WAR-TIME "HOOK-UPS"—SEE PAGE 359

A NEWNES PUBLICATION

Edited by F. J. CAMM

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EVERY MONTH

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★ PRACTICAL TELEVISION ★

EDITED BY
F. J. CAMM

EVERY MONTH.
Vol. XVII. No. 423 September, 1941.

Staff:
FRANK PRESTON.
L. O. SPARKS.

COMMENTS OF THE MONTH *BY THE EDITOR*

Broadcast Propaganda Again

CRITICISM continues to be levelled at the B.B.C. for its failure to put energy and ideas into the propaganda intended for consumption abroad. The critics point, perhaps with some justification, to the American style of broadcast, as well as to the Russian, where it is said they bring expert propagandists to the microphone in the form of journalists whose lives have been spent in moulding public opinion. The B.B.C., no doubt, has its answer to this criticism, but a point often overlooked is that America and Russia are countries whose national temperaments are somewhat different from ours. We are credited with being insular and phlegmatic as a race, and whilst the B.B.C. style of broadcast propaganda may be correct for home consumption, it does not tickle the palates of foreign listeners.

The B.B.C., however, cannot be held to blame, for during the war it may only read out such information as it is permitted to do by the Ministry of Information, and it is in this direction that improvement is needed. The Ministry of Information has not covered itself with glory on some of the occasions to which it should have risen. Members of Parliament have asked frequently that the Ministry of Information should use its imagination, and this suggestion in connection with the Hess incident merely elicited the ripost from Winston Churchill that there are certain things which stagger the imagination.

American Comment

THE matter has been raised again since the famous broadcast of Quentin Reynolds, the American newspaper correspondent. We have received many letters of approval of this style of broadcast talk, and it might be worth a trial over here. There is one other matter connected with propaganda which needs to be aired. Propaganda does not consist of warping the truth or inventing half-truths, nor in being careless with the truth in order to sway opinion abroad. A simple statement of fact has its own propaganda value, and to endeavour to dress it up or to give it an importance out of proportion to its incidence to the war is not only to destroy its propaganda value, but to destroy for ever belief in future statements made over the air. Truth must, therefore, be the first aim of our foreign propaganda. And we do not support the view generally held that we need to indulge in ballyhoo. We want our propaganda taken seriously, for any suggestion that it has been touched up, or any attempt made to render it humorous, would destroy it as propaganda. Unfortunately, the word propaganda has taken on a different meaning in the last few years. Publicity experts use the term to describe any methods they may adopt to "put it over"—an objectionable phrase savouring of the puffing of an unworthy article.

The point we make is that whatever method is employed we must not blame the B.B.C. for it. If it evolves its own plans they are doubtless sat upon by the Ministry of Information.

Words do not win wars, and as far as one can trace up to the present, none of the broadcast propaganda has had the slightest effect upon the peoples of other nations. The interesting and certainly entertaining broadcast talk of Quentin Reynolds tickled our palates for the time and was eagerly discussed the following day. It is soon, however, forgotten, and Germany gets on with the war.

V for Victory

WE do not attach a great deal of importance to what was announced from the B.B.C. as our new war weapon. Apparently the people of the vanquished countries are being encouraged to chalk the letter "V" on walls, and some wag has discovered that the opening bars of Beethoven's Fifth Symphony (reminiscent of Fate Knocking at the Door!) is really the morse equivalent of the letter V. Now this is entertaining, but we fail to see where it is a weapon of war, nor are we able to discern what possible effect it can have upon the Germans. It may annoy them in much the same way as we are annoyed when small boys chalk rude words on garden gates. We hope that it will inspire them to revolt against their leaders. Germans are occupying the countries, and it may be that it will inspire the vanquished peoples and buoy them up in the hope that we shall release them from their bondage. If this is the case, it was remiss of this country not to have inspired them before they were overrun. The effort should have been designed to make them resist instead of, as in most cases, to have been passively overrun.

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

Patents In War-time

THE war has naturally stimulated the production of inventions relating to munitions and warlike supplies and also inventions relating to articles of public consumption which have come into special demand owing to war conditions or modifications of such articles to meet the new conditions.

The various Government departments are taking an interest in such inventions and they have a special organisation for dealing with inventions. This we believe applies to the Ministry of Aircraft Production, the War Office and the Ministry of Supply. These departments appear to take note of any patent applications filed which from their title appear as though they might be of some interest to the department. When this is the case a formal letter is sent to the applicant, either direct or through his Patent Agent, asking the applicant to submit to the department a copy of his specification together with any particulars and explanation of the invention which would enable the department to consider whether it could be used in the National War Effort.

The Government departments have power to prohibit the publication of the particulars of any invention which they consider might be of benefit to the enemy if it should come to their notice. The departments also have the right to take over and use an invention, and they may in some circumstances arrange for the patent to be made secret or to delay acceptance of the application for the period of the war so as to avoid publication. These actions do not abrogate the inventor's rights in his inventions. Although the Government departments are entitled to use an invention for the national benefit, and are not actually obliged by law to make any payment in respect of such use, they do in practice make a suitable payment where an invention has admittedly been used by them. If they are unable to agree with the inventor with regard to the amount of the payment then this may in some circumstances be settled by arbitration.

A Novel Receiver Control

A Method Using a Midget Receiver to Operate a Large Receiver

THE following is a description of a system of remote control developed by the Radio Corporation of America in which a midget or other portable receiver is used to control another receiver, preferably one having a large output and employing a well-designed internal or extension speaker. The main idea of the scheme is to use an L.F. stage, preferably the output stage, as an H.F. oscillator which is modulated by the midget receiver signal. The radio-frequency oscillations are picked up by the large receiver and reproduced by the latter. The volume control of the midget receiver controls the gain of the signals reproduced by the main receiver.

Output Circuit

Figure 1 shows a method of wiring the output circuit of a midget receiver for this purpose. The tuner, frequency converter, I.F. amplifier, a second detector, volume control and first audio-frequency amplifier of the receiver are assumed to be quite normal, and are, therefore, shown in block schematic form. The output valve, which is of the beam valve type, is coupled to the first L.F. stage by means of the usual grid leak and coupling condenser. The cathode is connected to a switch which either switches in an un-bypassed cathode resistor for use with the receiver under normal conditions or, alternatively, a larger by-passed resistor for the purpose of reducing the current taken by the output valve when operating as an oscillator.

A further switch, ganged to the previous one, is located in the anode circuit, and serves to disconnect the speaker transformer primary winding, and to connect in circuit the reaction winding, which is coupled to the oscillatory tuned circuit connected to the screen-grid of the output valve. This tuned circuit is adjusted to a suitable frequency, such as at the low-frequency end of the medium-wave broadcast band, i.e., about 550 kc/s. A further tuned circuit is coupled to the oscillatory circuit, and is used to inject the radio frequencies into the power line or other cable to the main receiver. It will be seen that the receiving system is operated in a normal manner, whether receiving signals as a complete receiver, or supplying modulated signals as a control unit; the modulations in one case being applied to the loudspeaker, and in the other case being applied to the oscillator. Since the same valve serves as output valve and oscillator valve, no switching of the control grid circuit is required, and since in the case of the screen-grid output valve the oscillatory tuned circuit may be maintained in circuit for audio-frequency amplification, the switching is simplified.

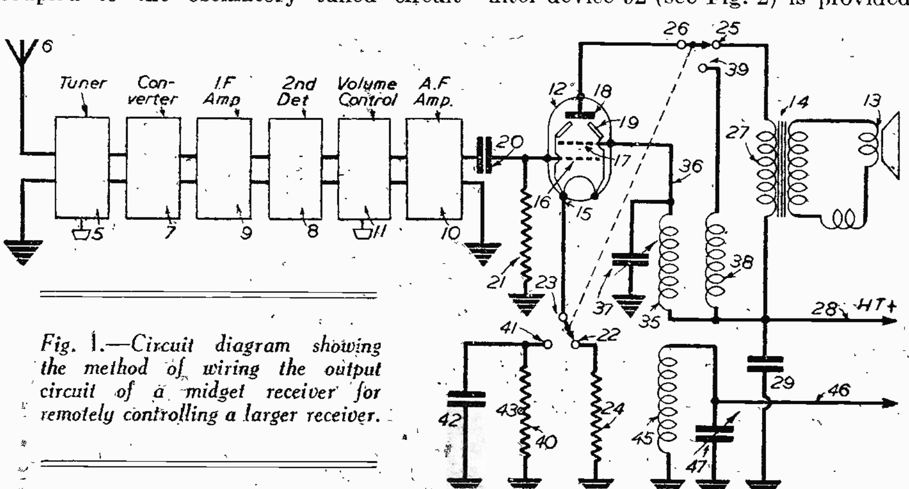


Fig. 1.—Circuit diagram showing the method of wiring the output circuit of a midget receiver for remotely controlling a larger receiver.

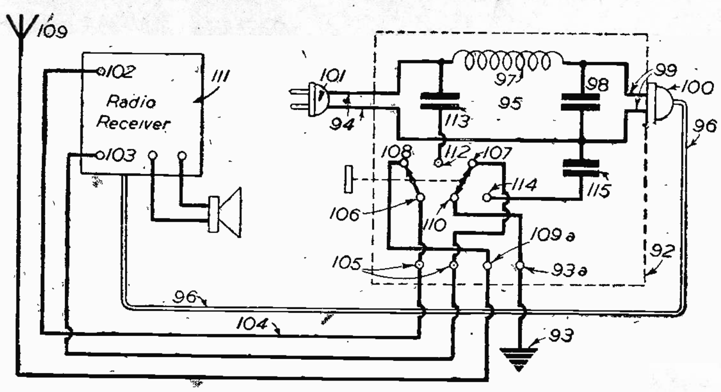


Fig. 2.—Circuit diagram showing the application of an aerial selecting and filter device.

Of course, more ambitious oscillator-modulator schemes may be devised, such as the provision of a separate triode as an oscillator, and the use of the output valve as a choke-controlled modulator, using the speaker transformer primary winding as the modulation transformer or choke. In addition, gramophone pick-up terminals may be connected to the midget receiver for use with either a pick-up or a microphone.

While the remote control system will operate satisfactorily in many installations merely by the radiation from the power line being picked up by the normal aerial of the remotely controlled receiver, it has been found that best operation may be obtained if the input circuit of the remotely controlled receiver is coupled to the power line.

Filter Device

For this reason an aerial selecting and filter device 92 (see Fig. 2) is provided for the remotely controlled receiver 111, which enables the user to switch from the standard aerial 109 and the earth connection 93 to the power line 94, to pick up directly the radiated modulated carrier wave from the remote control unit.

The problem of preventing hum modulation at the controlled receiver because of the short-circuiting action of the power rectifier device on the H.F. current arises. Accordingly, a filter 95 is included in the device 92, interposed between the power line 94 and the receiver power supply connection or cord 96, to isolate the line from the receiver.

The filter 95 includes a filter choke 97 in one lead of the power supply circuit and a by-pass condenser 98 across the output end of the filter. The terminal leads 99 of the filter are arranged to receive a plug-in connection 100 for the power cord 96 of the receiver. The leads 94 are provided with a plug 101 for the usual power outlet or baseboard power supply connection. The aerial and earth connections on the receiver 111, indicated respectively at 102 and 103, are connected through leads 104 with terminals 105 on the filter unit 92 which in turn are connected with the switch arms 106 and 107 of a suitable aerial selector switch. In the position shown the contact arm 106 for the aerial connection engages a contact 108 connected with a terminal 109a for the aerial 109, while the arm 107 is connected with a contact 110 having a terminal connection 93a for the earth 93. This provides the normal aerial and earth connections for the receiver 111.

Operation of Filter

When the arm 106 is moved to a contact 112, the aerial is coupled through a condenser 113 with one side of the power line on the power line side of the filter choke 97. The switch arm 107 is connected to move jointly with the arm 106 to engage a contact 114 through which the earth connection of the receiver is completed with the opposite side of the power line through a coupling condenser 115. This selective switching arrangement permits the radio receiver 111 to be coupled with the power line to receive the modulated oscillations therefrom directly, while the rectifier system is isolated from the power supply line and the modulated oscillations by the filter 95. In practice, the unit 92 is supplied with the remote control receiver for use in connection with any radio receiver for which the receiver of Fig. 1 may act as a remote control unit.

As similar hum troubles arise in the midget receiver, in the circuit of Fig. 1, a filter consisting of a portion of the tapped heater element of the power rectifier and suitable capacities should be provided between the power circuit and the power rectifier, to prevent the rectifier from short-circuiting the power line with respect to radio-frequency signals, or the modulated signals, whenever the rectifier conducts current. The oscillator coupling coil for the power line is connected to the line side of the filter thus provided.

Improved Loudspeaking Telephone

Radiator-type Loudspeaker having an Output of Twenty Watts

MANY high-quality sound-producing systems have been constructed in recent years with various loudspeaker elements designed to cover a wide frequency range. For the most part these systems have utilised multiple devices in which two or more loudspeaker units have

The new loudspeaking telephone, and its designer.

been used in combination, each component unit reproducing only a part of the frequency spectrum. Other systems have been constructed in which a single loudspeaker plays the double rôle of reproducing lower frequencies through a horn connected to one side of the diaphragm, and higher frequencies directly from the opposite side. In some cases, a rather wide frequency range has been produced, and very satisfactory quality has been obtained.

Several factors associated with sound radiation and vibrating systems have necessitated multiple systems for reproducing wide frequency ranges. The more important of these are the low-frequency radiation requirements, which demand large amplitudes even when large radiating surfaces are used; the inertia of the vibrating system which results in a loss of efficiency at the higher frequencies; and the directivity of sound radiators at higher frequencies, which is a function of the size of the radiator or diaphragm.

Multiple units generally involve complications, both in the mechanical structure and in the associated circuits. These complications can be overcome by careful design, but the result is an instrument of relatively high cost. For some time a low-cost speaker of high quality, small size, and moderate power capacity has been needed. Such instrument is required in broadcast monitoring rooms, and in reproducing systems for small rooms.

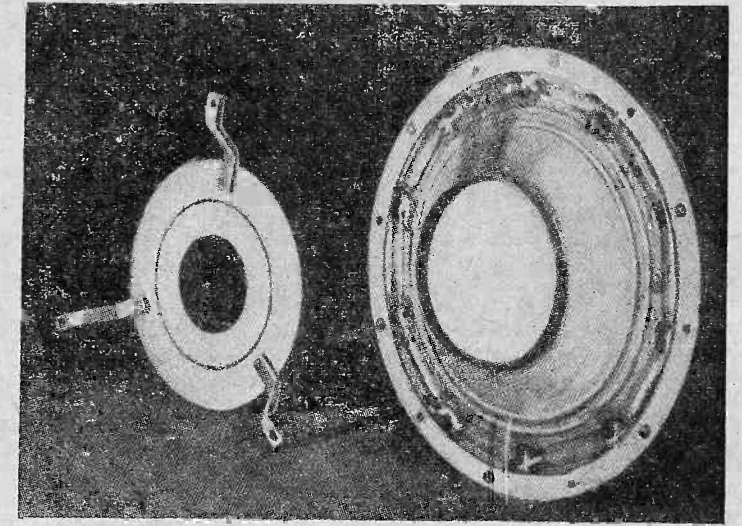


Fig. 1.—The diaphragm and magnet unit.

Direct Radiator Type

Low cost and small size are most readily obtainable in a direct-radiator loudspeaker; that is, one whose diaphragm radiates sound directly into the air, and which does not require a horn. To obtain the high-quality performance desired with a single loudspeaker of the direct-radiator type, the diaphragm must be small enough so that it will not be too directive at the higher frequencies. At the same time the diaphragm must be capable of operating at the large amplitudes required for radiating the lower frequencies. In addition, the effective mass of the diaphragm must be small enough to radiate the higher frequencies efficiently. Even with very thin metal diaphragms, mass reaction is sufficient to cause excessive loss in the high-frequency range if the diaphragm operates as a piston: that is, if all parts of the diaphragm surface move in unison. This effect can be overcome by using a diaphragm in which all parts do not move in unison when operated at higher frequencies, and such a diaphragm will radiate uniformly at all frequencies if properly designed. The problem, then, becomes one of determining the proper diaphragm material, and shape, to provide the desired high-frequency performance, and at the same time, to permit free piston vibration at low frequencies where large amplitudes must be provided for.

Thin metallic diaphragms offered the most favourable properties for such a development as far as the desired effects are concerned, but the problem of forming a diaphragm of this type, which would permit the necessary amplitudes at low frequencies, have the required high-frequency performance, and be free from rattles and extraneous sounds, required considerable experimental work. The development of such a device, however, was finally successful in the Western Electric 750A loudspeaker.

This instrument is a direct radiator with a formed metal diaphragm 8ins. in diameter, and a driving coil 4ins. in diameter, which moves in a permanent magnet field. The loudspeaker is intended for mounting in a closed cabinet of the proper design and capacity; when furnished so mounted, the combination is known as the 715A loudspeaker. Any cabinet of suitable design, however, may be used.

Response-frequency Characteristic

A representative response-frequency characteristic of the loudspeaker when thus housed is shown by the solid curve in Fig. 3. The sound pressures measured on the axis are relatively uniform from about 60 to 11,000 cycles, a frequency range sufficient for high-quality reproduction. The sound output is somewhat less uniform in the upper frequency range than for some horn-type speakers, but it is adequate for good

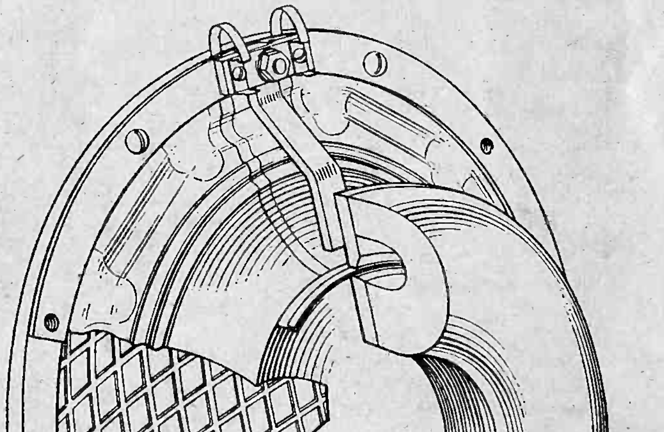


Fig. 2.—The driving coil vibrates in a narrow slot in the ring-shaped field magnet.

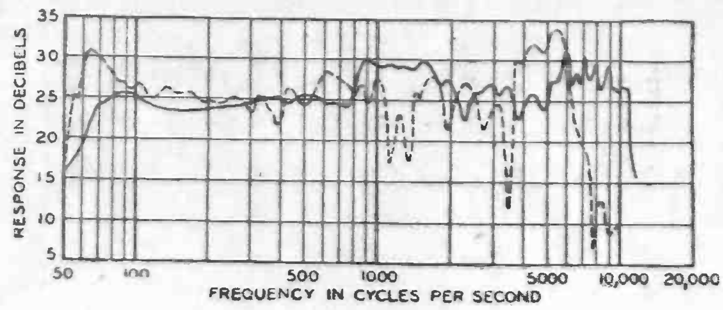


Fig. 3. — Response-frequency characteristic of the 750A loud-speaking telephone in its cabinet (full line) compared with that of one of the best commercial instruments (dotted line).

reproduction. For comparative purposes, the response-frequency characteristic of the best commercial cone-type dynamic speaker which has come to our attention is shown in dotted line on the same drawing. Identical testing conditions were imposed in measuring the two speakers. One feature of the 750A loudspeaker, the effect of which is indicated on the response curves, is application of mechanical damping which reduces the low-frequency resonance peak so as to eliminate so-called "hang-over" effects.

An inherent limitation in a device of this type, as compared with a more elaborate combination of horn-type speakers, is the inability to control the distribution of the radiated sound. As previously indicated, the reproduction from a speaker of this type is more and more deficient in the higher frequency range as the observer moves away from the axis of the speaker. The best quality is observed within a thirty-degree angle, but satisfactory performance over a wider angle is obtained for many purposes. The diminution of high-frequency radiation is not serious up to an angle of 45 degrees. In rectangular rooms of moderate size a single speaker usually suffices. For larger rooms, or rooms of considerable width, two or more speakers may be required for the best reproduction.

Twenty Watts Output

The efficiency of the new loudspeaker is equal to that of commercially available cone-dynamic speakers of the same size and weight. When reproducing speech or music it is capable of handling the maximum undistorted output of a 20-watt amplifier at single-frequency rating.

The 750A loudspeaker is not intended to replace existing multiple-unit systems, but rather to fill a long-felt need in situations where more elaborate devices are not required or may be prohibitive because of cost or size. In locations where high sound levels are not necessary, and where the angle of coverage is not too great, the instrument will reproduce speech and music with remarkable fidelity.—*Bell Laboratories.*

The British Institution of Radio Engineers

THE annual general meeting of the Institution was held on Saturday, June 28th, at the Federation of British Industries, London, S.W.1.

Giving the annual report of the council, Sir Arrol Moir, Bart., joint president, stated :—

"In its responsibility for conducting the Institution's examinations, the committee now under the able chairmanship of Mr. W. B. Medland, B.Sc., a past president, has done valuable work in providing a means of recognising the ability of students and offering to employers the means of securing qualified assistants. The terms of reference of the committee are: 'To formulate schemes for educational study in radio and allied engineering and to co-operate with the educational authorities in the arrangement of courses of instruction, to prepare schemes for and to hold examinations in radio and allied engineering, whether entitling successful candidates to membership of the Institution or otherwise, and to do all those things necessary for the carrying out of these terms of reference.'"

Sir Arrol Moir also submitted a proposal that a Professional Purposes Committee be established . . . with a view to investigating the progress made by the Institution in gaining independent professional status for the qualified radio and allied engineer. Such a committee would deal mainly with qualifications required for membership and classification of occupations coming within the orbit of our activities. This would assist general acceptance of the Institution's status and would provide for any revision necessary to the articles of association and the general activities of the Institution.

North-western Section

Referring to the inauguration of a North-Western Section of the Institution and the fusion of the British Institution of Radio Engineers and the Institute of Wireless Technology, he quoted a letter from Mr. James Nelson published in August, 1925. In this letter, Mr. Nelson referred to the foundation of a professional radio engineering body and stated "It is intended that the society shall be called The British Institute of Radio Engineers."

The report continued: "The Institutions Appointments Register, as distinct from the Central Register, has been kept in operation, although there have been but few members to submit to employers. Naturally, war needs take priority, but active service and Government appointments have created a large number of 'duration vacancies' which the Brit. I.R.E. has been able to fill. As further adjustments in industry become necessary, more opportunities of this kind may arise. Meanwhile, the Institution's war effort, referred to in my presidential address in December, 1939, has been continued with marked success. The expressed thanks of the War Office, the Air Ministry and the Ministry of Aircraft Production, besides other Government Departments and large bodies, for our work, indicates the official recognition of the professional status of the Institution's membership."

Council's nomination of Dr. C. C. Garrard, Ph.D., M.I.E.E., M.Brit.I.R.E., was unanimously approved by members, and Dr. Garrard therefore succeeds Sir Arrol Moir as president of the Institution.

The meeting concluded with the adoption of a proposal to inaugurate a building fund and an address by T. D. Humphreys (Associate member), of A. C. Cossor, Limited, on "Lesser Known Aspects of Measurement with the Cathode Ray Oscillograph."

The election of the 1941-2 general council, carried out by a postal ballot, resulted in the election of the following:

Mr. A. L. Beedle	Mr. W. E. Miller
Dr. P. P. Dalton	Mr. J. F. Paull
Mr. A. G. Egginton	Mr. J. A. Sargrove
Mr. L. Grinstead	Mr. W. D. Sell
Mr. G. Lea	Mr. H. Tibbenham.

Officer cadets undergoing Morse code practice under a sergeant-instructor. The young cadet on the extreme left is the third Earl Kitchener of Khartoum, grand-nephew of the famous soldier who raised a volunteer army of over a million men in the last war.

War-time "Hook-ups"

Circuits of Simple Sets Made by Readers During the War

IN response to Thermion's invitation in our June issue to readers to send in ideas for hook-up and simple receivers for use in the present difficult times, we have received many circuits and descriptions of such sets, and we publish a selection of the best ones.

Several readers submitted circuits of one and two-valve sets, and in our opinion the best effort was sent in by A. W. Jump, of Dunfermline, Scotland, who writes as follows:

"I was called upon to construct a set at short notice and within a limited time—in a town in which I was a complete stranger. I managed to rig-up a serviceable affair (I refrain from calling it a radio set!) notwithstanding many set-backs. I had no components handy, and a tour of the town's radio shops unearthed only ¼lb. of D.C.C. wire (of unknown gauge), one reaction condenser .0003mfd., two pre-set condensers (of unknown capacity!), one fixed condenser .0003 mfd. complete with clip and 2-megohm grid leak, one L.F. transformer (of doubtful make and still more doubtful vintage), and a quantity of wander plugs, together with an old paxolin strip. (Valves and batteries were to hand at my friend's house.) The great snag was valve-holders. Eventually I hit on the idea of cutting the paxolin strip into small squares somewhat larger than a valve base. Holes were then drilled to the dimensions and design of an ordinary B.V.A. triode, but large enough to take the threaded portion of a wander plug. The small ring was screwed right up, and the threaded portion screwed into the holes. The coloured cap was then screwed on and the whole tightened up. (The particular plugs used had small taps, and thus fitted, can be accommodated in the space.) They were then mounted on wooden strips, as shown in the sketch.

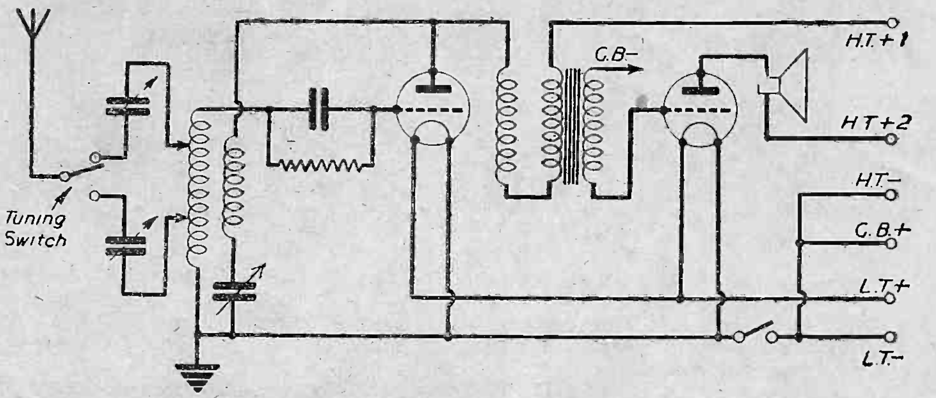
"Having overcome the valve-holder difficulty, the next problem was tuning arrangements, as I was without a tuning condenser. I wound about sixty turns of D.C.C. wire on a former, making tappings at intervals of 15 turns. (The former used was the cardboard cover of a cylindrical torch battery.) A reaction coil was then wound on the former (45 turns). My friend had meanwhile found two mains-type tumbler switches, one of which was of the '2-way' type.

"A small wooden box about 9in. x 8in. x 6in. was found, and into it I put the components to form a circuit, as illustrated. The H.F. choke was made by turning about 250 turns of the D.C.C. wire on to a 'deep' cotton reel. The two switches and the knob of the reaction condenser were the only controls, and these were mounted on the outside of the box.

"The aerial was introduced into the circuit by means of either of the pre-set condensers and the coil tappings. Connections to the coil were made by means of a piece of flex held secure by a small 'paper clip.'

"One of the condensers was then adjusted until the 'Home Service' could be heard, and the tuning switch reversed. The 'Forces' programme was then tuned by the other pre-set, and by selection of a suitable coil tapping. Thus either programme could be heard at will, simply by operation of the tuning switch.

"Results on this set, using a moving-coil speaker (W.B. Universal) were quite satisfactory, and although located at between fifty and sixty miles from the two 'local' transmitters, this little 'hook-up' provided adequate volume to fill a room 16 ft. square. It has been in use for over twelve months, and my friend has done nothing to it except change the accumulator and the H.T. battery (the latter only once!)"



Circuit diagram of A. W. Jump's two-valver.

A Four-valve Circuit

A much more elaborate circuit is that of J. Robinson, who writes as follows:

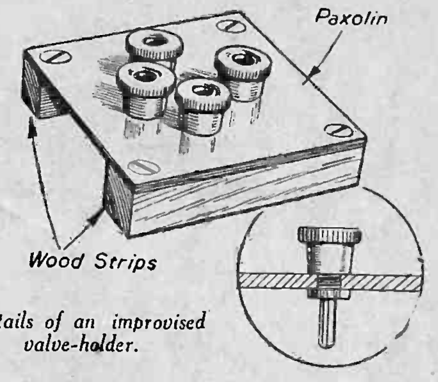
"The accompanying circuit diagram is of my war-time junk-box set.

"The H.F. stage was added later in order to increase the volume of the Forces programme. The wave-trap helps to stop that fool Haw-Haw from cutting in on the Home Service programme, and is also used as a volume control. The set is run from an A.C. power jack, the speaker being mains energised from a metal rectifier, but of which I have no details. The L.T. is trickle charged.

"This set has been used continuously since just after the outbreak of war, and has never given the least trouble."

Simple One-Valver

A useful and cheap little one-valve circuit was submitted by M. Lockwood (Wakefield). Here is his description:

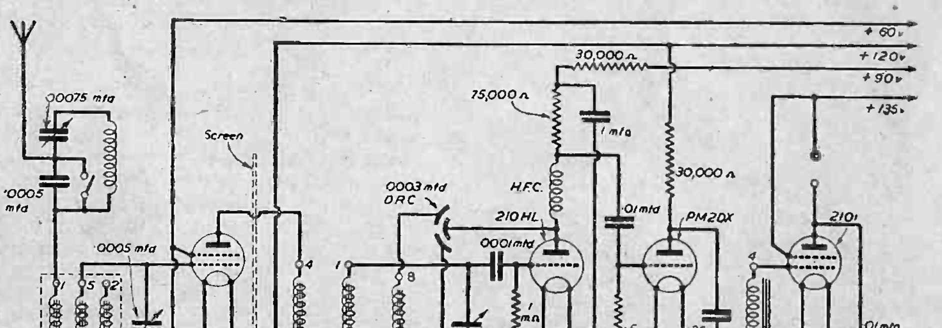


Details of an improvised valve-holder.

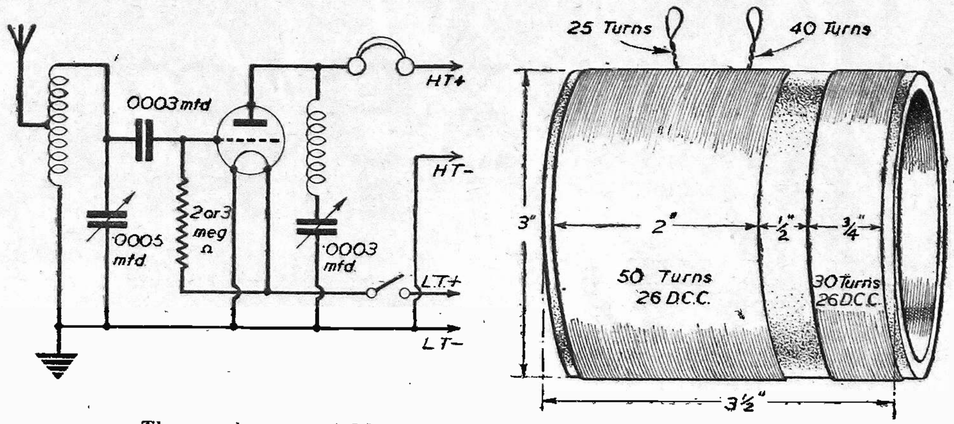
"The valve used in this simple circuit was a Mullard P.M.1. H.F., and I have received all the English stations (these tests were carried out just before the war) and several continental stations at good 'phone strength.

"It could be coupled to a transformer and/or an R.C.C. stage and used with loud speaker.

"The details for the medium-wave coil are shown in the sketch. The first tapping on the coil (grid winding) should be, in most cases, the one used, but if there are two stations on top of one another the second tapping should be used.



This is the circuit diagram of J. Robinson's four-valve set.



Theoretical circuit of M. Lockwood's single-valver, and details of coil.

"If a long-wave coil is wanted it is better to fit plugs at the points shown and mount sockets on a strip of ebonite fitted on two blocks of wood.

"For a long-wave coil a former of the same dimensions can be used, but 200 turns of No. 34 single silk-covered wire, with tappings at the 100th and 130th turn, are required for the tuning section, and 75 turns of the same wire will be needed for the reaction winding."

Two-valve Mains "Hook-up"

From amongst the circuits of mains-operated sets submitted, we have selected that of J. E. Woodward (Wolverhampton) as being the best "mains" effort. It is quite a useful and reliable "hook-up," and here is Mr. Woodward's description:

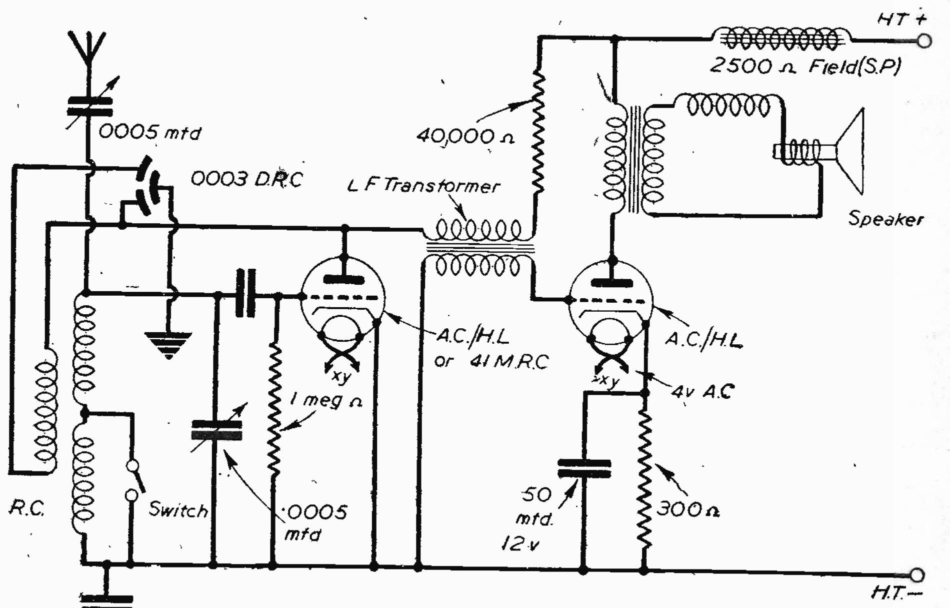
"The accompanying circuit diagram is of a very simple two-valve, all-mains set, which is used in the living-room as a standby set. Most of the components are from an old commercial receiver, which I bought (or begged) for 7s. 6d. This is practically the first set I have built, as the previous ones have been single-valve 'phone jobs. The job is in a radio cabinet, but chassis-less, as there are relatively few earth points. The earth leads are soldered to a strip of brass curtain rail, and then the earth proper taken from the rail itself.

"Various valve combinations have been tried, and the valves indicated gave the best quality, which *is extremely* good in view of the high impedance of the output value. The correct optimum load should be 8,000 ohms for the speaker in question, and the impedance of the AC/HL is quite a big percentage of mismatching. The aerial series condenser must be included to receive the Forces programme, the condenser being a variable one, as the selectivity of the single-tuned coil is naturally low.

"Incidentally, I have used no decoupling components, as I was in a hurry to build the set, as my commercial job had ceased functioning.

"It may interest you to know that only mains jobs interest me, although I can transcribe a battery diagram to all-mains working, thanks to your instructive journal, which I have taken for approximately four and a half years. I file all the technical articles into their respective categories such as L.F., H.F., superhet, etc., and have cuttings going back to 1936.

"It may be of interest to other readers to know that I am using a P.M. dynamic speaker as a mike, feeding into the L.F. amplifier of a commercial receiver, and it works well. The mike lead is approximately 50ft. of good quality lighting flex, and does not give rise to any interference or crackling."



Circuit diagram of J. E. Woodward's four-valve "mains" hook-up.

BROADCASTING WITHOUT A MICROPHONE

THE problem of developing musical instruments capable of producing powerful yet clear and undistorted sound, audible to audiences of many thousands, has engaged the attention of Soviet scientists for some years. The Acoustics Laboratory of the Conservatory of Music, headed by Professor N. Garbuzov, has been working on the development of new electrical instruments, a task in which designers and musicians, working in close co-operation, are opening up new paths for the development of music.

In the laboratory stands a highly-polished black instrument outwardly resembling a miniature organ. When the musican raises the lid and strikes the keys, just as with a dummy piano, no audible sound is produced. The various sounds, resembling those produced by a flute, an oboe, or even an organ, issue from the loudspeaker of the receiving set as the keys are pressed. This new electrical instrument, called a companola by its inventor, Igor Simonov, works on the same principle as a piano. Unlike a piano, however, each key is not attached to a hammer which strikes a string, but to a switch resembling a telephone relay. When the keys are pressed, they throw in contacts, switching in a system of resistances.

Frequency Range

Each of the usual musical instruments, such as the 'cello and trumpet, has a limited range of frequencies. The frequency range of this electrical instrument, on the other hand, is very broad, including that of many musical instruments. By simply changing the resistances the performer instantaneously changes the pitch. The companola may produce a staccato sound like that of a guitar and a drum, or the legato sound of a trombone. In the high registers the sounds produced by the instrument resemble that of an oboe or a flute.

The performer plays only the basic melody; all the remaining effects conceived by the composer, all the colour, are achieved electrically, with the aid of an ordinary audio-frequency oscillator (producing electrical vibrations which, upon passing through the loudspeaker, are transformed into sound), electrical resonators, filters, resistances.

Moreover, to play the companola does not require as much effort or as complex a technique as to play a piano. Without its amplifier it is no heavier than an average radio set, yet it can produce a sound that can drown a symphony or jazz orchestra. The musician, without exerting himself in the least, can make the instrument sound a "fortissimo" which, for power, is beyond anything so far known in instruments.

One of the usual sights at concerts is the tympanist, in the last row of the symphony orchestra, endlessly tuning his unwieldy instruments. And when he does play, he usually strikes only a few times in an entire number. In the Acoustics Laboratory of the Moscow Conservatory of Music was a small suitcase that resembles anything but a tympany.

The frailest girl may make the most powerful sound issue from your loudspeaker by applying her little finger to this "tympany," Simonov, the inventor, stated. As for tuning it—our "tympany" is equipped with a keyboard. Press the required key and without any tuning the sound you need is produced.

ON YOUR WAVELENGTH

By Thermion

Brains Trust Again

I NEED not refer to the many dozens of letters I have received apropos my comments on the so-called Brains Trust. On the principle that what I write always meets with the approval of my readers I intentionally dislike publishing letters savouring of flattery. Much more potent to publish letters of disagreement and we must admit that on odd occasions there is the other point of view. So from my post-bag relating to the alleged Brains Trust I extract a letter written by one Beauchamp, who hails from the salubrious district of Coventry, and this is what he says: "I disagree with your remarks in their entirety. I appreciate constructive criticism, but are your remarks constructive? I would refer to your derisive, ribald suggestions as to a better title for the programme. It would appear that you doubt the mental powers of the eminent men taking part in the discussions. In my view the majority of questions asked are difficult to answer and that were you suddenly requested to answer some of them, I guarantee you would fail utterly. In commenting upon the questions you apparently require those which can be answered by a plain Yes or No. This is altogether the wrong idea, for questions of that nature can easily be answered by reference to encyclopædias and text-books. The questions asked are, in the main, those which the public are unable to answer."

Professors

THIS reader is, therefore, agreeing entirely with everything I wrote. I have said that I do not doubt the ability of the Professors in their respective spheres. Perhaps I suffer from some reflex action engendered by my school days in that I abhor professors. To many it is a magic word like the word Editor. To me it merely denotes, as I have said before, a retentivity of mind and the ability to absorb and remember the teachings of others; and I have already pointed out that the many thousands of professors we have had since professorships were first introduced have not contributed anything measurable to science. And what is a professor? You have Professors of Conjuring, Professors of Tattooing and Professors of Dancing. Normally, however, the term is taken to mean one who has held a Chair at a University. Readers will excuse me, therefore, if I fail to doff my hat in awe and deference to professors. I have a measure of respect for Professors of Exact Sciences, such as Professors of Mathematics, Professors of Engineering and so on. I am not impressed by Professors of Psychology, nor by Professors of Economics, for they are inexact and very nebulous studies.

Regarding the questions I am quite unrepentant in my criticism. The fact that a professor thinks that love is a form of temporary insanity or that a man exerting effort pulls faces to frighten away his enemies, is of no greater value nor does it add any more to the world's heritage of knowledge than the views of any other member of the public. They are plain, conjectural answers which could be given by anybody. Another point. If a question is asked it should be answered in a positive way, leaving no room for doubt, and the gravamen of my criticism was that it is easy to propound questions, capable of many equally nebulous answers and providing, as I said, the opportunity for scientific guessing and idle, drowsy, drawing-room back-chat. I agree with my correspondent when he suggests it might have been useful to have added Sir Wm. Bragg to the Brains Trust, but whilst there are so many important, scientific questions capable of exact answers which the public ought to know, we should not waste valuable broadcast programme space by such balderdash. I appreciate that the members of the Brains Trust are very much victims of those who set the questions and, left to their own devices, I have no doubt that they could give us a more entertaining half-hour. A further point occurs to me. If we are to have a Brains Trust let us vary the members of it from time to time. As it is, the presumption is that only about four people in the country have brains. A suggestion, I add with some asperity, which I strenuously resent! In fact, it is one of my criticisms of the B.B.C. that they select one man to speak on a particular topic and continue with him *ad infinitum* and often *ad nauseum*.

Feature Speakers

THIS is particularly true of feature speakers. Variety is the spice of life and the very quintessence of entertainment. Therefore, I adjure the B.B.C. to provide not only variety of entertainment but variety in their variety, if you get my meaning. So, friend Beauchamp, when taking up the vitrolic pen, remember the old quatrain which goes like this:

Ye, who your lips would keep from slips,
Three things must you beware,
Of whom you speak, to whom you speak,
And When and Why and Where.

The usual enjoinder of the critic appeared at the foot of this letter to the effect that if I ignore it he will presume that I am unable to face criticism. Well, I think I have effectively taken the sting out of B.

Our Roll of Merit

Our Readers on Active Service—Eighteenth List.

H. Eltringham (A.C.2, R.A.F.), London, E.C.
A. Brewer (Sgt., R.A.F.), Malton, Yorks.
H. G. Baker (Signalman, S.C.S. Coy.), Jubbulpore, India.
S. Peers (A.C.2, R.A.F.), Stevenston, Scotland.
C. Waywell (A.C.2, R.A.F.), Newton-le-Willows.
W. L. Young (Capt., R.A.M.C.), Halifax.

THE B.B.C. "BRAINS TRUST"

Let us study this title, with logic aright,
And with diligence search until we see light;
We may get some reward for our pains.
Have we, all along,
Been reading it wrong,
Does it mean we've to
Trust they've got brains?

Construing it thus, need there be any fuss?
When the critic finds fault and complains,
We should gently point out
He's at fault, without doubt,
It just means we've to
Trust they've got brains!

When their culture runs mad makes the rest of us sad
And our tears they run down like the rains,
Wipe away the sad tear,
For now it seems clear,
It just means we've to
Trust they've got brains!

Though the subjects they tackle,
And rubbish they cackle,
The wise man from hearing refrains,
And remarks, with much sense,
We'll need fresh evidence,
Or we really can't
Trust they've got brains!

TORCH.

Ultra-short Wave Detectoscope

AN apparatus to "X-ray" opaque objects with ultra-short radio waves, 3-4 cm. in length, has been developed at the Institute of Physics of the University of Moscow. By employing this apparatus it is possible to disclose defects in articles made of wood, porcelain, glass and leather, as well as in bodies which are poor conductors of electricity. Analogous to the X-ray method, the ultra-short wave method is said to have the advantage of being able to disclose bodies which are usually opaque to X-rays—the presence of water in oil or pitch, for instance. A closed box containing articles like photographic films, which usually suffer from the action of X-rays, may now be examined with ultra-short waves, without its contents being affected.

By a special device it is also possible to "radiograph" articles with the ultra-short wave apparatus.

Publications by the Various Ministries

THERE are a large number of pamphlets, booklets and so forth which are issued from time to time by the various Ministries and which it would be useful for listeners to know about. A new monthly feature after the Sunday news at 1.0 p.m. began in July, which will keep people informed on recent publications. Mrs. M. A. Hamilton will be the speaker and two more of these broadcasts are to be given on August 3rd and 31st.

Gray Memorial Trust Award

THE Council of the Royal Society of Arts annually offer a prize of £50 under the Thomas Gray Memorial Trust, the objects of which are the advancement of the science of navigation and the scientific and educational interests of the British Mercantile Marine.

The prize for 1940 has been awarded to Mr. H. C. Walker, of Cheam, Surrey, for a device known as the Portable Valve Lifeboat Equipment, which is a self-contained radio auto-transmitter designed for the purpose of saving life at sea. A similar prize of £50 is offered for 1941. For details apply to the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2.

maker's literature, and which provides some very useful information. This is the anode current-grid volts curve, as shown in Fig. 5. In this case we have a number of corresponding curves, each drawn for a different value of anode voltage. Provided that there are a fair number of curves it is easily possible to plot I_a—V_g curves from I_a—V_g curves, or vice versa.

We often refer to the slope of anode current-grid volts curves, since this shows an important constant known as the

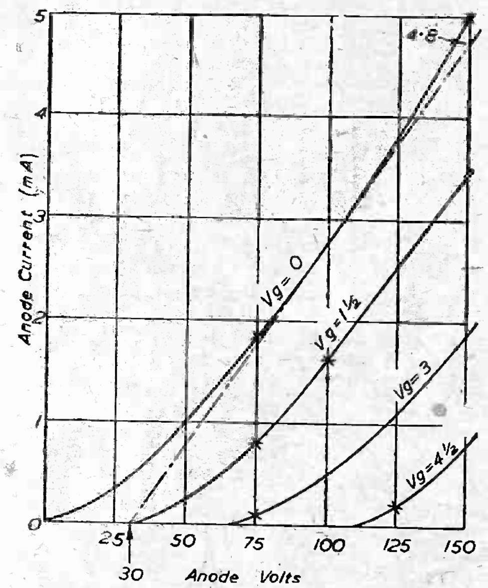


Fig. 4.—Anode current-anode volts curves for a battery triode of the "H.L." type. The chain line is used to find the anode resistance of the valve.

mutual conductance, generally abbreviated as G_m. The mutual conductance is the ratio between a very small change in anode current brought about by a very small change in grid volts, and is taken at 100 volts anode and zero grid volts. It can be obtained from the appropriate curve in Fig. 5 by drawing a normal or tangent to the 100-volt curve at the point where it crosses the zero grid-volts axis. It has been drawn as a chain line in Fig. 5.

As would be expected for the alternative name of "slope," the mutual conductance is found, after drawing the line by dividing the milliamps. indicated at one end of the line by the volts shown at the other. Actually, the line need not be drawn as long as in Fig. 5, but if it is shorter, a triangle should be drawn with the line as the hypotenuse, and the vertical height divided by the base. It can be seen from the example that, at the point defined, a change of 5.1 mA. in anode current is brought about by a change of 5.2 in grid voltage (from − 3.2 to + 2). It can therefore be seen that the mutual conductance is 5.1/5.2, or about 1.0 mA. per volt.

It was stated above that the mutual conductance is the ratio between two *very small* changes, and it may now be pointed out that the changes we have considered are by no means small. But since the straight line is normal to the curve, and since it is a ratio with which we are concerned, the result is the same. It would not be practicable to take ratios of infinitely small changes, and the most accurate results are obtained by making the line as long as possible after making quite sure that it is normal to the curve.

Micromhos or mA.-V.

Mutual conductance is sometimes—and more correctly—expressed in micromhos rather than in mA./V. The mho. is the unit of conductance, just as the ohm is the unit of resistance, and since one ohm equals one volt divided by one amp., it will be clear that one mho. is one amp. divided by one volt. One micromho is, of course, one millionth of a mho. We can therefore convert mA./V. into micromhos by multiplying the ratio by 1,000 (a million divided by 1,000 to change from mA. to amps.). The valve referred to above would thus be said to have a mutual conductance of 1,000 micromhos. The practice of giving the conductance in micromhos is chiefly confined to the conversion conductance of frequency-changers, but this term will be dealt with in the concluding article.

Amplification factor has already been referred to briefly, but having gained an impression of the meaning of internal resistance and mutual conductance we can return to this. The reason is that the amplification factor can be determined by multiplying together the R_a and the G_m of a valve. This is because the μ can be described as the ratio of the powers of the grid and anode of controlling anode current, and since mutual conductance is the ratio of anode current to grid volts, while anode resistance is the ratio of anode volts to anode current. If the two ratios are multiplied together, the expressions for anode current cancel out, leaving us with the ratio between a small change in anode voltage and the small change in grid voltage required to produce the same change in anode current. In determining the amplification factor or μ in this way it is important to remember that the current must be expressed in amps, not milliamps. For example, if a valve had a mutual conductance of 1.5 mA./V. and an anode resistance of 20,000 ohms, the amplification factor would be 1,5/1,000 times 20,000, which is equal to 30.

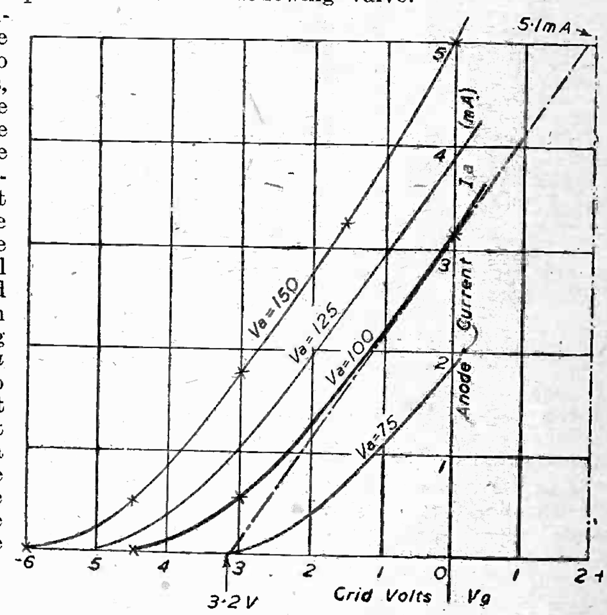


Fig. 5.—Anode current-grid volts curves for a battery triode of low mutual conductance. The latter is found by constructing a triangle as explained in the text.

Voltage Amplification

A point which is often overlooked is that the amplification factor of a valve is not necessarily the amplification which the valve will give when used in any particular circuit. The actual degree of amplification is known as the voltage amplification factor or V.A.F., and its value is governed not only by the valve constants, but also by the value of the anode load. Thus, for a resistance-capacity coupled amplifier, the voltage amplification factor is found from the formula: $\text{V.A.F.} = \dfrac{\mu \text{ times R}}{\text{R plus } R_a}$ where R is the resistance in ohms of the anode coupling resistor. It will be clear from this that the V.A.F. is always less than μ, even if R is made infinitely large. In practice, it is desirable, where possible, to make R between four and ten times R_a. The actual value of R is largely governed by the amount of voltage which can be "spared" as voltage drop across it.

In passing, it should be noted that stage gain, or the ratio of output to input voltage is even less than the V.A.F., due to the fact that the grid condenser and grid leak in series are virtually in parallel with the anode load resistor, and that these two act as a potentiometer feeding the grid of the following valve.

Some other important valve constants will be explained in a second and concluding article.

(*To be concluded.*)

WEEK'S GOOD CAUSE RESULTS

It is very gratifying to note that in two months listeners have raised for charitable objects over £26,790. Notwithstanding the manifold calls made at this time on the generosity of a free-giving people, the weekly B.B.C. "Good Cause" appeals still continue to find ready and generous response from listeners.

In March, as a result of five appeals, the total of £16,346 15s. 2d. was raised, and in April, four appeals produced a sum of £10,443 16s. 8d.

The one which registered greatest response was that made on March 23 by the late Lord Stamp on behalf of the National Children's Home and Orphanage. The total subscribed was £6,654 17s. 11d. This money was contributed before Lord Stamp was himself a victim of enemy action.

The next largest total recorded in this weekly appeal followed an address given by Madame Chiang Kai-Shek on April 27, supplemented by an appeal by Dr. Gordon Thompson, on behalf of the British Fund for the Relief of Distress in China. The sum received was £4,627 3s. 10d.

Dame Meriel Talbot's appeal on March 16, made in the interests of the Professional Classes and Gentlefolk placed in distressed circumstances as a result of the war, raised £3,839 15s. 3d. Next on the list comes £3,300 for the Central Council for the Care of Cripples, in whose interest an appeal was made by Emlyn Williams.

Christopher Stone on March 9 managed to obtain £2,214 19s. 5d. for "Seriously Disabled Ex-Service men of the Great War."

A sum of £1,659 15s. 11d. was raised through Cardinal Hinsley's April 6 appeal in the "Huts for the Forces" effort made by the Catholic Women's League. "Comforts for the Army," sponsored in the broadcast by Major-General Williams, raised £2,000.

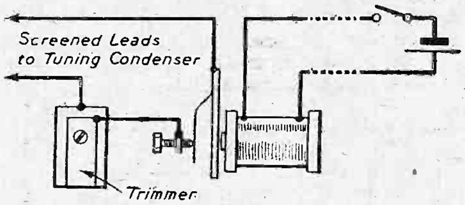
Mrs. Churchill was instrumental in bringing in £1,637 2s. 7d. to the Y.M.C.A. Fund used for the provision of huts and canteens, and the Norman Birkett appeal on April 13 produced £856 16s. 11d. for Boys' Organisations.

Practical Hints

Remote Control Switching

THE device described below was used as a remote control to change from Forces to Home Service stations. A trimmer from an old I.F. is used in conjunction with a sixpenny bell unit. The trimmer is connected so that when current is switched on at the remote control end, the trimmer is switched out of circuit.

To adjust with current on, and trimmer out of circuit, the set is tuned to the Forces programme. Switch current off (trimmer in) and adjust trimmer until set is tuned to Home Service, then by simply switching current on and off the set is tuned from Forces to Home Service as desired. Source of current is a cycle lamp battery which I have been using for two months, and it still works well.—M. I. HENDERSON (Darlington).



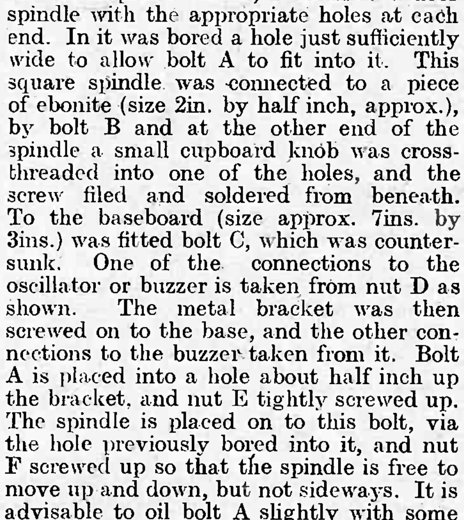
A simple remote control switching device.

> **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." DO NOT enclose Queries with your hints.

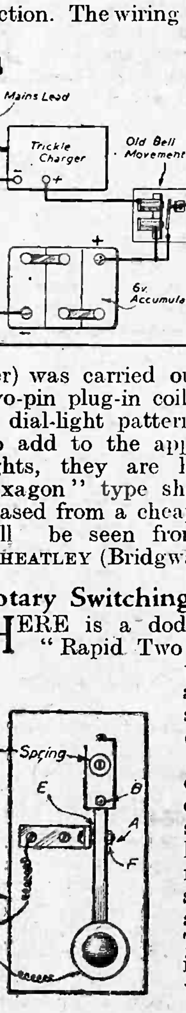
> **SPECIAL NOTICE**
>
> **All hints must be accompanied by the coupon cut from page iii of cover**

A Cheap Morse Key

THE accompanying sketches give some idea of how I constructed a very efficient morse key for the surprisingly low cost of sixpence. First, I obtained a door spindle with the appropriate holes at each end. In it was bored a hole just sufficiently wide to allow bolt A to fit into it. This square spindle was connected to a piece of ebonite (size 2in. by half inch, approx.), by bolt B and at the other end of the spindle a small cupboard knob was cross-threaded into one of the holes, and the screw filed and soldered from beneath. To the baseboard (size approx. 7ins. by 3ins.) was fitted bolt C, which was countersunk. One of the connections to the oscillator or buzzer is taken from nut D as shown. The metal bracket was then screwed on to the base, and the other connections to the buzzer taken from it. Bolt A is placed into a hole about half inch up the bracket, and nut E tightly screwed up. The spindle is placed on to this bolt, via the hole previously bored into it, and nut F screwed up so that the spindle is free to move up and down, but not sideways. It is advisable to oil bolt A slightly with some thin machine oil. From bolt B to bolt G on the bracket a very flexible piece of wire is connected to ensure an efficient contact. Then, through a hole previously drilled in the ebonite, a fairly long screw is placed. Between its head and the ebonite is a spring, obtained from an old torch. Finally a round headed screw is placed in at an angle at the edge of the ebonite. Thus, with the aid of a screwdriver, the gap across nut D and the spindle can be adjusted to one's own requirements by this screw. Also, if the tension of the spring is too strong, the long screw enables this tension to be decreased.—D. R. TAYLOR (Hull).

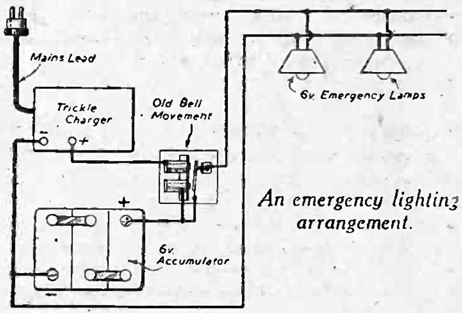


A cheap morse key made from odds and ends.



Emergency Lighting

NOWADAYS, for "blitz" and other reasons, it is very desirable to have a reliable device for ensuring that one is not "left in the dark" by mains failure, or fuses blowing. The accompanying diagram illustrates a device which is giving every satisfaction. The wiring to lights (three in number) was carried out with wire from old two-pin plug-in coils, and ordinary screw-in dial-light pattern 6 v. bulbs are used. To add to the appearance of the actual lights, they are housed in the "half-hexagon" type shades, which were purchased from a cheap stores. Other details will be seen from the sketch.—B. A. WHEATLEY (Bridgwater).

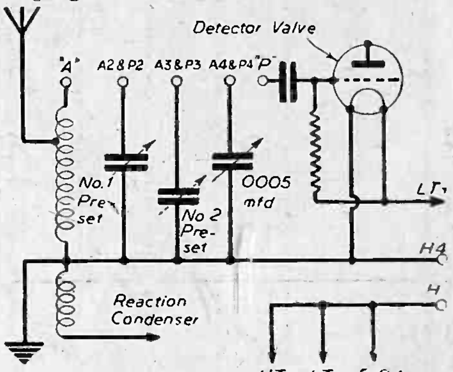


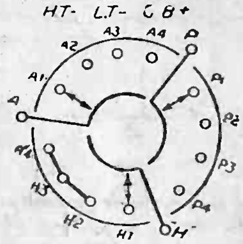
An emergency lighting arrangement.

Rotary Switching

HERE is a dodge for converting the "Rapid Two" receiver into a pre-tuned model, by the addition of a rotary switch and two pre-set condensers.

A glance at the circuit diagram of the detector stage and the switch (inset) will show how the connections are made. The alterations shown make the set into an ideal A.R.P. model. The L.T. current, etc., is fed into one pole, which acts as on-off switch, while the other two poles are connected—one to the grid coil, and one to the grid condenser. These sections give the operator manual tuning and two stations pre-tuned, e.g., Home Service and Forces programme; the whole controlled by one spindle and without the necessity of ganged switches.





Circuit diagram and detail of rotary switch for converting an ordinary two-valver into a pre-tuned receiver.

The wire from the grid condenser to the grid coil is broken and the two ends taken to the pole feeds marked "A" and "P" respectively. The grid end of each condenser (1 variable, 2 pre-set) is taken to contacts on "A" pole and "P" pole, as shown.

There is still 1 pole and 4 ways left. To the pole feed marked "H" is attached the H.T.—, L.T.—, and G.B.+, the single-pole on-off switch being taken out of the set. The three contacts marked H2, H3 and H4 are strapped, and a lead from H4 taken to the earth line.

When each pole's switch-bar is on contact 1 (A1, P1 and H1), it will be seen that the filament circuit is broken and the grid circuit also has no connection with the grid coil or the condensers. As the switch is moved to position 2 the filament current passes to the earth line via "H" pole feed and the three strapped contacts. The first pre-set condenser is brought into circuit and the grid coil and condenser are strapped by the switch. If this condenser is tuned to the Home Service and the reaction adjusted that is one station ready tuned for immediate operation at any time.

When the switch is turned to contacts "3" the second pre-set condenser is brought into circuit, the first one being open-circuited. This second condenser can then be adjusted to the Forces wavelength.

In position 4 the two pre-sets are "open" and the variable condenser is brought in, giving the user normal manual tuning control.

It will be seen that in positions 2, 3 or 4 the L.T. circuit is still allowed to close with the earth line—H2, H3 and H4 being strapped.

The switch used for this work is a Midget Rotary Selector 3-pole 4-way switch made by Bulgins, Ltd. (list No. 203). The control is a 1½in. diameter ribbed knob (list No. K4), also made by Bulgins. A large ribbed knob like this affords a good grip for smooth switching.—A. S. LONG (Horsforth).

ROUND THE WORLD OF WIRELESS

U.S.A. Television

WE are informed that as from July 1st, television broadcasting in the United States has been placed on a commercial footing by the Federal Communications Commission. The service will include the use of 525-line pictures, and the minimum programme service which each station must provide will be 15 hours per week.

Interference Suppressors in Germany

IT has been decreed by the Minister for Transportation in Germany that all new motor vehicles with combustion motors must be equipped with radio interference suppressors.

Russia's Radio Relay

RECENTLY the Russian Government ordered the surrender of all privately-owned wireless sets.

This was a precaution against enemy exploitation of the Russian system of transmitting Government instructions by wireless. Shortly afterwards, Stalin gave his powerful broadcast. How was it affected by the order? The answer is that throughout Russia there is a Government transmission received through an apparatus they term a house set, worked on the lines of the relay system. This service has not been interfered with, and the Russian Government's wireless communication with its people is maintained.

Epilogue Carried on During Blitz

MR. J. S. DE LOTBINIERE, B.B.C. West Regional director, told the story recently to the Bristol Rotarians of how the broadcast of a Sunday night epilogue was carried on during the height of a blitz.

The B.B.C. singers could not get to the studio, but Dr. J. W. Welch, Director of Religious Broadcasting; Paul Beard, leader of the B.B.C. Symphony Orchestra; and Stuart Hibberd, chief announcer, went down to a tiny underground studio made ready by engineers who were in a small emergency control room next door.

While bombs fell and anti-aircraft guns roared outside Paul Beard, kneeling down to be near the microphone, played Bach's "Air on G string" on his violin, while Dr. Welch and Stuart Hibberd sat on the floor to speak the epilogue.

Canada Calls from London

EVERY week a programme entitled "Canada Calls from London" is broadcast by the B.B.C. to Canada. This broadcasting period to Canadian listeners consists of two main features; namely, a "Newsletter in French," in which French-Canadians of all military ranks will tell Jacques DesBaillets of military life in Britain to-day; and "Canadians with Wings." This will be a weekly report on the activities of Canadians serving with the Royal Canadian Air Force and the Royal Air Force, and the broadcasts will be given in collaboration with the Canadian Broadcasting Corporation.

To Hear Their Parents

ONCE a fortnight British children evacuated to South Africa will hear their parents' voices in a new series of broadcasts in the B.B.C. South African service. Every eight weeks children will speak to the parents. The illustration on this page shows some of the parents at one of the broadcasts.

Parents in England listening to their evacuee children in South Africa during a recent broadcast.

Receiver Sales in Haiti

IT is reported that approximately 400 radio receivers were sold in Haiti during 1940, 80 per cent. coming from the U.S.A. Short-wave reception is generally good throughout the year in Haiti, but medium waves are satisfactory only from November to April.

New Woman Announcer

THE latest member of the staff of women announcers is Miss Joan Burman, the eighth woman to be officially appointed. Miss Burman was trained at the Central School of Speech and Drama in London. She will be the fifth woman war-time announcer of home programmes. Three others work exclusively for overseas programmes.

400 mc. Record

A RECENT report from America gives news of an amateur 400 mc. record of 20 miles; and a test, at five-minute intervals over a 112-mile path, on 112, 224 and 400 mc., using only 5 watts. No actual contact was made, but the 400 mc. signal was the only one to get through!

Crystal Sets Again!

THERE appears to be a growing demand for crystal sets and headphones in South Wales. Reception there with a crystal receiver is reported to be quite satisfactory, and several instances are known of such sets having been fitted up as stand-by equipment for receiving the news bulletins in case of failure of an ordinary valve receiver.

U.S. Monitoring Stations

THE United States Federal Communications Commission recently announced the establishment of "listening posts" to record, translate, transcribe and analyse short-wave broadcasts from foreign countries. These new monitoring stations are being set up on the recommendation of the Defence Communications Board.

G.M.T. from Delhi

THE four Delhi transmitters of All-India Radio now broadcast the Greenwich time signal. The B.B.C.'s transmission of the signal is received at the Delhi receiving centre and then re-broadcast. In order to cut out the B.B.C. programme when the time signal is superimposed thereon, as is sometimes the case, a filter has been incorporated in the receiving equipment which eliminates all but the frequency of the "pips."

WLW's Altered Time Schedule

STATION WLW, Cincinnati, has altered its operating times a half-hour forward, and now goes on the air at the earliest hour in its history — 5 a.m., E.S.T. The station will sign off at 2 a.m., E.S.T. Previously, the sign-on was at 5.30 and sign-off at 2.30. Under both the old and new schedules, WLW's operating span is 21 hours a day.

Radio Amateurs Wanted

MEN suitable for training as wireless mechanics are still wanted by the R.A.F. They must have a good standard of education, preferably with some knowledge of radio science—enthusiastic wireless amateurs, for example.

Telling America

WAR queries by Americans are to be answered by experts broadcasting overseas in a new weekly B.B.C. feature called "Answering You." It is expected that Sir William Beveridge, University College, Oxford, Mr. Francis Williams and Mr. T. Harrison will be among the permanent members of the Panel who will answer the American questions every Sunday at 2 a.m. (British time).

Sales of Sets in Canada

A NEW record for sales of radio sets was set up in Canada last year, the increase over 1939 being 18 per cent. The production of receivers in the Dominion increased by over 40 per cent., whilst the production of valves rose by 63 per cent. Of the 385,000 receivers sold, 57 per cent. covered the broadcast band only, whilst the remainder covered both the medium- and short-wave bands. The number of receiving licences in Canada is now well over 1,500,000.

Valve Constants and Characteristics

How to Understand and Make Use of the Data Supplied by the Valve Manufacturer

EVERY reader has heard and read of such terms as mutual conductance, amplification factor, anode resistance, anode dissipation and voltage amplification factor, but how many are completely familiar with the meanings of these expressions? It is worth while taking a little trouble to understand them, and the study of elementary valve theory can be very interesting.

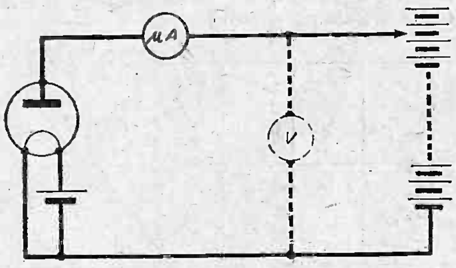


Fig. 1.—Connections to a diode used to obtain figures for plotting a graph of the type shown in Fig. 2. A micro-ammeter is used to measure anode current.

Let us start by considering the simplest type of valve—the diode. This is a valve in the true sense of the word, since it is primarily a "one-way" device, just as is the valve in a cycle tyre. If we connect a heating supply to its filament or, in the case of indirectly-heated types, the heater, and then connect a source of D.C. between the anode and cathode, a current will flow round the circuit provided that the anode is made positive with respect to the cathode. If the polarity of the voltage between the two electrodes were reversed, there would be no flow of current, the valve acting as a very good insulator.

Diode Characteristic Curves

Suppose we refer only to the first-mentioned connections and the circuit shown in Fig. 1; the current flowing round the circuit can be measured by means of the micro-ammeter shown, while the voltage between the electrodes may be measured by means of the high-resistance voltmeter shown in broken lines. If we were to vary the voltage (we may call it H.T. voltage) from zero upward, it would be found that the current shown by the micro-ammeter would rise until a certain point was reached, at which "saturation" would occur. If we were to take a careful note of the various voltage and current readings we could draw a graph similar to that shown in Fig. 2, where anode current is plotted against anode voltage. It is of passing interest to notice that the valve becomes quite a good conductor when the anode is given a positive potential. Conduction takes place between the electrodes which are in an evacuated glass bulb, and it is said that electrons (negative electric charges) are liberated by the heated cathode and are attracted toward the positively-charged anode.

The Grid in a Triode

Beyond that point we are not greatly interested in the diode, and we can deal with the more familiar triode, in which a grid is placed between the cathode and anode. We can still vary the current flowing through the circuit shown in Fig. 3 by altering the anode voltage, but we can also do so by altering the voltage or potential on the grid. Thus, if the anode voltage remained constant at any positive value we could increase the flow of electrons toward it by making the grid more positive in respect of the cathode; similarly, we could reduce the flow of electrons by making the grid more negative. It will be well to agree that in all cases the anode is more positive than the grid—as it is in practice—because if that were not the case the main electron flow would be from the cathode to the grid.

By using the simple test circuit shown in Fig. 3 we can obtain some interesting results. One of the most interesting is that the anode current is changed to a very much greater extent by altering the grid potential, or bias, by one volt than by altering the anode voltage to the same extent. In fact, it is often the case that

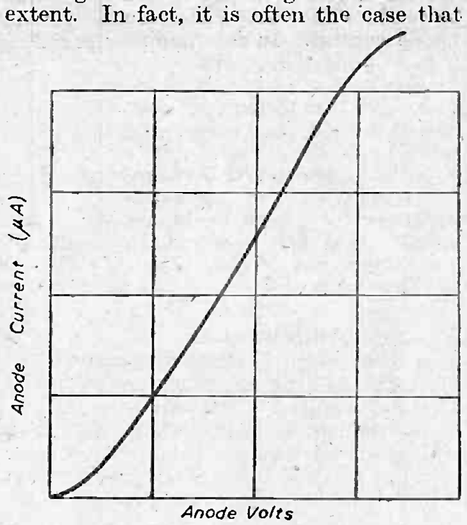


Fig. 2.—The type of anode current-anode volts curve obtained for a diode.

an alteration of one volt on the grid is equivalent, as far as anode current is concerned, to altering the anode voltage by 20 volts or more. It is not difficult to appreciate why this should be so, because the grid is much nearer to the cathode than is the anode, and all the electrons passing to the anode must pass through the grid, so that it has a far greater "controlling force."

It is the ratio of these two voltages which we describe as the amplification factor. This factor—generally indicated by the Greek letter μ—varies according to the actual anode and grid voltages applied to the valve, and therefore it is customary to give the figure applicable to an anode voltage of 100 and a grid voltage of zero.

Triode Characteristics

We will return to this factor later, but it will be better in the meantime to deal with some of the other valve constants. Fig. 4 shows a series of so-called anode current-anode volts curves which are applicable to a small battery valve of the "HL" type. It will be seen that each curve is for a given fixed grid bias from zero to $4\frac{1}{2}$ volts negative, and that the curves vary considerably according to the bias applied to the grid. From Ohm's Law we know that resistance is equal to volts divided by amps.; we can therefore find the cathode-anode resistance of the valve from these curves. Again, however, the figure is dependent upon the anode and grid volts, so it is the recognised custom to take the anode resistance, anode impedance, or internal resistance (all these names are used to signify the same property) at 100 volts anode voltage and zero grid voltage. The "shorthand" for these terms, by the way, is V_a or E_a and V_g or E_g, where the small letter set below the capital stands for anode and grid respectively. In a similar manner, anode resistance is often shown as R_a.

Finding the Anode Resistance

Referring to Fig. 4, we find the point on the $V_g=0$ curve directly above 100 volts on the lower scale and draw a straight line which is normal or tangential to the curve at that point. This line is produced to meet the two axes; at the points at which it meets them we take readings. In the example shown it will be seen that the chain line drawn meets the voltage axis at 30 and the current axis at approximately 4.8 milliamps. This tells us that, at the point chosen, a voltage of 120 (150−30) causes a current change of 4.8 mA. through the valve. The R_a of the valve in the conditions laid down above is therefore 120/4.8 multiplied by 1,000; the 1,000 is to change mA. to amps. Thus, the anode resistance of the valve represented is 25,000 ohms.

The R_a for any valve can easily be found if the anode volts-anode current curves are available, but to obtain reasonably accurate results it is necessary to have curves drawn to a large scale, or to re-draw them on a large sheet of squared paper. If these curves were not available, they could easily be drawn by using the circuit shown in Fig. 2, provided that high-grade voltmeters of very high resistance were employed.

Finding the "Slope"

There is another type of characteristic curve which is generally given in the valve-

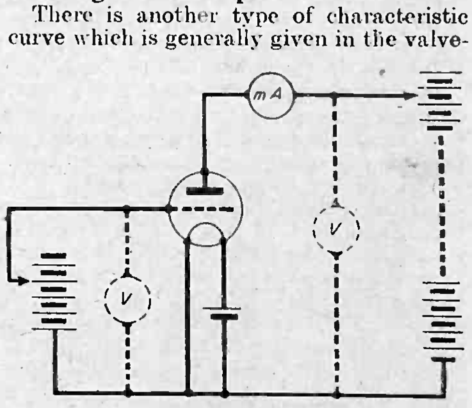


Fig. 3.—How a triode is connected for taking anode volts, anode current and grid volts figures for drawing curves of the kinds illustrated in Figs 4 and 5.

maker's literature, and which provides some very useful information. This is the anode current-grid volts curve, as shown in Fig. 5. In this case we have a number of corresponding curves, each drawn for a different value of anode voltage. Provided that there are a fair number of curves it is easily possible to plot I_a—V_g curves from I_a—V_g curves, or vice versa.

We often refer to the slope of anode current-grid volts curves, since this shows an important constant known as the

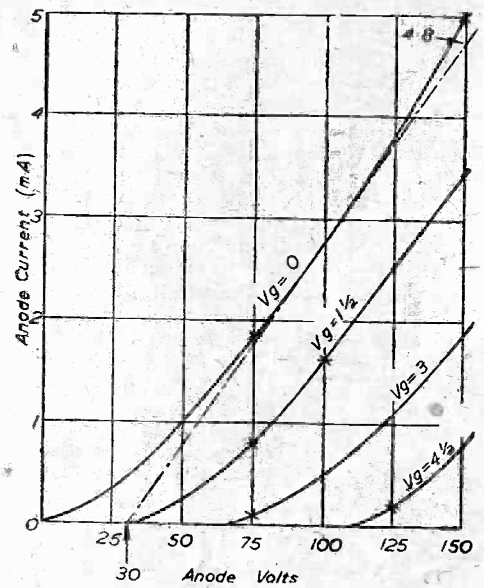


Fig. 4.—Anode current-anode volts curves for a battery triode of the "H.L." type. The chain line is used to find the anode resistance of the valve.

mutual conductance, generally abbreviated as G_m. The mutual conductance is the ratio between a very small change in anode current brought about by a very small change in grid volts, and is taken at 100 volts anode and zero grid volts. It can be obtained from the appropriate curve in Fig. 5 by drawing a normal or tangent to the 100-volt curve at the point where it crosses the zero grid-volts axis. It has been drawn as a chain line in Fig. 5.

As would be expected for the alternative name of "slope," the mutual conductance is found, after drawing the line by dividing the milliamps. indicated at one end of the line by the volts shown at the other. Actually, the line need not be drawn as long as in Fig. 5, but if it is shorter, a triangle should be drawn with the line as the hypotenuse, and the vertical height divided by the base. It can be seen from the example that, at the point defined, a change of 5.1 mA. in anode current is brought about by a change of 5.2 in grid voltage (from − 3.2 to + 2). It can therefore be seen that the mutual conductance is 5.1/5.2, or about 1.0 mA. per volt.

It was stated above that the mutual conductance is the ratio between two *very small* changes, and it may now be pointed out that the changes we have considered are by no means small. But since the straight line is normal to the curve, and since it is a ratio with which we are concerned, the result is the same. It would not be practicable to take ratios of infinitely small changes, and the most accurate results are obtained by making the line as long as possible after making quite sure that it is normal to the curve.

Micromhos or mA.-V.

Mutual conductance is sometimes—and more correctly—expressed in micromhos rather than in mA./V. The mho. is the unit of conductance, just as the ohm is the unit of resistance, and since one ohm equals one volt divided by one amp., it will be clear that one mho. is one amp. divided by one volt. One micromho is, of course, one millionth of a mho. We can therefore convert mA./V. into micromhos by multiplying the ratio by 1,000 (a million divided by 1,000 to change from mA. to amps.). The valve referred to above would thus be said to have a mutual conductance of 1,000 micromhos. The practice of giving the conductance in micromhos is chiefly confined to the conversion conductance of frequency-changers, but this term will be dealt with in the concluding article.

Amplification factor has already been referred to briefly, but having gained an impression of the meaning of internal resistance and mutual conductance we can return to this. The reason is that the amplification factor can be determined by multiplying together the R_a and the G_m of a valve. This is because the μ can be described as the ratio of the powers of the grid and anode of controlling anode current, and since mutual conductance is the ratio of anode current to grid volts, while anode resistance is the ratio of anode volts to anode current. If the two ratios are multiplied together, the expressions for anode current cancel out, leaving us with the ratio between a small change in anode voltage and the small change in grid voltage required to produce the same change in anode current. In determining the amplification factor or μ in this way it is important to remember that the current must be expressed in amps, not milliamps. For example, if a valve had a mutual conductance of 1.5 mA./V. and an anode resistance of 20,000 ohms, the amplification factor would be 1.5/1,000 times 20,000, which is equal to 30.

Voltage Amplification

A point which is often overlooked is that the amplification factor of a valve is not necessarily the amplification which the valve will give when used in any particular circuit. The actual degree of amplification is known as the voltage amplification factor or V.A.F., and its value is governed not only by the valve constants, but also by the value of the anode load. Thus, for a resistance-capacity coupled amplifier, the voltage amplification factor is found from the formula: $\text{V.A.F.} = \frac{\mu \text{ times R}}{\text{R plus R}_a}$ where R is the resistance in ohms of the anode coupling resistor. It will be clear from this that the V.A.F. is always less than μ, even if R is made infinitely large. In practice, it is desirable, where possible, to make R between four and ten times R_a. The actual value of R is largely governed by the amount of voltage which can be "spared" as voltage drop across it.

In passing, it should be noted that stage gain, or the ratio of output to input voltage is even less than the V.A.F., due to the fact that the grid condenser and grid leak in series are virtually in parallel with the anode load resistor, and that these two act as a potentiometer feeding the grid of the following valve.

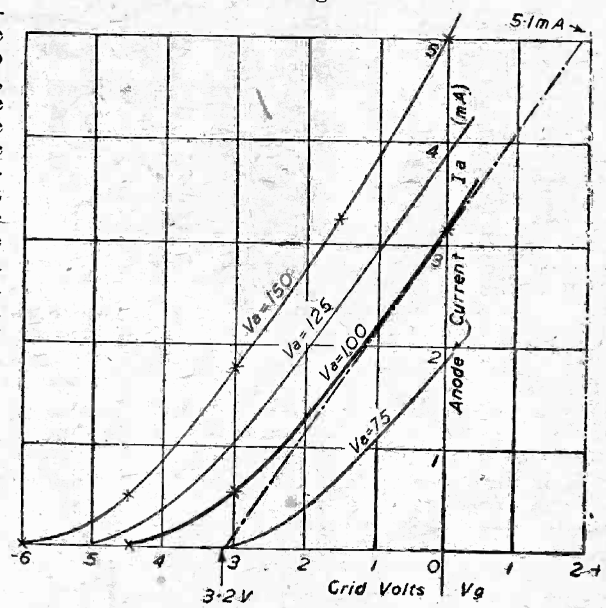


Fig. 5.—Anode current-grid volts curves for a battery triode of low mutual conductance. The latter is found by constructing a triangle as explained in the text.

Some other important valve constants will be explained in a second and concluding article.

(*To be concluded.*)

WEEK'S GOOD CAUSE RESULTS

IT is very gratifying to note that in two months listeners have raised for charitable objects over £26,790. Notwithstanding the manifold calls made at this time on the generosity of a free-giving people, the weekly B.B.C. "Good Cause" appeals still continue to find ready and generous response from listeners.

In March, as a result of five appeals, the total of £16,346 15s. 2d. was raised, and in April, four appeals produced a sum of £10,443 16s. 8d.

The one which registered greatest response was that made on March 23 by the late Lord Stamp on behalf of the National Children's Home and Orphanage. The total subscribed was £6,654 17s. 11d. This money was contributed before Lord Stamp was himself a victim of enemy action.

The next largest total recorded in this weekly appeal followed an address given by Madame Chiang Kai-Shek on April 27, supplemented by an appeal by Dr. Gordon Thompson, on behalf of the British Fund for the Relief of Distress in China. The sum received was £4,627 3s. 10d.

Dame Meriel Talbot's appeal on March 16, made in the interests of the Professional Classes and Gentlefolk placed in distressed circumstances as a result of the war, raised £3,839 15s. 3d. Next on the list comes £3,300 for the Central Council for the Care of Cripples, in whose interest an appeal was made by Emlyn Williams.

Christopher Stone on March 9 managed to obtain £2,214 19s. 5d. for "Seriously Disabled Ex-Service men of the Great War."

A sum of £1,659 15s. 11d. was raised through Cardinal Hinsley's April 6 appeal in the "Huts for the Forces" effort made by the Catholic Women's League. "Comforts for the Army," sponsored in the broadcast by Major-General Williams, raised £2,000.

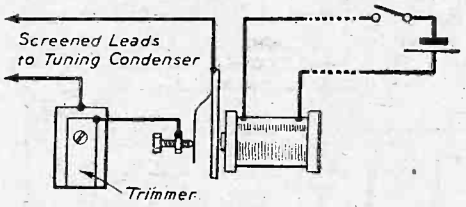
Mrs. Churchill was instrumental in bringing in £1,637 2s. 7d. to the Y.M.C.A. Fund used for the provision of huts and canteens, and the Norman Birkett appeal on April 13 produced £856 16s. 11d. for Boys' Organisations.

Practical Hints

Remote Control Switching

THE device described below was used as a remote control to change from Forces to Home Service stations. A trimmer from an old I.F. is used in conjunction with a sixpenny bell unit. The trimmer is connected so that when current is switched on at the remote control end, the trimmer is switched out of circuit.

To adjust with current on, and trimmer out of circuit, the set is tuned to the Forces programme. Switch current off (trimmer in) and adjust trimmer until set is tuned to Home Service, then by simply

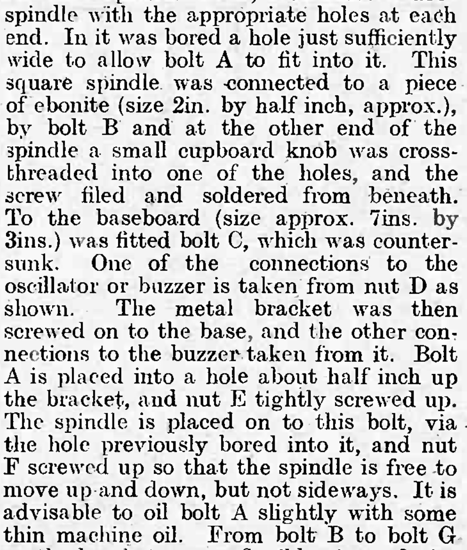


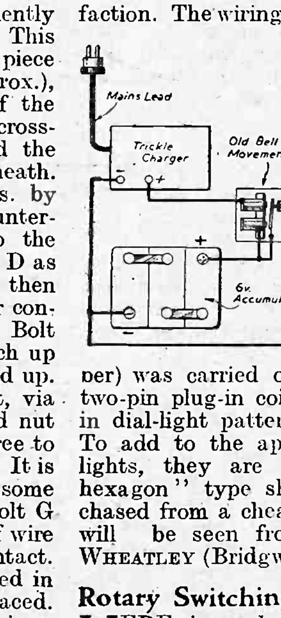
A simple remote control switching device.

switching current on and off the set is tuned from Forces to Home Service as desired. Source of current is a cycle lamp battery which I have been using for two months, and it still works well.—M. I. HENDERSON (Darlington).

A Cheap Morse Key

THE accompanying sketches give some idea of how I constructed a very efficient morse key for the surprisingly low cost of sixpence. First, I obtained a door spindle with the appropriate holes at each end. In it was bored a hole just sufficiently wide to allow bolt A to fit into it. This square spindle was connected to a piece of ebonite (size 2in. by half inch, approx.), by bolt B and at the other end of the spindle a small cupboard knob was cross-threaded into one of the holes, and the screw filed and soldered from beneath. To the baseboard (size approx. 7ins. by 3ins.) was fitted bolt C, which was countersunk. One of the connections to the oscillator or buzzer is taken from nut D as shown. The metal bracket was then screwed on to the base, and the other connections to the buzzer taken from it. Bolt A is placed into a hole about half inch up the bracket, and nut E tightly screwed up. The spindle is placed on to this bolt, via the hole previously bored into it, and nut F screwed up so that the spindle is free to move up and down, but not sideways. It is advisable to oil bolt A slightly with some thin machine oil. From bolt B to bolt G on the bracket a very flexible piece of wire is connected to ensure an efficient contact. Then, through a hole previously drilled in the ebonite, a fairly long screw is placed. Between its head and the ebonite is a spring, obtained from an old torch. Finally





A cheap morse key made from odds and ends.

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." DO NOT enclose Queries with your hints.

SPECIAL NOTICE

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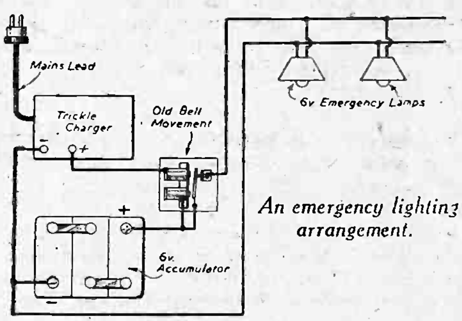
a round headed screw is placed in at an angle at the edge of the ebonite. Thus, with the aid of a screwdriver, the gap across nut D and the spindle can be adjusted to one's own requirements by this screw. Also, if the tension of the spring is too strong, the long screw enables this tension to be decreased.—D. R. TAYLOR (Hull).

Emergency Lighting

NOWADAYS, for "blitz" and other reasons, it is very desirable to have a reliable device for ensuring that one is not "left in the dark" by mains failure, or fuses blowing. The accompanying diagram illustrates a device which is giving every satisfaction. The wiring to lights (three in num-



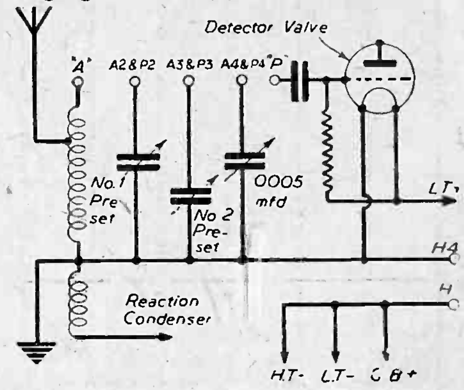
An emergency lighting arrangement.

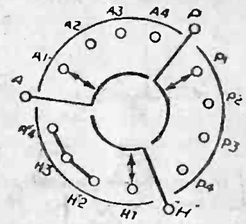
ber) was carried out with wire from old two-pin plug-in coils, and ordinary screw-in dial-light pattern 6 v. bulbs are used. To add to the appearance of the actual lights, they are housed in the "half-hexagon" type shades, which were purchased from a cheap stores. Other details will be seen from the sketch.—B. A. WHEATLEY (Bridgwater).

Rotary Switching

HERE is a dodge for converting the "Rapid Two" receiver into a pre-tuned model, by the addition of a rotary switch and two pre-set condensers.

A glance at the circuit diagram of the detector stage and the switch (inset) will show how the connections are made. The alterations shown make the set into an ideal A.R.P. model. The L.T. current, etc., is fed into one pole, which acts as on-off switch, while the other two poles are connected—one to the grid coil, and one to the grid condenser. These sections give the operator manual tuning and two stations pre-tuned, e.g., Home Service and Forces programme; the whole controlled by one spindle and without the necessity of ganged switches.





Circuit diagram and detail of rotary switch for converting an ordinary two-valver into a pre-tuned receiver.

The wire from the grid condenser to the grid coil is broken and the two ends taken to the pole feeds marked "A" and "P" respectively. The grid end of each condenser (1 variable, 2 pre-set) is taken to contacts on "A" pole and "P" pole, as shown.

There is still 1 pole and 4 ways left. To the pole feed marked "H" is attached the H.T.—, L.T.—, and G.B.+, the single-pole on-off switch being taken out of the set. The three contacts marked H2, H3 and H4 are strapped, and a lead from H4 taken to the earth line.

When each pole's switch-bar is on contact 1 (A1, P1 and H1), it will be seen that the filament circuit is broken and the grid circuit also has no connection with the grid coil or the condensers. As the switch is moved to position 2 the filament current passes to the earth line via "H" pole feed and the three strapped contacts. The first pre-set condenser is brought into circuit and the grid coil and condenser are strapped by the switch. If this condenser is tuned to the Home Service and the reaction adjusted that is one station ready tuned for immediate operation at any time.

When the switch is turned to contacts "3" the second pre-set condenser is brought into circuit, the first one being open-circuited. This second condenser can then be adjusted to the Forces wavelength.

In position 4 the two pre-sets are "open" and the variable condenser is brought in, giving the user normal manual tuning control.

It will be seen that in positions 2, 3 or 4 the L.T. circuit is still allowed to close with the earth line—H2, H3 and H4 being strapped.

The switch used for this work is a Midget Rotary Selector 3-pole 4-way switch made by Bulgins, Ltd. (list No. 203). The control is a 1½in. diameter ribbed knob (list No. K4), also made by Bulgins. A large ribbed knob like this affords a good grip for smooth switching.—A. S. LONG (Horsforth).

MODERN A.V

The Methods of Automatic Volu Suitable for Incorporation in Here Explained from the

AUTOMATIC volume control is extensively used in nearly all types of commercial superhet, but yet many home constructors appear to avoid it because they imagine that it involves "difficulties." That is not true, although there are some versions of the system which do involve the use of fairly complicated circuits; in general, however, such arrangements are suitable, or at any rate necessary, only for very advanced designs of receiver.

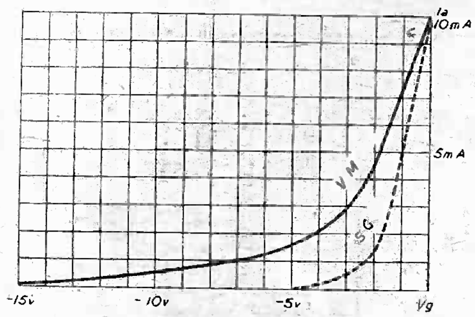


Fig. 1.—A representative Ia-V9 curve for a variable-mu valve. It shows that the "slope" is reduced with increasing negative bias. A broken line shows a corresponding curve for a "plain" S.G. type of valve.

Variable-mu Valves

It may be desirable to run over the principles of A.V.C. before considering the practical details. Automatic volume control depends essentially upon the use of high-frequency and/or a frequency-changer valve of the variable-mu type. That is, the use of valves the amplification of which can be varied over a wide range by altering the standing grid-bias applied to them. Fig. 1 shows in a very general way how a variable-mu valve operates.

This anode current grid voltage characteristic curve shows that the slope of the curve varies from almost a horizontal line at high negative grid voltages to a very steep one as zero grid voltage is approached. And since the "slope" or mutual conductance gives an indication of the gain or amplification provided, it will be seen that the gain can be controlled by controlling the applied grid voltage. For comparison, the corresponding curve for a non-variable-mu valve is shown by a broken line. In this case, anode current ceases when the negative bias reaches 5 volts; in other words, the valve is inoperative at any voltage in excess of that figure.

Cross-modulation

That is not the only failing of this type of valve, for when the grid voltage exceeds about -3, the valve is working on the lower bend of its characteristic. When that occurs the valve tends to detect instead of, or as well as, amplify. And it must be remembered that the grid voltage is not only dependent upon the D.C. bias applied to the grid, but also upon the amplitude of the signal which is fed on to its grid. Thus, on a strong signal the valve starts to detect, and distortion results.

What is perhaps a more serious fault is that a strong signal from a nearby transmitter may be detected, although the receiver is tuned to another and weaker transmission. When this happens we have what is known as cross-modulation. The effect is that the audio-frequency portion of the local-station transmitter is superimposed upon the carrier of the required station, and we have a form of interference which cannot be prevented by making the tuning circuits more selective.

Manual V.-M. Volume Control

Due to the considerably longer slope of the variable-mu valve, this form of interference cannot happen, since there is a far lesser tendency for detection to take place. All this is rather incidental to A.V.C., but it does show the desirability of using V.-M. valves in a modern receiver; they may be either V.-M. pentodes, V.-M. valves of the S.G. type, or frequency changers. When using variable-mu valves manual volume control is possible by biasing the grid through a potentiometer—in the case of battery valves—or by using a variable bias resistance in the case of indirectly heated valves. The connections for these are shown in simple form in Fig. 2.

Requirements of A.V.C.

Now let us look at the A.V.C. question. The primary object is to make provision for the output from the speaker to be maintained at a reasonably constant level regardless of the strength of the incoming signal. If this object is attained it follows that variations due to fading will automatically be "ironed out." It is probably true to say that the latter advantage is of chief importance.

How is A.V.C. obtained? By arranging that the V.-M. valves in the set (preferably the frequency changer and the I.F. amplifier) receive a negative bias which is proportional to the strength of the audio signal which constitutes the output from the second detector. Of course, the "primary" output from this stage is audio or low-frequency, which is used to operate the L.F. amplifier. But if we can rectify a portion of the output and use it as negative bias we meet the requirements set out above.

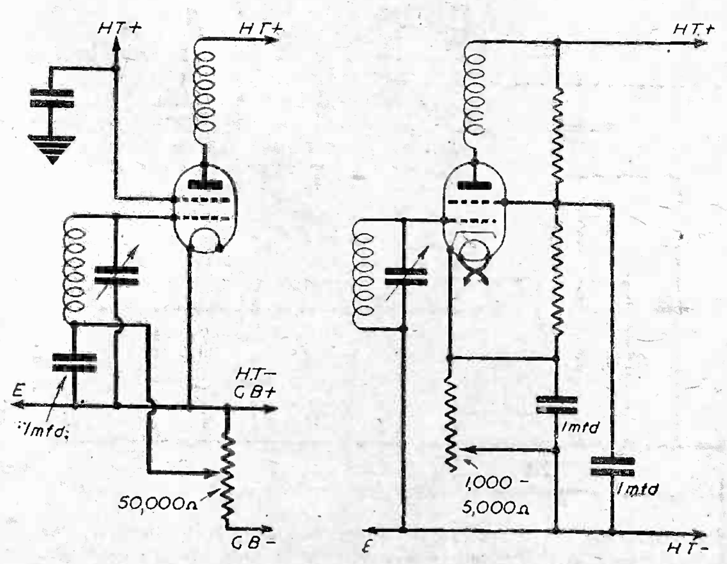


Fig. 2.—How V.-M. manual bias is normally applied to battery and mains V.-M. S.G. valves.

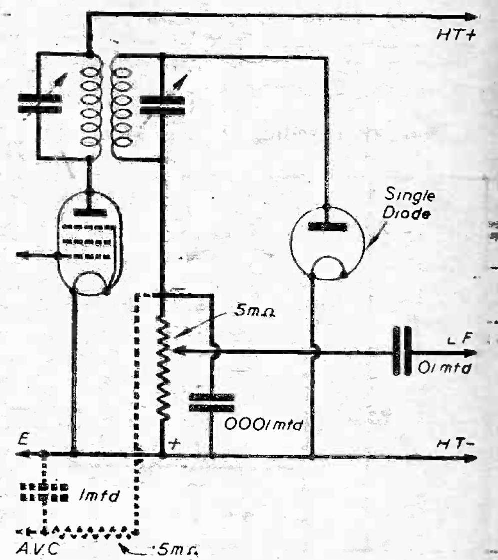


Fig. 3.—A very simple method of obtaining A.V.C. (see broken lines) when using a single diode for second detection.

The Simplest Form

When using a diode type of second detector this is easily arranged, as shown in a simplified diagram in Fig. 3. When the secondary of the last I.F. transformer is connected to the single diode as shown, there is an audio-frequency voltage developed across the .5-megohm resistor,

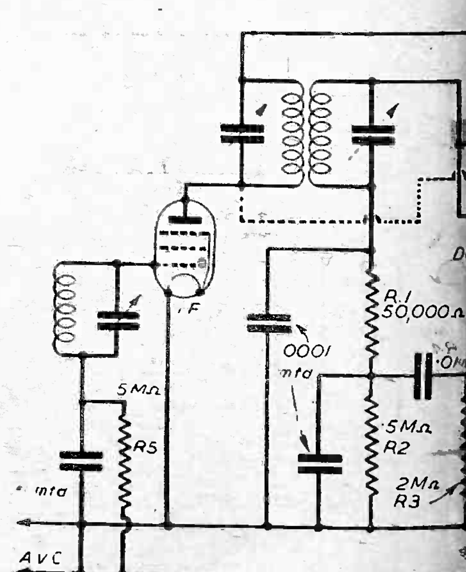


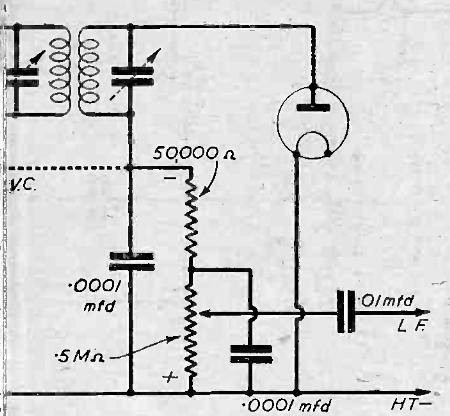
Fig. 5.—A circuit for delayed A.V.C., whe double-diode-triode wou

C. SYSTEMS

Control in General Use, and e-constructed Receivers, are actical Point of View

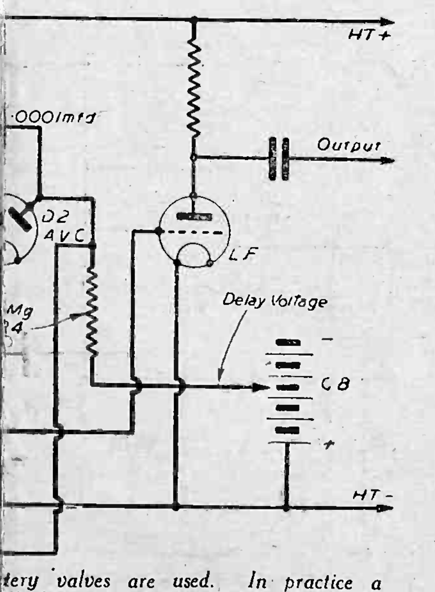
hich is known as a load resistor: it rresponds to the anode load used with a iode. As readers will remember from ementary valve theory, the diode conducts ly when the anode is made positive with spect to the cathode. Thus, each time e upper end of the I.F.— transformer condary becomes positive in respect to e lower end, electron current flows through e valve. From this it will be seen that e upper end of the load resistor becomes gative in respect of the lower or earthed d.

Therefore, after feeding the L.F. amplifier



. 4.—*A more practical form of the circuit hown in Fig. 3. It includes an H.F. filter.*

h the audio-frequency voltages developed oss the load resistor, we can smooth a rtion of the output for use as negative d bias. It is obvious that as the signal plied to the second detector increases in ength, so the negative bias voltage is reased in value. This is precisely what want. We therefore take a lead from negative end of the resistor, as shown



tery valves are used. In practice a lly be employed.

by broken lines in Fig. 3, pass the output through a smoothing system comprising a high resistance and a fairly high capacity, and use this to feed the grids of the V.-M. valves—often referred to as the "controlled" valves. This lead takes the place of the potentiometer lead shown in Fig. 1.

Checking H.F.

In practice, it is not quite satisfactory to use the simplest type of circuit shown in Fig. 3, since a certain amount of H.F. may pass into the L.F. amplifier and cause instability. We therefore use an H.F. filter consisting of a resistor of about 50,000 ohms, and a fixed condenser of .0001 mfd. or .0002mfd., as shown in Fig. 4. The A.V.C. bias is taken from the upper end of the two series resistors and fed to the controlled valves through condenser-resistor filters of the type shown in Fig. 3, using one resistor-condenser combination for each.

This is, at any rate, a workable circuit, but it suffers from one rather serious disadvantage. This is that a certain amount of A.V.C. bias is fed back to the controlled valves whenever any signal, no matter how weak, is received. As a result, weak signals are made still weaker, and therefore the advantages of A.V.C. are partially lost. What we require is a means of preventing the feed-back of any negative bias until signals of some predetermined strength are tuned in. This gives rise to the very widely-used system of "delayed A.V.C.," with which the signal must reach a certain level before additional control bias becomes effective.

Delayed A.V.C.

One method of providing for this is shown in Fig. 5, where the use of battery valves is assumed. In this case a further modification will be observed in the shape of a double-diode valve, where one diode is used for detection (D.1), whereas the second (D.2) is used only for A.V.C. Both may be fed from the same source, through a fixed condenser, as shown, and each diode has its own load resistor. Thus, in Fig. 5, R.2 is the load resistor for D.1, with R.1 as the H.F. stopper, and R.4 is the load resistor for the A.V.C diode; R.3 is merely a potentiometer volume control for varying the input to the L.F. amplifier.

It will be noticed that the lower end of R.4 is returned to a tapping point on the G.B. battery instead of to the earth line as before. Thus a small (and readily variable) bias is put on the anode of the A.V.C. diode,

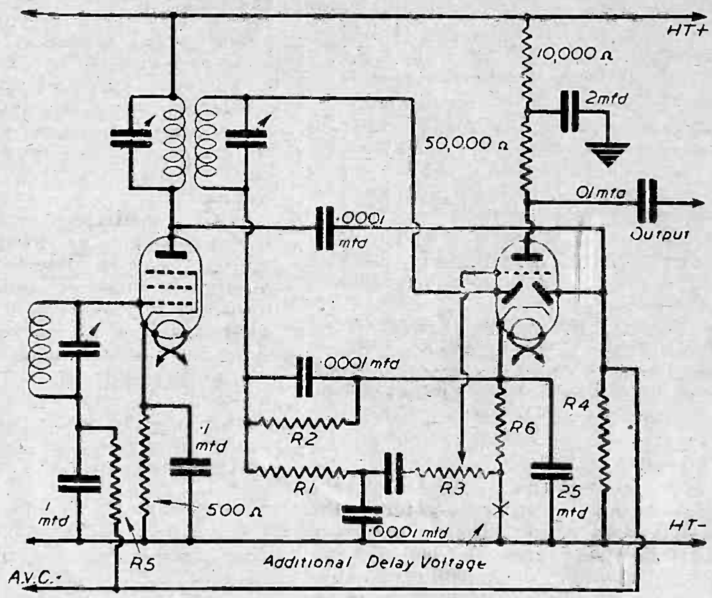


Fig. 6.—An arrangement similar in principle to that shown in Fig. 5, but using mains valves and a double-diode-triode for second detection, A.V.C. and L.F. amplification.

and until the signal voltage exceeds this figure, this portion of the double-diode valve cannot pass any current. When the signal voltage exceeds the delay voltage and the anode becomes positive, anode current flows, there is a voltage drop across R.4, and an A.V.C. voltage is applied to the controlled valves. The setting of the delay voltage can easily be done by trial, and will depend upon the number of controlled

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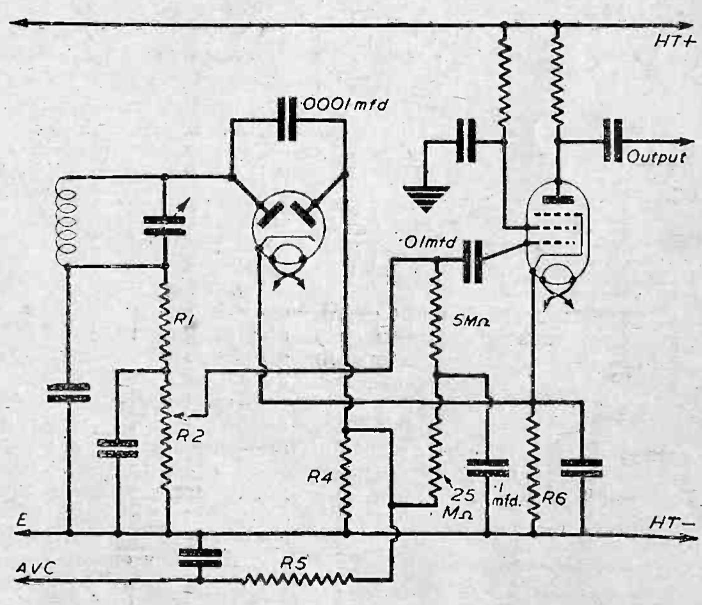


Fig. 7.—An A.V.C. circuit in which the amplification provided by the L.F. pentode is controlled to a certain extent at the same time as pre-detector stages are controlled. "Normal" bias is obtained across R6, additional bias being provided by the A.V.C. section of the D.D.T.

[MO]DERN A.V.C. SYSTEMS

(Continued from previous page)

[gi]ves and the input to the double diode. [I]n the case of a mains set the delay voltage could be obtained across a portion of a potentiometer connected across the H.T. supply, or by making use of the bias resistor of an L.F. valve, as we shall see later.

Improved A.V.C. Action

On further examination of Fig. 5 it will be noticed that the A.V.C. diode anode is shown connected to the anode of the last I.F. valve by means of a broken line. This is an alternative, and generally better connection. The advantage is that tuning is not quite as sharp at the anode as it is at the secondary of the I.F. transformer. This prevents the tendency for the A.V.C. bias to fall off immediately the receiver is slightly detuned; if it did so, full amplification would be given to the sidebands of the transmission and accurate tuning would be made more difficult. And if the set were slightly mistuned in this way, pronounced distortion would be observed.

Fig. 6 shows a more practical and usual version of the circuit shown in Fig. 5. In this case use is made of a double-diode triode valve for second detection, A.V.C. and first-stage L.F. amplification. The valve is indirectly heated, although the same arrangement could be used with a battery valve. This circuit is, in all its essentials, the same as that in Fig. 5, except that the delay voltage is obtained across the usual cathode biasing resistance which serves to bias the triode L.F. amplifier. Additionally, however, another resistor could be wired in series at the point marked with a cross if extra delay voltage were required. The value of R.6 is, of course, dependent entirely upon the valve used, and is generally in the region of 1,000 ohms. The bias voltage is normally about 3, which is generally correct for the delay. In passing, it should be noted that in this example the delay voltage is obtained by making the cathode positive in respect to the A.V.C. anode; this has exactly the same effect as making the anode negative.

Controlling L.F. Amplification

One other slight objection to A.V.C. is that variations in volume may occur due to the larger output from the diode detector, on strong signals being applied to the L.F. amplifier. One remedy for this is to apply A.V.C. voltages to the first L.F. stage, as well as to the H.F., F.C. and I.F. stages. A method of doing this when using a pentode first L.F. amplifier is shown in Fig. 7. In practice, use would probably be made of a double-diode pentode, but the circuit given is slightly easier to follow than it would be if that type of valve were shown, due to its being rather more "open." It will be seen that both audio, from the second-detector diode, and A.V.C. are fed on to the control grid of the pentode, which receives its normal fixed bias through R.6.

For ease in following the circuits given, the same resistor reference numbers are allocated to corresponding resistors in Figs. 5, 6 and 7. It should be appreciated that all values given are average ones, and may require to be slightly modified for certain valves. Makers generally state the values recommended, however, on their literature, so this should not cause any misunderstanding.

In addition to the forms of A.V.C. described, and which are widely used, there is another known as "amplified" A.V.C. But since this is normally used only on the most elaborate of receivers, and where a large H.T. voltage is available, it need not be discussed here. Actually, the H.T. voltage required is about 100 volts greater than that taken by the valves themselves.

B.L.D.L.C. The British Long-Distance Listeners' Club

More Notes on Members' Activities

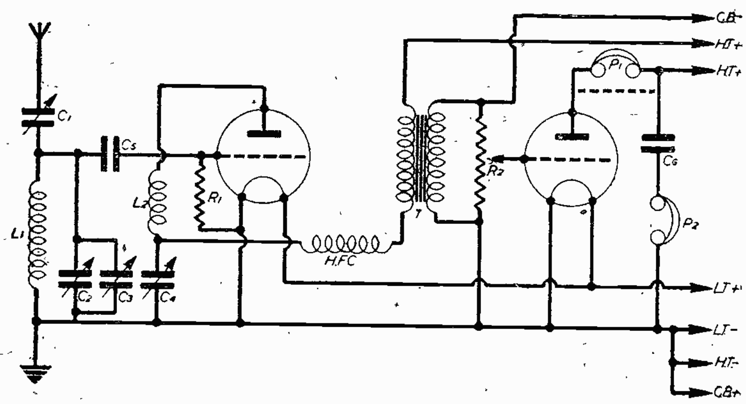
A Two-valve Short-waver

HERE is a note from member 462, describing his 2-valve short-wave set, which should prove of particular interest to beginners.

"As an old member of the B.L.D.L.C. I have pleasure in presenting an unusual type of short-wave receiver. It can be built for either mains or battery operation. I prefer the battery type, as below 15 metres there is no mains hum. In the accompanying diagram I have shown both positions of the 'phones, P1 is for battery and P2 for mains. Battery bias was used in both cases.

"For the mains version I used a metallised M.H.L. detector and a plain M.H.4 for output, as these were the only two valves I had, with cathode to earth in both.

"The unusual part of the circuit is the reaction. It will be seen that it departs from the usual practice of the H.T.1



Circuit diagram of V. H. Thomas's two-valver.

C1=.00005 mfd.	C6=2 mfd.	P2='Phones for mains version.
2=.0001 mfd.	R1=3 MΩ.	L1=Grid coil for band in use.
3=.000015 mfd.	R2=100,000Ω.	L2=Plate coil for band in use.
4=.0001 mfd.	T =L.F.T. (Cossor 3 : 1)	
5=.0001 mfd.	P1='Phones for battery version.	

feeding the transformer and through the H.F.C. to the plate and the reaction condenser at the earth end of the coil; it is fed through the transformer to H.F.C. through the reaction coil and to the plate, and the condenser moving vanes are at earth potential. This makes reaction very smooth indeed.

"*Winding the Coils.*—The grid coils are constructed from 18-gauge enamelled wire and are shown in a table of coil values given in PRACTICAL WIRELESS dated July 24th, 1937. The reaction or plate coils are two-thirds of the amount of turns as the grid coils. They are on 1½in. formers and plug into a 4-pin valve holder.

"I think that this receiver is what is needed for newcomers to the S.W. bands as it is easy to build either baseboard or chassis type. I have made it both ways and strangely enough the baseboard type gives better results for the battery version, and the chassis version better results for mains operation.

"I have had a lot of S.W. receivers, but this one has surpassed them all—including American superhets—as it is so quiet in operation and so easy to handle."

Hotting-up Experiments

MEMBER 7,001 writes as follows:

"Many thanks for membership certificate for B.L.D.L.C. I will inform you of my experiments, etc., in the near future. At the present I am building a single-valve short-wave set using H.F. pentode, and am hotting it up to get the most out of it.

"Before the war I was the holder of an A.A. licence and just about ready for my full ticket, so you will understand my disappointment. I am now concentrating on receivers with a view to getting the best out of them and when the war is over I hope to go on the air as a fully-licensed operator."

News from India

MEMBER 6,892 (H. G. Baker), who is a signalman, stationed in India, sends the following interesting letter:

"Very many thanks for the membership card, for the B.L.D.L.C. and letter; also for insertion of my request for correspondents. Although I am writing this at my old Q.R.A., i.e., W/T Stn., I have given you my new Q.R.A. in case I have moved out by the time you receive it.

"I shall be forwarding a report of my activities, at a later date, and sincerely hope it will contain something of interest to readers. My spare-time is very short nowadays, but I will do my best. I'll ask Reg. Fox, AC4YN, to help, now that he is on the air again, as I work him every day for a weather report."

Contacts Wanted

MEMBER 7,007—J. Dibben, Pilton, St. Michaels Road, Wareham, Dorset—wishes to get in touch with a young member who is interested in S.W. work, and also MW and DX reception.

Member 6,770—D. Cox, 25, Carnarvon Road, West Bridgford, Nottingham—wishes to correspond with any reader overseas.

Problems of Amateur Receive

Operating Battery Sets from the Mains ; Combined H.T. and L.T. Trickle Chargers

By FRANK PREST...

LAST month the more conventional methods of supplying power to a battery receiver were discussed. It was shown, however, that dry high-tension batteries are not usually economical when the H.T. current is in excess of, say, 20 mA ; even for lower current ratings, it is generally more satisfactory and less expensive in the long run to adopt other means of obtaining the H.T. current.

H.T. Accumulator Units

High-tension accumulators are suitable for discharge rates up to 50 mA or so, but have the disadvantage that charging often presents a difficulty. Milnes units—banks of nickel-alkali-type cells—are in many respects more convenient than the usual type of lead-acid H.T. accumulator, in that they can be charged from a standard six-volt accumulator. And it is obviously easier to have an accumulator of this type charged. In addition, it is less bulky and easier to transport to the charging station, even if provision for charging is not available in the home.

There are three main types of Milnes H.T. unit, for maximum discharges of 60, 30 and 15 mA respectively. All three are particularly trouble-free and, in general, more convenient than lead-acid types. They have the disadvantage over dry batteries of being rather expensive in first cost; running costs, however, are very small. The principal feature of these units is that they are built into 120-volt assemblies and have a special switching system whereby all the cells may be in series (supplying 120-volts) or in series-parallel for charging from a six-volt supply.

Mains-operated Eliminators

It is not proposed to deal further with the supply of H.T. from accumulators, but instead to explain some methods of taking the high-tension current from the mains. It has never been the policy of this journal to recommend the use of battery sets when a mains supply is available, but there are many readers who, for their own reasons, still prefer to build battery sets. In any case, there is no difficulty in obtaining current supply from the mains, provided that reasonable precautions are taken and that the design of the eliminator is suitably worked out in the first place.

We may start by looking at the question from the point of view of the reader who is "on" D.C. As far as H.T. is concerned, all that he needs is a suitable means of smoothing the supply—which has a superimposed ripple which would cause hum—and of cutting down the voltage to that required by the receiver. For smoothing, an iron-cored choke and a couple of large-capacity condensers will suffice, while the inclusion of a resistor will permit of the voltage being dropped to the maximum of 150, which is usual with battery valves.

A.D.C. Eliminators

A circuit for an eliminator is given in Fig. 1, although this also includes provision for charging the two-volt accumulator. The lamp and on-off switch shown toward the right of the diagram may be ignored for a moment while we look at the H.T. supply portion. First, we have two fuses rated at .5 amp., one in each mains supply lead, for safety. Then we have a change-over switch, which should be of the standard Q.M.B. type. This is followed by a smoothing choke marked as having an inductance of 30 henries, and by a voltage-dropping resistor. Across the feed we have a couple of 4-mfd. smoothing condensers, which should be of the paper-dielectric type ; a third condenser is shown in broken lines, and although it is not essential, it does help still further in ensuring that the supply is really well smoothed. It may be omitted when the unit is first made, and then added later if it is found that some additional smoothing is required. This depends to a large degree on the nature of the mains supply.

It will also be observed that a 1-mfd. condenser is connected between the negative line and an earth lead. Actually, the earth lead from the receiver should be transferred to this new position. The purpose of the condenser is to prevent any possibility of short-circuiting the mains if the mains plug is inserted wrong way round or if the positive main should be earthed at the supply.

Component Specifications

All condensers should be suitable for a working voltage of not less than 250, whilst the choke should possess a rated inductance ...r the region of 30 henries when carrying the total H.T. current required by the receiver. The purpose of the fixed resistor is to cut down the supply voltage, and its value and wattage rating will depend upon the mains voltage and the current required.

The resistance value can easily be found from Ohm's Law, by dividing the voltage to be dropped by the current *in amps.* Thus, if the supply voltage were 230, and were to be cut down to 150, at 20 mA, the resistor should have a value of 4,000 ohms. For 40 mA in the same conditions the value would be 2,000 ohms. The wattage rating is determined by multiplying the square of the current *in amps.* by the value of the resistor. Thus, in the first case considered, the rating should be 20/1,000 times 20/1,000 times 4,000, which is 1.6 watts. Consequently, a standard 2-watt resistor would be chosen. In the second case use could be made of a four or five-watt resistor of 2,000 ohms, or of two 4,000-ohm, 2-watt resistors in parallel.

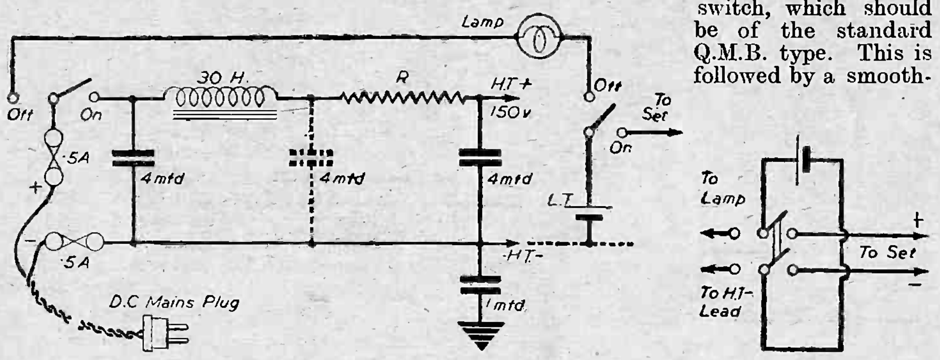


Fig. 1.—Circuit for a D.C. eliminator and trickle charger. Inset are shown alternative connections for the battery-charging switch.

Correct Polarity

The mains plug would, of course, be of a type to suit an existing power or lighting point, and it should be connected to the power unit by means of good-quality lighting flex. Since the correct polarity must be obtained on D.C. working it may be necessary to reverse the plug in its holder when first trying out the eliminator, which will not operate the set if the polarity is wrong. Once that has been done it is worth while to mark the plug so that it can be inserted correctly at any future time. In the case of a three-pin plug, which is to be preferred, the leads should be reversed if they are found to be wrong.

Trickle Charging

Accumulator charging from D.C. is never an economical proposition when only a single accumulator is to be charged from, say, 230-volt mains. This is because 228 volts is wasted. Nevertheless, the convenience of the arrangement may be considered worth while, especially when current is bought cheaply. Trickle-charging can be carried out very simply by inserting any ordinary electric lamp—which serves as a voltage-dropping resistor

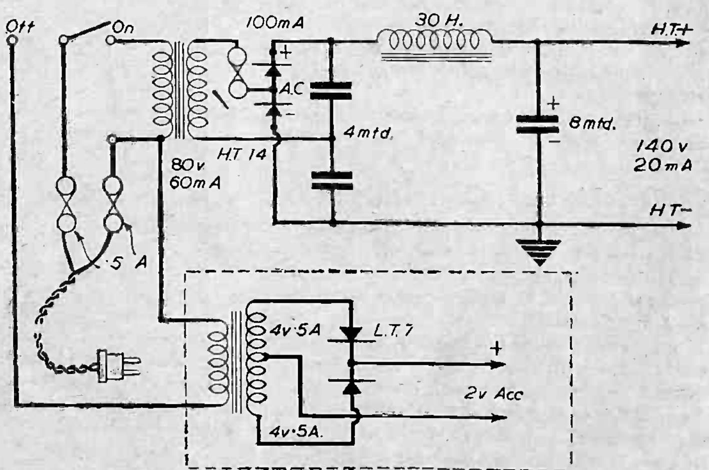


Fig. 2.—A combined H.T. eliminator and trickle charger for A.C. mains. If not required, the trickle-charger portion (enclosed by a broken line) may be omitted.

—in series with the accumulator, as shown in Fig. 1. When using a 60-watt lamp the charging rate will be about .25 amp., which is generally adequate if the battery is charged at all times when the set is out of use. In fact, if the L.T. current taken is not more than about .25 amp. it will be sufficient to use a 25-watt or 40-watt lamp. When the L.T. load is more than .5 amp. it might be necessary to use a higher-wattage lamp to ensure that the battery is always fully charged. For a charging rate of about .4 amp. a 100-watt lamp will serve, while a 150-watt lamp will charge at around .6 amp. It may be considered more convenient to use a larger lamp and to charge the battery overnight only once every few days. That is a matter which can best be settled by the individual, once he appreciates the simple principles involved.

Provided that L.T.— is connected to the earth line in the receiver and that the on-off switch is in the positive lead, it will be sufficient to fit a switch in an additional positive lead only, as shown. Where the connections are otherwise it will probably be better to use a double-pole change-over switch, connecting the centre pair of terminals to the battery, one pair of outer terminals to the set and another pair to the mains supply, as shown inset in Fig. 1.

Correct Sequence of Switching

In using any eliminator, always switch on the filaments before switching on the H.T., by means of the mains switch indicated; and always switch off the H.T. before switching off the L.T. When employing an arrangement such as that under discussion the method is first to switch the charging switch to the "on" position, and then to move the H.T. switch to the "on" position; the switch on the set may be left "on." When the set is to be switched off, turn off the H.T. switch and then turn the charge switch to the "off" position if the accumulator is to be put on charge.

A.C. Eliminator and Charger

A.C. mains are more usual than D.C., but the necessary eliminator is slightly more complicated due to the fact that a mains transformer and rectifier are required to step down the mains supply and to convert the A.C. into D.C. Fig. 2 shows a convenient type of circuit where provision is also made for charging the accumulator from a separate transformer and rectifier. The H.T. mains transformer should, of course, be chosen to suit the rectifier to be used, and in Fig. 2 it is assumed that a Westinghouse type H.T. 14 metal rectifier is to be used connected in a voltage-doubler circuit. This provides a maximum output of 140 volts, 20 mA, and the necessary transformer has a secondary wound to provide 80 volts at 60 mA.

Alternative Outputs

Two condensers are required in the voltage-doubler circuit, and these should be of the paper type and need have a working voltage of no more than 200. In addition there is a large smoothing condenser which should, for convenience and economy be of the electrolytic type rated at not less than 350 volts working. If greater H.T. outputs are required alternative rectifiers will be required and the transformer secondary should have an output appropriate to the rectifier chosen. Thus, the following rectifiers used as voltage-doublers (this arrangement is preferred owing to the greater ease of smoothing and lower transformer secondary voltage) require transformers with outputs as stated: H.T.15 for 230 volts, 30 mA—140 volts, 120 mA; H.T.16, for 330 volts, 60 mA—240 volts, 200 mA; H.T.17 for 225 volts 100 mA—150 volts, 300 mA. In the last-mentioned case only the series condensers for the voltage-doublet circuit should have a capacity of 8 mfd. In all cases the voltage-doubler condensers should have a working voltage of two to three times the voltage of the transformer secondary, while the smoothing condenser should be rated at twice to three times the maximum H.T. voltage.

A.C. Trickle Charging

A very economical method of accumulator trickle charging is possible with A.C., since a transformer can be used to step down the mains voltage to that required to operate a 2-volt output metal rectifier. The L.T. transformer shown in Fig. 2 has a centre-tapped secondary, each half of which should give 4 volts at .5 amp. The output from the L.T.7 rectifier shown is 2 volts at .25 amp. The single-pole change-over Q.M.B. switch shown serves to switch on the H.T. unit (in the "on" position) or to bring the accumulator on charge (in the "off" position). If it is not required to charge the accumulator at any time when the receiver is out of use the two transformers can be disconnected by switching off the wall switch or removing the mains plug. As with a D.C. eliminator, switch the L.T. on before the H.T. and off after the H.T. It is not strictly necessary to disconnect the accumulator from the set while it is on charge, but some readers may prefer to do so since the voltage will be slightly in excess of normal while the accumulator is still on charge.

Mains units for A.C. receivers, and power supply for A.C./D.C. receivers will be explained in a later article of this series.

ITEMS OF INTEREST

Ediswan Home Guard

GENERAL SIR PETER STRICKLAND, K.C.B., recently inspected "A" Company, of the 27th Middlesex Battalion, The Home Guard, at the Ponders End Works of The Edison Swan Electric Co., Ltd. Sir Felix J. C. Pole (Chairman of Associated Electrical Industries, Ltd.) was among those present.

The 27th Middlesex Battalion of the Home Guard is recruited from factories in the vicinity of Enfield and Ponders End, and the Ediswan factory has furnished the full complement of men of No. 2 Platoon, "A" Company. After inspecting the Guard of Honour drawn up at the works gate, General Strickland was joined by Lieut.-Colonel R. M. Hawkins, commanding the 27th Battalion, and Major J. H. W. Morgan, commanding "A" Company, who accompanied him to the parade ground.

Indian Literary Competition

THE B.B.C. is inviting its listeners in India to write short articles in English or Hindustani (Urdu or Hindi script) of not more than 18,000 words—or poems of not less than twenty lines (ten couplets) in Hindustani (Urdu or Hindi script), on any one of the following subjects: Democracy; Dictatorship; Communal Unity in India; Pen Pictures of a Soldier. The B.B.C. offers a prize of £15 for the best article and £15 for the best poem. Contributions must be original and should reach the Indian Section of the B.B.C. by October 1st, 1941.

New Signature Tune for the B.B.C.'s Empire Service

AS a regular and most popular broadcaster to the Empire, Big Ben has now a rival in the band of the Grenadier Guards. "The British Grenadiers," a marching tune known all over the world, has become a signature tune for the B.B.C.'s Empire Services. A recording specially made for the purpose by the Grenadier Guards Band now introduces each of the transmission periods of the day's broadcasting, and each of the announcements periods, "London Calling." In all, "The British Grenadiers" is heard by overseas listeners ten times each weekday and seven times on Sundays.

Used not only by the Grenadier Guards, but by all the Fusilier Regiments, the Royal Artillery and the Royal Engineers, the origins of the march are obscured by its age—both author and composer are unknown. There are six verses in all.

Inspection of Home Guard by General Sir Peter Strickland.

Noise Suppression

Various Arrangements for Dealing with the Problem are Described in This Article

MODERN broadcast receivers capable of considerable sound output, and having a wide frequency response, are liable to reproduce transient or static crash impulses at uncomfortably high volume levels, and the purpose of the present article is to describe some arrangements by which such effects may be mitigated. The arrangements to be described operate by controlling the length of the load line of the output valves of the amplifier.

Since the potential drop across the biasing resistance in the cathode lead of an amplifying valve varies in direct proportion to the anode current, the curve AC of Fig. 1 represents the locus of the grid biasing potentials as a function of the anode potential. The lines EF, E'F', etc., represent the load lines, the slope of which is a function of the output-circuit impedance determined by the particular valve employed. The anode swing of the valve is limited to the length of the line EF, E'F' (the length of which is a function of the anode potential) being limited at the abscissa axis by the anode-current cut-off, and at the line AB by grid current. Thus, the length of the load line may be controlled by adjusting the anode voltage.

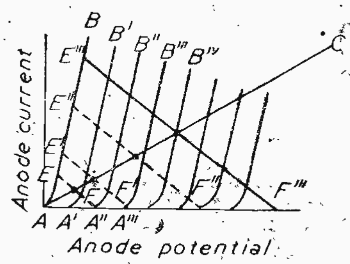


Fig. 1.—(Left) Anode current-potential curve.

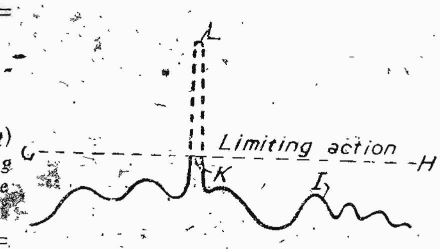


Fig. 3.—(Right) Curve representing amplitude of noise impulse.

L.F. Amplifying Stage

Referring now to Fig. 2, a conventional diode rectifier and low-frequency amplifying stage is shown, and it will be evident that by changing the value of the anode circuit resistance 1, the potential supplied to the anode 2 may be adjusted at will to control the length of the load line EF, E'F', etc., and so limit the maximum amplitude of signal or noise oscillations.

In Fig. 3 the broken line GH represents the maximum amplitude which signal or noise oscillations may have for a particular value of the anode resistance 1. If the amplitude represented by the line GH is so high that the signal oscillations, the envelope of which is represented by the solid line I, do not exceed the amplitude GH, then the signal oscillations will be reproduced in the output circuit. When, however, the input contains a transient noise impulse represented by the curve L, the maximum amplitude of the noise impulse occurring in the output circuit is limited to the amplitude GH as shown at K. If it were not for the amplitude limiting connection the noise impulse would have an amplitude L.

The adjustable tapping 3 on the diode load resistance is ganged with the adjustable contact arm 4 of the anode resistance 1, so that movement of the tapping 3 to the upper end of the diode-load resistance to increase the audio output of the amplifier, is accompanied by a corresponding decrease in the value of the anode resistance 1 to effect an increase in the potential supplied to the anode 2 of the amplifier 5. The length of the load line EF is thus automatically increased as the strength of the signal oscillations supplied to the control grid of the amplifier is increased. Where the received signal is subject to fading, the automatic volume control of any preceding HF amplifier should have a flat characteristic for optimum noise reduction.

Automatically-operating Circuits

Figures 4, 5 and 6, show automatically-operating circuits. An output amplifier stage in Fig. 4 is constituted by push-pull connected valves 6 and 7, the cathodes of which are connected to the negative terminal 8 of the anode potential supply

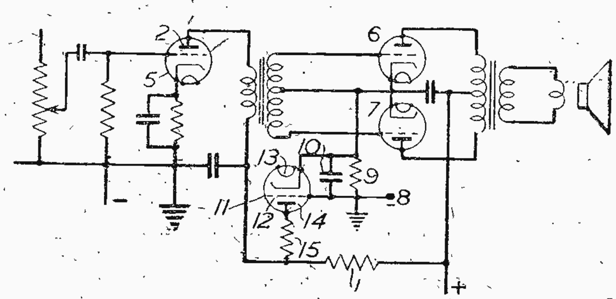


Fig. 4.—Circuit diagram of an output amplifier stage.

through a resistance 9 which is shunted by a condenser 10 having a capacity to provide a low impedance in comparison to that of a resistance at twice the lowest audio frequency supplied to the amplifier, and yet to have a high impedance at syllabic frequencies. By syllabic frequencies are meant that range of frequencies from zero to approximately 30 c.p.s which is the frequency range of the occurrence of

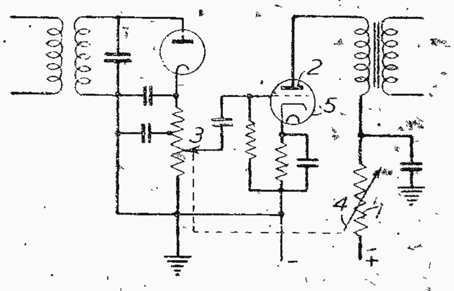


Fig. 2.—Circuit diagram of a diode rectifier and L.F. amplifier stage.

syllables in ordinary speech. An additional valve 11 has its control grid 12 and cathode 13 connected across the terminals of the resistance 9 and the anode 14 is supplied through the resistance 1 and the resistance 15.

Bias Control

In operating the arrangement shown in Fig. 4, the potential across the resistance 9 has a D.C. component and an A.C. component of syllabic frequency. This potential controls the bias of the grid 12 and thus controls the anode current.

The valves 6 and 7 are connected as a Class-B power amplifier, the anode current of which increases approximately linearly with increases of input signal strength. At low signal strength the average anode current is relatively small, and the control grid 12 consequently has a small negative bias. The anode current of the valve 11 at this instant is relatively large, and in flowing through resistance 1 produces a large voltage drop which in turn greatly reduces the potential supplied to the anode 2 of the valve 5. The length of the load line EF (Fig. 1) for the valve 5 is, therefore, greatly decreased during periods of low signal strength. The reduction of the permissible anode swings is thus effected automatically.

As the strength of the audio signal increases, the anode current of valves 6 and 7 also increases, giving an increased drop across resistance 9, and causing an increase in the negative bias potential applied to the grid 12. The consequential decrease in anode current of the valve 11 results in a decrease in the drop across the resistance 1 so that the potential on the anode 2 is increased giving a longer load line EF for the valve 5.

(Continued on page 374)

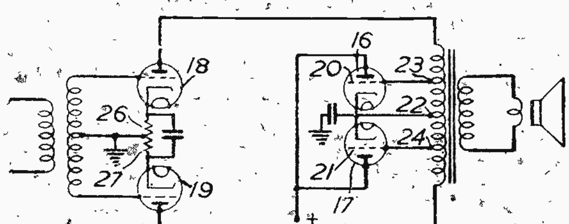


Fig. 5.—An automatically-operated output circuit.

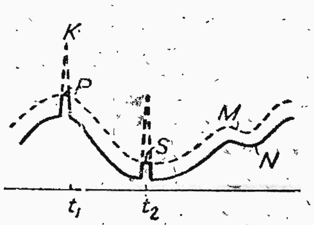


Fig. 7.—Graph representing maximum amplitude of oscillations.

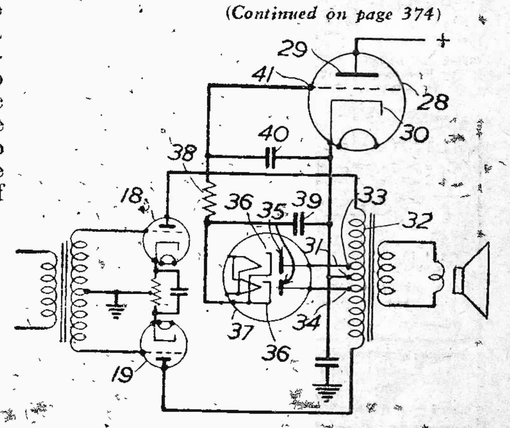


Fig. 6.—A modification of the circuit given in Fig. 5, showing how a high-mu valve is incorporated.

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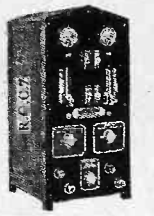

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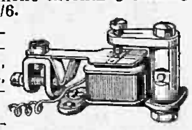

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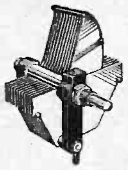

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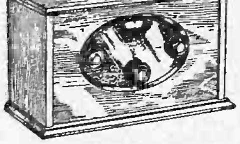

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Noise Suppression

Various Arrangements for Dealing with the Problem are Described in This Article

MODERN broadcast receivers capable of considerable sound output, and having a wide frequency response, are liable to reproduce transient or static crash impulses at uncomfortably high volume levels, and the purpose of the present article is to describe some arrangements by which such effects may be mitigated. The arrangements to be described operate by controlling the length of the load line of the output valves of the amplifier.

Since the potential drop across the biasing resistance in the cathode lead of an amplifying valve varies in direct proportion to the anode current, the curve AC of Fig. 1 represents the locus of the grid biasing potentials as a function of the anode potential. The lines EF, E'F', etc., represent the load lines, the slope of which is a function of the output-circuit impedance determined by the particular valve employed. The anode swing of the valve is limited to the length of the line EF, E'F' (the length of which is a function of the anode potential) being limited at the abscissa axis by the anode-current cut-off, and at the line AB by grid current. Thus, the length of the load line may be controlled by adjusting the anode voltage.

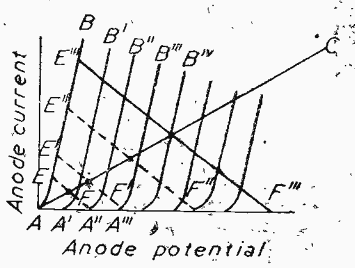
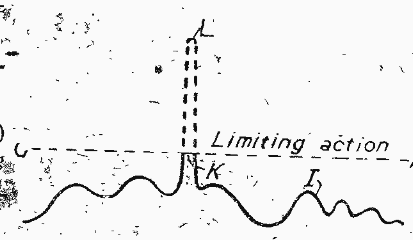


Fig. 1.—(Left) Anode current-potential curve.

Fig. 3.—(Right) Curve representing amplitude of noise impulse.



L.F. Amplifying Stage

Referring now to Fig. 2, a conventional diode rectifier and low-frequency amplifying stage is shown, and it will be evident that by changing the value of the anode circuit resistance 1, the potential supplied to the anode 2 may be adjusted at will to control the length of the load line EF, E'F', etc., and so limit the maximum amplitude of signal or noise oscillations.

In Fig. 3 the broken line GH represents the maximum amplitude which signal or noise oscillations may have for a particular value of the anode resistance 1. If the amplitude represented by the line GH is so high that the signal oscillations, the envelope of which is represented by the solid line I, do not exceed the amplitude GH, then the signal oscillations will be reproduced in the output circuit. When, however, the input contains a transient noise impulse represented by the curve L, the maximum amplitude of the noise impulse occurring in the output circuit is limited to the amplitude GH as shown at K. If it were not for the amplitude limiting connection the noise impulse would have an amplitude L.

The adjustable tapping 3 on the diode load resistance is ganged with the adjustable contact arm 4 of the anode resistance 1, so that movement of the tapping 3 to the upper end of the diode-load resistance to increase the audio output of the amplifier, is accompanied by a corresponding decrease in the value of the anode resistance 1 to effect an increase in the potential supplied to the anode 2 of the amplifier 5. The length of the load line EF is thus automatically increased as the strength of the signal oscillations supplied to the control grid of the amplifier is increased. Where the received signal is subject to fading, the automatic volume control of any preceding HF amplifier should have a flat characteristic for optimum noise reduction.

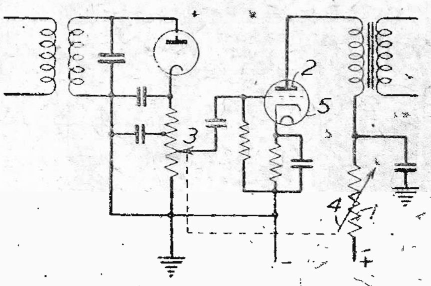


Fig. 2.—Circuit diagram of a diode rectifier and L.F. amplifier stage.

Automatically-operating Circuits

Figures 4, 5 and 6, show automatically-operating circuits. An output amplifier stage in Fig. 4 is constituted by push-pull connected valves 6 and 7, the cathodes of which are connected to the negative terminal 8 of the anode potential supply through a resistance 9 which is shunted by a condenser 10 having a capacity to provide a low impedance in comparison to that of a resistance at twice the lowest audio frequency supplied to the amplifier, and yet to have a high impedance at syllabic frequencies. By syllabic frequencies are meant that range of frequencies from zero to approximately 30 c.p.s which is the frequency range of the occurrence of syllables in ordinary speech. An additional valve 11 has its control grid 12 and cathode 13 connected across the terminals of the resistance 9 and the anode 14 is supplied through the resistance 1 and the resistance 15.

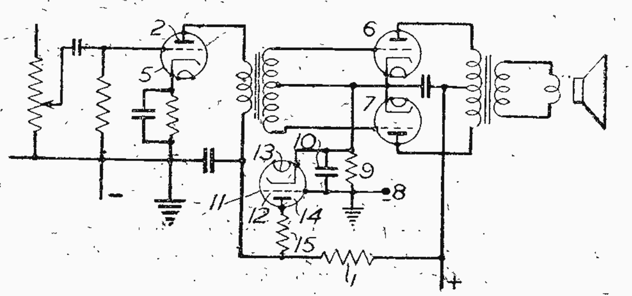


Fig. 4.—Circuit diagram of an output amplifier stage.

Bias Control

In operating the arrangement shown in Fig. 4, the potential across the resistance 9 has a D.C. component and an A.C. component of syllabic frequency. This potential controls the bias of the grid 12 and thus controls the anode current.

The valves 6 and 7 are connected as a Class-B power amplifier, the anode current of which increases approximately linearly with increases of input signal strength. At low signal strength the average anode current is relatively small, and the control grid 12 consequently has a small negative bias. The anode current of the valve 11 at this instant is relatively large, and in flowing through resistance 1 produces a large voltage drop which in turn greatly reduces the potential supplied to the anode 2 of the valve 5. The length of the load line EF (Fig. 1) for the valve 5 is, therefore, greatly decreased during periods of low signal strength. The reduction of the permissible anode swings is thus effected automatically.

As the strength of the audio signal increases, the anode current of valves 6 and 7 also increases, giving an increased drop across resistance 9, and causing an increase in the negative bias potential applied to the grid 12. The consequential decrease in anode current of the valve 11 results in a decrease in the drop across the resistance 1 so that the potential on the anode 2 is increased giving a longer load line EF for the valve 5.

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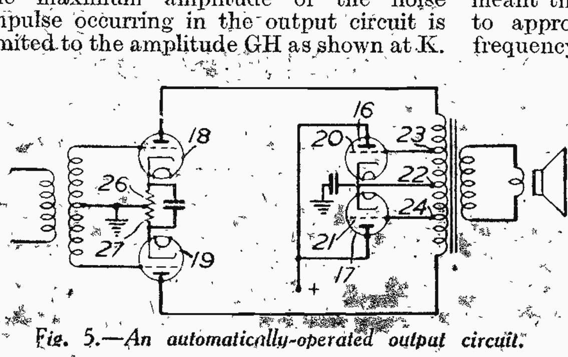

Fig. 5.—An automatically-operated output circuit.

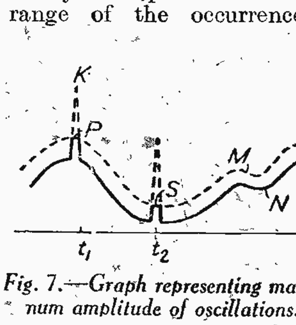

Fig. 7.—Graph representing maximum amplitude of oscillations.

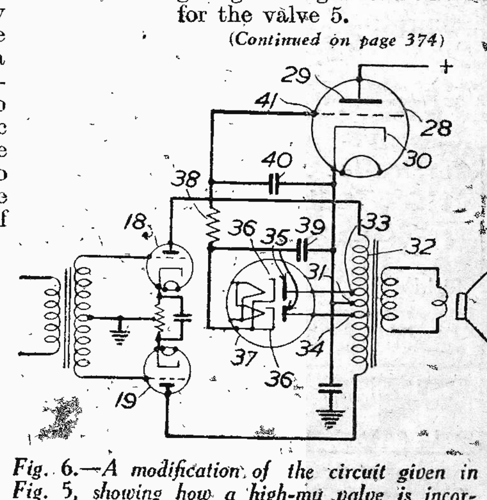

Fig. 6.—A modification of the circuit given in Fig. 5, showing how a high-mu valve is incorporated.

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Limiting Action

The broken line M in Fig. 7 represents the instantaneous limiting action, and, therefore, the maximum amplitude of oscillations permitted in the output circuit of the valve 5. The extent of the limiting action varies with the strength of the syllabic frequency component appearing across the resistance 9, the envelope of this component being represented by the solid line N. A transient static impulse occurring at the time t_1 is limited in amplitude to the value P. Without the limiting action, this static impulse would appear in the output circuit with the amplitude R. A second transient signal impulse appearing at the time t_2 is limited to a smaller amplitude S since the strength of the syllabic frequencies appearing in the output circuit at the time t_2 is smaller than at the time t_1.

In the arrangement shown in Fig. 5, the operation is similar to that of Fig. 4, except that the change in anode potential for the limiting audio-frequency amplifier is effected by a valve in series with the anode supply.

Class B Amplifiers

A pair of high mu-type valves 16 and 17, such as are used as Class-B power amplifiers, are employed for this purpose. The anode impedance of these valves changes rapidly with changes in grid potential. Assuming that an input signal produces an increase in the anode current of the valve 18, then the anode current of the valve 19 will decrease, causing the bias potential on the grid of valve 17 to become more positive, thereby decreasing the anode/cathode impedance of this valve. A larger anode current now flows through the valve 17 to supply the increased instantaneous value of anode current required by the valve 18. Similarly, increases in the anode current of valve 19 are supplied through the valve 16.

The average bias on the grids 20 and 21 is determined by the average drop between the points 22, 23 and 24, of the transformer winding, which in turn depends upon the average current through the valves 18 and 19. The latter is determined by the drop across the cathode resistances 26, 27. Since this potential drop varies at syllabic frequency, the average bias on the grids 20 and 21, and therefore the average impedance of the valves 16 and 17 likewise varies at syllabic frequency to produce corresponding variations in the value of the average anode potential supplied to the valves 18 and 19. In other respects the operation is similar to that of the Fig. 4 arrangement.

Potential Drop

In Fig. 8 the average potential drop across the valves 16 and 17 is represented as the potential E_1, and the average anode potential supplied to the valves 18, 19, is represented by the potential E_2. As illustrated in this figure, the magnitude of the potentials E_1 and E_2 changes with change of the input signal strength. The sum of the potentials E_1 and E_2 neglecting the small bias voltage drop across the resistors 26 and 27 for a given input signal strength must, of course, equal the potential of the anode source which is assumed constant. The relation between the strength of the output signals, and the strength of the input signals is given by the line E_3 of Fig. 8, while E_4 represents the relation between the input signal strength and the maximum output of the amplifier as thus limited.

Fig. 6 shows a modification of Fig. 5, in which a single high-mu valve 28, having similar operating characteristics to the valves 16 and 17 of Fig. 5, has its anode 29 connected to the positive conductor and its cathode 30 connected to the centre-tap 31 of the primary winding 32 of the output transformer. The taps 33, 34 are connected, respectively, through the anode and cathode 35 and 36, respectively, of diode rectifier 37, and through a filter resistance 38 and condensers 39, 40, to the control grid of the valve 28. The filter 38, 39, 40 is arranged to filter from the potential supplied to the grid 41, all potentials having a frequency higher than the syllabic range of frequencies. The double-diode rectifier 37 has the advantage that it doubles the lowest audio-frequency signal components.

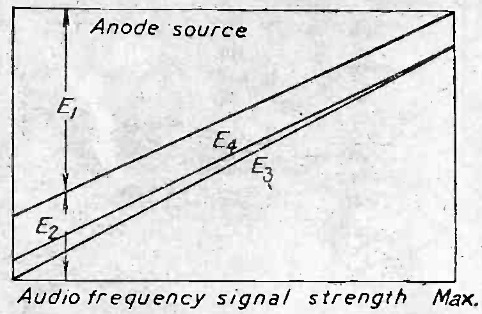


Fig. 8.—Graph representing relative strength of output and input signals.

The control potential supplied to the grid 41, through the rectifier 37, controls the anode-to-cathode impedance of the valve 28, so as to adjust the anode potential supplied to the anodes of the valves 18 and 19. The operation of this modification differs only from Fig. 5 in the method of controlling the impedance of the valve 28 included between the positive conductor, and the centre-tap 31 of the transformer winding 32.

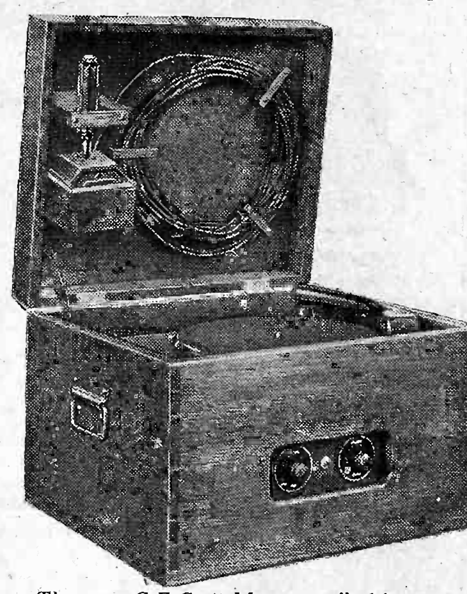
This system was developed in the laboratories of the General Electric Company, Schenectady, New York.

G.E.C. Sound Reproduction

An Improved Version of the "Microgram" Amplifying Equipment

THE General Electric Co., Ltd., recently announced details of a modified and improved version of their "Microgram" amplifying equipment.

The new "Microgram" embodies a three-stage low-frequency amplifier with microphone and gramophone inputs, an induction gramophone motor, a moving-iron armature pick-up, a transverse-current type microphone and 50ft. of connecting cable, all within a portable oak table type cabinet measuring 20½ins. by 17ins. by 13½ins.



The new G.E.C. "Microgram" 14-watt amplifier.

The amplifier employs a MH41 resistance capacity coupled to a MH4, which is transformer-coupled to two PX25 arranged in push-pull in the power stage. The H.T. rectifier is an MU14. All are Osram valves.

Dual input circuits permit the use of either microphone or pick-up, either independently or mixed, and both inputs can be independently controlled by volume controls located on a small panel let into the front of the cabinet. The only other control is the mains switch.

Power Handling Output

The maximum power handling output is approximately 14 watts, and the output circuit is so arranged that low impedance speakers of either 15 ohms or 7.5 ohms may be used. The microphone is a new high fidelity model, the polarising current for which is supplied by a special circuit incorporated in the amplifier. Thus the need for external batteries or other external D.C. sources is obviated. Normally, the microphone is resiliently mounted on a neat handgrip, but it is easily detachable, so that if desired it may be used in conjunction with a table or floor type stand. Details of these stands are available on request.

Compact and Portable

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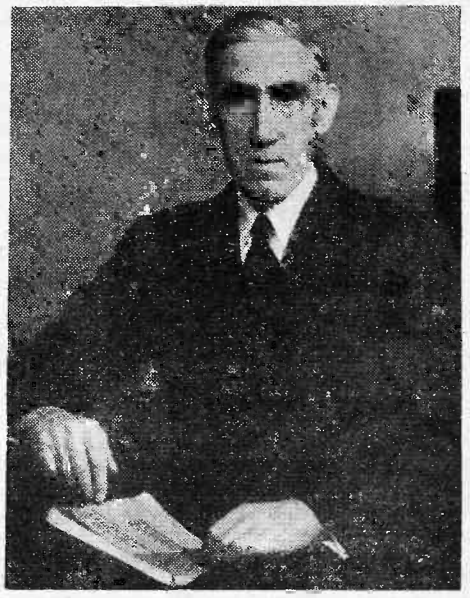

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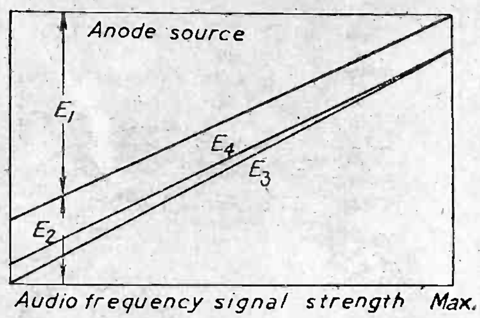

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The control potential supplied to the grid 41, through the rectifier 37, controls the anode-to-cathode impedance of the valve 28, so as to adjust the anode potential supplied to the anodes of the valves 18 and 19. The operation of this modification differs only from Fig. 5 in the method of controlling the impedance of the valve 28 included between the positive conductor, and the centre-tap 31 of the transformer winding 32.

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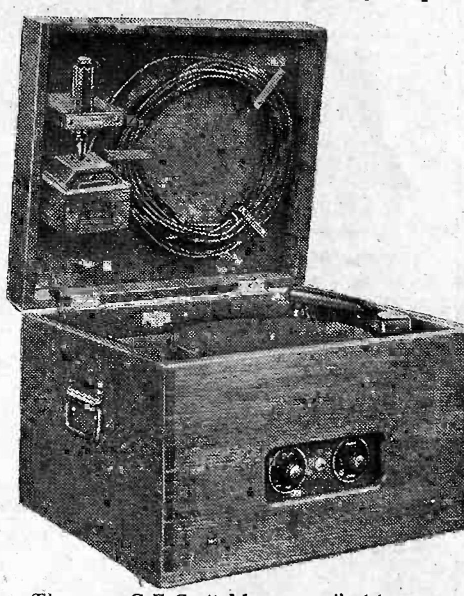

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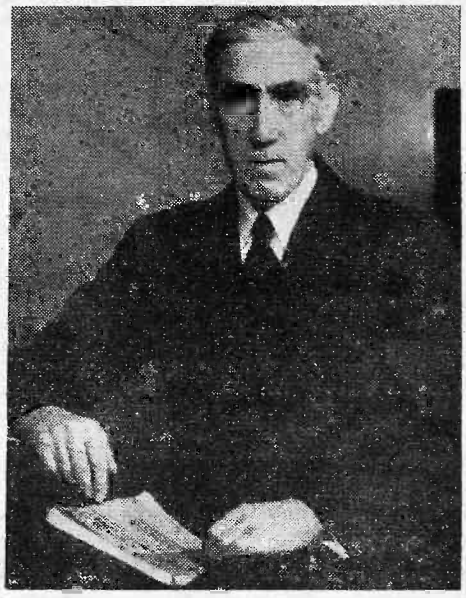

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Noise Suppression

Various Arrangements for Dealing with the Problem are Described in This Article

MODERN broadcast receivers capable of considerable sound output, and having a wide frequency response, are liable to reproduce transient or static crash impulses at uncomfortably high volume levels, and the purpose of the present article is to describe some arrangements by which such effects may be mitigated. The arrangements to be described operate by controlling the length of the load line of the output valves of the amplifier.

Since the potential drop across the bias-ing resistance in the cathode lead of an amplifying valve varies in direct proportion to the anode current, the curve AC of Fig. 1 represents the locus of the grid biasing potentials as a function of the

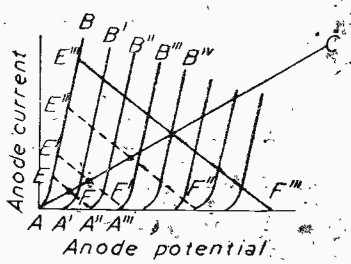
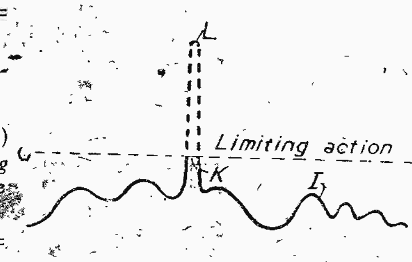


Fig. 1.—(Left) Anode current-potential curve.

Fig. 3.—(Right) Curve representing amplitude of noise impulse.



anode potential. The lines EF, E'F', etc., represent the load lines, the slope of which is a function of the output-circuit impedance determined by the particular valve employed. The anode swing of the valve is limited to the length of the line EF, E'F' (the length of which is a function of the anode potential) being limited at the abscissa axis by the anode-current cut-off, and at the line AB by grid current. Thus, the length of the load line may be controlled by adjusting the anode voltage.

L.F. Amplifying Stage

Referring now to Fig. 2, a conventional diode rectifier and low-frequency amplifying stage is shown, and it will be evident that by changing the value of the anode circuit resistance 1, the potential supplied to the anode 2 may be adjusted at will to control the length of the load line EF, E'F', etc., and so limit the maximum amplitude of signal or noise oscillations.

In Fig. 3 the broken line GH represents the maximum amplitude which signal or noise oscillations may have for a particular value of the anode resistance 1. If the amplitude represented by the line GH is so high that the signal oscillations, the envelope of which is represented by the solid line I, do not exceed the amplitude GH, then the signal oscillations will be reproduced in the output circuit. When, however, the input contains a transient noise impulse represented by the curve L, the maximum amplitude of the noise impulse occurring in the output circuit is limited to the amplitude GH as shown at K. If it were not for the amplitude limiting connection the noise impulse would have an amplitude L.

The adjustable tapping 3 on the diode load resistance is ganged with the adjustable contact arm 4 of the anode resistance 1, so that movement of the tapping 3 to the upper end of the diode-load resistance to increase the audio output of the amplifier, is accompanied by a corresponding decrease in the value of the anode resistance 1 to effect an increase in the potential supplied to the anode 2 of the amplifier 5. The length of the load line EF is thus automatically increased as the strength of the signal oscillations supplied to the control grid of the amplifier is increased. Where the received signal is subject to fading, the automatic volume control of any preceding HF amplifier should have a flat characteristic for optimum noise reduction.

Automatically-operating Circuits

Figures 4, 5 and 6, show automatically-operating circuits. An output amplifier stage in Fig. 4 is constituted by push-pull connected valves 6 and 7, the cathodes of which are connected to the negative terminal 8 of the anode potential supply

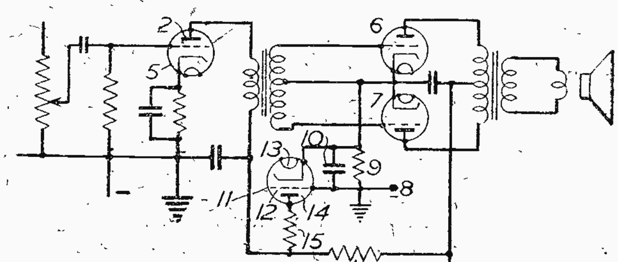


Fig. 4.—Circuit diagram of an output amplifier stage.

through a resistance 9 which is shunted by a condenser 10 having a capacity to provide a low impedance in comparison to that of a resistance at twice the lowest audio frequency supplied to the amplifier, and yet to have a high impedance at syllabic frequencies. By syllabic frequencies are meant that range of frequencies from zero to approximately 30 c.p.s which is the frequency range of the occurrence of

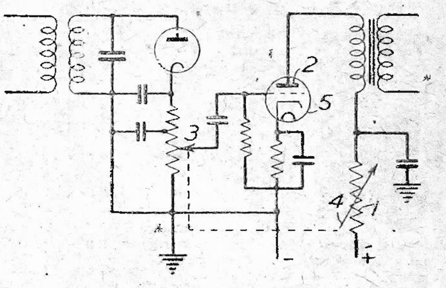


Fig. 2.—Circuit diagram of a diode rectifier and L.F. amplifier stage.

syllables in ordinary speech. An additional valve 11 has its control grid 12 and cathode 13 connected across the terminals of the resistance 9 and the anode 14 is supplied through the resistance 1 and the resistance 15.

Bias Control

In operating the arrangement shown in Fig. 4, the potential across the resistance 9 has a D.C. component and an A.C. component of syllabic frequency. This potential controls the bias of the grid 12 and thus controls the anode current.

The valves 6 and 7 are connected as a Class-B power amplifier, the anode current of which increases approximately linearly with increases of input signal strength. At low signal strength the average anode current is relatively small, and the control grid 12 consequently has a small negative bias. The anode-current of the valve 11 at this instant is relatively large, and in flowing through resistance 1 produces a large voltage drop which in turn greatly reduces the potential supplied to the anode 2 of the valve 5. The length of the load line EF (Fig. 1) for the valve 5 is, therefore, greatly decreased during periods of low signal strength. The reduction of the permissible anode swings is thus effected automatically.

As the strength of the audio signal increases, the anode current of valves 6 and 7 also increases, giving an increased drop across resistance 9, and causing an increase in the negative bias potential applied to the grid 12. The consequential decrease in anode current of the valve 11 results in a decrease in the drop across the resistance 1 so that the potential on the anode 2 is increased giving a longer load line EF for the valve 5.

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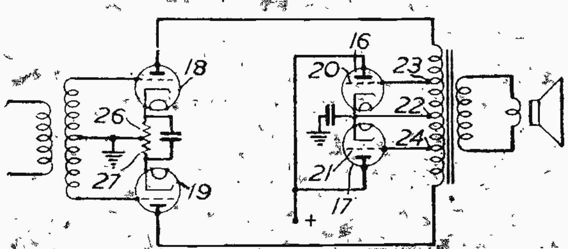

Fig. 5.—An automatically-operated output circuit.

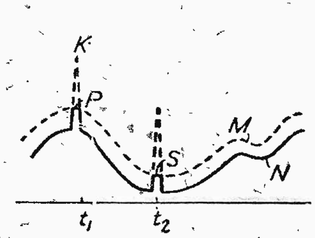

Fig. 7.—Graph representing maximum amplitude of oscillations.

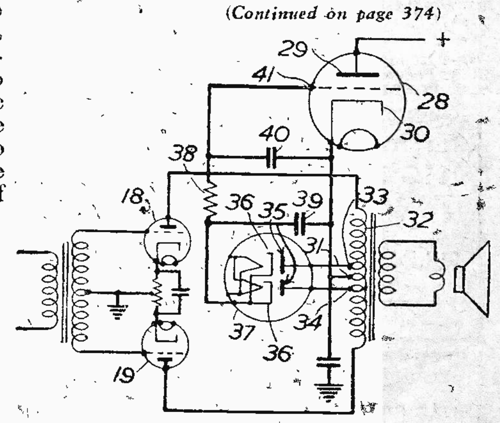

Fig. 6.—A modification of the circuit given in Fig. 5, showing how a high-mu valve is incorporated.

Limiting Action

The broken line M in Fig. 7 represents the instantaneous limiting action, and, therefore, the maximum amplitude of oscillations permitted in the output circuit of the valve 5. The extent of the limiting action varies with the strength of the syllabic frequency component appearing across the resistance 9, the envelope of this component being represented by the solid line N. A transient static impulse occurring at the time t_1 is limited in amplitude to the value P. Without the limiting action, this static impulse would appear in the output circuit with the amplitude R. A second transient signal impulse appearing at the time t_2 is limited to a smaller amplitude S since the strength of the syllabic frequencies appearing in the output circuit at the time t_2 is smaller than at the time t_1.

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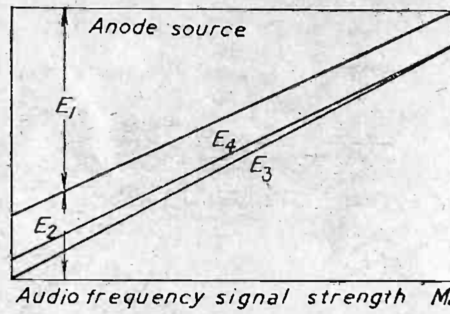

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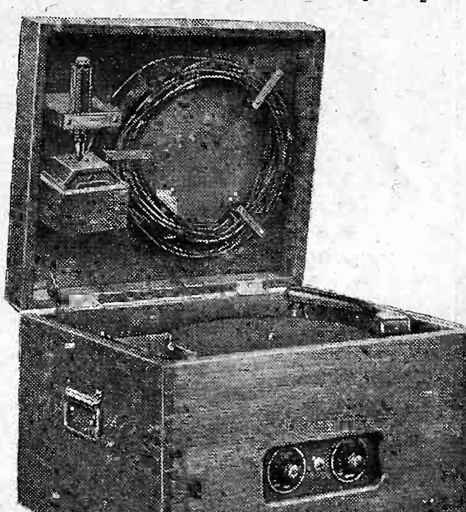

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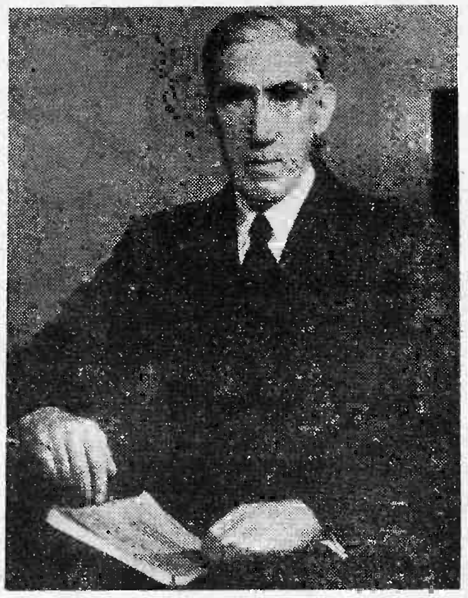


Sir Frank Gill.

In fact, the only constant factor in the situation was the Government's determined and consistent deduction of 10 per cent. from the company's earnings. On that point alone there was no vacillation or change in policy.

After the transfer to the Post Office Sir Frank visited extensively what are commonly called "furrin" parts. He travelled as a consulting telephone engineer in the U.S.A., South America, Portugal and Turkey.

But perhaps his greatest achievement came after his Presidential address to the Institution of Electrical Engineers in 1922. In that address he outlined the far-reaching international scheme whereby long-distance telephone circuits would be made possible throughout the continent of Europe.

* * * *

Barry Kay has, for the time being, relinquished his position as radio sales manager of E. K. Cole, Ltd., in order to join the Board of Trade. Mr. Kay has been appointed Deputy Controller of Factories and Storage Premises for the South-western Area, and he took up his new duties at the beginning of June.

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).

Children's Broadcasts from America

SIR,—In view of the considerable number of parents of children evacuated overseas who have written to the B.B.C. complaining that they have no receiver capable of picking up the weekly S.W. children's message programmes from Canada and America, I would like to suggest to amateur radio clubs who have the necessary accommodation, that they offer to arrange reception of these stations each week, on a reliable receiver in their "headquarters," in order that local parents may not miss the few seconds which are of so great a sentimental value to them.

I am sure that the local evacuation authorities would co-operate wholeheartedly in passing the necessary information to the parents concerned.

I understand that Messrs. Chappell, of London, have kindly adopted this scheme, but, naturally, this is available only to those parents who can conveniently reach London.

Amateur radio fans who carried out this plan, at negligible cost to themselves, would be "doing their bit" in a highly commendable way, and I am sure that the general public would be grateful for this service.—PETER JACKSON (Letchworth).

Using a Doublet Aerial with a 4-pin Coil

SIR,—In past issues of PRACTICAL WIRELESS I have seen numerous suggestions for adapting a doublet-type aerial for use with a 4-pin short-wave coil. The following method I have used will be of interest to fellow short-wave experimenters.

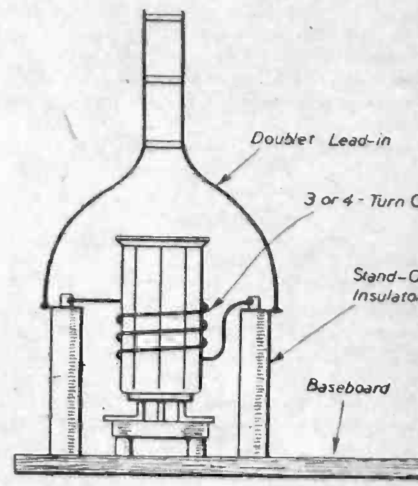
First obtain a foot or two of 14 gauge tinned copper wire, and from this wind a three or four-turn coil, the diameter of which will allow a ½in. clearance when the 4-pin coil is inserted in its holder. Next, two ceramic stand-off insulators, 1½in. high (Eddystone, cat. No. 1029) are mounted, one on either side of the coil-holder. To these two insulators, the 3 or 4-turn coil is mounted (as shown). To complete the device the doublet leads are taken to the terminals of the insulators. This idea saves the former from being drilled, and possibly split as in other suggestions I have tried. The coils are easily changed, by slipping through the fixed coil and plugging into the holder.—JOHN HUNTER (Leigh, Lancs.)

Our Useful Handbooks

SIR,—I am now a radio-mechanic attached to the R.A.F., and I owe a lot to PRACTICAL WIRELESS for the numerous articles, etc., from which I picked up a lot of the experience I now have.

While in Northern France and Belgium during the early part of the war, my wife used to send my copies of "P.W." over, and through these I kept in touch with my old hobby. Your radio publications appeal to me very much, and up to now I have "Radio Engineer's Vest-pocket Book," "P.W. Service Manual," "Practical Mechanics Handbook," "Short-Wave Manual," and "Television and Short-Wave Handbook," this latter one being published some years back. I must compliment Mr. F. J. Camm on the very clear and well-illustrated chapters in the "P.W. Service Manual." The others are equally well written, and form part of my regular reading matter.

Wishing PRACTICAL WIRELESS continued and deserved success.—W. E. WILLIAMS (Rhyl).



Method of using a doublet aerial with a 4-pin coil, as described by J. Hunter.

S.W. Station Identification

SIR,—With reference to Mr. Whaley's letter, and also to John Parkin, I have to inform them that the station referred to is the N.B.B.S. (New British Broadcasting Station).

It is German controlled, and situated, to the best of my knowledge, in the Black Forest.

The programme starts by playing "Loch Lomond" and ends by a sadly untuneful rendering of "God Save the King." The times and wavelengths have been verified, and originally this station operated on 50.63 metres, changing to 25.05 metres on May 25th, 1940. Since that date it has been increased by the two additional wavelengths of 30.77 m. and 41.07 m. I hope this information will be of use to your correspondents.—JOHN N. ELLIS (Esher).

Correspondents Wanted

C. WAYWELL, 10 Fern Avenue, Newton-le-Willows, Lancs, would like to correspond with any readers interested in S.W. work.

G. Packman, Morton Cottage, Fernhill Heath, Nr. Worcester, wishes to get in touch with a young medium-wave enthusiast.

S. B. Gardiner, Cheam School, Headley, Newbury, Berks, who is a beginner in radio, wishes to get in touch with another young beginner.

Comment, Chat and Criticism

Outline of Musical History—23

By Our Music Critic, MAURICE REEVE

AT this point we can pause to consider how Beethoven's great misfortune of deafness affected him.

He was just thirty, the idol of Viennese society, financially well off, and the great hope of the musical world. How magnificently he wrestled with the awful problem must for ever be his greatest glory. From the moment that he first took counsel with himself, so his music, little by little, took on that strain of nobility, resignation, and finally sublime revelation, which became his monument and our heritage.

On October 6th he feels the end is approaching, so he writes what is known as the Heiligenstadt Will—meant for his brothers.

It must not be imagined that Beethoven had become some sort of permanent invalid. So far as we can tell for certain, he was more or less deaf in one ear, from now onwards. This meant, of course, the utmost concentration of thought if he was to continue practising the art of music. It necessarily drove him right in on himself, so that he had his own thoughts and images as his chief companion. He has to abandon piano playing as a profession, making just an occasional appearance in a new work of his, if his health at the time permitted.

A New World

He entered into a new mental and spiritual world, and, no doubt because of this, the works poured forth faster, and became greater. We cannot describe them all here, or even refer to them all, opus by opus. The piano Sonata in A flat, op. 26, is, in my opinion, eminently more suited to form a landmark in his creative style than op. 22. It is altogether a great work and original to a degree. He defied convention by placing the scherzo second in the order of the movements instead of third. The first is a theme and variations, and the third a splendid funeral march. Op. 27 contains two more piano sonatas, the second being the "Moonlight." Both re labelled "quasi una fantasia." The first movement of op. 27, No. 2, whose quiet serenity and atmospheric suggestion not only impelled the publisher to dub it "Moonlight," but must also have inspired Debussy and his school a hundred years later, is a masterpiece of philosophical reflection and economy of treatment.

Then there are the two Sonatas for piano and violin, op. 23 and 24. Quintet for two violins, two violas and 'cello, op. 29; three Sonatas for piano and violin, op. 30. "Pastoral" piano sonata, op. 28, fifteen variations for piano on a theme from "The Men of Prometheus," and the second Symphony in D, op. 36, written in the close of 1802 and first performed on April 5th, 1803. These are the chief works of the period; there are many others in smaller forms, of which examples, such as the seven Bagatelles, op. 33, are famous to-day.

"The Mount of Olives"

Nor should his vocal works be omitted. The oratorio, "The Mount of Olives," was written at this time. It was based on the New Testament story of Christ in the Garden of Gethsemane. Beethoven intended it to be "modern," consequently it is rather a forced hybrid and lacks the master's true spirit. It had great success on its first production, but is little known now. There were also Masses and Cantatas and numerous soli, together with large collections of settings of Scotch, Irish and Welsh folk tunes to the order of the Edinburgh publisher, Thomson. The songs "Adelaide" (1795), "Ah, Perfido!" (1796), and "In Questa Tomba" (1807) are still widely sung.

All these works, to a greater or less degree, tell of the man who has taken certain resolutions and momentous decisions for the future regulation of his life, and of his changed outlook on things. Whereas the joy of living and the winning of success seem to pervade his first pages, we are now face to face with the realisation of stern facts and the taking of enormous resolves. The spirit of his own words, "I will grapple with fate; it shall never drag me down," and "I will as far as possible defy my fate . . ." are in every note. His slow movements have obtained that poignant loveliness that have made them so justly famous, and his allegros and rondos that turbulence and restlessness which typify the struggle which he was perpetually waging with destiny. And so we come to the end of the "first period" with the production of the second Symphony in D, op. 36.

It received its first public performance at a concert in the theatre "an der Wien," and the programme also contained the "Mount of Olives" and the third piano Concerto in C minor, op. 37, with himself as soloist. Difficult as it may be for us to imagine—we who hear all his symphonies several times every year, and with the ability that naturally gives us of comparing them in the light of historical perspective—the critics thought it inferior to the first.

We cannot be expected to prefer it to any of the mighty sequence that began with the production of the next one, but popular opinion would probably rank it as more original, if not so lovable as its forerunner. The slow movement, larghetto, is exquisite in every way, and the scherzo, its most significant movement, clearly foreshadows the one to come in the 9th.

Country Life

Mention has been made of Ludwig's love of the country and how he sought it for some of his noblest inspirations.

Several summers were spent at Hetzendorf, a picturesque village near the Imperial summer palace of Schönbrunn, where his first patron, the Elector, had found peace and quiet after having left Bonn in the tumult of the French advance. There he would forget his worries, his deafness and his loves, and wander with his sketch book in hand. Years later he visited the scene with Schlinder and pointed out his favourite seat between two leafy boughs of an old oak tree. He would seek the solitude of the forests and the glades, with which the countryside around Vienna then abounded, and engage a couple of small rooms "far from the madding crowd," and the restraints of society and piano playing.

Masterpieces

Slowly, but surely, he was shedding the influences of the past and letting his now fully-matured genius roam in all its spaciousness. The masterpieces which were to be produced in the next few years would place him, in the eyes of his contemporaries, as the greatest living musician. Certainly, even at that early date, and before the Eroica Symphony or the Kreutzer and Appassionata Sonatas had been written, there was no one living within measurable distance of him. The great names with which we now associate him had either gone or were not yet born. J. S. Bach and Handel had been dead fifty years—long enough for them to have become historical figures as we think of them. Mozart went ten years back, Schubert was five or six. Wagner, Liszt, Schumann, Chopin and Mendelssohn were still to come. Haydn alone, amongst those whom we, to-day, rank as the great musicians, was alive and he had but a few more years left. These few dates will serve to show to a remarkable degree the bridge that Beethoven formed between the classicists of the eighteenth, and the romanticists of the nineteenth, centuries.

Meeting with Czerny

About this time a youth was introduced to Beethoven who was destined to achieve fame as the bane and nightmare of five generations, to date, of piano students—one Carl Czerny. He was presented by Krumpholz the violinist, and many distinguished musicians were there.

Beethoven has now entered the "second" period of his creative musical life. Although hitherto influenced by his forerunners, notably Mozart and Haydn, he has shown unmistakable signs of his own individuality. Whilst some of his works at this stage might almost be mistaken for theirs, more especially some melodies and passage work, there are others which no one but he could possibly have written. These may be said to include the Sonatas in A, op. 2 No. 2, E flat, op. 7, D, op. 10 No. 3, C sharp minor, op. 27 No. 2, the scherzos of the first and second Symphonies and the finale of the latter. From here onwards he journeys viâ the three piano sonatas op. 31, the violin and piano sonata in A, op. 47, the Concerto for piano and orchestra in C minor, op. 37, to the third Symphony in E flat, the "Eroica," op. 55. To quote the writer in "Grove's Dictionary of Music and Musicians," "This splendid and truly astonishing second period contains the opera of 'Leonora-Fidelio,' with its four overtures; the Mass in C; six symphonies (Nos. 3 to 8), the overture to 'Coriolan'; the 'Egmont' music; the piano concertos Nos. 4 and 5 in G and E flat; the violin concerto; the Rasonmowsky quartets and those in E flat, op. 74 and F minor, op. 95; the three later piano trios; the 'Liederkreis'; and last, but not least, a dozen piano sonatas."

Replies to Queries

Faults in a Superhet

"I have a commercial set which has a 6A8G frequency-changer. It has a simple tuning stage, and the values are freq. chg., H.F. pen, D.D. triode, pentode output, and rectifier.

"If the set is tuned to the medium and long waves there is just a rushing sound and an intermittent whistle similar to morse. There is silence on the short waves. If I put my finger on the top cap of the 6A8G there can be heard very faintly one or two stations. This latter effect was only noticeable after replacing the valve.

"Can you advise me as to the cause of the trouble?"—A. T. Bullock (Rochester).

IT is very difficult to give an accurate diagnosis of the fault in your superhet without having more complete details or making a few simple tests, but it would appear likely that the coils or wave-change switching arrangements are at fault. On the other hand, the anode or screening-grid circuits of the frequency-changer could be disconnected, in which case they may give the indications you described.

We suggest that you test for voltage between earth and the anodes and grids of this valve, and also check the current flowing to each of these electrodes. You might also make a careful examination of the wave-change switches and test for continuity of the coil windings—including continuity through the switches.

Make especially sure that there are no breaks in the aerial-tuning and input circuits to the first detector, since it is likely that an open circuit will be found somewhere in this region.

QSL Cards

"Being a new S.W.L. to DX I am unacquainted with QSL cards. Could you please furnish me with information about them?"—T. Russon (Dudley).

QSL cards are acknowledgments sent by transmitting stations, both commercial and amateurs, of reports sent to them of their transmissions, etc. At the present time it is no longer legal to send such reports overseas. Brief essential items are required, i.e., type of receiver, weather, time, strength and quality of signal, interference and type of aerial in use. Normally a report is sent on logging a station. International Reply Coupons should be sent to cover the cost of reply.

All-wave Tuner

"While looking through your back numbers, I noticed in an issue of P.W. dated 7-10-33, an article headed 'All About All-wave Tuners.' Suggestions and diagrams are embodied for an L.M.S. coil, but no length or gauge of wire was specified. Can you supply me with these particulars as I should like to wind my own unit?"—L. West (Penge).

THE gauge of wire, number of turns, and the size of the former all depend upon the wave-ranges required from the tuner. There are no long-wave stations at the moment, but we presume you wish to wind a tuner to cover what may be termed the usual ranges, the short-wave band covering from 15 to 50 metres; medium waves from about 200 to 550; and the long waves from 1,000 to 2,200 metres. The tuning condenser would be a standard .0005 mfd., but should be of good design in order to give a good performance on the short waves. The former should be 2½in. in diameter, and about 6in. in length, and if you can obtain an ebonite tube and turn slots in it, so much the better. Failing that, use a Paxolin tube and make artificial slots by sticking narrow strips of paper round the tube, winding the coil in the spaces left between the strips.

For the short-wave grid winding use 20 S.W.G. tinned-copper wire, 4 turns, spaces about 1/32in. The S.W. reaction winding should be 15 turns of 28 D.S.C.; the S.W. aerial winding 2 turns of the 20-gauge wire; the medium-wave grid winding 45 turns of the 28 S.W.G.; the reaction winding next on the former being 100 turns of a finer gauge, say 32. The spacing between this and the M.W. coil may be found critical, as the reaction winding has to act on both medium and long waves. About ¼in. or ⅜in. should therefore separate them, and turns taken off if it is found that reaction is too fierce on medium waves. The long-wave winding should be slipped into three sections, using the 32-gauge wire, and putting 50 turns into each section. These turns may be piled up haphazard, but the M.W. grid winding should have the turns laid carefully side by side—after the manner of cotton on a cotton-reel. Use a good type of low-capacity switch (or switches) for wave-changing.

RULES

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

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

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

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

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

Microphony in S.W. Converter

"I recently made a short-wave superhet converter, operated in conjunction with a 5-valve mains receiver. It has operated perfectly as regards sensitivity, and I have received stations from all over the world. Its main fault about which I should like your advice, is a certain amount of instability in the form of microphony when the volume is increased.

"I have used the converter in conjunction with other receivers, and in all cases microphony has resulted on turning up the volume. None of these receivers show any signs of microphony when used on other wavebands even on full volume. The fault therefore points to a microphonic detector valve in the converter, but padding or gripping this valve does not appear to have any effect on the fault. Can you please advise me?"—H. Varley (Darlington).

IT is quite possible for microphony to be experienced when receiving short waves, in spite of the fact that such trouble is absent on medium and long waves. This is due to the higher frequency and the general characteristics of short-wave detection. The interference need not be confined to the detector valve, although this is the most common source; variable condensers should also be suspected, and, if necessary, be mounted on rubber buffers. Excessive anode volts on the detector can produce adverse effects; therefore, in addition to the usual precautions, make sure that detector operating conditions are correct, and that the oscillations generated are not too powerful.

Amplifier Modification

"I have built an amplifier, using direct coupling with a PX4 triode as output valve from a circuit you published some time ago. I was wondering if the excellent quality obtained with this arrangement could be further improved by using two PX4's in push-pull.

"The only way I can see of doing this is to tap off the inverse phase from the bias resistor of the driver valve, but I do not know if the signal amplitude applied to the grid valve fed from the driver cathode would be the same as that of the other valve. Will you please let me have your opinion on the matter?"—L. McGee (Bristol).

WE cannot advise from experience on the suggested amplifier modification you propose, but we do not consider that it would prove very satisfactory. There would be many practical difficulties in balancing the output valves, and even if the method could be made successful we should anticipate that a good deal of experimental work would be necessary.

We should be more inclined to favour the use of parallel output valves—with suitable provision for loading them—or a complete change-over to a paraphase arrangement.

Resistance of Headphones

"I want to make some experiments with crystals and a crystal set I have just made. Does it make any difference what resistance the headphones have? 2,000 and 4,000 ohms seem to be used indiscriminately."—Howard Gomerville (Oxford).

PHONES of 2,000 or 4,000 ohms are quite satisfactory. The latter are more sensitive, but less robust from the point of view of current carrying capacity. With a crystal receiver, this does not enter into the question, as the rectified signal is minute and no standing current—as in the case of a valve—is present.

Fitting Tone Control to Oscillator

"I am desirous of putting a tone control on my L.F. oscillator. Will you please advise me how I can do this?"—D. Doland (Norbury).

THE tone can be varied by fitting a small condenser across the grid and L.T. negative. Values must be determined by tone required. A similar effect can be obtained by fitting a filament rheostat in one lead to the filament of the valve. A value of 6-10 ohms will be satisfactory.

The coupon on page iii of cover must be attached to every query

Practical Wireless
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These Blueprints are drawn full size.

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

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Amateur Wireless ... ... 4d. " "
Wireless Magazine ... ... 1/4 " "

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

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

PRACTICAL WIRELESS

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Cameo Midget Three (D, 2 LF (Trans))	—	PW51
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Battery All-Wave Three (D, 2 LF (RC))	—	PW55
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The Centaur Three (SG, D, P) ..	—	PW64
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The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
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F. J. Camm's Oracle All-Wave Three (HF, Det, Pen)	—	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	—	PW84
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The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	—	PW89
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F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
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MISCELLANEOUS.

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AMATEUR WIRELESS AND WIRELESS MAGAZINE

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Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve : Blueprints, 1s. each.		
£5 5s. S.G. 3 (SG, D, Trans) ..	—	AW412
Lucerne Ranger (SG, D, Trans) ..	—	AW422
£5 5s. Three: De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	—	WM327
Economy Pentode Three (SG, D Pen)	—	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans) ..	—	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen) ..	—	WM389
Certainty Three (SG, D, Pen) ..	—	WM393
Minitube Three (SG, D, Trans) ..	*Oct.* '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC, Trans) ..	—	AW370
2HF Four (2 SG, D, Pen) ..	—	AW421
Self-contained Four (SG, D, LF, Cl. B)	*Aug.* '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2 LF)	*Feb.* '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF Pen, DDT, Pen)	*Apr.* '36	WM404
Five-valve : Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

Mains Operated.

Two-valve : Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C. ..	—	AW383
Mantovani A.C. Three (HF, Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan.* '36	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen) ..	—	WM329
Harris' Jubilee Radiogram (HF, Pen D, LF, P)	*May* '35	WM386

SUPERHETS.

Battery Sets : Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
'Varsity Four	*Oct.* '35	WM395
The Request All-Waver	*June* '36	WM407
1935 Super Five Battery (Superhet)	—	WM379
Mains Sets : Blueprints, 1s. each.		
Heptode Super Three A.C. ..	*May* '34	WM359
"W.M." Radiogram Super A.C. ..	—	WM366

PORTABLES.

Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two H.F. Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans) ..	—	WM367

SHORT-WAVE SETS. Battery Operated.

One-valve : Blueprints, 1s. each.		
S.W. One-valver for America ..	15.10.38	AW429
Roma Short-Waver	—	AW452
Two-valve : Blueprints, 1s. each.		
Ultra-short Battery Two (SG, det, Pen)	*Feb.* '36	WM402
Home-made Coil Two (D, Pen) ..	—	AW440
Three-valve : Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	*July* '35	WM390
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF, Pen, D, RC, Trans) ..	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valver Short-waver (SG, D, LF, P)	P.W. 22.7 39	WM383
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super ..	—	WM397

Mains Operated.

Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	P.W. 13.1.40	AW453
"W.M." Long-wave Converter ..	—	WM380
Three-valve : Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C. ..	—	WM352
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans) ..	—	WM391

MISCELLANEOUS.

S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM 392 (1/-)	—	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	—	WM403
New Style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-)	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	*May* '36	WM405
Wilson Tone Master (1/-)	*June* '36	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM40

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ADVERTISEMENTS are accepted for these columns at the rate of 2s. per line or part of a line. Minimum charge 4s. All advertisements must be prepaid. Each paragraph will commence with the first word in bold face capitals. All communications should be addressed to the Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

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A CABINET for every radio purpose. Send measurement of chassis, etc., and say what kind of cabinet required. Stamp for reply. Inspection invited. **H. L. SMITH AND CO., LTD.,** 289, Edgware Road, W.2. Tel.: Pad. 5891.

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

WEBB'S Radio Map of the World. Locates any station heard. Size 40" by 30", 4/6, post 6d. On linen, 10/6, post 6d. WEBB'S Radio Globe—12" model. Radio prefixes, zones, etc., 27/6.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: GERrard 2089.

MISCELLANEOUS

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

24-HOUR Service on all makes, particularly home-constructed sets; also American multi-tube receivers. —R. A. Radio, 62, The Broadway, N.W.7. 'Phone: Mill Hill 4313.

PUBLIC APPOINTMENTS

WIRELESS TECHNICAL INSTRUCTORS REQUIRED IN ARMY UNITS

Emoluments.—Pay 8s. 9d. per day (7 days a week). Clothing, rations and accommodation or, if this cannot be provided, allowances at authorised rates. If married and otherwise eligible family allowance payable in respect of wife and children, subject to allotment from pay.

Candidates should preferably be under 35 and over 24 and—

(a) Hold one of the following qualifications:

Graduateship of the Institution of Electrical Engineers.

Final (Grade III) Certificate of City and Guilds of London Institute Examination in Radio Communication.

Higher National Certificate in Electrical Engineering.

Certificate of City and Guilds of London Institute in Radio Service Work.

OR

(b) Be able to pass an examination on the following syllabus:

Simple algebra, including quadratic equations; simple trigonometrical ratios and identities; vectors.

Properties of electrical currents; heating of conductors; magnetic fields; unit of current; Ohm's Law; resistance in series and parallel; potentiometers.

Magnetic effect of current; fields due to parallel wires; field due to a solenoid; electro-magnets. Meters.

Induction; effect of rotating a coil in a magnetic field.

Mutual and self induction and inductance; effect of inductance on growth and delay of current.

Capacity; charging storage and discharge of condensers; through resistance and inductance.

Alternating currents; vector diagrams; effect of resistance variation; effects of L and C in A.C. circuit; phase difference of currents; resonance in a series circuit; parallel circuit of L and C; Q factor.

Elementary knowledge of valves; simple theory of amplifiers; oscillators and detectors; general principles of radio practice.

Suitable Candidates will be interviewed at local centres, and, if successful, will be enlisted and appointed Acting Sergeant Tradesman. For those who are on the Schedule of Reserved Occupations, special arrangements will be made to enable them to be enlisted. In the event of any applicant found to be reserved under Schedule of Reserved Occupations special application will be made for relaxation of the Schedule. No guarantee can be given that this application will be successful.

Application Forms may be obtained by post card from the Under Secretary of State, The War Office (A.G.6c), Whitehall, S.W.1.

RADIO CLEARANCE, Ltd.

LOW-LOSS Ceramic Valve Holders. Lissen Hi-Q., baseboard and chassis, 7-pin, **1/-** each.

LOW-LOSS Short-wave Condensers, variable Ceramic insulation brass vanes, Lissen Hi-Q minimum capacity 20 mfd. List, 5/6 each; our price, **2/6** each.

PUSH-PULL Switches, Lissen 2-point, **4d.** each.

YAXLEY type Switches, 6-bank, **3/-** each.

YAXLEY type Switches, 9-bank, **3/6** each.

MIDGET SPEAKERS, Goodmans Energised, 600 ohms field, including transformer, new, boxed, **10/6** each.

STRAIGHT LINE 3 wave-band Dials, **1/11** each.

MAINS TRANSFORMERS, 300-0-300v. 100 m.a. 5v. 2 amps., 6.3 5 amps. Drop-through chassis type, **12/6** each.

MAINS TRANSFORMERS. Wearite 100 watt, auto transformers, 100-110v., 200-200v., reversible, **14/11** each.

MAINS TRANSFORMERS, 250-0-250v., 80 m.a. 4v. 1 amp., 4v. 4 amp., 200-250 mains, new, boxed, **12/6** each.

MAINS TRANSFORMERS, 350-0-350v. 4v. 5 amps., 500-0-500 4v. 1 amp., 6.3v. 4v. 2 amp., **12/6** each.

CHASSIS Mounting Valve Holders, English Clix type, 4-5-7pin, **3d.** each.

CENTRALAB Volume Controls, midget type, 1,000, 2,000, 5,000, 25,000, 50,000, 100,000 ohms, less switch **2/9** each.

4-WAY Push-button Switches, **1/3** each.

DROPPING Resistances, for all purposes. Total resistance 535 ohms. 5 taps in steps of 50 ohms. Standard for Pye, Lissen, Ever-Ready, etc., **3/6** each.

10FT. Coils Connecting Wire, **4d.** each, glazed, Red or White.

BRAIDED Screened Cable, Single and Twin, **9d.** per yard.

PUSH-ON Pilot Lamp Holders, **3d.** each.

PLESSEY Single Gang .0005 Variable Condensers, **1/11** each. 2-gang .0005 Variable Condensers, with Vernier Control, **1/11** each.

SOLID Dielectric Condensers, by well-known maker, .0005 Tuning and .0001 Reaction Differential, **6d.** each.

B.I. Wire-end Bias Electrolytics, 50 mfd., 12v., **1/6** each.

TUBULARS, wire-end non-inductive paper condensers. All sizes up to .01, **5d.** each; .1, **7d.** each.

T.C.C. 2 mfd. Electrolytic Condensers, 200v. working, **1/3** each.

CONDENSERS, .0005 triple, **1/9** each.

DOUBLE FUSE HOLDERS. Complete with 2 1 amp. fuses, **1/6** each.

R.I. Parafeed L.F. Transformers, **2/-** each.

GOOD assortment of Mains and Filament Transformers, L.F. Chokes and Alum Chassis, etc.

MAINS ENERGISED SPEAKERS, by well-known makers. 6,000, 2,000, 3,000, 2,500, 1,500 and 1,000 Ohms. **12/6** each, complete with transformer.

PHILLIPS all-wave chassis. Battery, A.C., and universal, from **15/-** each.

All orders must include SUFFICIENT POSTAGE TO COVER. Hours of Business: Weekdays, 9-4.30. Saturday, 9-1 p.m.

PLEASE WRITE YOUR NAME AND ADDRESS IN BLOCK LETTERS.

We cannot undertake to answer enquiries unless postage is included (2½d.).

RADIO CLEARANCE, Ltd., 95, HIGH HOLBORN, LONDON, W.C.1.

Telephone: HOLborn 4631.

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LOUDSPEAKER repairs, British, American, any make, moderate prices.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

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

MORSE TRAINING

FREE. "Book of Facts," tells you all about The Candler System of Code training. Courses for Beginners and Operators.—Write: Candler System Co., (LO), 121, Kingsway, London, W.C.2.

NEW LOUDSPEAKERS

3,000 Speakers, P.M. and energised, 4in. to 14in., including several Epoch 18in.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

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"RADIO Bargains." Few brand new 1940/1 models in makers' sealed cartons with guarantees, and used models at reduced prices, also valves. State requirements.—"Radio Bargains," 261-3, Lichfield Road, Aston, Birmingham, 6.

COULPHONE RADIO, New Longton, Preston.— Tungsram and American valves. Latest type P.M. Speakers, with transformer. 8in. Goodmans, 18/6. 10in. Rola, 22/6. Electrolytics, 500v. 8 mfd., 2/9; 8+8 mfd. (4 leads), 4/9; 16+8 mfd., 6/3; 50 mfd. 50v., 2/9. Goldring Pick-ups, with volume control, 17/6. Erie and Dubilier 1-watt resistors, 6/6 doz. Volume controls with switch, 4/3. Tubulars, valve holders, etc. S.A.E. new list.

GALPINS ELECTRICAL STORES

ELEC. LIGHT CHECK METERS, small, late type, good makers, fine condition, electrically guaranteed, 200/250 volts 50 cy. 1 ph. A.C. 5 amp., **10/-**; 10 amp., **12/6**; 20 amp., **15/-**; post free.

D.C. ELEC. LIGHT CHECK METERS, 200/250v. 5 and 10 amps., **7/6** post free.

VOLTAGE CHANGING TRANSFORMERS, auto wound, 100/240 or vice versa, 1,000 watts, **£3 2s. 6d.**

PRESS BUTTON UNITS, 8-way 7 x 6 x 1½, fitted capacitators, condensers, etc., for three-gang tuning, **5/6** post free.

THREE-WAY press button switches, fitted paxolin terminal strip, **2/-** post free.

H.T.8 METAL RECTIFIERS, secondhand, but in perfect working order, **7/6** post free.

AUTO. CHARGING CUT OUT AND VOLTAGE REGULATOR, ex-R.A.F., suit any dynamo up to 20v. at 15 amps., fully adjustable, with wiring instructions, complete in metal case, **3/6**, post **9d.**

WIRELESS CHASSIS (bomb surplus), containing many valuable modern components shortly unobtainable, late type only, satisfaction guaranteed, **7/6** and **12/6** each, carriage paid.

SOLID BRASS LAMPS fitted small B.C. double contact holder and 12 volt bulb, price **3/-** post free.

110 VOLT D.C. MOTOR, totally enclosed, rated at 8 amps., ball bearing, in new condition, make good slow-speed dynamo, weight approx. 75lbs., price **45/-** carriage forward.

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GALPINS ELECTRICAL STORES, 21, WILLIAM STREET, SLOUGH, BUCKS. Cash or C.O.D.

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THE SPOT FOR KEEN BARGAINS.

MORE MONEY-SAVING BARGAINS FROM THE CABIN. SUPPLIES ARE GETTING DIFFICULT. LAY IN A FEW SPARES WHILE THE GOING'S GOOD.

CRYSTAL and catswhisker in tin box. New stock, lower price, **6d.** each. Very useful to experimenters. Also Lucerne permanent crystal detectors, **1/6** each.

PLESSY 3-gang .0005 mfd. Superhet screened variable condenser, 3½in. long, 3in. wide. A really marvellous line at the ridiculous price of **1/3** each.

VARIABLE CONDENSERS. Parcel of 5 gross to clear, solid job, first-class condition, 2-gang, .0005 mfd., **9d.** each.

CRYSTAL Replacements for permanent crystal detectors. Brand new, **1/-** per set.

TRIMMERS. New 200m.mfd. on Frequentite ceramic base. A beautiful line, **4d.** each.

DUAL-RANGE COILS. A new line and a fine job, too. Manufactured by one of the best coil makers. Fully screened, a real bargain to clear at **1/-** each.

SUNDRY ITEMS. New lines collected from all sources to be cleared at very low prices:—

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EKCO mains dropping resistances. Total resistance 700 ohms, with 3 tappings. **2/6** each.

L.F. TRANSFORMERS by Lotus. Brand new. **1/-** each.

DUAL-RANGE COILS. Five only, Varley square peak, new, in original boxes, complete with circuit. Listed at 15/-, our price **4/-**. Also 6-pin brand new, complete with circuit, **2/-** each.

SIX ONLY Lotus 2-gang .0005 mfd. complete in boxes, with drive knob and escutcheon. Brand new, listed at 14/-, to clear **4/-**.

PUSH-PULL Switches. 2-pt., **3d.** each, **2/6** dozen.

LOW-LOSS Coil mounts, 2-pin, **3d.** each, **2/6** dozen.

5-pt. ROTARY Switches. Useful for wave-changing, etc. **6d.** each.

VALVE HOLDERS. 7-pin Chassis mounting, brand new, **3d.** each, **2/6** dozen.

TWIN Binocular H.F. Chokes, brand new, to clear at **5d.** each.

SLOW-MOTION Drives, 50—1 ratio, ideal for short-wave work. **9d.** each.

EKCO Twin H.F. Mains Filters, **1/6** each.

NEW Supply of Resistances and Condensers. Paxolin stripped carrying approximately 8 resistances and 4 condensers of useful values, **1/3** complete.

WE HAVE NOT BEEN BLITZED AND ARE STILL GOING 100 PER CENT. SEND YOUR ORDERS WITH EVERY CONFIDENCE. "THE CABIN" KEEPS GOING!

Postage must be included with all orders.

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75, Newington Butts, S.E.11. 'Phone: Rodney 2180.

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NGLAND'S GREATEST BUYERS OF SURPLUS ADIO AND ELECTRICAL GEAR. STOCKS SSEMBLED FROM GOVERNMENT, G.P.O., ARMY, .A.F. AND PROMINENT RADIO AND TELEVISION ANUFACTURERS. ALL TO BE SOLD AT LOW PRICES, FREE OF PURCHASE TAX.

ELEVISION diode valves. Surplus quantity to clear low price. Unused Mullard Type EA50, midget pe, size 69 m.m. x 12 m.m. overall. 6.3 v. heater at amp.; 10/6 each.

ONDENSERS.—Special offer of metal cased paper ndensers, 300 v. working. Made by big and well own government contractor. All brand new and nused. 2 mfd., 1/9; 1 mfd. x 1 mfd., 1/9; 1 mfd., -; .5, .25 and .1 mfd., 8d.

UBULAR condensers, paper type 186. .5 mfd. 450 v. .C. working, to clear, 5/6 doz.

ESISTORS, 10 watt, 100 ohm vitreous enamelled ains resistors, 1/3 each.

URN-TABLES.—Bargain line to clear stocks. 6in. ll-bearing bakelite turn-tables, cheap 1/3 each.

X-BAIRD. Paxolin squares, 2⅜in. x 2in., to clear, 9d. oz. Wax impregnated cardboard panels, 10½in. x 6in., 3 doz. 30 ohm volume controls, wire wound, 1/3 ch. Short-wave coil 7.23 metres mounted on ceramic immer, 1/- each. A big range of volume controls, ohms, 1/9; 200 ohm, 1/-; 1,000 ohm. 1/3; 2,000 hm, 1/-; 5,000 ohm, 1/6; 1 megohm, 2/3. All above ems are high quality television components, new and nused.

LEXIBLE DRIVES. Well made, shielded cable drives r remote control. Ideal for radiogramophones. pprox. 2' long. To clear, 4/- each.

LECTRO-MAGNETIC COUNTERS. Resistance 0 ohms. Counting from 1-12,999. Size 4⅜" x 2" x 1¼". x-G.P.O. Invaluable for countless purposes, 9/6 ch. A smaller type, 1-1,999, size 4¼" x 1½" x 1⅜", 6. Cannot be repeated, and doubtful if they can be rchased brand new to-day.

MALL MECHANICAL COUNTERS, with striker m registering up to 9,999. Heavily constructed to and any amount of hard wear. To clear, 3/6 each.

ALVEHOLDERS. Belling-Lee special H.F. 5-pin, hassis mounting in black bakelite, 6d. each, 5/- doz.

LESSEY Small block type condensers, two tappings, 005 and 0.1 mfd., 350 v. test, 1/- each, 10/6 doz.

NGLE Earpieces. A good line for experimenters ith flexible metal sheathing, chromium-plated. Only few to clear. 2/6 each.

ARIABLE CONDENSERS. Well made heavy 3-gang perhet condensers. Die cast frames in first class ondition. Low price to clear stock 1/3 each.

MALL REVERSIBLE A.C. MOTORS (as used for otortuning). 25-30 volts A.C. Built-in reduction gear indle. Speed about 60 r.p.m. A first-class job with undreds of applications. 8/6.

UDAK PICK-UP HEADS. High resistance coil, ade by the famous Audak Company of New York. xtensively used in sound recording and laboratories deal for gramo turn-table amplifiers, 6/6 each.

UDAK CUTTING HEADS. Heavy duty type. 3-5 hm coil. A really high-class instrument, 17/6.

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CREENING shields in aluminium, 6½in. x 5in. x 5¼in., rand new and unused, 2/6 pair.

OILS of wire. Approx. 30 gauge stranded sleeved ire in coils weighing 12¾ oz., 2/-. Also scanning coils, imilar gauge, 9¼ oz., 1/6. Also 17-gauge stranded otton and rubber covered, 2 lbs. 11½ oz., 4/-.

ULGIN 250 v. 5 amp. socket with plugs mounted on racket, unused, 1/- each.

UTPUT TRANSFORMERS. Primary 300 ohms D.C. econdary .5 ohm D.C. Brand new, manufacturer's ype, 4/6. Also new chokes, 3 henry, 150 ohms, 3/- each.

RESISTANCES. Assorted values and makes, Erie, T.C.C. American, etc. Resistances are in short supply —get a dozen or so while you can. Low price of 1/6 doz.

TAPPED mains resistances. Another good line, for 2 amp. valves. Tapped at 200, 230 and 250 volts. To lear. 4/- each.

WESTINGHOUSE Rectifiers. The popular type H.T.S. Slightly used, but guaranteed in good condition and working order. Only 8/6 each.

B.I. CONDENSERS. Block type oil filled in metal cases with terminals. High quality components. 4 mfd. 95 v. d.c. test, 3/6 each. Also .1 mfd. 1,000 v. d.c. est, 2/6 each and 0.25 mfd. 1,000 v. d.c. test, 2/6 each.

RELAYS. Small relays for operation on 2 v. D.C. with 6-way make and break switches. Brand new, many useful applications, 5/- each.

TRIMMERS. Twin trimmers on ceramic base, brand new, to clear 6d. each, 5/- doz.

SEE ALSO OUR DISPLAY ADVT. ON PAGE 371. SUFFICIENT POSTAGE MUST BE INCLUDED. REGRET NO C.O.D. ORDERS ACCEPTED.

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

SOUTHERN Radio's Wireless Bargains. Most lines previously advertised still available. New list to be advertised shortly. Southern Radio, 46, Lisle Street, London, W.C. 'Phone: Gerrard 6653.

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

AMERICAN AND B.V.A. VALVES. These are getting very short. We have many types available at keenest prices. Send us your lists for a quotation.

SPEAKER TRANSFORMERS. Now available, now stocks of a superior line. Soundly constructed, brand new, manufacturer's type, pentode output, 3/- each.

SOLDER. Very best quality resincore solder, 50 per cent. tin, 12 gauge, 6d. a length.

VARIABLE CONDENSERS. 3-gang, .0005 mfd. A fine job with die-cast frame and solid aluminium vanes, 2/6 each.

MAINS TRANSFORMERS. Manufacturer's type. Input 200/250 v. A.C., tappings for 5 v. rectifier, 6.3 v. platers, 350-0-350 v. Not new, but in perfect condition, 9/6 each.

RESISTORS. Enormous purchase enables us to make an amazing offer to servicemen and experimenters. Genuine Erie, brand new, 1 watt resistors. All various useful and practical values, in approximately 18 sizes, 4/- dozen, 40/- gross.

Hold large stocks of the above, can quote extremely low terms for large quantities. Postage extra.

GEE ELECTRIC, 15, LITTLE NEWPORT ST., W.C.2.

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OFFERS: 2-v. S.W. set, valves and parts.—Jordan Ecclesall Vicarage, Sheffield.

AVOMINOR, in case, complete as new, £2/5/0. New Premier, S.W. A.C. Kit, as delivered, with extra coils, £5/5/0.—E. Evans, 15, Church Road, Shirley, Birmingham.

SHORT-WAVE EQUIPMENT

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

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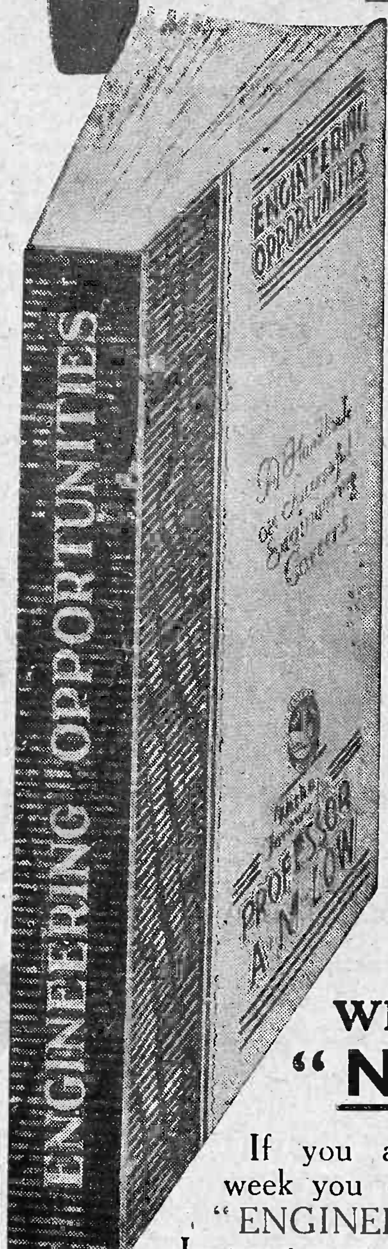

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