numbers or quantities is equal to the difference of their squares.*

Suppose we encounter, during calculation, the expression 25^2-24^2. Remembering the rule for the 3rd identity, we write

$$(25+24)\ \ 25-4)=49\times1=49$$

This, it will be agreed, can be solved mentally once the rule is committed to memory. Without knowing the rule, some little time would be taken to work it out.

Another example:

$$\begin{aligned}&.245^2-.041^2.\\ =\ &(.245+.041)\ \ (.245-.041)\\ =\ &.286-.204\\ =\ &.282\end{aligned}$$

Suppose we wish to know the factors of a^4-b^4. Remembering the 3rd identity,

$$a^4-b^4=(a^2+b^2)\ (a^2-b^2)$$

We know from the 2nd identity that $a^2-b^2=(a+b)\ (a-b)$; therefore the factors of

$$a^4-b^4=(a^2+b^2)\ \ (a+b)\ \ (a-b)$$

Therefore, it can be said that a^n-b^n *can be divided by* $a+b$ *when* n *is odd, and when* n *is an even number it can be divided by* $(a+b)$ *and* $(a-b)$ *; and* a^n+b^n *is divisible by* $a+b$ *when* n *is odd.*

Now let us take the expression $a^2+13a+40$, the factors of which are $a+8$ and $a+5$. Here we see that:

The first term is the product of a and a, or a^2.
The middle term is the product of the first term and the sum of 8 and 5.
The last term is the product of 8 and 5.

From this, it is a fairly simple matter to find the factors of an expression.

Example: Find the factors of $a^2+8a+15$.

We know that the sum of the two numbers must be 8 and their product 15.

Now 6 and 2, 7 and 1, 5 and 3, 4 and 4 are pairs of numbers which total 8, but of these only one pair, 5 and 3, will give a product of 15. So the two figures required are 5 and 3 and the factors of $a^2+8a+15$ must be $(a+5)$ and $(a+3)$.

Find the factors of $x^2+22x+105$.

The sum of the figures must be 22 and their product 105. Split 22 into pairs of numbers:

21	and	1
20	,,	2
19	,,	3
18	,,	4
17	,,	5
16	,,	6
15	,,	7
14	,,	8
13	,,	9
12	,,	10
11	,,	11

Inspection shows that only one pair of numbers gives the product 105, and those are 7 and 15. Hence the factors of $x^2+22x+105$ are $(x+15)$ and $(x+7)$.

The factors may also be found by *Substitution*, that is, by substituting a value for x to bring the quantity to zero. Take the expression $x^2-15x+56$.

Inspection shows that two possible factors of 56 are -8 and -7, which equal -15 when added together, and $+56$ when multiplied together. To check this assume $x=8$.

Then $64-120+56=0$. As $x=8$, so $x-8=0$ and therefore -8 must be a factor.
Now try the other factor, 7.

$$49-105+56=0.$$

This value of x also satisfies the equation. As x in this case equals 7, then $x-7=0$, and so the factors of $x^2-15x+56$ must be $(x-8)$ and $(x-7)$. Prove by multiplying them together:

$$\begin{array}{r} x-8 \\ x-7 \\ \hline x^2-8x \\ -7x+56 \\ \hline x^2-15x+56 \end{array}$$

Examples

Factorise the following:

$$a^2-a-54$$
Answer: $(x+6)$ $(x-9)$.
$$a^2-22a+57$$
Answer: $(a-3)$ $(a-19)$.

What quantity must be added to x^2-2xy to make it divisible by $x-y$?
Answer: $\pm y^2$.
$$x^2-10x+4xy-y^2-32y+21$$
Answer: $(x-3+5y)$ $(x-7-y)$.
$$x^2y+5xy-4x+6y-8.$$
Answer: $(xy+3y-4)$ $(x+2)$.
$$ax^2y+bx^2y+3ay+3by-az-bz$$
Answer: $(x^2y+3y-z)$ $(a+b)$.
$$12x^2-13xy+14y^2.$$
Answer: $(3x-7y)$ $(4x-2y)$.

Indices

We have seen, in a previous article on logarithms, that the number which expresses the *power* of a number is termed the *index*.

Hence in $x^2, y^5, a^4, a^2y, xy^7$, the *indices* are, respectively, 2, 5, 4, 2 and 7.

The rules regarding indices which have been given in connection with logarithms also apply in algebra. We have seen that, in multiplying two numbers, such as 10^2 and 10^3, we *add* the indices, and write 10^5 as the product. It is important to remember that we must, when multiplying, only add the indices of similar quantities. If we wish to multiply 7^3 by 5^2 we must not add the indices and write 7^5. Simple arithmetic would prove that to be wrong; but if we need to multiply 7^3 by 7^5, we may add the indices, and express the product as 7^8.

The rule is: *To multiply together different powers of the same quantity, add their indices, when the numbers are positive.*

Thus, $x^4\times x^3=(x\times x\times x\times x)\ (x\times x\times x)=x^{4+3}=x^7$.

When one power is to be divided by another, the index of the divisor must be subtracted from that of the dividend.

Thus $\dfrac{x^5}{x^2}=\dfrac{(x\times x\times x\times x\times x)}{(x\times x)}=x^3$

Therefore: $\dfrac{x^5}{x^2}=x^{5-2}=x^3$

When the indices are symbols, the plus sign must be placed between them when the different powers of the same quantity are to be multiplied together, and the minus sign must be placed between them when they are to be subtracted.

Thus $x^m\times x^n$ would be written x^{m+n}, and $\dfrac{x^m}{x^n}$ would be written x^{m-n}.

When a power of a quantity is itself to be raised to a power, the indices must be multiplied together. Thus $(x^2)^5=x^{2\times 5}=x^{10}$

Similarly $\sqrt{x}$ is written $x^{\frac{1}{2}}$
$\sqrt[3]{x}$ is written $x^{\frac{1}{3}}$
$\dfrac{1}{\sqrt{x}}$ is written $x^{-\frac{1}{2}}$
$\dfrac{1}{\sqrt[3]{x}}$ is written $x^{-\frac{1}{3}}$

Fractiona Indices

The rules apply to fractional and negative indices. When multiplying a fractional power of a quantity by the fractional power of another quantity the indices are added, and similarly when dividing such fractional powers of quantities the indices are subtracted.

Thus $x^{\frac{1}{5}}\times x^{\frac{1}{3}}=x^{\frac{1}{5}+\frac{1}{3}}=x^{\frac{8}{15}}$ and $x^{\frac{1}{4}}\times x^{\frac{1}{4}}=x^{\frac{1}{4}+\frac{1}{4}}=x^{\frac{1}{2}}$; $x^{\frac{1}{2}}\times x^{\frac{1}{2}}=x^1$, and so on.

Hence $x^{\frac{1}{3}}$ means the cube root of x
$x^{\frac{1}{2}}$ means the square root of x
$x^{\frac{2}{3}}$ means the cube root of x^2

also $\dfrac{x^{\frac{1}{2}}}{x^{\frac{1}{4}}}=x^{\frac{1}{2}-\frac{1}{4}}=x^{\frac{1}{4}}$

and $\dfrac{x^{\frac{1}{4}}}{x^{\frac{1}{2}}}=x^{\frac{1}{4}-\frac{1}{2}}=x^{-\frac{1}{4}}$

and $\dfrac{x^{\frac{1}{3}}}{x^{\frac{1}{3}}}=x^{\frac{1}{3}-\frac{1}{3}}=x^0=1$

and $(x^2)^3=(x^3)^2$ (both equal x^6).

It is most important that the rules of indices be learned, and the following examples should be worked out:

$$x^{1\frac{1}{2}}\times x^{\frac{3}{4}}$$
Answer: $x^{2\frac{1}{4}}$
$$x^{\cdot 125}\times x^{\cdot 375}$$
Answer: $x^{\cdot 5}$, or $x^{\frac{1}{2}}$, or $\sqrt{x}$
$$\frac{x^5}{x^{\frac{3}{4}}}$$
Answer: $x^{4\frac{1}{4}}$
$$\frac{(x^5)^3}{x^2}$$
Answer: x^{13}
$$x^{\frac{1}{3}}\div x^{\frac{1}{2}}$$
Answer: $x^{-\frac{1}{6}}$
$$\frac{x^{-\frac{1}{2}}}{x^{-\frac{1}{2}}}$$
Answer: $x^0=1$
$$\frac{x^{-\frac{1}{2}}}{x^{\frac{1}{2}}}$$
Answer: x^{-1}, or $\dfrac{1}{x}$

Notice that the sign of the index of the denominator is changed. Thus in the last example:

$$\frac{x^{-\frac{1}{2}}}{x^{\frac{1}{2}}}=x^{-\frac{1}{2}-\frac{1}{2}}=x^{-1},\ \text{or}\ \frac{1}{x}$$

Fractions

Algebraic fractions are treated in the same way as arithmetical fractions, but in algebra it is often more convenient to write out the factors of an expression in simplifying the fractions. Factorisation of algebraic expressions has already been dealt with.

Remember that, as in arithmetic, when comparing, adding or subtracting fractions, they must have a *common denominator*, and the latter should for ease of working be as small as possible.

Take, for example, $\dfrac{1}{5a}+\dfrac{1}{4}$.

Multiply the numerator and denominator of $\frac{1}{4}$ by $5a$, obtaining $\frac{5a}{20a}$; now multiply the numerator and denominator of $\frac{1}{5a}$ by 4, obtaining $\frac{4}{20a}$. The latter is thus a common denominator.

Hence $\frac{1}{5a}+\frac{1}{4}=\frac{5a}{20a}+\frac{4}{20a}$

$$=\frac{5a+4}{20a}$$

Examples:

Simplify $\left(\frac{1}{2}+\frac{1}{2x}\right)\div\left(4x-\frac{4}{x}\right)$

Express this as a fraction in the usual way:

$$\frac{\frac{1}{2}+\frac{1}{2x}}{4x-\frac{4}{x}}$$

Now simplify by reducing to a common denominator:

$$\frac{\frac{2x+2}{4x}}{\frac{4x^2-4}{x}}$$

Here it will be seen that the numerator and denominator of $\frac{1}{2}$ have been multiplied by $2x$ to produce $\frac{2x}{4x}$; and the numerator and denominator of $\frac{1}{2x}$ have been multiplied by 2 to produce $\frac{2}{4x}$. As in arithmetic, the value of a fraction is not altered if numerator and denominator are both multiplied or divided by the same number—any convenient number.

Thus, $\frac{2x}{4x}+\frac{2}{4x}=\frac{2x+2}{4x}$

Now for the denominator portion. Here we write $4x$ as $\frac{4x}{1}$ and multiply numerator and denominator by x, producing $\frac{4x^2}{x}$; so we now have $\frac{4x^2}{x}-\frac{4}{x}$, which is the same as $\frac{4x^2-4}{x}$. Next write the whole as an ordinary fraction:

$$\frac{2x+2}{4x}\times\frac{x}{4x^2-4}$$

Note here the application of the rule for division in fractions, which applies: *Invert the divisor and multiply.* It will be seen that $\frac{4x^2-4}{x}$ thus becomes $\frac{x}{4x^2-4}$. Applying the usual rules, the expression becomes:

$$\frac{x(2x+2)}{6x(2x+2)(2x-2)}$$

$$=\frac{1}{6(2x-2)}$$

Here it will be seen that $x(2x-2)$ has cancelled out, leaving 1 for the numerator and $6(2x-2)$ as the denominator.

In this example advantage has been taken of factorisation to effect cancellation of quantities common to numerator and denominator.

Highest Common Factor

It is not always possible, however, to factorise, and we therefore, as in arithmetic, make use of the *Highest Common Factor* (H.C.F.), which is tantamount, as in arithmetic, to finding the *Greatest Common Multiple* (G.C.M.).

The highest common factor of two or more expressions is the highest expression which will divide without remainder into each of the expressions.

Suppose we wish to simplify:

$$\frac{a^4+a^3+2a-4}{a^3+3a^2-4}$$

First we divide the denominator into the numerator thus:

$$a^3+3a^2-4)a^4+a^3+2a-4(a-2$$
$$a^4+3a^3-4a$$
$$-2a^3+6a-4$$
$$-2a^3-6a^2+8$$
$$6a^2+6a-12$$

This equals 6 (a^2+a-2)

Now divide a^3+3a^2-4 by a^2+a-2

$$a^2+a-2)a^3+3a^2-4(a+2$$
$$a^3+a^2-2a$$
$$2a^2+2a-4$$
$$2a^2+2a-4$$

The Highest Common Factor is, as shown above, a^2+a-2.

Lowest Common Multiple

We find the *Lowest Common Multiple* when we wish to compare, subtract, or add two fractions. The lowest common multiple of the denominators of a fraction is the smallest expression into which each of the expressions will divide without a remainder.

One method is to find the H.C.F. of the expressions in the manner indicated above, divide one of the expressions by it, and then multiply the quotient by the other.

In the above example the H.C.F. of the two expressions has been found to be a^2+a-2.

Divide this into the first expression:

$$a^2+a-2)a^4+a^3+2a-4(a^2+2$$
$$a^4+a^3-2a^2$$
$$2a^2+2a-4$$
$$2a^2+2a-4$$

Therefore the L.C.M. of a^3+3a^2-4 is $a^2+2\ (a^3+3a^2-4)$.

Quadratic Equations

Factors, indices, H.C.F. L.C.M. and fractions are necessary for a proper understanding of methods of solving quadratic equations. Let us now return to them. As we have seen, any equation in which the highest power of the unknown quantity is 2, such as x^2+y^2, is known as a *quadratic equation.*

The well-known equation $a^2+2ab+b^2$ is a quadratic equation, and the solution of such equations is concerned with finding their *root*. A quadratic equation may contain the unknown in its first and second powers, or they may contain only the second power of the unknown. The simplest quadratics to solve fall in the latter class, and I shall deal with those first. Let us take a simple example:

$$5x^2=20$$

Then $x^2=\frac{20}{5}=4$

Then $x=\sqrt{4}$

$x=\pm 2$ (plus or minus 2).

It is important to remember the rule that *all quadratic equations have two roots.* We have seen in an earlier article that when two positive quantities are multiplied together the product is positive, and also that when two negative quantities are multiplied together the result is also positive. When a negative quantity is multiplied by a positive quantity the result is negative. Hence the rule: *The two roots of a positive quadratic are positive* or *negative.*

A real value for a negative quantity cannot be found, and so such quantities are termed *imaginary quantities*, and when roots of quadratics reduce to negative quantities they too are said to be imaginary and without practical meaning.

The square root of any positive number must, therefore, be positive or negative, and although in ordinary arithmetic we express the square root of a number as two positive quantities, they are really positive or negative.

Solve:

$$x=\frac{75}{3x}$$

By cross multiplication $3x^2=75$

and $x^2=\frac{75}{3}$

$x^2=25$

$x=\pm\sqrt{25}$

$x=\pm 5$

(Cont. on p. 452)

Solve:

$$5x^2+125=0$$
$$\therefore 5x^2=-125$$
$$x^2=-25$$
$$x=\pm\sqrt{-25}$$

This is an example of an imaginary quantity.

Now, in quadratics of the form $ay^2+by=16$ it is nearly always convenient to equate the quantity to zero as in the above example:

$$ay^2+by-16=0$$

It is necessary to understand what is meant by a *perfect square* before we deal with the general methods and formulæ for the solution of quadratics. For example the quantity $a^2+10a+25$ is a perfect square because its roots are $\pm a+5$. Thus

$$\sqrt{a^2+10a+25}=\pm(a+5)$$

Also $\sqrt{a^2-8a+16}$ is a perfect square because the factors are $\pm(a-4)$.

From these two expressions we can deduce a rule. Let us take the first two terms of each of the above expressions, a^2+10a and a^2-8a. It will be seen that to convert both to a perfect square 25 has been added to the first, and -16 to the second.

It is obvious that $25=\left(\frac{10}{2}\right)^2$, and $16=\left(\frac{8}{2}\right)^2$.

This, it will be seen, is in each case the square of $\frac{1}{2}$ the coefficient of a, and the rule is: *To convert an expression such as x^2+xy into a perfect square $\left(\frac{x}{2}\right)^2$ must be added to it.*

Hence x^2+xy becomes a perfect square, when $\frac{x^2}{4}$ is added to it.

So, in a general quadratic of the form $ay^2+by+c=0$, we must first make the coefficient of y equal to 1 by dividing throughout by a, and the equation becomes

$$y^2+\frac{b}{a}y+\frac{c}{a}=0$$

Transposing:

$$y^2+\frac{b}{a}y=-\frac{c}{a}$$

Now convert the left-hand side into a perfect square by adding the square of $\frac{1}{2}$ the coefficient of y (applying the rule already given), and to preserve the equality of the equation add the same quantity also to the other side.

The square of $\frac{1}{2}$ the coefficient of y is $\left(\frac{b}{2a}\right)^2$ and the equation becomes:

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

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

(To be continued.)

Radio Terms Defined

Capacity or Capacitance

ANOTHER component which is as vitally essential to a radio receiver and transmitter as an inductance is the condenser. Although a pure inductance has to possess very low self-capacity, it is necessary, in the case of tuned circuits, to use additional external capacity by employing condensers.

A condenser can be defined as that which is able to receive and retain a charge of electricity or, in other words, *electrostatic energy*.

The amount of energy which any one condenser will hold depends on the size and construction of the condenser.

A condenser consists of two or more metal plates, each of which is separated from its neighbour by some suitable insulating material or medium. This insulating medium is known as the *dielectric*, and it can be formed from such substances as mica, glass, bakelised paper or, as in the case of variable condensers, air, to mention only the most usual.

By virtue of their construction, i.e., no direct electrical connection between the two plates or set of plates, no *direct* current will flow through a condenser, but if such is applied to the plates, then the component will become charged.

The ability to receive and hold a charge in this manner is due to electrons and protons present in the conductors; the electron being the smallest possible quantity of negative electricity while the proton is its positive counterpart. When electrons are in motion, it is stated that an electric current exists, or, conversely, an electric current is due to the flow of electrons. When a voltage is applied, therefore, to the condenser, one set of plates receives additional electrons, and the other becomes deficient. The former will be in a negative state and the latter in a positive.

If the dielectric and construction is perfect, the condenser will hold its charge until a path is provided between the plates. If a piece of wire is joined to the two points, the additional electrons on the negative plate will flow or surge along the wire to the positive plate and constitute an electric current, as explained above.

The name condenser only applies to the actual component. When one wishes to speak of the ability of a condenser to take a charge it is usual to refer to the *capacity* or *capacitance*.

Dielectric Constants

The capacity of a condenser depends on the nature of the dielectric, the number of plates in each set or section, the area of the plates and the distance between each plate. As the nature of the dielectric plays such an important part in the resultant capacity, a table has been prepared showing the relative values of the different materials to air, which is taken as the standard or unit. Such values are known as the *dielectric constants* of the materials.

The variable types are used whenever it is required to tune the associated circuit by varying the capacity in or across the circuit. These are so designed that one set of plates is free to be rotated so that they interleave with the other set which is fixed.

The shaping of the plates, or vanes, governs the law which any particular condenser will follow as regards its variation in capacity with relation to the movement of the moving vanes.

For circuits requiring a constant capacity, condensers having a fixed value are used.

With these types, great care has to be taken in their construction to see that no variation can take place as regards the factors which control their capacity, otherwise, their value would vary over wide limits.

It is usual for the makers to specify definite voltages for the safe working of different types, and on no account should these figures be ignored, as a breakdown in a condenser might result in serious harm to the associated components.

Measurement of Capacity

The unit of capacity is the *farad*. This, however, is far too large for radio work, so this is divided into a *million* parts and the term *microfarad* applied to the new units thus formed. For high-frequency work, microfarads are often too large, so these are, in turn, divided by a million and we obtain the micro-microfarad.

It has been explained that a condenser will not allow direct current to pass through it, but it must not be thought that the same law applies to alternating currents.

With A.C. the plates will become alternatively charged positive and negative which, in effect, will be equivalent to the alternating current passing through the condenser. Considerable use is made of this property in radio apparatus.

Comment, Chat and Criticism

Post-war Broadcast Programmes

Suggestions for Improving Wireless Musical Entertainment

By Our Music Critic, MAURICE REEVE

THERE is little doubt that the B.B.C.'s post-war plans are well under way. The end of the war won't arrive finding it in doubt or irresolution concerning what it intends giving the public. We have already heard rumours of a radio city that is going up in place of Broadcasting House, and we need not hesitate to prophesy that television will be the main inspiration in formulating programmes.

In spite of the fact that the highbrow and the lowbrow hate each other and all their works, and that Mr. Brown, compelled to listen to a Brahms symphony from next door on a hot summer's afternoon, turned on "Swing those hips, baby," as loudly as it could be blared out to drown the too cerebral efforts from over the wall; the pre-war programmes were designed with much ingenuity and gave a large measure of satisfaction to many listeners.

It was amazing, all things considered, how wide was the sphere of activity through which we were taken during a day's programmes. Considering that he must only belong to a small minority of the listening public, the highbrow music lover had little to complain of so far as total hours given to his art was concerned.

Good Music

A keen musician once said to me, "it is really appalling how little good music is broadcasted." I had studied the *Radio Times* rather carefully that week, so I was able to correct, and astonish him at the variety of classical music that had come over just then. Symphonies, concerts, chamber works, songs, piano recitals, Bach's Chorals, all manner of famous and beautiful things were performed that week. Unfortunately they were, for the most part, given in tiny doses of fifteen or twenty minutes; the symphonies, etc., were in splendid isolation, and I think I am correct in saying that the B.B.C. Symphony Concert from the Queen's Hall on the Wednesday evening was the only thing of its kind. To make matters worse, the "snippet" programmes were given at the most impossible times—I often broadcasted at 7.45 a.m. and 6.30 p.m., and even my musical soul rebelled at having to play the Moonlight Sonata before my eggs and bacon, so I am sure it must have been much worse for those listening and frying at the same time—that my friend, and I am sure many others, missed many of those plums that week.

Awkward Hours

What the music lover had given him with one hand was often taken back with the other. Often my own friends, after making every effort to listen in to my broadcasts, with the personal element adding to their efforts, would have to admit it was impossible to do so owing to the "awkwardness of the hour." Whilst nothing can ever be perfect for anyone all the time, the music lover—for the most part a professional or business man or woman or a busy housewife, was frequently scurvily treated in this respect.

The twin programme is obviously necessary for avoiding the worst exasperations of tuning, and I suggest that a triple one is really indispensable if as near complete satisfaction as is attainable is to be given. I also advocate the segregation of different types of entertainment on to the one programme, so as to avoid that other annoyance of constantly having to "change over" and "fiddle about" for the new wavelength. I see no reason why two or three consecutive hours of classical music, or of any other particular kind of entertainment, cannot be given in one dose. To those whom it is a "dose," I would say, "there is nothing in the world to stop you fiddling about and looking around for something else you may prefer," but my highbrow listener cannot sit down to it at any other time and as to him it is a banquet and not a "dose" of anything he must come first! As the same line of thought would be applied to all and every taste, no one would be accused of favouritism.

In this way a person could have a complete evening's music, drama, opera, music-hall, or what he would. The need for potted opera and special radio abbreviations of plays would disappear. A man could listen to "Hamlet" or half a dozen Beethoven quartets without being made to feel that he was being cursed by others. That admirable series the "Foundations of Music" deserved many of the jests and much of the ridicule that was heaped upon it—there was no sense in, or reason for, having to listen to the last movement of one Beethoven sonata and the first two of another—as frequently happened—except the observance of the fetish that they must not exceed twenty minutes!

Mechanical Reproduction

Another point—mechanical reproduction should be made of most of the programmes, and the third "station" could consist of the other two rearranged and shuffled, enabling one to hear certain items one day which they were unable to attend to when they were first given. This is being done now, to a limited extent. The cinemas do it by giving a popular film on a Sunday which was in the weekly bill a few weeks before.

Another, and very important, point. Most people, and especially the better informed on any given subject, must be very tired of the way the B.B.C. insisted on "teaching" its listeners through the medium of its announcers or the *Radio Times*. Certain famous works are broadcasted several times during a year, but to hear Beethoven's or Tchaikovsky's "Fifth" prefaced each time with such a comment as, "This symphony, the most popular of all the master wrote, was created at the height of his powers. Coming, as it did, hard on the heels of the Fourth, the Sixth quartet, the opera 'So and So,'" etc. "B—— (or T——) was overflowing with creative genius, and this justly famous work is fairly packed with some of his most beautiful melodies and original harmonies," etc. I suggest that the B.B.C. get all such comments off its chest at the first performance each year of all the great masterpieces.

Broadcasting House

I have no space left in which to discuss the possibilities of television in post-war broadcasting, but will conclude with a few words on the temple from which our wireless entertainment will emanate in future. Broadcasting House is an unlovely and an unloved place. It was a sort of cross between the Regent Palace Hotel and a penitentiary for ladies and gentlemen. It took ages—many broadcasts—before one could get to feel "at home" there, which probably accounted for many of the spiritless performances given from there. Also, it seemed to have been designed on very unbusiness-like lines, and I should imagine it was a very "difficult" and "tiring" place for those who had to work long hours.

The Broadcasting House of the future should consist of many buildings. I see no reason why offices, control rooms, concert and music-halls, theatre, church—almost everything, in fact, should be centralised under one roof and, as it were, between four walls. All the departments above mentioned need their own special atmosphere and intimate associations if the best performances are to be given in any branch of art. And no wonder we didn't always hear that "best" when soloists had to perform in the church and actors in the music-hall

Impressions on the Wax

Review of the Latest Gramophone Records

H.M.V.

SERGE KOUSSEVITZKY and the Boston Symphony Orchestra give a wonderful performance of Mozart's Symphony No. 29 in A major, K. 201, on *H.M.V. DB*5957 and 5958. It is in four parts. The first is concerned with the first movement—allegro moderato—which is a merry tune into which is introduced a second subject in march rhythm. The first part of the second movement—andante—is on the reverse side, and it is —in my opinion—one of the finest parts of the symphony. It is a most graceful movement—rich in beautiful work for the strings. Part two, *DB*5958, completes the second movement and continues with the third, minuetto and trio.

The Preludes to Act 1 and Act 3 of La Traviata, by Verdi, are recorded on *H.M.V. DB*5956—double-sided—by the N.B.C. Orchestra, conducted by that great *maestro* Arturo Toscanini. The recordings are distinctly outstanding—not solely because of the features already mentioned—but by virtue of the wonderful recording balance of the N.B.C. Orchestra, which was—in fact—specially established for Toscanini by the National Broadcasting Company of America. The individual instruments are beautifully defined.

At any time a beautiful player, Moiseiwitsch rises to great heights in his masterly performance of Beethoven's Sonata No. 21 in C Major (Waldstein), Op. 53. There are three records, *H.M.V.* C3289 to 91; five sides are occupied by the Sonata, and the sixth records Rondo in C, Op. 51, No. 1.

The first recording by the popular screen comics, Bud Abbot and Lou Costello—with The Sportsmen Quartet—is entitled, "Laugh, Laugh, Laugh," and it is the highlight of the latest releases in the variety section. It is in two parts on record *H.M.V. BD*1009.

From the Dance Section, I have selected one of Joe Loss's latest, "Moonlight Cocktail" and "You Again," *H.M.V. BD*5748.

Parlophone

"THAT'S a promise to you" and "I'll just close my eyes," are the two numbers—both in fox-trot time—which Billy Thorburn, H. Robinson Cleaver and Don Adams as the vocalist, offer on *Parlophone F*9116.

Joe Daniels and his Hot Shots in Drumnasticks, has selected "Time on My Hands" and "Down Beat," for his contributions this month. *Parlophone F*1915.

Geraldo and his Orchestra give a fine performance of that fascinating tune, "Blues in the night," which is featured in the film of the same name. On the other side of the disc is "Moonlight Cocktail," and Geraldo presents it in a style which makes most enjoyable listening. *Parlophone F*1914.

Tin Pan Alley Medley No. 46 consists of a selection of the latest popular hits, which Ivor Moreton and Dave Kaye—on two pianos—weave into a skilfully arranged medley on *Parlophone F*1918.

Columbia

COLUMBIA have released two fine recordings by Louis Kentner playing Polonaise in A Major and Etude in C Minor, Op. 10, No. 12, by Chopin. These are on *Columbia DX*1083, and deserve every recommendation.

"The Marriage of Figaro," Mozart, provides excellent material for that talented soprano, Joan Hammond, who, accompanied by The Hallé Orchestra, gives a beautiful rendering of the (Recit): "Still Susanna Delays" and (Aria): "Whither Vanished." These occupy both sides of *Columbia DX*1082.

The Regimental Band of H.M. Grenadier Guards have recorded "Ballet Russe" (No. 2)—Valse Lente—and "Ballet Russe" (No. 5)—Marche Russe—by Luigin, on *Columbia DB*2078. These are two fine recordings.

Isobel Baillie, on *Columbia DB* 2080, sings in a delightful manner the famous traditional ballad "Comin' Thro the Rye" and "Think of Me."

Turner Layton, at the piano, sings "I'll Just Close My Eyes" and "Somebody Else's Children," on *Columbia FB*2807.

Two piano solos by Carroll Gibbons, "Smoke Gets in Your Eyes" and "The Way You Look To-night," are on *Columbia FB*2804, which I recommend.

Victor Silvester's Strings for Dancing, offer "Morgenblatter", J. Strauss, arr. Silvester, and "Waltzing in the Ballroom," which introduces Bal Masque; Thoughts; Valse Vienna and Valse Septembre, *Columbia FB*2805. For those who like it "hot," Nat Gonella and his Georgians serve up "He Stole My Heart Away," and "Who'll Buy a Rose from Margareeta?" with Nat taking the vocals. The record is *Columbia FB*2800.

Decca

IN the Decca releases, I find two more notable pianoforte records. The first I tried is a particularly good recording of an equally good performance of Schubert's Sonata in A Minor, Op. 164—allegro ma non troppo—by Kathleen Long. It is on both sides of *Decca K*1067.

Moura Lympany—with such exquisite expression and technique—records three more of the Rachmaninoff 24 Preludes on *Decca K*1028. She has selected No. 14, in E Major, Op. 32, No. 3; No. 18 in F Major, Op. 32, No. 7, and No. 13 in B Flat Minor, Op. 32, No. 2.

Those which I have extracted from the 10 in. F series are chiefly in the Dance section, but there are two exceptions, one of which is the Bournemouth Municipal Orchestra, playing that rather fine piece, the "Dance of the Hours" from La Gioconda. It is recorded on both sides of *Decca F*8150.

The other record is by that popular artiste Adelaide Hall, who makes a splendid recording of "Song of the Islands," and "The Pagan Love Song," Her vocal performance is enhanced by the accompaniment by Ronald Peachy and his Royal Hawaiians. *Decca F*8058.

Mantovani and his Orchestra, on *Decca F*8145, put up a fine show with "Spanish Cocktail," a medley of Spanish numbers, and a rumba serenade "Siesta."

"Strange as it May Seem," vocal by Anne Shelton, and "This Love of Mine," are the two numbers recorded by Ambrose and his Orchestra, *Decca F*8156. Hatchett's Swingtette offer "Watch the Birdie," and "I Said No," on *Decca F*8140. "Somebody is Taking My Place," and "You Again," are played by Oscar Rabin and his Band on *Decca F*8144, while Bob Crosby and his Orchestra, on *Decca F*8158 give "A Zoot Suit" and "Don't Sit Under the Apple Tree."

Brunsw ck

THE single record I have to mention from the Brunswick list is one which gives two recordings by the ever-popular Deanna Durbin. She has selected two well-known numbers, "Love's Old Sweet Song," and "When the Roses Bloom Again," which she sings well. *Brunswick O*3334*B*.

Rex

THE Band of H.M. Irish Guards have recorded two fine Marches on *Rex* 10,134. They are entitled "With Sword and Lance," a splendid martial air, and "By Land and Sea," which is a ceremonial march.

Billy Cotton and His Band play "Moonlight Cocktail" and "This Love of Mine," on *Rex* 10,135. On *Rex* 10,137 Joe Petersen gives a vocal rendering of "Where the Bluebells and the Heather Grow Together," and "Somebody Else is Taking My Place." He is accompanied by James Bell at the Wurlitzer Organ.

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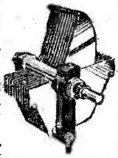

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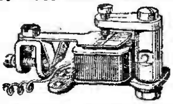

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THE object of an H.F. choke is, as its name implies, to choke back the high frequencies, and for this purpose inductance only is required. The smallest capacity will by-pass the high frequencies and, therefore, an efficient choke would consist of an inductance only. Commercially, it is not practicable to wind a choke of this nature, but the distributed capacity can be kept at a very low value by adopting the sectional winding.

Cutting Down the Bass

"I have built a splendid A.C. receiver, but it gives rather too much bass for my liking. I believe it is actually due to the loudspeaker, as the values in the circuit are quite standard, and one of the L.F. stages is fed with the transformer. What is the simplest way of reducing the bass notes—if possible, with some sort of adjustable reducer?"—C. H. T. (Hounslow).

A TONE control may be fitted in your loudspeaker circuit if this is used with an output-filter circuit. You need a large-capacity condenser, say, .25 or .5 mfd., and a variable resistance of 15,000 ohms. The latter should be connected across the condenser and the two should then be inserted in series with one loudspeaker lead. Adjustment of the resistance value will vary the degree of low-note response, and, obviously, when the resistance is short-circuited it will short-circuit the condenser and the normal response of the receiver will be obtained.

Parallel-fed Transformer

"Would you be kind enough to show me how I may be able to change an ordinary L.F. transformer to a parallel-fed transformer coupling unit, and let me know what resistances I must use for same?"—P. J. (Wigan).

THE parallel-fed arrangement is simply the addition of a resistance and condenser, and the three components may be mounted on a small ebonite panel or the resistance and condenser may be mounted direct on the transformer. The connections are as follows: Anode of the valve to one side of resistance and one terminal on the fixed condenser. Other terminal of resistance to H.T. positive (or decoupling components), and other terminal on condenser to terminal P on transformer. Terminal H.T. on transformer is joined to earth, whilst terminal G is joined to the grid of the next valve, and the G.B. terminal is, as usual, joined to the grid-bias battery. It is, however, possible to modify the ratio of the transformer by various combinations of the four connections, and this has been explained on several occasions in our pages.

Reaction Problems

"In examining various commercial coils I notice various methods of winding the reaction coil. Is there any rule which should be followed? Furthermore, the condenser used to control reaction seems to vary from .0001 to .0005, and may be differential or ordinary. As a beginner I am somewhat confused and should like to know the ins and outs of this business."—H. P. (Bristol).

ALL that is required in a reaction circuit is that a coil shall be inductively coupled to the grid coil and the degree of H.F. feed-back controlled by a condenser. Obviously, therefore, the size of the coil, its position in relation to the grid winding, and the capacity of the condenser will all be inter-related and must generally be found by trial and error. The differential condenser, having two sets of fixed vanes, allows an anode by-pass circuit to be used and controlled by the setting of the reaction condenser.

RULES

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons:—

(1) Supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.
(5) Grant interviews to querists.

A stamped, addressed envelope must be enclosed for the reply. All sketches and drawings which are sent to us should bear the name and address of the sender.

Requests for Blueprints must not be enclosed with queries, as they are dealt with by a separate department.

Send your queries to the Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. The coupon on page iii of cover must be enclosed with every query.

Pick-up Connection

"I have a four-valve A.C. mains receiver which gives exceptionally good quality of reproduction on radio, but when I connect a pick-up between the grid and the cathode of the detector valve I cannot get faithful reproduction of gramophone records."—P. R. (Harrogate).

AS you have connected the pick-up lead to the cathode of the detector valve, this valve is not biased, and therefore it cannot function very satisfactorily as an amplifier. The pick-up leads should be connected between the grid of the valve and the earth line of the set, and a bias resistance should be connected between the earth line and the valve cathode. The value of this resistance should be chosen in accordance with the valve manufacturer's instructions, and it is advisable to connect a condenser having a capacity of approximately 1 mfd. across it. Biasing will not be necessary for rectification, however, and therefore the leak grid should be joined between the grid and the cathode.

Removing Hum

"With further reference to your letter, I have not tried the centre-tapped resistance across the heater terminals. Could you give me some idea of the values to use and outline the principle? Is the centre tap connected to earth? The L.T. windings on the mains transformer are already centre-tapped and earthed."—W. S.(Chelsea).

THE usual value for the resistance is 30 or 50 ohms. Although the actual L.T. winding is centre-tapped, it is possible that this centre point is unbalanced by the actual heater circuit wiring, and thus it is often found advisable to remove the connection between this point and earth and to fit a small potentiometer of the above value direct to the heater terminals on the valve-holder in the receiver. The arm of this potentiometer is then joined to earth, and it may thus be moved about until an exact electrical balance is found and the hum removed. It will not, of course, remove hum due to other causes, but it is one of the first precautions to take when hum difficulties are encountered.

A Speaker Problem

"I am contemplating constructing a receiver which specifies a 2,500-ohm field. I should like to use my speaker, which has a 2,000-ohm field. Could you please inform me what adjustments are necessary to enable me to do this?"—J. W. (Bristol).

AS the circuit has been designed with a resistance of 2,500 ohms in the H.T. positive line it is necessary to adhere to this value, and therefore, as your speaker is 500 ohms short of the total required, all that is necessary is to include a fixed resistance of 500 ohms in series with the field winding. A substantial component, such as a Bulgin 20-watt wire-wound resistance, should be used.

Blueprints

"I wish to get a wiring diagram of a commercial five-valve A.C. superhet. Do you stock blueprints of the products of the various British firms?"—H.K.L. (Mitcham.)

NO, the blueprints we publish are those covering only our own designs. Suggest you write to the makers.

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).

Centring M.C. Speaker Cones

SIR,—Many of your readers will doubtless be interested in the following dodge for the rapid centring of moving-coil speaker cones, which I have successfully used over a period of years. All that is required is a mains transformer with a filament winding, and a screw-driver, the method being as follows: Slacken off the centre fixing screw and then apply an A.C. current to the speech coil. Due to the opposing magnetic field between the speech coil and the field magnet, the coil will then automatically centre itself in the gap. While the current is still switched on, carefully tighten the centre screw. Make sure that there is a washer under the head of the screw, as this will prevent the action of tightening the screw from throwing the coil off centre. For the ordinary low resistance coil, an A.C. voltage of 2 volts is ample. This system also has the advantage that the coil is centred while actually vibrating, i.e., under working conditions.—L. HOLLINGWORTH (Ealing).

L.T. From Dry Cells

SIR,—I read with interest Mr. F. G. Rayer's letter in the August issue of PRACTICAL WIRELESS. A few days afterwards I read in the same issue under the heading "Component Tolerances" the following:

"What is not always as obvious is that if the voltage is too low the valves might be still more seriously affected. The reason is that if the heater is not raised to the correct temperature, the 'sucking' of the electron stream from it causes gradual disintegration. This is, of course, most pronounced in the case of large-power output valves and rectifiers, the anode current of which is comparatively heavy. It is very easy to ruin a high-efficiency output valve taking a high anode voltage by under-running the filament or heater."

I think I previously stated in correspondence that the valve might be injured if the anode voltage was increased to make up for the loss of volume when using a 1.5 volt dry cell. It seems probable that it depends on the value of the voltage applied to the anode. I have found a 1.5 volt dry cell very useful for experimental work, and I have not noticed any damage to valves, probably because I have not used high anode voltages.

It would be interesting to test two valves of similar characteristics over a period, one with 120 volts on the anode and 2 volts on the filament, and the other with 20 to 40 volts on the anode and 1.5 volts on the filament, with suitable G.B. voltages, and note the condition of each valve at the end. I have not the time for this experiment, but I still favour a 1.5 volt dry cell for experimental work, where only small anode currents and voltages are required.—D'ARCY FORD (Exeter).

SIR,—On the subject of L.T. supply from dry cells, last year my brother and I built a little portable having two 2-volt 0.1 amp. valves in series, working from a 4½ volt box battery (and two 9 volt G.B. batteries in series for the H.T.). The results have been most satisfactory, the voltage appearing not at all too high, and, as the current drawn is one-third or less of that taken by a bulb, the battery has a very useful life (an ordinary flat type battery could, of course, be used, but the terminals on the box type make the latter much more convenient). Only once has the portable's performance been poor, and this I discovered was caused by the L.T. leads to the box battery having been unknowingly reversed. One point, however, which has to be borne in mind when using the above arrangement, is that both valves must take the same current.—R. V. GOODE (York).

Transmissions from WRUL

SIR,—I have just made a three-valve set from an old circuit in PRACTICAL WIRELESS; it has two Cossor 220 V.S.G.s and a triode output. It also has four-pin coils, and not six as specified. So far I have only received the normal American stations. I recently received a letter from WRUL, with their programme schedule, and here are a few extracts: 10.00 a.m. to 10.55 a.m., Monday through Saturday (beamed to Far East) 17.75 mc/s and 15.35 mc/s. 11.00 a.m. to 12.30 p.m., Monday through Saturday (beamed to Middle East), 17.75 mc/s and 15.35 mc/s. 1.15 p.m. to 6.30 p.m., Monday through Saturday (European beam), 11.73 mc/s, 9.70 mc/s and 6.04 mc/s. Sundays: 10.00 a.m. to noon, 11.79 mc/s, 11.75 mc/s (European beam); 2.00 p.m. to 7.00 p.m., 9.70 mc/s, 11.79 mc/s, 6.04 mc/s (European beam); 7.00 p.m. to 9.15 p.m., 9.70 mc/s, 11.79 mc/s, 6.04 mc/s (beamed to Western Hemisphere). There is a programme for Australia on Mondays, Wednesdays, Fridays at 5.15–5.30 p.m. News at 10.00 a.m. and last-minute bulletins at 10.45 a.m. (Mondays through Saturdays). News bag at 4.45 to 5.00 p.m. on Mondays, Wednesdays and Thursdays. On Mondays at 7.00 to 8.00 p.m., there is instruction in the international morse code. Times are Eastern War Time.—B. G. MEADEN (Liverpool).

B.B.C. Postscripts

SIR,—May I congratulate you upon your excellent comment on "Government Speakers on the Air." Your remarks might also, I think, have included such persons as are so often inflicted upon us in unnecessary postscripts. There is one who, not only in his talks, but also in his plays and sketches, bores thousands of listeners.

It seems that the B.B.C. has fallen off its non-political perch, for not only does it constantly hand over its microphones to various undesirables, who all have an axe to grind, but in its news it seems to give undue weight to the views of these undesirables even when away from the microphone.

What, if anything, can be done by the ordinary long-suffering individual except switch off in disgust? Or is it wrong and anti-social to be an *individual* any more?—ANTHONY J. NOTT.

Superhet Alignment

SIR,—After reading the article by "Experimenters" on "Radio Examination Papers" I should like to point out, with reference to superhet alignment, that in correct commercial practice the superhet is lined differently from the method outlined by the "Experimenters." Usually the second I.F. is lined first, and *then* the first I.F. For additional accuracy—particularly where good short-wave reception is essential—the meter is fixed across the cathode bias resistor on the I.F. valve (when A.V.C. is used).—N. SOLOMONS (Finchley).

A Moving-coil Milliammeter

SIR,—I see in "Notes from an Amateur's Log-book" in the July issue, an account of a project to design and make one's own moving-coil meter.

Having done this over 20 years ago, resulting in a meter which has been in constant use ever since, I would point out that the springs gave me little trouble, two non-magnetic watch hair springs being used. The bearings were two of the kind that are used in small alarm clocks for the balance wheel spindle. These I sent to a firm of jewellers, who fitted them with agates. What I found the most difficult work was the fitting of the pivots to the ends of the moving coil so that they were central with the coil, square to it, and dead in line with each other. This is necessary if the air gaps are to be kept short, which is important for sensitivity. My scale is 4in. long, divided into 60 divisions, each equal to one hundredth of a milliampere: that is, the full scale reading is .6 of a milliampere with no shunts.—A. O. GRIFFITHS (Wrexham).

Stations WCW and WLWO

SIR,—I would like to thank Mr. A. T. Whithorn for his reply to my letter concerning station WCW. This station has always given WCW as its call sign, however, its owners as "Press Wireless," and its locality as New York. I have never as yet picked up the station of which he speaks, namely, WOWO. It is, of course, just possible that the ownership may be the same and consequently the programmes of both stations might be identical.

On the other hand, there exists another station on the 19-metre band with a very similar call sign to the one he gives. This is station WLWO, whose studios are in Cincinnati, Ohio, and transmitters at Mason. The owners and operators in this instance are the Crossley Radio Corporation of America.—JOHN W. MACVEY (Kelso).

SIR,—I disagree with K. T. Whithorn's statements in the August issue concerning station WCW. This station transmits news on the 18-metre band every hour from Radio City, New York.

With reference to WOWO, this is in actual fact WLWO transmitting on the 19-metre band from the same place with the same programme. Recently, on five consecutive evenings I have received the above stations with my 0-v-1 battery receiver, sometimes on the loudspeaker. As from July 12th, WLWO now operates on a wavelength of 25.6 metres, as well as on the 19-metre band.—E. G. COLLIER (Henley-on-Thames).

S.W. Broadcasts

SIR,—In reply to two B.L.D.L.C. members, the "Voice of Free India," announcing variously as "Azadian Radio" and "The Voice of Azad Hina," operates on 20.39 and 26.16 metres, 14.74 and 11.47 mc/s (14.00-16.00 G.M.T.) and on 14.47 mc/s only (01.30-03.30). As far as I know, the station is German-controlled. As regards WGEO on 9.53 mc/s, I have not heard it, but according to the G.E.C.'s programme summary (14.00 on WGEA, 15.33 mc/s) it works to Latin America 22.00-03.30, to Europe 04.00-05.00, and to Australia 10.00-12.00.

The C.B.S. have a new European schedule: WCBX on 15.27 mc/s, 10.00-19.45; WCRC on 11.83 mc/s, 10.00-19.30, and WCDA now appears to work on 9.59 m/cs, 19.30-20.45, but has never been heard. The first few hours are also transmitted on a Latin American beam in either the 19 or 31-metre band.

WCW, 15.85 mc/s, works 13.00-22.45; WCB, also owned by "Press Wireless," transmits in French on 15.58 mc/s, 19.45-20.45; WDO on 14.47 mc/s, works 12.00-16.15 and 16.30-22.00.

Chungking transmits news in English on XGOY on 11.90 mc/s at 31.30, and the Australian stations VLG7, on 15.16 mc/s, and VLR8, relay London at 20.45 and give news at 21.95. VLG7 works 20.30-22.10 and 02.00-04.00 on 15.16 mc/s. A summary is given at 21.00 of all Melbourne short-wave stations.

Guatemala gives English announced programmes each Sunday on TGWA, 15.17 m/cs between 20.45 and 22.00.

A station was heard on 14.42 m/cs on June 27th at 18.35 calling SCY, Lisbon, in English. Could it be identified?

VWY2 in Bombay transmits to London each Saturday on 17.97 mc/s between 11.15 and 11.45. All times are G.M.T.—D. W. KAHAN (Harrogate).

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.

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(Continued top of page 460.)

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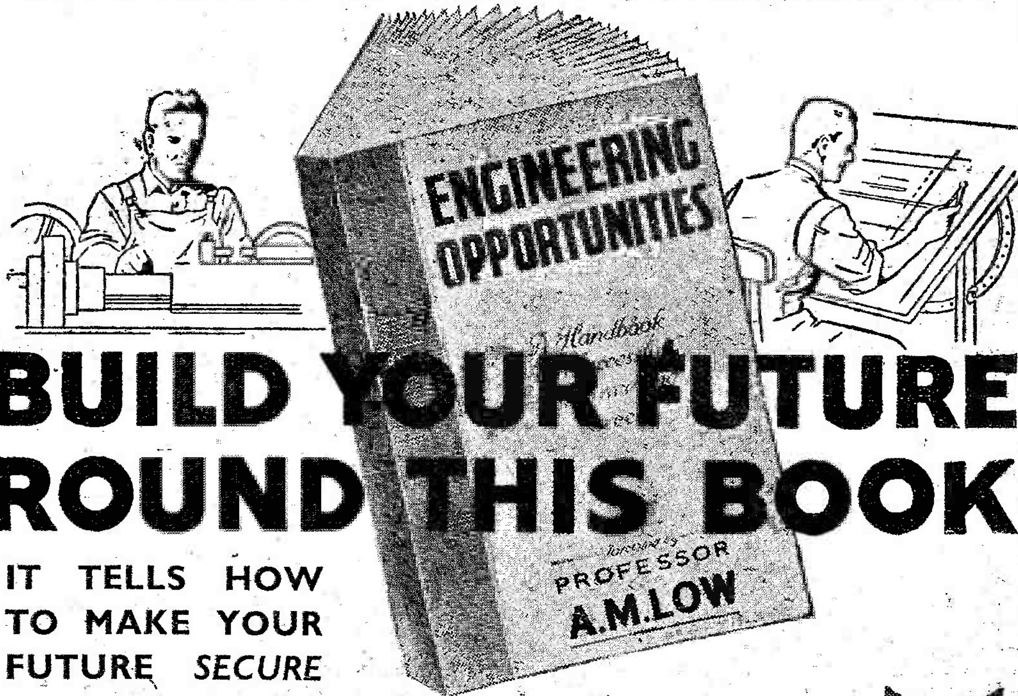

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