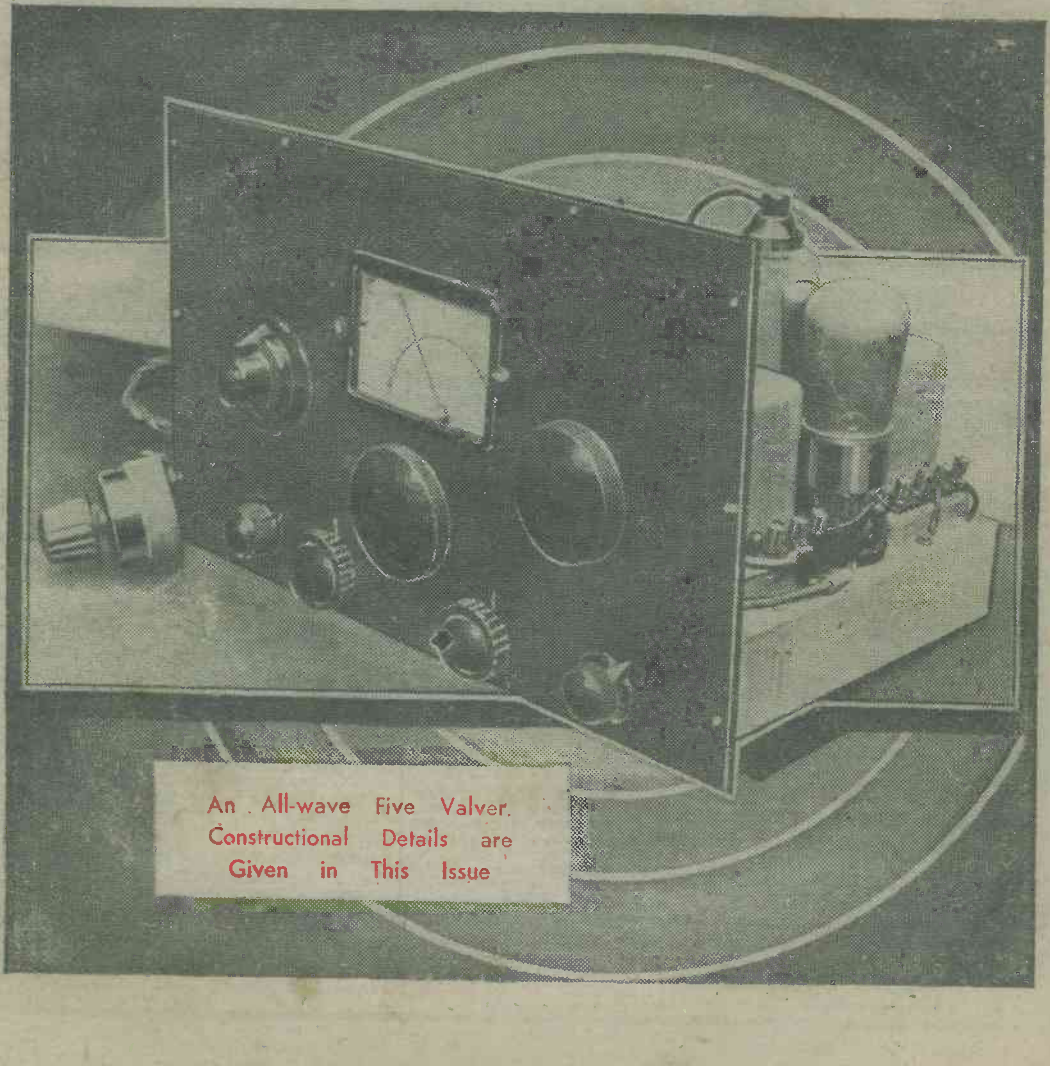
CURRENT AND VOLTAGE REGULATION

Practical Wireless 9D EVERY MONTH

Editor F. J. CAMM

Vol. 21 No. 465 NEW SERIES MARCH, 1945



An All-wave Five Valver. Constructional Details are Given in This Issue

Practical Wireless

and PRACTICAL TELEVISION

13th YEAR OF ISSUE

EVERY MONTH.
Vol. XXI. No. 465. MARCH, 1945.

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Radio Industry Council Formed

The Radio Industry Council

THE new Radio Industry Council is a fusion of the British Radio Equipment Manufacturers' Association, the British Radio Valve Manufacturers' Association, the Radio Component Manufacturers' Federation, and the Radio Communication and Electronic Engineering Association. Thus, the old Radio Manufacturers' Association ceases to exist as such.

At the inaugural luncheon recently held, Mr. F. B. Duncan outlined the work of the industry, adumbrated future developments, and dealt with the possibilities of post-war television.

Wireless transmission and reception originated in these islands as a result of the work of Marconi, Fleming, Clerk-Maxwell, and others. It is often forgotten that British Broadcasting was started by half a dozen commercial firms who started a new industry and art which has benefited the whole of mankind.

It was in 1922 that these six manufacturers held a meeting, pooled their money augumented by a fund created by general subscription to which all manufacturers contributed, to start a radio programme in London. This operated as the British Broadcasting Company, but as a result of public demand for more rapid development and expansion the Government stepped in and took it over as the British Broadcasting Corporation. The developments since that date do not need to be retold. We know that they led to the first television service. A great amount of money has been spent and lost in developing television, but the outbreak of war dealt it a crippling blow just as it was in process of perfection.

Radiolocation

THE scientific development, however, made possible radiolocation, and it also provided the scientists, engineers and craftsmen, who operated the laboratories, factories, and staffed the technical units of the armed forces. The industry, therefore, was confronted with the dual task of rapidly expanding its output, and also providing trained personnel for the Services. As output increased so did the demand for service personnel, so the industry had to take in novices and train them, as their own skilled people joined the Services.

Factory space, personnel, methods and machinery have all expanded during the war, and as a result the industry manufactured enormous quantities of scientific gear. Radiolocation apparatus enabled men on the ground to detect and plot the course of enemy aircraft which was miles away. Every anti-aircraft gun-site, and every searchlight in this country was equipped with special radiolocation gear which reduced the human error in sighting. New discoveries enabled British naval vessels to be the first to apply dead-accurate gun laying by radio beam. In 1941 an Italian fleet was sunk by the guns of British cruisers in pitch darkness.

On D-Day a new type of radiolocation enabled airborne and parachute troops to be accurately concentrated by radio on minute landing areas in complete darkness, and to-day pin-point aerial bombardment is assured by the recently disclosed "black box" which gives the pilot an ever-changing picture of the earth seen below him so that neither darkness, cloud, nor fog obscure the target.

Dealing with the question of the new Council Mr. Duncan said that the radio industry from its earliest day has realised the need for co-operation within the industry, and for this reason various sections have maintained their own associations, but they realised also that there were political, technical and other questions that needed coordinating, and so the Radio Industry Council has been established.

It aims to continue the expansion in the use of radio and electronic apparatus of every kind, and to develop the export market.

Post-war Television

AN immediate expansion of work in the field of television is anticipated when the war ends, and the Council has made its submission to the Television Committee under Lord Hankey for an immediate restarting of the pre-war system of television, not only in London, but for the whole of the country.

Attention was drawn to the great possibilities in the use of electronic technique, particularly in the fields of navigation, railway traffic, and in cooking and heating. Thus, the radio trade can look forward to great prosperity as a result of war developments.

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

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

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

ROUND THE WORLD OF WIRELESS

New Year Honours

MR. W. A. DAWSON, toolroom foreman on the staff of Whiteley Electrical Radio Co., Ltd., has been awarded the British Empire Medal. Mr. Dawson has been in the service of the company for over fourteen years, and this award is a tribute to the skill and tireless effort that he and his department have shown during the past five and a half years of war.

The M.B.E. has been conferred on Mr. J. M. Lawrence, who has been production manager of the Philips factory organisation since November, 1940. Prior to that he had been in charge of the drawing office since he joined the company in 1929.

Mr. W. A. Dawson.

Another member of Messrs. Philips's staff, Mr. G. T. Egan, has been awarded the B.E.M. Mr. Egan has been toolroom superintendent since March, 1937.

The award of the B.E.M. has also been made to Mr. Kenneth Warwick, assistant chief inspector of the Philco Radio and Television Corporation Ltd.

Sponsored Radio

WE understand that large offers involving tens of thousands of pounds from British and American firms for permission to relay sponsored programmes from Radio Eireann, the Irish broadcasting station, have been turned down by the Eire Government. Splendid!

Telephony by Tube

IT was stated at a radio meeting held in Newcastle last month that radio engineers were experimenting with telephony on very short waves, sent through tubes instead of being radiated like a broadcast programme. The advantages of the system are said to be almost complete freedom from atmospherics, or the interference of car ignitions.

Obituary

COMMANDER VALENTINE HARRY GOLDSMITH R.N. (retired), general manager of the B.B.C.'s publications, has died in London at 58. He served in the North Sea during the last war.

Joining the B.B.C. as assistant director at the Manchester station in 1924, he later took charge of the B.B.C.'s administration branch in London, became director of business relations in 1933, and general manager of publications in 1936. He was chairman of the committee responsible for the design and decoration of Broadcasting House studios.

B.B.C. War Reporting Unit

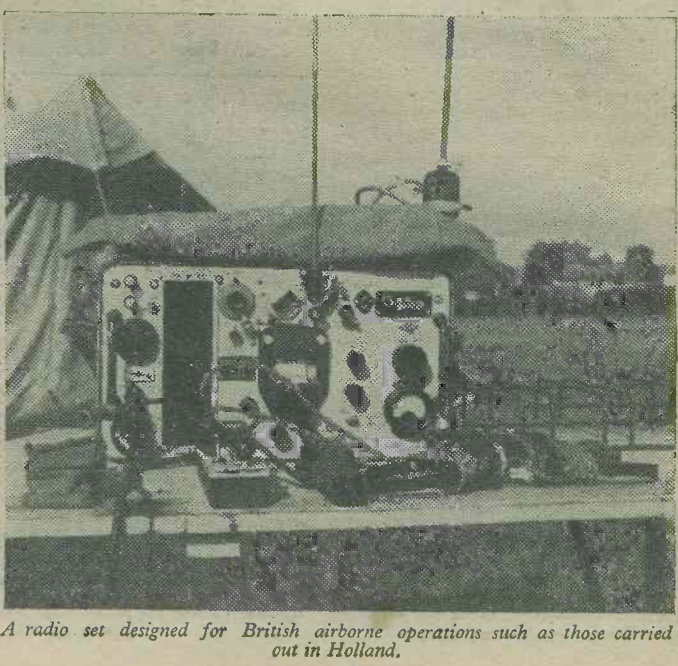
THE great event in broadcasting during 1944, as in most fields of national service, has been the invasion of Normandy. On D-day the War Reporting Unit of the B.B.C. came into operation. This new unit reaped the fruits of much experience of battle reporting. One corps of special reporters, many of them veterans of other campaigns, received training with the units they were to accompany. B.B.C. engineers had produced new equipment; for example, a recording apparatus, little larger than a portable gramophone, which the reporters would carry into action with them, and new mobile field "studios" and transmitters. Thus many broadcasts of historic action were obtained in the weeks following D-day when B.B.C. men went with the forces on to the beaches, and jumped with the airborne troops. Those war reports were fully shared by American networks and stations, and it is reported that 725 out of 914 American stations used B.B.C. invasion reports.

Further Milestones of 1944

OTHER milestones in the year 1944 included the expansion of ABSIE (American Broadcasting Station in Europe) on April 30th. For this the B.B.C. provided all technical facilities, while there was a mutual arrangement for broadcasting time.

In November, the B.B.C.'s own messages from enemy prisoners-of-war in our hands were expanded into actual programmes by those prisoners to their countrymen.

In the overseas services, broadcasting throughout the Empire has been maintained. The main developments both within and beyond the Empire have been in the strengthening of broadcasts in Japanese, Chinese, Indian and other Eastern languages. The B.B.C. office in New Delhi has also been considerably built up during 1944. These activities are signs of the recognition of the coming importance of the Eastern field of war. Our



A radio set designed for British airborne operations such as those carried out in Holland.

friendly co-operation with American broadcasting has also been marked by a further extension of re-broadcasting. In other fields, the general policies and arrangements of the previous year have been maintained.

"Europe and Ourselves"

OUR men are at the moment fighting in Europe; V-bombs and rockets are being fired at us from there; citizens of European countries are walking about our towns and villages in British battle dress with the flashes of Poland, France and other Allies on their shoulders. We know these men, but what do we know of the countries from which they come?

Europe is separated from Britain by twenty-two miles of water, or a few minutes' flying time, yet to many of us it is a place that is completely strange, containing "far away countries of which we know nothing."

"Europe and Ourselves," a new series of weekly talks which began on January 15th, should do much to remedy this sad deficiency. The first five broadcasts are analytical talks on the countries of Europe; the next three deal with its soil, its people and its governments; and lastly come three controversial discussions on the future.

This new series of talks contains questions which are certain to affect the lives of every British citizen as the Government's housing scheme, full employment and social security, and the speakers will discuss them in the same every-day terms.

"X-Ray" Bombsight

ACCORDING to a recent announcement one of the war's most closely guarded secrets, details of which have lately been released, is the "X-ray" bombsight, which has been developed with the aid of radar. All Allied bombers and fighters are now fitted with this invention which enables airmen flying in dense cloud or fog to "see" their targets. The pilot simply switches on his set, and a continuous wave is transmitted from the plane to the ground. The wave hits the ground and rebounds, while in the cockpit of the plane there appears on a small screen an image of the target. The picture is not as clear as a television picture, but the outlines are presented in sufficient detail to permit of accurate bombing.

Radar is a development of radiolocation, and Sir Robert Watson-Watt —who was knighted for his work on the anti-aircraft device—is one of the team of British scientists who developed radiolocation to produce radar.

Pictures by Radio

SUBMARINE telegraph cables play an important part in the communications system that has been built up behind our armies in the Mediterranean. The cable ship "Mirror" is one of the fleet of cable ships owned and operated by Cable and Wireless Ltd, and she has been on active duty in the Mediterranean since the Allied landings in North Africa. Part of the duty consists in transmitting pictures by radio to headquarters in London (see illustration on this page).

Radio-controlled Flame Thrower

IN a recent German broadcast it was announced that a new secret weapon has been put into operation on the Western front. It was described as a radio-controlled flame-thrower battery with a jet of flame 200 yards long, which starts burning only 50 yards from the battery itself.

I.E.E. Meeting

AT a meeting of the Institution of Electrical Engineers (Radio Section), held in the Lecture Theatre of the Institution, Savoy Place, Victoria Embankment, London, W.C.2, on January 16th, a discussion of "Frequency Allocation for Long Distance Communication Channels (over 1,000 miles)," was opened by R. L. Smith-Rose, D.Sc., M.I.E.E.

An additional ordinary meeting of the I.E.E. was held on January 25th when a discussion took place on "Part-time Further Education at Technical Colleges—Including Courses for those Returning from the Forces" (Second Report on Education and Training for Engineers). This Report, prepared by the Post-War Planning, Education and Training and Personnel Sub-Committee, was presented by Sir Arthur P. M. Fleming, C.B.E., M.I.E.E., at the ordinary meeting on January 18th.

Radio Factory for India!

AT a recent conference attended by six Indian scientists visiting this country, Prof. S. K. Mitra, of Calcutta University, stated that two leading radio concerns had begun negotiations in India for the establishment of either an assembly plant, or a factory for the manufacture of radio components in India.

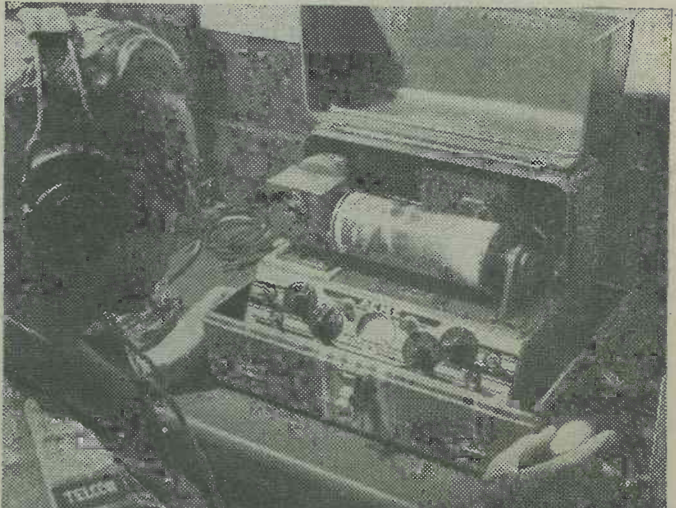
Post-war Television in U.S.

AT the Television Broadcasters Association Congress held recently in New York, it was stated that soon after the war television sets would be available to the general public at about £75.

But—only cities with a minimum population of half a million could support a television broadcasting station.

FM Sets in U.S. Army

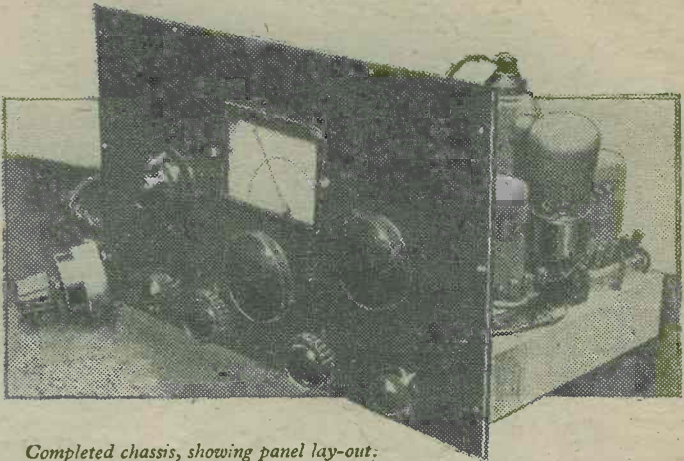
IT is learned that the American Forces in Italy used FM pack transceivers during the Anzio landings, and they are probably now in general use. It has been proved to be a valuable item of radio equipment, and particularly successful for amphibious communications.



Transmitting a picture by radio to London from the cable ship "Mirror," somewhere in the Mediterranean.

AN ALL-WAVE FIVE

Incorporating Some Novel Features



Completed chassis, showing panel lay-out.

THIS receiver has a number of interesting and novel features, all of which enhance the results obtained. The main advantage of the circuit lies in the fact that no switching whatever is used in the S.W. detector circuit, wave-change switching being carried out by switching the filament circuits so that the desired portion of the receiver is operative.

A separate S.W. detector complete with tuned circuit is used, and as this is independent of the rest of the circuit results are equal to those provided by an ordinary short-wave set. Band-spreading is used, the band-spreading condenser being ganged with the condenser used for tuning medium and long waves.

It will be seen that the intermediate L.F. stage is optional, a double-pole double-throw switch transferring the output from the detectors either to the anode of the L.F. valve or to the parafeed transformer connected to its grid. It will be found very useful to be able to switch in this stage when listening to weak short-wave signals, while when the H.F. stage is operating on medium or long waves the stage is not generally needed.

'Phones may be connected to the primary of the second L.F. transformer for short-wave listening, and the optional L.F. stage can be switched in or out as before. When using 'phones, the output tetrode is switched off in its filament circuit.

For medium- and long-wave operation, a V.M. H.F. stage is available, although for economy in local listening setting the change-over switch in the central position cuts out this stage. A separate switch is used for selecting the medium- and long-wave bands.

It will be seen that the following circuits are immediately available by setting the switches in appropriate positions: o-v-o, o-v-1, o-v-Tetrode, or o-v-2 on any wavelength. Ditto on long and medium wavelengths with H.F. stage if desired. The receiver will consequently be found very satisfactory and interesting to operate.

A manufacturer's surplus metal chassis was used, 8in. by 11in. by 2in. deep. Looking at Figs. 1 and 2 it will be seen that there is not a great deal of wiring to be done. The components should be placed upon the chassis and all holes marked for drilling. If a large drill is not available for the valve-holder holes, ¼in. holes can be drilled to coincide with the valve pins mounting the holders below the chassis. This is done with the L.F. and output stages.

When all the large components have been secured with small bolts, wiring can be commenced. No difficulty should arise in this. Fig. 2 shows connections to the octal coil-holder, or the manufacturer's leaflet can be consulted. The coil-holder is mounted above the chassis on 1½in bolts to shorten wiring. Any standard screen coils available can be used in the medium- and long-wave tuning section of the receiver, those shown being the Wearite "Unigen."

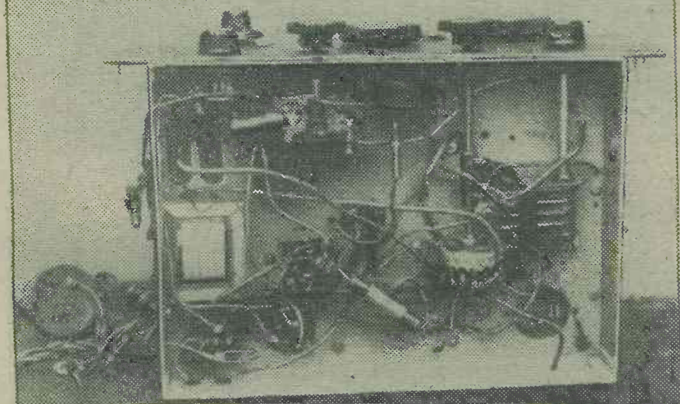
Any type of tuning dial can be used, provided it is smooth in action. It is so located that the short rear spindle of the band-spreading condenser coincides with the spindle of the two-gang .0005 condenser, and a flexible coupler is used to transmit the drive as shown in Fig. 1. It may be necessary to raise the gang condenser with spacing washers, but this depends upon the exact component employed.

Insulated wire is used and connections should be run as shown. One lead only requires screening, that from the long- and medium-wave detector anode to the H.F.C. Use screened wire for this lead, connecting the outside braid to the chassis.

The valve-holders between the two screened coils were fixed to the top of the chassis to enable better wiring to be obtained. (See Fig. 1.)

The V.M. potentiometer is secured to the side of the cabinet in a position as shown in Fig. 1. Two sockets for 'phone connections are also secured to the side of the cabinet, together with the switch for disconnecting the filament of the output valve when desired.

Fig. 2 shows sub-chassis wiring. No difficulty should arise in wiring the switches. The left-hand switch (Fig. 2) is for selecting medium or long waves.



Under chassis view.

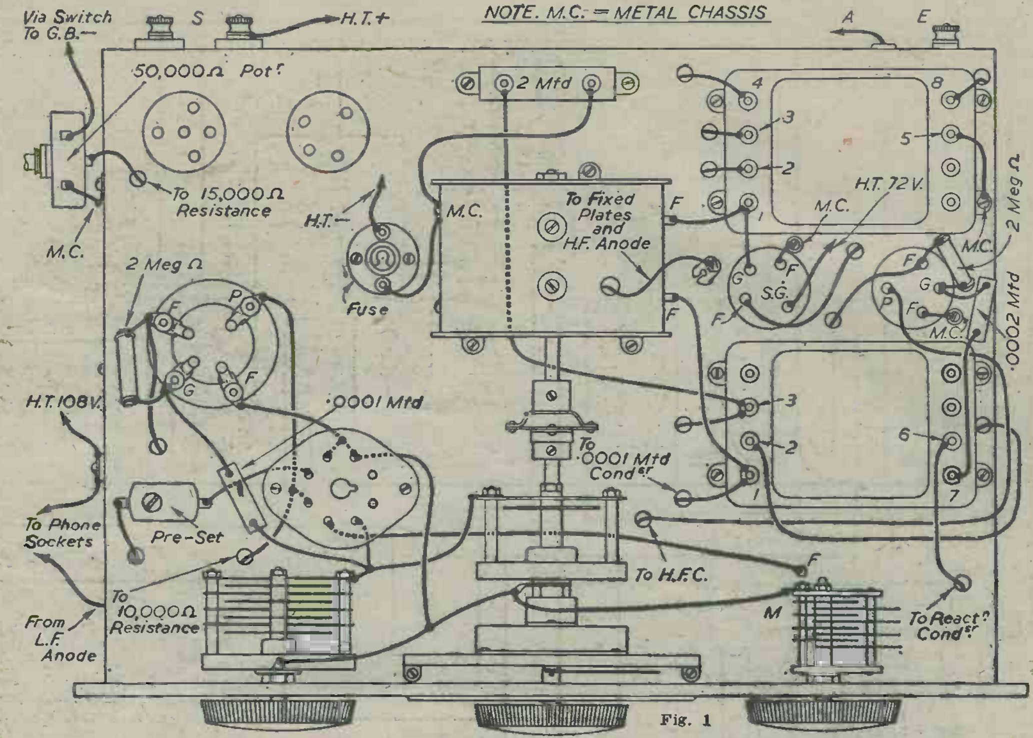
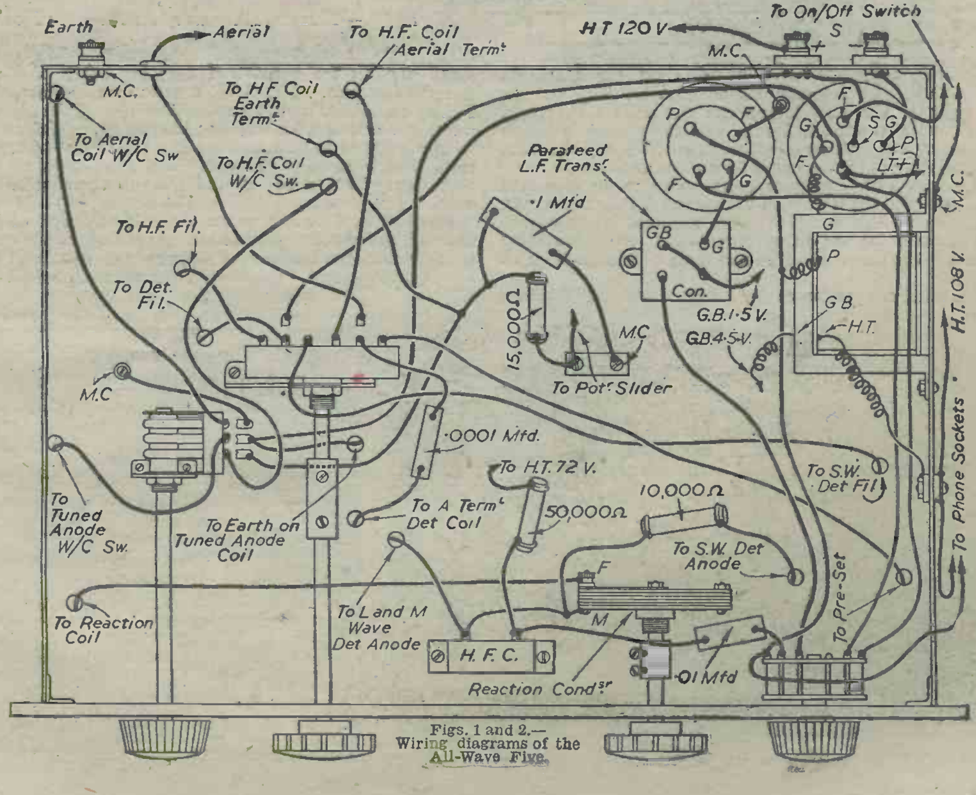


Fig. 1



Figs. 1 and 2.—Wiring diagrams of the All-Wave Five.

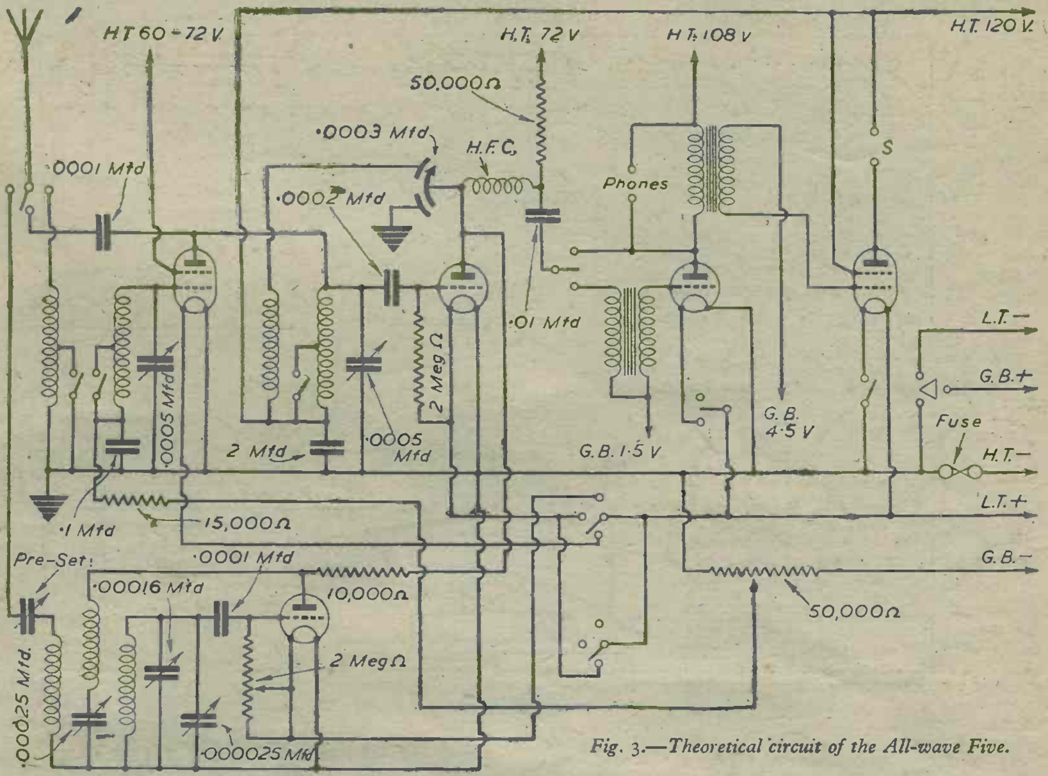


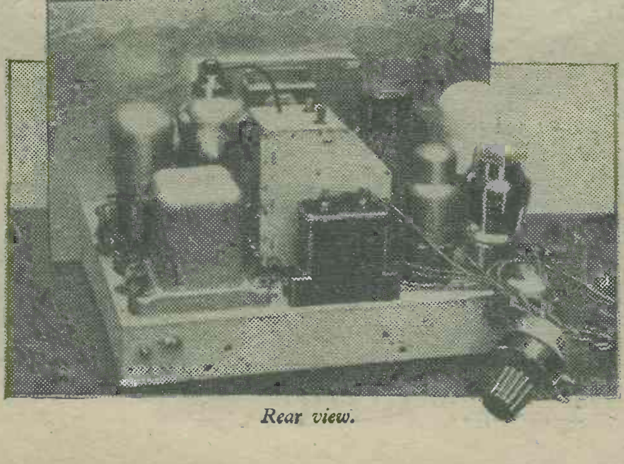
Fig. 3.—Theoretical circuit of the All-wave Five.

The switch adjacent to it switches on the filaments of the H.F. and detector valves (consult Fig. 3). To the right is the switch for the optional L.F. stage. Next to it is the medium- and long-wave reaction condenser, the spindle of which must be insulated from the chassis as it is connected to the detector anode.

The 15,000 ohm resistor is anchored to an insulated strip, and also the lead from the second L.F. transformer, as shown in Fig. 2. No aerial terminal is employed. The three-point on-off switch is of the household "pear" type connected to the ends of the leads as in Fig. 3.

The band-set condenser (left, Fig. 1) was fitted with a small dial on the panel and a spring catch to give a definite location. The S.W. reaction condenser (right, Fig. 2) needs only a plain knob. The back of the plywood panel is covered with foil and braced by being screwed to the front of the cabinet up the edges and along the top. The bottom of the cabinet is removable, so that access may be had to the underside of the chassis with ease.

If when first switching on there is any sign of L.F. instability the connections to the secondary of one of the transformers can be reversed. There is considerable L.F. amplification, and the transformer cores should be at right angles as shown in Fig. 3.



Rear view.

COMPONENTS

Octal coil-holder with 6-pin coils to tune from 9 to 170 metres (or as desired). (Premier Radio.).
.00016, .00025 and .000025 mfd. short-wave condensers.
Flexible coupler.
Tuning drive and dial.
.00006 pre-set.
4-pin baseboard mounting valve-holder.
Three chassis mounting 4-pin holders. One 5-pin ditto.
2-gang .0005 condenser.
50,000 ohm potentiometer.
2 mfd. condenser.
Fuse and holder.
One double-pole double-throw switch.
One triple-pole triple-throw ditto.
One 3-point ditto for on-off switching.
One 3-point ditto for wave-changing.
.1 mfd. paper condenser.
15,000, 50,000, 10,000 ohm and two 2-megohm resistors.
Two .0001 mfd. mica condensers. .0002 paper condenser
.0003 solid dielectric reaction condenser.
One .01 paper condenser.
Parafeed transformer. L.F. transformer for direct feed.
High-frequency choke.
Two screened dual-range coils.
Knobs, pair of plugs and sockets, rod for extension spindles, etc.
S.G. or H.F. pentode ; two detectors ; L.F. and output tetrode.

Current and Voltage Regulation

A Brief Explanation of Methods Adopted for Stabilising Voltage and Current Supplies for Receivers, Transmitters and C.R. Tubes

THERE are many occasions on which a stable voltage or current supply is essential for correct operation of a piece of equipment, and the methods of obtaining such a supply are both interesting and instructive. One of the most obvious instances of the need for a stable current supply is in connection with a D.C. or A.C./D.C. receiver which must be suitable for operation from mains supplies of differing voltage. Despite the variations of supply voltage, it is necessary that the heater current through the valves should remain uniform. Wide changes, either upward or downward, would result in impaired efficiency and reduced life of the valves.

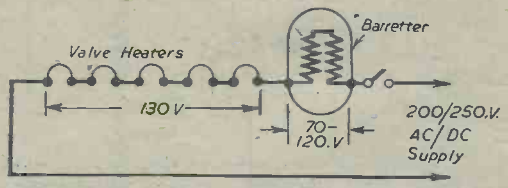


Fig. 1.—How a barretter is used to regulate the current passed by the heaters of an A.C./D.C. receiver intended for use on mains voltages between 200 and 250. The voltage figures given are representative values added for the purpose of giving an example.

Current Stabilisation

The simplest and most effective method of stabilising the heater current in such a case is by the insertion of a barretter ("Amperite" is a usual American term) in the heater circuit, as shown in Fig. 1. The barretter is similar in construction to an electric lamp bulb, but the filament is usually of iron wire, while the bulb contains a gas, such as hydrogen, at low pressure. The device is designed to pass a certain current, and it will do so despite wide changes in applied voltage. As the applied voltage is increased and therefore the current through the filament tends to rise, the filament resistance increases and so cancels the tendency for an increase in current.

Barretters are made for a range of current-carrying capacities, and with various voltage-dropping ranges. For example, the Osram type 202 is rated at .2 amp. and has a working range of voltage drop of 120 to 200. The type 304, on the other hand, passes .3 amp., with a voltage range of 95 to 165. In practice, a type is chosen which will pass the required heater current and which has a working range from the difference between the total heater voltage and 200 volts to the difference between the total heater voltage and 250 volts. That assumes that the voltages of the mains on which the receiver is likely to be used will lie within the range 200 to 250; in practice, a far wider working range will generally be available, as may be gathered from the examples quoted above.

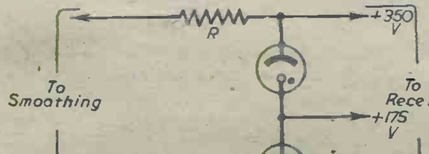


Fig. 3.—Two stabilisers in series for higher voltage; a tapping is provided for an intermediate voltage.

Use of Barretters

When the current to be stabilised is less than the rated current of the nearest barretter available, the circuit may be shunted by fixed resistors in order to obtain the degree of control required. A barretter operates at a dull red heat; at lower temperatures the control effect falls off; at higher temperatures there is a danger that the filament will be burnt out. It should be remembered that the device will dissipate a good deal of heat when in use, and therefore that adequate ventilation must be provided. Another point to bear in mind is that the barretter should not be situated in a strong magnetic field if damage to the iron filament due to attraction and consequent distortion is to be avoided.

H.T. Voltage Regulation

Voltage stabilisation first came into prominence in connection with wireless receivers when class B and Q.P.P. amplification were first employed. If a receiver with an amplifier of one of these kinds were to be operated from a mains-driven power pack the H.T. voltage would fluctuate violently, in sympathy with the variation in H.T. current, which is a feature of the amplification systems under consideration. Changes in H.T. voltage would produce distortion of a serious nature. In passing, it should be stated that changes in H.T. voltage with current are due to the D.C. resistance of the rectifier and smoothing choke. A special low-resistance metal-oxide rectifier was produced which, to a large extent, overcame the difficulty. In general, however, it is desirable to employ a voltage regulating device of the neon-tube variety; a circuit is shown in Fig. 2. It will be seen from the circuit that the neon or gas-discharge tube is connected in parallel with the H.T. supply to the receiver. The neon must be of a type which has a striking voltage slightly below the nominal H.T. voltage.

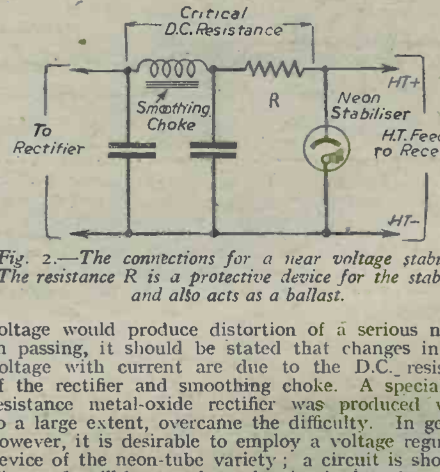


Fig. 2.—The connections for a near voltage stabiliser. The resistance R is a protective device for the stabiliser and also acts as a ballast.

Action of the Neon Stabiliser

Thus, when the power unit and set are first switched on the neon will glow, indicating that a current is being passed through the neon. When the receiver is drawing its maximum H.T. current and therefore the H.T. voltage is at a minimum the neon tube will just glow, passing a low value of current. But as the H.T. consumption of the set falls and the rectified voltage from the power unit tends to rise in consequence, the voltage applied across the neon will rise. As a result the neon will pass more current. At intermediate current consumptions the neon will pass more or less current. The shunting effect of the neon regulator will therefore ensure that the H.T. voltage actually applied to the receiver will remain constant.

It will be noted in Fig. 2 that a fixed resistor is shown in series with the smoothing choke between the rectifier and the H.T. output terminals. The purpose of this is to prevent an excessive current from being passed by the neon in the event of a disconnection in the receiver H.T. circuit. Its value is dependent upon the particular neon regulator in use and the D.C. resistance of the choke. For one type of regulator the combined resistance of the choke and resistor should be 1,800 ohms.

When the maximum H.T. supply voltage is too high for an easily obtainable regulator, it is possible to connect two in series, as shown in Fig. 3. In that case, the junction between the two may be used as a supply point for a lower H.T. voltage. It is also possible to connect two regulators in parallel when increased regulation is required. A circuit for this is shown in Fig. 4, where it will be seen that an additional small resistor is included in the anode circuit of each regulator. The purpose of this resistor is to "balance" the two tubes and so to prevent one of them—which may have a slightly lower striking voltage—from acting as a short-circuit to the other.

A Triode Valve Regulator

A simple type of valve voltage regulator of a type which may be used to control a high voltage is shown in Fig. 5. Here it will be seen that the anode and cathode are connected to the H.T. positive and negative supply points, while the grid is connected (through a minimum-bias battery) to a slider on a shunt resistor. As the current drain falls the voltage drop across the series resistor falls, so causing a higher voltage to be applied to the anode of the valve. That, in itself, results in the valve passing a higher anode current and so tending to equalise the current load. In addition, however, the voltage applied to the grid becomes more positive, or less negative. That also results in the passage of an increased anode current. The grid therefore acts in the capacity of an "amplifier" as far as the action of the valve is concerned.

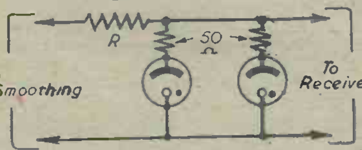


Fig. 4.—Increased current variation can be dealt with by connecting stabilisers in parallel as shown.

An "Amplified-Control" Regulator

A valve type of voltage regulator in which a greater degree of "control amplification" is provided is shown in Fig. 6. Here use is made of a triode of low-impedance type and capable of passing a heavy anode current and also a pentode. Although the final voltage control is provided by the triode, the triode is itself controlled by the pentode. It will be seen that the bias on the pentode is fixed by means of a bias battery in the cathode circuit, and that the grid is connected to a slider wired across the supply output leads. There is a high resistance in the anode circuit of the pentode, and this provides the bias for the triode.

Should the load on the output fall, the voltage would tend to rise. This would cause an increase in positive bias to the pentode grid (which is equivalent to a reduction in negative bias) and so result in increased anode current. At the same time the screening grid would become more positive, this also producing a rise in pentode anode current. As the anode current rises the voltage drop across the anode load resistor increases, so making the anode less positive, or more negative. And since the anode is connected to the grid of the triode, the negative bias on the grid is increased. This has the effect of increasing the impedance of the triode and so cutting down the output voltage. This counteracts the initial tendency for the voltage to rise and so maintains the voltage at a constant value

If the load on the output terminals were to rise the supply voltage would tend to fall. This would reduce the positive bias on the pentode grid and also the positive voltage on the screen. The anode current would therefore fall, and with it the voltage drop across the anode load resistor. The negative bias on the grid of the triode would, in turn, be reduced, causing an increase in curent through the triode. The latter would compensate for the increased load on the output terminals.

It is obviously inconvenient to introduce a dry battery into a system of this sort, but at the same time the operation of the circuit is dependent upon the application of a steady bias voltage which is independent of supply variations. To overcome the battery difficulty, the battery may be replaced by a neon tube. For reasons which have already been explained, this will result in the application of a stabilised bias voltage, and will give exactly the same result as that obtained by the use of a battery.

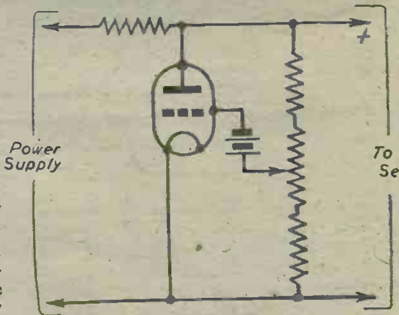


Fig. 5.—A triode value used as a voltage regulator.

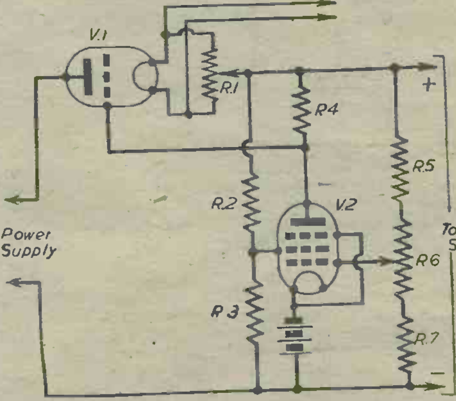


Fig. 6.—A voltage-stabiliser circuit which gives a very good range of control. The components shown are: V.1, triode of high anode current rating; V.2, pentode control value; R.1, "humdinger"; R.2 and R.3, screening grid potentiometer; R.4, pentode anode load; R.5, R.6, and R.7, control grid potentiometer.

In a circuit such as this, it is desirable that the triode should be of the directly heated type, since there would be a high potential difference between the heater and cathode; this could result in breakdown of insulation. It is also necessary that a separate L.T. winding be provided on the transformer to supply the filament of the triode, which is "up in the air" in relation to other filament and heater circuits. For similar reasons, the extra L.T. winding should be very carefully insulated from the other windings. Although the pentode grid is shown as being connected to a slider on the potentiometer R.6, the setting is not altered once the correct adjustment has been found.

Interference Prevention

Some Easily Applied Methods of Eliminating the Effects of Interference and Jamming are Explained in this Article

THE subject of this article is an old one, but it is one which has become more than usually topical of late. One reason is that during war conditions there can be little or no control of international broadcasting; another is that the enemy is doing his utmost to put out his "fake" news, and at the same time to prevent our world broadcasts of "real" news from reaching countries outside the British Empire. This set of conditions gives rise to both interference and jamming.

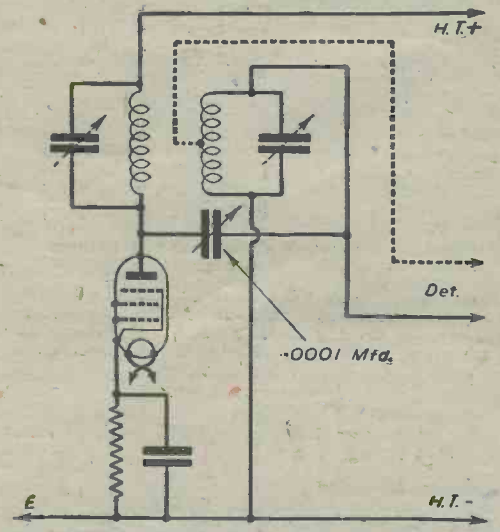


Fig. 1.—Variable-selectivity I.F. by using "top capacity" variable coupling and a means of increasing selectivity by taking the "detector" lead from a centre tap instead of from the end of the I.F. transformer secondary.

Interference and Jamming

Perhaps it would be well in the first place to draw a clear distinction between interference and jamming, because they are quite different, although they may bring about the same result. By interference we mean the unintentional spoiling of one broadcast by another on or near the same frequency. Jamming on the other hand can be described as interference of a deliberate nature. All readers are no doubt familiar with the "warbling" note heard on the B.B.C. foreign-service broadcast on a wavelength in the region of 350 metres. This, one may assume, is intended as a form of jamming; it may not cause serious interference in this country, but might well blot out the transmission at points nearer to the jamming transmitter.

Interference is usually noticed as a heterodyne whistle when two transmitters are operating on closely spaced frequencies. Alternatively, it might take the form of "side-band splash" which is heard as a general distortion when two transmitters on fairly close frequencies are modulating at the same time. This form of interference is most noticeable during a "silent" period, or break in programme, of either station. The other one can be heard, probably distorted, due to the receiver not being correctly tuned to it, but more clearly than when both transmissions are being modulated. Either station can be heard clearly when the other is completely "off the air."

Receiver Faults

Before deciding that a whistle or "drone" is due to interference it is a good plan to try listening for a few minutes at different times of the day on the frequency where trouble is experienced. If the interference or whistle is always present, it may be that it is due to a fault in the set, if it is of the superhet type. In that case it will be necessary to look round for poor earth-bonding of screens, a loose coil or I.F. transformer can, or a defective I.F. valve. Another test that may give an indication consists of replacing the aerial by a short length of wire; a faint whistle due to interference should then cease. If the interference is present right round the tuning dial, or over a fair portion of it, one may assume with fair safety that the fault is internal and not due to interference.

"Side-band Splash."

Genuine interference which is heard as a whistle or steady drone can seldom be prevented by making adjustment to the set, but in many cases it is possible to eliminate side-band splash by increasing the sharpness of tuning. The same process may in certain cases be helpful in reducing the annoyance if the tuning can be varied very slightly at the same time, to de-tune the heterodyne note. This will generally result in loss of quality of reproduction, but it is better to cut the treble slightly than to endure the unpleasant noise.

Sharpening the Tuning

Methods of sharpening tuning have often been described in these pages, so it is not proposed to explain them again. Instead, a brief summary of the simpler methods will be given. In the case of a "straight" receiver the simplest method of all is to reduce aerial length as much as possible and/or to reduce the capacity of the condenser in series with the aerial. When the aerial is taken to a tapping on the aerial coil, the tapping point should be moved towards the earth end of the coil. The object in each case is to reduce the damping effect of the aerial on the tuned circuit. As most readers are probably aware, sharpness of tuning can be

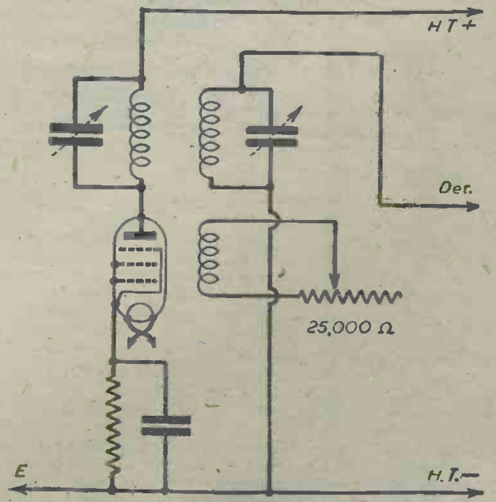


Fig. 2.—Variable I.F. selectivity by using a third winding of few turns with a 25,000 ohm variable resistor in parallel.

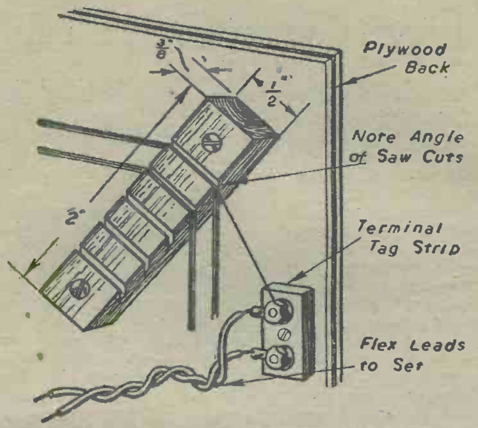


Fig. 3.—A simple form of construction for a frame aerial fitted to the back board of the receiver cabinet.

increased to a marked extent by tightening the reaction coupling. For this to be really effective it is necessary that reaction control should be smooth, and that there should be no tendency for the set to burst into oscillation as the reaction setting is advanced. Smooth reaction control can best be obtained by careful choice of H.T. voltage on the detector valve, by ensuring that the earth connection is good and, sometimes, by inserting a 250 ohm resistor in series with the reaction condenser.

The selectivity of a "straight" circuit can also be increased by adding another tuned stage, or by replacing the single-circuit aerial tuner by a band-pass filter. Neither of these expedients can really be described as simple, however, and therefore the matter can be dismissed.

Where an H.F. stage is already used, it is often a good plan to connect the detector grid condenser to a tapping on the tuned-grid coil and perhaps also to reduce the capacity of the grid condenser. When tuned anode coupling is employed, the same result can be obtained by moving the grid condenser connection to a tapping nearer to that end of the coil which is connected to H.T. positive.

In the case of a superhet, all of the modifications already mentioned, with the exception of reaction control, are applicable. In addition, there are other steps that may be taken. The most important concerns the sharpening of the tuning of the intermediate-frequency transformers. In general, these will already be sharply tuned, and further sharpening may tend to impair reproduction. In consequence, the most satisfactory step is to provide a means of varying selectivity, so that tuning can be sharpened when necessary and flattened when interference is not present. With some types of I.F. transformer it is possible to move the primary and secondary windings farther apart; this will sharpen tuning to a marked degree. If this is not possible and the secondary is centre-tapped, the "grid" connection may be transferred from the end of the winding to the tapping, as shown by a broken line in Fig. 1.

Variable Selectivity

Fig. 1 shows an effective method of providing variable selectivity when the windings can be spaced to give a normally very high degree of selectivity. A .0001 mfd. variable or pre-set condenser is connected between the two high-potential points on the windings; that is between the anode end of the primary and the grid (or diode anode) end of the secondary. An increase in the capacity of the condenser will produce the effect of closer coupling between the windings, and so broaden the tuning. Another method of providing variable selectivity is shown in Fig. 2, where it will be seen that there is a third winding on the transformer. This so-called tertiary winding has about one-twentieth of the number of turns as the other two windings (say about a dozen turns for the average 465 kc/s transformer) and is placed between the primary and secondary. A 25,000 ohm variable resistor is connected between its ends, and it is this which gives control of band-width. As with the other method described, the transformer should, in the first place, be modified so that it gives very sharp tuning.

Directional Reception

In the case of jamming, or "on-frequency" interference, increasing selectivity of the receiver is useless, or practically so. It is then necessary to provide a means of eliminating the unwanted signal before it is passed to the receiver input stage. This may sometimes be done by cutting down the size of the aerial, but this is effective only when the ratio between the strengths of the wanted and unwanted signals is fairly high. The only real solution lies in the use of a directional aerial. A fixed aerial with directional properties may help, but that will normally be effective only in the case of one pair of transmissions. A variably-directional aerial is more useful.

Frame Aerial Connections

The method of connecting a frame to a superhet, or a straight set with H.F. stage, is shown in Fig. 5.

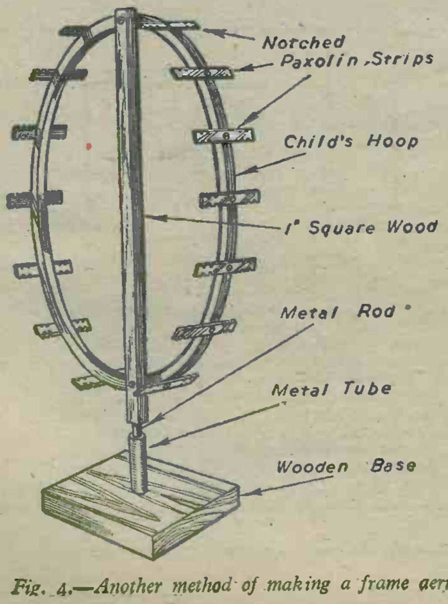
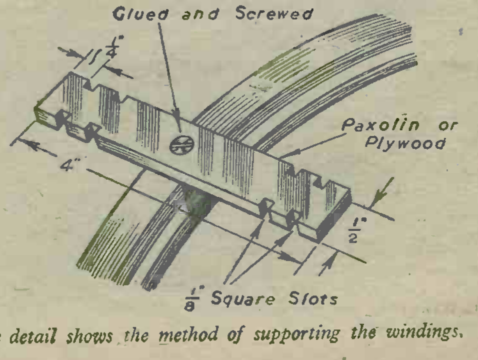


Fig. 4.—Another method of making a frame aerial.



The detail shows the method of supporting the windings.

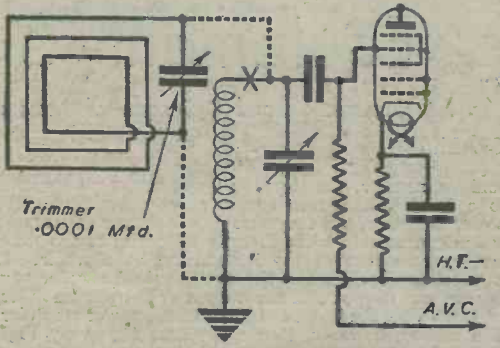


Fig. 5.—The method of connecting a frame to a superhet or an H.F.-Det.-L.F. receiver with ganged tuning.

The tuning coil should be disconnected at the point marked with a cross and the frame connected in its place. Since the frame will have different characteristics than the coil which it replaces, it is desirable to connect a variable trimming condenser across the frame, as shown. The length of winding on the frame should be adjusted, after tuning in a strong signal, so that signal strength is at a maximum when the trimmer is about its midway setting. After that, the ganged tuning condenser can be used in the ordinary way; the trimmer will then be adjusted as necessary for maximum signal strength.

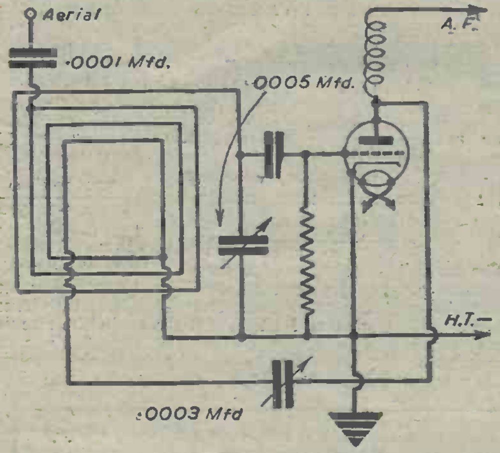


Fig. 6.—How a frame may be used with a Det. L.F. receiver with reaction.

In the case of a detector-L.F. type of receiver, it will be necessary to put a reaction winding on the frame, as shown in Fig. 6. This consists of an extension to the winding, about one-half the number of turns on the tuning section being added for reaction. An external aerial connection is also shown, this being taken to a tapping about half-way along the tuned winding. This is provided for use when the directional properties of the frame are not required.

Frame aerials can also be used for S.W. reception by reducing the number of turns. Further frame aerial details are given in "The Practical Wireless Encyclopædia."

This brings us to the use of a frame aerial, which is seldom seen to-day, except in small portable receivers. As is well known, a frame aerial has the property of giving maximum pick-up from stations in line with its plane, and minimum pick-up from stations in a line at right-angles to that plane. It is seldom that both wanted and unwanted stations are in the same line, and therefore interference can be prevented or reduced by rotating the frame.

It is true that a frame aerial is less sensitive than an elevated wire, but that the average small superhet will give excellent reception when used with a frame is proved by the number of satisfactory portable receivers in use. Even a "straight" receiver of good design will operate fairly satisfactorily when used with a frame aerial, especially if it is not less than about 2ft. square (or an equivalent size if of another shape). With a superhet, a frame aerial measuring 1ft. by about 9ins. should be adequate.

Making a Frame Aerial

The simplest method of making a frame aerial is probably that illustrated in Fig. 3, where it is assumed that the aerial is fitted to the back board of the receiver. Four strips of wood 3ins. long, and having a cross section of ½in. by ⅜in. have four slanting saw cuts made in them and they are screwed one towards each corner of the plywood back board. The saw cuts should be fairly wide because they are to receive the windings. This can be arranged by using a pair of hacksaw blades fitted into the frame side by side.

A small tag strip or terminal block should be attached to the back of the set at a point nearest to the aerial tuning condenser to provide an attachment for the beginning and end of the winding.

How Many Turns?

Suitable wire is 30 gauge d.c.c., and the number of turns depends upon the overall size of the frame. As a guide, it may be stated that the total length of wire required will vary from about 35ft. for a frame with turns about 2ft. long to 60ft. for a frame with turns about 6ft. long. The reason for the variation in length is that the inductance and capacity are dependent not only upon the length of wire, but also upon the number and size of the turns. Start by soldering one end of the wire to one of the soldering tags on the tag strip, and put on the estimated length of wire, dividing it roughly between the four saw cuts.

Another method of making a frame aerial—this time one for use outside the receiver, is shown in Fig. 4. A number of notched paxolin or plywood strips are attached to the periphery of a child's wooden hoop, and the winding is put on as before. It may be started and terminated, as before, at a terminal tag strip, this time attached to the vertical support. Flexible leads will run from the loop to the receiver, and these should be not more than 2ft. long if they are unscreened; for longer leads, up to about 5ft., use screened connecting wire. If a fairly long unscreened lead is used, the pick-up by it will reduce the directional effects of the frame aerial itself.

Sound Amplifying Equipment—6

Estimating Gain. Practical Considerations Relating to the Construction and Operation of Mixers

By L. O. SPARKS

A WIDE mixing combination can be obtained between any of the inputs, while fade-overs between any two of the inputs are merely a matter of manipulation of the controls. It should be noted that the earthy ends of all channels are taken direct to the common negative earth line, and that the potentiometer Rv (0.25 megohms) acts as an input control to the second valve with respect to the output from the first stage only. The values of R3, R4 and R5 are the same as those for R1, etc.

The systems described in this series, according to the merits given to each, are perfectly satisfactory for all general purposes, but no mention has been made of T-attenuators or bridge circuits for use on low-impedance lines and to provide constant impedances, etc., as these are hardly necessary for the class of work under consideration.

In this article, constructional details are given of a mixer unit which has proved highly satisfactory.

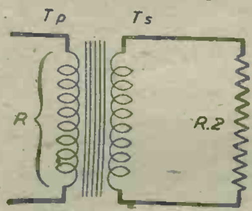


Fig. 1.—The reflected load R of the primary is equal to R2 $\left(\frac{Tp}{Ts}\right)^2$, when R2 is the secondary load.

Having given general consideration to various forms of circuits suitable for the mixing of two or more inputs (see January issue), they can now be examined more closely from the point of view of efficiency and construction.

Efficiency

For the purpose of this article, we can ignore the main or power amplifier, which it is assumed is fully capable of handling its share of the installation. With any of the equipment preceeding the power amplifier, we are directly concerned with the voltage amplification of the input signal or signals, and their control and/or mixing. The pre-amplifiers have one main object to achieve, namely, the stepping up of the input signal(s) to a level sufficient to ensure correct loading of the power amplifier, but they also provide other advantages which can be said to be directly beneficial to the satisfactory operation of the installation as a whole. It is possible to calculate the exact gain between, say, microphone output and the output of the pre-amplifier, or, if need be, the input terminals of the power amplifier. The mixers, however, excepting those shown by Figs. 5, 6 and 7 (January issue), act as attenuators and reduce the effective signal strength reaching the grid of the first valve. This is an item which must be borne in mind when considering their use, and when thinking in terms of overall magnification; the more mixer circuits, the greater will be the reduction, and it is wise to assume that, say, a two mixer arrangement will result in the signal strength reaching the valve being halved, and so on.

Estimating Gain

Using the two-valve pre-amplifier already described as an example (the theoretical circuit is shown by Fig. 1, page 492, of the November issue), the effective stage gain for V1 and V2 can be calculated from the formula :—

Effective amplification $= \frac{\mu Rl}{Rl + Ra}$ where Rl represents the anode load; Ra the impedance of the valve, and μ the amplification factor of the valve. Taking V1 first, we get $\frac{72 \times 50{,}000}{50{,}000 + 18{,}000}$ which equals $\frac{3{,}600{,}000}{68{,}000} = 53$ (approx.).

For V2 we get, Effective amplification $= \frac{52 \times 30{,}000}{30{,}000 + 11{,}500}$

$$= \frac{1{,}560{,}000}{41{,}500} = \frac{15{,}600}{415} = 37.5 \text{ (approx.)}.$$

The two stages together give an overall effective amplification of 53×37.5 or 1987.5. This theoretical value seems at a glance to be excessively high, but by virtue of the potentiometers R1 and R5, shown in the circuit diagram, the actual input to either of the valves can be controlled, and, furthermore, one has to bear in mind the voltage value of the input signal to V1, line con-

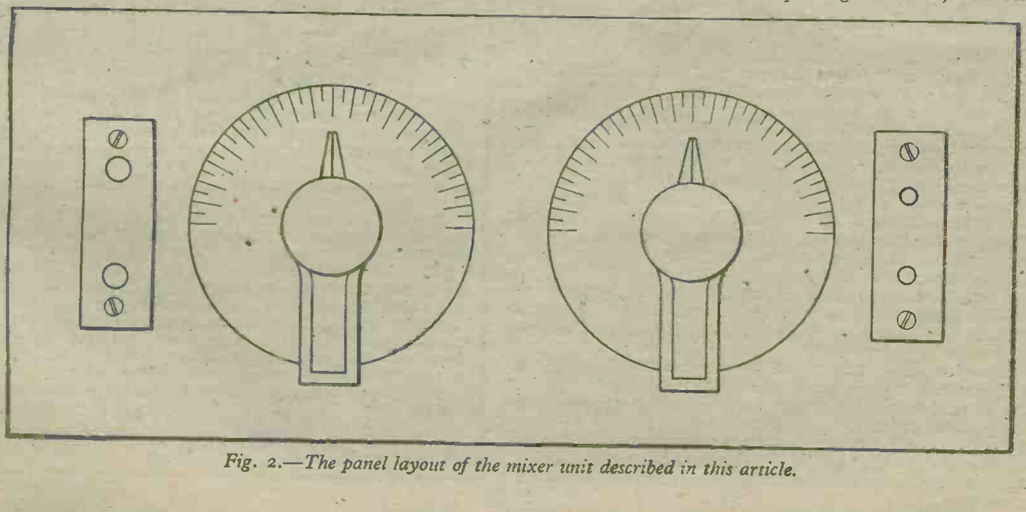


Fig. 2.—The panel layout of the mixer unit described in this article.

ditions and the voltage required at the input of the power amplifier to fully load its output.

Assuming a microphone forms the input signal source a reasonable average value of the voltage to be expected, bearing in mind various types, etc., will be in the region of, say, .02 volts. This means that the grid of V2 will receive 1.06 volts when its potentiometer is set to its maximum. This input will not, in any way, be out of keeping with the valve specified for V2, but R5 will have to be adjusted to keep the overall amplification down when the total voltage across the output of V2 is considered, subject, of course, to the requirements of the power amplifier and general operating conditions. It is, however, far better to have a good reserve in hand rather than be operating such a unit full-out, and then having to use the volume control on the power amplifier at its maximum setting to obtain the required results. This statement must not be confused with the advice given in a previous article, about letting the pre-amplifier give its maximum gain (according to operating conditions, etc.), and keeping the power amplifier down.

With transformers used for matching purposes, etc., one is concerned with the primary offering a suitable load to the source to which it is connected, and many constructors made the mistake of thinking that this load is directly concerned with the D.C. resistance of the primary. This is not so, in fact, apart from voltage dropping reasons one could, speaking in a general sense, ignore the D.C. resistance. The load offered by the primary, is directly connected with the square of the turns ratio of the transformer, and the *load* connected across the secondary. It is usual to speak of the primary load as the " reflected load " or " load looking into the primary." Referring to Fig. 1, let R represent the primary load; Tp and Ts the turns on the primary and secondary respectively, and R2 the load imposed on the secondary.

From the above we can write $R = R2 \times \left(\frac{Tp}{Ts}\right)^2$ and from this we find that the ratio of the impedances is equal to the turns ratio squared. This can be written $\frac{R2}{R} = \left(\frac{Tp}{Ts}\right)^2$ or, as we are chiefly concerned with finding

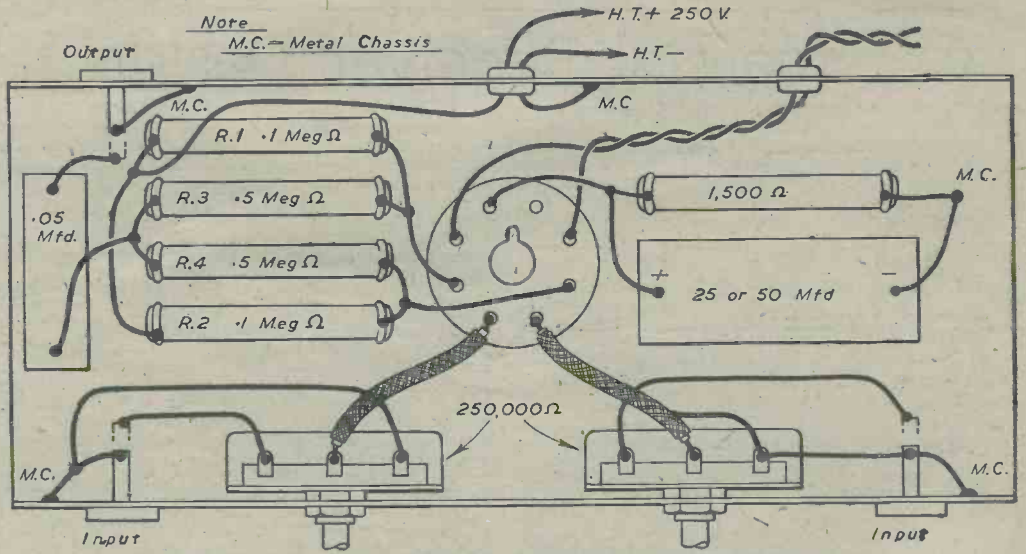


Fig. 3.—The layout and wiring of a two-channel mixer using a 6NT6 valve.

Microphone Transformer

For the above calculations we have assumed an average input for microphones, but no mention has been made concerning the ratio of the microphone transformer with relation to the input to V1. It would seem feasible to use a component having a very high ratio to allow the greatest step-up to be obtained of the minute voltages developed across the " mike," thus increasing the signal at the grid of V1. This would be quite in order, provided one was not concerned with the grid-input impedance of the valve. The following example will make the matter more clear.

Supposing the volume control across the grid circuit of V1 is 0.25 megohms, as in the case in the design under consideration, then this would actually represent the load across the secondary of the microphone transformer. Now the microphone has a certain impedance, and this is usually stated by its manufacturers, but, if such information is not to hand, the figure can be determined quite easily. Impedance is the ratio of voltage to current in a circuit, therefore, if the " mike " under test passes 18 mAs. at 9 volts, its impedance will be $\frac{9 \times 1,000}{18} = 500$, it being necessary to multiply by 1,000 as the current is expressed in milliamps.

the correct ratio required for impedance matching, it can be rearranged thus :—

The turns ratio $\frac{Tp}{Ts} = \sqrt{\frac{R2}{R}}$

Applying this to the example, the impedance (R) of the microphone is 500 ohms, and the value of the potentiometer across the secondary (R_2) is 250,000 ohms, therefore the impedance ratio becomes $\frac{250,000}{500}$ or 500. The turns ratio then must equal the square root of 500, i.e., $\sqrt{500}$, which equals 22.4 (approx.), say, 22, which indicates that the microphone transformer requires a step-up ratio in which the secondary has 22 times the number of turns of those used for the primary, and this holds good for whatever number of turns is used for the primary, provided the secondary load is the same. This is mentioned to stress the fact about the *turns ratio* being the *vital point* and not the number of turns on the primary.

Constructing " Mixers "

The circuits shown in the previous issue, Figs. 1 to 4, call for little comment so far as their construction is concerned; being of the simple type, they are often incorporated in the pre-amplifier, or even the power amplifier, but if the latter, it is advisable to take special care regarding the location of the components and their screening. It is usually necessary to screen the grid leads and the metal cases housing the potentiometers, and so arrange the components that they are well away from any leads carrying raw A.C., yet so located that the grid and inter-connecting wires are as short as possible.

Still referring to the January issue, Fig. 6 is better than Fig. 5, unless pentodes are used in place of the triodes, in which case Fig. 5 is quite satisfactory and capable of giving a high gain. With a valve of the 6N7G type, i.e., a twin-triode or Class B valve, Fig. 6 is recommended, and it is this arrangement which is used in the mixer unit described below.

Construction

The unit incorporated only a few components, and if it were not for the volume controls and their dials, the whole thing could be made much smaller than the one shown. A suitable chassis is one having dimensions close to 7in. × 3in. × 3in., formed out of sheet tinned iron. There is no need for the chassis to be of the usual stout plate, as there are no heavy components to be carried. The layout and wiring—underside of the chassis—is shown by Fig. 2, and although a four-pin chassis mounting valve-holder was used for the power supplies in the original (mounted on the back of the chassis) the H.T. and L.T. leads are shown separately in the diagram for clarity. The valve is the 6N7G, and this required an octal valve holder, but if this valve is not to hand, it is quite permissible to use two separate triode valves, of the medium impedance type, and ample room will be found on the chassis shown for their accommodation. The two potentiometers control the inputs to the two triode sections, thus allowing perfect mixing—plus a slight gain—to be obtained. The three-two-socket strips, two of which are used for the inputs, and one for the output, can, if so, be replaced by single-circuit jacks. The panel layout is shown in Fig. 3, and it will be found that better control can be obtained, so far as the operator's comfort is concerned, if, when constructing the chassis, the panel is given a slope of about 60 deg.

Commercial Receiver Design—I

THE general characteristics of a broadcast receiver are sensitivity, selectivity, and fidelity. Selectivity is defined as the effective valve of the carrier voltage that must be induced in the aerial to set up the standard output when the carrier is modulated 30 per cent. at a frequency of 400 cycles.

The sensitivity is the ability of the receiver to respond

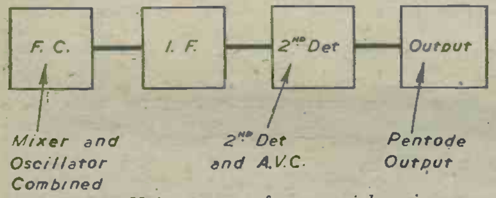


Fig. 1.—Unit sequence of commercial receiver.

to small radio signal voltages, and is measured in terms of the voltages that must be induced in the aerial by the signal to produce a standard output from the amplifier. The standard output is 0.05 watt in a non-inductive load resistance, having a valve corresponding to the load resistance into which the amplifier has to operate. Lastly fidelity which represents the extent to which the receiver reproduces the different modulation frequencies without frequency distortion.

Over these, selectivity, sensitivity and fidelity, there are other points such as further refinements as A.V.C. system, noise to signal ratio, mains hum suppression, and power output obtained without distortion. How many of the broadcast receivers employ quieting arrangements, automatic frequency control? Very few of our commercial receivers unless they are very expensive. In fact, very few incorporate an R.F. stage before the frequency changer.

The design of commercial receivers depends a great deal upon such merchandising requirements as "the best receiver for a standard selling price," most of these are influenced by the sales features that are pressed at the time of buying.

Design Factors

Some factors covering the design are the L.F. power output, the sensitivity, and the carrier amplitude desired at the detector for normal operation. The L.F. valve and anode supply voltage are selected to give the required output.

The minimum L.F. amplification between the detector and output valves is the gain that will give full excitation for the output valve when the carrier voltage at the detector is completely modulated and has an amplitude equal to the normal detector level.

The voltage step up between the aerial and second detector must be such that with a voltage corresponding to the required sensitivity acting in the aerial circuit, the required carrier level will be developed at the second detector. The aerial to first grid gain is necessarily low in ordinary commercial receivers, as these must be designed so that the first tuned circuit will keep its alignment when aerials of different constants are used, and to achieve this the aerial coupling must be small.

Fig. 1 illustrates a schematic diagram of a commercial receiver costing from £11 to £15 at a minimum, having a complement of 5 valves including a rectifier, being an A.C./D.C. receiver.

I propose giving an outline of A.V.C. systems and quieting arrangements, tuning indicators, automatic frequency control circuits, and such refinements shown in Fig. 2.

(To be continued.)

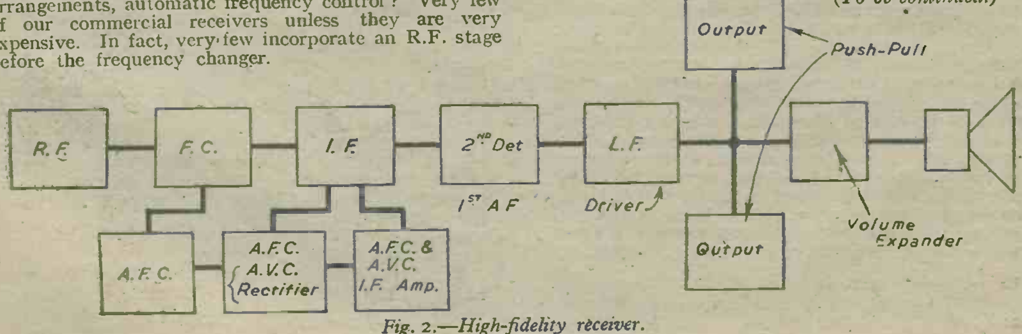


Fig. 2.—High-fidelity receiver.

An Earphone Pick-up

By "EXPERIMENTALIST"

BY applying direct, non-electrical sound vibration to the thin, soft-iron diaphragm of an earphone rather than indirect sound vibration, i.e., audible sound, speech, music, etc., it may be made to operate as a pick-up. In other words, we get a diaphragm-operated pick-up, which is similar to, but distinct from, the conventional moving-iron pick-up.

Direct, non-electrical sound waves can be applied to the diaphragm by means of the stylus parts of a gramophone sound-box. It is only a matter of fitting the stylus to the diaphragm and attaching the needle-holder part to the cover of the earphone. Any reader, consequently, desiring a cheap, efficient, auxiliary pick-up, will no doubt be interested in the actual model constructed and tested by the writer.

Reproduction is extremely loud owing to super-sensitivity. By using special fibre (thorn) pick-up needles, however, loudness is reduced and reproduction improved. Tests on a simple 2-valve set gave excellent results, with better tonal quality on a superhet receiver. An independent volume-control is not necessary, unless desired.

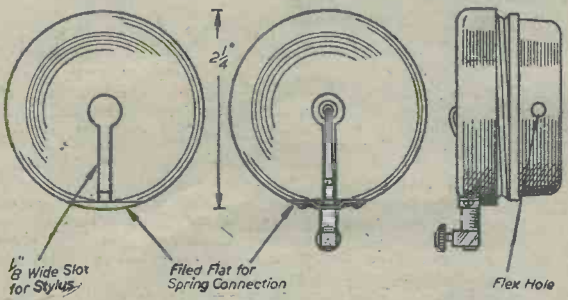


Fig. 1.—Showing how the earphone cover is filed, with front and side views of finished piece.

Preparing the Cover

The writer used an old B.B.C. bakelite ear-piece, but almost any type of ear-piece may be incorporated providing it has a bakelite casing. Remove the screw-off cover and file a slot in it (for the stylus) with the edge of an ⅛in. thick flat file. A small, flat recess is filed directly beneath the slot for the spring connection, as shown at Figs. 1 and 2, then holes drilled and threaded for the tiny fixing screws.

An old gramophone sound-box provides the necessary parts and screws. It may be necessary to bend the stylus straighter to make it longer or bend it more to shorten its length. The size of the stylus used in making the model was 1⅛in. from the "crook" end to the base of the spring connection; this is the average length.

The stylus slot cannot be made anywhere in the cover piece. Its true position is determined by the outlet hole (for the flexible wire leads) in the main ear-piece. A special universal-jointed pick-up arm has been designed so that the leads run within it, out of view, to two terminals in the base.

One must, to ensure that the outlet hole is in alignment with the holder unit, screw the cover on tightly and mark the stylus slot lines diagonal (about 40 degrees) with the horizontal position of the outlet hole. This also ensures the correct needle-holder slant, of course.

Pick-up Head Assembly

The stylus, when removed from the sound-box, will have a tiny washer and nut. A hole is drilled in the centre of the earphone diaphragm to accept the threaded end of the stylus. Set the diaphragm within the cover and attach the stylus to it, following which the spring connection is screwed to the recess at the outside of the cover, as indicated at Fig. 2.

If, when the cover is screwed on the main ear-piece, the slant of the stylus should prove to be greater than the angle desired, it will be necessary to fit a packing ring (cut from paper) between the cover and diaphragm, as shown. One could have the packing ring at the outside of the diaphragm, but, by doing so, the distance between the diaphragm and the pole-pieces of the magnetic coils is affected and this might interfere with good reproduction.

Incidentally, should reproduction be rather harsh and high-pitched, this fault is rectified by fitting packing rings of paper against the diaphragm, at the outside. The writer used thin blotting paper. If two paper rings are necessary, i.e., one to correct the stylus slant and the other to keep the diaphragm farther away from the pole-pieces, it is advisable to have the diaphragm between them, as the rings serve to "pad" the diaphragm more effectively.

The Holder Unit

A holder unit for the pick-up head is made from ½in. diameter iron or brass tubing, such as that provided by towel rails. A side and top view of the holder, with dimensions, is given at Fig. 3.

It will be seen that in order to provide a circular clip it is necessary to make four cuts down one end with a hacksaw. The depth of the cuts is 4in. By sawing the metal at an angle, this depth can be easily reached; the opposite cut is made even by reversing the tubing in the vice and cutting it at an angle. Alternatively, the hacksaw blade fittings may be turned so cutting can be down at right-angles.

Having cut the tubing, remove the waste portions and then bend out the clip portions and straighten their curvature out flat with a hammer. The clips are then bent to form a ring which will take the main earphone piece, with tightening lugs at the ends for an ⅛in. thick machine screw. The opposite end is cut and filed as shown; there is no need to flatten out the supporting tab.

The Arm Piece and Pivot

An arm piece is made from a 5in. length of ½in. tubing. The end is prepared, as shown at Fig. 4, with a 3/16in. hole drilled through near the opposite end. This hole is for the entry of the wire leads into the tubular pivot.

The pivot is made from ⅜in. diameter tubing (or tubing which fits snugly into the "bore" of the arm

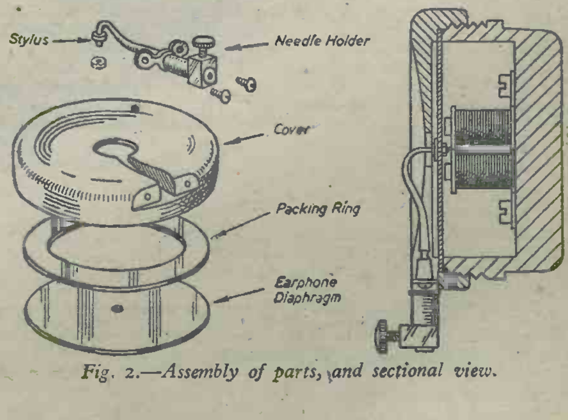
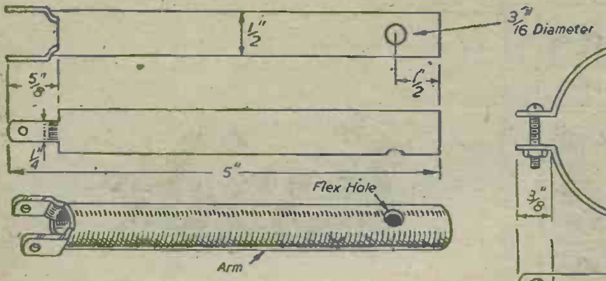


Fig. 2.—Assembly of parts, and sectional view.



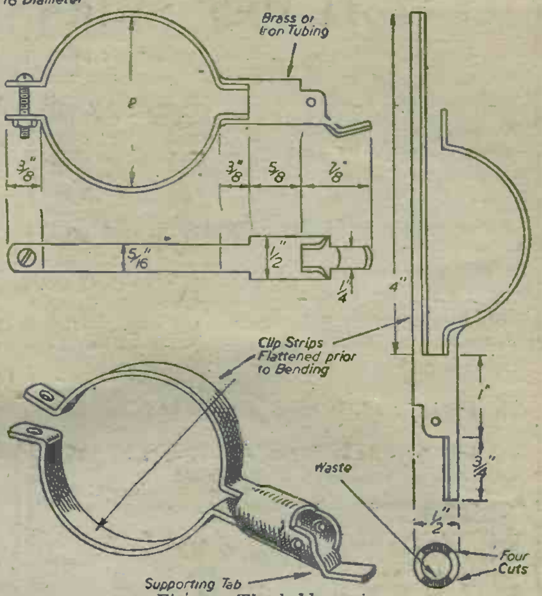


Fig. 3.—The holder unit.

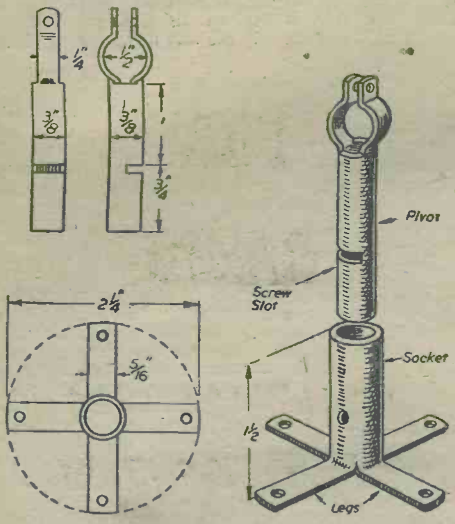


Fig. 4.—Details of arm piece, pivot and socket.

tubing), it having a tightening clip at one end and a cross slot for the socket screw. This screw, while enabling the pivot to turn freely in the socket, prevents it from lifting out.

Not having a suitable piece of tubing with which to make the pivot, the writer reduced the diameter of ½in. tubing by slitting it down one side and cutting out a channel ⅛in. or so wide. The gap was easily closed in a vice and the tubing filed true; true shaping, on a suitable iron core, with a hammer is possible.

The Socket and Base

A four-legged socket for the pivot is made from a 3in. length of ½in. tubing. Two central, right-angle cuts down one end provide the legs. The metal is bent outwards with the fingers and the strips flattened on an anvil. Do not bend the legs at right-angles with pliers, as the jaws of these make a sharp bend which, owing to the curvature in the metal, might cause a break. Gradual flattening with a hammer is the safest course.

A hole is drilled and threaded at one side of the socket to engage with the slot in the pivot. Before drilling holes at the ends of the legs, obtain an old bakelite, batten-type 4-pin valveholder. The base of this serves as a base for the socket. The diameter is about 2¼in.

A view of the base, stripped of all its fittings, is shown at Fig. 5. The legs of the socket are cut and drilled to engage with four recesses and screw holes in the base, as shown by the bottom view.

(Continued on page 151)

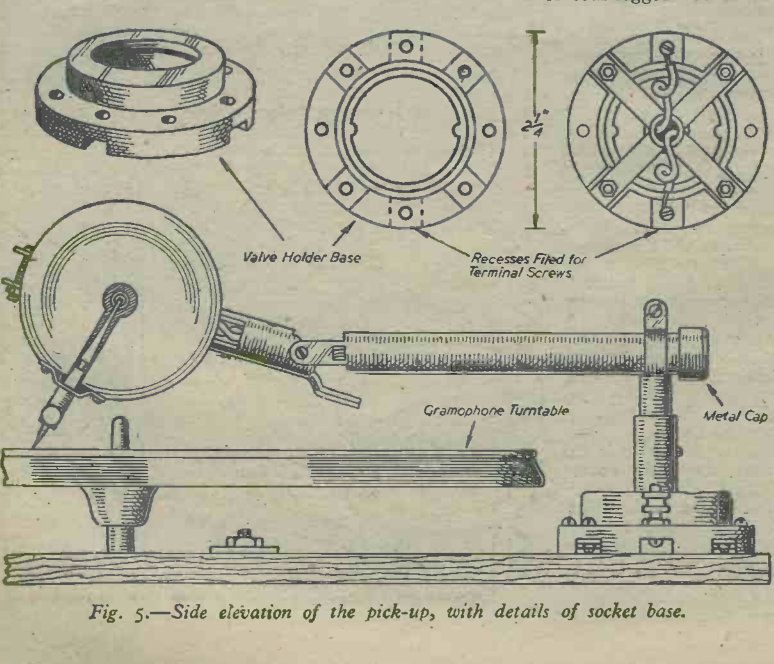


Fig. 5.—Side elevation of the pick-up, with details of socket base.

Two extra recesses are needed for the wire terminals, so these are duly filed where indicated. The remaining holes are for a couple of fixing screws.

Assembling the Parts

Having made all the necessary parts, connect a 12in. length of good quality twin flex to the earphone coil terminals. Bring the ends through the holder unit and attach the latter to the earphone pick-up head. The wire is then threaded through the arm piece which, at this juncture, is bolted freely to the holder unit.

Having brought the wire ends through the 3/16in. hole at the opposite end of the arm, push them through the pivot (the clips on this may require to be opened somewhat) and force the pivot clips on the arm, directly beneath the flex hole, then tighten the clips with a small bolt and nut. Insert the pivot into the socket and bolt the socket legs to their base.

Cut the flexible wire and bare the ends for connection to the terminal screws. It is advisable to put a twist or curl in the wire to facilitate easy swivel movement. Complete the assembly by fitting a metal cap to the end of the arm piece. The top part of an old scent spray was used by the writer, but the metal ferrule on old screwdrivers, etc., could doubtless be used. An alternative is to plug the arm end with cork or fit on a suitable toothpaste tube cap.

The side elevation at Fig. 5 shows the general arrangement of the pick-up mounted on the motor-board of a gramophone cabinet. It will be seen that in order to insert fresh playing needles the pick-up head can be turned over to rest on the supporting arm. The small supporting tab on the holder unit prevents the needle from coming in contact with the motor-board surface when the pick-up is lifted from records and swung to one side. Oil all movable parts.

Principles and Practice of Hot Cathode Mercury Vapour Rectifiers

By E. G. BULLEY

RECTIFIERS of this type depend upon the presence of mercury vapour and because of its introduction inside the valve, the electrons emitted from the cathode collide with this vapour and produce what is known as ionisation. This characteristic is typical of any mercury vapour rectifier and is easily recognised by a blue glow inside the valve. Ionisation in hot cathode mercury vapour rectifiers has the property of neutralising the space charge which keeps the voltage drop constant and the internal resistance of the valve very low. It is these properties that enable this type of rectifier to handle large currents, whereas in the case of high vacuum rectifiers the voltage drop actually depends upon the gradual increase of the current with an increasing load.

Hot cathode mercury vapour rectifiers to-day are preferred in high voltage equipment for rectification. This is because the constant voltage drop and low internal resistance result in good regulation.

The application of this type of rectifier should be considered carefully before actual steps are taken to design high voltage equipment incorporating them for rectification. It is good practice to obtain advice and data of the valves one proposes to use; this information is willingly furnished by the valve manufacturer who also will advise on the best possible method of installation. Nevertheless, all hot cathode mercury vapour rectifiers should be subjected to the following condition for safety and satisfactory service.

It is essential that the H.T. supply be delayed by means of a suitable delay switch, to enable the cathode to reach its specified operating temperature; this delay time varies being dependent upon the size of the rectifier and this can be seen clearly by referring to the data of the Osram rectifiers mentioned in this article. Failure to respect the delay times laid down by the valve manufacturer will result in the total destruction of the emitting surface of the cathode; this usually is defined as "sputtering" and can be described as the destruction of the coating material caused by the application of the anode voltage before the correct cathode operating temperature has been reached, resulting in the coating flaking off.

The operation of these rectifiers should always be in a well ventilated position whether they be of the small type, such as the Osram GU50, or the Osram GU7. Most larger types of hot cathode mercury vapour rectifiers are subjected to forced air cooling, whereas in the case of the smaller designs the ordinary air cooling is sufficient. Failure to operate any hot cathode mercury

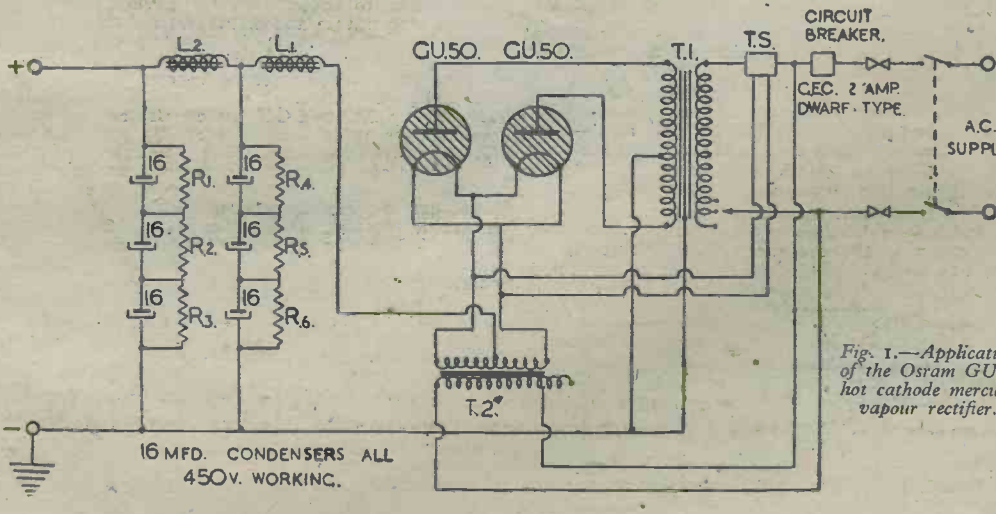
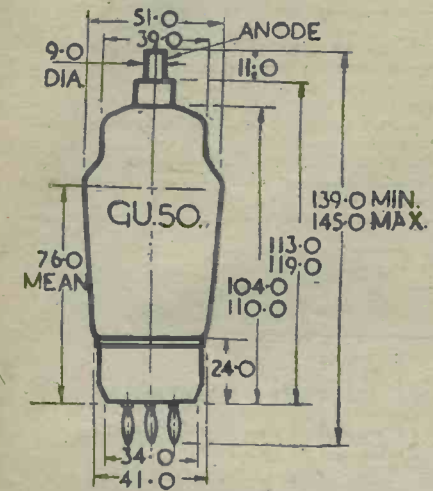
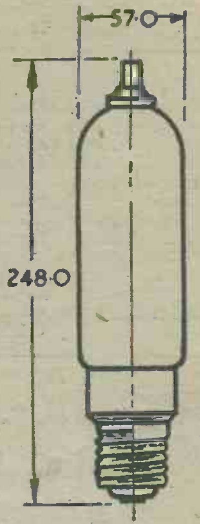


Fig. 1.—Application of the Osram GU50 hot cathode mercury vapour rectifier.





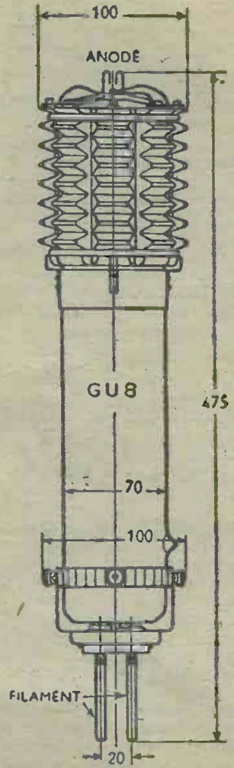


Fig. 2.—Dimensions of the various G.E.C. hot cathode mercury vapour rectifiers.

vapour rectifier within its circumambient temperature, laid down by the manufacturer, will result in the conduction of electrons in the reverse direction to normal—this phenomenon can also result from the maximum inverse voltage being exceeded; it is of importance to remember these factors.

The application of a small hot cathode mercury vapour rectifier, namely the Osram GU50, can be seen in Fig. 1. An important point to remember is that it is very good practice to mount this type of rectifier in an upright position. These rectifiers should be used in a choke input filter circuit; this not only applies to the smaller types, but it is good practice to install the larger ones in a similar circuit wherever possible. The reason for this, is the local interference they can cause. Nevertheless, great care also should be taken when selecting the transformers and chokes; these components should have a very low resistance.

Fig. 1 is a typical circuit and is very useful for the power supply of an amplifier. It is appropriate at this stage to give the values of the components incorporated in the circuit.

R1—R6 50,000 ohm resistances only required if series connected electrolytic condensers are used as shown. (A paper 4 mfd. may be used in place of each group of three electrolytics.)

L1—L2 Should not be less than nine henries at 500 mA. D.C. Resistance not greater than 100 ohms.

T1 For reasonable good regulation the primary winding should be designed for .55 KVA, and the secondary for .8 KVA; 1,300+1,300 volts for D.C. output, 465 mA. at 1,000 volts.

T2 Filament transformer, secondary winding 4 volts at 6 amps.

T3 Delay switch for H.T. supply.

So much for the values of the components, the next consideration is the operating characteristics of the valve, i.e., GU50.

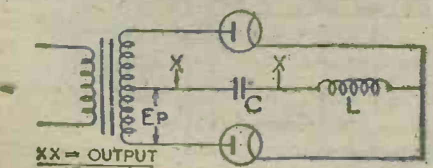


Fig. 3.—One application of the mercury vapour rectifier—biphase half-wave rectification.

Fil. volts 4±.4.
Fil. current, 3 amps. (approx.).
Peak inverse anode volts, 5,200 max.
Peak anode current, 1 amp. (approx.).
Average anode current, .25 amp.
Forward voltage drop, 12 approx.
Delay time, 30 secs.

It is essential to remember, however, that when first installing a hot cathode mercury vapour rectifier, the H.T. should be delayed for a period between 15 and 30 minutes, to ensure that the cathode reaches the correct temperature and distributes the mercury inside the valve.

Comparison of the physical dimensions and shape of various hot cathode mercury vapour rectifiers manufactured by the G.E.C. can be seen by referring to Fig. 2. The already discussed GU50, the GU20 and 21 and the much larger types, namely the GU7 and GU8; the GU20 and GU21 are identical in their external physical dimensions and basing, but differ in operating characteristics. This can be seen later in the article and will be of use to radio engineers planning to design equipment incorporating the hot cathode mercury vapour rectifier. This also applies to the GU7 and GU8, both identical in shape, etc., but differing in operating characteristics:

	GU20	*GU21*
Fil. volts	4	4
Fil. current (approx.)	11 amps.	11 amps.
Permitted range of condensation temps. .. .. .. (Temps. of that part of bulb on which mercury is collecting.)	20°-60°C.	20°-60°C.
Max. permitted ambient temp. in still air	35°C.	35°C.
Peak current	4 amps.	4.7 amps.

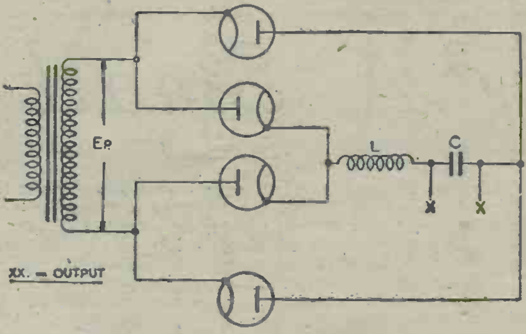


Fig. 4.—Single-phase full-wave rectification.

	GU20	*GU21*
Peak reverse voltage	8,750	11,600
Delay time after 15 mins. shutdown	8 mins.	8 mins.
Delay time less than 15 mins. shutdown	1 min.	1 min.

	GU7	*GU8*
Fil. volts	2.35	2.35
Fil. current	40±5	40±5
Peak reverse voltage	13,500	22,000
Max. ambient temps.	38° C.	34° C.
Min. ambient temps.	10° C.	12° C.
Max. condensation temps.	58° C.	54° C.
Min. condensation temps.	30° C.	32° C.
Frequency (C.P.S.) ..	50	50

We have reviewed the characteristics of five hot cathode mercury vapour rectifiers selected from the Osram range, and it is interesting to study the various circuits in which the GU20 and 21 can be incorporated. Figs. 3 to 6 inclusive show the various applications to which these valves can be put for rectification of raw AC.

They can be classified as :—

Fig. 3.—Biphase half wave.
Fig. 4.—Single-phase full wave.
Fig. 5.—Three-phase half wave.
Fig. 6.—Three-phase full wave.

These circuits supply rectified current up to specified values at certain voltages depending entirely upon the circuit selected. On no account, however, should the maximum peak reverse voltage be exceeded, no matter what circuit is preferred. It is advisable, also, to note that if the operation of a rectifier is to be at a higher frequency than that laid down by the manufacturer, the maximum figure for voltage must be reduced.

The minimum valves for "L" shown in Figs. 3, 4, 5 and 6 are important and are so arranged to ensure that no heavy peak current flows through the valve and that the smoothing circuit does not resonate to supply frequency.

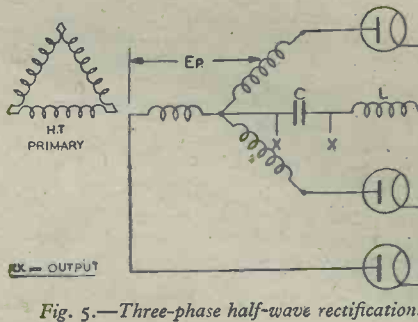


Fig. 5.—Three-phase half-wave rectification.

Valves for "L" are given in a tabulated form below and for convenience both the GU20 and the GU21 are shown in the same table.

Summarising, it is easy to see the principles of the hot cathode mercury vapour rectifier and its various methods of application.

To-day this type of rectifier is finding its way into modern equipment such as R.F. heating, transmitting and specialised apparatus, because of the good regulation offered as well as the ability to handle large currents.

Bibliography

A. W. Hull, "Gas Filled Thermionic Tubes." Trans. A.I.E.E., Vol. 47, No. 3—July, 1928.

H. T. Ramsay, "The High Power Hot Cathode Mercury Vapour Rectifier," G.E.C. Journal, Vol. X, No. 1—February, 1939.

The author is indebted to The General Electric Co., Limited, of London, for permission to use technical data and drawings relating to "Osram" rectifiers set out in this article.

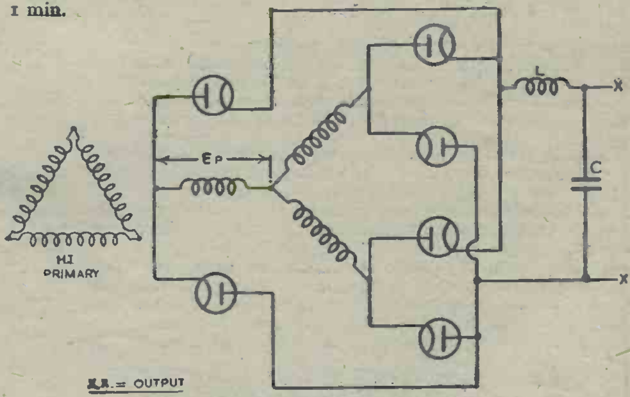


Fig. 6.—Three-phase full-wave rectification.

Circuit	Type	Max. D.C. Output		Min. Value of "L" Henries	Min. Value of "C" mfd.	Ep RMS volts	Ripple at 'XX'	
		E.d.c.	I.d.c.				Amplitude E.d.c.	Frequency
Fig. 3	GU20	2,500	2	6	4	2,750	8%	100 C.P.S.
Fig. 3	GU21	3,300	2.3	6	4	3,630	8%	100 C.P.S.
Fig. 4	GU20	4,750	2	12	2	5,300	8%	100 C.P.S.
Fig. 4	GU21	6,600	2.3	12	2	7,260	6%	100 C.P.S.
Fig. 5	GU20	3,500	3	6	4	3,000	1%	150 C.P.S.
Fig. 5	GU21	5,000	3.5	6	4	4,270	1%	150 C.P.S.
Fig. 6	GU20	7,000	3	9	1	3,000	.2%	300 C.P.S.
Fig. 6	GU21	10,000	3.5	9	1	4,270	.2%	300 C.P.S.

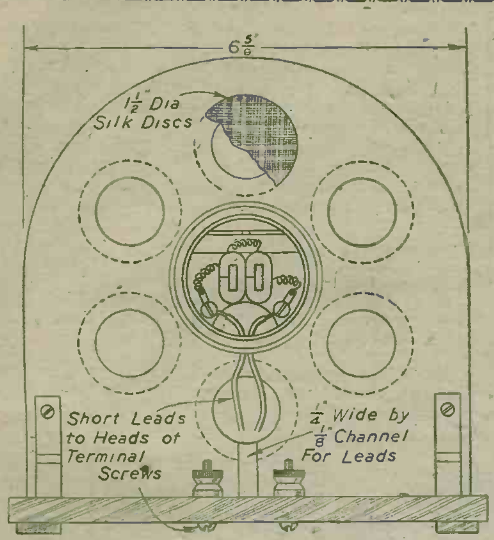


Fig. 2.—A back elevation, showing earphone piece in position and groove to be cut for flex wires.

A Small Lo

A Practical Instrument made

IS it possible to convert an earphone piece into a loudspeaker unit? If you have ever wondered, this article shows that the conversion is feasible and practical. An earphone piece is, after all, very similar in working principle to the reproducer in early horn-type loudspeakers.

The horn, of course, served mainly as an amplifier. Instead, however, of using a horn for amplification, one can obtain louder and better reproduction by fitting a sheet iron diaphragm of heavy gauge over the poles of the twin coils; a stiff, steel wire, soldered to the centre of the diaphragm serves as a sound post. By connecting the end of the latter to a paper cone, the result is a new form of moving-iron type of speaker.

The application of these principles to the early reproduction units probably led to the invention of the moving-iron cone type as we came to know them. Such loudspeakers have now become obsolete, but are still in use in many receivers. They are not so sensitive as the modern moving-coil speakers. Results obtained on the home-made model are, consequently, of a similar nature as the moving-iron type, and when you remember that the reproducer unit is that of an ordinary low-resistance earphone, and the other components merely odds and ends, it gives one a great feeling of satisfaction, if not achievement, to hear the speaker working.

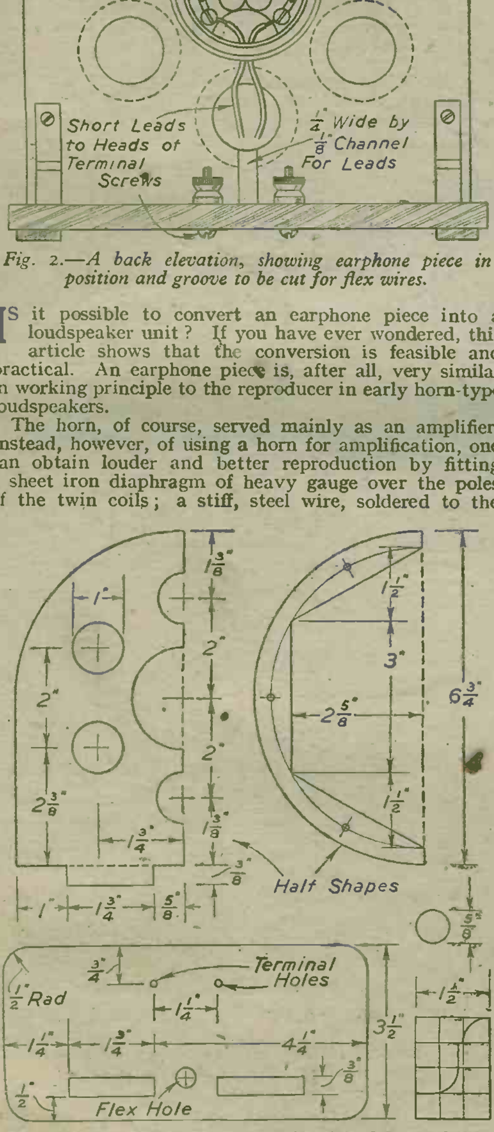


Fig. 1.—Size and shape of base, bracket, front and cone flange.

For Extension Use

The writer has designed the earphone speaker primarily for extension use. It is possible, if desired, to incorporate a similar speaker into a valve set, in which case a front piece only is wanted, or one could make use of the front of the wireless cabinet.

To make an independent speaker, prepare a front piece to the size and shape shown at Fig. 1, using ⅜in. thick wood. Cut the cone flange from (preferably) ⅛in. thick plywood. Only half of both parts are shown, so cut out complete.

The base and two end brackets are cut from ⅜in. wood, the latter being plotted in ½in. squares. In making his experimental model, the writer used polished oak from an old wireless cabinet; thus the wood was virtually finished, the edges only requiring to be touched up with polish.

The six 1in. diameter holes in the front are bored with a centre bit, doing so from both sides to prevent splintering. The 2in. diameter central hole is cut with a fretsaw to take the earphone casing tightly and neatly.

Having cut a groove in the back of the front piece for the short wire connections leading from the earphone terminals (see Fig. 2), glue the front to the base and screw the end brackets in position. Add the ⅝in. diameter wooden toes (cut from 3/16in. plywood) to the bottom corners of the base and fit a couple of wireless terminals.

The Wire Connections

Unscrew the cap (cover) from the earphone piece and fit a 6in. length of twin flex to the coil terminals. Force the 'phone casing into the stand front and bring the wires through the base hole and connect the ends to the base terminal bolt heads, as can be gathered from the back elevation.

The wires leading from the 'phone unit are bedded in the channel, or groove, so the cone flange, when attached, will rest flat. Six 1½in. diameter discs of fancy silk material are glued over the sound holes, as indicated. Apply the glue to the *wood* and press the discs on.

Diaphragm and Sound Post

The thin, soft iron diaphragms in earphone pieces are unsuitable for indirect reproduction of sound impulses set up in the twin electro-magnets. A heavier gauge of sheet iron is wanted. The writer used a piece of metal cut from an old wireless chassis, the thickness being about 3/32in.

The diaphragm is cut to a special shape, as detailed at Fig. 3. First scribe the diameter, then an inner diameter which is divided into six. Bore ⅛in. holes at these points, cut the metal to the circumference line, then remove the waste portions (see dotted lines).

oudspeaker

...ade From an Earphone

Drill a hole in the centre of the diaphragm to take, somewhat tightly, a 2½in. length of bicycle wheel spoke. This serves as a sound post and should be soldered perfectly vertical with the diaphragm. It is imperative, by the way, that the surface of the diaphragm is quite flat. Any slight irregularities should be filed out.

Moreover, you should obtain a *new* bicycle wheel spoke and a nipple which screws on fairly tightly. A slack nipple (which is used for connection to the sound post and allows adjustment) will create faulty reproduction, because it is the nipple which is a fixture in the apex of the cone. It serves a dual purpose by connecting the cone to the sound post and allowing the cone to be tightened or slackened in order to obtain best results.

Making the Cone

The cone is made from thin parchment paper or stiff cartridge paper. The blue-coloured paper which covers drawing books is ideal stuff to use.

A piece 8½in. square is needed. Divide it into four and into eight, as shown by the dotten lines at Fig. 4. Scribe

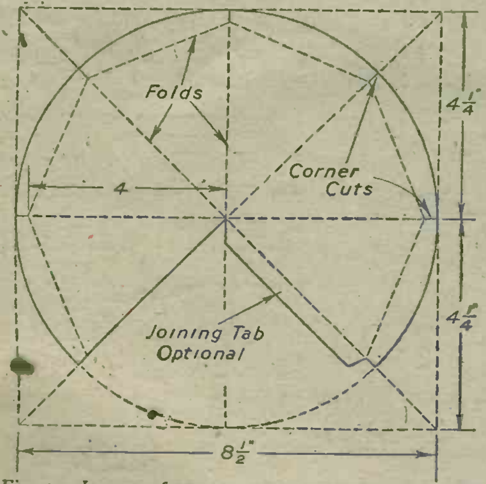


Fig. 4.—Layout of paper pattern which forms the cone.

a 2¼in. radii line, then a 2in. radii line. Rule straight lines from point to point to form edge folds and make six ¼in. cuts at the corners, i.e., when the pattern has been cut to the outlines.

Fold the paper at the dotted lines and draw the paper into a cone and glue together with the joining tab. If rather thin paper is used, the cone needs to be stiffened with strips of gummed paper tape.

These strips are folded—or, rather, *creased*—prior to shaping the ends, as detailed at Fig. 5. The top plan of the cone shows how the strips fit together at the apex.

To ensure firmness at the apex, a six-pointed "star" is cut from strong paper to the size and shape shown and glued on the apex. Before doing so, however, the apex point of the cone should be flattened by rubbing glasspaper across it. When the "star" is attached and the glue allowed to set, a hole is made for the bicycle spoke nipple.

Insert a ½in. diameter stiff paper washer over the stem of the nipple. Push the end of the nipple through the cone apex (from the inside) and force a small metal

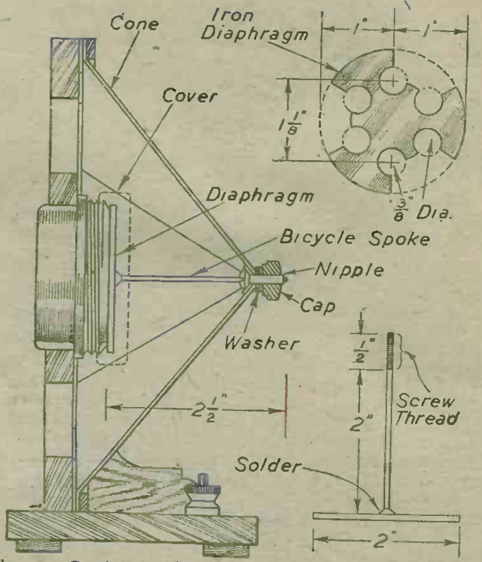


Fig. 3.—Sectional side view, with details of sheet iron diaphragm.

washer over the nipple projection to prevent the stem pulling through. Apart from the washer, an adjusting knob (the screw-off cap from a toothpaste tube) is fitted on tightly, as shown by the sectional side view.

Completing the Speaker

To complete the speaker, set the diaphragm over the 'phone unit and screw on the cover. Place the cone over the sound post and turn the nipple until the cone rests flat on the stand back. Set the flange ring over the

(*Continued on page 157.*)

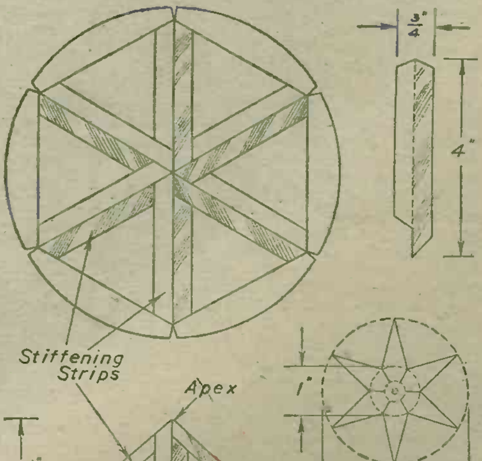


Fig. 5.—Top plan of cone, with side view, showing how stiffening strips are attached, with sizes of strips and apex star.

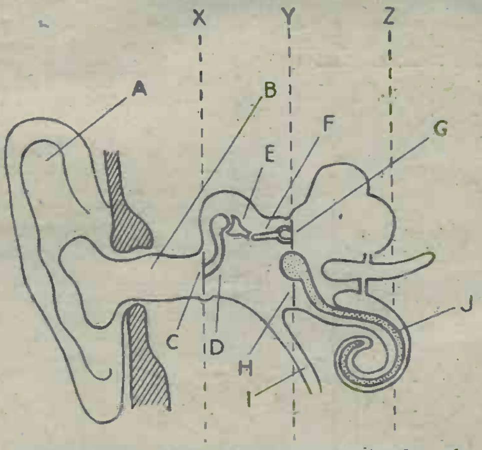
Aids to Hearing

An Introductory Article Covering Some of the Vital Problems Associated with this Rather Complex Subject. By a Member of the Technical Staff

DURING the days when the Query Service was in full operation, many requests used to be received from readers for constructional details of some form of hearing-aid. In spite of the temporary ban on readers' queries, such requests are still received, and this may be due to (a) more people suffering from deafness; (b) the price of commercially produced equipment being beyond their means; or (c) the thought that the defective hearing can be remedied by some device which will make all sounds louder.

Ample proof has been given in the past (when the component supply problem did not exist) that the Editor is always willing to satisfy feasible requests made by readers of "P.W.," by publishing new designs, etc. With electronic hearing-aids, however, the technician alone is not in the position to provide the solutions to the many problems which can be involved in defective hearing and satisfactory counter measures. While he can, for his part, see to and produce sound amplifying apparatus to satisfy certain specific requirements, it must be left to the pathologist to diagnose the cause of the deafness and to advise whether or not deaf-aids can be used and, if so, what form they can take.

Although constructional details of hearing-aids will be given in this article, it cannot be over-emphasised that such designs are solely put forward with the hope that they may be of some use to those who have already had proper medical advice, and who wish to construct their own equipment, though the present is hardly the best time to choose for such work, owing to the midget component supply problem. On no account is a reader advised to make his own hearing-aid and use it without having had a thorough medical examination, otherwise serious harm may result, and the absence of medical diagnosis during the early stages of the trouble might well allow the root cause to progress beyond the stage of successful treatment. To avoid any misunderstanding, the writer feels it is advisable to state that such information as is contained in this article, apart, of course, from that dealing with the electronic side, is solely the result of interest he has taken in the matter owing to the fact that he himself experiences annoying periods of deafness.



The mechanism of the human ear, showing how the vibrations are transmitted from the ear drum C in the outer ear to the membrane G between the middle and inner ears.

The Ear

Before dealing with the electro-acoustic side of the problem, it will be well to consider, in a non-medical way, the mechanism of the human ear, which is shown in a very elementary form by the diagram on this page.

The ear is best thought of as consisting of three sections, these being known as the outer, middle and inner ear, the respective areas being indicated on the diagram by the vertical broken lines. The outer ear is the pinna (A), and this has a shell-like formation and serves as the collector and director of sound waves on to the tympanic membrane or ear drum (C), through the auditory channel (B). The membrane separates the outer and middle ears, and it is normally aperiodic over the full frequency spectrum embraced by the human ear. On sound waves reaching (A) and (B), the membrane or ear drum is set into a state of vibration, and it is necessary for such vibrations to be carried to the inner ear if normal hearing is to take place.

The middle ear consists of an air filled chamber, approximately that between lines X and Y, and to allow the atmospheric pressure to be equalised on both sides of the ear drum a small tube, known as the eustachian tube, exists between the chamber and the pharynx, and this is indicated by (I). On the inner side of the middle ear are two more membranes separating the middle and the inner ears, and one of these membranes (Fenestra ovalis or oval window) is linked by means of three small bones or ossicles to the ear drum, which form a mechanical system for the transference of the vibrations of the ear drum to the inner ear. The ossicles are shown by (D), (E) and (F), the parts being known as the hammer, anvil and stirrup bone respectively. The inner membrane is (G), while (H) denotes the second one (Fenestra rotunda) (round window).

Coming now to the inner ear, things become a little more difficult to understand in, shall we say, a mechanical sense, and as it is well outside the scope of this article, a brief description of the main parts must suffice. For example, there is a bony labyrinth and a membranous labyrinth, There are the semicircular canals, etc.; there is a fluid in the labyrinths, in fact, one can think of the inner ear being filled with fluid; there is the cochlea (J) which resembles in shape a snail's shell, from which, incidentally, it obtains its name. It is in the cochlea that exists the most wonderful part of the ear, a part which is known as the organ of Corti or basilar membrane, which carries out the amazing task of analysing the vibrations before the auditory nerves transmit them to the brain which, in turn, interprets them into what we know as sound. The semicircular canals, etc., are the organs of orientation, and these enable us to appreciate movement, direction and balance.

Forms of Deafness

It may seem wrong to speak of forms of deafness, when a deaf person is simply deaf; there are, however, different causes of deafness, and the loss of, or impaired, hearing does not always take the same form; therefore, while one type of aid might be highly suitable for one form, it could be far from satisfactory, or even useless and harmful, to another. For example, as in the case of the writer, there is deafness which cannot be helped by hearing-aids, while at the other end of the scale there is just loss of sensitivity which can be practically eliminated by a very moderate degree of amplification.

The most common form of deafness seems to be that directly connected with defects in the outer and middle ears of such a nature as to restrict or prevent the full operation of those parts concerned with transmitting the sound vibrations to the inner ear. For example, the auditory channel (B) might be obstructed; the ear drum may become thickened; the movement of the membrane (G) of the inner ear might be restricted, or the joints of the ossicles may become stiff. Blocking of the eustachian tube would create unequal pressure on the ear drum, while any inflammation of the delicate parts would directly affect their efficiency. All these possible causes are chiefly concerned with the outer and middle ears, and while they would directly affect the normal operation of the inner ear by its usual mechanism, it is usually possible still to make use of the inner ear by conveying the sound vibrations to it via the skull bones. Another source of deafness can exist when the outer and middle ears are to all intents and purposes perfect, but when some defect exists in the delicate and somewhat complicated parts forming the inner ear, and if the root of the trouble is connected with the basilar membrance, a form of deafness is produced which may well be extremely difficult to alleviate by any form of hear-aid. Finally, elderly people sometimes experience difficulty in following normal conversation, although tests may reveal the ears to be normal, and this form of "apparent" deafness provides another problem for the designer of hearing-aids, as these are likely to be of little use unless one of the other forms is also present.

From the above it will be obvious that the diagnosing of the source of the trouble must be left to the medical profession, and, in view of the complexity of the complete mechanism of the ear, preferably an ear specialist.

The sensitivity of the ear is closely connected with the frequency of the tones heard, and the actual width of the frequency band audible varies with individuals, particularly if any form of deafness is present. A healthy person can often hear tones ranging from 25 to 20,000 cycles per second, but one with impaired hearing would have an uneven and restricted frequency response curve, according to form of deafness present. If volume or intensity of sound is considered, it will be found that the sensitivity of the ear falls within certain defined limits, the extremes of which are known as the "threshold of audibility" and the "threshold of pain or feeling." Use is made of these two characteristics for diagnosing the form of deafness, the apparatus used being a form of audiometer. This, in its commonest form, can be thought of as a well-designed L.F. oscillator producing a wide range of pure tones, the pitch and intensity of which can be controlled by the operator. The patient is provided with an earpiece (a single headphone) which is connected to the output of the oscillator, and the operator proceeds to carry out tests for audibility over the normal frequency range, and according to the settings of the controls, which are usually calibrated in frequency and decibels, he is able to prepare a very accurate frequency response/audibility curve of the patient's ears. If necessary, a further series of tests are also applied with the patient using a bone conductor reproducer in place of the headphone. From the graphs obtained the specialist is able to get a pretty accurate idea of the form or source of the deafness, and, if a hearing-aid is found necessary to help to overcome the trouble, he is also able to specify the frequency characteristic of the equipment to be used.

The average frequency band covered by the speaking voice is approximately 120 to 10,000 cycles per second, but the actual width of this band can be cut quite drastically without seriously affecting intelligibility, but this does not mean that any one restricted section of the whole band would be satisfactory for all forms of deafness. The ear has peculiar properties so far as apparently making good missing fundamental tones, and this applies in particular to the lower register when pure higher harmonics are being received. This characteristic allows the response of a hearing-aid to have a comparatively high low-note cut-off, which, at the same time, is useful in keeping down low frequency background noises, and enabling the designer of the aid to make the apparatus more compact.

(To be continued.)

Books Received

TELEVISION FOR EVERYMAN. By F. W. Kellaway, B.Sc. (Hons.). Published by John Crowther, Ltd. 56 pages. Price 2s. 6d. net.

THIS handy book, written in non-technical language, provides a background of knowledge that will enable all interested in television to follow the post-war developments in the science with added interest. The contents of this book will enable the intelligent amateur to understand the progress made, and how much more we can yet expect. The volume is illustrated by several line drawings and photographs.

RADIO WAVES AND THE IONOSPHERE. By T. W. Bennington. Published by Iliffe and Sons, Ltd. 82 pages. Price 6s. net.

IN this book the author aims to explain the phenomena of the ionosphere and its importance in connection with long-distance short-wave communication. The book contains no mathematics, and anyone capable of reading a simple technical article should be able to read and understand this book, thus considerably improving his knowledge of short-wave problems. The text is illustrated by numerous diagrams.

PHYSICS AND RADIO. By M. Nelkon, B.Sc. (Lond.). Published by Edward Arnold and Co. 388 pages. Price 8s. 6d. net.

THIS book, which is intended for radio mechanics, wireless operators and students, is virtually an elementary text book of those principles of Physics which concern Basic Radio, and therefore contains some of the essentials of Sound and Light. The text is divided into 25 chapters covering, amongst other subjects, The Electrical Structure of Matter; Direct Current Theory; Electrolysis; Electromagnetic Induction; Alternating Current Circuit Theory; Basic Principles of Valves; The Power (Output) Stage in a Receiver; The Principles of Sound; and the Cathode-ray Oscilloscope.

The book is profusely illustrated with diagrams.

A SMALL LOUDSPEAKER *(Contd. from page 155.)*

cone and drive in six ⅜in. by 6 roundhead iron screws.

Connect wires from the speaker terminals to the output terminals of a receiver and switch on the latter. If you hear much rattling, the tension of the cone is too loose. Turn the adjusting knob to rectify matters.

Should reproduction be rather weak, make sure the set is properly tuned up to full strength. If reproduction is still muffled and somewhat faint, the diaphragm is either too close to or too far away from the tops of the iron coil cores. Remedy matters by fitting 2in. rings of blotting-paper either below or above the diaphragm, as the case might be.

If the cone appears to be too stiff, so that reproduction is partly "killed" by the stiffness, remove the six flange screws and place a small cardboard or metal washer over the cone edging tabs, right over the screw holes, replace the flange ring carefully and drive home the screws. The six washers, of course, keep the flange away from the edging tabs of the cone and thereby allow more "play" or movement.

Under test, on a two-valve set, the earphone loudspeaker gave excellent results and could be heard plainly all over the house (with all doors open, of course). If, therefore, your model is disappointing, it will be largely the fault of materials used, rather than these instructions, which faithfully follow the construction of the actual working model.

Television Practice—3

Saw-tooth Waveforms—Synchronisation—Definition

Saw-tooth Waveforms

THE production of saw-tooth waveforms, particularly in their application to oscilloscopes and other small-tube test apparatus has been discussed in previous issues. Basically the principle employed is the charge and discharge of a condenser, the comparatively slow exponential rise of voltage across the plates being utilised to draw the light spot across the fluorescent screen, with the sudden discharge allowing the spot to return to its initial position in readiness for the following sweep.

In oscilloscope design we are generally concerned only with a single line time-base as it is called, the spot sweeping across the same portion of the screen with great rapidity giving to the eye the impression of a straight line without breaks. In television, while the same principles apply, a system must be employed such that the spot does not move along its own track for every

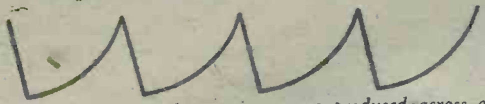


Fig. 11.—Saw-tooth scanning waves produced across a condenser, showing the exponential build-up.

sweep, but moves downwards between each line by an amount equal to its own diameter. In this way the complete area of the screen is covered by the spot, giving a continuous patch of light instead of a line to the eye. This implies that we must employ two time-base systems, one to move the spot horizontally and the other to move it vertically.

The manner in which saw-tooth waveforms for both these time-bases are produced in television receivers is essentially the same as that employed for saw-tooth production in an ordinary oscilloscope. A condenser is allowed to charge through a resistance from some source of D.C. potential, and on reaching a certain point is abruptly discharged, generally through a saturated valve. An essential of the saw-tooth scanning waves produced (Fig. 11) is that the portion representing the charge must be substantially linear, otherwise a host of troubles will appear. During the return period, or discharge time, the exact shape is not particularly important, but the ratio of forward time to return time should be as small as possible.

With tubes employing electrostatic deflection a saw-toothed voltage wave is required; with electromagnetic deflection a saw-toothed current wave is necessary. It is customary to use electrostatic deflection for line scanning and magnetic deflection for frame scanning, though this is not absolutely essential. Voltage saw-toothed waves are easier to produce for reasons which will be given later.

A simple voltage wave may be produced by such a means as that illustrated in Fig. 12. The valve V is biased beyond cut-off by the battery B, and remains cut off until a large positive pulse, greater in magnitude than the voltage presented by B, is applied across the resistance R. Starting at the point where the valve is not conducting the condenser C begins to charge up from the battery B1 through the resistance R1, this rise being exponential in form. This build up goes on until the positive *synchronising* pulse appears across R, when the valve suddenly conducts and discharges the condenser. As soon as the positive synchronising pulse disappears the valve again becomes non-conducting and the cycle of events repeats.

The frequency of the saw-toothed wave produced will depend upon the frequency of recurrence of the synchronising pulse, and is controllable by this means. In a complete, self-contained circuit, the synchronising pulse may be arranged to come from a form of blocking oscillator or a phase reverser controlled by the condenser build-up itself. Various forms of saw-tooth generators were discussed in earlier articles on oscilloscopic design, including the blocking oscillator, multi-vibrator and Puckles type circuit. The rise of voltage across the condenser may be made substantially linear by utilising only the initial part of the charge cycle or by employing a constant current device in place of the plain charging resistor. These things have also been fully discussed before.

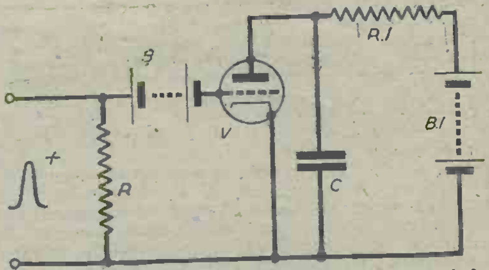


Fig. 12.—A simple saw-tooth generator triggered by positive synchronising pulses.

For line scanning where the frequency of the waveform has to be fairly high (number of lines per frame times number of frames per second), saw-tooth generators employ hard valves in preference to gas-filled types, the time lag of the latter introducing distortion unless special precautions are made.

For electromagnetic scanning it is necessary to produce a saw-tooth waveform of current, for the deflection of the electron beam passing along a cathode ray tube depends upon the magnitude of the current flowing in the deflector coils. There would be no complications about this matter if the deflector coils possessed resistance only, for the application of a saw-toothed voltage waveform across them would result in a saw-toothed current flowing through them. But the coils possess inductance as well as resistance, so that when a saw-toothed voltage waveform is applied to

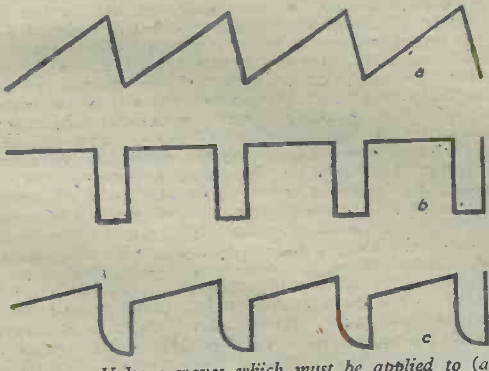


Fig. 13.—Voltage waves which must be applied to (a) resistance only, (b) inductance only, (c) resistance and inductance in order to produce a pure saw-tooth current wave.

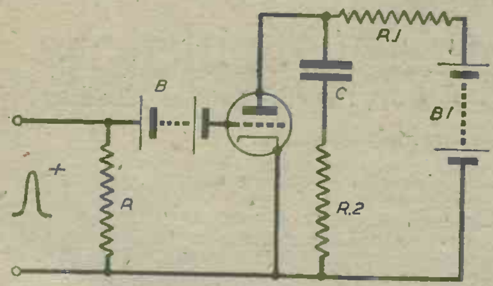


Fig. 14.—A circuit suitable for producing a voltage wave of the shape shown in Fig. 13 (c).

them the resulting current suffers a distortion which destroys the saw-tooth effect. In order to overcome this difficulty it is necessary to so produce a waveform that when it is applied to the deflector coils the desired saw-tooth automatically results. Knowing the inductance and resistance of a particular pair of deflector coils it is a fairly simple matter to calculate the waveform of voltage that must be applied in order to achieve this. As we have remarked, for coils possessing resistance a saw-toothed waveform only is required (Fig. 13a). For coils having no resistance, only inductance, we should have to apply a series of square pulses having a duration equal to the fly-back time; the resulting current would then be of saw-tooth form, for the build-up of current through a pure inductance follows the same law as the voltage charge of a condenser (Fig. 13b). In actual practice, where resistance and inductance are both present in the coils we must combine the waveforms of (a) and (b) in proportions depending upon the relative magnitudes of the resistive and inductive components present; the resulting current will then be of the desired shape (Fig. 13c).

The manner of producing a voltage wave shaped as in Fig. 13c is actually not so difficult as might first appear, a circuit suitable for the purpose being given in Fig. 14. This is very similar to Fig. 12 except that a resistance R2 is connected in series with the charging condenser C. The operation of the system with regard to the synchronising pulses across R and the build-up of voltage across C is exactly the same as for the previous case, and is employed to overcome the resistance drop of the deflector coils. The voltage across R2, however, can be shown to follow the form of a pulse such as is shown in Fig. 13b, provided that its ohmic resistance is very much smaller than that of the charging resistance R1. The reason for this is that there is a sudden rush of current through R2 as the condenser C discharges, compared with the small and practically constant current flowing during the period of charge.

The manner of causing a spot to scan the fluorescent screen by a combination of horizontal and vertical time-base systems should now be apparent. Starting with the spot in the top right-hand corner of the tube (Fig. 15), a saw-toothed waveform is applied to the horizontal deflector plates having a frequency equal to the number of lines required per frame multiplied by the number of frames required per second, and a saw-toothed current waveform is passed through the vertical deflecting coils having a frequency equal to the number of frames required per second. Suppose a 200-line picture is required at 30 frames per second; then the horizontal time-base frequency will be 200×30=6,000 cycles per second. So the spot will be moved across the screen 200 times in 1/30th second, all the time being moved down by an amount which determines the height of the picture and which should be 200 times the line width if overlap or spacing is not to occur. At the end of the 1/30th second one frame has been completed, the spot is returned very quickly to its starting point, and the cycle of events is caused to repeat indefinitely. The lined area of the screen is referred to as a "raster."

The manner in which each time-base is triggered off in complete synchronism with the similar scanning process at the transmitter will be discussed in the next section.

Synchronisation

The received image is locked to the transmitter by a series of line and frame synchronising pulses, these pulses being produced by the scanning system of the television camera and transmitted along with the television signal to the receiving station. Received there they are used to control the scanning devices of the latter so that the position of the cathode-ray spot on the frame of the reproduced image is in the same relative position as the picture element being scanned at the transmitter. There are several methods of generating synchronising pulses, the most common being a form of controlled multi-vibrator locked to the scanning system of the television camera.

The object, in any case, is to mark with a distinctive pulse the end of each line and the end of each frame. To distinguish between them, the frame pulse is made of longer duration than the line pulse, the receiver separating them by this duration difference. The pulses are transmitted with the vision signal and to avoid interference with the latter are made to correspond to the polarity of black, their amplitude being very much greater than the greatest signal amplitude for a black section of the image. Overloading of the transmitter is prevented by a form of limiting amplifier which maintains and limits the peak amplitude to about 50 per cent. more than black.

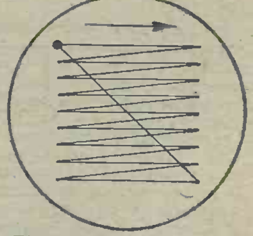


Fig. 15.—Exaggerated diagram depicting a spot tracing out an area by a series of lines.

The first job of the receiver on picking up the combined signal and synchronising pulses is to separate one from the other, this being easily achieved by taking advantage of their difference in amplitude. A valve is biased sufficiently beyond cut-off to ensure that the maximum possible signal currents fail to open it; only the synchronising pulses which are of much greater amplitude than the signal currents lift the bias sufficiently for the valve to conduct and so appear in the anode circuit free of signal variations. These pulses are then applied to a network which separates the line and frame pulses themselves by discriminating between their frequency and duration. A block diagram of this part of a television receiver is given in Fig. 16.

An advantage is gained by transmitting the synchronising pulses with a polarity corresponding to black in the reproduced image, for if the duration of them is made equal to the fly-back time of the spot, both at the end of each line and at the end of each frame, the cathode-ray spot is cut off during these periods and no return lines appear to interfere with the picture.

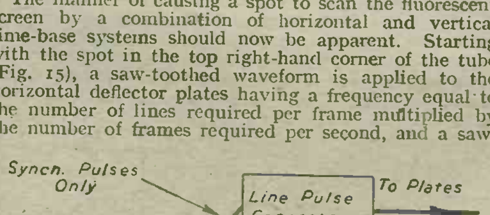


Fig. 16.—Block diagram of the synch. signal, line and frame separator systems.

(To be continued.)

Negative Resistance Oscillators

The Dynatron and Transitron Circuits and Measurements with Negative Resistance Oscillator

By P. FREEMAN, B.Eng.(Hons.)

IN the days when screen grid or tetrode valves were commonly used as R.F. amplifiers in broadcast sets, many experimenters must have noticed the peculiar slope of the anode voltage-anode current characteristic curve for this type of valve. It will be seen that as the anode voltage is raised from zero to maximum the anode current, for a constant screen voltage, does not increase continuously but, over a short range of anode voltage, actually decreases, giving rise to the expression "tetrode kink." An exaggerated diagram of this portion of the curve is shown in Fig. 1. The "kink" is due to secondary emission of electrons from the anode to the screen grid. Bombardment of the anode by electrons shot off from the cathode causes the release of a certain number of new electrons from the metallic coating of the anode. When the screen voltage is sufficiently high many of these "anode electrons" find their way to the screen grid and cause a current in the

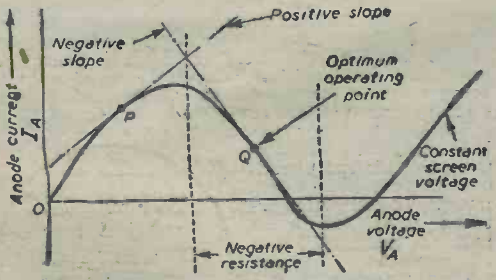


Fig. 1.—Dynatron characteristic.

reverse direction to the normal cathode-anode current. At certain potentials (i.e., when the screen grid voltage is greater than the anode voltage) the secondary emission of anode electrons exceeds the emission of cathode electrons and the net effect is a decrease in anode current for a rise in anode voltage.

Now the internal resistance of a valve is measured by the slope of its anode current-anode voltage characteristic, that is by drawing a tangent at any required point on the curve. If the tangent makes a positive angle with the axis of anode voltage as at P_1, then the internal resistance is positive. This is the case, of course, with valves used under normal conditions. When, however, the tangent makes a negative angle, as at Q, the internal resistance is negative. By suitable variation of the electrode potentials the slope of the characteristic curve may be altered and hence the amount of negative resistance changed. A tetrode operating under these conditions is known as a "dynatron." A pentode may also be used to generate negative resistance and is known as a "transitron." Its method of operation is described later.

The Dynatron or Transitron

To understand how the dynatron or transitron can be used for practical purposes it is necessary to visualise it in a circuit as a *negative* resistance. That is to say, it will act in opposition to any *positive* resistance in the circuit. A coil and condenser connected together to form a tuned circuit are equivalent to a high positive resistance (dynamic resistance) at the frequency to which they are tuned. The lower the inherent losses of the components the higher will be this dynamic resistance. An efficient tuned circuit might have a dynamic resistance of several megohms, while inferior components would reduce this to only a few thousand ohms. When the losses are reduced to zero, the dynamic resistance becomes infinity and the circuit commences to oscillate. By connecting a *negative* resistance in series with the tuned circuit the losses may be neutralised and the conditions of oscillation fulfilled. The amount of negative resistance which has to be introduced is a measure of the losses in the circuit. Both dynatron and transitron circuits may be used for this purpose and by calibrating the grid bias control the amount of negative resistance introduced can be easily determined. A negative resistance generator is thus a valuable instrument for the practical analysis of radio circuits. Losses in coils, chokes, tuning condensers, valve-holders, etc., may be compared and measured and inefficient components replaced by better ones.

A description is given below of circuits of several well-tested negative resistance generators. Any of these may be used to provide the basis of a permanent apparatus for the radio workshop. It is recommended that the battery circuits should be tried first as the conditions of operation are less rigid than is the case with the mains-driven circuit.

The Dynatron Circuit

Fig. 2 shows the circuit of a battery-driven dynatron. The most suitable valves to use are the Mazda ACS2 or the American type 24, but most indirectly heated tetrodes can be made to work satisfactorily. A 0-10 milliammeter I_s in series with the screen circuit gives a reliable indication of when the external tuned circuit connected between A and B has been put into oscillation. All tetrodes of the same type do not, unfortunately, show the same dynatron characteristics, as their power to develop secondary emission depends on the construction and metallic composition of the anode. New valves in general exhibit more pronounced secondary emission than ones which have been in use for some time. This disadvantage, coupled with the difficulty of obtaining tetrode valves, may necessitate trying the transitron circuit described below. The grid bias must never be reduced to zero or near zero in a dynatron circuit or the screen current will rise rapidly and the dynatron properties of the valve seriously and irreparably impaired.

The Transitron Circuit.

The transitron generator possesses all the advantages of the dynatron and none of its disadvantages. It functions independently of secondary emission and its efficiency as a negative resistance generator does not depend on the age of the valve. Almost any type of R.F. pentode can be used provided the suppressor grid is brought out to a separate pin on the base. The method of operation of the transitron is as follows: The suppressor grid voltage is chosen so as to make the

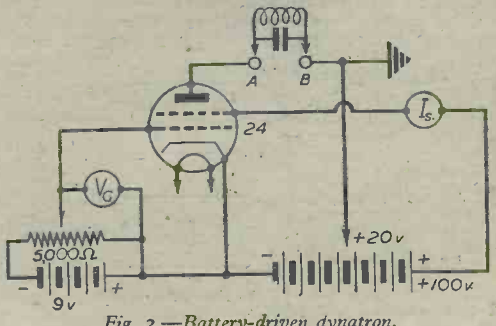


Fig. 2.—Battery-driven dynatron.

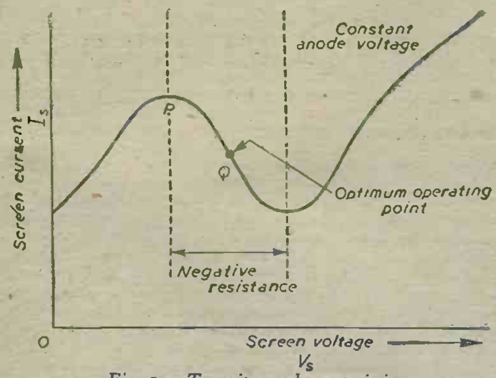


Fig. 3.—Transitron characteristic.

suppressor grid negative with respect to the cathode. Electrons from the cathode that have passed through the screen grid are repelled by the suppressor grid and return to the screen because of its high positive voltage. Hence the suppressor grid with its retarding negative potential acts as a virtual cathode. A small negative increment of voltage across the tuned circuit AB is transmitted to both the screen and suppressor grids, via the condenser C (see Fig. 4), causing the suppressor grid to repel more electrons and the current to the screen grid to increase. Hence the mutual conductance between the screen and suppressor grids is *negative.* The characteristic screen current-screen voltage curve is shown in Fig. 3. It will be seen to be similar in shape to the dynatron characteristic shown in Fig. 1. This negative mutual conductance is equivalent to a negative resistance introduced into a circuit connected across A and B. The optimum operating point is at Q, midway between the points on the curve between which the mutual conductance is negative. When a small negative bias is applied to the control grid, the total current flowing to the screen grid may be controlled and the slope of the current-voltage characteristic varied. Hence a flexible means is available for varying the amplitude of the oscillation and the magnitude of the negative resistance. In a well-designed oscillator the frequency stability is extremely good provided the amplitude of the oscillation is kept small. The wave form is also exceptionally pure and free from harmonics.

Practical circuits of transitrons are shown in Figs. 4 and 5. These have been designed for a 6K7G valve. Other valves which work well are 6J7G, EF6 and VMP4G, although the optimum electrode voltages may be slightly different. As in the case of the dynatron, the valve used must be indirectly heated. A cheap and convenient way to heat the cathode is to use a bell transformer (tapped at 3, 5 and 8 volts), with a suitable series resistance. The battery-driven oscillator shown in Fig. 4 presents no constructional difficulty. The condenser C should be non-inductive and have good insulation.

The battery B_1 consists of two 9 v. grid bias batteries in series and is used to provide both suppressor and control grid voltages. The suppressor voltage is fairly critical, usually between -8 v. and -15 v., and depends on the H.T. voltages used. A 120 v. battery B_2 supplies the high tension, the full 120 v. being used on the screen grid and from 20 to 40 volts on the anode. An indicating milliammeter I_A is placed in the anode lead.

A mains driven circuit is shown in Fig. 5, component values again being suitable for a 6K7G. The H.T. is obtained from an eliminator or power pack capable of supplying about 150 volts at 30 m/a D.C. It is essential for the valve electrodes to be fed from a low resistance network, otherwise it will be found impossible to keep the oscillator at its optimum working point. All the bypass condensers should be non-inductive and mounted as close to the valve base as possible.

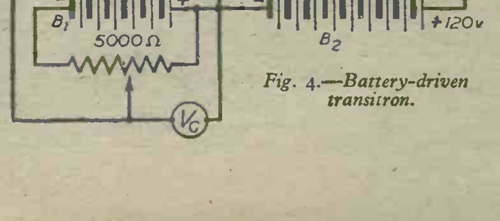


Fig. 4.—Battery-driven transitron.

Operation of Negative Resistance Generators

The operation of both dynatrons and transitrons is similar. A tuned circuit consisting of coil and condenser is connected between the terminals A and B and the bias voltage as indicated by the voltmeter V_G is set

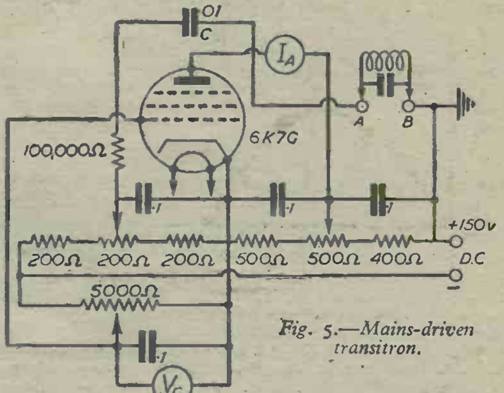


Fig. 5.—Mains-driven transitron.

to a maximum by means of the 5,000 ohm potentiometer. The H.T. supply is switched on and the reading of the indicating meter I_S or I_A noted; this should be in the region of a few milliamps. The grid bias is gradually reduced until the meter kicks slightly downwards, indicating that oscillations in the tuned circuit have commenced. Touching terminal A lightly with the finger will now cause a rise in current. The critical setting is to adjust the grid bias to the threshold of oscillation. This point is most accurately found by listening to the signal on a broadcast receiver and varying the grid bias until the signal is just audible. Readjustment of anode and suppressor voltages should be carried out until oscillations can easily be generated in circuits of very low dynamic resistance, such as a coil and condenser shunted by 10,000 or 20,000 ohm resistance. To neutralise such large losses the negative bias must be reduced to a low value, since reduction of bias causes an increased quantity of negative resistance to be generated.

Measurements with Negative Resistance Oscillators

A negative resistance oscillator may be used to generate oscillations in any two terminal circuit, even though it is screened and inaccessible. An example of this is the production of oscillations in coils or I.F. transformers in a radio set by simply connecting test leads from the coil tags to the terminals A and B. The amount of negative resistance necessary to start oscillations is a measure of the efficiency of the component being tested.

A transitron or dynatron circuit provides a stable source of oscillations from 50 cycles up to 50 megacycles per second by simply changing the constants of the tuned

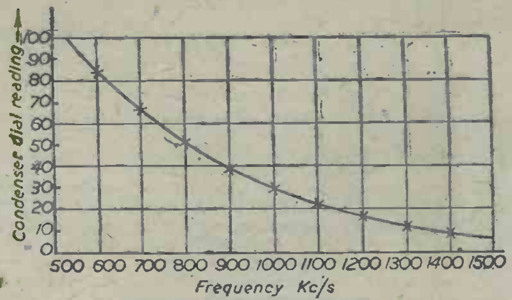


Fig. 6.—Condenser calibration.

circuit across AB. Thus a frequency of 400 cycles per second is produced when the tuned circuit consists of a 0.1 mfd. condenser in parallel with an inductance of 1.5 H; the medium wave broadcast band is covered by a .0005 mfd. variable condenser in parallel with a coil of 200 μH inductance. A modulated R.F. signal can be readily obtained by connecting an A.F. tuned circuit in series with an R.F. tuned circuit and putting both across the terminals A and B. As a stable R.F. signal generator it may be used to match coils and condensers in ganged circuits to a high degree of accuracy. As an A.F. generator of very pure wave form it may be used to test the frequency response of audio amplifiers and is particularly valuable for obtaining frequency characteristics for oscillographic reproduction. The most valuable asset of the negative resistance oscillator in the radio workship is to compare the dynamic resistances of tuned circuits, measure the R.F. resistances of various components, test R.F. chokes for impedance and absorption over their certified band of working frequencies, measure aerial characteristics and test R.F. losses in insulating materials. The method of using the oscillator to measure R.F. resistance is described below.

Measurement of R.F. Resistance

The optimum voltages for anode, screen and suppressor grids must be determined and made permanent, the only variable control is the grid bias potentiometer. Suppose that the R.F. resistances and losses of components in a receiver require to be measured at various frequencies in the medium wave band. A tuned circuit comprising a .0005 mfd. variable condenser with a calibrated dial and a 200 μH coil (an old type 60 turn plug-in coil) is connected across A and B. Both these components should be selected to have the lowest possible losses (e.g. a ceramic insulated air spaced tuning condenser and a Litz wire coil on a high insulation former). The condenser is set at minimum and the grid bias altered until the circuit is just oscillating. The signal is tuned in on the medium wave band of a broadcast set and the wavelength or frequency noted. The process is repeated for about 10 condenser settings right up to the maximum capacity of the condenser. A calibration curve showing frequency in kilocycles for condenser dial reading is next drawn (Fig. 6). The grid bias control is next calibrated; for this the following resistances are required: 2, 1, 0.5, 0.25, .1 megohm, 50,000, 25,000 and 10,000 ohms. These should be of the composition type and non-inductive. The tuned circuit is set for 600 Kc/s, the 2 megohm resistance shunted across and the grid bias reduced until the circuit just oscillates (listen to the signal on a broadcast receiver or watch the indicating milliammeter), note down the grid bias voltage as recorded by the meter V_G. This test is carried out at frequencies of 700, 800, 900, 1,000, 1,100, 1,200, 1,300, 1,400, and 1,500 K/cs and the 2 megohm line X_1 Y_1 drawn on a graph representing grid bias voltage and frequency (Fig. 7). The 2 meghom resistance is next replaced by a 1 megohm resistance and the whole series of readings repeated from 600 to 1,500 Kc/s. This gives points for the 1 megohm line X_2 Y_2. Sets of readings are obtained for each resistance in turn giving the lines X_3 Y_3, X_4 Y_4, etc., in Fig. 7. From the graph of Fig. 7 the grid bias voltage necessary to generate a negative resistance of any magnitude between 10,000 ohms and 2 megohms at any frequency in the medium wave band can be directly estimated. If the negative resistance is only required at one particular frequency (say 1,000 Kc/s) the process of calibration is considerably shortened, as only the resistance points corresponding to this frequency need to be determined. Having obtained a calibration curve similar to Fig. 7, the apparatus is ready for use. Suppose it is necessary to find out what resistance an R.F. choke presents at a frequency of 1,000 Kc/s. The choke is shunted across the tuned test circuit and the condenser adjusted to produce oscillations at 1,000 K/cs. The grid bias is set to the threshold of oscillation and the grid voltage read off. Examination of the grid bias calibration curve will show the R.F. resistance of the choke at the required frequency. Again suppose it is decided to measure the damping introduced by screening a coil in a receiver under construction. The coil is shunted across the oscillating circuit and the R.F. resistance

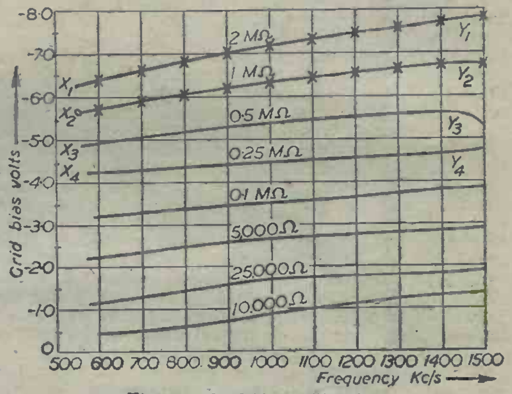


Fig. 7.—Grid bias calibration.

determined; the experiment is repeated with the coil screened and the new R.F. resistance calculated. The difference in values being a measure of the damping introduced by the screen. The R.F. insulation resistance to earth of various components such as valve sockets, coil holders, wave change switches, can be readily measured with a pair of short test leads at various frequencies. It is very instructive to analyse the circuits of a home-built receiver in this manner, by connecting or removing each item in turn from the aerial input to the detector valve, and finding out which components introduce the most damping and could with more careful design be made more efficient.

Once the fundamental principles of the negative resistance oscillator are understood, many other applications will suggest themselves to the experimenter or service engineer.

ON YOUR WAVELENGTH

By THERMION

Our Readers On Service

MR. BEVIN in a recent speech stated that he tried to get people to make and operate radar from the radio industry, but personnel had been reduced, and those remaining had become almost automatons due to mass-production methods, and he failed completely. Then he made an appeal on the radio, and had more than 200,000 applications from which 70,000 to 80,000 radio mechanics were quickly trained, thus proving that there was a vast reservoir of ability in this country which had made great contribution to our success in the war.

Many hundreds of our readers responded to this appeal and are now in the Services. Members of our staff in the early days of the war joined up to help in the training. The readers of this journal have thus put their knowledge to the best possible use—the service of their country—and many of them graciously admit the debt they owe to this journal. I often feel that the Government is not sufficiently appreciative of the work which technical journals perform, nor of the help they render to the country, both in print and behind the scenes. Someone should tell the story over the air one of these days. Individuals are permitted to tell their stories, and by reflection to take credit for their work. The Press has done a remarkable job and is proud of its achievement.

The B.B.C. Charter

AT the end of next year the B.B.C. Charter expires. Technical developments, wartime changes, and social needs make a vast reorganisation of British radio inevitable. A political organisation asks how is the B.B.C. to develop and puts forward some suggestions and examines the argument for commercial radio. It shows unfavourable comparison with American radio is unfounded, for British listeners have only heard the top line shows selected by the American Government for the men over here, and presented without an advertising blurb, and not the average output of commercial stations.

Then we come to the gravamen of this political party's clamour. It says that commercial broadcasting does not make for greater freedom of speech, and it quotes a number of American sources to prove it, and to show the dulling effect of advertisers' attempts to condition people to be good customers on the critical faculties of their audience. This party's main proposals are constitutional changes to turn the B.B.C. from a royal monopoly into a public service under full Parliamentary control, and to ensure that its administration is no longer carried on in secrecy.

"It All Depends"

I THOROUGHLY enjoyed Nat Gubbins's debunking of the Brains Trust in a recent issue of a Sunday paper. I also plucked the following literary gem (by Quentin Hogg, M.P.) from the "Daily Telegraph," and pass it along for the approval or otherwise of my readers.

"Sir,—I like to think that somewhere in the recesses of Bloomsbury there is a dear old lady who will be entirely convinced by Dr. Joad's intellectual contortions.

"In 1933 a body of young men decided by vote that they would fight for King and Country 'in no circumstances.' Who procured this decision? Dr. Joad. In 1940, despite their decision, they fight for King and Country and some of them get killed. What is Dr. Joad's attitude? Apparently he is busy beating the recruiting sergeant's drum and blaring the bugle of patriotism.

"Now, if Dr. Joad had said, 'Boys, I'll come clean. I made a big mistake. I now believe the contradictory of what I said in 1933,' the apology, if somewhat belated, might at least have been thought manly and even a little disarming, although it would still have been the young men, and not Dr. Joad, who had to pay for his trifling error.

"But such, it seems, is not Dr. Joad's attitude. He 'invites my attention to a list of propositions' which, if a little confusing and even a trifle irrelevant, are clearly designed to show that Dr. Joad was right all along and that the young men ought to continue to value his advice.

"This is altogether too large a bolus to administer to one who, like Dr. Joad, has studied logic and is familiar with the law of contradiction.

"I rather fancy that Dr. Joad himself is more uneasy about the matter than he cares to pretend. Otherwise I cannot conceive why he should trot out the usual herring of the reds in the shape of the League, Abyssinia and the Wicked Tories. I explained to him as long ago as 1933 (if he had cared to listen) that no Government of whatever complexion could preserve the peace by collective security or the League unless young men in Britain were prepared to fight for King and Country which provided the real nucleus of this arrangement.

"I understand that Dr. Joad has made a certain study of the life of Socrates. But it is to the Socrates of Aristophanes's 'Clouds,' and not to the Socrates of history (who fought for his country at Delium), that one has to turn in order to parallel the logic of 'Britain's foremost philosopher'."

Our Roll of Merit

Readers on Active Service—Fifty-first List

W. Woodland (Cpl., R.A.F.).
K. Faulconbridge (Pte., S.E.A.C.).
F. Smith (Capt., R.A.).
D. Profit (L/Bdr., Signals).
S. Knight (S/Sgt., R.E.M.E.)
F. Herod (Sgt., R.A.F.).

THE SONG HITS OF TIN PAN ALLEY

Overheard in Music Shop

CUSTOMER: "But surely you know the number I mean? It goes like this: 'Di-de-doh, boo-boo-boh, umplemdidi, diddly ho.'"

SALESMAN: "Sorry, miss, but I don't seem to remember it. What are the words?"

CUSTOMER: "Those *are* the words."

The earliest men who lived in trees
Conversed by grunt and growl and sneeze.
The horrid sounds they made revealing
The crude emotions they were feeling.
Some umpteen thousand years have passed
Now modern man seems travelling fast
To where he sprang from long ago.
Surely his "song-hits" prove this so?
Sheer gibberish gurgled in his throat
To tunes without melodious note,
Which Dance Band Leaders hail with glee
And plug them via B.B.C.
We ask "Quo Vadis" whither going?
And Echo answers "There's no knowing."
The wheel turns round, full circle reaches,
We're drifting back to howls and screeches.
We'll yet climb back into the trees
To croon song-hits and hunt for fleas.
A frightful prospect, far from grand,
Should B.B.C. lend helpful hand
Or monkey talk in future ban
And stick to human words for man?
Nor offering Tin Pan Alley help
By plugging all it cares to yelp?

"TORCH."

Direct Disc Recording—5

(*Continued from page* 102, *February issue*)

IN the previous article we saw how necessary it is to use the best type of cutting stylus, and how important it is to make sure that the cutting edge is perfect before attempting to cut a disc.

We now have to consider another very important point, the correct angle to use for the cutter and head, which makes all the difference as to whether good or bad results are obtained, even if using a perfect cutter.

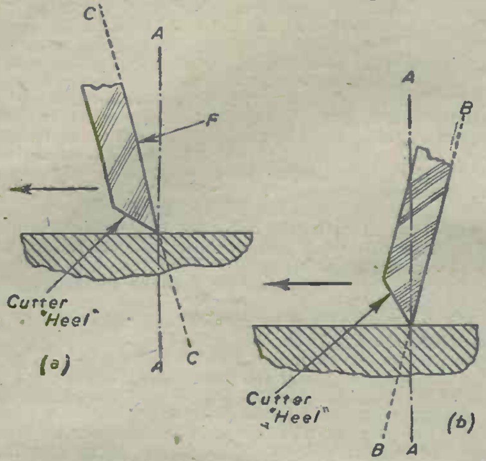


Fig. 1.—Measuring the heel angle.

Although a number of articles on disc recording have been published from time to time in the various radio and kindred publications, very little has been said regarding the actual cutting of the disc and the correct

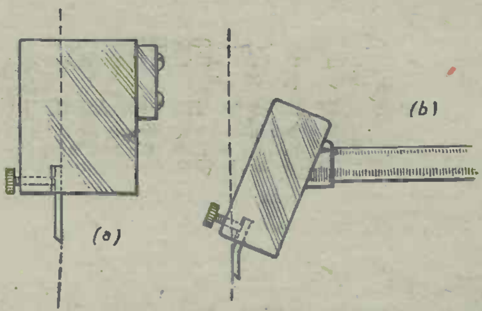


Fig. 2.—a, Head and cutter in line ; b, bent cutter.

angle, in the vertical plane, of the cutter and head in relation to the disc. Where mention has been made of this point it has usually been assumed that steel cutters with V-shaped cutting edges would be used, and as the older types of disc did not allow such ease of cutting as the present-day types the tendency was to advise a "lagging" angle of anything up to 10 deg. As many cutting heads were converted pick-ups, or little better, and as many were made for use on pick-up tracking arms, the user was offered various types of cutting stylii of unusual shapes, designed to compensate for the unusual mounting positions found when using these makeshift types of cutting heads.

With the great improvement found in modern steel cutters, and also in the coating materials used on the discs, which allow more easy cutting, at the same time having a longer playing life, we can afford to discard our old ideas and pet theories—and, incidentally, all the "stunt" types of cutters—and state quite definitely that angles between 5 deg. "leading" to 5 deg. "lagging" will cover all cutter requirements whether they be steel, alloys, or sapphires.

The modern steel cutter and the shank of the sapphire cutter is usually found to be $\frac{3}{4}$in. in length, with a diameter of 0.06in. Some cutter heads require a slightly shorter shank of the order of $\frac{1}{2}$in. Too long a shank should be avoided, as also should a bulky one such as is often found in sapphire cutters where the shank ends in a larger portion into which the sapphire is fixed.

The Correct Angle

Reference to Fig. 1a and 1b will show the "leading" and "lagging" angles which can safely be used and depending upon the particular type of stylii in use. Line AA is vertical in each case; BB is "lagging," whilst CC is "leading." In each case the angle is measured between the surface of the disc and the cutter face, which is the part which meets the disc as it revolves. When using a modern type of cutting head, in which the head is adjustable, the head and the cutting stylus will be in line as in Fig. 2a; older types permanently attached to the tracking arm at an angle had to use a bent cutter to obtain the correct angle as shown in Fig. 2b. This should be avoided if at all possible. The

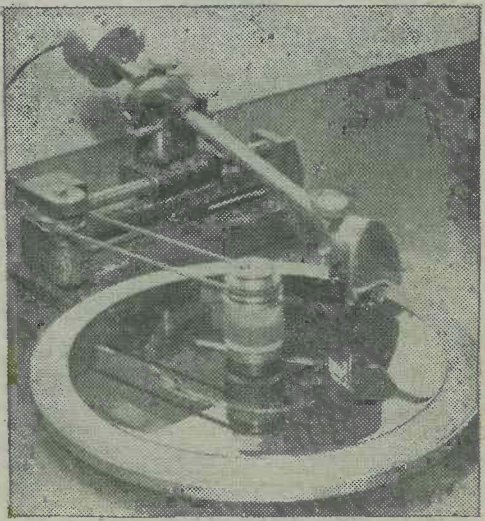
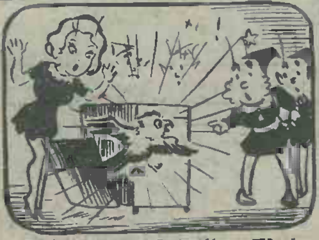


Fig. 3.—Older type of long arm with counterpoise.

cutter head should be so mounted as to allow of accurate adjustment in all directions, and once the correct angle has been obtained it should not be altered unless a different type of stylus is to be used, when readjustment may be necessary. Very slight alterations of angle and weight can make a considerable difference in the cut obtainable and the resulting surface noise, etc. When once correct for a particular type of stylus it is usually unnecessary to make alterations as stylii are replaced, although slight differences in each stylii in any batch are almost unavoidable. In any case it is desirable to make a trial cut with each new stylus, a very slight alteration in weight is sometimes required. Differences in discs and the temperature of the recording room may also require slight alterations in weight from time to time.

(*Continued on page* 167.)



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Just hark at it now,
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"You're right," exclaimed OO, "Look what's here."

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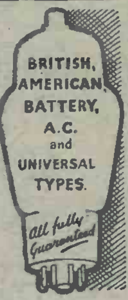

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Solder—Per pound reel, 13 or 16 gauge, 5/6.

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J. BULL & SONS
(Dept. P.W.),
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(See our Classified Advertisement on page 175)

AUSTERITY RADIO LIMITED

For

CONSTRUCTORS' KITS

see last month's issue

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Primary, 10-0-200-220-240; screened primary. H.T. 375-0-375 at 175 ma.; LT1, 5 v. 2 a.; LT2, 6.3 v. 4 a.; LT3, 6.3 v. 4 a. Price 52/6 each post 1/1.

350-0-350; 150 ma.; L.T.s, 6.3 v. 5 a.; 4 v. 4 a.; Rec. 5 v. 2 a.; 4 v. 2½ a.; can be used with international or English valves. Colour coded. Mains Input tapped 200/220/240 A.C. 50/-, post 1/1.

400-0-400; 120 ma.; L.T.s: 4 v. 2½ a.; 4 v. 4 a.; 4 v. 2 a.; 4 v. 2 a.; long Colour Coded Leads, with high insulation. (200/220/240) Mains Input Tappings. 45/-, post 1/-.

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Trimmers. T.C.C. Straight Line Air Spaced, 5 to 35 pf. max., 1/-. Single Ceramic, postage stamp type, 30 pf., 9d.; 30/80, 100/12, 150/250, 180/200, 1/- each. Twin Trimmer, Ceramic, .0005, 2/6.

Silver Mica Condensers, wire ended, 40pf., 88pf., .00015, etc., 9d. each.

Resistors, standard values, ¼ watt, 6d.; 1 watt, 1/- each.

Mains Dropping Resistors, with variable tappings .2 a., 1,000 ohms, 6/-; .3 a. 750 ohms, 7/- each.

Wire Wound Resistors, 500, 1,000, 2,000 ohms, 10 watt, 2/6 each.

Multicore Solder, 6d. box.

Volume Controls, 10,000, 50,000, 100,000, ½ meg., 1 meg., 3/6, less switch.

Toggle Switches. Miniature, on-off, single pole, 2/6. D.P., D.T. 3/3.

Coils. Short Wave, 16 to 50 metres, on Paxolin Formers, colour coded, A. & H.F. with reaction, boxed matched pairs, 4/- with circuit. Aerial and Oscillator Coils, Long, medium and short (16-50 m.) on one former 12/6 pair. A. & H.F. Medium Wave, Midget, 8/6 per pair.

Line Cord. 3-core, .3 amp. 60 ohms per foot, 5/- per yard.

Flexible Couplers. ¼" spindle, 1/- each.

307, HIGH HOLBORN,
LONDON W.C.1. *'Phone HOLborn 4631*

The average steel cutter will be found to cut best at between 2 and 5 deg. "lagging"; the alloys at about 1 deg. "lagging," or even vertical; whilst the sapphire types vertical, or in certain cases up to a few deg., say 3, "leading." It cannot be emphasised too strongly that adjustments as small as 1 deg. and a few grammes can, and do, make a considerable difference between a good or only a medium cut. Most well-adjusted equipment will give good results, but equipment which has been adjusted expertly will give just that "extra bit" which puts the results in a class by themselves. This is especially true with the better class of blanks; indeed, the better the blank the more accurate the cutting must be, and the more obvious become the mistakes in adjustments.

Generally speaking, a "lagging" angle of 1 deg. or more produces the least amount of trouble, especially with sharp-pointed steel cutters, as it will be obvious that a "leading" angle with these types would "dig in" and not cut perfectly, producing a sort of "hill and dale" serrated effect in the bottom of the groove, resulting in a high-pitched squeal on playback.

On the other hand, with the sapphire types of cutter a vertical or "leading" angle will produce the quietest cut, as, of course, the tip is highly accurately "lapped" and polished.

To digress for a moment from the subject of angle adjustment and weight. It should be the aim of all recording enthusiasts to use a definitely shaped cutter point rather than the old idea of a sharp V point. It is then possible to design, and use, a playback point with a definitely shaped tip radius and thus ensure as perfect tracing as possible of the original cut. We shall go more fully into this point when discussing playback in a later article.

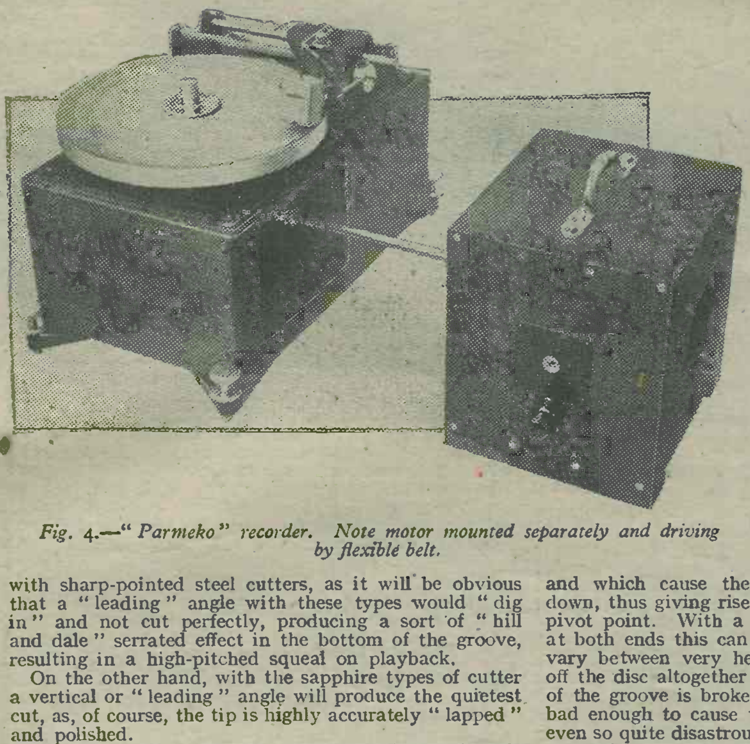


Fig. 4.—"Parmeko" recorder. Note motor mounted separately and driving by flexible belt.

Depth of Cut

Next we have to regulate the depth of cut so as to be reasonably constant around 0.0025in. If the groove is cut too shallow there is a danger of the pick-up not tracking correctly and groove jumping will result; if it is too deep a danger of over cutting, or of cutting through to the metal or glass base in which case the cutting point will be damaged, a serious point if a sapphire is being used. In any case a too deep cut results in an excess of surface noise on playback.

In professional recording on wax it is usual to find that the cutter head and carriage are so mounted as to enable a carefully adjusted counterbalance weight to regulate and control the depth of cut, even though the turntable and the wax are perfectly flat and accurately made from all points of view. In direct recording even if the base is flat, it is seldom that we find the coating perfectly flat, even though the variations may be very small indeed. It is therefore necessary to allow the cutter head some vertical movement, and as the weight of the cutter head must also be correctly adjusted, so as to put the correct pressure on the cutter whilst cutting, it is convenient to pivot the cutter head and cradle at some point and provide a means of counterbalance, preferably adjustable so as to be able to alter the weight applied to suit different types of stylii and discs. A weight of about 2-3 ozs. is generally sufficient, but no hard and fast rule can be made on this point, although it is very unusual for the weight to be greater than 3 ozs., if it requires more than this it is fairly certain that the cutter is blunt, or that the disc is too hard, either of which will result in poorly shaped grooves with excessive surface noise on playback.

Depth Adjustment

There are three usual ways of applying this counter-weight and groove depth adjustment, i.e., counterbalance by means of adjustable weight; by means of a coiled spring; by an "advance ball."

The older types of equipment, as shown in Fig. 3, usually had a fairly long arm carrying the cutter head, pivoted about a point, and at the other end a balance weight which could be moved up and down the portion of the arm at the back of the pivot point, thus making it possible to adjust the actual weight applied at the cutter point. This method is quite a good one always provided that the discs and turntable are reasonably flat.

Trouble is likely to arise when discs are used that are not flat, and which cause the cutter head to ride up and down, thus giving rise to a "see-saw" effect about the pivot point. With a long arm fairly heavily weighted at both ends this can be very bad, causing the cut to vary between very heavy and very light, even lifting off the disc altogether with a result that the continuity of the groove is broken. Admittedly, the use of a disc bad enough to cause this extreme is bad practice, but even so quite disastrous results can come from one small eccentricity in the disc which happens to coincide with the natural period of the cutter head and tracking arm.

In any form of balanced arm pivoting about a point the arm and, in our case, the cutter head at the one end and the counterbalance at the other has what we term a "natural period" of vibration in a vertical plane, such vibration being transmitted from an uneven disc or turntable via the cutter head and stylus; the amplitude, or amount of vibration, depending upon how free and easy the arm is in its fixings. It will naturally be as free as is consistent with no amount of side play. The period will be a product of the weight of the arm, cutting head and counterbalance, and the length of the arm. When the uneven parts of the disc occur at about the same time interval as this "natural period" the whole arm will bounce up and down, and if too frequent will give the arm no time in which to settle down again.

Modern designs favour a heavy carriage with a short, robust arm of, say, 3ins. in length, at one end is the cutter head on its own swivel adjustment, whilst at the other end it is pivoted between needle bearings. When this part is lowered for cutting it comes into contact, on its underside, with an adjustable stop fixed on to a blade

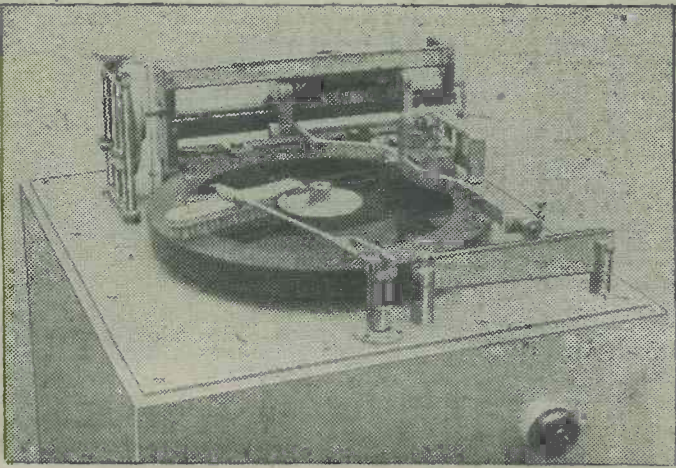


Fig. 5.—Illustrating the "girder" type of traversing carriage used in the M.S.S. profesional recorder.

which forms part of a similar carriage pivoted about the same point, but projecting in a back direction and equipped with a counterweight. The whole period of motion about the fulcrum is kept low. Another method of construction is that shown in Fig. 5, where a cutter head is mounted on a girder-like construction in such a manner that in itself it is just correctly balanced for cutting angle and weight. The front portion of the carrying arm, or girder, is then allowed to rest on a bar, and as it is equipped with a small wheel can run along the bar during tracking, thus ensuring that no vertical motion of the whole carrying arm occurs at all. This method does prove very effective, even when uneven discs are used.

The use of any form of coiled spring to control groove depth by weight adjustment is not to be advised. It is not possible to obtain sufficient accuracy in tension over long periods, due to the spring becoming "tired." Springs are also affected by changes in temperature, and in general they will always be found to be a cause of trouble.

"Advanced Ball" Method

The last-mentioned method, the "advanced ball," is advocated by some manufacturers, but it is a very doubtful method. It consists of a ball, either sapphire or polished steel, mounted on a plate fixed to the cutter head and with a vertical adjustment. It rides on the disc surface just ahead of the cutting stylus and thus keeps the stylus at any predetermined depth of cut. As the ball, for obvious reasons, has to be some little distance from the stylus there is naturally some disc material between the two which is quite sufficient, if the disc is uneven, to cause a pivoting motion. In any case it is quite likely to interfere with the easy disposal of the swarf. Where all the conditions are ideal and can be repeated time and time again, such as in professional wax recording, together with swarf removal by suction methods, the "advanced ball" method may possibly have some use, but not in direct disc recording. The whole question of cutter head mounting will be discussed in more detail when we come to traverse mechanisms and drives, etc., our purpose in mentioning it at this stage is only in connection with weight control.

In an effort to damp out the smaller vertical movements of the cutter head due to slight unevenness in the disc, several "vertical dampers" have been produced of varying effectiveness, the best probably being the oil dash pot type. A small dash pot full of light oil is mounted as a fixture at the back of the carriage (although in some designs this is also found at the front), into this pot is submerged a small circular disc attached by a bar to the counterbalance lever. Any small vertical vibrations of the counterbalance are thus damped out by the action of the oil on the circular disc which moves up and down in the oil; this action also helps considerably in the case of the more violent vibrations as it has a steadying effect, checking excessive bounce.

Several other similar types are available using the same principle, but instead of oil a tight-fitting piston and cylinder with an air leak which can be adjusted to allow the correct cushioning effect. Other types use spring-controlled dampers, which are not so good owing to the tendency of the spring to vary in tension, and in itself to vibrate.

The best cure of all for all these troubles is, of course, to have a perfectly flat disc and turntable. When we have this no trouble at all is found, but as it is not by any means possible to ensure that his happy state of affairs can always be achieved some method of assistance must be provided for the imperfections of disc and turntable. We must not forget that we are cutting grooves only some 0.006in. in width in a sensitive material, at the same time we are modulating those grooves in a lateral direction and we are also trying to keep them at a constant depth of only two and a half thousandths of an inch! All with the object of playing them back afterwards with another shaped stylus which we expect to be driven, together with its tracking arm (sometimes quite heavy), across the record by these self-same grooves. Only by realising this can we understand how essential it is that all adjustments, weights, and drives must be as accurate and as free from unwanted vibrations as possible. In our next article we shall deal with the crystal and the electro-magnetic types of cutter heads; the need for frequency compensation volume indicators and their applications.

(To be continued.)

QUERY SERVICE SUSPENDED

NOTWITHSTANDING the announcements frequently made in recent issues that our query service has been suspended owing to staff shortage, readers continue to address queries to us. We regret that we are unable to make any exception. Our attention must be entirely confined to the production of this journal. We observe from some of the queries that correspondents who are not readers of the paper have been advised to write to us concerning commercial receivers by the manufacturers of those receivers, who have closed down their own service departments because of staff shortage! We cannot undertake to perform the work of the service departments of manufacturers. It is only reasonable to expect them to help their customers out of difficulties.

May we reiterate that we do not and never have undertaken to provide circuit diagrams nor to modify circuit diagrams, nor to select designs to suit individual readers' lists of components.

We issue a fully cross-reference index to every volume of PRACTICAL WIRELESS at 10d. by post and if readers would consult these they would find that many of their queries have been answered by information already published.

We do not undertake, either, to answer telephonic inquiries, or to answer questions aroused by articles or books produced by other publishers. Such queries should quite properly be addressed to the journal or to the author of the book concerned.

Practical Hints

THAT DODGE OF YOURS!

Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*. Mark envelopes "Practical Hints."

SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page iii of cover.

Efficient Home-made Coils

WANTING to make some coils for the high-fidelity receiver described in the February 1944 issue, and not having any formers, I used empty "Durofix" bottles, these being approximately the correct diameter.

A compact coil wound on a glass bottle.

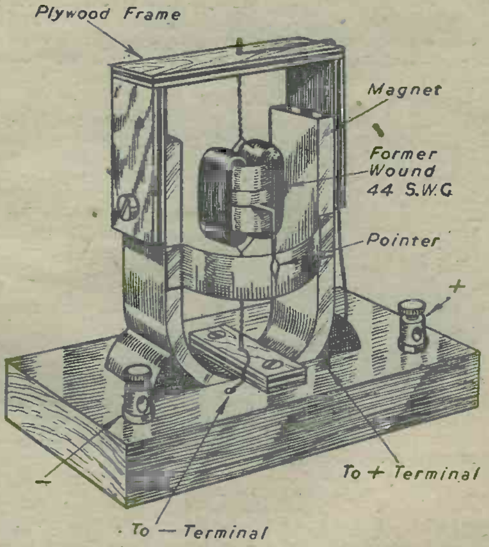
All that is necessary for the construction of the coil is some strong "binding" or carpet thread. One end of this is fixed to some firm object, or held in a vice, and looped around the top of the bottle and over the beginning of the wire, pulled tight and knotted. At the end of the winding, the thread is first knotted to the wire and then tied around the bottle in the same manner as before.

The coil is mounted on a small square of paxolin by drilling a hole through the cork and securing it with a 6BA bolt, a large size washer being used under the head of the bolt to prevent it pulling through the cork.—A. PETTIGREW (Calne).

An Easily-Constructed Galvanometer

AS can be seen from the sketch a horse-shoe magnet is mounted on a heavy timber base, the timber being scooped out and the magnet set in, supported by two small wooden blocks at each side. The pole-pieces having been removed from the magnet a light plywood frame was bolted on to the magnet. Another small wooden block is fixed at the bottom in order to arrange the suspension of the moving-coil. The former for the moving-coil is made from aluminium, and is wound with 44 S.W.G. enamelled copper wire. It is suspended at the top and bottom by means of the winding itself, each end of the winding being soldered to gramophone needles inserted in the plywood frame and bottom block respectively. Thus, by arranging the position of the needles the coil is made to swing very freely. The external connections consist of two screw terminals, each terminal having its connection soldered to the top and bottom needle respectively. The coil is fitted with a pointer (made also from aluminium), and is held on to the former by means of the winding itself. Matters are so arranged that, although the pointer is well secured, it can move a little to either side, then by this means it is possible to arrange the pointer so that it is in the centre position between the poles of the magnet. The scale is arranged by means of a single lamination (soft-iron), which is bent into a curve, and is held across the face of the magnet (due to the attraction of the magnet). A narrow piece of white paper is pasted on to this soft-iron lamination, and thus the scale divisions can be marked.

I have used this galvanometer for many purposes, such as testing mains-transformers, inter-valve transformers, testing resistors, etc. I secured a deflection with a 250,000 ohms (quarter meg.) resistor, using only a 3-volt battery. And, in this connection also, I might mention that by applying a voltage from a H.T. battery through a suitable resistor in series a full-scale deflection of a little over one milliamp was obtained. I have even used this simple instrument to measure the plate current of valves by means of suitable shunts.—J. F. O'CONNOR (Tuam).



A simple moving-coil Galvanometer.

Cleaning Wires

WHEN soldering many of the finer gauges of wire difficulty may be experienced due to rapid oxidation of the wire, and thus although good flux may be used it may be found that the wires will be burnt away before the solder becomes attached. Chemical cleaners should not be used to clean fine wires, and one of the most satisfactory plans is to rub the wire very carefully between a sheet of very fine glass-paper doubled.

Emery is probably too coarse and will take away too much of the wire, whereas the finer grades of glass-paper will only remove the enamel covering and will be unlikely to remove any of the actual wire. The iron must be really hot and a drop of solder should be supported on the iron, and the tip of the wire, after dipping in the flux, should be plunged into the molten drop of solder and withdrawn fairly quickly.—A. J. (Pinner).

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).

Esperanto

SIR,—I have just read J. C. D. Smith's letter about Esperanto in the readers' pages with interest. As an official instructor for the British Esperanto Association I can vouch for all he says. In a test with an educated person years ago I found he could understand about half of an Esperanto passage although he had not previously read any of the language. This may appear sweeping, but some Esperanto words are substantially the same in many languages. Others can be recognised, e.g., "domo"—house, "homo"—man, etc. All words are spoken as spelled, and I myself found I had no difficulty in learning to speak the language without any oral tuition whatever.

The underlying idea is that better understanding between peoples shall bring about universal peace. Before the war, Esperanto was being broadcast by 40 foreign radio stations.

I believe Esperanto will grow rapidly in future, for radio is so international that fans will realise the value of the language.—F. G. RAYER (Longdon).

[*We do not think that Esperanto will ever become a universal language. The name alone is unfortunate.*—ED.]

Jamming

SIR,—With reference to the open letter to the B.B.C. in your January issue, I can assure Mr. L. H. Buckley that he is lucky to have only suffered this nuisance for two years; we have had it since the outbreak of war, and had it not been for the continental stations I would have dismantled my receiver long ago.

It would be interesting to know what ill-natured authority it is that deliberately jams a sacred concert, beautifully rendered and transmitted with perfect clarity and tone from Berlin, as has happened several times lately. Can there be a touch of dog-in-the-manger about it?

To change the subject, I wonder why the term "wireless set" is still in use when it is obviously obsolete? I assume that it dates back to the time of 2LO and 5IT, when components were bought and assembled at home, but now, in these days of commercial receivers, it is reminiscent of cutlery and crockery.—C. FIELD (St. Asaph).

Ohm's Law

SIR,—When asked "What is Ohm's law?" the majority of people answer in a rather vague tone, "$I=V/R$" or "The current passing through a conductor is directly proportional to the potential difference applied to its ends and inversely proportional to its resistance." Both definitions are quite common in elementary books on electricity.

In my opinion a much better answer is: "The ratio of the potential difference (V) across a conductor to the current flowing through it (I) is a constant provided that the physical conditions (temperature, tension, etc.) remain unchanged"—and further: "This constant is termed the resistance of the conductor and is given in ohms provided that the potential difference and current are measured in volts and amperes respectively." Ohms are thus volts per ampere.

The important point to grasp is that whereas V and I are variables and can therefore have an infinite number of different values, their ratio, V/I, is a constant for any particular conductor, i.e., is independent of the values of V and I, and it is because of this fact that we are able, given any two of these quantities, to calculate the third.

Ohm's law applies equally well to both part and complete circuits and is generally true of all solid and liquid conductors.

It has been accurately checked to at least .001 per cent. without revealing any deviation from the value V/I. Thus resistance is a very valuable and trustworthy property of the electric circuit and because of this is used as the basis of all practical electrical measurements.

It is interesting to note that Ohm's law cannot normally be proved by using ordinary voltmeters and ammeters since their calibration is based upon the assumption that the law is true.

Although usually applied to circuits carrying steady currents only, Ohm's law can, in its extended form (Kirchoff's laws), be applied to any circuit. For instance, Ohm's law for alternating current circuits is $V/I=Z$, where Z is termed the impedance of the circuit. Z is only a constant when the frequency is kept constant, or when there is no inductance or capacitance associated with the circuit. When the latter conditions hold Z and R are the same, so that Ohm's law in its original form is true of all A.C. circuits containing resistance only.—"SIMPLETON" (Plumstead).

An Appreciation

SIR,—Among those articles I like, or have liked, are "Your Service Workshop," which has proved of great use to me, "Radio Examination Papers," and "The Manufacture and Testing of Valves." I also enjoy reading the "Open to Discussion" page. I would like more space to be devoted to this. A series which I have found of great value recently is the "Valve Data Sheets." May I suggest that these data sheets be published in pocket-book form, like the *Engineer's Pocket Book*.

[*They are now in the press.*—ED.]

The only thing I dislike in your journal is Thermion's "On Your Wavelength." I am afraid that he is seldom on mine. Why must he always confine himself to criticising the B.B.C.'s programmes, lyric writers, and dance band leaders?

[*Because they invite it.*—ED.]

Another series which I have liked is that on "Frequency Modulation." I, personally, would like more of these as it seems that F.M. is going to play an important part in post-war radio. Perhaps more practical details of F.M. receivers would be a help. It seems that there have been quite a few applications for opening up F.M. transmitters in the U.S.A. after the war and it looks as though we will be left behind in our development of this branch of radio. The Army have been using F.M. principle in their "Walkie Talkie" outfits. I have tried to construct a F.M.—C. G. WILLIAMS (Sidcup).

Matching the Output Stage

SIR,— As you will be aware, many of your readers have constructed the A.C./D.C. midgets that you have described in PRACTICAL WIRELESS of late. However, in each description an important omission has occurred and that is the importance of correct matching of the output stage.

In most cases valves of the 25/50 L6G1 have been stipulated; these valves being of the beam tetrode type, have low optimum loads in the region of 2,000 ohms and even to match them to the usual voice coil of 3-5 ohms a transformer ratio of 20 : 1 is required. However, in the majority of cases no doubt readers are using the 3½in. Goodman L.S. units with a voice coil impedance of 12 ohms. This necessitates a transformer

(*Continued on page 172.*)

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SWITCH FUSE in wrought iron case, 3-way, for 400 volts at 40 amp. 45/-.

ROTARY CONVERTER, input 40 volts D.C., output 75v., 75 m/A, A.C., also would make good 50v. motor or would generate. £2.

AUTO TRANSFORMERS. Step up or down, tapped 0-110-200-220-240 ; 1,000 watts. £5.

POWER TRANSFORMER, 4kW, double wound, 400 volts and 220 volts to 110 volts, 50 cycle, single phase. Price £20.

AUTO TRANSFORMER, step up or step down 500 watts, tapped 0-110-200-220-240 volts. £3 10s.

½ WATT WIRE END RESISTANCES, new and unused. price per doz., 5/-, our assortment.

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SEARCHLIGHT, by famous maker, size 22in. dia., 18in. deep, complete with cradle, reflecting mirror 20in. dia., for electric bulb fitting, no bulb, adjustable focus, glass front, price £7 10s.

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INPUT TRANSFORMERS, ratio 12 to 1, centre, tapped, price 15/-.

P.P. OUTPUT TRANSFORMER, ratio 6.2 to 1, centre tapped, price 10/-.

POWER TRANSFORMER, pri. 95/100 v., sec. 260-0-260 at 80 m/A, also 5 v. at 3A, price 12/6.

METAL RECTIFIERS, size 14 × 3¾ × 3¾in., output 50v., 1 amp., 35/- ; another 5½ × 2in., output 100v., 250 m/A, 17/6 ; another 200v., 50 m/A, 10/-.

CABINET LOUDSPEAKER, for extension only, 5 watt output, 8in. dia. cone, high quality, size of cabinet 16 × 14 × 8½in. × ½ thick, cabinet slightly marked at top, price £3.

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MOTOR PUMPS. We can give immediate delivery of the famous Stuart Turner 12-volt D.C. motor pumps ; 120 galls. per hour, 84/-. Same type but for A.C. mains, 136/-. Pumps only : R type twin-piston rotary for ¼ h.p. motor drive, £3.5.0. Aquarium aerators, £5.

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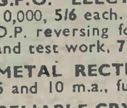

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with a ratio as low as 12 : 1. As your editor will point out, the common output transformer has ratios of 80, 60, 40 to 1—matched secondary of 3-5 ohms, even the multi-match models of the Rolo Co. do not go as low as 12 : 1.

If the correct transformer is not used, not only will the constructor be disappointed in the low volume but to a greater extent in the *distortion* present. Even with slight mismatching, distortion is present when using valves of the beam tetrode type.

For the benefit of readers who have been disappointed with poor results from their midgets I trust you will bring this important point home in a future issue. It cannot be realised what a difference the correct ratio will make till the constructor tries both.—JOHN C. ROBERTSON (Dorset).

Canada's S.W. Transmissions

SIR,—I have recently received transmissions from Canada's first international short-wave transmitter. This is CHTA, and it broadcasts test transmissions daily at 10.45 G.M.T. till 13.15 G.M.T., on 15.22 mc/s. The station broadcasts in English, French and German.

I heard recently, between 11.00 and 11.25 G.M.T., a station whose call sounded like "Radio Paramaribo, 15405 kc/s." Speech was in English and, I think, Dutch, and the station signed off at 11.25 with the Dutch national anthem. I suppose this is Paramaribo, Dutch Guiana. Has any other reader heard this station?

The station heard by F. J. Longman on 19 m. was perhaps MCQ3, on about 20.8 m., which is a B.B.C. mobile transmitter, "somewhere in Europe," and which transmits war reports to B.B.C., London, at the times stated. I have also heard MCQ1 on 39.6 m. at 21.00 G.M.T. working two-way with GBB2 (Rugby) on 43.5 m.

Referring to Mr. J. M. Brunt's letter, Radio Centre, Moscow, broadcasts in English on 15.74 mc/s and 11.83 mc/s. from 11.00 G.M.T. till about 13.45 G.M.T.

The Italian station on about 35.3 m. announces as "The Voice of the Italian Social Republic" and broadcasts a programme in English, starting at 17.30 G.M.T.—WILLIAM H. BORLAND (Dumbartonshire).

R.I. Club of Wales

SIR,—The formation of the Radio Industries Club of Wales and Monmouthshire is announced, following an inaugural meeting of members of the radio trade and industry in Cardiff on December 14th. It was unanimously decided that the new club, like the R.I. Club of Scotland, be affiliated to the original R.I. Club in London.

At the meeting in Cardiff, the honorary secretary and the honorary luncheon secretary of the London club explained the objects and organisation of the parent body, and it was unanimously agreed that the new club should operate on similar lines.

The meeting elected a committee of ten members, who proceeded with the drafting of the rules, and organised the first luncheon, which was held on January 24th, 1945, in Cardiff.

Before the meeting terminated, H. B. Ducé was unanimously elected the first president of the Welsh club.

Following the inaugural meeting the newly-elected committee met and elected its officers as follows: Chairman, J. F. Paull; vice-chairman, W. Summerville Vernon; hon. secretary, A. G. W. Sanders; hon. treasurer, F. C. King.

The club is open to executives of radio manufacturers, wholesalers and retailers, and to those in allied branches of radio. Manufacturers and wholesalers who have branches in Wales and Monmouthshire are asked to bring the club to the notice of their staffs.

Details of membership may be obtained from the honorary secretary at Magnet House, Kingsway, Cardiff. —W. E. MILES (London).

British Mediterranean Station

SIR,—In reply to G. Hinbest's request for information about the "British Mediterranean Station," I hope the following will be of some use. "The British Mediterranean Station" (ME 19) is situated in Palestine. It operates on frequencies of 6135, 7215 and 9665 kc/s (48.90, 41.58 and 31.04 m.). News in Englfsh include bulletins at 15.15, 17.45 and 21.00 G.M.T.

Some of the stations which I have received may be of interest. They include: VLG (Melbourne), VLC6 Shepperton, VLC2 Shepperton, X6OY Chungking, SUV Cairo, PRL8, CR7BE, FZI, TAP, HVJ, Leopoldville, "Radio Shonan" (31.42 m.), "All-India Radio," Moscow, "Voice of the Italian Social Republic," "New British Broadcasting Station" (German) and the usual list of American and German stations.

I would like to know the frequency or wavelength of "The National Congress Radio" in the 31 m.b. Can anyone oblige?

The RX is an 0-V-1 and I am using an old triode H.F. valve in the L.F. stage. Best wishes to "P.W."—R. REYNOLDS (Liverpool).

SIR,—The British Mediterranean station operates on the 31, 41 and 49 metre bands, giving news at 8 p.m. B.S.T. and on Sundays a programme summary. Here is some other short-wave "gen." TAP, Ankara, gives news in English at 6.15 p.m. B.S.T. on 31.70 metres; Armed Forces Radio on WCBX, 19 metres and WCBN, 27 metres, transmits a good schedule from 6.30 p.m. to 11 p.m. every evening. Last week I heard WJQ, New York, calling Shaef in Paris on 28 metre band at 7 p.m. A station of the A.M.T.T.C. was heard testing on 30 metre band at 8 p.m.—B. HAYES (Bletchley).

Circuit Conversion

SIR,—Regarding J. M. T. Wood's circuit conversion published in "P.W.," Jan., 1945, surely if the filaments of the battery valves were supplied with A.C. current from the L.T. secondary of the transformer, reception would be marred by a background of 50 v. hum due to the emission of the valves varying with the A.C. current. I have been experimenting with S.W. reception, but as yet have not had good results, receiving morse but not telephony stations. I have also built the one valver described by E. H. Percy in the August, 1944, issue, receiving Home and Forces programmes at good strength with 9 volts H.T. and a few yards of flex for aerial and no earth. All the best to "P.W."—K. PAINTER (West Bromwich).

Stations Identified

SIR,—With reference to two letters in "P.W."—Radio Sicarto on the 16 m. band is Radio Jokjokarta, Java, and is run by the Japs, giving news and programmes of dance music from 12.00 G.M.T.—about 16.00.

The second is about Radio Shonan, formerly Singapore, which broadcasts daily on 31.42 m. from 21.30–22.05.

I have been a regular reader of "P.W." for the past ten years, and like the new form very much, but would like to see it published weekly once more. Also would it be possible to publish a list of S.W. stations with times of broadcasting, say every other month!

Here is a log of S.W. stations received during the past month on a 1-V-2 RX using 1.4 valves: TAP, 31.7 m. PRL8, 25.6 m., FZI 31 and 25 m., Leopoldville, Algiers, HBL, Radio Dakar, 26.13 m., British Med. Station, HCJB 24.09 m., Stockholm, Moscow, CSW, WRUL, WRCA, WLWO, WNRA, WCBX, WNBI, WCRC, WDK, WOA2, EAS.—R. ALDRIDGE (Amersham).

Economy DX3

SIR,—I note with interest R. T. Ambin's (Bath) unsatisfactory results with the "Economy DX3." Perhaps my own experiences will be of interest to readers.

I modified the original circuit as follows. The R.C.C.

was substituted by a 1 : 5 L.F. transformer and the power valve by an output tetrode.

When I first built this set it was intended to use it primarily for monitoring our Home Guard transmissions, but it proved to be so succesful that it has since been used for DX work. My log includes Moscow, Radio Algiers, Vatican City, Radio Nacional Rio de Janeiro and many American and other stations—many at loud-speaker strength. I used Eddystone 6-pin plug-in coils and at first found that the reaction was rather coarse, but rather than interfere with the coil windings I overcame this trouble by connecting a 50,000 ohm pot. in the H.T. +line to the screen of the R.F. valve and adjusted it to suit—a little unorthodox perhaps, but it worked!!

The set is built as a portable, the L.T. supply being derived from two 1.3 v. dry cells in series. The antenna is a copper tube $\frac{1}{4}$ in. dia., × 6 ft. long mounted directly on top of the case.—A. D. SPACKMAN (Swindon).

Converting Battery Set for Mains Operation

SIR,—I had a battery receiver which I wanted converted to mains. So, instead of going to the shop and buying two A.C. valves, I disconnected the filament wires from the valves on the set and wired them in series and connected them to the heater winding of the transformer; as the winding was 4 volts and the valves were 2 volts each, and in series, the voltage was perfect. You will see what I mean by my circuit enclosed.—J. M. T. WOOD (Enfield).

Tees-side Radio Club

SIR,—I would appreciate it very much if through the medium of PRACTICAL WIRELESS you would draw the attention of your readers to the following details:

A radio club is being formed on Tees-side, known locally as the Tees-side Radio Society. Would anybody interested communicate with me at the above address?—G. REEVE, Redlands, Weston Cres., Norton-on-Tees.

Hearing Aids

SIR,—The statement by Lord Templemore in the House of Lords that the Medical Research Council have set up a committee to investigate standard hearing aids which could be sold at a reasonable price, seems to imply that the price of existing aids is not reasonable.

So far as I have been able to trace, the prices of valve type aids start at about £20 and go up to as much as £50. In view of the cost of far more complicated wireless (and television) sets, to say that these prices are excessive is an understatement!

Would it be possible to have a PRACTICAL WIRELESS design for a small pocket aid, using midget valves and giving a choice between crystal and carbon microphones? The construction would certainly not be beyond the abilities of the average radio enthusiast, and such an instrument would be a boon to those whose hearing is below normal.

Meanwhile, I should be interested to hear from any readers who have constructed successful aids of this type.—W. W. BARRETT (Stroud, Glos),

Bath Radio Club Formed

SIR,—A Bath Radio Club has just been formed in this city, as a local chapter of the British Short-wave League, but it is not restricted to members of the latter organisation, being open to all with technical or non-technical (especially the latter for a start) short-wave or other radio interests.

It meets on the second Wednesday evening of each month at the School of Economic Science, 4, Wood Street, Milsom Street, Bath, from 7.30 to 9.15 p.m., a small collection being taken for expenses. Easy technical lectures are being arranged, along with log-comparisons, demonstrations of apparatus, etc., and morse practice is to be tackled in due course. Anyone interested can attend as a visitor or get further details from me.—WILLIAM A. WELSMAN (Bath Spa, 40, Newbridge Hill Bath, Somerset).

More Stations Identified

SIR,—In the January issue of PRACTICAL WIRELESS, F. Armstrong asks for details of some B.B.C. transmissions. The wavelengths of these vary with the season of the year; the present (winter) schedule of the B.B.C. N. American Service is as follows:

Call Sign	Metres	Mc/s sec.	Time.	Directed to
GRH	30.53	9.825	21.15-04.45	N. America
GSU	41.32	7.26	21.15-04-45	"
GSI.	49.10	6.11	21.15-04.45	"
GRC	104.2	2.88	00.00-04.45	"
?	30.67	9.783	01.15-02.00 02.15-04.45	" "
GSZ	31.12	9.64	21.15-23.45	Pacific Seaboard of Canada
?	30.67	9.783	01.15-02.00 02.15-04.45	

The B.B.C. African Service Schedule is:

GSV	16.84	17.81	15.30-17.15	C. & S. Africa
GSI	19.66	15.26	15.30-21.00	"
GVW	25.64	11.70	15.30-21.00	"
?	30.67	9.783	17.30-21.00	"
GRJ	41.01	7.32	18.30-21.00	"

Of the many other B.B.C. broadcasts, two giving good reception here are:

B.B.C. Eastern Service—News in Japanese, followed by commentary in English, from 11.00 to 11.30 (English at 11.20), broadcast on 16.86, 19.46, 42.13 metres (42.13 m. is the best).

Also in the Eastern Service, news in an Eastern language (Gorjon or some similar name) from 13.30 to 14.00, on 49.10 m. This transmitter carries the G.F.P. from 14.00 to 15.15.

The Allied Expeditionary Forces programme on 514 m. is sometimes rather weak here during the daytime, but good reception is obtained on the short waves (which are experimental), as follows: 07.00 to 09.30, 6.195 mc/s, 48.43 m.; 09.45 to 14.15, 7.32 mc/s, 41.01 m.; 14.30 to 18.00, 6.195 mc/s, 48.43 m.

I have had excellent reception of the test transmissions of the new International Service of the Canadian Broadcasting Corporation. These have been from CHTA, Sackville, New Brunswick, on Sundays from 10.45 to 13.15 on 19.67 m., 15.22 mc/s. According to the "Radio Times" they started regular transmissions on January 28th at above time, and also from 20.00 to 22.30 (daily).

In the February isue, J. H. Blunt asks for details of Moscow. This is on 19.32 m., reception not reliable. (It appears beamed to the U.S.A., although I have no confirmation of this, but I have heard U.S. war correspondents calling home on this wavelength.) Radio Brazzaville stated on New Year's Eve that Paris was planning world-wide broadcasts. All times given are G.M.T.—R. H. GARSTANG (Southport).

Testing Gramo. Motor Speed

SIR,—With reference to Mr. Binstead's letter, page 130, your February, 1945, issue, a 50 c/s supply gives 2 "flashes" per cycle, and the formulæ are:

$$1 \ldots \text{R.P.M.} = \frac{2\,f\,60}{\text{No. of holes or sectors}}$$

$$1(a) \ldots \text{R.P.Sec.} = \frac{2\,f}{\text{No. of holes or sectors}} \quad \text{hence} \ldots$$

$$1(b) \ldots \text{No of holes or sectors} = \frac{2\,f}{\text{R.P.M.}} = \frac{2\,f\,60}{\text{R.P.Sec.}}$$

It thus certainly is true that for 78 R.P.M. there can only be approximation, but 77 holes or sectors, not 78, is the general rule, apparently. Then, by (1) . . .

$$\frac{2 \times 50 \times 60}{77} = \frac{600}{77} = 77.922077 \text{ R.P.M.}$$

which may be approximated to the slightly lower value, 77.92. This latter is only 0.1015384 . . . % low—a negligible amount!—H. T. STOTT (Barking).

Impressions on the Wax

Review of the Latest Gramophone Records

H.M.V.

THE outstanding release in the record world this month, is, without question, a new and brilliant recording of Elgar's Second Symphony (Symphony No. 2 in E Flat. Op. 63) by H.M.V. The work is performed by the B.B.C. Symphony Orchestra conducted by Sir Adrian Boult, who, of contemporary conductors, is generally acknowledged to be the finest interpreter of the composer's major works. It was during 1910-11, two years after the cordial reception of his First Symphony, that Elgar, who was an exceedingly sensitive artist, judged himself capable of undertaking the great task of another major work. He originally intended it to be dedicated to King Edward VII, but owing to the death of the King it was dedicated to his memory. The encouragement Elgar received from the production of his First Symphony brought forth other notable contributions to the symphonic field, but it is his Second Symphony which stands in the front rank of the great orchestral compositions of the world. The work is in Four Movements, Allegro vivace e nobilmente; Larghetto; Rondo: presto, and, finally, Moderato e maestoso. The score is unusually full, and one can readily appreciate the great task which must have been involved in the instrumentation, and the physical labour of committing the full orchestration to paper. Space prevents me from attempting to analyse each movement; in fact, with this or any symphony of a comparable nature, I think it is a question of each listener interpreting the composition according to the reactions it produces on his own imagination. Most great works, and this symphony in particular, stimulate our senses and set our imagination off on voyages far and wide, each of us being carried through different scenes and emotions according to the susceptibility of our finer senses. Elgar's 2nd Symphony in E Flat *H.M.V. Album Series* (No. 378) six records, *DB* 6190-5. Auto couplings *DB*8967-72. I am including two more H.M.V. 12in. records in this review, as they are both delightful records which will be welcomed by all who enjoy perfect singing. The first is *H.M.V. C*3419 on which that talented soprano Joan Hammond, with the London Symphony Orchestra, has recorded two airs from Verdi's opera "Il Trovatore." They are "No Star Shone on the Heav'nly Vault" from Act I, and Recit.: "Why Fear For Me," Aria: "Love, Fly on Rosy Pinions," Act IV. Miss Hammond gives us a splendid performance. The second of these two vocal records, is *H.M.V. C*3418, a fine recording by Webster Booth of "Morgen (To-morrow)" Op. 27 No. 4 by Richard Strauss (English words by Bernhoff) and that great favourite of an earlier generation, "Come Into The Garden Maud." Needless to say, the rendering of both of these songs is superb.

In the H.M.V. 10in. series, I suggest *BD*1096 on which "Hutch" has recorded "No One Else Will Do" and "Don't You Know I Care," *FB*3077 if you want two good fox trots played by Carroll Gibbons and the Savoy Hotel Orpheans, the numbers being "My Favourite Dream" and "Come Out, Come Out Wherever You Are," and finally, *BD*5869 on which Eric Winstone and his Band have recorded also "My Favourite Dream" and "The Happiest New Year of All," a very nice waltz.

Columbia

HERE are three 12in. records which should prove very popular. Louis Kentner (pianoforte) playing a most delightful tone-poem, written originally for the piano, by the Russian composer Balakirev, most noted for his symphonic poem "Thamar," and his Oriental piano fantasy "Islamey," which Liszt played. It is the latter which Louis Kentner has recorded on *Columbia DX*1175, and his performance is an outstanding example of his brilliant technique and complete mastery of the keyboard. The next record is rather unusual, but none the less delightful. It is *Columbia DX*1176, and consists of Andre Kostelanetz and his Orchestra playing four of the best songs from "Porgy and Bess," a Negro play set to opera by Gershwin and Heyward. The operatic presentation caused something of a sensation when it was performed, being as it is a mixture of jazz, appealing melodies and tragedy. However, I certainly recommend it for your hearing.

This month we can buy Nos. 3 and 4 of the Old Time Dance Series which are played by Harry Davidson and his Orchestra on *Columbia DX*1177. No. 3 is "The Valeta," and No. 4 a "Barn Dance," and these make a thoroughly enjoyable record for the lighter moments. Here is a nice selection of 10in. records: Albert Sandler and his Palm Court Orchestra, on *Columbia DB*2161, playing two popular favourites of the ever-green type. One is "Alice Blue Gown," and the other "Vienna, City of my Dreams." A nice record. On the piano—or, rather, pianos—we have Rawicz and Landauer, those brilliant duettists, playing "Snowflakes" and "Serenade," on *Columbia DB*2160. Their skill and synchronisation is amazing and I strongly recommend their latest contribution. "Little Star" and "Tabu" are the two numbers selected by Felix Mendelssohn and his Hawaiian Serenaders this month, and recorded on *Columbia FB*3073. They put up a good performance, and Harry Brooker and his Electric Guitar considerably adds to it. "Do You Believe in Dreams" is what Paula Green and her Orchestra want to know on *Columbia FB*3075. They link this with "When They Ask About You," and present both numbers in an attractive manner. Carroll Gibbons at the Piano records what he has been pleased to call "Carroll's Tribute to 'Fats' Waller," and he plays many of the numbers which will always be associated with that great personality of modern Negro musical expression.

Parlophone

AS usual, I open my selection of Parlophone latest releases with one by Richard Tauber. On *RO*20535 he sings, in splendid style, "Love, Here Is My Heart" and a feature song from the film "Cover Girl," namely "Long Ago (And Far Away)." The rest are for the dance enthusiasts, whom I am sure the following will please. *Parlophone F*2051 is by Geraldo and his Orchestra, playing two good foxtrots, "The Same Little Words" and "You, Fascinating You." The No. 1 Ballroom Centre Dance Orchestra (The Skyrockets) have chosen "Heavy Gang" and "It's All Right for You," which they present in their own inimitable style on *Parlophone F*2053. Finally, Billy Thorburn's The Organ, The Dance Band and Me offer two tempting waltzes in the form of "When We Dance the Victory Ball" and "Friends and Friends," which make a topping record.

A Reminder

DON'T forget that if new records are to be made you must return old ones to your dealers now. The matter is becoming very urgent, as records are wanted not only by you for your enjoyment, but for many other purposes as well. Have you taken any old ones back? Apart from helping the war effort, you can turn them into money, as the dealer will pay cash for them.

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(Continued top of next column)

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

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

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