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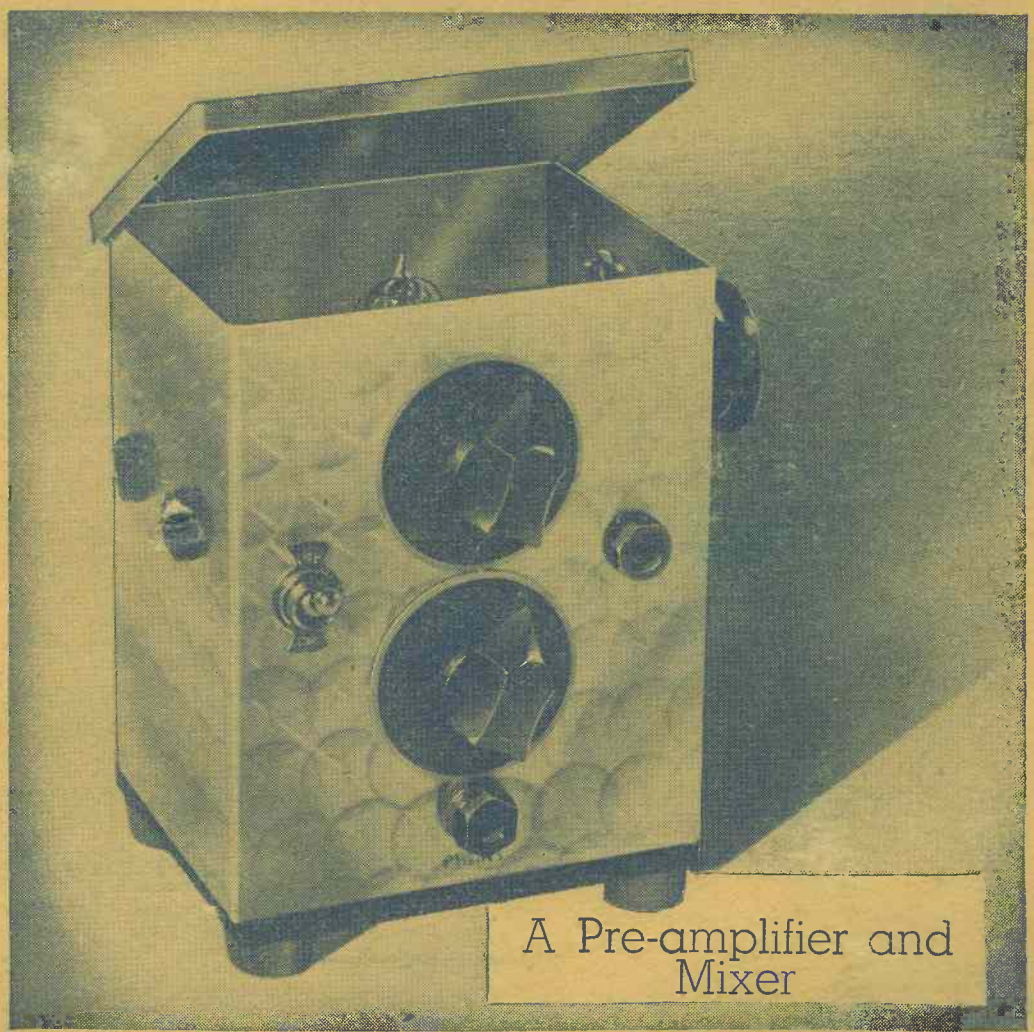
EVERY WEDNESDAY

Feb. 3rd, 1940.

Contents



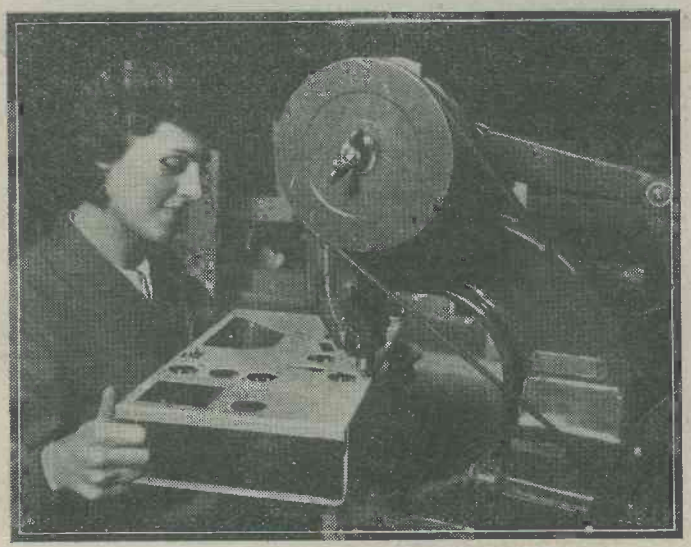
A Pre-amplifier and Mixer

Practical and Wireless
PRACTICAL TELEVISION
EVERY WEDNESDAY
Vol. XV No. 385. Feb. 3rd, 1940.
EDITED BY F. J. CAMM
Staff: W. J. DELANEY, FRANK PRESTON, H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Head Amplifiers

IT is often necessary to employ a small specially built amplifier in conjunction with microphones, either to remove certain forms of instability or to provide additional gain. With some instruments, for instance, it is not possible to run long leads to an amplifier, and when such a microphone is used on a large stage, the length of lead which would be needed to connect to an amplifier off stage would probably prevent the microphone from working, or at least seriously impair the results. These small amplifiers are generally known as Head Amplifiers, and although they are not needed with every microphone, such an instrument will be found to offer many advantages even with simple mikes. In the design of such an instrument many novel features may be introduced, and in this issue we give details of construction of a small self-contained amplifier which will undoubtedly interest many constructors, even if they are not building public-address or similar equipment. The amplifier incorporates one of the midget Hivac valves, jacks and mixing controls and will be found to offer many sources of interesting experiment.



Components are mounted on chassis in the Ekco factory by rivets fed from an auto-riveting machine. Note the rivets feeding down the riveter head.

Anniversary

THIS week marks the anniversary of two or three interesting events in radio history. On February 2nd, 1896, Marconi came to England, and on February 3rd, 1870, the Government took over the British telegraphy system. Oliver Heaviside died on February 4th, 1925.

"Eagle Under the Sea"

THE Polish for "eagle" is "orzel," and this was the name of a Polish submarine which, early in the war, quite quietly pushed itself into history. In the early morning of September 18th, the submarine slipped out of an Estonian port, where it had been interned. With no charts and with five torpedoes as its sole ammunition, the Orzel escaped a series of relentless and determined attempts at recapture. By day, she cruised submerged, quite blind and never knowing when she might strike an obstruction. By night, every effort was made by her enemies to prevent her surfacing in order to charge her batteries. Finally, on October 14th, a faint message was picked up in Britain: "Beg permission entrance and pilot, but have no chart. Orzel."

Stephen Potter, who, on February 6th, will produce a programme based on this heroic episode, has been in close personal touch with Lieutenant-Commander John Grudzinski, who commanded the Orzel, and other officers. He was profoundly struck with the matter-of-fact attitude that the gallant crew took of their exploit. When finally the submarine was led into harbour by a British destroyer, the men had only three requests—to land their sick, to replenish their water supplies, and to be given breech blocks for their guns. They were then prepared to go to sea forthwith on whatever patrol the British Navy might desire.

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"Forever England"

ONE of the most successful programmes which owe their origin to the war is Val Gielgud's "Forever England," which was originally produced last October. This feature, which illustrates the spirit of the British Army through four centuries of fighting men, is to be repeated on February 1st.

Hen Party

MEN must work, but women must not necessarily weep. In these days of A.R.P. and A.F.S. lots of women have plenty of time on their hands when their men folk are out on duty. "Hen Party," a Northern variety show to be broadcast on February 1st, is designed to alleviate the tedium. It is a drawing-room party, composed entirely of women, all of them Northern radio variety artists.

The "Northcountrywoman"

DO housewives buy their green-groceries from a street hawker or do they buy them from a shop? Listeners will hear a talk around questions of this sort in "The Northcountrywoman" programme on February 1st. Apparently, green-grocery establishments, mobile or stationary, in the North, are the subject of a controversy, for the title of this contribution to the feature is "What is the matter with green-grocers in the North?" The subject will be debated by Mrs. Margaret Ryan, editress of the series, and Alderman George Hall, a well-known figure in the life of Manchester, who has two green-grocer's shops in the city.

The Grain of Mustard Seed

BARBARA BURNHAM is producing H. M. Harwood's "The Grain of Mustard Seed," to be broadcast on February 2nd. This was one of the early post-war plays produced at the Ambassador's Theatre, London, in 1920. It is a comedy with a strong political background and though extremely topical at the time, is extraordinarily apposite now. It is the story of a business man with his own very definite ideas, up against a bunch of cynical politicians.

H.T. Current Economy

Potentiometer Control of Grid Bias : Automatic G.B. Variation Produced by Signal Output : A Simplified Economiser Circuit By Frank Preston

BECAUSE of the difficulty of obtaining dry batteries of all kinds and the possibility that supplies will be still more scarce in future—it is worth while considering methods of cutting down H.T. consumption. Most of the methods available have been employed before, but in many cases they were abandoned a few years ago; this was not because they were unsatisfactory but largely because more efficient valves, taking lower anode currents, were produced. Additionally, of course, class B and Q.P.P. came into fairly wide use. Both of these systems are economical, especially when a fairly high signal output is required. When only a low output is needed the additional cost of the equipment for these two forms of amplification might not be considered to be fully justified.

Recent articles in these pages have

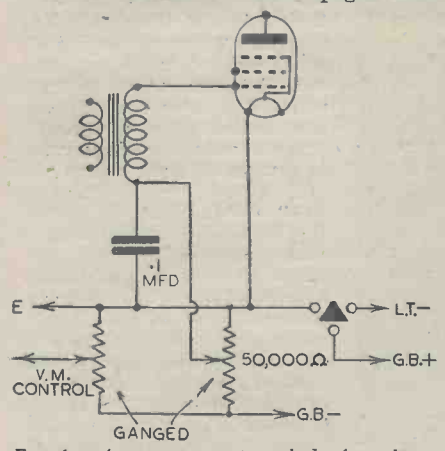

Fig. 1.—An experimental method of combining variable-mu volume control and grid bias control.

shown how valves can be cut out when a lower volume level is sufficient, so that aspect of the question need not be referred to now. Methods of economising in the number of valves and of replacing valves by others of more efficient type have also been explained. And most readers are fully aware that H.T. current consumption is at a minimum when the grid bias voltage is at a maximum. There is a limit to the permissible increase in G.B. voltage, though, since if it is raised too much, quality suffers and volume is lost.

Increased Grid Bias

In general, it is satisfactory to increase the bias when the volume control is turned down; this is explained by the fact that the grid swing on the output valves is narrower at low inputs. Bearing this in mind, there is something to be said in favour of using a potentiometer to supply the G.B. voltage to the output valve. When the volume control is turned up, the G.B. voltage can be reduced slightly by turning the potentiometer knob, and vice-versa.

One method of doing this is shown in Fig. 1, where it is assumed that the volume control operates by varying the bias on a variable-mu valve. The two potentiometers are shown as being ganged together, but there are various practical difficulties in arranging this efficiently, so the actual arrangement shown must be considered as being of an experimental nature only.

In the first place it is necessary that the maximum voltage to be applied to the grids of the H.F. and output valves should be the same. If this were not so it would be necessary to include a switch in series with one potentiometer to prevent a constant leakage of current between the two negative G.B. tappings through the two potentiometers. In addition, the variation in G.B. applied to the output valve must be much less than of that to the H.F. pentode. It might be possible to overcome this if only a small variation in volume is thought necessary, by so ganging the potentiometers that the arms of the two are in different relative position, and that on the potentiometer for the output valve is on the end portion of a graded potentiometer. If the two potentiometers are used independently the matter is considerably simplified, and there will seldom be any objection to taking both potentiometers to the same G.B. negative tapping.

Decoupling

Another method of economising in battery cost is to make sure that the detector valve—and H.T. valves also, for that matter—is well decoupled; the advantage in this is that it is possible to continue to use the battery after its voltage has fallen very considerably. When decoupling is not used, or if it is not very efficiently carried out, serious distortion becomes troublesome once the voltage has fallen by about 30 per cent. Another item which is helpful in this connection is a large-capacity condenser wired directly across the H.T. battery, between positive and negative terminals. This may have a capacity up to 4 mfd., but should not be of the electrolytic type. Do not forget, when prolonging the use of an H.T. battery in this manner, that the G.B. voltage must be gradually reduced as the battery runs down if reproduction is to be fairly good and volume level is to be kept as high as possible. Automatic G.B. provides the simplest and most effective means of ensuring this without the need for any adjustment.

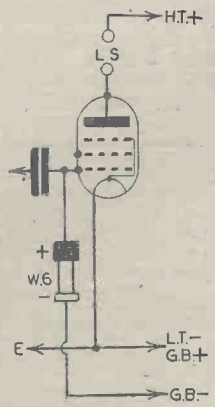

Fig. 3.—A simplified H.T. economiser arrangement suitable for use with an R.C.C. stage.

Automatic G.B. Regulation

An entirely different method of reducing H.T. current consumption is one which was used fairly widely a number of years ago. Many constructors appear to have forgotten

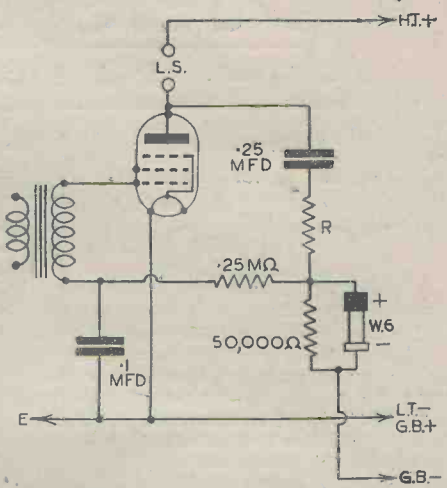

Fig. 2.—A "standard" H.T. economiser circuit incorporating a Westector. Suitable values for resistor R are given below.

it now. The object of this system is to provide a means whereby the G.B. voltage is regulated automatically according to the strength of the signal being received. Strictly, it depends upon the strength of the signal as fed to the output valve, and therefore the bias is automatically increased when, for instance, the volume control is turned down.

Valve	H.T. voltage	Value of R	Anode Load of Valve
		ohms	ohms
Pen 220A	150	100,000	7,500
220 P.T.	120	100,000	9,000
Pen. 200 220 H.P.T. P.T.2	150	150,000	17,000
P. 220A P. 2	150	20,000	4,000
P. 220 L.P.2 220 P.A.	150	60,000	10,000

There is far more in this idea than is at first apparent, since the carrier wave is fully modulated for only a very small percentage of the period of a transmission. Thus, even when the volume control is turned full on, the output valve receives a signal providing maximum grid swing for only a few minutes in every hour. It is upon this fact that class B and Q.P.P. rely for their advantages. Fig. 2 shows an economiser circuit which has frequently been employed with complete success. A pentode valve is shown in the output stage, but the principle is equally applicable when a triode or tetrode is used. The idea is that a portion of the audio-frequency current in the anode circuit of the valve is by-passed through a fixed condenser and a fixed potentiometer, across one arm of which is wired a Westinghouse H.F. metal rectifier. As may be seen, the bottom of the potentiometer is connected to the G.B. negative terminal. But instead of using, say, the 4½-volt tapping, a total of about 9 volts G.B. would be used.

Thus, when there is no audio-frequency current supplied to the output valve, the full bias is applied to the grid. When the valve is handling a signal, however, part of the available A.F. current is rectified by the "Westector" (a style W.6 is

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Locating Faults—2

Further Details of Set Testing are Given in This Article

By L. O. SPARKS

ASSUMING that the detector and L.F. stages have received the tests already suggested, and that they are passed as satisfactory, the next step is to examine the pre-detector stage which, in the circuit in question, is a simple tuned S.G. circuit.

By connecting the aerial, via a small fixed condenser to the connection normally taken to the top cap of the S.G. valve, we were able to prove that the set was or was not O.K. from the detector grid coil to the output stage. If then, when the aerial is connected to its correct input, i.e., the aerial tuning circuit across the grid of the S.G. valve, no signals, signals plus instability, no signals but only instability or signals but very little increase in amplification are the result, then the trouble must obviously be connected with the H.F. stage which also includes the aerial tuning arrangements.

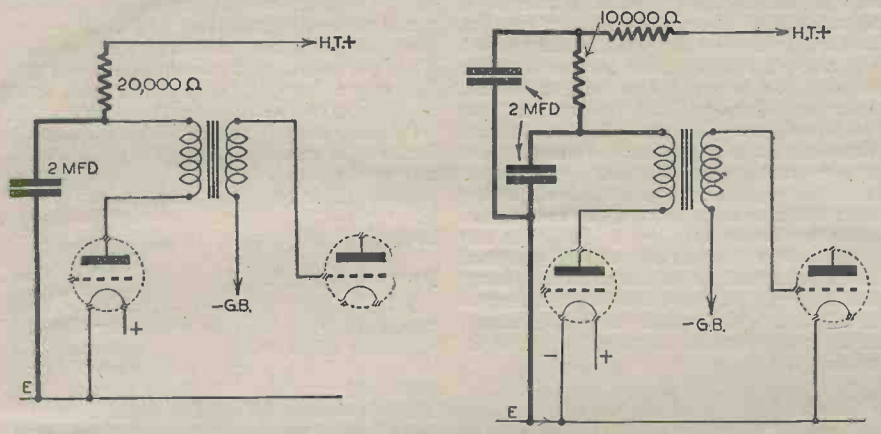

Fig. 1.—(Left) The most simple form of anode de-coupling. If this does not produce the required result then the method on the right should be used.

H.T. Voltages

Commence investigations by carefully measuring the H.T. voltages on the actual anode and screen-grid terminals. If these are low, check back on the respective H.T. supply lines and examine all components electrically connected to them, i.e., de-coupling condensers, potentiometers, H.F. coupling condenser feeding detector grid coil, H.F. choke, resistances, and finally all associated wiring for high resistance joints. These can be caused by a fractured wire, a loose and dirty connection or a poor (cold) soldered joint.

Next, measure the anode current by inserting the milliammeter in the anode circuit between the H.F. choke and the H.T. supply. If the reading is low, that might be due to the valve being below normal, excessive bias, when such is employed, low screen voltage instability or low filament current. If, on the other hand, the anode current is high, then faulty valve characteristics might again be responsible. A high screen voltage or an open grid circuit, i.e., no complete path between the grid and earth or bias, could also produce the same result.

Aerial Tuning Circuit

When one is satisfied that the H.F. valve, and its operating conditions are in order, then the aerial tuning circuit should be subjected to a thorough examination, particular attention being given to the coil connections, checking them against wiring diagram or coil maker's instructions. Tuning condenser, including its trimmer, should be tested for short circuit, i.e., vanes touching. Wave-change switching, aerial series condenser and connections to actual aerial and earth sockets—especially if a metal chassis is used—must all come under observation, and finally, if no other faults are revealed to account for the trouble, continuity tests must be applied to each winding of the coil to see if any break or faulty connection exists in that component.

Other Faults

So far we have only dealt with "no signals," but there are many other likely faults; therefore the most common of these are dealt with below.

One of the most frequent is instability. This can be present in two major forms, namely, H.F. and L.F. and each form can produce many other associated troubles. Generally speaking, however, H.F. instability usually indicates its presence by whistles, erratic reaction and tuning, distortion and poor signal strength. The L.F. counterpart also usually reveals itself by some audible symptom which can take the form of a slow "flub-flub" sound which rises, according to nature of the instability, to a much more frequent "tub-tub-tub" note of a higher pitch. A rather shrill shriek can also be produced, while at other times the trouble will do no more than to produce a weak continuous whistle to let you know that it is there.

H.F. Instability

When seeking a cure for H.F. instability one must pay attention to many items. Firstly, see that the detector and H.F. valves are operating at correct voltages; high values make the trouble most likely. See that the wiring of the grid and anode circuits is not responsible by being so arranged as to allow interaction between them. With S.G. valves it is always advisable to screen the anode lead by making use of metallised sleeving, and seeing that the metallising is connected to earth. Give particular attention to all anode decoupling resistances and condensers associated with these valves. Low values for the de-coupling resistances and condensers can often cause the trouble, while faulty layout of the components, poor screening or high resistance earth connections will all contribute to instability. In the case of the detector valve, the cause can be connected with the design of the reaction circuit, i.e., reaction condenser of too large capacity or too many turns on

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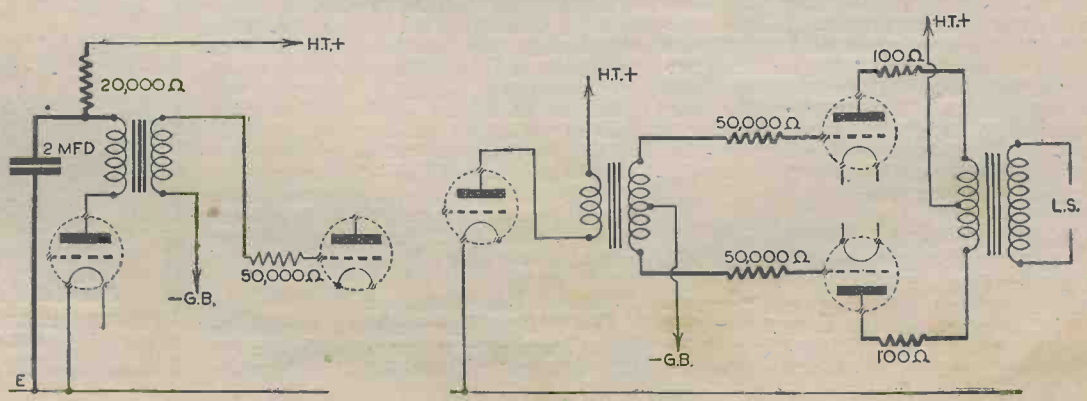

Fig. 2.—(Left) Anode and grid decoupling for single and push-pull circuits. The values shown are usually quite satisfactory.

Comment, Chat and Criticism

Moods in Music

Our Music Critic, Maurice Reeve, Discusses the Serious Frame of Mind of the English Concert-goer

THE old saw that said an Englishman takes his pleasures sadly, and seriously, was not so far from the truth as might be thought. All of us know the dead seriousness with which we hang upon the result of an Anglo-Australian Test Match, whilst those who have seen an encounter between Yorkshire and Lancashire know all about a fight to a finish. As the late Lord Hawke once remarked, when asked why the Yorkshire team of the day didn't seem as if they were going all out for a win, "If you can't win, why lose?" And so it is with most other things, with a few honourable exceptions. Music is not one of these. The gravity and aloofness of the average concert-goer as he makes his way to Queen's Hall, stands in the queue, and then sits for half an hour waiting for the fun to begin, is truly formidable. Nothing can detach him from his mood of self-absorption. Any neighbour trying to make conversation, even of the most intelligent and informed kind, is choked off with scorn and anger, whilst if anyone should dare intrude upon his self-created mental world peopled with beloved images and phantoms and memories, even to turn over the leaves of his programme or to ease his aching limbs, sore from a long sojourn in one posture, he gets such a look as will cause him to blush with shame for his "want of culture" and "love of music." These are facts. Is there any wonder that the English take their pleasures seriously?

Ritual

But therein lies the fun. The excitement largely consists in the making a ritual of it, and the casting a glamour round it, everything from the great artist invisible behind the curtain screening off the artist's room from profane eyes to the gentlemen with black waistcoasts under their "tails," who greet you in mellifluous tones with, "Programme and notes sixpence!" And the portrait that may be inside that programme! Why, that will beggar description!

Of course, the artists themselves are largely to blame, though they cannot always be held responsible. An adequate performance, especially from memory, needs a concentration of all one's faculties which few can fully appreciate other than those who know from experience. This is necessary for the mere mechanical presentation of the work—the unfaltering technical performance of it, in addition to the avoidance of any possible lapse of memory. The interpretation of it requires something else as well, which the audience is naturally going to contribute to or detract from, according to how it demeans itself.

Unbending Musicians

But I do think that, apart from all these considerations, as well as the very important one of platform deportment and "personality," concerts are apt to tend towards the ultra serious, and that musicians giving them might unbend occasionally, even to the extent of permitting smoking. I am sure that they would be well repaid, and that it is only a question of time, and the gaining of experience on the part of the concert-going public, when such things as the striking of matches during a performance would never be heard throughout a season. After all, a great actor is as great an artist as a great musician, yet though he lets you know the fact in a hundred ways, I don't think he is quite so self-opinionated as they are in the musicial world.

Is it, therefore, any wonder that the average Englishman prefers music of a contemplative character—so far as the shorter forms are concerned, at any rate? Is it really surprising that he would prefer listening to even such mild-mannered pieces as Elgar's "Salut d'amour" or Tschaikowsky's Chanson Triste, whilst taking his tea in a popular restaurant, than to more exciting and stimulating subjects? In thinking of this problem, and jotting down the names of the first twelve pieces that came to my mind—for the list in my last article on the subject was no personal choice, but merely the result of an imaginary plebiscite—I could not but help coming to the conclusion that a definite taste in music has been bred as the result of this trait in our national character.

Waltzes

If you run your mind quickly over English music it will again be borne out. Take English waltzes. Is there a lively one amongst the well-known ones? Is there anything that even remotely resembles Strauss or Waldteufel? "Destiny" and "Salome" are two of the best and very typical of many. Both are sad and wistful to a degree. Not, mind you, the sadness of melancholy or unhappiness, but the sadness as of regret for a thing that has passed, no matter how beautiful it was and no matter how sweet the memory of it is. Then take the very titles of some of Strauss's most famous numbers—"Wine, Women and Song," "Artist's Life," "The Bat," and a host of others. All tell of joy in the present and thrill of being alive—champagne and diamonds—let's eat, drink and be merry for to-morrow we die!

Is there a suite the mood of which is comparable to Tschaikowsky's Casse Noisette? Contrast Elgar's two wonderful symphonies with the Fifth, Sixth, Seventh or Eighth of Beethoven. I am not in any way comparing the *quality* of our music with that of foreign origin—such a thing does not enter into the scope of this article at all. I merely set out to try and show that there is very little English music of a really joyous and irresponsible nature, in which the composer might be imagined as saying "Whoopee," and "I don't care a hang for anybody!"

National Temperament

The national temperament cannot be defined as wholly sad or melancholy; on the contrary. "Pickwick" is perhaps the most typically English book ever penned, and most of the literature, from Sterne and Fielding to Wodehouse, abounds in gaiety and jollity. Our painting, too, breathes a fine spirit of nonchalant good humour. Our best poets, on the other hand, are more in tune with our best musicians. We have few who sing of the joys of living; most of the immortals breathe that little sigh of wistful regret, either of something lost or else unobtainable. Probably the national traits of any country should not be looked for in such artificial creations as music or poetry—our attitude towards such an event as the war is no doubt a much more accurate key to it. Here we have the Englishman at his most sublime. The war won, right from the word go. Scarcely a thought given to such things as its duration or its cost, for the very reason, no doubt, that it would be as impossible for him to conceive of us losing it as for anyone to prove to him that there was a better fighter than he. Magnificent truculence which the French seemed to adopt in the last war with splendid results.

Proper Attitude

I think that a proper attitude towards music should be serious, and that to approach it in a flippant or irresponsible frame of mind would be quite wrong. Such a listener would be the biggest loser. But music is a creature of such infinite moods and inexhaustible enchantments, and variety, that we should only listen to it when our mentalities are at their most receptive, and our minds in their most malleable moments. We should never listen if we feel at all "fixed" in our ideas, and at all unlikely to accept the composer's point of view. It is because we listen at such unsuitable moments that so many people are heard saying, "I cannot stand this or that man's music." We should stand them all, which needn't stop us liking one composer better than another. The fact that Elgar is English, Debussy French, and Wagner German, is the source of music's infinite variety. What would the world be like if we all did any one thing in exactly the same way?

The "Ideal" Radiogram

Complete Details of a Seven-valve A.C. Receiver Designed for the Highest Quality on Radio and Gramophone.

By W. J. Delaney

SOME time ago I described in these pages the arrangement which, in my opinion, constituted the Ideal Home Receiver. It was pointed out that gramophone reproduction should be considered as a separate section, and not a mere adaptation of a radio circuit for this purpose. Many readers wrote asking for some practical details of a receiver built on these lines, and the following are the essentials of a receiver which has been built and given great satisfaction from every point of view. The theoretical circuit is given below, from which it will be seen that there are seven valves plus a rectifier, but that in two cases double triodes are employed, thus giving the equivalent of a nine-valve circuit. Owing to the fact that an English equivalent is not available for one of these stages, and in the interests of economy, the receiver was designed round American valves, but these are available from the Premier Supply Stores, although a permit is necessary for the output valves, which are the well-known 6L6 type.

The Circuit

A single H.F. stage is employed for radio reception, but to provide sufficient selectivity to prevent station overlap a band-pass tuning arrangement is employed. A third coil is used to couple the H.F. and detector stage and the three coils which were chosen were the Varley BP113. The terminal reference symbols are given in the circuit diagram. The H.F. valve is of the variable-mu type and thus a simple and effective radio volume control is available, although a further control is fitted on the L.F. side. The use of two controls is desirable, as the first permits the signal voltage to be selected to provide really good quality rectification, whilst the L.F. control enables the output level to be selected to suit the needs of any particular listening period. The detector is a straight-forward leaky-grid arrangement with values chosen to provide good quality on signals of average input. Weak stations will not, in any case, provide quality output, and the receiver is only intended to provide two or three alternatives which can be reproduced at a standard which will satisfy the real music critic.

The inclusion of reaction may be thought by some to offset any reasonable quality output, but this is only included to provide the little extra selectivity which may be needed when, for some particular reason, a distant station is required on a wavelength which is close to a powerful station, and under normal conditions it is not used.

The L.F. Circuit

The output from the detector is taken to a change-over switch, mounted on the coil chassis. This enables the coil wave-change switch to provide also a gramophone position, and the grid of the L.F. valve is fed from the arm of the switch. The coupling condenser is on the L.F. side of the switch and thus serves also as the coupling from the gramophone amplifier, which is the section at the lower part of the circuit. This is a contrast expander arrangement, the pick-up being joined across two volume controls. A multi-grid valve is used and is of the variable-mu type, the signal being fed to this as well as to a triode in the following stage. This amplifies the signal, and from the anode the signal is taken to the remaining triode section of the double-triode valve, but this is used as a diode or half-wave rectifier, grid and anode being "strapped." The rectified voltage developed across the load resistance is then fed back to the first valve and by this means the gain of the valve is varied with the signal, but in such a manner that any decrease in volume of the signal results in a greater decrease in the signal voltage at the anode and vice-versa. Thus the contrast is expanded and a much more realistic result is obtained. This arrangement has, of course, been dealt with before in these pages.

The output from the contrast expander circuit is taken to the change-over switch already mentioned, and the change-over switch feeds another double-diode, the first half of this acting as a straight amplifier, whilst the other section acts as a phase-inverter so that a push-pull output stage may be operated by a resistance-capacity coupled arrangement. This form of amplification is admittedly the best for real quality, provided that it is properly designed and operated, and the use of the separate phase-changer does effectively do the work. In the interests of quality the coupling condensers for the push-pull stage are of the oil-dielectric type. The use of adequate decoupling components will be

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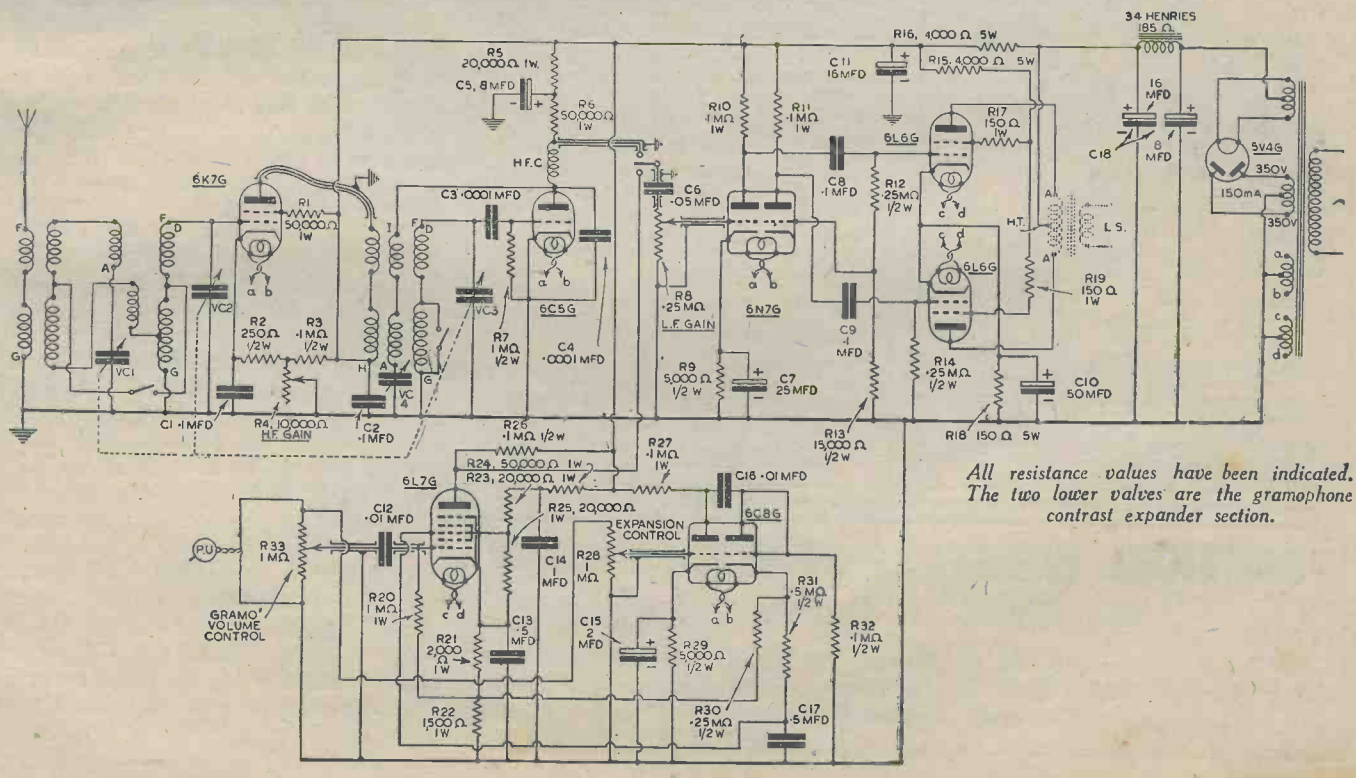


All resistance values have been indicated. The two lower valves are the gramophone contrast expander section.

THE "IDEAL" RADIOGRAM

(*Continued from previous page*)

noted, an 8 mfd. electrolytic condenser and 20,000 ohm resistance being used on the detector stage, whilst the output stage is fed from the maximum H.T. tapping. To lower the voltage to a suitable value for the remaining valves a 4,000 ohm 3-watt resistance is used and decoupling is provided by a 16 mfd. electrolytic condenser. A similar capacity is used for the smoothing circuit after the choke, and an 8 mfd. electrolytic is employed on the mains side of the choke. The 8 and 16 mfd. units are of the double type and space is thereby saved and an economy effected.

Mains Transformer

The mains transformer is a standard Premier model, and two separate heater windings are provided. These are used to feed various valves, and the circuit is "split" to provide a suitable load for each) winding (they are rated at 2 amps. each) and also in a successful endeavour to reduce hum or instability.

There are seven controls, although one of these could be omitted without loss of efficiency. There is the main tuning control (a dual speed slow-motion drive by J. B.); the wave-change and gramo switch; reaction; H.F. gain; L.F. gain; gramo gain (or volume control), and expansion control. It is this latter which may, if desired, be left on the chassis without bringing it out to the panel. It is usual to set this at a pre-arranged setting where it provides the degree of contrast desired on the records which are used. If, of course, your taste embraces both dance music and symphony, then you will need a panel control, as the two forms of music do not need the same degree of contrast expansion. Dance music, in fact, requires very little, whilst good symphonic discs need the maximum expansion for the most realistic results. A good speaker is, of course, absolutely essential, and the receiver is at present being used with a dual combination of large diameter moving-coil in conjunction with a tweeter fed through a frequency filter. The reproduction leaves little to be desired, although unfortunately radio signals are, at the moment, owing to changes enforced by national security, not up to pre-war standards, although they appear to be improving.

NEW SERIES

RADIO ENGINEER'S POCKET-BOOK

No. 4

Capacity of a Fixed Condenser

$$C=\frac{.0885\ AKN}{1{,}000{,}000\ d}$$

Where K = Specific Inductive Capacity of dielectric.
N = Number of dielectrics.
S = Area of overlap of plates in square centimetres.
d = Thickness in centimetres.

Another Formula:

$$C=\frac{AKN}{4{,}500{,}000\ d}$$

Where A = Area of one plate in square inches.
K = S.I.C. of dielectric.
N = Number of plates minus one.
d = Thickness of dielectric in inches.

OHMS LAW

For D.C. $I=\frac{E}{R}$

For A.C. $I=\frac{E}{Z}$ where $Z=$ impedance of circuit.

Watts dissipated. $=I^2R=EI.$

Watts dissipated. $=I^2R$ $=E\ I\ cos\ \emptyset$ where $\emptyset$ = phase angle between E and I.

Capacity of Condensers in Parallel.

$$C=C_1+C_2$$

Capacity of Condensers in Series.

$$C=\frac{1}{\frac{1}{C_1}+\frac{1}{C_2}}=\frac{C_1C_2}{C_1+C_2}$$

Resistances in Parallel.

$$R=\frac{1}{\frac{1}{R_1}+\frac{1}{R_2}}=\frac{R_1R_2}{R_1+R_2}$$

Resistances in Series. $R=R_1+R_2$

Resistance, Capacity and Inductance in Series.
Resulting Impedance.

$$Z=\sqrt{R^2+\left(\omega L-\frac{1}{\omega C}\right)^2}=\sqrt{R^2+X^2}$$

No. 5

Reactance of Coil. $2\pi fL.$
π, 3·14; f, frequency; L, inductance in henrys

Reactance of Condenser. $\frac{1}{2\pi fC}$
C, capacity in farads.

Net Reactance. $X=X_L-X_C$

At Resonance, $f=\frac{1}{2\pi\sqrt{LC}}$, or $\omega^2=\frac{1}{LC}$

Wavelength. $\lambda=1884\ \sqrt{LC}$
λ, in metres: L, in microhenrys; C, in microfarads; $\lambda\times f=300{,}000{,}000.$

Resistance of a Tuned Circuit at Resonance (Dynamic Resistance).

$$R=\frac{L}{C\times r}$$

r being the equivalent series resistance.

Magnification of Tuned Circuit. $m=\frac{\omega L}{r}$

Current in Series Circuit at Resonance. $I_{res.}=\frac{E}{r}$
where r is equiv. series resistance of circuit at wavelength concerned (high-frequency resistance.

Peak Separation (Band-pass Tuners).

$P=\frac{\sqrt{\omega^2M^2-r^2}}{2\pi L}$ cycles (inductive coupling).

$\omega=2\pi f$; M, mutual inductance in henrys; r, equivalent series resistance of tuned circuit; L, inductance in henrys.

$$P=\sqrt{\frac{1}{\frac{C^2}{C_m^2}}-r^2}\ \frac{}{2\pi L}$$ (capacity coupling). cycles

C_m = coupling capacity in farads.

Inductance of Single Layer Coil.

$$L=\pi^2n^2D^2/k+10-2$$

L, in microhenrys; π, 3·14; D, diameter in cms.; number of turns to the cm.; l, length in cms.; k, a factor depending upon the length/diameter ratio.

When $\frac{D}{l}$ =	0·1	0·5	1·0	2·0	3·0	4·0
k =	0·96	0·82	0·69	0·526	0·429	0·365

Notes from the Test Bench

Electrolytic Condensers

ONCE again we must point out that certain types of electrolytic condenser must be mounted in a certain position. The question of polarity is understood and very few constructors connect these components with wrong polarity. If they do, of course, the condenser is destroyed. On the other hand, many constructors mount cylindrical electrolytics, which must be kept in a vertical position, on a chassis which will eventually be placed in a cabinet in such a way that the condenser will be lying horizontally. In a radiogram, for instance, the chassis may be suspended from the motor-board, or mounted on the side of the cabinet. The actual position in which the condenser will finally be used should, therefore, be carefully considered. This question does not apply to the carton type of electrolytic and some dry electrolytics.

Panel Controls

MANY constructors grumble at the finished appearance of their receivers on account of the fact that the control knobs are not all of the same pattern. This is due to the fact that some manufacturers supply control knobs with their components and they do not all use the same pattern. It should be remembered, however, that firms such as Bulgin can supply many different types of control knob, and if it is not possible to match existing knobs it is possible to obtain a set of one pattern. Knobs may all be of the same size, the differences in spindle size being accounted for by small reducing sleeves which may be obtained in various sizes so that knobs with a standard $\frac{1}{4}$in. bush may be used.

Filament Winding

WHEN it is desired to use a valve with a mains transformer which has a winding rated to deliver more voltage than the valve takes, it is quite in order to use series resistances to drop the excess voltage. An example is the use of 4-volt valves on a 6-volt heater winding. It is important to note, however, that the excess voltage should be dropped not across one resistance connected to one heater lead, but by using two resistances of equal value, one in each heater lead. This is on account of the fact that the use of one resistance will unbalance the winding if the centre-tap is being used and hum will be introduced. If, of course, the centre tap is being dispensed with, or a hum-dinger or similar device is being used, then a single resistance may be used for the voltage dropping.

ON YOUR WAVELENGTH

By Thermion

A Significant Resolution

AN important resolution was passed at the A.G.M. of the R.M.A. It reads: "That the R.M.A. desires to work under the Government global allocation scheme for the supply of raw materials for the manufacture of broadcast receiving equipment, and accepts the responsibility for the sub-division amongst individual manufacturers of material so allocated."

This means, if the Government acquiesces, that all materials would be controlled by the R.M.A., and that individual manufacturers would have to apply to them for their supplies.

From Adelaide

I HAVE just received a Christmas card from one of my readers living in Adelaide. Apt name. Accent on the *delayed*! All the same, reciprocal greetings to the sender.

Frost and Radio

FOR those who like radio posers, here is one which was recently put to me by a friend. During the keen frost (all the water in the pipes of my friend's house was frozen) he switched on his A.C. receiver in the usual way, but it was completely "dead" apart from the illumination of the pilot bulbs. Not being a wireless enthusiast, my friend didn't know what to do about the set. He switched the mains supply off and on again a few times, but the speaker still failed to emit even a background hiss.

Having no knowledge of radio, he thought that the frost had affected the receiver. So he placed an electric fire near the set and went back to deal with the frozen pipes. In just over 20 minutes the speaker "burst into song," as he put it, although the set had not been touched in the meantime.

Afraid I cannot subscribe to the frost theory, but neither can I give any better explanation from the facts which I have set out above. Can you?

"MORCEAU"

The Soft Answer turneth away wrath, and Polite Requests are better than Rude Demands.

A READER from ayent the Tweed
Has ventured on a foolish deed;
He signs himself as Mr. J. A. C.
Lacking manners, sad to state,
He threw about his weight,
And what followed you shall very quickly see.

"I demand an A.C.R.;
Send it to me, at Forfar."
But the Editor quite firmly answers: "Nix;
Your demand will not be met,
And no Ticket will you get
For such very elementary short-wave tricks.
From your high horse please dismount
'Doorstep Stations' do not count.
Our Certificates are awarded 'For Far' Farther—
Shocking pun, but you deserve it—
'A.C.R.' We must reserve it;
And, when claiming, kindly note that we would rather
More civility were used
And our rules were not abused;
And before you join our little expert band,
Get the stations, then advise us,
Something good, which might surprise us.
And when claiming, write it 'Please,'
And not 'Demand.'"

"TORCH."

The Paris International Trade Fair

I HEAR that, encouraged by offers of support from all quarters, and undaunted by the unknown risks that lie ahead, the Committee of the Foire de Paris announce their thirty-second annual Trade Fair—to be held, as usual, in May—from the 11th to the 27th.

The Committee realise that the abandonment of this important commercial and industrial event, at a time like the present when manufacturers are faced with an entirely changed economic situation, would suggest the relaxation of the policy pursued by the Governments of both France and Great Britain—a policy having as its fundamental principle Franco-British solidarity. It is the hope of the Committee that the Paris Fair will be the means of furthering still more this valuable co-operation and of binding together the industrial interests of both nations.

The international aspect of the Fair will be developed to an even greater extent this year. Already important national sections have been promised from Italy, Holland and Spain, as well as the usual interesting displays from Switzerland, Belgium, etc. Thus, not only will the wishes of the French exhibitors be fulfilled, regarding the continuance of the Fair, but also those of oversea manufacturers, many of whom will be exhibiting for the first time.

This eagerness to participate in the Fair this year is an indication of the determination to safeguard the future—a very necessary forethought when one thinks of the inevitable unemployment that will surely occur after the war *unless* every possible branch of commerce and industry is exploited and developed to the full.

In deciding to hold the Fair as usual this year, at the Porte de Versailles, the Committee and exhibitors alike are showing the same courageous spirit as in 1917, when a similar decision was made in circumstances even more alarming than those of the present day. At that time the German trenches were only 100 kilometres from the capital.

Inventions Competition

THIS important and always popular Competition is being organised, as usual, in connection with the Fair. Last year 769 inventions were submitted by 517 competitors, representing 15 countries.

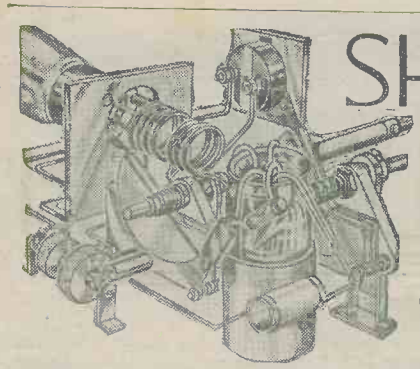
In spite of adverse financial conditions the Committee of the Fair are making no changes in the value of the prizes this year. The figure devoted to this purpose will still be 25,000 francs, as on previous occasions. In addition, there will be the usual medals, diplomas and prizes offered by the President of the Republic, Members of the Government and other Paris bodies.

All persons wishing to compete should send in their Application Form (obtainable from the London Office of the Fair, at 17, Tothill Street, S.W.1, or direct from 23, rue N.D. des Victoires, Paris 2) not later than March 31st. The inventions themselves should arrive in Paris, at the Exhibition Grounds, Porte de Versailles (15), by May 3rd at the latest.

Pocket Receivers

I HAVE been drawn into so many discussions lately, when meeting some of my numerous friends in the Services, about the most suitable design for a really efficient pocket receiver, that I think it is time some of my readers expressed their opinions. There is no doubt about the problem being one which is creating considerable interest, as there are now so many thousands of enthusiastic listeners in uniform who, by very virtue of their present occupations, are unable to make use of a standard receiver or even one of the many small portables, and it is only natural that they want some form of simple receiver to enable them to pass away some of their lonely hours by listening to the B.B.C. programmes.

The introduction of the all-battery type of valve would have been thought by many to have solved the problem, but at the moment these do not appear to have been generally released. Furthermore, the difficulty of obtaining batteries also tends to offset the advantages of this type of valve. No doubt many readers have their own ideas regarding the most suitable circuit. Some favour the small, simple reacting detector followed by one or more L.F. stages, according to the type of reception desired, i.e., headphone or loudspeaker. Others favour the American idea of using multiple valves, where these are obtainable, for the building of a small superhet with only two or three valves in all. Midget components are available in some cases, but not in a sufficiently wide range at the moment for a really comprehensive set. Still, as I said before, it would be interesting to have readers' ideas in this connection, especially so far as concerns the sets which may have been built or thought about by members of the Services.



SHORT-WAVE SECTION

A "SPARES-BOX" SHORT-WAVE CONVERTER

Constructional Details of a Cheap but Efficient Unit

EVERY home constructor turns sooner or later to the short waves. But some get no further than a consideration of the various published circuits before giving up the idea, anticipating endless difficulties in the shape of new equipment, elaborate screening, and so on. Others are disappointed by the poor results of their first efforts and return in disgust to ordinary broadcast work.

To help friends in both these categories, I set myself to find the simplest, fool-proof way of obtaining satisfactory results on the short-wave bands.

Briefly, the set had to be built only from apparatus likely to be found in every constructor's "spares-box"—that is, a sort of addition to the "spares-box" series that appeared in these pages some time ago. To be satisfactory in operation, the set had to provide fairly good selectivity, a good range of stations, enough power to operate a loudspeaker, and be free from threshold-howl, body-capacity effects, and similar ailments peculiar to simple short-wave receivers.

Simple to Construct

Probably the only answer to the above is the short-wave converter, and the apparatus described herein fulfils all these requirements, without demanding any great skill in its construction. In the first place you should have at your disposal a superhet receiver or a good "straight" receiver employing at least one stage of H.F. amplification. This is a fair assumption, since very few homes are without their commercial superhet or H.F.—Det.—L.F. receiver.

No claim to originality is claimed as far as the details of the circuit are concerned, since all have appeared in past issues of PRACTICAL WIRELESS. The arrangement of these details, however, may be new to some readers. That the arrangement is fully satisfactory may be evident when it is stated that this unit has been constructed with apparatus (including valves) at least eight years old, and without one square inch of screening. Results have been obtained as good as other far more ambitious sets.

Most constructors use one valve to serve the dual functions of oscillator and detector, but here two separate valves are used—an ordinary triode (HL or L) and an ordinary "straight" S.G., as shown. Otherwise the circuit is fairly straightforward. The unit can be made up on a wooden baseboard about 8in. square.

The Coil

The coil (originally described in PRACTICAL WIRELESS for the "Simplest Short-Waver") is wound on a 2in. diam. cardboard cylinder. The details are as follow:

(1) Aerial winding: 3 turns, side by side, of 26 gauge enamelled wire.

(2) Grid winding (spaced ⅛in. from aerial winding): 7 turns of 20 gauge enamelled wire (obtained from an old bell-magnet coil), turns spaced by diameter of wire used.

(3) Reaction winding (spaced ⅛in. from grid winding): 5 turns of 26 gauge enamelled wire, close-wound.

The completed windings can be held firmly in position by a thin coat of shellac. The wire gauges specified are not critical.

This coil, when tuned by a .00016 mfd. condenser, has a range of 20 to 40 metres, roughly. But such a condenser is not likely to be found in a "spares-box," so I decided to use an ordinary broadcast component of .0005 mfd. capacity (which must, by the way, have a reasonably good slow-motion drive). To reduce the effective capacity of this tuning condenser, I connected a .0003 mfd. fixed condenser in series with it, as shown. The reaction condenser is a standard .0003 mfd. component. For the series aerial condenser, a fully-variable Polar "Vol. Con." is used, but a pre-set may be used.

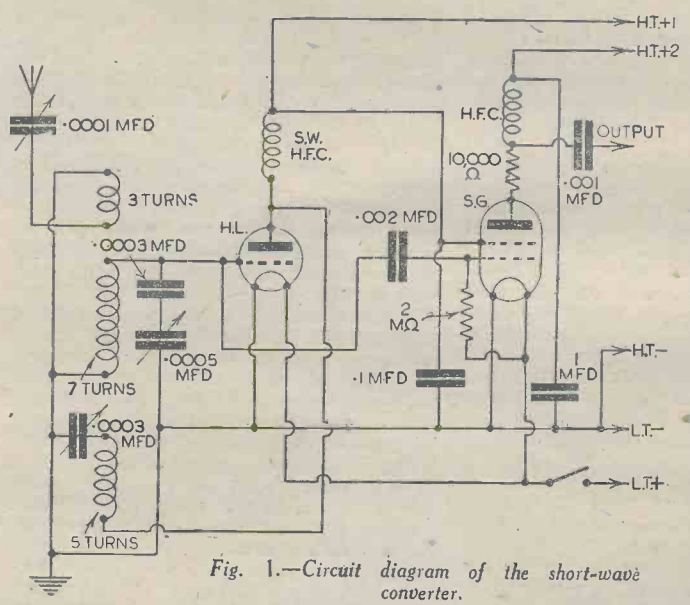


Fig. 1.—Circuit diagram of the short-wave converter.

H.F. Choke

The construction of the short-wave H.F. choke is fairly easy, being that described also for the "Simplest Short-Waver." It consists of 150 turns of 36 gauge enamelled wire wound on a ¾in. diameter test-tube or ebonite former. The 150 turns are wound in five sections of 30 turns each. The turns are pile-wound, and the sections are spaced ¼in. from each other. A cork screwed to the baseboard provides an easy method of mounting the choke.

When assembling the components, take a little more care than with the construction of a broadcast receiver, to ensure that the disposition of the components enables you to make the shortest, most direct connections possible.

Even when the converter is used to feed a mains receiver, it is advisable to use a separate H.T. battery and L.T. accumulator for the converter supply. Adjust your H.T. voltages for maximum efficiency after a little experimenting.

Using the Converter

First, tune your receiver to 1,500 metres, where, in normal times, you would receive the National programme. Then transfer the aerial lead from its terminal to the aerial series condenser of the converter. In its place, i.e., in the aerial terminal of the receiver, connect the converter lead marked "Output." Then, with converter reaction set at zero, switch on the converter and slowly advance reaction until the loudspeaker "comes to life" in the form of a slight hissing sound. Tune slowly along the dial, and several stations should come in at good loudspeaker strength. Any dead spots along the range of the coil can be removed by a careful manipulation of the aerial series condenser. For both this condenser and the reaction condenser, a position can be found which will give maximum efficiency throughout the whole range of the coil without alteration. If a "straight" receiver is used, its reaction condenser, too, can be permanently set after some experiment.

To the experienced short-wave constructor, this apparatus may appear a makeshift affair. But I still maintain that its simplicity and extraordinary efficiency, even on a poor aerial, will be sufficient to encourage the hitherto unsuccessful short-wave constructor to further efforts and renewed interest. Then the makeshift apparatus can be replaced with modern advertised components.

Using a Wearite three-pole anti-capacity switch between converter and receiver, provides a very easy method of converting your set to "all-waves." The connections are shown in Fig. 2. [G.W.B.]

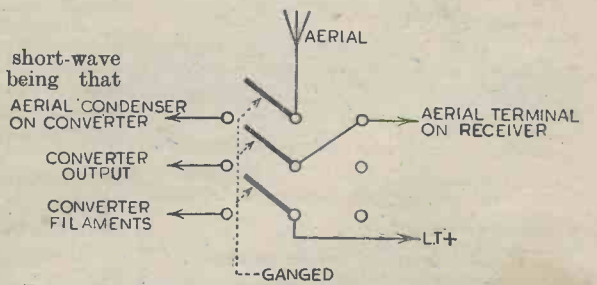
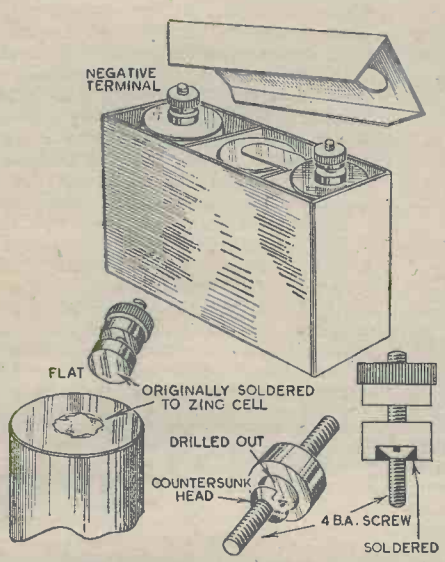


Fig. 2.—Diagram of connections for a three-pole anti-capacity switch.

Practical Hints

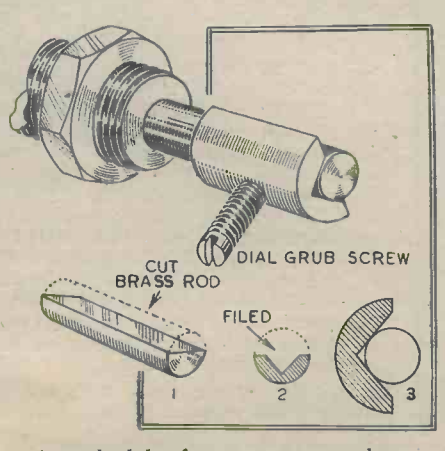
A Use for Old Battery Terminals

AS I use a tester in which 4.5 volts is supplied by one of the terminal type large-capacity batteries (as illustrated), I have, through occasional replacement of these batteries, accumulated a number of spent cells, and it occurred to me that instead of throwing them away I could make economical use of the negative pole terminals which have solid shanks, as shown.



A method of utilising old battery terminals.

One of the reasons which prompted the idea was occasioned by the necessity which arose one day, when servicing a receiver, for a more convenient chassis return method than that which was originally employed. In this instance I was pondering over the better scheme to adopt when I hit upon the idea of drilling a suitable hole in the solid shank of one of these terminals, recessing a screw which I then soldered in place, and finally fitting this to a more accessible point in proximity to the earthy line. The accompanying sketch clearly defines the method adopted, and various other arrangements will, of course, suggest themselves, warranting the collection of such terminals.—G. M. NORMAN (Minehead).



A simple dodge for converting a condenser spindle to a larger diameter.

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.

Conversion for Small Shafts

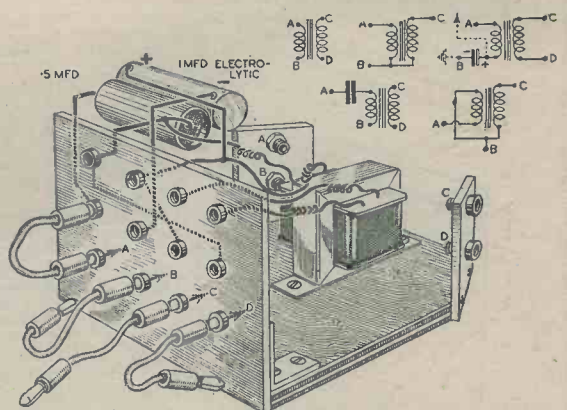
RECENTLY when looking through my junk-box in search of a respectable dial for the reaction condenser on my new set, I found a very nice dial, but was dissappointed to discover that the spindle of the reaction condenser was too small, and that the dial ran eccentric. However, this was soon rectified by the following simple method which will probably help many others who have discarded perfectly good dials. I measured the diameters of the reaction condenser spindle and the dial inlet, I then took a small piece of brass rod of the same diameter as the dial inlet, and cut it in half lengthways (see diagram 1). I put the piece of brass rod in a vice face upwards, and with a triangle shaped file, filed a V-shaped groove in the centre and along the rod (2). When I had filed the groove deep enough to allow the centre of the reaction spindle to be also the centre of the semicircle of the brass rod when the two were combined as in (3), I inserted the brass rod into the inlet of the dial, so that the V was exactly opposite the grub screw, and tightened up. — J. COPLEY-MAY (East Sheen).

A Multi-circuit Transformer Unit

AS an aid to testing, I have found the multi-circuit unit here illustrated particularly useful. Instead of employing a switching scheme, I decided to use plugs and sockets, as they seem to provide a more practical method of change-over.

The wood base on which the transformer is mounted has two corners cut to permit the input and output panels to be mounted at an angle, and these panels are similarly fitted with sockets for convenience in adjustment, these are indicated by the reference letters A, B, C and D. These sockets are correspondingly wired to four sockets on the change-over panel.

When any of the circuits shown inset are required, the appropriate "strapping" is carried out by the fly-lead plugs, by plugging into the particular sockets A-D, and connecting up to the combination sockets above them. The condensers, although illustrated above the panel, actually rest on the baseboard, rather heavier gauge wiring being used to keep them "anchored." —S. F. KELTON (Manchester).



A plug and socket switching unit for transformers used for testing purposes.

A Pre-amplifier

Constructional Details

Home Bro

ONE form of radio entertainment which is becoming increasingly popular is that of "Home Broadcasting," this being largely attributable to the more frequent gatherings now round the fireside.

The majority of receivers making provision for gramophone reproduction afford at least two stages of L.F. amplification, and this is normally quite suitable, assuming the circuit conditions to be up to standard, for the average domestic requirements in the direction of home broadcasting.

The merits of microphone reproduction, however, depend very considerably on the ability of the "home producer" to equalise the sound distribution of the performers in the broadcast with the instruments or effects, good mixing being essentially the factor which ultimately determines the feasibility of, say, a thriller play or a musical item.

This consideration then brings one immediately to the question of microphone to performer distance, the word performer of course being literally applicable to the effects side. For good dramatisation, where the actions and positions of the performers are to be unrestricted, and even with the best microphone obtainable, it is practically essential for an "easy running" reproduction to provide some degree of pre-amplification where not more than two stages of receiver amplification is in evidence.

It is along these lines that the writer carried out some interesting but quite simple experiments to ascertain the better way of meeting the requirements just mentioned, and with no mean view to the question of expense. The serviceableness of a pre-amplifier called for the combined advantage of a mixer control and pilot point to keep a check on the reproduction.

Circuit Details

Fig. 1 shows the scheme adopted, and a preliminary study of this circuit, in conjunction with the other illustrations, will more clearly define the reasons governing the layout. The mixer circuit makes provision for two microphones, but there is no reason why this should not be increased to three or four, provided these are kept to the same circuit potentiometer sequence.

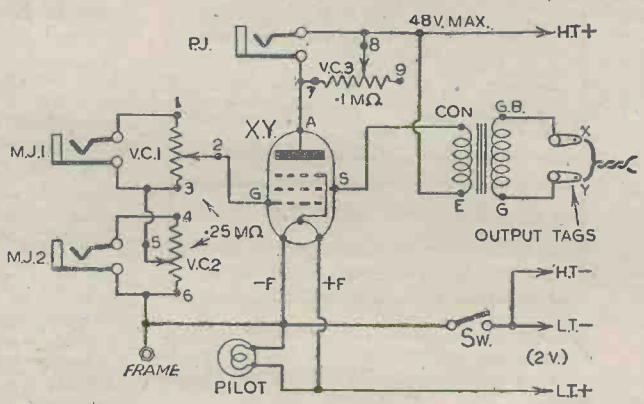


Fig. 1.—Theoretical circuit diagram of the combined pre-amplifier and mixer unit.

The microphone jacks MJ1 and MJ2 are fed through the medium of these potentiometers to the grid of a Hivac midget pentode of the type X.Y., the "earthy" end of this mixer circuit being directly connected to the negative line and frame.

It will be apparent, therefore, that a somewhat higher anode current will flow than would be the case if the grid bias were introduced, but as the lesser of two evils, namely that of either increasing the size of the unit to accommodate a dry cell, or providing a separate battery, as against a low H.T. (since excessive gain is not desired which could soon introduce microphone distortion through overload), the latter consideration is preferable.

The transformer chosen is from the Bulgin range, and is of the filter feed type, but in view of the necessary primary load restriction to a safe maximum current of 1 to 1.5mA, the screen-grid circuit depicted was decided upon, and by so doing, the anode circuit could readily be commissioned for the pilot 'phone tapping.

The simple volume control in parallel

Volume C
Differentia

IN simple straight receivers it has been the practice to use a differential condenser for coupling two H.F. circuits, as, for example, for coupling an aerial to the input circuit, in order to control the volume of reproduction. This type of circuit has the advantage that variation in the coupling does not upset the tuning.

There still remains, however, the disadvantage that one is frequently unable, when listening to a powerful local transmitter, to reduce its signal strength sufficiently. This is because, even when the differential condenser is set to give minimum coupling, energy still reaches the moving plate of the differential condenser *via* the residual capacity existing between it and the fixed plate connected to the aerial.

In the accompanying figure is shown a new circuit which eliminates this disadvantage. The differential condenser is indicated by D. One fixed plate is connected directly to the aerial, and the other to earth, the rotor being connected to the aerial-coupling coil A. The latter is inductively coupled to the grid coil S, and for best results it is desirable that a step-up ratio should exist between the two coils. The aerial is also connected to the top end of the grid coil S (or to a tapping on the coil) *via* the condenser C.

It is the capacity C, in combination with the reversed coupled primary winding A,

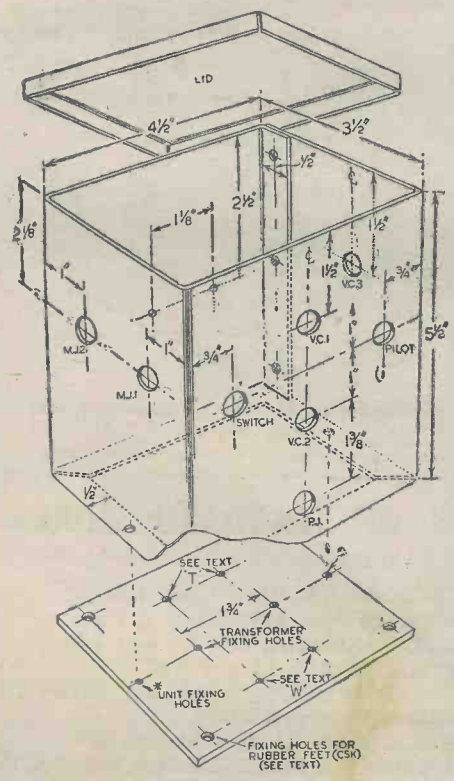


Fig. 2.—Constructional details of the casing.

COMPONENTS FOR THE PRE-AMPLIFIER AND MIXER UNIT

Pilot Bulb fitment
One type D19 (red) miniature signal fitting (Bulgin).
One type B206 bulb. (Bulgin).

Potentiometers
One 100,000 ohms (without switch) (Erie).
Two 250,000 ohms (without switch) (Erie).

Valveholders
One type X114 midget (with soldering terminals) (Clix, B.M.P.).

Jacks and Plugs
Three open circuit type (midget) (Igranic).
Three type P38 plugs (Bulgin).

Switch
One type S.80 T (Bulgin).

Valve
One type X.Y.2 (Hivac).

Spades, plugs
Two type MP.1a plugs (red, black) (Clix).
Two type R415 spade terminals (red, black) (Clix, B.M.P.).

Transformer
One type L.F.12 (Bulgin).

Knobs
Two type K58 (Bulgin).
One black wheel type knob (Webb's Radio).

Dials
Two type IP7 (Bulgin).

Unit
Aluminium box (Peto-Scott).
Ebonite base (Peto-Scott).

Miscellaneous
6BA nuts and bolts (Bulgin).
Shakeproof washers for 6BA bolts (Bulgin).
Push-back wire (Bulgin).
Rubber feet and washers (Bulgin).
Solder tags (Bulgin).
H.T. battery (see text re L.F. gain and bias adjustment) (Drydex).
L.T. 2v. accumulator (Exide).

Phones

and Mixer Unit

a Compact Unit for casting Use

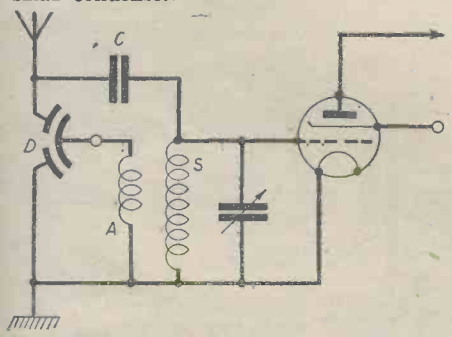
with the pilot 'phone jack, PJ, only effects a slight change in screen current by .1 mA at the maximum H.T. setting of 48 volts, this variation falling, of course, proportionally with any decrease in H.T. This point, however, is important in so far as the resistance of the pilot 'phones are concerned, and is based on 2,000-ohm earpieces, with the potentiometer at maximum.

It must be remembered, therefore, that on no account should the headphone jack be removed unless either the pilot volume control is mid-scale to zero setting, or, preferably, when the unit is switched off, as a surge of anode and screen current will take place; the normal maximum screen current with 'phones in circuit should read .71 mA at 48 volts.

For any increase in L.F. gain above that provided on 48 volts, a slightly modified circuit will be necessary, introducing grid bias, but the operating conditions of the circuit here will meet the majority of requirements admirably, whilst the fact that exceedingly good results are obtainable even down to 36 and 24 volts, examples

ntrol by a Condenser

which eliminates the harmful residual coupling present when the differential condenser is set to minimum value. As will readily be seen, the aerial is now coupled to the grid circuit over two paths, that through the differential condenser and the aerial coil A being of opposite polarity to the path *via* condenser L and the coil S, so that compensation of the harmful residual capacity of the differential condenser is achieved, and the volume of the strong signals can be adequately controlled. As the capacity C has to be very small it is quite likely that the capacities of the connecting leads may be sufficient to dispense with a separate small condenser.



Circuit diagram incorporating a differential condenser for controlling volume.

another advantage in the design, namely ease of portability. A well-balanced component layout (see Fig. 2), with rigidity as an important feature, combine to make the unit a true facility and a pleasure to handle.

Construction

No. 18 gauge aluminium is employed for the unit box, a 3/16in. ebonite base being used for neatly mounting the transformer. Fig. 2 gives full constructional details for the unit box and base, and a word or two here will clarify the measurements given.

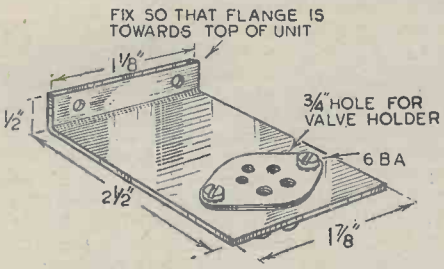


Fig. 3.—Details of valveholder bracket.

All large drillings for the components excepting the on-off switch drilling should be ⅜in. clear, the jack drillings requiring a slightly larger (but less than ½in.) diameter. All other holes, including those in the ebonite, are carried out with ⅛in. bit, the four holes for the rubber feet being countersunk as depicted, whilst for neatness it is preferable that the transformer fixing screws—which are 6BA—should be of the countersunk type, let in through the underside of the base and secured with nuts on the transformer. For this reason, then, the holes should be countersunk on the under side.

It will be seen in the diagram that four other holes are required either side of the transformer fixing holes, two of these (marked "W") are for passing through the L.T. leads (see the wiring diagram, Fig. 4); the other two (marked "T") are for fixing the output tags. The positions of these holes are not critical, and can be determined after temporarily positioning the transformer—make sure they clear the unit flanges when the base is finally fitted.

The above comment also concerns the unit-to-base-fixing screw-holes indicated by the asterisks.

The box construction needs little explanation here, but as the fixing-screw holes are not designated in any way, it would be as well to mention that these are simply equidistant, and can be drilled for 4 or 6BA bolts as desired.

Wiring and Assembly

With regard to the wiring and assembly, after mounting the box components, the transformer and base fitments should be assembled in readiness for wiring after dealing with the rest of the unit. The valveholder, which is mounted on a separate bracket (detailed in Fig. 3), should not be mounted in the unit until the other connections have been made.

The potentiometer wiring, and that of the jacks MJ1 and MJ2, should be arranged so that it will not foul the valve when this is finally fitted. The valve base wiring can be carried out with suitably determined lengths of wire, since the bracket will still be "floating" for convenience in handling. Similarly, the transformer connections may be made then, neatly adjusting all leads, the valveholder and base can be fitted, two screws or small terminals and shakeproof washers serving to clamp the base.

There is one point concerning the jacks—it will be necessary for these to be turned when fitting, so that the switch and transformer are not fouled, and in the case of P.J. it will be necessary to use the spacer washers on the front of the box, and not behind the jack, as is normally the case.

All wiring which might prove confusing due to the perspective of the diagram (the view taken in the wiring diagram, Fig. 4, is that which would be apparent if the back of the unit were removed) is correspondingly lettered in the circuit Fig. 1.

The X, Y tags are connected (preferably by screened leads) to the pick-up terminals of the radio set, a separate earth being made at the unit if desired by connecting to L.T. negative.

In conclusion, the writer would like to recommend quite strongly the economical use of cone speakers as very able make-shift microphones, the opening comments in this article being fully complied with by this means, as proved after extensive experiments under normal "home broadcast" conditions.

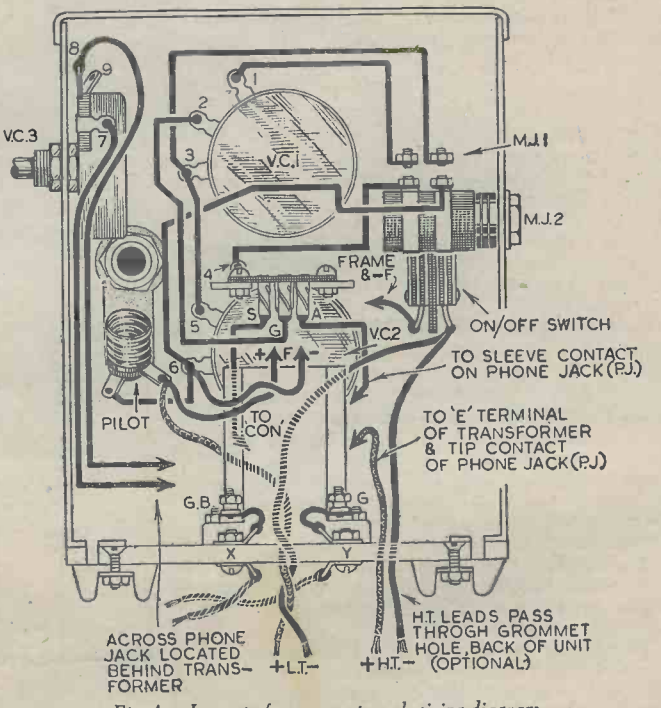


Fig. 4.—Layout of components and wiring diagram.

The Power Amplifier in Practice—1

A New Series of Articles Covering the Considerations of the Valve, the Method of Use, and the Considerations of the Output Circuit

By F. E. HENDERSON, A.M.I.E.E.

TO all users of broadcast sets and amplifiers, the term "power valve" has become a familiar one. Not always appreciated, however, are some of the considerations governing the design of the power valve itself, its method of application and its coupling to the "load" (the loudspeaker, in a broadcast receiver or special amplifier). This series of articles is intended to show the importance of observing certain fundamentals if the whole of the output stage is to pull together to produce the desired results.

The first of these articles deals with the valve itself—that transformer of D.C. energy (if such a confusion of electrical definition may be allowed) as provided by the power supply, into alternating or "speech frequency" energy to drive the loudspeaker mechanism with the least loss and least distortion of the input signal.

In some power amplifiers a valve is not used, the transference of energy taking place by mechanical means solely, but it is not proposed to deal with these here.

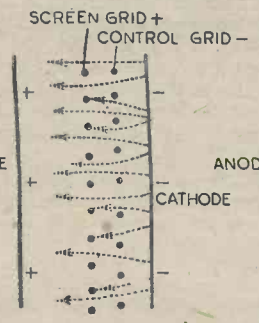


Fig. 1.—Electrode arrangement without alignment of grids. Many electrons meet the screen grid in their path to the anode.

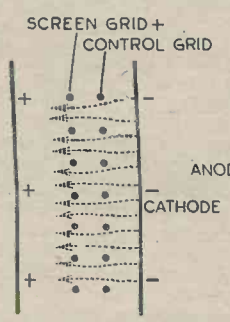


Fig. 2.—Electrode arrangement with alignment of grids. Low screen current. The screen grid attracts fewer electrons as it is partially shielded by the "shadow" of the control grid.

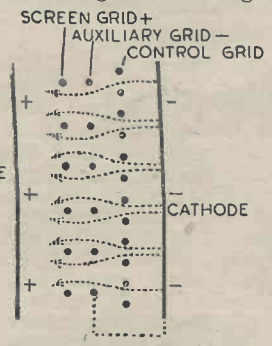


Fig. 3.—An alternative design, suitable for close mesh control grids, utilising an auxiliary grid at cathode potential, aligned with screen grid.

(1) Consideration of the Valve

Let us look at some of the fundamental features of the thermionic valve from first principles and see how each feature in its design is dependent on the others, leading to a final design aimed at including all those points which will play their part in practical application.

In general there are three main considerations affecting the design and performance of such a valve:

1. The frequency or range of frequencies at which it is to operate.
2. The expenditure of power in the grid (input) circuit.
3. The requirement of power handling capability in the anode (output) circuit.

The first consideration is one which we do not often think of as important in an output valve for audio frequencies, but actually it does become important particularly with high-slope pentodes and tetrodes, due to the fact that "feed-back" through a valve is dependent on its mutual conductance and anode-grid capacity. The higher the mutual conductance, the more important it is to reduce the anode-grid capacity in cases where good reproduction of high notes and transients is required.

Some high-slope output pentodes are, therefore, made with an anode or grid connection to the top of the bulb if they are intended to cover a very wide frequency range.

The expenditure of power in the *grid circuit* will depend on the extent to which the applied signal is allowed to drive the grid into the positive or grid current region. This is sometimes done in order to secure a larger power output from a given value than would otherwise be possible.

This application is called "positive grid drive," and as such will be treated in greater detail later.

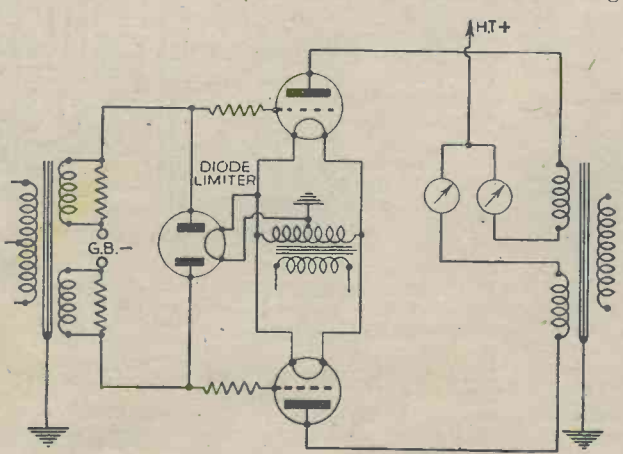


Fig. 5.—Signal voltage limiting circuit for use with power triodes in class AB1 push-pull, showing the diode.

Fig. 4.—A power tetrode, showing the "fins" on grid supports to assist cooling.

Normally, in conditions which avoid grid current, the grid is maintained at a sufficiently large average negative potential so that the expenditure of power in the input circuit is negligible. (In practice, the prevention of peak grid voltages of such magnitude as would cause grid current on the *peaks* is difficult.)

On the assumption, therefore, that the grid current may be neglected, the expenditure of power in the grid becomes solely dependent on any leakage resistance present in the valve or wiring.

The requirement of power in the *anode circuit* is a consideration common to all applications of the power amplifying valve.

Important Features

In the design and operation of a valve for such a purpose the following must be taken into account:

1. The alternating watts required to be developed in the "load."
2. The watts lost in the form of heat generated within the valve itself—this depends on:
   (a) The anode (and screen) voltage at which the valve is to operate.
   (b) The standing anode (and screen) current feed which can be supplied from the source of D.C. power.
3. The total cathode electron emission required.
4. The resulting heater or filament wattage required.
5. The A.C. grid voltage required to give the desired change in anode current (i.e., mutual conductance of the valve).
6. The linearity or otherwise of the valve curves in the region of high negative grid-bias, and, in a pentode or tetrode, the extent of the "knee" of the curve.
7. The operating temperature of the grid or grids.
8. The extent of "negative" grid current permissible under working conditions (determined by the extent of evacuation of bulb and contents).

(*Continued on page 428.*)

PRACTICAL TELEVISION

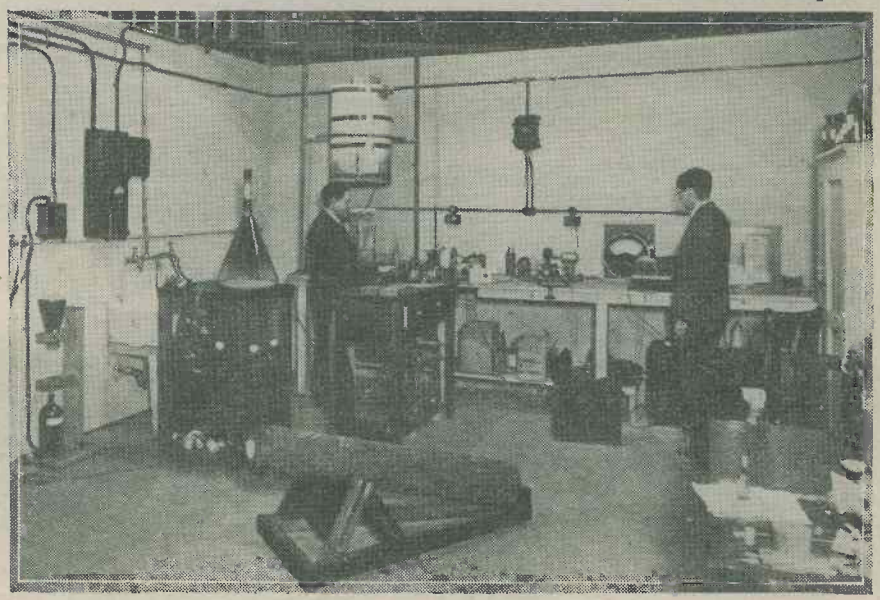
February 3rd, 1940. Vol. 4. No. 188.

A Receiver Problem

IN spite of the many advantages associated with the design of tuned radio-frequency (T.R.F.) receivers for television signal reception, there is still a large section of the industry, both in this country and abroad, who pin their faith in the super-heterodyne set. In the latter case, the problems facing the designer are of a very intricate character, and not the least of these is first detector considerations. It is appreciated that the process of frequency conversion that is carried out in the early stages of the superhet is essentially one of small percentage modulation of the local frequency oscillator, this being undertaken by the incoming television signal. In practice, there are three main methods of operating the appropriate valves so that this modulation can be undertaken successfully. In the case of two of these both the signal and oscillator voltages are applied to different electrodes in the same valve, and the methods differ simply by the oscillator electrode being before or after the signal electrode, when considered on the basis of the direction in which the electrons flow inside the valve. Curvature of the valve characteristic is not a requirement in these two schemes, but is so in the case of the third where both the oscillator and signal voltages are impressed on the same valve electrode, and modulation is brought about by characteristic curvature. From a careful investigation, which has been undertaken abroad of all the points involved in these three methods, it is said that for television working the last-named scheme, that is, using a signal electrode for the dual voltage application, has certain specific advantages. These advantages are associated with the measure of gain involved, signal to noise ratio, oscillator circuit interaction, and high-frequency input conductance. Of course, there is the important point of whether a high-frequency stage precedes the first detector or not, and this was taken into consideration in the investigations.

Electron Multiplier Design

THERE are two separate and distinct schools of thought who, while pinning their faith in the use of electron multipliers for certain specific purposes, show distinct preference for either the electro-magnetic or electro-static operated types. There is no doubt that each have their advantages and disadvantages, although both give very wide limits of sensitivity and linear response at all frequencies up to a hundred or more megacycles. The use of an external magnet can be a drawback when this magnetic field has a disturbing influence due to certain features of design, and it is for this reason that the protagonists of the electrostatic type have carried out considerable research in electrode shaping and positioning so as to minimise space charge limitations and provide the highest degree of accuracy in electrostatic focusing. As is well known, the static multiplier consists essentially of a series of secondary emissive targets which are maintained at progressively higher potentials, and the impact of the initial electron stream on the first target produces secondary electrons which repeat the function in a cumulative manner at each multiplying electrode down the tube. To obtain the maximum efficiency it is essential to be able to predict the electrostatic field due to a given configuration and orientation of electrodes coupled with the motion of the electron within that field. In the immediate neighbourhood of the secondary emissive target there should be a field of high enough intensity to ensure that the secondary emission is saturated. On the other hand, the impinging electrons have to be directed against this field. In effect, therefore, the ultimate aim of the designer of this useful electronic device is to see that the shape and potentials of the target electrodes is such that a field is created which is properly directed in the immediate neighbourhood of the surface, yet be capable of guiding the amplified electron stream from one stage to the next. One of the foremost scientists in this field, namely, Zworykin, of the R.C.A., has produced a considerable amount of valuable data for this purpose and by so doing increased the efficiency and practical performance of this device.



Elaborate apparatus has to be used in the research laboratories of the cathode ray tube manufacturer.

Efficient Mixing Supervision

IT is always difficult to assess the relative degrees of importance associated with the multitudinous stages involved in the complete television service, starting from the pictures produced at the camera, to the electro-magnetic signal radiated from the aerial. Any failure of one section to contribute its full quota to the chain of events will evidence itself either in the technical quality of the received picture, or the entertainment value of the complete programme. It is for this reason that so much attention is devoted to detail, and from the programme angle one very important phase is the mixer control which comes under the jurisdiction of the producer. The practical form in which this process is undertaken varies with each individual type of service but, broadly speaking, the principles involved are the same. It is therefore interesting to examine one piece of equipment built for this specific purpose, in order to see how the person in charge can perform his duties with the maximum efficiency. In this particular transmitting unit the mixing desk has been designed in a semi-circular or horseshoe shape so that each control is within easy reach, while monitoring is quite straightforward. The centre section has two compartments in each of which is displayed the screen face of a large cathode ray tube on which is built up a complete television picture, while by the side of this is a small oscillograph tube on which is traced the wave formation of the combined video and synchronising signals. One compartment covers the supervision of the outgoing picture transmission radiated from the aerial system, while the other provides for the preparation of the picture which is next to be faded into the programme. By arranging these units in juxtaposition a smooth transference or blending from one picture to the other can be undertaken without causing any violent changes in the fading process. With some services both mechanical and electrical scanning are employed, the former being generally associated with the transmission of standard talking films. Under these circumstances special provision has to be made to cover the use of an electrical time base generator, and the slotted disc mechanical time base generator, both of which produce the line and frame pulses essential for holding the picture steady within the receiver mask. By proper supervision and an intimate knowledge of the programme requirements, the use of apparatus similar to that which has been described ensures a continuity of service which adds materially to television's enjoyment.

Independent Dual Control of Amplification

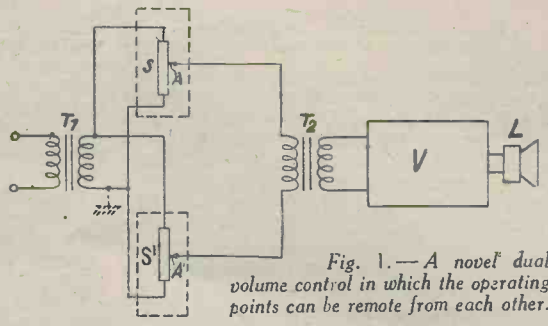


Fig. 1.—A novel dual volume control in which the operating points can be remote from each other.

IT is often desired to regulate the amplification of an amplifier from two distinct positions: as, for example, the volume of a receiver may be controlled at the receiver itself and also from some remote spot.

A circuit which provides two such controls, each capable of regulating from zero up to practically the greatest volume obtainable from the receiver independently of the setting of the other, is shown in Fig. 1, the operation being as follows: The secondary voltage from the transformer T1 is applied to the two ohmic potential dividers S and S¹, which are located one at each of the controls, and which have linear distribution of resistance. The voltage between the two slider arms A and A¹ is fed via the transformer T2 to the succeeding part of the amplifier V which has the loudspeaker connected in its output. Three leads are required to each control, but with suitable arrangements one of these may be an earth lead. It will be readily seen that the amplification can be reduced to zero by setting the slider arms A and A¹ to corresponding positions, while t can be raised to a high value by making the slider settings as different as possible.

When one of the controls, say S, is incorporated in the receiver itself, the (tapped) secondary of the transformer T1 may take the place of the separate potential divider, the grid of the output valve making adjustable contact along this secondary winding.

A Modification

Fig. 2 shows a receiver circuit embodying another modification of the arrangement. Here the anode resistance Ra of the valve V1, located in the receiver itself, forms one of the potential dividers. The remote control potential divider R¹a is in parallel with Ra as regards A.C., though separated from it as regards D.C. The corresponding slider arms A and A¹ are respectively connected, via condensers, to the control grid and cathode of the output valve V2, which is connected to earth by an ohmic resistance Rk not bridged by capacity.

It is, of course, possible to use capacity potential dividers, somewhat after the manner of differential condensers, in place of the ohmic resistances: this modification of the idea would be particularly useful in connection with high-frequency amplifiers.

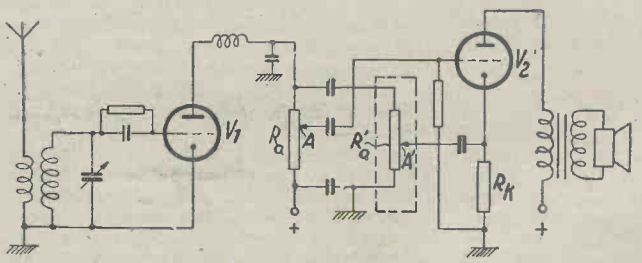


Fig. 2.—A slight modification of the above embodied in a receiver circuit.

Varley Dry Accumulators

WE recently reviewed the special dry accumulators produced by the Varley Company, and we are now informed that a comprehensive range of these cells is available. For the benefit of those readers who are anxious to use these in various apparatus we give below full details of the range, with measurements and prices from which their suitability for any special purpose may be ascertained.

TYPE	VOLTAGE	AMPERE HOUR CAPACITY at slow rate	AMPERE HOUR CAPACITY at 20 hr. rate	SIZE AND WEIGHT Height	Width	Depth	Weight	PRICE	
				ins.	ins.	ins.	lbs. oz.	s. d.	
V.20	2	20	10	4 3/16	2 13/16	2 13/16	2 12	10 6	For Wireless and Emergency Lighting purposes.
V.40	2	40	20	5 9/16	2 13/16	2 13/16	4 0	13 9	
V.60	2	60	24	4 7/8	3 9/16	3 9/16	5 0	15 0	
V.80	2	80	40	6 1/16	3 9/16	3 9/16	6 12	19 3	
Cycle	2	—	8	3 7/16	2 19/32	1 11/32	1 5¼	5 6	For Cycle and Hand Lamps.
4.T.1.	¼	—	2½	3 1/2	3	1 1/2	1 4	8 3	For Portable Wireless and Hand Lamps.
T.1.	2	—	5	3 1/2	3	1 1/2	1 4	8 3	
T.2	2	—	8	4 7/16	3	1 1/2	1 12	9 6	
4.T.2.	4	—	4	4 7/16	3	1 1/2	1 11½	9 6	
				Diameter ins.					
T.U.1.	2	—	2½	2 7/16		1 5/16	0 7	3 0	For Hand Torches.
T.U.2.	2	—	4	3 7/16		1 5/16	0 10½	4 0	
T.U.B.1.	2	—	2½	3 1/4		1 1/2	0 8½	5 6	For Deaf Aid Instruments.
T.U.B.2.	2	—	4	4 1/4		1 1/2	0 11½	6 9	
P/V.20	2	20	10	4 7/16		2 13/16	2 10½	13 6	For the Mariol Power-Lite Lamp.

TELEVISION TIME-BASE GENERATORS

ONE simple method for producing short durationed but large amplitude pulses is the blocking oscillator, and it is essential with this device to ensure that it is independent of output circuit changes. A special scheme has been developed to give pulses of various shapes by using what is termed an electron beam valve. This is really a device having a cylindrical shaped control electrode with a horizontal slit, and this is made to surround the cathode. The anode is of similar design and between the output anode and the oscillator is interposed a suppressor plate. The oscillator is electron coupled, the cathode being joined to a tapping point on the oscillator coil to which is coupled electro-magnetically the synchronising coil. Since the output anode is arranged to be effectively isolated, output load changes produce the minimum effect on the performance of the oscillator, which is the condition imposed as mentioned in the opening paragraph. In the anode circuit can be placed a resistance or inductive load, depending on the required sharpness of the short duration steep sided pulses. Furthermore, it is possible to produce a square-shaped pulse by bringing the cathode tap on the oscillator coil near to the point where the coil is joined to the control electrode. It will be seen, therefore, that a device of this nature is very flexible in character, and changes can be undertaken in a simple manner to suit the requirements of associated equipment.

H.T. CURRENT ECONOMY.

(*Continued from page 414*)

suitable) and a voltage is produced across the lower arm of the potentiometer (shown as having a value of 50,000 ohms), and this is in "opposition" to the voltage supplied by the G.B. battery. Since this "opposition" voltage increases with increased output from, and therefore input to, the pentode, the effective G.B. applied to the valve is reduced as the input to the valve is increased. That is, of course, precisely what is required to fulfil the requirements which were outlined above.

Component Values

It will be seen in Fig. 2, that the G.B. is taken through a .25-megohm fixed resistor, and that a .1 mfd. fixed condenser is connected between the G.B. terminal of the L.F. transformer and earth. These components comprise an A.F. filter, and their purpose is to prevent low-frequency reaction which would be introduced if part of the audio-frequency current in the anode circuit of the valve were fed back into the grid circuit; the position is quite comparable to that which holds in connection with a detector valve with reaction.

Suitable values are given in Fig. 2, for all components except the upper arm of the potentiometer, which is marked R. The correct value of this is dependent upon the optimum load and amplification factor of the valve, and an accompanying table shows the value recommended by Westinghouse for a few well-known valves. Similar values can be used for other valves of corresponding types. The table also shows the bias voltage which has been found most suitable, but when any doubt arises tests should be made starting with twice the normal G.B. voltage. Slight experimental modifications can then be made until the most suitable is found; always use the highest consistent with satisfactory reproduction. This circuit can be used with any type of battery output valve, whether transformer, resistance-fed-transformer, or resistance-capacity coupling is used.

Simplified Arrangement

There is a much simpler system which is suitable for use in many R.C.C. circuits and this is shown in Fig. 3. It is believed that this arrangement was originally developed by the makers of Tungsram valves. As may be seen, the usual grid leak is replaced by a W.6 "Westector," no other alteration being required. As with the circuit previously referred to, the G.B. tapping should receive twice the normal G.B. voltage required by the valve for the particular H.T. voltage employed.

LOCATING FAULTS—2

(*Continued from page 415.*)

the reaction winding. A poor H.F. choke, the use of an anode by-pass condenser of insufficient capacity, inter-action between components in the anode and grid circuits and long leads can all aggravate matters; therefore, consideration must be given to all these items until one's experience enables one to pick out the most likely cause.

L.F. Faults

On the L.F. side, one is also concerned with H.F. currents and the interaction between the various stages and, bearing this in mind, it is not surprising to note that the remedies are very similar to those already quoted.

The trouble can invariably be cured by concentrating on all anode and grid circuits of the L.F. valves, although one must expect the anode of the detector valve to come into the question sometimes. See that the H.T. supplies to the various anodes are de-coupled in an efficient manner. If such refinements are not already embodied in the circuit, then their inclusion will, without doubt, eliminate the trouble in the majority of cases. Grid de-coupling, i.e., preventing any stray H.F. from getting through to the next stage by means of a resistance in series with the grid connection, should also be tried (and used when more than one L.F. stage is in use), while reversing the connections to the secondary of an L.F. transformer will often be all that is necessary with the low continuous whistle form of instability. In too many cases, no condenser is provided between anode of output valve and earth; similarly, too many constructors do not think of providing a large-capacity condenser across the H.T. supply, as this single component will often prevent instability from being set up, in a simple battery-operated set, when the H.T. battery voltage starts to fall below a certain value.

For the benefit of the beginners, two anode de-coupling circuits are shown in Fig. 1, the one on the left being the more common. The value of the resistance should be as high as possible consistent with the anode getting its required voltage. If this value does not provide sufficient de-coupling, the single resistance can be replaced with two of half the value, condensers being provided at the end of each as shown in the diagram on the right.

The method of connecting H.F. grid-stoppers is shown in Fig. 2, together with anode stoppers which should be included in the anode circuits of most output stages using push-pull arrangements.

THE POWER AMPLIFIER IN PRACTICE

(*Continued from page 424*)

If we measure the steady anode current when no signal is applied and multiply this by the actual anode voltage (remembering to convert milliamperes into amperes) we get a value representing the power developed within the anode itself and dissipated there in the form of heat. This is known as the *anode dissipation*, or anode wattage, and must not be confused with the output wattage developed in the "load."

In pentodes and tetrodes the screen also takes power, the extent to which it does depending upon the way the screen is designed and placed, and the more power absorbed in the screen the lower the *efficiency*, that is, the ratio of useful output to total power expanded. With triodes this efficiency can only be increased by so choosing the design and material of the anode that it may be allowed to handle a larger wattage during the time the signal is applied than under conditions of no signal, and this method will be referred to later as "Class B" amplification. With tetrodes and pentodes, however, it is possible to increase the efficiency (that is, reduce the loss in the valve) by so designing the screen that its power absorption is reduced to a minimum.

A method used is "alignment" of the grid and screen wires, which is finding favour in many modern valves.

Fig. 2 shows an electrode system in which this alignment of control and screen grids has been carried out, resulting in a material reduction in screen-grid current—a greater proportion of the cathode emission being available for the anode current.

Similar methods using a shaped electrode, or auxiliary electrodes at cathode potential, are also used, Fig. 3. It will readily be appreciated that from a manufacturer's point of view true alignment—turn for turn—between control and screen grids calls for precise tooling, as any deviation from true alignment may cause excessive heating at some points.

One of the most worrying aspects to the designer of a power valve is to avoid high temperature in the grid—a state of affairs which becomes more difficult to avoid as the operating temperatures within the valve increase with greater anode dissipation. This leads to what is termed "grid emission," the grid actually emitting electrons which add to the total anode current and lead to a cumulative destructive effect. The real danger is in resistance-capacity coupling, where the grid emission current flows through the grid leak and neutralises the bias. Means are usually taken, therefore, to cool the grid—often by the use of radiating fins on the grid support wires, or extensions which increase the area for radiation (Fig. 4).

Further Features of Design

Having taken into account the considerations necessary to allow a power valve to withstand voltages and dissipation adequate for the purpose required, other features of design must allow for an adequate anode current, so that the necessary output power may be delivered.

This calls for two considerations: first, that the cathode has ample electron emission at the temperature of operation to satisfy the peak demand for anode current without signs of saturation, and in the case of a triode, that the internal resistance (anode impedance) of the triode is sufficiently low to allow of full advantage being taken of the cathode emission without resort to excessively high anode voltages. The valve must always be working under what is known as the "space charge limited condition"—that is, the anode current must be practically independent of the cathode temperature when in use. This is why the filament or heater wattage is usually greater in the case of the power output valve than in other valves designed purely for voltage amplification.

As the voltage and wattage increase, so the success of any design becomes more dependent upon attention to detail, and when power valves come into use at really high wattages, any number of queer effects are liable to occur, not at first sight obvious. One such, to which has been given the term "trigger effect," sometimes occurs with low-impedance triodes driven into grid current. Under certain conditions of use, the peaks of signal voltage are such as to cause what would be expected to be a steadily rising grid current, to reverse, leading to a reduction in bias, great increase in anode current and destruction of the cathode emission by gas evolution. Such a condition may be overcome by wiring a small diode in circuit between grid and cathode, so as to limit the extent of peak voltage which can be developed at the grid. (Fig. 5.)

Enough has been said to show that the design of a good power valve must be the result of many considerations and compromises between economy and performance.

Methods of usage to obtain good results in practice will be described in the next article.

(*To be continued*

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).

DX on Medium Waves

SIR,—The letters on medium-wave DX which recently appeared in your fine weekly have been a source of interest to me. In that light I am tempted to offer my experiences of that type of listening.

As far back as September, 1934, I bought my first radio—a straight-3 mains set—and with it I used an antenna 15ft. high, 50ft. long. With more luck than judgment I logged my first American, WCAU, one morning at 04.30. By 19/4/36—when that receiver gave way to a more powerful type—I had logged 25 North and Latin American stations, including WCAU, WABC, WTIC, WEAF, WNAC, WBZA, WPG, WBT, KSL, WHAM, WRVA, WESG and LR1,2,3,4,5. Of the Canadians, etc., these were logged: VONF, CKY, CRCT, and were received at a time when the transatlantic reception peak was fading away, and when it was generally thought that nothing less than a powerful superhet would bring in the Americans.

With the 6v S.H. ten more Americans were logged and over a dozen Latin Americans identified, including WEEI, WCSH, WAAB, KMOX, WBAA, LR6,9,10, LS2,9, LU7, LT3, PYG2 and CMQ, making a grand total of 34 North Americans and 19 Latins. The signals of these stations—especially the Latins—frequently peaked R7-8.

Turning to Europe, one may be inclined to assume that there is no DX to be logged, as Europe is represented by Hamburg, Fécamp, etc. But this is not so. Just try logging those Europeans with less than 1.5 kW input. There are many whose power does not exceed 500 watts. The best part of the medium-wave band for this type of DX is 196-240 metres.

In conclusion, I would like to add my thanks to Mr. Burton for informing your readers on this subject, and all I can add to his remarks is "Make no mistake, there is plenty of DX on the medium waves." Incidentally, as a result of Mr. Burton's letter I wrote to him using the address at the end of his letter. My letter was returned as "insufficiently addressed." Will Mr. Burton please note?—ROBT. WM. IBALL (Worksop, Notts).

Transmissions from Radio Eireann

SIR,—Fellow readers may be interested in the following information regarding the short-wave transmissions of Radio Eireann, the Irish short-wave station, as taken from a letter veri received here in answer to a report I sent to this station recently.

During the next few weeks the station will be transmitting each day on 9.595 mc/s (31.27 m.) with a power of 1.5 kilowatts. Between 12.30-13.30, 14.00-15.00, 17.30-21.30, 22.00-23.00 G.M.T. I would also like to compliment you on the high standard maintained by PRACTICAL WIRELESS despite the war, and also place on record my appreciation of the many new friends made through writing to enthusiasts whose letters have appeared in the section "Open to Discussion" at various times.—A. HART (Ilkeston).

Learning the Morse Code: Correspondent Wanted

SIR,—I wonder if there is anyone in this district who is interested in mastering the Morse Code? I shall be pleased to hear from any local reader who has either started, or intends to start, learning the code.

May I take this opportunity also of endorsing other readers' opinions of your paper? I have been a reader since its first issue (in the old "Mains Express" days) and give it full marks for consistency, topicality, and real common-sense articles.

I hope to see you keep the home constructor's flag flying well into the future.—H. STENNING (52, Clarence Square, Brighton).

Exchanging S.W.L. Cards: Indoor Photography

SIR,—To keep up the "ham" spirit I should like to exchange my card with anyone in this country or abroad. Readers may be interested to know how I have been taking some indoor photographs of my gear—one of which appears in the January 13th issue of PRACTICAL WIRELESS. The camera used is a No. 2 "Brownie" loaded with an ordinary shilling film. I have found that four minutes' exposure with 160 watts lighting gives quite a good photograph. In my case I used two lamps, one a 60w. and the other a 100w., but no doubt a 150w. or two 75's would do.

For "close-ups" I have been using a portrait attachment, which costs 3s., fitted into the lens opening.—S. E. JANES (72, Kimberley Road, Croydon, Surrey).

Prize Problems

PROBLEM No. 385.

MARTIN built a small one-valve set which gave quite good results, but he decided that a differential reaction condenser might be of more use. He accordingly purchased one of suitable value and connected it to the anode, reaction coil and earth. He found, however, that there was no reaction. Why was this? The reaction coil was internally connected to the earthed end of the grid winding and the differential condenser was of the same capacity as his original reaction condenser. Three books will be awarded for the first three correct solutions opened. Entries should be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 385 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, February 6th, 1940.

Solution to Problem No. 384.

When Smithers connected his cells in parallel he reduced the voltage to that of a single cell—1.5 volts. What he intended to do was to obtain another battery and connect both in parallel, so retaining the voltage rating.

The following three readers successfully solved Problem No. 383 and books have accordingly been sent to them: H. J. Witch, 3, Cobden Street, Russell Rown, Bristol, 5; H. G. Rowlinson, Brantwood, 65, Wordsworth Street, Keswick; G. W. Brown, 25, Anderson Street, Bishop Auckland, Co. Durham.

Practical Wireless

BLUEPRINT SERVICE

PRACTICAL WIRELESS	*Date of Issue.*	*No. of Blueprint*
CRYSTAL SETS.		
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set ..	27.8.38	PW94
STRAIGHT SETS. Battery Operated.		
One-valve: Blueprints, 1s. each.		
All-Wave Unipen (Pentode) ..	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve: Blueprint, 1s.		
The Signet Two (D & LF) ..	24.9.38	PW76
Three-valve: Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow) ..	22.5.37	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D, (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow) ..	12.6.37	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen) ..	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P) ..	14.8.37	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen) ..	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D, (Pen), Pen)	30.4.38	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve: Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P) ..	1.5.37	PW4
Fury Four (2 SG, D, Pen) ..	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D, (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P) ..	26.9.36	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	3.9.38	PW90
Mains Operated.		
Two-valve: Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen) ..	—	PW18
A.C.-D.C. Two (SG, Pow) ..	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve: Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow) ..	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen) ..	—	PW35B
Ubique (HF Pen, D (Pen), Pen) ..	28.7.34	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	11.5.35	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve: Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	24.7.37	PW45
Universal Hall-Mark (HF Pen, D Push-Pull)	—	PW47
SUPERHETS		
Battery Sets: Blueprints, 1s. each.		
£5 Superhet (Three-valve) ..	5.6.37	PW40
F. J. Camm's 2-valve Superhet ..	—	PW52
Mains Sets: Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve) ..	—	PW43
D.C. £5 Superhet (Three-valve) ..	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4 ..	31.7.37	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four ..	16.1.37	PW73
Four-valve: Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model .. } Push Button 4, A.C. Mains Model }	22.10.38	PW95
SHORT-WAVE SETS. Battery Operated.		
One-valve: Blueprint, 1s.		
Simple S.W. One-valver	23.12.39	PW88
Two-valve: Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve: Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	30.7.38	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen) ..	1.10.38	PW83
PORTABLES.		
Three-valve: Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen) ..	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve: Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF, (Pen))	19.3.38	PW86
MISCELLANEOUS.		
Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE		
CRYSTAL SETS.		
Blueprints, 6d. each.		
Four-station Crystal Set ..	23.7.38	AW427
1934 Crystal Set	—	AW441
150-mile Crystal Set	—	AW450
STRAIGHT SETS. Battery Operated.		
One-valve: Blueprint, 1s.		
B.B.C. Special One-valver ..	—	AW387
Two-valve: Blueprints, 1s. each.		
Melody Ranger Two (D, Trans.) ..	—	AW388
Full-volume Two (SG, det, Pen) ..	—	AW392
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)	*June* '33	WM327
Economy-Pentode Three (SG, D, Pen)	*Oct.* '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans) ..	*Mar.* '34	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

These Blueprints are drawn full size.

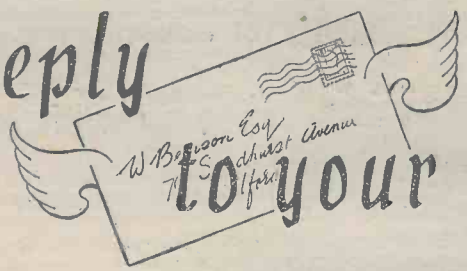
Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices, *which are additional to the cost of the Blueprint.* A dash before the Blueprint Number indicates that the issue is out of print.

Issues of Practical Wireless ... 4d. Post Paid
Amateur Wireless ... ... 4d. " "
Wireless Magazine ... ... 1/3 " "

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

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

In reply to your letter



Station Address

"I know that you do not usually give station details as part of your Query Service, but I recently heard a broadcast from an American station announced as KGEI, but, unfortunately, I was unable to catch the address or ownership of this station, although for the most part the programme was well received. As I am interested in collecting QSL cards and similar data I should like to write to the station, and wondered if you could give me any indication as to ownership and address in this particular case."—K. G. (Kenton).

THE station is owned by the General Electric Company and is the Treasure Island transmitter. Address any communication to the G.E. Company at that address, U.S.A., and it will be delivered.

Dry Battery Making

"I recently wrote for details as to the making of pocket-lamp batteries and you recommended your book "Accumulators." I have now made up a sample cell from the details given therein but the results are not very good. The battery gives only just 1 volt, and will not light the lamp. I have followed the instructions rigidly, and should be glad if you could assist me in obtaining better output."—S. R. (Edinburgh).

IT is not a simple matter to make a perfectly satisfactory dry cell at the first attempt. Apart from the fact that the chemicals must all be quite pure, there is a correct degree of moisture which must be included. The formula gives plaster of Paris, and if you make this too wet the cell will not function properly, whilst if too dry it will also fail to function. A wrong proportion of the manganese dioxide will also result in low voltage. Perhaps attention to these points will enable you to obtain better results.

Gramo. Amplifier

"I want to get an amplifier (A.C.) for playing gramophone records. What do you recommend for an ordinary house? Would Nos. WM 387 or WM 392 of Blueprint Service be suitable, please?"—H. S. S. (Pontymister).

THE problem of suitable volume is not simple of solution. Whilst one listener prefers an output of 10 watts, another will be quite satisfied with only 1 watt. For all normal purposes, where you are keen on obtaining real quality, a fairly large output is advised, although the amplifier should not be run "all out." In this way better quality is obtained, as you are always working well within the capacity of the output stage. The Enthusiast's Power Amplifier will deliver about 10 watts, whilst the second print you mention is only a 5-watt amplifier. Unless you have a very large room and a really good speaker capable of handling the large output, and mounted on a suitable baffle, the 5-watt unit should be quite satisfactory for all normal home purposes.

Substituting a Valve

"Could I use an output triode instead of the output pentode in the 'Short-wave A.C. Two-valver' in your issue dated January 13th, 1940? If so, what would the connections be? I am going to make this my first mains operated set."—D. E. F. (Edinburgh, 9).

A TRIODE would not give the same amplification as a pentode and thus you would not gain anything by substituting the valve. If, however, it is a case of economy and you wish to use the triode for the time being, then the screen voltage dropping resistance must be omitted, and the tone control resistance, condenser and switch would also not be needed. The bias resistance value would have to be changed, no doubt, to suit the new valve.

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.

Meter Resistance

"I have a radio-meter and am not certain regarding resistance tests with the meter. The L.T. resistance is marked 200 ohms, and the H.T. is marked 8,000 ohms. Please will you explain this to me?"—W. G. (Holyhead).

THE resistance values marked on the instrument have nothing to do with resistance testing. They merely give the resistance of the instrument from which its suitability for making various voltage tests may be gained. For instance, the H.T. resistance, that is, when the H.T. terminals are used, is 8,000 ohms, and thus if the H.T. voltage range is 120 volts, this means that a current of 15 mA will flow and this means that it will be unsuitable for measuring the voltage on the screen of a valve or a low-voltage tapping on a mains unit. By this we mean that it will give an incorrect reading as the meter will take much more current than the screen or the mains unit is designed to pass and thus there will be a voltage drop. Generally speaking, for measuring detector voltage, screen voltage and mains units a meter with a resistance of at least 1,000 ohms per volt should be used. This means that the resistance of a 120 voltmeter would be 120,000 ohms.

R.C. Coupling

"I have bought a small battery amplifier with R.C. coupling, but there is a funny fault which I cannot trace out. When switched on it works for a minute or two and then gradually distorts and signals get weaker and weaker. Then there is a plop and signals are clear again. There are only two valves and I attach a diagram of the arrangement and should be grateful if you could suggest what is wrong."—S. O. F. (Blandford).

THE fault is quite obvious from the diagram and is in the method of arranging the components in the second stage. You will see, if you examine the circuit again, that you have connected the grid leak on the anode side of the grid condenser, and not on the grid side. Apart from the fact that the grid is thus choking, giving rise to the weakening of signals, etc., there is also an additional drain on the H.T. as your anode resistance and the grid leak are in series across the H.T. supply. Transfer the grid leak connection to the other side of the grid condenser and everything should be in order.

REPLIES IN BRIEF

The following replies to queries are given in abbreviated form either because of non-compliance with our rules, or because the point raised is not of general interest.

G. W. (Dublin). The speaker will handle up to 10 watts so is quite suitable. Use an output filter circuit.

L. R. (York). The dial light is responsible. Fit an on-off switch so that it may be switched off when not needed.

J. C. (Sunbury). We have published the data, but it will be included in due course in the small Notebook pages which are being published weekly.

E. M. (Rotherham). We have no details of the instrument, but would hesitate to recommend its use until more complete details have been given.

N. G. (S.W.11). In this particular case we would not recommend you to make the coil. It may be obtained ready made from T. W. Thompson.

C. G. (Wakefield). We regret that we have no details of the coils mentioned.

D. J. C. (Ongar). Write to Messrs. Peto-Scott or Premier Supply Stores. They will quote for a kit or the separate parts.

C. P. (S.E.18). The best plan is to get into touch with one of the technical training schools who make a point of training for the position mentioned. Adverts. appear from time to time in our pages.

A. M. (Kilmarnock). We suggest a set of Varley coils. Connections will, of course, have to be modified as the coils are not numbered in the same manner.

G. A. (West Croydon). You could use the transformer, and it might be found that the voltage delivered would be suitable. This would depend upon the regulation of the transformer. On the other hand, there might be a slight drop in the H.T. which would result in the set being run rather inefficiently.

W. S. S. (Birmingham). The two coils are unsuitable, as you must use one with a reaction winding and one with an aerial winding.

G. R. (Sunderland). Sixty volts should be quite suitable. Is there any sign of reaction, or is it only this circuit which is defective?

L. E. (Portsmouth). Two valves in parallel would be best. Obtain another valve similar to the one now in use in the output stage.

G. R. T. (Blackpool). 20-gauge tinned copper would be suitable. Make joints carefully and do not worry about soldering tags in this case.

H. A. (Kingston). The tweeter mentioned is quite a good model and may be recommended.

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

RADIO CLUBS & SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

ASHTON-UNDER-LYNE AND DISTRICT AMATEUR RADIO SOCIETY

Secretary: K. Gooding (G3PM), 7, Broadbent Avenue, Smallshaw, Ashton-under-Lyne.

Headquarters: 17a, Oldham Road, Ashton-under-Lyne.

DESPITE the restrictions imposed by the "black-out," attendances at the meetings continue to be satisfactory, and there is still a fair amount of activity. The Sunday afternoon meetings at 2 p.m. are proving to be popular with members who have to travel a distance. At a recent meeting it was resolved that all members on active service should be made honorary members for the duration of the war, and a list of such members has been compiled, and is displayed in the club-room for use of home members who desire to correspond. Several members are making good use of their time whilst "off the air" by rebuilding receivers, and the super seems to be the order of the day. Morse practice continues, and at an early date it is proposed to construct a Signal Generator for the use of members.

A recent visitor to the club was 2FCC (now with the Militia), and he has now joined the society for the duration of his stay in the locality.

A TELEVISION RECEIVER REFINEMENT

WHEN endeavouring to cover the widest possible service area from a given television transmitting station, many problems arise in connection with the best type of receiver to suit the varying conditions. In this connection certain situations show that the inclusion of an automatic volume control system in the set would be a distinct advantage. Under ordinary circumstances, however, a standard A.V.C. system would not only compensate for fading variations but would also tend to destroy essential variations in picture brightness. This is due to the fact that with up-to-date television transmitting services the general carrier wave level is varied in exact accordance with the average picture brightness, or in other words D.C. is present in the signal to give true pictorial value to the scenes televised. All A.V.C. systems designed for use in television receivers, therefore, must not be affected by alterations in the general incoming carrier level, but must only be responsive to changes in a predetermined selected signal component. The best method is therefore to link the A.V.C. system with the synchronising system, which to conform to picture standards is radiated at a constant level. Many schemes have been devised for this purpose, and in one ingenious form the rectangular shape synchronising signals are first of all separated from the vision signal, and then converted to a modified saw-toothed wave. This is done with a view to facilitating the process of rectification. The circuit used is a triode valve which is normally biased to the cut-off condition. Across a condenser joined in the output circuit between anode and cathode will appear a form of saw-toothed voltage the amplitude of which will vary in accordance with the magnitude of the synchronising pulse. This saw-toothed signal is then rectified by a diode valve and the rectified voltage used as a gain controlling bias to produce the correct nature of A.V.C. control.

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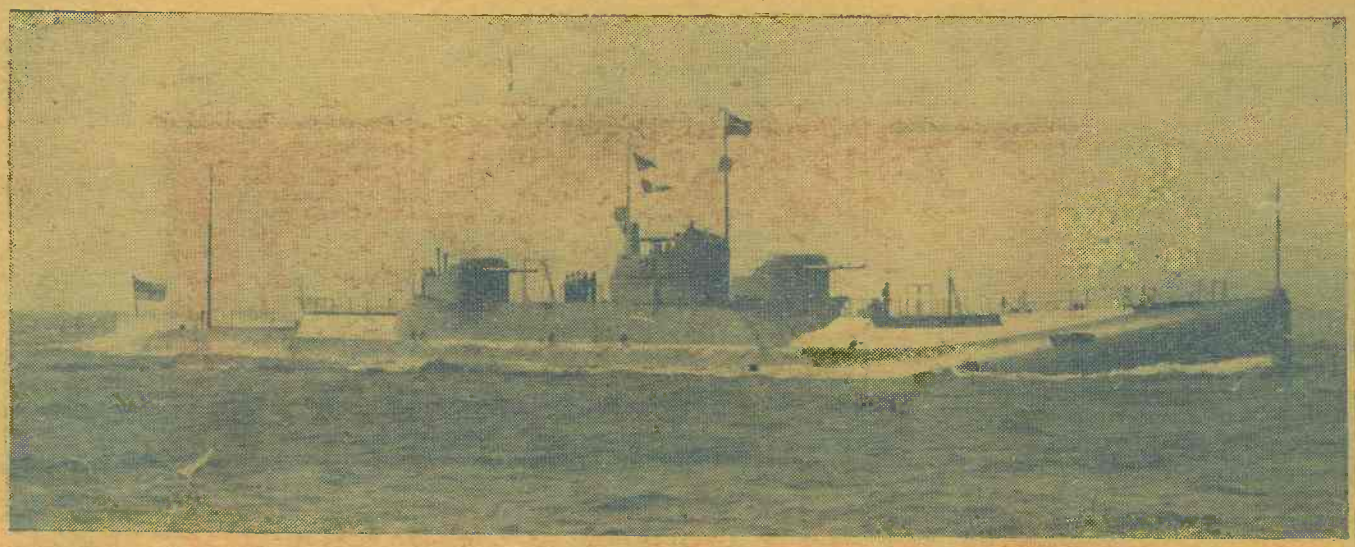

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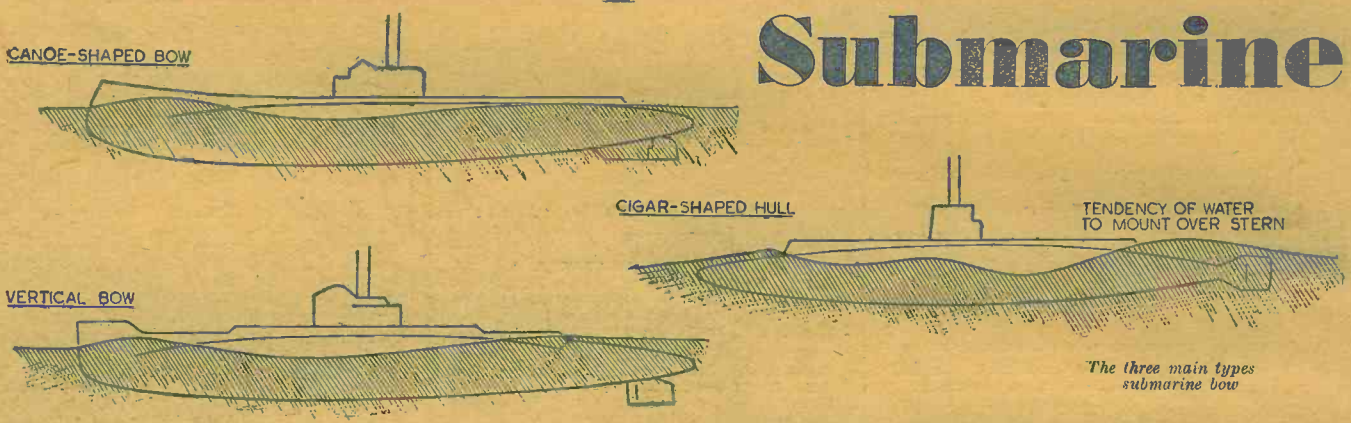

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IN THE FEBRUARY

PRACTICAL MECHANICS

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