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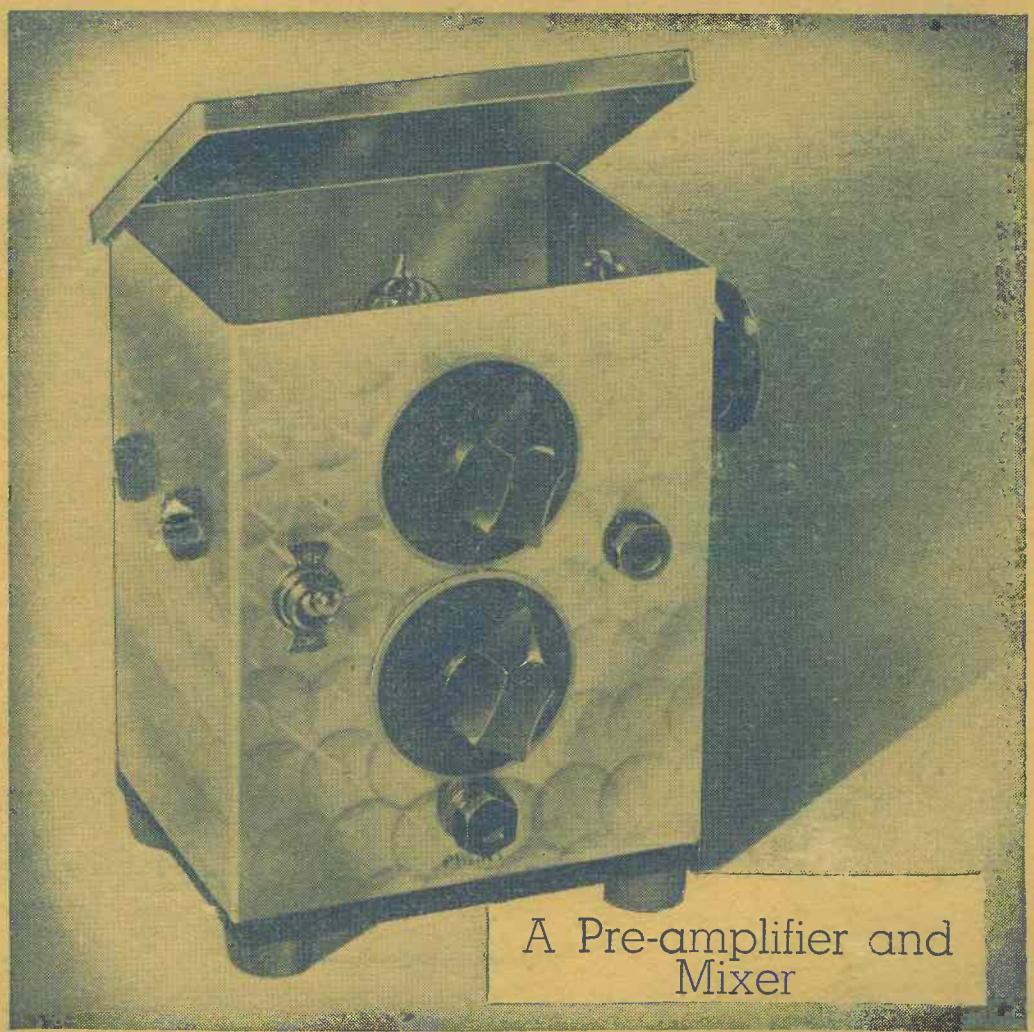
EVERY WEDNESDAY

Feb. 3rd, 1940.

Contents



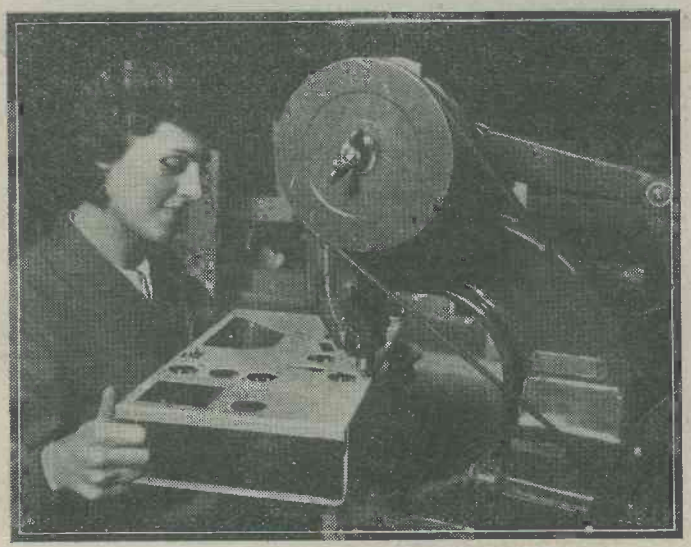
A Pre-amplifier and Mixer

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

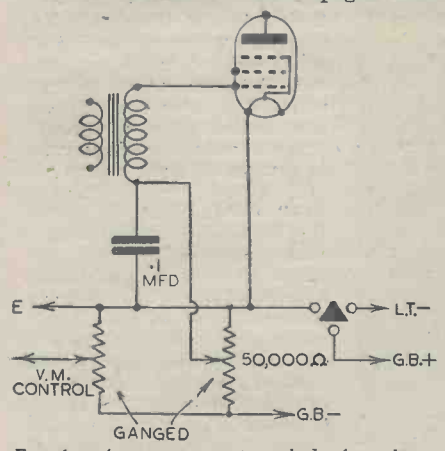

Fig. 1.—An experimental method of combining variable-mu volume control and grid bias control.

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.

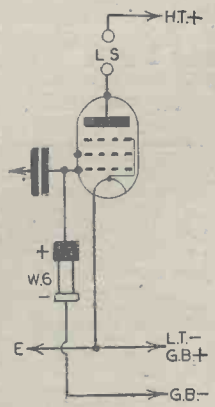

Fig. 3.—A simplified H.T. economiser arrangement suitable for use with an R.C.C. stage.

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

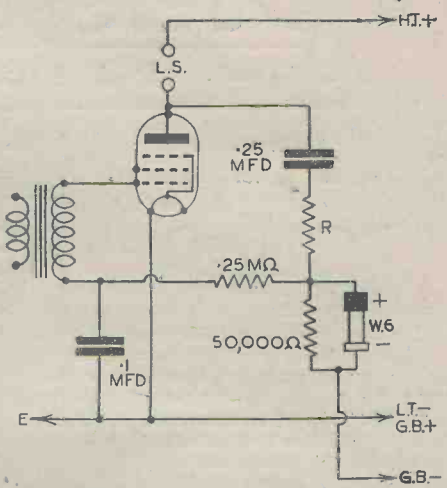

Fig. 2.—A "standard" H.T. economiser circuit incorporating a Westector. Suitable values for resistor R are given below.

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.

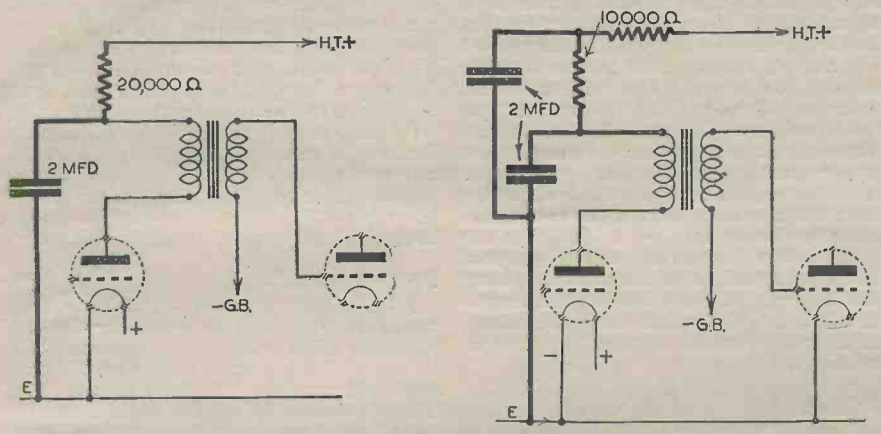

Fig. 1.—(Left) The most simple form of anode de-coupling. If this does not produce the required result then the method on the right should be used.

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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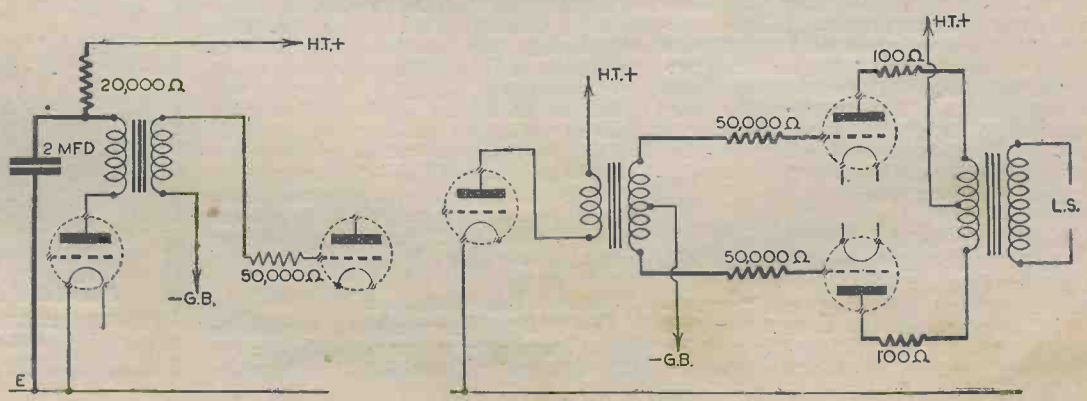

Fig. 2.—(Left) Anode and grid decoupling for single and push-pull circuits. The values shown are usually quite satisfactory.

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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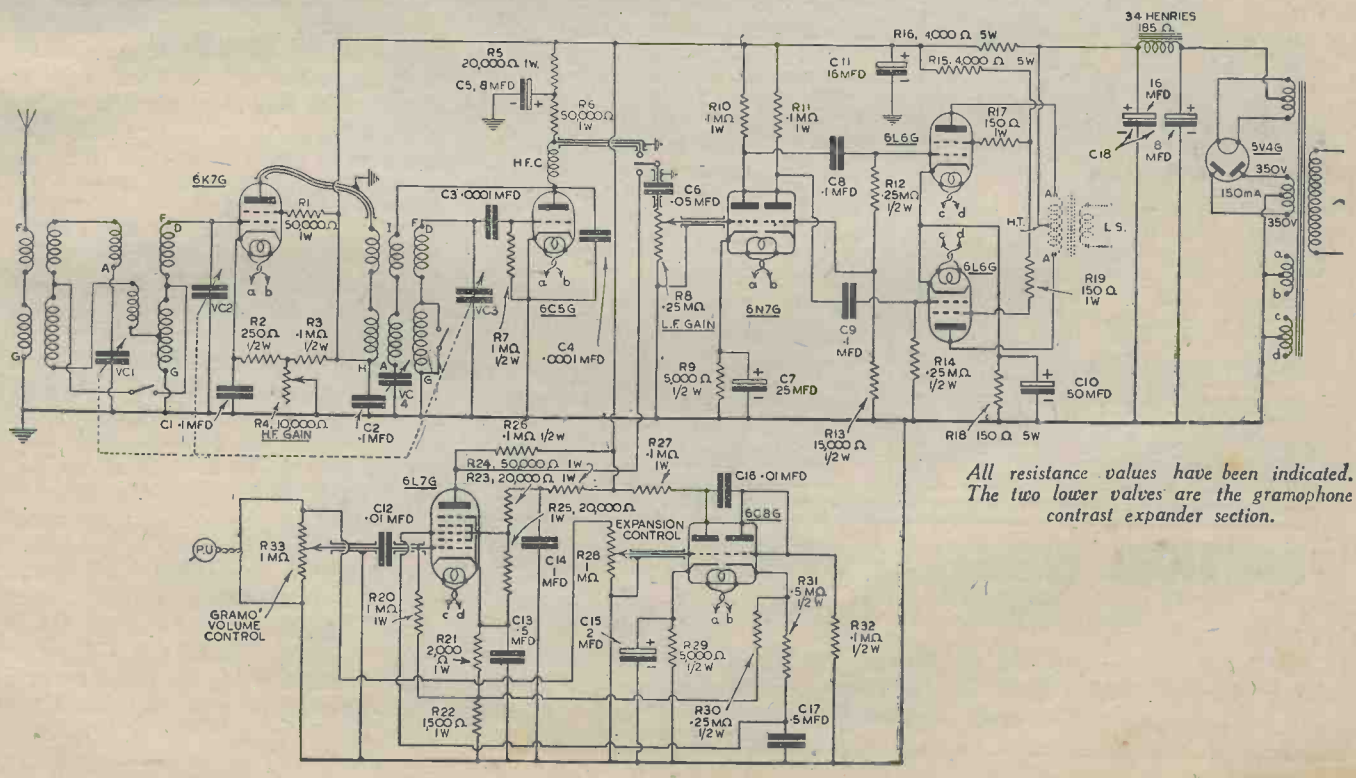


All resistance values have been indicated. The two lower valves are the gramophone contrast expander section.

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.

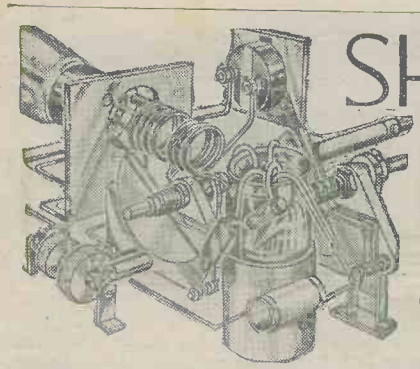
In spite of adverse financial conditions the Committee of the Fair are making no changes in the value of the prizes this year. The figure devoted to this purpose will still be 25,000 francs, as on previous occasions. In addition, there will be the usual medals, diplomas and prizes offered by the President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

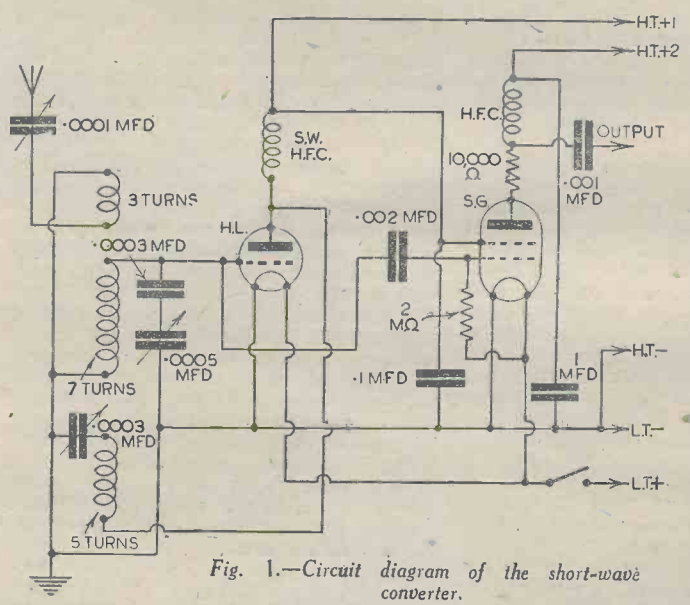


Fig. 1.—Circuit diagram of the short-wave converter.

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.]

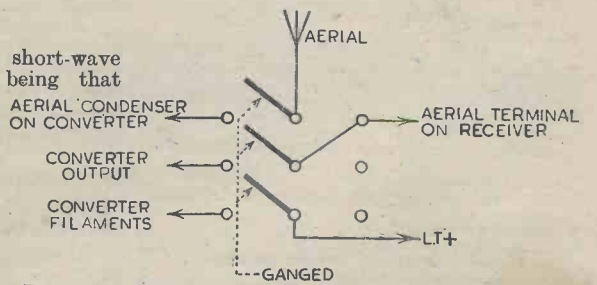
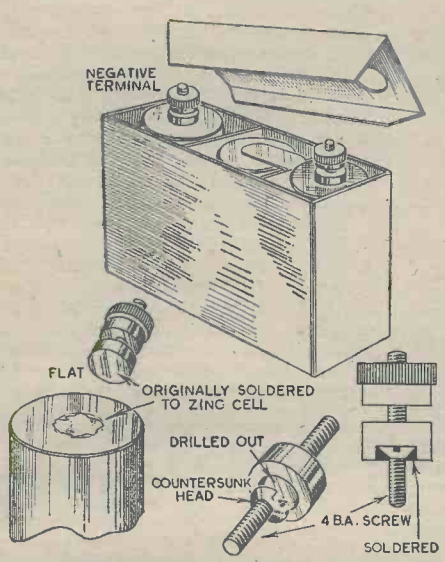


Fig. 2.—Diagram of connections for a three-pole anti-capacity switch.

Practical Hints

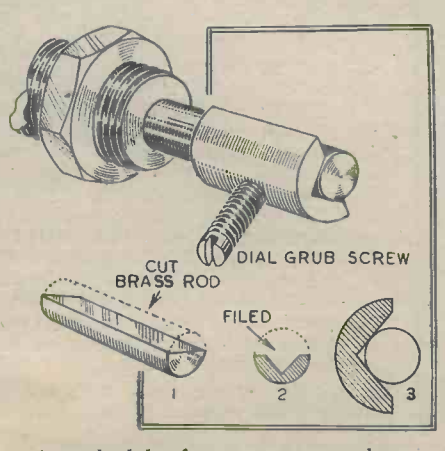
A Use for Old Battery Terminals

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

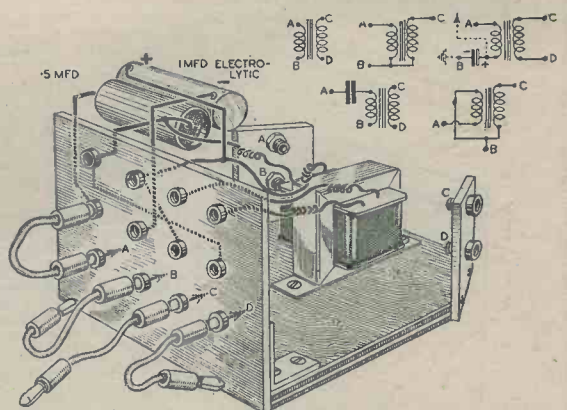
RECENTLY when looking through my junk-box in search of a respectable dial for the reaction condenser on my new set, I found a very nice dial, but was dissappointed to discover that the spindle of the reaction condenser was too small, and that the dial ran eccentric. However, this was soon rectified by 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.

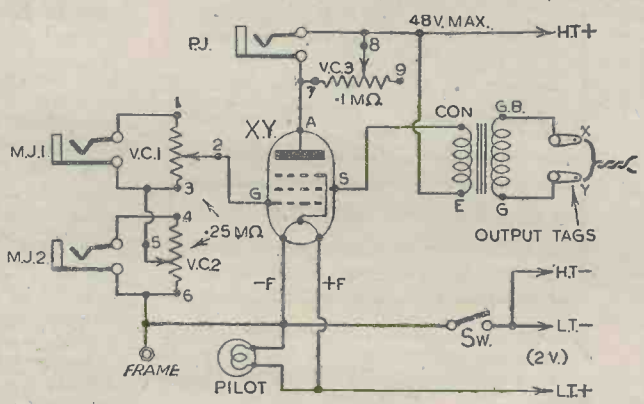


Fig. 1.—Theoretical circuit diagram of the combined pre-amplifier and mixer unit.

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,

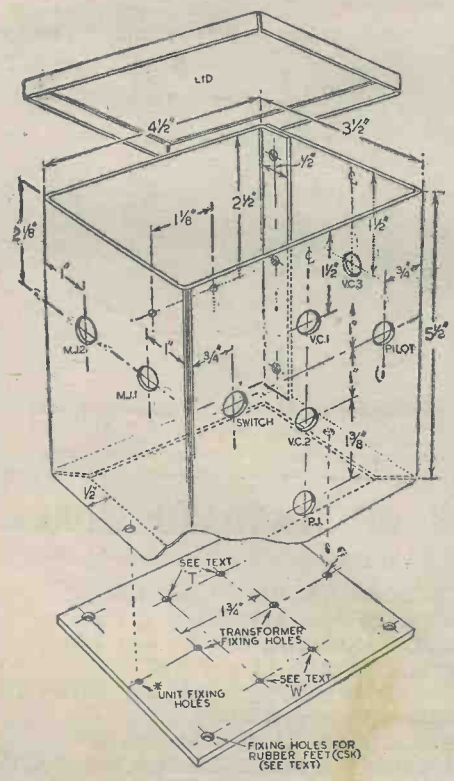


Fig. 2.—Constructional details of the casing.

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

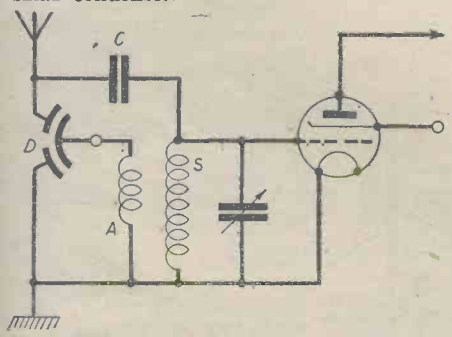
with the pilot 'phone jack, PJ, only effects a slight change in screen current by .1 mA at the maximum H.T. setting of 48 volts, this variation falling, of course, proportionally with any decrease in H.T. This point, however, is important in so far as the resistance of the pilot 'phones are concerned,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

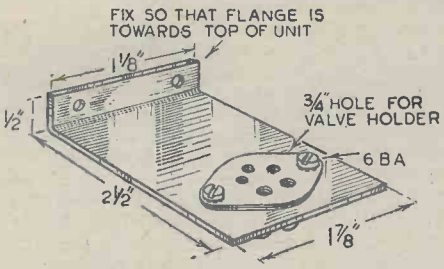


Fig. 3.—Details of valveholder bracket.

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.

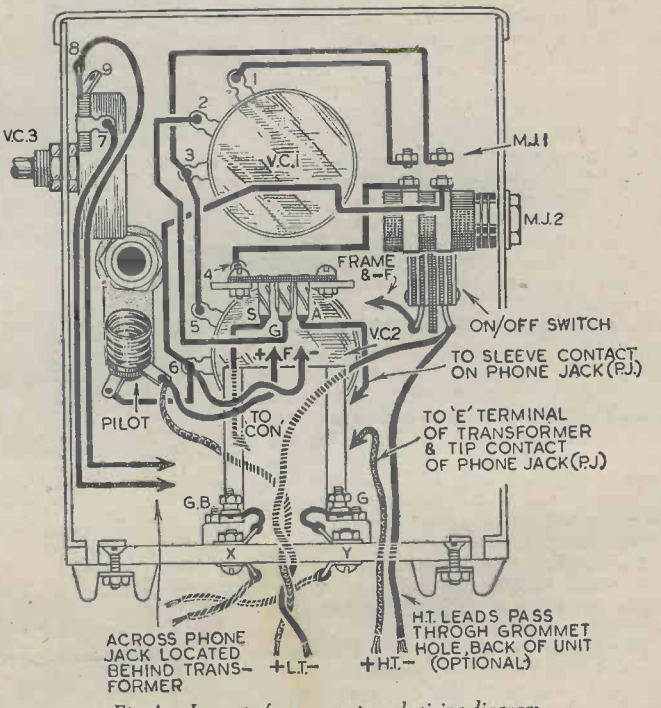


Fig. 4.—Layout of components and wiring diagram.

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.

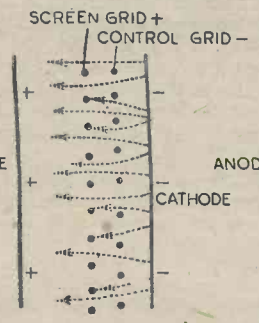


Fig. 1.—Electrode arrangement without alignment of grids. Many electrons meet the screen grid in their path to the anode.

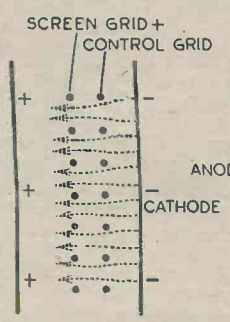


Fig. 2.—Electrode arrangement with alignment of grids. Low screen current. The screen grid attracts fewer electrons as it is partially shielded by the "shadow" of the control grid.

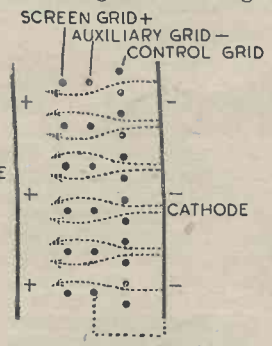


Fig. 3.—An alternative design, suitable for close mesh control grids, utilising an auxiliary grid at cathode potential, aligned with screen grid.

(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.

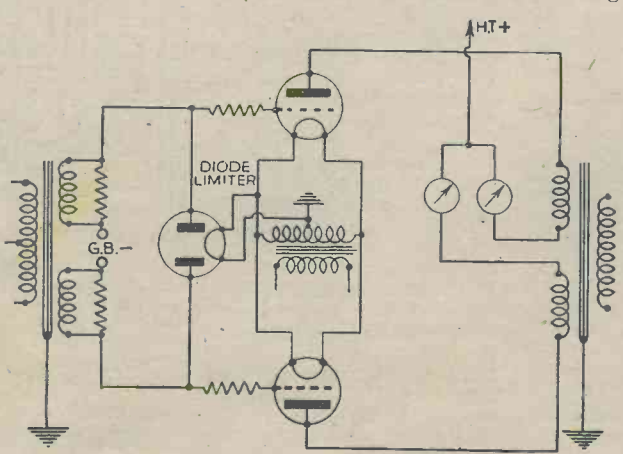


Fig. 5.—Signal voltage limiting circuit for use with power triodes in class AB1 push-pull, showing the diode.

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

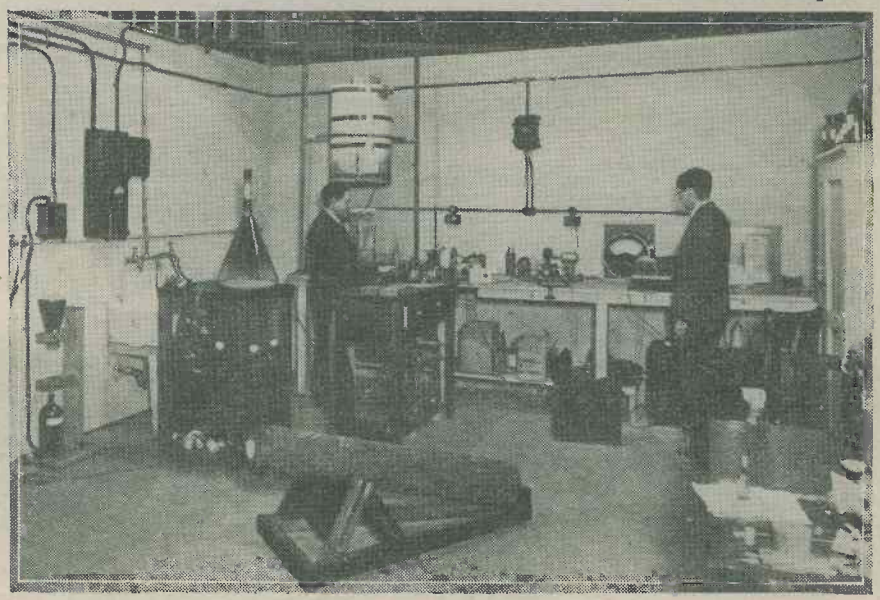
February 3rd, 1940. Vol. 4. No. 188.

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

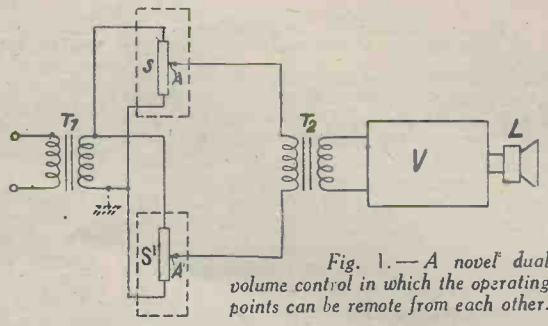


Fig. 1.—A novel dual volume control in which the operating points can be remote from each other.

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.

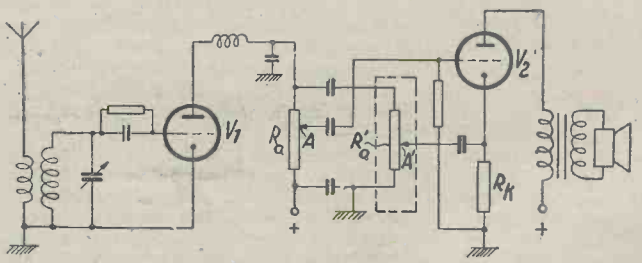


Fig. 2.—A slight modification of the above embodied in a receiver circuit.

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.

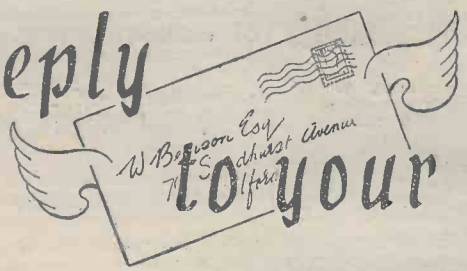
Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices, *which are additional to the cost of the Blueprint.* A dash before the Blueprint Number indicates that the issue is out of print.

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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Ditto, 3-gang .. .. **2/-** each

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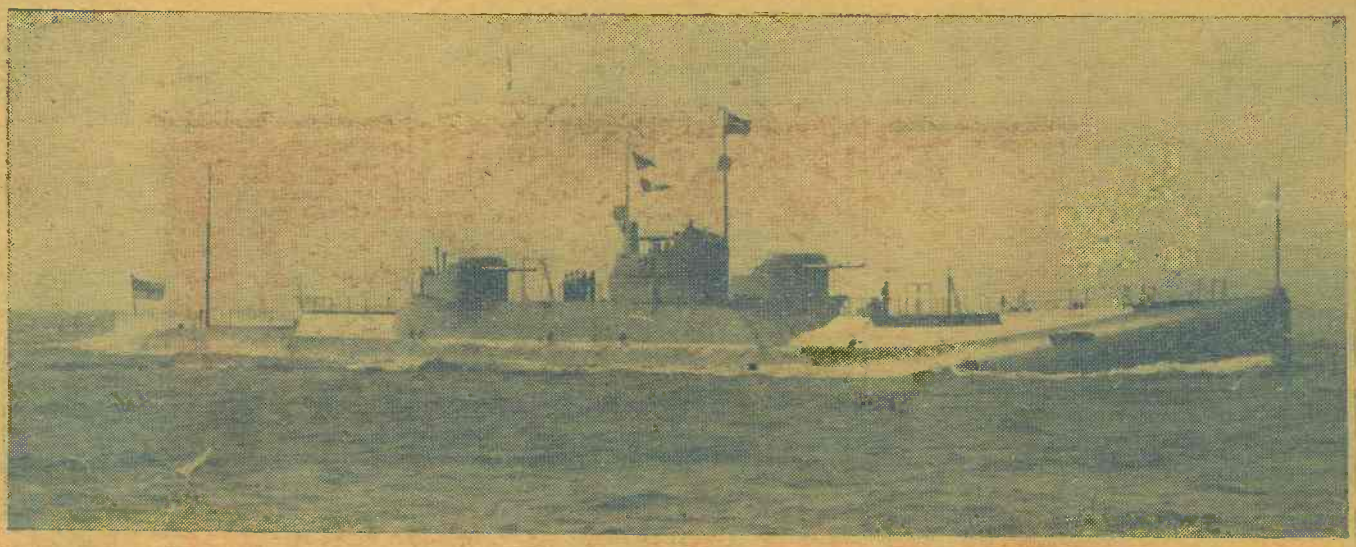

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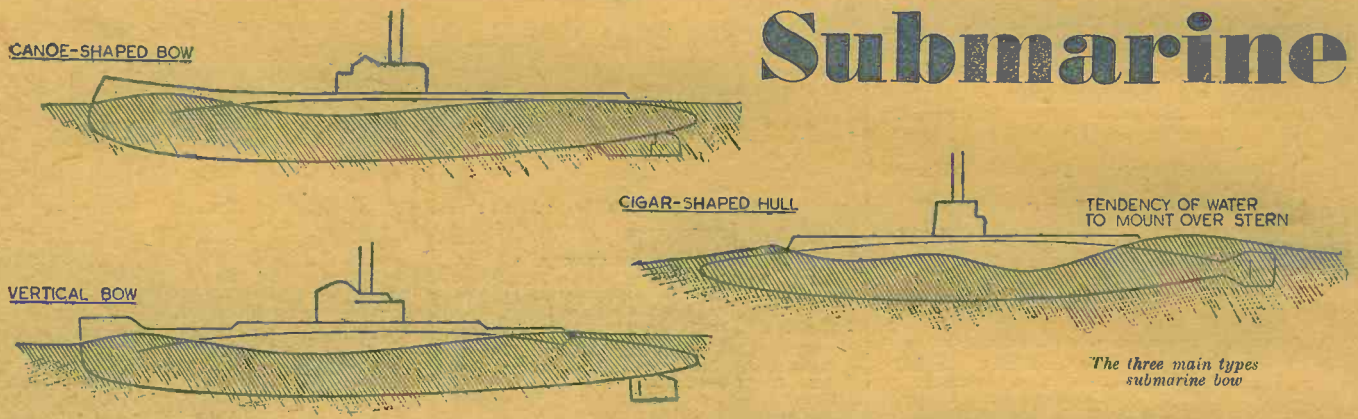

The three main types submarine bow

How the submarine torpedo-boat has developed through more than thirty years of intensive research and the many difficulties which had to be overcome before it reached its present-day perfection, is described in a new series of articles in PRACTICAL MECHANICS. Part I deals with Earlier Submarines, Superstructure, Double Hull Construction, Submerging, A Floating Hull, Reserve Buoyancy, Stability, and Diving Powers.

Other Contents of the February PRACTICAL MECHANICS include :

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IN THE FEBRUARY

PRACTICAL MECHANICS

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Practical and Wireless

PRACTICAL TELEVISION

EVERY WEDNESDAY

Vol. XV No. 386 Feb 10th, 1940.

EDITED BY
F. J. CAMM

Staff:
W. J. DELANEY, FRANK PRESTON.
H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Ideal Home Equipment

THE subject of the best receiver still crops up regularly, and the variations in what different listeners consider the ideal are most interesting to study. We recently described an arrangement which we considered the ideal, and in response to many requests we give in this issue constructional details of a receiver built on those lines. But the receiver circuit alone is not the end of the problem. For instance, although the receiver described has a special gramophone amplifying section incorporating a contrast expander, a speaker has not been specified, nor has a cabinet or designs for one been dealt with. The listener who is out to get the very best from the receiver will house the set in a small cabinet which will include only the gramophone motor and turntable—and perhaps a storage space for records. The speaker, or rather the speakers, for a tweeter is highly desirable, should be mounted on a special flat baffle and placed in a suitable position in the room. This is one of the greatest problems. The proper type of baffle, a square of at least 3ft. of 1in. timber, does not present a very neat appearance, and is not easily accommodated in the average room. Consequently a compromise has to be effected, and in this much of the advantages of a receiver may be lost. Cabinets can be designed to offer good results, but they are not easy to design, and the furnishings of the room will also play a part in modifying the effects of quality output.

The set maker overcomes a difficulty. Here is an ingenious machine which winds 10 coils at a time, under the control of a single operator.

Lauder to Broadcast

THE B.B.C. announces that Sir Harry Lauder will be heard in the first of three broadcasts on Friday, February 16th, at 8.30 p.m.

Sir Harry, who will broadcast from a studio, will sing a number of his old songs which have been associated with him throughout his career. He will also be heard in a new song, "Pin Your Faith in the Motherland," which he gave for the first time last week at a concert for the Troops. Sir Harry has written this song since the outbreak of war. He will be accompanied by the B.B.C. Scottish Orchestra, and the broadcast will last half an hour.

He will also be heard in two broadcasts during March, the dates of which will be announced later.

Sir Harry Lauder's broadcast on February 16th marks the return to the microphone of one of the outstanding variety artists of the last war. His concerts between 1914 and 1918 realised nearly a quarter-of-a-million pounds for comforts for the Troops.

R.A.F. Comforts Appeal

THE Royal Air Force Comforts Committee appeal to their helpers throughout the country to send woollen garments and other comforts to their headquarters at Berkeley Square House, Berkeley Square, W.1.

Issues made direct to local Air Force units and to individuals are much appreciated, but the official Comforts Committee in London cannot meet all the requests from Royal Air Force personnel serving in France and at isolated units at home unless the bulk of the available goods are sent to them.

At the present time approximately 100,000 various woollen items are required to meet existing demands. County and town comforts organisations and working parties should, therefore, send goods to Berkeley Square House as soon as completed without waiting until the full projected quota is ready.

In Good King Charles's Golden Days

BERNARD SHAW'S latest play, "In Good King Charles's Golden Days," has been chosen for the first of a new fortnightly series of broadcast excerpts from current plays running in London and the provinces. "In Good King Charles's Golden Days" opens a tour of the provinces at the Theatre Royal, Newcastle-on-Tyne, on February 12th, prior to its London production. It was first produced at the Malvern Festival last year. Listeners will hear the last act, which is in the form of a duologue, played by Ernest Thesiger as King Charles and Irene Vanbrugh as Queen Catherine. The programme will be introduced by Ivor Brown, who has written an appreciation of the play and its author.

A Tale from Timbuctoo

ON February 9th, listeners will hear what happened to a lady whose husband wished her "in Timbuctoo," when "A Tale of Timbuctoo," by Bernard Rowley, is to be produced by Howard Rose.

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

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

Automatic Tone-control Circuits

An Electrical Method of Auto-control of Selectivity in the L.F. Stages

THE arrangements described in the following notes afford means for automatic control by purely electrical methods, and are of particular interest in connection with the automatic control of selectivity in the low-frequency stages of a receiver. Generally, the idea is to connect in parallel with the anode-cathode path of the regulating valve a frequency-dependent potential divider from which the grid of the valve obtains its signal voltage; and the values of the circuit elements of this potential divider are so chosen that it operates either as a rejector or as a shorting circuit.

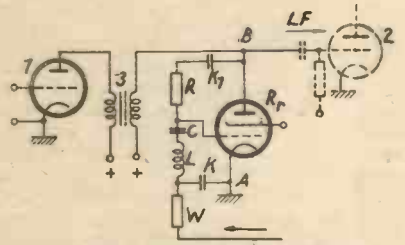


Fig. 1.—Basic circuit of the electrical auto-tone-control arrangement.

An arrangement for rejector operation is shown in Figure 1, in which the two valves 1 and 2 are coupled by the L.F. transformer 3, and the control device, consisting of regulating valve Rr with parallel connected potential divider RCL, is connected between the points B on the L.F. lead and A on the earth lead. The regulating voltage is led up via the filter WK, and the condenser K1 keeps the anode D.C. voltage from the grid: capacity C and inductance L form a resonance circuit tuned to about 700 cycles, which acts as a parallel resonance circuit between points B and A. Figure 2 shows the equivalent substitution circuit, valve 1 and transformer 3 being replaced by the generator delivering short-circuit current Jk and possessing internal resistance Ri. The resonance resistance R¹ of the oscillating circuit, and also its inductance L¹ and capacity C¹ are in parallel with this internal resistance. The actual values of R C L in Figure 1 are such that the resonance resistance R¹ in Figure 2 is large compared with Ri, or about equal to Ri, while the reactances of L¹ and C¹ are of the same order of magnitude as Ri. A large value of R¹ is obtained by a small ratio of the loss resistance, which is to be imagined as lying in series with L and C in Figure 1, to the resistance R: the inductance L¹ in Figure 2 is small if C in Figure 1 is small, and the capacity C¹ in Figure 2 is large if L in Figure 1 is large.

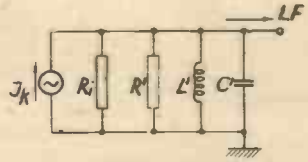


Fig. 2.—The arrangement of Fig. 1 redrawn symbolically.

If in Figure 1 the regulating voltage is varied so as to increase the amplification of the valve Rr, R¹ in Figure 2 decreases: this is, however, unimportant as long as R¹ is equal to, or large compared with, Ri. At the same time L¹ decreases and C¹ increases: starting from a value large compared with Ri, the inductive or capacitative resistance at high and low frequencies drops to a value less than Ri: hence, the current Jk generates a lower A.C. voltage across the whole parallel circuit at the high and low frequencies. Figure 3 shows how the volume Lst depends on the frequency f at the various values of anode A.C. current indicated on the individual curves, and it is seen that the transmission coefficient at resonant frequency is approximately constant within the regulating range. The amplification of the valve Rr is naturally the greater the greater the setting of anode D.C. current.

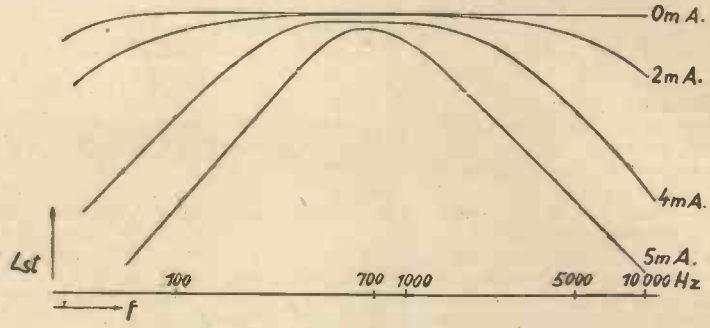


Fig. 3.—Curves illustrating the effects of this new circuit.

Alternative Circuit

The alternative circuit of Figure 4 is also a parallel resonance circuit, the potential divider C_1R_1 operating between points A and B as capacity, and the potential divider R_2C_2 operating between these points as inductance. K_1 and W serve the same purposes as in Figure 1. If the regulating voltage were led directly to the grid via a grid leak, K1 might be introduced in front of or behind the resistance R_1.

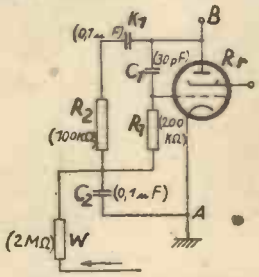


Fig. 4.—An alternative arrangement.

In Figure 5 the potential divider R L C_1 operates as a series resonance circuit, tuned to, say, 9 kc/s, and Figure 6 shows the equivalent substitution circuit with the their mutually compensating action is maintained. At the same time R_1 decreases so that the L.F. voltage across output terminals drops. In Figure 6 R_1 is the smaller the greater the ratio of the resonance resistance of LC_1 in Figure 5 to the resistance R: a narrow resonance curve is obtained for the shorting circuit of Figure 6 if the oscillating circuit LC_1 in Figure 5 has low attenuation.

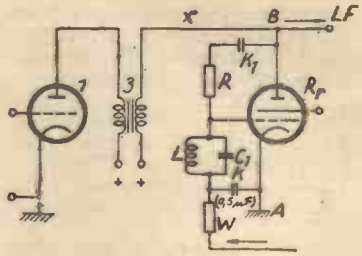


Fig. 5. — The use of a series resonance circuit.

It is of course possible to replace the transformer coupling by a resistance coupling: if valve 1 is a pentode the anode resistance should be taken as Ri, since the effective Ri for the circuit arrangement between B and A consists of the internal and external resistances of the valve in parallel. The internal resistance Ri can also be increased by introducing

(Continued on page 449).

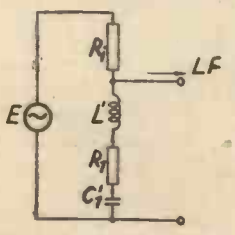
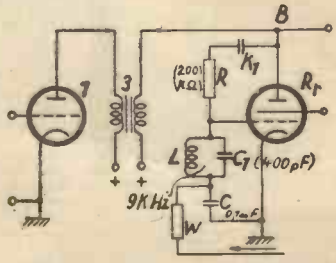
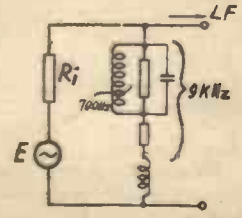


Fig. 6.—Illustrating the resonance short-circuit feature.





Figs. 7 and 8.—A combination of the arrangements previously described.

A Spares-Box A.C. Transportable

A Transportable Receiver is Always a Handy Stand-by Receiver, as it Affords Radio in Any Room Without Aerial and Earth Complications

By THE TECHNICAL STAFF

THE request cycle has rotated very definitely this month towards a receiver of the portable type, for A.C. mains operation, and of such design that components from the spares box can be used. While admitting that the number of requests certainly calls for some acknowledgement, we must ask those readers who have written to appreciate that their requirements are rather exacting, and that it would be impossible for us to produce a design which would satisfy all specifications and at the same time allow each individual reader to utilise the parts he has on hand without any modifications to the layout and/or wiring.

Bearing such considerations in mind, and the fact that we naturally wish the design to appeal to as many of our correspondents as possible, we give above a suggested circuit and layout with the hope that those who wish to make up a set of this type will be able to carry out such simple alterations as might be necessitated by the gear their spares box contains. Please do not write and ask us to provide diagrams to show you how to use this or that particular component or valve, as this is one item which the hard-worked Query Service cannot undertake to do, owing to the time which would be involved if such facilities were granted to all of our readers.

The Circuit

On account of cost, it is advisable to keep the number of valves in the circuit as small as possible, consistent, of course, with satisfactory results; therefore, it is decided to use the conventional three-valve arrangement (plus rectifier) in the form of H.F., Det. and Pentode output.

The diagram is shown in Fig. 1. It will be noted that the H.F. stage is of the variable-mu type, thus providing a very smooth form of pre-detector volume control, and that it is coupled to the detector grid tuning coil by means of the efficient but simple "tuned-grid" method of coupling.

The coil shown is the Wearite "Unigen" dual-range coil. This particular component was selected as it is fairly compact, very efficient, and quite widely used. Other makes or types can be used according to individual requirements, but it is rather essential to use a screened or canned component, otherwise there will be the danger of instability due to interaction.

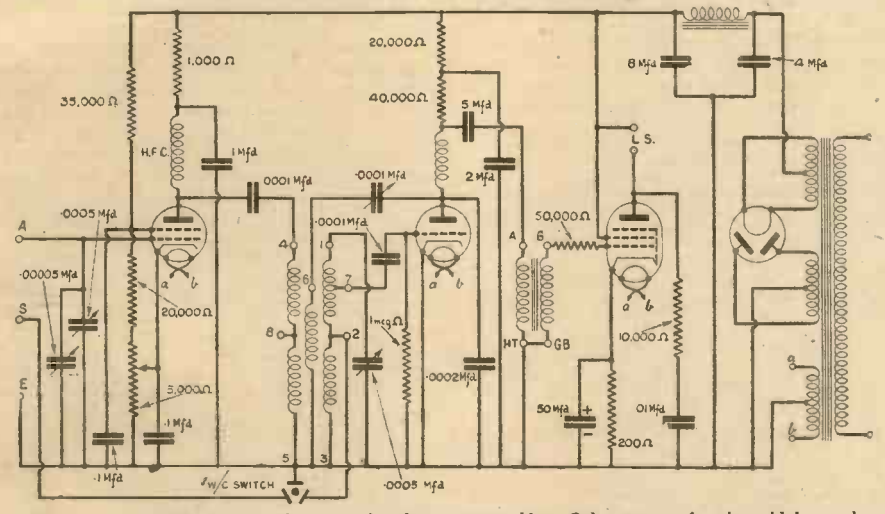


Fig. 1.—A suitable theoretical circuit for the transportable. Other types of coil could be used.

Should one be only interested in the medium-wave stations, and under existing conditions this is an item worthy of consideration, the coil terminals normally connected to the wave-change switch can be connected together and one component eliminated. Similarly, if only one waveband is required, the construction of the frame aerial will be considerably simplified and, incidentally, the overall efficiency of the receiver be improved, as the winding for the long-wave section would then be no longer necessary. There are so many little snags connected with the satisfactory reception of long-wave stations on a simple portable of this type, that we would advise the constructor to seriously consider making the set for medium waves only.

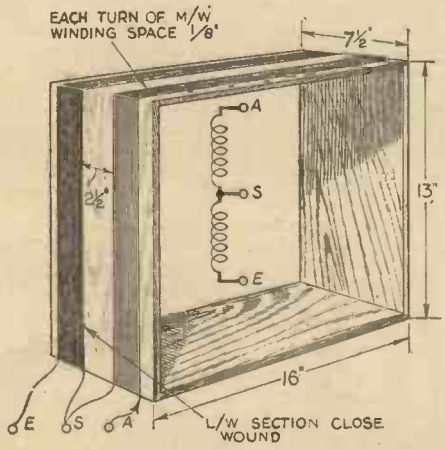


Fig. 3.—Shows the winding data and theoretical circuit for the frame aerial. A to S, med. waves, 14 turns 26 s.w.g.; S to E, long waves, 40 turns 32 s.w.g.

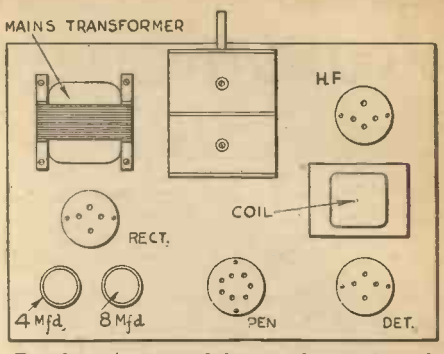


Fig. 2.—A suggested layout, showing how the mains equipment is located to one side of the chassis away from the coil.

The triode detector is perfectly straightforward. A screen-grid valve could be used in this position, with an appreciable increase in gain, but if such a valve is used, then one must expect to spend a little time experimenting to determine the most satisfactory screen voltage, as this governs to such a large extent the smooth and efficient operation of a valve of this type in the detector position. As stressed many times before, the screen voltage should be on the low side, i.e., roughly half the value normally specified for H.F. work.

The output from the detector is fed into the pentode output valve via a standard parallel fed transformer coupling. The use of the transformer helps to give a gain increase, thus making sure that the pentode gets a reasonable load, but care must be taken to see that it does not introduce any hum into the circuit by being within the effective field of the mains transformer. If such should be experienced, the transformer should be rotated about its vertical axis until a position is reached where the hum is the least. Plain resistance-capacity coupling could be used which, while reducing the over-all amplification obtainable, would help to reduce the possibility of hum.

Rectifier

In Fig. 1 a valve rectifier is indicated, one of the 250-volt 60 mA. D.C. output type, but there is not the slightest reason why a suitable type of Westinghouse metal rectifier should not be used. The latter, however, will take up rather more space than a valve, but the other components could be readjusted to provide for this.

If possible, use a mains transformer of the shielded kind and not too bulky. Do make sure that it is securely fastened to the chassis and that all associated connections are beyond suspicion and properly insulated. The smoothing condensers should be of the electrolytic type, to save space, and for the same reason it will be found advantageous to use the ordinary tubular kind for the other condensers indicated.

(Continued overleaf)

NEW SERIES

RADIO ENGINEER'S POCKET-BOOK

No. 6.

Abbreviations used in Table on pages 8 and 9.

I.H.—Indirectly heated. D.H.—Directly heated.
M.—Metallising. F.—Filament.
H.—Heater. C, C1, etc.—Cathodes.
A, A1, etc.—Anodes (Ao—Oscillator anode).
G or G1—Control grid (Go—Oscillator control grid).
G2—Screening grid. G3—Suppressor grid.
D, D1, etc.—Diodes (anodes).

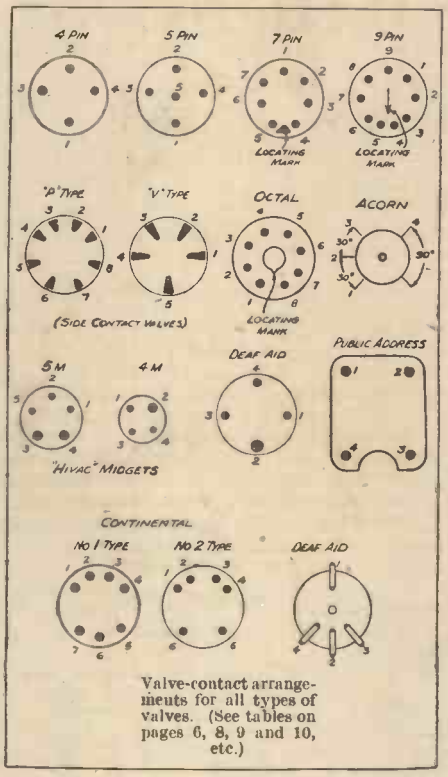
Valve Base Connections for American (Octal) Valves.

Valve Type	Base	Pin Connections 1	2	3	4	5	6	7	8	Top Cap
Triode .. I.H.	Oct.	M	H	A	—	G	—	H	C	—
Triode .. I.H.	Oct.	M	H	—	A	—	—	H	C	G
H.F.Pentode I.H. Output Pentode	Oct.	M	H	A	G2	G3	—	H	C	G1
I.H.	Oct.	M	H	A	G2	G1	—	H	C	—
Heptode I.H.	Oct.	M	H	A	G3 G5	Go (G1)	Ao (G2)	H	C	G4
Double-diode I.H.	Oct.	M	H	D2	C2	D1	—	H	C1	—
Double-diode-triode I.H.	Oct.	M	H	A	D1	D2	—	H	C	G
Rectifier, Full-wave .. I.H.	Oct.	M	H	—	A	—	A	—	H, C	—
Rectifier, Full-wave .. I.H.	Oct.	—	H	H	A2	C2	A1	—	H, C1	—
Rectifier, Full-wave .. I.H.	Oct.	M	H	A	—	A	—	H	C	—
Rectifier, Full-wave, Gaseous	Oct.	M	—	A	—	A	—	—	C	—

Valve Base Connections for Acorn and Deaf-Aid Valves.

Type	Base	Pin Connections 1	2	3	4	5	Top	Bottom
ACORN								
Triode ..	1	H	C	H	G	A	—	—
H.F. Pentode ..	1	H	C	H	S	SG	A	G
DEAF AID								
Triode (D.H.) ..	2	A	G	F	F	—	—	—
Triode (I.H.) ..	2	A	C	H	H	—	G	—
Triode (Mullard)	3	A	G	F	F	—	—	—
PUBLIC ADDRESS								
Triode	4	A	F	G	F	—	—	—

No. 7.



Valve-contact arrangements for all types of valves. (See tables on pages 6, 8, 9 and 10, etc.)

Subsequent pages will give data for connections of all the valve types shown in the diagrams on page 7 above.

No. 8

VALVE BASE CONNECTIONS FOR STANDARD (B.V.A.) VALVES
See page 6 for definitions of abbreviations used.

Valve Type	Base	Pin Connections 1	2	3	4	5	6	7	8	9	Top Cap
Triode .. .. D.H.	4	A	G	F	H	G	—	—	—	—	—
Triode .. .. I.H.	5	A	G	H	H	H	G	A	—	—	—
Triode .. .. I.H.	7	M	—	H	H	H	G	A	—	—	—
Tetrode .. .. D.H.	4	G2	G1	F	H	F	—	—	—	—	—
Tetrode .. .. I.H.	5	G2	G1	H	H	H	—	—	—	—	—
H.F. Pentode or Tetrode .. D.H.	7	M	G1	G3	H	F	—	G2	—	—	A
H.F. Pentode or Tetrode .. I.H.	5	G3	G1	H	H	H	—	G2	—	—	A
H.F. Pentode or Tetrode .. I.H.	7	M	G1	G3	H	H	—	G2	—	—	A
H.F. Pentode or Tetrode .. I.H.	7	M	G1	G3	H	F	—	G3	—	—	A
H.F. Hexode .. .. D.H.	7	M	A	G3	P	F	—	—	—	—	G1
Output Pentode .. .. D.H.	4	A	G1	P	P	G2	—	—	—	—	G1
Output Pentode .. .. D.H.	5	A	G1	P	P	—	—	—	—	—	G2
Output Pentode .. .. I.H.	5	A	G1	P	H	C	—	A	—	—	G1
Output Pentode .. .. I.H.	7	A	G1	H	H	H	—	A	—	—	G1
Output Pentode .. .. D.H.	7	—	G1	G2	P	F	—	—	—	—	G1
Heptode .. .. I.H.	7	Ao	Go	G2	H	H	O	A	—	—	G1
Heptode .. .. D.H.	7	Ao	Go	G2	P	F	M, G6	A	—	—	G4
Octode .. .. D.H.	7	G2	G1	G3, G5	P	H	G, M, G6	A	—	—	G4
Octode .. .. I.H.	7	G2	G1	G3, G5	H	H	—	A	—	—	—
Class B Output .. .. D.H.	7	G2	G1	A1	F	P	—	A2	—	—	—
Double-diode .. .. D.H.	4	D1	D2	F	H	F	—	—	—	—	—

No. 9

Valve Type	Base	Pin Connections 1	2	3	4	5	6	7	8	9	Top Cap
Double-diode .. .. I.H.	5	D1	D2	H	H	C	—	—	—	—	G1
Double-diode-triode .. D.H.	5	A	D2	F, M	P	D1	—	—	—	—	G
Double-diode-triode .. I.H.	7	D1	M	D2	H	H	C	A	D1	G1	G
Triple-diode-triode .. .. I.H.	9	D2	D3	—	H	H	O	A	D1	M	G
Single-diode-tetrode .. .. I.H.	7	—	G1	G2	H	H	O, M	D	Ao	M	A
Triode-pentode .. .. D.H.	9	G2	A1	G3	F	F	—	Ao	Go	G1	G1
Triode-pentode .. .. I.H.	9	G2	A1	G3	H	H	C	Ao	Go	G1	G1
Triode-hexode .. .. D.H.	7	Ao	Go	G2	P	F	M	A	—	G1	G1
Triode-hexode .. .. I.H.	7	Ao	Go	G2	H	H	C	A	—	G1	G1
Double-pentode .. .. D.H.	7	G14	G11	A1	P	P	G2, G24	A2	A2*	—	—
Double-pentode .. .. D.H.	9	G14	A1	G21	P	P	—	D1	D2	M	G1
Double-diode-H.F. Pentode I.H.	9	G2	A	—	H	H	C, G3	C	G2	G3	G1
Double-diode Output Pentode I.H.	7	D1	A	D2	H	H.	—	G2	G3	—	G1
Double-diode Output Pentode I.H.	7	D1	C	D2	H	H	A	—	—	—	G1
Rectifier, Half Wave .. .. D.H.	4	A	—	F	F	—	—	—	—	—	A
Rectifier, Half Wave (H. Volt) D.H.	4	—	—	F	F	—	—	—	—	—	—
Rectifier, Half Wave (H. Volt) I.H.	5	A	—	H	H	C	—	—	—	—	A
Rectifier, Half Wave (H. Volt) I.H.	4	—	—	H, C	H	H	—	—	—	—	—
Rectifier, Full Wave .. .. D.H.	4	A	A	F	P	H	—	—	—	—	—
Rectifier, Full Wave .. .. I.H.	4	A	A	H, C	H	H	—	—	—	—	—
Rectifier, Full Wave .. .. I.H.	5	A	A	H	H	C	—	—	—	—	—
Rectifier, Full Wave .. .. I.H.	7	H,C,T	A1	C1	H	H	C2	A3	—	—	—
Barretter	4	—	—	F	F	H	C	A	—	—	—
Tuning Indicator (C.R.) .. I.H.	7	—	G	Targ.	H	H	O	A	—	—	—

A SPARES-BOX A.C. TRANSPORTABLE

(Continued from previous page)

Loudspeaker

In the original set, a small moving-coil P.M. model was used, and this gave most satisfactory results, but if one has an energised model to hand having a field resistance of, say, 1,500 ohms, then that could no doubt be used, but it will naturally reduce the ultimate H.T. available for the valves. The L.F. choke would, in such circumstances, not be necessary as the energising field would then act as the smoothing inductance. In other words, the field would be connected in place of the choke.

There are many surplus small moving-coil loudspeakers now on the market, so no difficulty should be experienced in obtaining a suitable component if one is not on the shelf.

Construction

Apart from the suggestions given below regarding the layout of the components and the making of the frame, very little can be said about the actual construction and housing of the set, as so much will depend on the size and kind of cabinet used. In the circumstances, therefore, each individual constructor must use his own initiative and settle all the finer details to suit his own considerations.

All the parts for the set are mounted on a simple chassis measuring 12in. by 9in. by 3in., which can be made from metallised five-ply wood or sheet aluminium. The speaker is mounted on a small baffle which, in turn, is fastened to the inside of the front of the cabinet. Be careful when doing this and don't allow the fixing screws to go right through and spoil the finish of the cabinet.

The details given for the frame aerial have to be based on certain dimensions, these are given in Fig. 3, but if other measurements have to be used, the same length of wire for each section will still be required. This is, of course, if the same spacing and gauges of wire are employed.

While speaking about the frame aerial, it will be noted that a small vernier variable condenser is connected across the tuning condenser used for the aerial. This should be mounted on the front panel so that the aerial and the H.F. coupling coil can be brought dead in tune on any part of the tuning range of the receiver. This may seem unnecessary to many, bearing in mind the small trimming condensers fitted to gang condensers to allow one to adjust the tuned circuits, but, unfortunately, it is not an easy matter to gang a frame aerial with a standard coil, owing to the fact that a frame winding does not follow or obey the same tuning laws as an ordinary dual-range coil.

A PRE-AMPLIFIER AND MIXER UNIT

IN last week's issue we described the construction of a compact unit for home-broadcasting use under the above title, and omitted to specify the type of phones which were recommended. As many readers will have seen from page 425, however, Ericsson supersensitive phones are indicated, and these are of the high sensitivity light-weight type ideal for normal use. These are available in three different resistance ranges, and the resistance suitable for the mixer unit in question is 4,000 ohms.

ON YOUR WAVELENGTH

By Thermion

Wisdom from the Minister of Economic Warfare!

I LISTENED in the other evening to Mr. Ronald Cross, Minister of Economic Warfare. He told his listeners, in dealing with the question of bakelite, that it was made of milk. I now tell the Minister of Economic Warfare, Mr. Ronald Cross, that it is not. Gallalith and casein are made from milk. I have no doubt that by this time he has learned what bakelite is composed of.

Our A.C.R. Certificate

I HAVE had a further communication from John A. Clark, Jnr., of Forfar, Angus. You remember that he wrote demanding an A.C.R. Certificate, and said that he would not be satisfied until he got it. Here is a list of the countries which the aforesaid Clark submitted as qualifications:

1. Europe.
2. Asia.
3. Africa.
4. North America.
5. South America.
6. Australia.

We wrote pointing out that he had not complied with the conditions because the reception of British stations did not come within the classification of Europe, as our pertinacious friend from over the Border, with all the top-of-the-world aplomb inbred in the Scottish race, seems to suppose. We pointed out that anyone could receive British stations on any old set. Moreover, North America and South America are not two separate continents, but one continent.

This reader has overlooked the fact that there are only five continents not six, and as he wishes to maintain that reception of home stations comes within the classification of Europe, I recommend him to study any dictionary and look up the word continent, wherein he will find it defined as "Europe as distinguished from the British Isles." John A. Clark, of Forfar, Angus, is, therefore, still without an A.C.R. Certificate.

Oh, to Remain in England!

THE German Government is so annoyed with the British propaganda broadcasts that it has made it an offence punishable with death for any German to be caught listening in to British broadcasts. The German junta are, of course, afraid of the inevitable revolt once the docile population of Germany has learned the truth. They have made great capital in their broadcasts over the sorry show put up in South Africa by General Hertzog. I listened to those broadcasts which were made in German, but the Germans were not told the result of the voting. Some day, of course, the Germans will wake up. They were always known as blockheads or boches, and this present war shows that they have not changed in the past 25 years. They climbed down at the end of the last war like whipped curs or a flock of third-rate sheep.

In this country we are told the truth even when it goes against us. When a German submarine was in Scapa Flow the British public were informed. When our ships are sunk the British public is informed. Our broadcasts are fair to both sides. In fact, when Mr. Churchill was dealing with the German submarine exploit at Scapa Flow he paid great tribute to the courage and skill of the German U-boat commander. It is impossible for an Englishman to understand how a race can be kept in constant subjection and not demand to know the truth. I refuse to believe that it is misled. The tragic part of it is that one Englishman, and a Scot at that, named J. Baillie-Stewart, is in Germany traitorously fostering anti-British propaganda. Baillie-Stewart, you will remember, was the "Officer in the Tower" who was imprisoned before the war for selling secrets to the enemy through the fictitious German female Marie Louise. I do hope that when this war is over we catch this Mr. Baillie-Stewart and punish him for the traitor that he is.

Had he been a German operating against Germany as he has against the English, the Gestapo would have riddled him with bullets without the expense of a trial. I recommend my readers to listen in to some of the German broadcasts, and particularly those which are broadcast in German. As a painter Hitler is well able to paint any picture in a particular colour, on the principle well known in the building trade, that a coat of paint hides a multitude of bad work.

We must admit that our own broadcasts are scrupulously fair.

Mains-earth Connection

A FRIEND was transferring his mains receiver from one room to another, but was at a loss to know how he could conveniently obtain an earth connection. This was because the receiver was to be in a corner of the room remote from the window and well away from any water pipes. He looked surprised when I suggested that he could use the third (earth) point of the three-pin power point.

In this case it provided just as good an earth return as did his buried plate used in the other room. Sometimes, however, this is not so because the earth connection made by the electrical contractors may be of fairly high resistance. Even then it might be possible to use the earthed socket by making a sound earth return from a cleaned portion of the conduit tube to a nearby cold-water pipe.

Incidentally, it was found that the set in question was very unsatisfactory on the mains aerial in one room, whilst this aerial was fully satisfactory in another. I had not time to attempt to find a reason, but you might be able to think out a few possible causes of this apparently peculiar behaviour.

Phosphorescent Phosphors

AN illustrated lecture on "Phosphorescent Phosphors" will be given on Thursday, February 8th, at 6 p.m., by Dr. Leonard Levy, M.A. (Cantab.), D.Sc. (Lond.), F.I.C., and Mr. D. W. West, A.S.G.I., A.I.C., before a meeting of the Institution of Electronics.

The meeting will be held at the Royal Society of Arts, John Street, Adelphi, W.C.2, and invitation to attend is accorded to any of my readers who are interested.

B.B.C. Relays from Abroad

I AM informed that the exchange of broadcast programmes between countries all over the world has grown considerably in the last few years and, so far as the B.B.C. is concerned, this international sharing of radio talent scored a new record in 1939. Despite the outbreak of war, listeners in Britain were able to hear during the year no fewer than 530 relays from abroad, compared with 433 in 1938 and 255 in 1937.

Picked up by line, by public radiotelephone service, and by direct reception at the B.B.C.'s receiving station at Tatsfield, these transmissions brought outside broadcasts and studio performances from the majority of European countries as well as from Canada and the U.S.A., Australia, India, South Africa and other places as far apart as Moscow and Honolulu. Four programmes were picked up from the *Mauretania* at sea and relayed to listeners. Another sea programme came from the *Dominion Monarch*.

Although these programmes involved great distances and the frequent use of repeater stations in the case of line relays, technical successes numbered 92.9 per cent. of the total, compared with 92.4 per cent. the previous year, and 87.7 per cent. in 1937.

The highest number of European relays was taken from France, which provided 99 programmes, 98 of which were complete technical successes. Italy and Switzerland each supplied 40.

British listeners heard 146 relays from the U.S.A., 83 being picked up by the B.B.C. at Tatsfield and the remainder by the Post Office radiotelephone service. Ten cities and towns of Canada provided 22 programmes. South Africa was tapped for 24 transmissions, and Egypt for no fewer than 41.

The majority of these re-transmissions were completely successful. Partial successes, which were considered, nevertheless, to be good enough in quality for relay to listeners, were marred by distortion, fading or interference. Only 7.1 per cent. of the relays were distorted or otherwise spoilt to such a degree as to warrant their cancellation.

Comment, Chat and Criticism

Dance Rhythm and Music

Our Music Critic, Maurice Reeve, Discusses the Association of Dance Rhythms with Music

THE influence and close association of dance rhythms with music has existed from the very earliest days of recorded history. Unfortunately, however, its precise relationship as a scientific and reproduceable art is not known, owing to the fact that no system for recording music was devised till countless centuries later. But that the very earliest pagan ceremonies and tribal customs were accompanied by various beatings of drums and tomtoms, rhythmic movements and sinuous contortions of the participants, and, as in the worship of the Delphic Oracle, set dances and chantings by trained ballets and choruses, is testified to by the ancient classical writers. It is also confirmed by the visits of explorers to those countries inhabited by so-called uncivilised and rude peoples where the very self-same rituals—combinations of religious or tribal worship to the accompaniment of music and dancing—can be observed this very day.

Pagan Rhythms

The analogy, in fact, is so close that the belief is now generally held that all kinds of music, whether of figure or phrase, had its origin in the dance. The beatings of instruments to the accompaniment of exotic gestures and wailing monotones were the first musical compositions. They were usually indulged in for celebration of victory over rival tribes or the sacrificial tribal rites, and were calculated to stimulate the fervour and arouse the passions. Their counterpart—though probably in a much more sophisticated form—can be witnessed to-day in such American Negro dances as the St. Louis Blues or the Charleston, and the Hawaiian Hula; whilst the ancient pagan rhythms are exemplified to perfection in a musical work like Ravel's famous Bolero, a marvellous stimulant of primitive feelings, and an excitement creator.

Musical Recitation

From these times onwards song and dance walk down the ages hand in hand. As the savage rites and fetishes began to assume the complexion of religions, the accompanying monotones took on a more serious and plaintive character, and their extreme of monotony began to be varied with an occasional cadence. This first vague approach to musical recitation must have received its first rhythmic arrangement when accompanied by rhythmic gestures—the two processes of song and dance thereby being combined. The progress of modern music has been similar. The connection between popular songs and dancing led to a definiteness in the rhythm and periods of secular music. In course of time such tunes were used by serious composers of choral music as the main thread of their works. They exercised a modifying, or mollifying, influence on the hitherto supreme element of pure harmony, and caused an emphasis on the rhythmic element in the work.

The fact that serious music has always been more carefully recorded—doubtless because it has been more highly esteemed—means that many writers of often excellent secular music have been lost to posterity. Serious musicians—up to the time of Beethoven at any rate—have fought very shy of the more pungent and exotic rhythms, the result being that their works are, for the most part, great masses of harmony and long threads of melody with rhythm rather conspicuous by its absence, so far as a definiteness over long periods is concerned. Suddenly, however, the rhythmic impulse that had been infused into choral dance music passed into serious music, and transformed the old chansons mondaine into a lively rhythmic tune, at the same time giving a fillip to modern harmony such as it would probably never have received if left altogether in the old path.

Madrigals

The first change of the chanson mondaine into the typical madrigal seems to have been greatly helped by the advance in artistic merit of the various dance forms, such as were sung in parts by voices, and by the closely allied frottole and villanella. As early as Arcadelt and Festa definite dance rhythms are found in movements obviously meant to be just madrigals. Composers, however, rarely kept in view the particular class in which some future age would be likely to place their work, but just lumped them all together as under the group heading of madrigals. Although many of these madrigals are pervaded with some dance rhythm or other, the best writers of madrigals, such as Marenzio, Palestrina, Vecchi, and the English masters would be difficult to class in any definite dance group implying a rhythmic connection with a particular dance. But they all owe a great deal to the dance. Whether this was by sophisticated design, or merely because the science of musical composition was not yet at that stage of advancement enabling a writer to put his every thought and intention on to paper, is not clearly discernible. The result, however, was valuable to music's future, albeit by design or otherwise. For by keeping the composition more or less independent, they were enabled to find out such things as the elementary principles of chord management by modifying conventional modes by instinct, whilst more serious writers were thwarted through a too strict adherence to forms and rhythms. A freedom of action was preserved which helped dance music to react upon serious music in secondary ways, as well since its composers led the way in grouping and balancing chords, the treatment of tonic and dominant harmonies, and the simpler branches of modulation. The dances of that day thus grew up in sturdy independence, whilst the madrigals kept free of the more obvious rhythms, doubtless to their benefit. When they finally came to an end, it was because they passed into part-songs with a definite tune, and not because they succumbed to the irresistible influence of the dance rhythm *per se*.

Opera and Oratorio

About 1600 all existing dance music together with the formulated ideas on it, was deposed by the new forces of Opera, Oratorio and, above all, instrumental music, then looming large on the horizon. In the declamatory forms the results were often vague and immature, but in most cases composers, in tackling these newly-discovered large-scale musical forms, openly or covertly surrendered to the charm of dance rhythms in some form or other. In fact, in both Italian and German music the dance principle as a definite form was only two generations off. Many chorales and other movements, at the turn of the century, were either adaptations of popular songs or modelled on them. These, as pointed out, obtained their form through their connection with the dance. Many of the movements in the works of Monteverdi, Cavalieri, Gagliano, etc., contained such headings as "Ballo a 3." The great French master, Lully, influenced the future profoundly—in fact, his music is as much terpsichorean as dramatic. Handel, Rameau, and Gluck also built up many of their movements on dance rhythms, but here the dramatic and musical elements are of the first importance. Movements like the "Ballet des Ombres heureuses," from Gluck's "Orphee," are as beautiful dance music in classical form as one will ever hear.

In modern times the traditional connection between the dance and religion has ceased, except in such cases as the dancing that is indulged in in Seville on Corpus Christi day (see the remarkable work by the Spanish Jew, Albeniz, "Corpus Christi in Seville"). And Mendelssohn has dance movements in "Elijah" (Baal choruses), and "St. Paul" ("O be Gracious Ye Immortals" and "How Lovely are the Messengers").

PROGRAMME NOTES

Northern Concert

ANOTHER brass band concert from the North is to be given by Baxendale's Band on February 8th, and a recital of organ music is to be played the same day by Stanley Tudor at the Gaumont Theatre organ, Manchester. Jack Hardy and his Little Orchestra, with Dorothy Pierce (soprano) as the solo artist, will be heard on February 9th.

Pantomime Matinée

ON February 7th, listeners will hear an extract from the Birmingham Theatre Royal matinée, "Babes in the Wood," a Tom Arnold production. Revnell and West play the Babes; Helen Breen, as Robin Hood, is Principal Boy, and the chief comedians are Clarkson Rose, as Nurse Merryweather, and Billy Danvers, as Jack o' the Green. Anne Bolt plays Maid Marian, and the Chevalier Brothers the Robbers. The scene is Sherwood, and the Royal Mastersingers are Robin Hood's Merry Men.

PRACTICAL TELEVISION

February 10th, 1940. Vol. 4. No. 189.

Securing Proper Contrast

IT is quite freely admitted by engineers engaged in solving television's multitudinous problems that one of the most important, and, incidentally, by no means the least difficult, is to obtain a received picture on the home set which exhibits adequate contrast characteristics. When the immediate concern is only one of conveying intelligence, quite a low contrast range is sufficient but for clear, lifelike pictures to be reproduced and so sustain the entertainment value of the radiated programmes, a greatly increased range of tonal values is essential. If the cathode-ray tube picture reproducer is studied as a whole, there are many factors which can be said to contribute towards reducing picture quality. Tube size, inadequate brightness, screen face curvature, imperfect synchronism and light reflections from the internal glass walls are but a few of the items, but careful investigation has shown that inadequate contrast with its attendant causes produces the maximum detrimental effect on the individual observer. In simple terms, contrast merely expresses differences in brightness over the picture in so far as television is concerned. The relative brightnesses of the picture's intermediate tonal values contributes in a large measure towards the realism or lifelikeness of the scene, while with intricate patterns the gradient between areas of different brightness must be taken into consideration when assessing pictorial efficiency. Two items which affect contrast have already been mentioned, namely, internal reflections and screen face curvature, but to these can be added the room illumination in which receiving is undertaken, troubles from stray electrons and halation. With cathode-ray tubes of modern design the most important of these two items seems to be halation and a combination of internal reflections and screen curvature. These need to be examined very carefully when acceptance tests for television-ray tubes are being undertaken. The accompanying illustration shows one stage in such acceptance tests, the cathode-ray tube under observation being mounted in a simple horizontal rack and furnished with the appropriate voltage supplies and signals. The characteristics of the spot, degree of halation and measure of contrast are all examined, and any tube not falling within certain predetermined limits is rejected.

Internal Reflections

IT is useful to consider for a moment what is likely to happen inside the glass envelope of an ordinary cathode-ray tube used for television picture reconstitution. At a small bright area of fluorescence the light flux is diffused in all directions and in addition to the proportion reaching the eyes of the person looking in, due to the internal concave nature of the tube's screen face, a percentage of the light flux will travel in a straight line to an area of fluorescence which for picture purposes should be dark. At the same time partial scatterings and reflections from the internal side walls of the tube will result in a certain degree of light flux from this action being directed on to the same dark area. It is evident, therefore, that the amount of darkness revealed by any given area is in effect dependent upon the brightness of other areas, and the ideal range of contrast which the tube should exhibit for given picture signal conditions is thereby reduced. Coating the glass envelope with a non-reflecting surface will bring about a marked reduction in this defect, but in any case, it is an important point to watch.

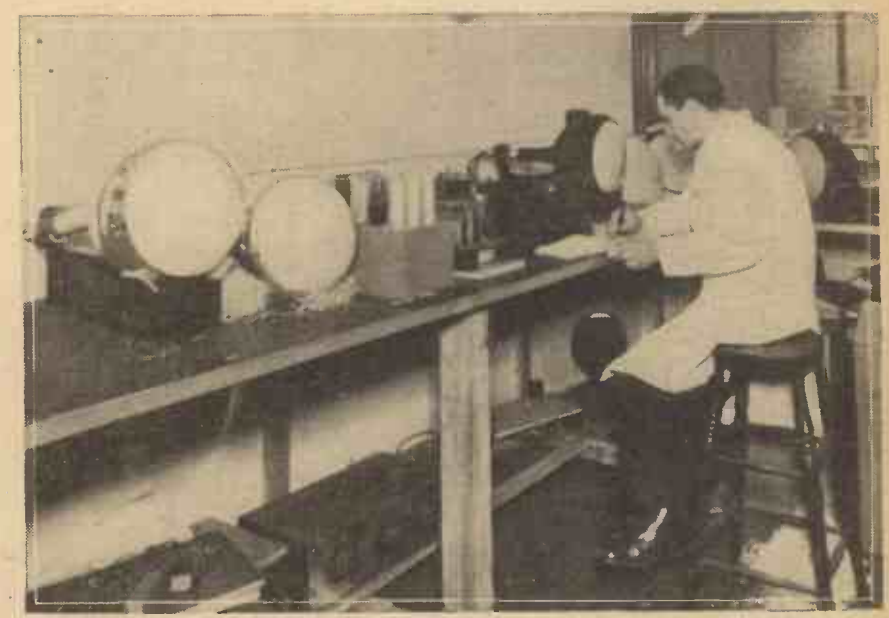
Halation

IF a stationary spot of light is observed carefully on the screen of a cathode-ray tube it will be seen to consist of concentric circles of illumination, each of which decreases in intensity as it gets farther from the spot centre. This is the spurious defect known as halation, and it will be at once obvious that it is detrimental to contrast. It is brought about by the rays of light from the bright area whose original degree of fluorescence is dependent upon the speed with which the electrons of the tube's cathode ray beam strike the powder adhering to the internal front face. Due to the thickness of the glass, each individual light ray emitted from the bright area will pass to the outside edge of the front face and then be reflected back through the glass thickness to the back face, and so on until the whole illumination is dispersed. These successive internal reflections evidence themselves as concentric circles of illumination having diminishing brightness as the radial distance increases. This tends to destroy the sharpness of the observed picture and is one reason why present-day cathode-ray tubes have much thinner front screens than the earlier prototypes, which, of course, suffered from other material defects. Many cathode-ray tube manufacturers, particularly in America, where the advent of a television service has brought about a demand for tubes of a character never before thought of, have carried out very careful researches into all the factors which individually contribute their quota towards reducing the range of contrast in received television pictures. It is obvious that the psychological reaction of the home viewer is the ultimate criterion for judging the quality of the images, and many of the tests have been undertaken with this factor as the underlying basis both for undertaking the work and analysing the results. From this work the value of a cathode-ray tube with a flat screen has become evident, while the methods used for fixing the fluorescent powder to the inner screen face have also undergone drastic revision in an effort to provide pictures of better contrast.

Television and War-time Development

THE application of television to war-time services in one form or another has by no means been lost sight of by the authorities responsible for either defence or attack. This was made clear recently by the Minister of Co-ordination of Defence when he spoke in the House of Lords about a television set which the Admiralty had produced, capable of allowing the captain of a warship to watch a shell fired from his own vessel exploding on its target. Naturally, no details of the methods employed in this particular case were revealed, but Lord Chatfield said that although it carried out the task satisfactorily the equipment was too large, and subsequent development is being carried on by commercial enterprise. It is, of course, known that when electron cameras are employed for producing the television signal relating to a remote or nearby scene, the photo-electric properties

(Continued on page 452)



Cathode-ray tubes undergoing one stage in acceptance tests, particularly in regard to the degree of contrast range exhibited.

Planning the Layout

In this Article it is Shown how a "Basic" Component Arrangement can be Adopted and Modified to Suit Different Chassis or a Baseboard

By FRANK PRESTON

ONE of the greatest difficulties experienced by the constructor in making a receiver to a given circuit, when full constructional details are not available, is to decide on a suitable arrangement for the components. Even though he may be aware of the general rules which should govern the spacing of certain parts, the close arrangement of others, and the use of short leads and screened leads, he often lacks the necessary confidence to complete the plan.

In the case of a complicated or unusual circuit, simple rules as to layout are not always helpful, but when dealing with fairly usual circuits of either the "straight" or superhet type, there are certain general "formulæ" which can be followed with a reasonable chance of success. Most important of all is to keep the tuning condenser and tuning coils close together so that very short and direct leads can be used between them. It is also wise to keep the H.F. and detector valve holders, or the frequency-changer valve holder in the case of a superhet, near to the terminals of the tuning components to which they are connected. Where there are two or more unscreened components, such as H.F. chokes and coils, they should, as far as possible, be placed fairly well apart and arranged with their axes at right-angles to one another.

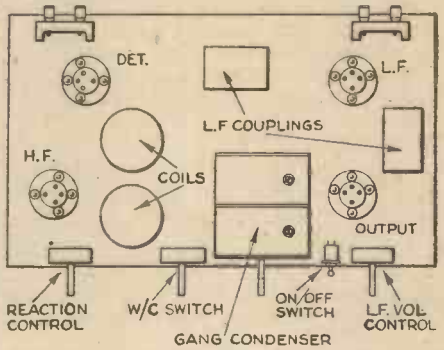
Separate Mains Unit

If two L.F. transformers, or a transformer and a choke are used, they should also have their cores at right-angles, or nearly so. A mains transformer and the smoothing components should be well away from the parts of the receiver itself, unless they are adequately screened with soft iron. Even when screened in this way, they should be well clear of any unscreened leads, coils, valves or chokes in the pre-L.F. stages. For experimental purposes, and in other instances where cabinet shape allows, it is by far the best plan to build the mains-supply portion—preferably with the output stage—on a separate chassis or baseboard, which can be mounted several inches away from the receiver proper. Not only does this help in preventing mains interference, but it enables this unit to be used with any other experimental set that might be made.

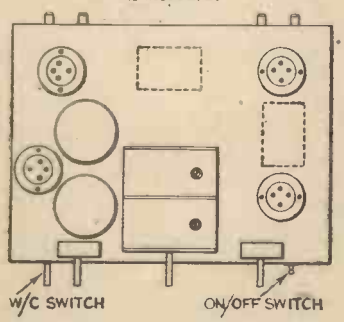
The less-experienced constructor and experimenter will often find it best to adopt some kind of "standard" layout, which can generally be modified as necessary to suit a different type of circuit, a different form of chassis or a differently-shaped cabinet. As regular readers know, PRACTICAL WIRELESS has always favoured and advocated the use of a chassis in preference to a baseboard, although there are a few instances in which the latter can be slightly more convenient.

Three Alternatives

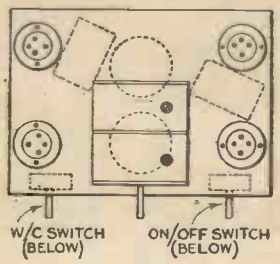
In an accompanying illustration I show three different forms of construction as applied to a receiver of the H.F.-Det.-L.F.-P. type; the same layouts can also be adapted to suit the usual form of superhet circuit, F.C.-I.F.-2nd Det.-Pen. It will be seen that although the three illustrations refer to the same set, the layout varies in each case. Despite this, however, the same principle of planning will be evident throughout. The top diagram refers to baseboard construction, when the receiver is essentially much larger as far as length and depth are concerned. The layout would be convenient if use were to be made of a long, low cabinet, but it would not be expected to be quite as efficient as the arrangement shown in the centre of the illustration. It might appear from the diagram that there is a good deal of unnecessary space, unless it is remembered that space must be found for all the small components, such as resistors, condensers and chokes, for example. With this layout wiring would be straightforward and easier than usual, but some of the leads would be rather long.



Baseboard.



Shallow Chassis.



Deep Chassis.

These plan diagrams show how a basic layout can be used for baseboard construction, or for chassis of different proportions.

A Shallow Chassis

The centre diagram shows a layout which is better in every respect; it is suitable for adoption with either a wooden or metal chassis. When using wood for the chassis it is always a good plan to use metallised material, so that earth-return leads are not necessary and a fair amount of screening is provided by the chassis itself. Tuning coils and the gang condenser are still mounted side by side, but they are much closer together since the leads from the coils may be taken through the chassis. Additionally, all components can be much closer than with the baseboard arrangement, due to the fact that there is a good deal of space underneath the chassis for the small components and for the majority of the wiring. Besides, items such as wave-change switch and on-off switch can be mounted on the front of the chassis itself, the reaction and volume controls being carried on brackets mounted above the chassis. If necessary, it would be a simple matter to make room for all the controls on the front of the chassis.

Extreme Compactness

The bottom diagram shows a still more compact arrangement, although in this case it is assumed that the chassis is deeper than in the example previously discussed. It must be deep for the coils to be accommodated under it. This layout would therefore be very convenient when a narrow cabinet of the upright type were to be used and if an external speaker were required. Alternatively, the receiver chassis might be placed alongside a large speaker unit. For this arrangement to be fully satisfactory it would be necessary to use coils with terminals, or with leads coming out at the side. This is by contrast with the centre layout, for in that case coils with terminals or leads brought out on the underside would be most convenient, although not essential.

This third layout is exceptionally compact, and need not present any special difficulties in connection with wiring provided that one or two of the chassis sides can be removed (when using a wooden chassis; the ends of a metal chassis would be open) until all wiring is complete. In some cases it would be found better to mount the coils on the left-hand side member of the chassis, or on a bracket mounted across the chassis (from front to back) somewhere near the centre. It would probably also prove convenient to mount some of the smaller components on the vertical sides of the chassis.

Symmetrical Controls

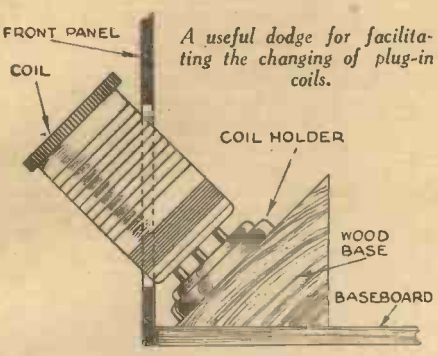
In each of the typical "standard" layouts illustrated it will be seen that the controls are arranged symmetrically, without introducing long leads in consequence.

(Continued on page 449).

Practical Hints

Coil-changing Dodge

THE accompanying sketch shows a novel dodge which I have incorporated in my receiver to save trouble in coil changing. The idea is to cut a hole



A useful dodge for facilitating the changing of plug-in coils.

in the front or side of the set and to screw the coil holder on to a wooden mount in the position shown. The top of the coil then protrudes at the front or side of the receiver, whichever arrangement suits best. This allows the coil to be changed without difficulty, but needless to say it applies only to plug-in coils.—A. COOK (Ayr).

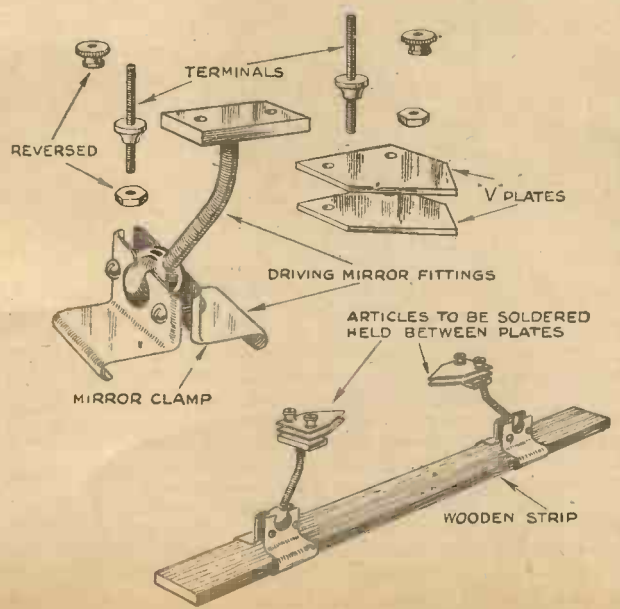
A Soldering Clamp

ANYONE who has done light soldering work has experienced times when another pair of hands would have been very useful. Here is a device which effectively provides for such cases.

The local sixpenny stores will provide fittings primarily intended for a small adjustable driving mirror for a motor-car. They consist of a bracket with a spindle terminating in a ball joint, with the socket in the form of a clamp, and this can be easily adapted in the manner shown in the sketches.

Two plates are cut from steel, brass, or aluminium, for each of two sets of these fittings. They are V-shaped, and ¼in. holes are bored the same distance apart as those of the brackets. They are bolted to the bracket with brass terminals by reversing the small nut with the milled terminal nut.

The part of the fittings which normally grips the mirror is then made to grip a strip of wood of similar width, and when the two sets of fittings are thus mounted they may be made to slide towards and away from each other, as required; and the two articles, being soldered together, are held between the V-shaped plates and adjusted to any desired position.—JOHN H. MARR (Glasgow).



A novel clamping device for holding work while soldering.

THAT DODGE OF YOURS!

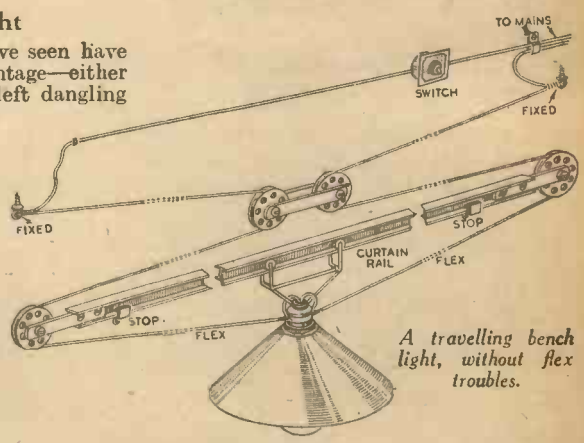
Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending 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.

An Improved Bench Light

ALL the bench lights I have seen have at least one disadvantage—either the slack end of the flex is left dangling on the bench or a pulley weight gets in the way of shelves or cupboards in the workshop. The idea illustrated has neither of these encumbrances, the slack flex being automatically taken up whatever the position of the lamp; the latter can be readily slid along the rail according to its capacity. The curtain rail is obtainable at any sixpenny stores, as well as the pulley runners; the other items required are 1½in. grooved pulleys, and some 1/16in. strip brass. The lamp is hung on to the pulley runners by means of a short length of fairly stiff wire formed into a triangular loop. Rail stops (optional, but recommended) are fitted at each end of the rail to prevent "overrunning" the ends. The ends of the flex wires are fixed to either wall, as indicated.—E. WILLIAMS (Llanelly).



A travelling bench light, without flex troubles.

Reducing Output from H.T. Eliminator

IT frequently happens that, when buying a new eliminator, it is desired to obtain one which will give a sufficiently high output for operating a more powerful receiver which may be contemplated a little later on. When this is done, however, it is very likely that the voltage applied to the present set will be a good deal too high on account of the small current consumption. This difficulty can be overcome in a very simple manner by connecting a fixed resistance between the positive and negative terminals of the eliminator to "absorb" the surplus current. The correct value for the resistance can easily be calculated by dividing the output voltage of the eliminator by the difference in current between the maximum rated output and that required by the set and multiplying by 1,000. For example, if the eliminator is rated to give 150 volts at 30 milliamps, the resistance required will be found by dividing 150 by 15 and multiplying the answer by 1,000. This simple calculation gives the value as 10,000. It will generally be desirable to employ a resistance rated at not less than 2 watts.—E. WATSON (Pinner).

The "Ideal"

Constructional Data and V New De-luxe Instrument

LAST week I gave the theoretical diagram and mains details of this new receiver, and in this issue will be found a complete list of parts and wiring diagrams, chassis dimensions, etc. It should be pointed out that the price list of components may be subject to changes which may take place due to the war and shortage of materials, but the receiver will be found very economical to construct, although running costs will not be too low. However, with a receiver of this type it cannot be expected to be maintained as cheaply as a two- or three-valver, but the results will certainly be found to justify both the cost of construction and maintenance. In an endeavour to keep constructional costs down, and in view of the difficulty experienced by many readers in obtaining metal for a chassis, a plain wooden assembly has been used, and this is very simple to make up, consisting merely of a piece of ¾in. three-ply wood measuring 16in. by 9in., with three runners of ⅝in. plywood measuring 3½in. deep. These are attached to the rear and sides of the chassis. In addition another piece of the thick plywood is needed upon which the coil unit is mounted, and this should measure 6½in. by 3in. It is mounted in the position shown in the chassis illustration below.

Order of Construction

Owing to the very compact form which has been adopted for the construction of this receiver it is essential to carry out the construction in a definite order. First of all cut all pieces of wood to size. Next drill the valveholder holes in the chassis carefully mark out the positions of the component-mounting brackets. In this connection it will be noted that seven such brackets are mentioned in the specification, and two extension control outfits. In the original receiver the expander control was left as shown in the photographs as it is not necessary to adjust this continually (in the manner of a volume control) and it may be set according to the type of records you generally use. If, however, you intend to use dance and symphonic records it will be desirable to mount a further bracket at the front of the baseboard and to obtain another length of the extension control rod. coupler and panel bush so that a suitable panel control for this particular component may be provided.

Mounting the Components

The valveholders may now all be screwed into position, again preferably using nuts and bolts with shakeproof washers. Now attach leads to the left-hand side of the coil unit, and drill clearance holes right through the mounting flange and wooden base, leaving a few inches for subsequent connection. Carefully position the coil base for attachment to the baseboard at each end. Note carefully the position of the screws you use to clear the condenser. Mount the latter by means of bolts

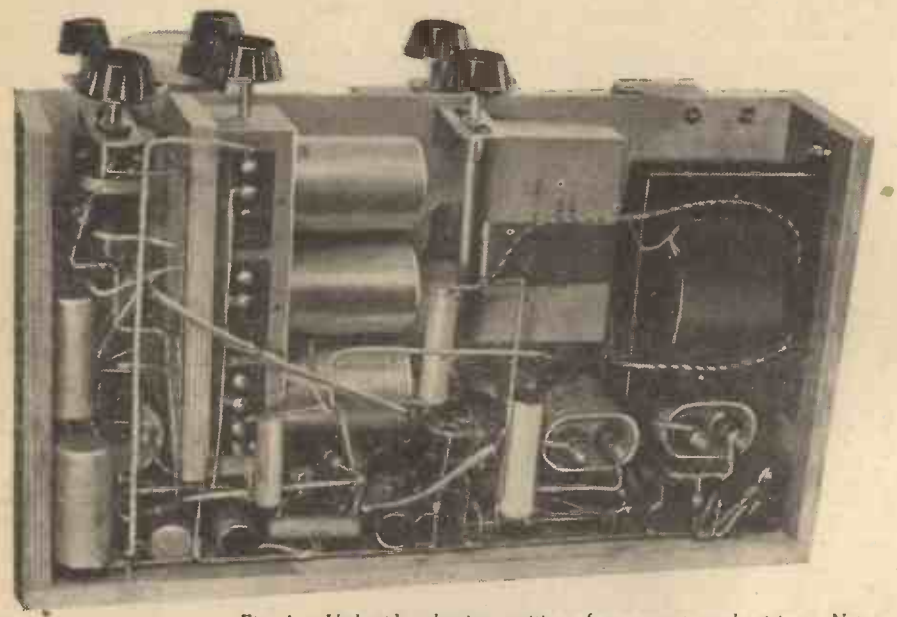


Fig. 1.—Underside, showing position of components and wiring. Note method of mounting the coil unit.

from the details in Fig. 4. Next cut the hole in the rear runner for the loudspeaker socket and the slot or holes for the two socket strips—according to the method preferred to mounting these. Next mount the coil unit on the small wooden base, using bolts through the mounting holes in the flange, with shakeproof washers underneath. It is desirable to adopt this method of mounting as it will be found difficult to tighten screws, etc., should the coil come loose at some future date. Next through the tapped holes in the base. Before mounting the dial, the coil base should be screwed into position, suitable screws being inserted in front of and behind the gang condenser. Next attach an anchoring bolt at the end of the rear runner, as shown in the wiring diagram, and solder a length of stout bare copper wire to this and across to the earth terminal, running this wire about ½in. below the bottom edge of the runner. All runners may now be screwed into position, and the mains transformer mounted. Wire up the heater sockets, noting carefully how these are coupled to provide more or less equal loads for the two heater windings, and to reduce interaction and instability.

Next bolt into position the two oil-dielectric coupling condensers and attach all volume controls to the appropriate mounting brackets. Run a bare wire along the exposed terminals of the coil unit, from the terminal G nearest the control knob to the earthing terminal at the rear, and then on to the bare wire on the rear chassis runner, coupling, on the way, the other two G terminals. Mount the H.F. choke, and then connect together the grid condenser and grid leak, and with insulated

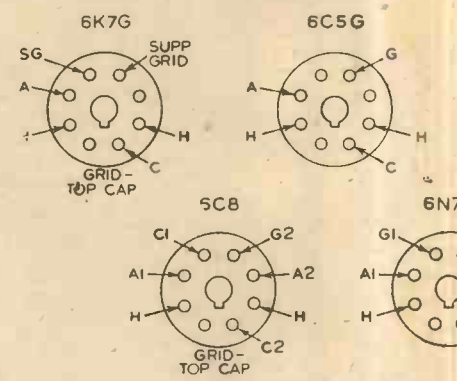


Fig. 2.—Pin connections for the valves. Note

LIST OF CO

	£ s. d.
One 3-gang coil unit, type BP113 (Varley)	1 1 0
One 3-gang condenser, type 2122 (J.B.)	0 15 0
One airplane drive, dual ratio, type 2131 (J.B.)	0 6 6
One mains transformer, type SP352A (Premier)	0 13 6
One smoothing choke, type C150 185 (Premier)	0 11 6
Thirty fixed resistors (Erie):	
Two 150 ohms, One 2,000 ohms, One 1,500 ohms, Three 20,000 ohms, Three 50,000 ohms, Two 100,000 ohms (1 watt type RMA8); One 250 ohms, Two 5,000 ohms, One 15,000 ohms, Four 100,000 ohms, Four 250,000 ohms, One 500,000 ohms, One 1 megohm (½ watt type RMA9); One 150 ohms, Two 4,000 ohms (5 watt type RMA0)	0 17 0
Eighteen fixed condensers (Dubilier):	
Two .0001 mfd., type 690W, One .0002 mfd., type 690W, Two .01 mfd., type 4601/S, One .05 mfd., type 4602/S, Three .1 mfd., type 4603/S, Three .5 mfd., type 4608/S, Two .1 mfd., type 950A, One 25 mfd., type 3016, One 50 mfd., type 3004, Two 8-16 mfd., type 3115	2 5 9

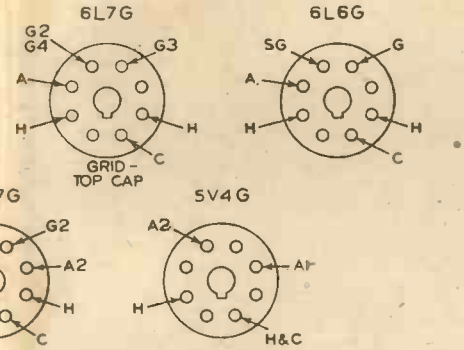
Radiogram

Wiring Instructions for this - By W. J. DELANEY

sleeving over the ends, wrap them in a small tin or copper shield, with screened sleeving projecting. The screening of these two components, and the introduction of screened sleeving in the other parts shown in the diagram, coupled with the use of the large smoothing condensers, makes this receiver absolutely quiet and stable—in fact the quietest receiver which I have yet had on test. There is no trace of hum or H.F. noise and between stations you cannot tell whether the receiver is on or off.

Wiring

The majority of the fixed condensers and resistors are wired direct to the valveholders



that this is the underside view of the sockets.

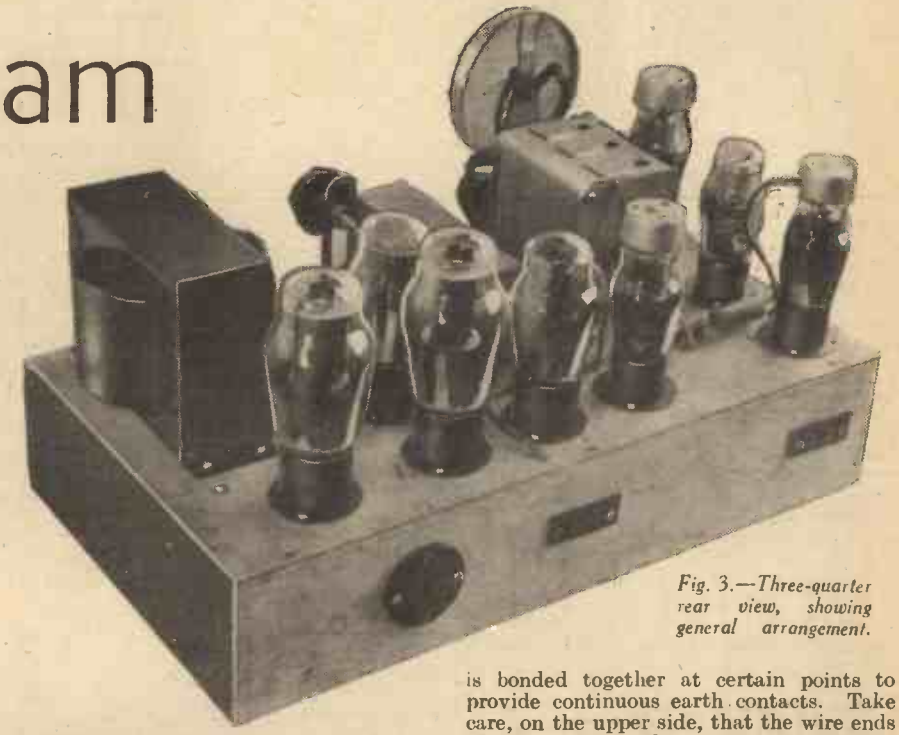


Fig. 3.—Three-quarter rear view, showing general arrangement.

or other points to which they are joined, and it is difficult to show the exact positions in the wiring diagram. Care is essential in view of the very compact arrangement of the parts, but by proceeding slowly and cutting the wire ends carefully it will be found that the components may be tucked away very neatly and wiring is not really difficult. The two large electrolytic blocks are mounted by means of straps cut from stout brass, bolted to the chassis. The two 4,000 ohm 5-watt resistors are suspended in the wiring, and to avoid the risk of the output screen component introducing a short-circuit through the coil screens, a piece of stout waxed cardboard is bent round the first coil as shown in the illustrations. The L.F. choke is the last component to be mounted, and its two leads taken to the leads from the smoothing condenser block. Note that the 16-mfd. unit is on the receiver side of the choke, whilst to the other side the centre-tap lead from the mains transformer is joined.

Cut down the brass rod to a length suitable for the panel with which the receiver is to be associated and mount the panel bushes on the front component-mounting brackets. The couplers are, of course, screwed to the control spindles by one of the screws and the other locks the extension rod. Lastly, mount the slow-motion drive. Note carefully the use of the screened sleeving and the way in which it is bonded together at certain points to provide continuous earth contacts. Take care, on the upper side, that the wire ends of the tubular condenser are not permitted to come into contact with the screened sleeving. Attach the top-cap connectors to short lengths of connecting wire with the sleeving over, measuring the lengths required by inserting the valves into the appropriate sockets.

Mains Connection

The transformer is provided with loose leads, marked at the various mains voltages. No mains connector has been specified for the receiver as the two appropriate leads were attached to a length of twin flex (the joints being soldered and well taped) and carried to a special mains connector on the back of the radiogram cabinet. Similarly, there is no output

(*Continued overleaf*)

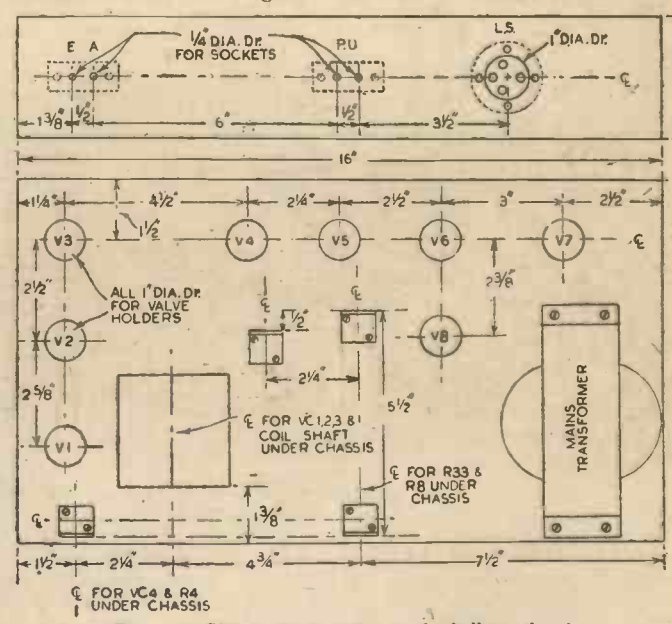


Fig. 4.—Chassis construction and drilling details.

COMPONENTS

	£ s. d.
One .25 meg. volume control, type B (Dubilier)	0 3 6
One 1,000 ohm wire-wound potr., type VG.42 (Bulgin)	0 5 0
Two 1 megohm volume controls, type B (Dubilier)	0 7 0
Eight Octal chassis type valveholders (Clix) (X.218)	0 6 8
One 4-pin chassis valveholder (X.111)	0 0 5
Two 2-socket strips (A.E. and Pick-up) (Clix)	0 0 10
Seven component mounting brackets (Peto-Scott)	0 2 4
Two couplers, type 2005 (Bulgin)	0 0 6
* Two shaft rods, 9in. long x ¼in. (Bulgin)	0 1 0
Two Panel bushes, type 1048 (Bulgin)	0 0 6
One Junior H.F. Choke, type HF.8 (Bulgin)	0 3 0
One S.P.C.O. Switch S.135 (Bulgin)	0 2 0
One .0003 mfd. reaction condenser (Polar)	0 2 6
Three top-cap connectors, type P.103 (Bulgin)	0 1 6
Eight valves—Triad Octal: One 6K7G, One 6C5G, One 6L7G, One 6C8G, One 6N7G, Two 6L6G, One 5V4G } Premier	2 4 3
One wooden chassis 16in. by 9in. with 3½in. runners.	
Connecting wire, insulated sleeving, screened sleeving, screws.	
*One Loudspeaker.	

* SEE TEXT.

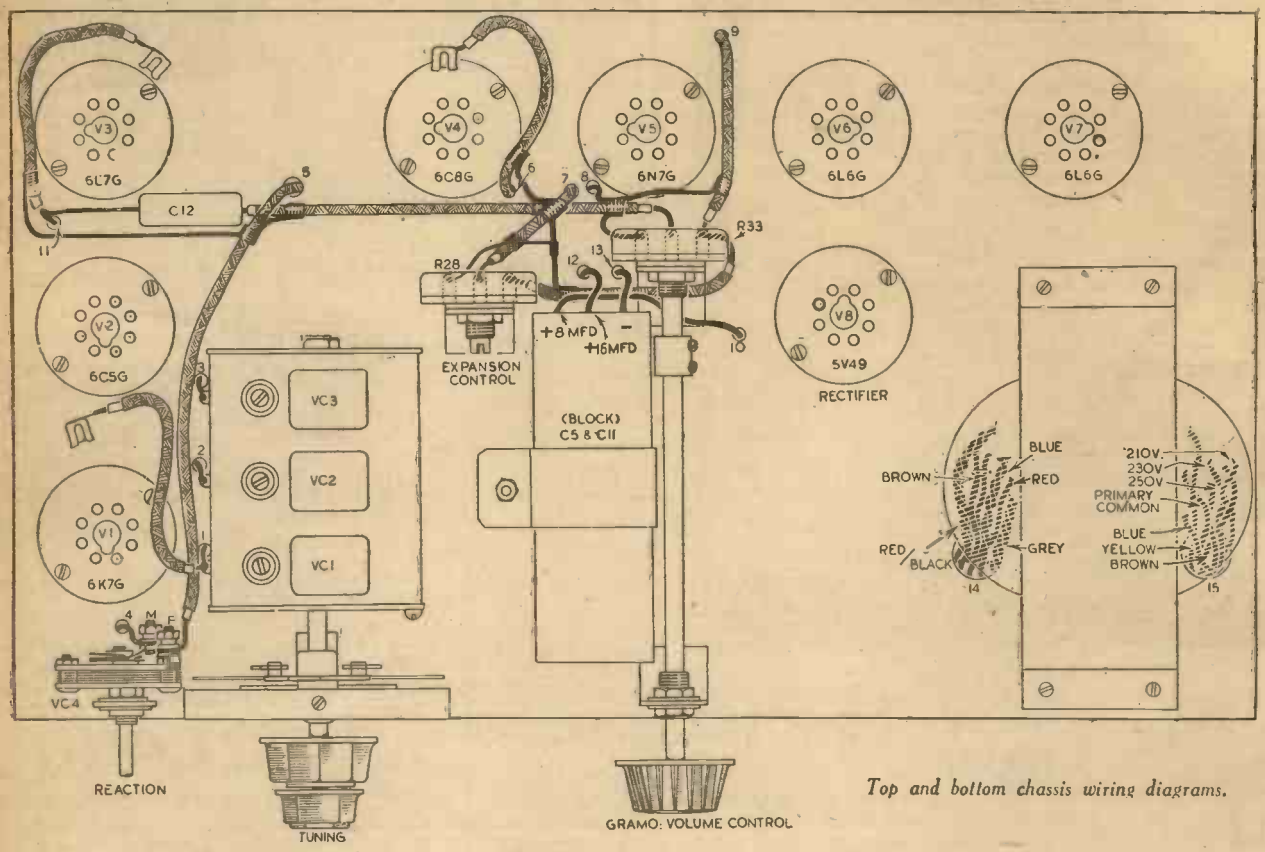
THE "IDEAL" RADIOGRAM

(Continued from previous page.)

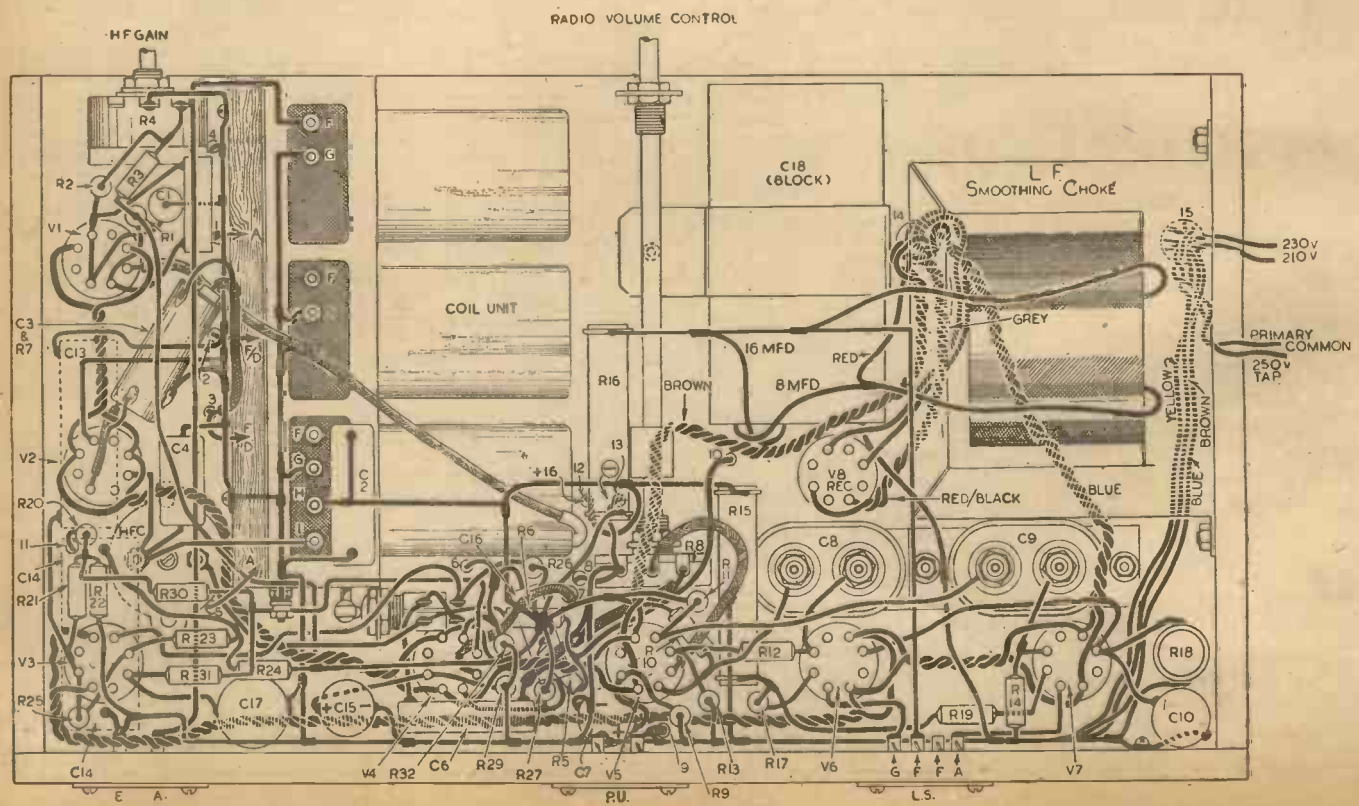
transformer on the receiver, and three leads have to be taken from the speaker socket to the primary of a suitable push-pull transformer. This must be obtained with the speaker and designed to provide a suitable load—about 6,000 ohms, anode to anode.

In the wiring diagrams printed below the mains transformer is indicated as having coloured leads, and these colours are those which were used on the original model. In addition to the colour, however, each lead is provided with a label giving clearly the identification needed and therefore this should also be followed, in conjunction with the theoretical diagram which was published last week. Note that the three transformer leads which are indicated as being joined to the earth bus-bar, are the centre tap of the H.T. secondary, and of the two L.T. windings.

Next week one or two further points in connection with construction, and the operating notes, will be given.



Top and bottom chassis wiring diagrams.



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).

A Den, and an Offer

SIR,—Having been a reader of your fine paper for a number of years, I thought a photograph of my den might interest other readers. I have just had a new card printed, and will be pleased to swap it with any "ham" on A.A. Wishing PRACTICAL WIRELESS every success in the future.—ARTHUR V. OGLESBY, 81, Stockton Lane, York.

Exchanging S.W.L. Cards

SIR,—I have been a reader of PRACTICAL WIRELESS for the past five years, and may I take this opportunity to thank you for a very fine paper.

I should like to exchange my S.W.L. card with other S.W.L.s or A.A. "hams," either at home or overseas. I will QSL 100 per cent.—E. W. KEELEK, BK148, Albert Street, Grimsby, Lincs.

A Den in a Cupboard

SIR,—I enclose a photograph of my den which, as can be seen, is built into a cupboard which can be completely shut up when not in use. The RX on the left is a home-built 1-v-1, with an aerial-tuning device on the left of it, which is used with an ordinary inverted-L aerial. This has only recently been built, and employs Colpitts reaction, which seems to work very well, particularly on high frequencies. On the right is a 20-watt amplifier with effects, mike and input mixer, into which are fed two mikes and P.U., which, incidentally, was made from a design in PRACTICAL WIRELESS recently. A very successful play was broadcast this Christmas, the speaker, a Rola G-12, being used downstairs. Many useful hints were collected for this play from PRACTICAL WIRELESS. I much appreciate the S.W. section, but I think a really good article on S.W. aerials would be a good idea in these times of extensive S.W. listening.—A. E. CAWKELL (Stansted, Essex).

A reader, A. E. Cawkell, of Stansted, Essex, has built his radio den in a cupboard, as shown here.

Manila and Lourenco Marques

SIR,—I would like to thank you for sending my B.L.D.L.C. membership card.

During my S.W. listening in the past fortnight, I have come across two new stations on the 31-metre band. Namely: KZRA, "The voice of the Philippines," Manila, on 9,640 kc/s. Heard through bad QRM at R6, QSB-3, Q4 on Friday, January 19th, 3 p.m. The programme mainly consisted of requested dance music. Also, Lourenco Marques, Portuguese East Africa (no call-sign given), testing on 9,645 kc/s, with special European programme. Heard at R9 Q5, on Saturday, January 13th, 8.10 p.m.

Both these stations were received on my home-constructed 0-v-2, working off an eliminator. The antenna is 75ft. long and 30ft. high, and points E. and W.—R. T. G. DAVIS (Liverpool).

A comfortable corner in the den of another reader, A. V. Oglesby, of York.

Freak Reception

SIR,—I wish to report a strange case of freak reception. One evening recently, at 20.15, while tuning my "Hallicrafter Ski Buddy" on the *medium* wave, I was astonished to hear an American voice saying, "This is Benny Goodman and his band broadcasting from New York." I could not catch any closing announcement as the station was jammed toward the end of the programme. The wavelength was 1,070 kc/s. The set is in perfect trim, and I would like to know if any other reader heard this programme. I have been a short-wave listener for the past seven years, and am convinced that the station was American. Wishing your journal continued success.—R. ROBERTSON (Rhuddlan, N. Wales).

A 14 mc/s Log from Bournemouth

SIR,—At this time of year S.W. logs seem to be very few and far between; although the conditions at present are very bad I submit my 14 mc/s log for the week January 8th-14th:

Fone: HA3B, EA7BB, LY1J, ES5C, HA9Q, EA9CM, HA8Q, PK1OG, I1TAK, W1, 2, 3, 4, 8.

C.W.: ES1E, W8BF, OK3LD, HA9U, UE3KQ, ES2G, HA7E, HA3N, AA5NN, U5KY, HA8T, ES5C, HA8R, I1OK, D4BIU, I1EC, and YU7LX.

The receiver is a 7-valve superhet. The antenna is an indoor one, 18ft. long.

I should like to correspond with any S.W.L. in Sheffield.—J. DOUGLAS KAY, 24a, Watcombe Road, Bournemouth.

Back Number Wanted

SIR,—I should be glad if any reader would sell me a copy of PRACTICAL WIRELESS, describing the construction of the "Universal Hall-Mark" 4-valver, as it is now out of print.—J. D. HARRIS; 61, The Rise, Beaufort, Mon.

Correspondents Wanted

SIR,—I have been a keen reader of your journal for the past year and find it most helpful.

I am 16 years of age and am very keen on short-wave listening. My receiver is a three-valve short-waver and the best stations I have logged so far are Chunking and the American stations. I should like very much to correspond with any short-wave enthusiast of my own age in England or U.S.A.—BRENDAN O'DONOGHUE (186, South Circular Road, Dolphin's Barn, Dublin, Eire).

SIR,—Thank you for my B.L.D.L.C. card, which I have just received. I think that is very attractive indeed.

I would like to exchange my S.W.L. card with anyone interested, especially with an S.W.L. in King's Lynn. I would also like to add that practically all my knowledge of wireless has been gained from reading PRACTICAL WIRELESS.—F. C. HART (18, Debden Road, Saffron Walden, Essex).

Prize Problems

PROBLEM No. 386.

MELBORNE'S receiver had been giving poor quality for some time, so he purchased a new H.T. battery. When he connected this, although it had the same voltage rating as his previous battery, results seemed even worse. He did not possess a voltmeter, but he was assured by his dealer that the battery was new and up to standard, and his accumulator was freshly charged. He took his valves and had them tested, and they were found in order. What was wrong? Three books will be awarded for the first three correct solutions opened. Entries must 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. 386 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, February 12th, 1940.

Solution to Problem No. 385.

When Martin connected his differential condenser he so connected the plates that the variation of the moving section did not transfer the energy from anode to earth or reaction winding. Consequently, there was no reaction effect.

The following three readers successfully solved Problem No. 384 and books have accordingly been forwarded to them: D. H. Godrick, 24, Brandon Street, Leicester; R. Hemmings, 95, Coningham Road, Shepherd's Bush, W.12; J. W. Filer, 57, Elemore Lane, Easington Lane, Hetton-le-Hole, Co. Durham.

Impressions on the Wax

A REVIEW OF THE LATEST GRAMOPHONE RECORDS

THE new Cochran show "Lights Up," provides Tommy Handley with some really comic material in the song, "All for a Glass of Champagne" *Decca F* 7377. On the reverse side is "The Organ Grinder" song. Cyril Fletcher, the popular radio comedian, is funnier than ever in his "The Mermaid" on *Decca F* 7308. The record also includes "The Invisible Man" and "Cuthbert Bostril."

Following up their series of albums the latest to be issued by the Decca Company is a Hoagy Carmichael Album. Each of the twelve songs in the album could tell of a different episode in the composer's life.

Some sixteen years ago, Carmichael was a student at Indiana University, where he led his own little band. He was a rabid follower of the new "jazz" music and spent all his time listening to the Wolverine Orchestra. Sometimes they would let him sit in with the band and play the piano. One day he was strumming over a tune of his own, which he called "Free Wheeling." The band called it Riverboat Shuffle and made a record of it. So Carmichael became a composer. "Washboard Blues" was another epic of that time. The tune was based on a theme he heard hummed by an old washerwoman at work. On a little-known Brunswick record (02206) there is the very first recording of it. Hoagy played the piano solo.

Years later Paul Whiteman heard the record and persuaded Hoagy to sing it for him with the Whiteman band. From that moment the Carmichael name was made. Still later, Hoagy's piano solo on the older record was published. He called it "Lazybones." Then there is the story of his first trip to Hollywood. He had crossed the continent with the Whiteman band to make the "King of Jazz" film. His only success was to sell "Rockin' Chair," which he had written for Louis Armstrong to Mildred Bailey as her theme song. Broke to the wide, he was smuggled back to New York under Bing Crosby's berth. The album contains six records, *Decca F* 7157/62.

Overnight Hit

The big success of Gracie's Christmas Broadcast was her rendition of "Goodnight, Children Everywhere." After the broadcast, everybody was humming it and within a few hours it had become an overnight hit. But previously, Gaby Rogers, the composer, had hawked his composition from publisher to publisher. He knew it was good, but only one publisher agreed. Vera Lynn has made a record of this tune on *Decca F* 7339, and coupled it with "Over the Rainbow."

In similar style to the Disney masterpiece, "Snow White," is "Gulliver's Travels," the Paramount film which was given its première at London's Carlton Theatre. This brilliant coloured cartoon contains some catchy tunes—notably "It's a Hap-hap-happy Day" and "Bluebirds in the Moonlight." Ambrose and his Orchestra have recorded these two and four others from the film in a brilliant double-sided selection—*Decca F* 7325.

Brunswick

Also presented at the Empire Theatre, London, is another Technicolor fantasy, the "Wizard of Oz." It stars Judy Garland and Brunswick have prepared a delightful album of the main musical features. Judy Garland sings "Over the Rainbow" and "The Jitterbug," and there are three other records by Victor Young and his Orchestra. Perhaps the most fascinating of these is the double-side "Munchkinland." All four records are contained on *Brunswick O* 2886/9, and with the album there is a leaflet showing scenes from the film.

Brunswick have also arranged two all-star tie-ups for their latest list. Frances Langford teams with Rudy Vallee in "This Can't be Love" and "The Shortest Day" on *Brunswick O* 2883, while on *Brunswick O* 2881 we have Bing Crosby singing with the Andrew Sisters to the accompaniment of Joe Venuti's Orchestra. The titles are "Ciribiribin" and "Yodelling Love."

Ben Lyon and Bebe Daniels have made a new record of "Ling'ring on Your Doorstep" and "A Mother's Prayer at Twilight" on *Decca F* 7338, while the new lists contain recordings by Adelaide Hall singing "Serenade in Blue" and "Fare Thee Well" on *Decca F* 7340. The Street Singer, who records an old favourite, "Just A'Wearyin' for You" coupled with "I Love You Truly"—*Decca F* 7318 and Hildegarde singing "Some Day I'll Find You" and "Dance, Little Lady"—*Decca F* 7310.

Lovers of the songs of Irving Berlin will welcome a new album by Brunswick, of ten old and new favourites played by Paul Whiteman and His Orchestra—*Brunswick L* 2854/8.

Dance Records

Dancers are amply catered for by the record companies this month. Decca release two records by Jack Payne and of these I recommend "It's a Hap-hap-happy Day" on *Decca F* 7328. The same company offers a strict tempo record of "We'll Meet Again" by Mantovani's Orchestra on *Decca F* 7341, and a fascinating version by by Arthur Young (at the Novachord) and the Hatchett Swingtette, of "My Wubba Dolly"—*Decca F* 7336.

From the Brunswick list I recommend "You Taught Me to Love Again" by Jan Savitt and His Tophatters—*Brunswick O* 2879—and the swingy "Dallas Blues" by Woody Herman's Band on *Brunswick O* 2842.

Rex offers three records by Billy Cotton, you should hear "Bella Bambine" on *Rex* 9706, as well as two by Jay Wilbur, whose "In an Eighteenth Century Drawing-room"—*Rex* 9704—is a delightful record.

LATEST PATENT NEWS

Group Abridgments can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, either sheet by sheet as issued, on payment of a subscription of 5s. per Group Volume or in bound volumes price 2s. each.

Abstracts Published.

VALVE CIRCUITS FOR WIRELESS RECEPTION ; IMPEDANCE NETWORKS. —Hazeltine Corporation. No. 507620.

In a band-pass circuit, the voltage output, variable in phase with the frequency of the input, from a network

Fig. 1.

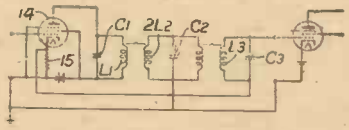


Fig. 2.

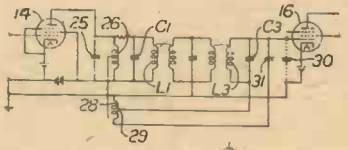


Fig. 3.

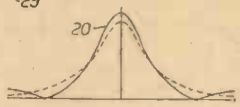


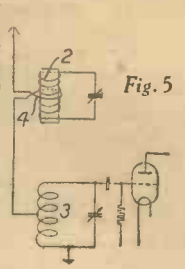
Fig. 4.

C1, L1 ; C2, 2L2 ; C3, L3 is combined with a voltage, the phase of which varies less rapidly with frequency, the constants of the circuit being such that the two voltages are in phase at the centre frequency and opposite in phase at the limiting frequencies of the band. The second voltage may be derived from a resistance 15 in the input circuit, Fig. 1, or from a coupling 28 to a further tuned circuit 25, 26 in the output of valve 14, Fig. 2. The arrangement gives a characteristic curve as shown at 20, Fig. 3, having a zero response at 10 k/c on each side of the centre, and this may be converted to the characteristic 22, Fig. 4, by increasing the coupling of the tuned circuits or by symmetrically detuning two of the circuits. In the arrangement shown in Fig. 2, inherent input capacity 30 in the valve 16 may be neutralised by a connection over a condenser 31 to part of winding 28.

VALVE CIRCUITS FOR WIRELESS RECEPTION.—Lorenz Akt.-Ges. C.. No. 507882.

A tuned rejector circuit 2, Fig. 5, is tightly coupled to the coil 4 comprising a single turn in the aerial circuit. The circuit 2 may be the image rejector of a superheterodyne receiver, its tuning being ganged to the main tuning condenser in the input circuit 3.

Fig. 5



LATEST PATENT APPLICATIONS.

These particulars of New Patents of interest to readers have been selected from the Official Journal of Patents and are published by permission of the Controller of H.M. Stationery Office. The Official Journal of Patents can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. weekly (annual subscription £2 10s.).

314.—Baird Television, Ltd., and Banfield, A. C.—Methods of fixing photographic film. January 5th.

546.—Blumlein, A. D.—Radio receivers and application thereof. January 10th.

547.—Blumlein, A. D.—Method and apparatus for the measurement of small capacities and applications thereof. January 10th.

473.—Johnson Laboratories Inc.—Radio stage foundation. January 9th.

264.—Philips Lamps, Ltd.—Radio circuits for heat reception. January 4th.

565.—Philips Lamps, Ltd.—Method of mixing sound records. January 10th.

400.—Scophony, Ltd., and Gale, A. J. —Reproduction of recorded sound. January 8th.

Specifications Published.

516620.—Bosch, F. J. G. Van Den.—Cathode-ray tubes.

516495.—Marconi's Wireless Telegraph Co., Ltd.—Radio receivers.

516455.—British Thomson-Houston Co., Ltd.—Cathode-ray tubes

516631.—Kolster-Brandes, Ltd., and Lock, C. E.—Indicators for radio television receivers.

516633.—British Thomson-Houston Co., Ltd.—Electric control apparatus for tuning radio receivers.

516637.—Baird Television, Ltd., and Merdler, L. R.—Cathode-ray tubes.

516504.—Brown, N. H. B.—Radio receivers.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at the uniform price of 1s. each.

AUTOMATIC TONE-CONTROL CIRCUITS

(Continued from page 434)

into the L.F. lead, say at X, in Figure 5, a series resistance.

The circuit of Figure 7, with its equivalent substitution circuit of Figure 8 combines the two preceding arrangements and provides both a parallel resonance circuit LC_1 tuned to 9 kc/s and a series resonance circuit LC tuned, say, to 700 cycles (neglecting C_1). In this case when the valve Rr is regulated there is a simultaneous weakening of the high and low frequencies and an intensification of the short-circuiting effect at 9 kc/s, as illustrated in illustrationon page 449.

In all cases the potential divider has such high ohmic resistance that it exerts no appreciable direct effect between A and B, but only on the circuit detour via the regulating valve.

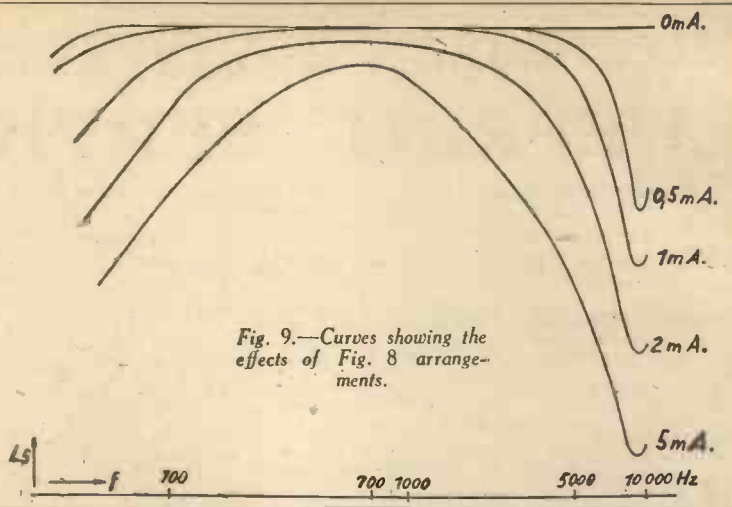


Fig. 9.—Curves showing the effects of Fig. 8 arrangements.

PLANNING THE LAYOUT

(Continued from page 440)

This is an important point if the receiver is to look smart and "professional" when finished. It will be appreciated that the diagrams are not intended to illustrate any particular design, but more particularly to show how any one design can be modified without departing from a basic general arrangement. In many instances it might be found that some of the components indicated could be moved to positions which would make wiring more convenient, or even make some of the important grid-circuit wires shorter; this is governed to a large extent by the shape and size of the parts actually employed.

Preliminary Trials

Before commencing to mount the components, and even before making or buying the chassis, it is well worth while to carry out a few simple tests with the components placed on a large sheet of cardboard, or in a shallow cardboard box of a size similar to that of the proposed chassis. By moving the components slightly in various directions it will soon be found which positions are best. Lines can then be drawn around the components and the card used as a template when building. While planning in this manner do not overlook the fact that all component terminals should be reasonably accessible for wiring. Should it be found that some components will be awkwardly situated from this point of view, leads should be attached before the components are screwed down. Make the leads amply long, and then cut them off when the wiring is being done. Leads of this kind are best soldered, since if they were to work loose difficulty would be experienced in re-connecting them.

When the chassis has to be unusually deep—say, more than 3in.—it is often a good plan to mount some of the parts on the chassis sides and to fit leads to these. The majority of the wiring can then be done before the sides are fitted.

Broadcast Features

Anglo-French Football

IN this cold weather the soldiers of France and their comrades in the B.E.F. are keeping themselves fit by rigorous exercise. Association Football has long been almost as popular in France as in this country, and teams of serving soldiers of both nations will take part in friendly games on February 11th, 15th and 18th. Running commentaries on these matches will be given by Raymond Glendenning, who will have a busy week visiting the different playing fields.

"The Kitchen in War-time"

THE talks on "The Kitchen in War-time" have been much appreciated by women listeners. They are being continued in February as are those by a hotel manager on getting the best value out of marketing. Now that rationing has started, these should be especially helpful.

The Shadow of the Swastika (8)

THE final episode of the series entitled "The Shadow of the Swastika," produced by Laurence Gilliam, will include short excerpts from the previous seven programmes, which have covered the rise of the Nazi party from its beginning in 1919 until the present day. Although the series ends on February 8th, an epilogue will be broadcast on February 22nd, which will show what has happened in the greater German Reich since the outbreak of war.

Practical Wireless
BLUEPRINT SERVICE

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 " "

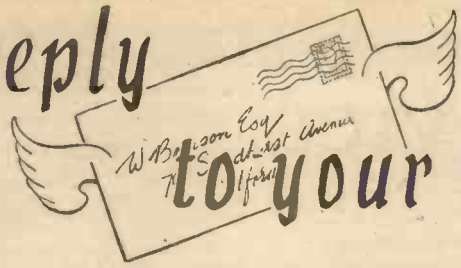
The index letters which precede the Blueprint Number indicates the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS. A.W. to *Amateur Wireless*. W.M. to *Wireless Magazine*.

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.

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	PW68
PORTABLES.		
Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen) ..	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	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	—	AW444
150-mile Crystal Set	—	AW450
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
B.B.C. Special One-valver ..	—	AW387
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans.) ..	—	AW388
Full-volume Two (SG, det, Pen) ..	—	AW392
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
Four-valve : Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC, Trans) ..	—	AW370
2HF Four (2 SG, D, Pen) ..	—	AW421
Self-contained Four (SG, D, LF, Class B)	*Aug.* '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2 LF)	*Feb.* '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF Pen, DDT, Pen)	*Apr.* '36	WM404
Five-valve : Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Consolectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C. ..	—	AW383
Mantovani A.C. Three (HF Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan.* '36	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	— *July* '33	WM329
Harris' Jubilee Radiogram (HF Pen, D, LF, P)	*May* '35	WM386
SUPERHETS.		
Battery Sets : Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
'Varsity Four	*Oct.* '35	WM395
The Request All-Waver	*June* '36	WM407
1935 Super-Five Battery (Superhet)	—	WM379
Mains Sets : Blueprints, 1s. 6d. each.		
Heptode Super Three A.C. ..	*May* '34	WM359
"W.M." Radiogram Super A.C. ..	—	WM366
PORTABLES.		
Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two H.F. Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans) ..	—	WM367
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
S.W. One-valver for America ..	15.10.38	AW429
Roma Short-Waver	—	AW452
Two-valve : Blueprints, 1s. each.		
Ultra-short Battery Two (SG, det, Pen)	*Feb.* '36	WM402
Home-made Coil Two (D, Pen)	—	AW440
Three-valve : Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	*July* '35	WM390
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF Pen, D, RC, Trans) ..	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valve Short-waver (SG, D, LF, P)	22.7.39	WM383
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super ..	*Nov.* '35	WM397
Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	13.1.40	AW453
"W.M." Long-wave Converter ..	—	WM380
Three-valve : Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C. ..	—	WM352
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans) ..	*Aug.* '35	WM391
MISCELLANEOUS.		
S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM392 (1/-)	*Nov.* '35	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	*Mar.* '36	WM403
New style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-) ..	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	*May* '36	WM405
Wilson Tone Master (1/-)	*June* '36	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM048

In reply to your letter



Meter Switching

"I am making up a general-service meter, and in it I intend to mount a 0-1 milliamp. Instrument with separate resistances for each range. Is there any drawback to using a selector switch in conjunction with these resistances, so that various ranges may be selected? The reason I ask this is that there is bound to be some resistance effect in the switch contacts and wiring, and I wonder if this serious."—S. T. O. (Wokingham).

IT is quite in order to adopt the arrangement mentioned, and this is, in fact, the general scheme adopted in commercial instruments. In order to avoid differences due to switch resistance you can install the switch and then adjust the resistances when the switch is set to the various ranges. In any case it is desirable to make up the resistances for each range, rather than to use standard commercial components, if any high degree of accuracy is required. It should be remembered that the normal tolerances on commercial components are not designed to cover the use of them in test meters, but in normal broadcast apparatus where a very high degree of accuracy is not called for.

Colpitt's Circuit

"In a short-wave article I was reading I saw a reference to a Colpitt's circuit, and I wonder if you could tell me what this particular arrangement is. I do not seem to have seen it in any of your circuits or short-wave articles."—H. E. (Bromley).

WE have published a design using this arrangement, but it was in the early days, and the issues are now out of print. The main details of the arrangement, which is a detector stage, are that the anode is coupled to one end of the grid coil through a fixed condenser, and the grid coil is tuned by two variables connected in parallel with it, and the junction of the two condensers is earthed. The grid is joined to the opposite end of the grid coil through the usual grid condenser, and a grid leak is joined between grid and earth.

Making I.F. Transformers

"I am going to make up some I.F. transformers as described in your issue dated November 4th last. You specified ribbed formers, but I have tried dozens of shops and cannot get these. Will it be in order to use ordinary cardboard or paxolin and build up the ribs with thin strips of wood?"—L. R. (Bangor).

THE idea you mention is quite in order. However, you may find it simpler to use the paxolin former and build spaces for the pile winding by using discs of paxolin or cardboard slipped over the former. These should be stuck in position and will leave small bobbins into which the pile section may be wound. If you adopt the idea you mention, however, the strips of wood should be of some hardwood and must be stuck on very firmly to enable you to cut the slots which are needed. If you prefer to try and get the ebonite formers specified, write to the British Ebonite Co., Ltd., Hanwell, London, W.7.

Metal Rectifier Data

"I have a metal rectifier marked Style H.T.17, and I have not used this for such a long time that I have forgotten the data and cannot find any details in my note-book. Could you please give me the rating of this particular model as I wish to make up a small mains two-valver?"—H. E. G. (N.W.9).

THE rectifier is rated to deliver a smoothed output of 200 volts at 100 mA. The input, for half-wave working, should be 250 volts at 150 mA, or for a voltage doubler circuit 150 volts at 300 mA. The doubler condenser should have capacities of 4 mfd. and the working voltage of these should be 250 volts.

Licence for Radio Parts

"I understand that it is not now possible to purchase a super-power valve (having an anode dissipation of 10 watts or more) without a special licence. I wonder if you could tell me the procedure to be adopted as I wish to obtain a replacement valve for my home receiver."—K. L. (Birmingham).

ALL that is necessary is to apply at your local post office for a licence form and complete this as indicated on the form. You will see that the name of the supplier of the valve or other part has to be entered in three separate places, and the form then posted to the postal authorities. The address is printed and no stamp is required. In due course part of the form will be returned to you and a part to the supplier you have mentioned on it, and you can then call and purchase the valve without difficulty.

Dial Light Fitting

"I have a small dial light fitted to my receiver, but this is continually giving me trouble. When I have had the set in use for a few weeks, a crackling develops and I have noted that the dial light flickers. After removing the back of the set and performing several contortions I can get at the dial and then find that the bulb has come loose in the holder. It is very awkward to get at and I have had to do this two or three times. Is there any way of making this a fixture as I find that if the bulb is turned very hard to lock it the glass comes loose in the holder."—G. T. (Devonport).

ONE of the new spring holders supplied by Bulgin will solve your difficulty. This has a special spring grip and is available in twelve different patterns, one of which will undoubtedly be found suitable for your particular dial. Even so, care should be taken when first screwing the bulb in not to turn too hard against the coiled spring or you will loosen the glass bulb. It is not necessary, however, with this particular holder, to exert such excessive force as the holder will grip the bulb quite satisfactorily.

Portable Design

"I wish to try out a small receiver of a type which may be carried by hikers or soldiers on the march. The circuit does not present much difficulty, but I am not so clear on the design of the aerial. What do you think is the most suitable type, a self-contained frame in the containing case, or a rod aerial?"—V. R. A. (Ilfracombe).

WE assume that the receiver is to be made in the most compact form possible, and, therefore, a frame aerial would no doubt prove inefficient, if not impossible, considering the size of case which would be used. Therefore, a vertical rod is the most satisfactory. For portability this should preferably be of aluminium and a telescopic arrangement would no doubt be found worth while. A great deal depends, however, on the waverange covered by the receiver, the aerial for short-wave working being shorter than that required for medium-wave results.

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.

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. R. (Perth). The valve is a very old model, and the filament is rated at 6 volts. This must be D.C., not A.C.

H. F. G. (Co. Fermanagh). The trouble may be due to the wiring of the set. That is, your description is in order, but your actual wiring may not agree. On the other hand, the aerial may be unduly large.

J. E. (Glasgow). The only satisfactory plan would be to use a wave-trap.

R. N. H. (W.3). Any neon may be used. The flashes depend upon the capacity of the condenser.

H. R. T. (Ilfracombe). You should use much more grid bias—say 16 volts. The valve is of the "long base" type.

W. R. (Dorking). Screen all the H.F. section. A vertical panel running across the chassis should prove quite satisfactory.

J. H. (W.3). We think the idea very good, and you should find it quite satisfactory.

K. E. (Luton). The buried earth was obviously more efficient. You were probably getting H.F. instability with the alternative arrangement, and this would tend to boost signals.

L. R. F. (Basingstoke). Three valves should be ample, especially if a high-efficiency output pentode is used.

G. S. T. (Wembley). Try a smaller primary winding. Your tapping points should enable this to be done very easily.

B. R. (Gloucester). The standard is 8 turns per volt with 1 square inch core.

J. S. (Manchester). At least 30 henries should be used. Less will undoubtedly prove ineffective.

S. R. (Chippenham). The valves are not now obtainable and must be replaced by standard modern types.

N. R. (Belfast). The form is obtainable from your local post office.

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

PRACTICAL TELEVISION.

(Continued from page 439).

of the mosaic plate can be adapted to penetrate cloud, mist and fog screens. Indeed, on several occasions when outside broadcasts were being conducted before the cessation of the television service, the weather conditions were of such a nature that satisfactory pictures seemed impossible! Due to the infra-red sensitivity of the cameras, however, the results observed on home receivers were so good that few viewers realised the adverse weather conditions under which the transmission was being undertaken. Combining infra-red characteristics with telephoto lenses it is easy to see how long range television would be possible. No doubt the details furnished recently in these columns concerning compact television transmitting equipment developed by the Italians, and installed in aircraft, can have some bearing on long-distance operations from quite another angle, and it seems certain that as in the last war, where radio development received such a tremendous impetus, a similar state of affairs may be forthcoming for television as a result of present hostilities.

Camera Improvements

IT is only by maintaining a continuous research into problems associated with the transmitting end of the television chain that engineers can be assured that at the point of signal generation the equipment is kept at a high standard. As an example of one form of distortion which causes difficulty, mention can be made of the fact that with an ordinary type of iconoscope electronic device there is always a tendency for random or stray electrons to cluster near the edges of the mosaic or signal plate. This electronic cloud will produce a voltage dependent upon the electron density, and the result is a distortion of the picture because of the incorrect potentials at the leading and trailing edges of both the line and frame scans. There are several ways in which this effect can be neutralised so as to restore the transmitted picture to its correct geometrical formation, but one of the simplest schemes is that suggested on the Continent. The practice in this case is to make the screen of a size in excess of ordinary picture requirements and thereby form a margin round the actual rectangular area taken up by the optical picture focussed on to the mosaic. The scanning beam of electrons is then made to traverse the sides, top and bottom of this marginal area during the conversion of the optical picture to its electrical signal equivalent. As can be seen, the potential which will be acquired by this marginal section will be a uniform one and equivalent to that produced by a dark area of the picture. This uniform low potential will therefore not cause distortion when compared with the condition brought about by random voltages due to stray electrons. Due to the fact that the length of scanning traversal is increased, steps have to be taken with the time base generator circuits to ensure that although the traverse time over the actual picture area is the same as that holding for a mosaic without a marginal section, the traverse speed over the margin, and for the fly-back period must be increased so that the line or frame stroke times are maintained at their correct values.

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COULPHONE RADIO, 22, Grimshaw Lane, Ormskirk. Collaro A.C. Gramophone Motors, 12in. turntable, 25/-. Midget and Portable Receivers. 1½d. stamp list.

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THE famous HALLICRAFTER SX23, released by the makers only in July, 1939, can still be supplied by Webb's Radio at
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Practical and Wireless
PRACTICAL TELEVISION
EVERY WEDNESDAY
Vol. XV. No. 387. Feb. 17th, 1940.
EDITED BY
F. J. CAMM
Staff:
W. J. DELANEY, FRANK PRESTON,
H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Midget Receivers

A TYPE of receiver which is very popular in America is the midget Universal mains model. This is now produced in many interesting cabinet finishes, usually moulded, and is intended for plugging into either A.C. or D.C. mains, and needs no aerial or earth. Some of these receivers give a really wonderful performance, picking up stations a considerable distance away, although generally speaking the quality is not of the highest order. They are not intended as quality receivers, however, their main purpose being to provide signals in the bedroom or in other stand-by positions. They often employ a superhet circuit and make use of multi-valves and special midget components. Several firms in this country have turned their attention to this type of receiver, and some interesting models are now available. Unlike the American counterparts, however, these are provided with ordinary mains flex leads. The American instrument usually has a special line-cord, as it is called, which is a mains flex incorporating a resistance running the whole length of it, and this runs at a fairly high temperature. We give in this issue some of the points of interest connected with this type of instrument, as it would appear that many listeners are now interested in midgets of the portable type.

Automatic screwdrivers and spanners, suspended on overhead springs, make component-mounting a swift and simple operation at the Ekco works.

Television Position

THE Postmaster-General, in reply to a question in the House of Commons, recently stated that he could hold out no hope of an early resumption of the television service. Although it had been said that the services were being continued in some other countries, he stated that no information had been received that they had passed the experimental stage. The suspension is due, of course, to conditions of national safety, the use of a single station of this type providing an ideal direction-finder for aircraft.

War Delays Station Construction

CONSTRUCTION of WLWO, new 50,000-watt international broadcasting station of the Crosley Corporation, is being delayed by the war. It was planned to have the station ready for operation by January 1st, but two shipments of a special material from England have thus far failed to arrive.

The material consists of a very special type of high-voltage insulating board. It is hoped that the transmitter will be ready for broadcasting a few weeks after the material is received. WLWO is operating on 10,000 watts at present.

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

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

"The Dream of Gerontius"

THE B.B.C. announces that a performance of "The Dream of Gerontius," by the B.B.C. Symphony Orchestra and a chorus drawn from the B.B.C. Chorus, the Bristol Choral Society and the Bristol Philharmonic Society, will be given under the direction of Sir Henry Wood at the Colston Hall, Bristol, on Palm Sunday afternoon, March 17th next.

The names of the soloists and ticket arrangements will be announced later.

War-time Concert Party in Gaelic

TO keep up the hearts of Gaels in war-time, a concert party has been gathered together by An Comunn Gaidhealach, the Highland Society of Scotland which attends to all cultural matters of Gaeldom. One of their concerts under the title "Let's sing a merry song" will be presented to Gaelic-speaking listeners on 261.1 metres on February 15th.

Broadcasting on Leap Year Day

A PROGRAMME in celebration of Leap Year will be broadcast on February 29th—a day which occurs only once in four years. The programme will include both frivolous and serious material about Leap Year, and it is being put together by Francis Worsley and Leslie Baily.

Music-makers' Half-hour

GRACE COLE, a fifteen-year-old girl from Langold, near Worksop, Nottinghamshire, will take part in the "Music-Makers' Half-Hour" on February 15th. She will play a cornet solo. In the series of programmes entitled "Music-Makers' Half-Hour," Denis Wright presents personalities who play in brass bands, and the idea of the series is to induce others to take up playing for their own amusement. In the programme on February 15th a Northern brass band will also be heard—Foden's Works Band from Sandwich, Cheshire. This band is carrying on as usual in spite of war conditions which entail long working hours for them, and their rehearsals have accordingly to be squeezed into what little spare time they have. Foden's Works Band was founded in 1900 and has had considerable success at Belle Vue and Crystal Palace. Incidentally, they were also heard in a programme on February 11th.

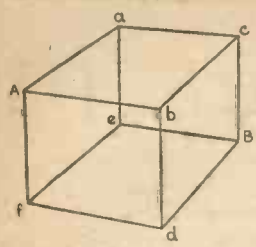


Fig. 1

A Resistance Problem

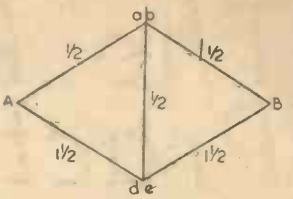


Fig. 4

A Detailed Solution to a Rather Novel Resistance Network Arrangement. By Sir Ambrose Fleming, M.A., D.Sc., F.R.S.

FROM time to time we receive amongst our query correspondence a request to solve a resistance network problem which is more or less in the form of a "catch" question. The problem is to assume the construction of a cube in which each side has a resistance of 1 ohm, and then to find the equivalent resistance at two diagonally opposite points—and in some cases the current which will flow through the network. A problem such as this is involved and cannot be satisfactorily dealt with in a letter. However, the following will show how such problems should be worked out and will clear up once and for all the difficulty which confronts many students of electricity.

We have first to redraw the diagram of Fig. 1 as follows: Since sides Aa and Ab are equal, it follows from the symmetry of the network that the points *a* and *b* are at equal potentials when current is flowing from A to B. Also *d* and *e* are at equal potentials. Hence we can connect points *a* and *b*, also *d* and *e*, without disturbing the resistance from A to B and therefore the wires *ae* and *bd* each of 1 ohm may be united to a single wire of half an ohm resistance. We can then redraw Fig. 1 to an electrically equivalent network as in Fig. 2 where the points of junction of wires are marked with the same letters as in Fig. 1.

We note that the two wires joining A with *ab* are each of 1 ohm resistance, and therefore in parallel together are equal to ½ ohm. The same for ab to C, f to *de* and de to B.

Hence we can redraw again as in Fig. 3 or equally as in Fig. 4, where the junctions of wires are marked with the same letters as in Fig. 1.

We have, therefore, solved the problem if we can find the resistance between A and B of an arrangement of wires as marked in Fig. 4. This can be done by the use of Kirckhoff's Corollaries to Ohm's Law.

This law states that in a network of conductors the sum of the products of current and resistance taken round each cell, or mesh, must be equated to the electromotive force in that mesh and that the sum of the currents at each junction must be zero.

The difficulty, however, is to foresee in which direction the currents are flowing in each wire. Maxwell therefore suggested that we assume that the actual currents in each wire are the difference between imaginary currents all flowing in the same direction, say clockwise, round each cell or mesh.

I also suggested in a Paper published in September, 1885, in the *Philosophical Magazine*, that the resistance between any two points on a network of wires might be ascertained by joining those points by a conductor of zero resistance, having in it an electromotive force of 1 volt. The resistance between those two points was then the reciprocal of the current flowing in the wire of zero resistance, as shown in Fig. 5.

We will solve the problem first algebraically, and then give the result in actual ohms for the network in Fig. 4 equivalent to that of Fig. 1. We mark the resistances P, Q, R, S, and G. The zero resistance joining the points A and B is shown by a dotted line. Let x, y, z denote the imaginary currents round each mesh. Then, if R denotes the resistance of the network between A and B $x = \frac{1}{R}$ or $R = \frac{1}{x}$.

We have therefore to find the value of x by the Kirckhoff rules, as follows:

The true current in R is $x-y$ and that in S is $x-z$. Also in P it is y and Q it is z. Also the E.M.F. in mesh x is 1 volt. We have, then, the following equations:

$$R(x-y) + S(x-z) = 1$$
$$R(y-x) + G(y-z) + Py = 0$$
$$S(z-x) + G(z-y) + Qz = 0$$

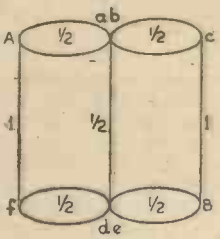


Fig. 2

Fig. 3.

We rearrange these equations as follows:

$$(R+S)\ x - Ry - Sz = 1$$
$$-Rx + (R+G+P)\ y - Gz = 0$$
$$-Sx - Gy + (S+G+Q)\ z = 0$$

We have here three equations with three unknown quantities, x, y and z. We can solve these equations by *determinants*. I need not explain this method here because it is fully explained in my book, "Elementary Mathematics for Electrical Engineers," page 18, chapter II. The book is published by George Newnes, Ltd., of Tower House, Southampton Street, Strand, London, price 5s.

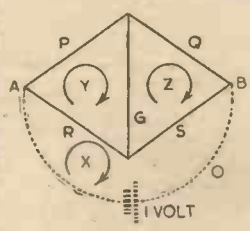


Fig. 5

The solution for x in the last three equations is

$$x = \frac{\begin{vmatrix} (R+G+P), & -G \\ -G, & (S+G+Q) \end{vmatrix}}{\begin{vmatrix} R+S, & -R, & -S \\ -R, & (R+G+P), & -G \\ -S, & -G, & (S+G+Q) \end{vmatrix}}$$

that is, x is given by the quotient of two determinants and the resistance of the network, as in Fig. 5, is equal to $\frac{1}{x}$.

Now, referring to Figs. 4 and 5, we have the following numerical values: $P=\frac{1}{2}$, $Q=1\frac{1}{2}$, $R=1\frac{1}{2}$, $S=\frac{1}{2}$, $G=\frac{1}{2}$, $R+G+P=2\frac{1}{2}$, $S+G+Q=2\frac{1}{2}$. Hence: substituting in the determinants, we have

$$x = \frac{\begin{vmatrix} 2\frac{1}{2}, & -\frac{1}{2} \\ -\frac{1}{2}, & 2\frac{1}{2} \end{vmatrix}}{\begin{vmatrix} 2, & -1\frac{1}{2}, & -\frac{1}{2} \\ -1\frac{1}{2}, & +2\frac{1}{2}, & -\frac{1}{2} \\ -\frac{1}{2}, & -\frac{1}{2}, & +2\frac{1}{2} \end{vmatrix}}$$

or, writing out the determinants, we have

$$x = \frac{6\frac{1}{4} - \frac{1}{4}}{12\frac{1}{2} - \frac{3}{8} - \frac{3}{8} - \frac{3}{8} - {}^{45}/_{8} - {}^{4}/_{8}}$$

$$x = {}^{6}/_{5}$$

and $R = {}^{5}/_{6}$ ohm,

which is the resistance of Fig. 1 between A and B.

If the reader cannot follow the method of solving the equations by the use of determinants then his best way is to insert the numerical values of P, Q, R, S, G in the three last equations and solve in the ordinary way.

Thus we obtain

$$2x - 1\tfrac{1}{2}y - \tfrac{1}{2}z = 1$$
$$-1\tfrac{1}{2}x + 2\tfrac{1}{2}y - \tfrac{1}{2}z = 0$$
$$-\tfrac{1}{2}x - \tfrac{1}{2}y + 2\tfrac{1}{2}z = 0$$

Multiplying by 2, we get

$$4x - 3y - z = 2$$
$$-3x + 5y - z = 0$$
$$-x - y + 5z = 0$$

Adding all three we have

$$y + 3z = 2$$
$$\text{or } z = \frac{2-y}{3}$$

Substituting this value of z in the three equations we have

$$12x - 8y = 8$$
$$-9x + 16y = 2$$
$$-3x - 8y = 10$$

Multiply the first of these equations by 2 and add the result to the second equation and we obtain

$$24x - 16y = 16$$
$$-9x + 16y = 2$$

therefore $15x = 18$ or $x = {}^{6}/_{5}$ and therefore $R = {}^{5}/_{6}$ ohm as before.

Accordingly it is clear that the resistance of the cube formed of 12 wires each of 1 ohm resistance between diagonal corners A to B is ${}^{5}/_{6}$ of an ohm.

Mr. Walker might exercise himself in finding the electrical resistance of the same skeleton cube between adjoining corners. That is, find the resistance of the cube between A and B as shown in the above diagram. The answer is $R = {}^{7}/_{12}$ ohm when each wire is 1 ohm. These values of the resistances of a skeleton cube of wires could be checked experimentally by making such a cube and measuring its resistance on a Wheatstone Bridge.

The Power Amplifier in Practice—2

Further Considerations of the Method of Use

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

VALVE amplifiers in practice may be classified into three main groups, which for ease of reference are commonly denoted as Class "A," Class "B" and Class "C."

Class "A."—Class "A" operation of a valve may be described as the condition in which both half-cycles of an alternating signal-voltage are amplified equally. The average anode current as indicated by a D.C. milliammeter is constant whether a signal is being amplified or not.

Class "B."—If the valve is so designed, and the grid so biased, that the anode current is zero for half the A.C. cycle, the valve is said to be in the "Class B" condition. For audio-frequency work it is essential always to use a pair of valves if this condition is to be used, so that both halves of the signal wave are amplified. In Class "B" amplifiers the mean anode current rises with increasing signal amplitude.

A condition intermediate between Class "A" and Class "B" is called "Class AB." Where there is no provision for driving the grids into the positive region, the term "Class AB1" is used.

"Class AB2" denotes one of these intermediate class amplifiers in which positive drive is provided for. (The term "Class B" is loosely applied to any stage which operates partially in the grid current region, more particularly to the well-known zero bias push-pull stage.)

Class "C" may be described as the operation of a valve such that under static conditions the applied values of anode and grid voltages in relation to the characteristics of the particular valve concerned are more than sufficient to reduce the anode current to zero, so that when the signal voltage is applied to the grid, appreciable amplitude is required before anode current flows on the positive half cycle. We need not further discuss Class "C" in relation to speech frequency power amplifiers, this method being confined to power amplification at radio frequencies.

Class "A" is the most straightforward method of applying our power valve, and reasonable efficiencies can usually be obtained with small distortion of the applied signal with no special difficulties in the choice of associated components. It is recommended where simplicity in circuit and economy of the component parts is preferable to the highest efficiency of operation.

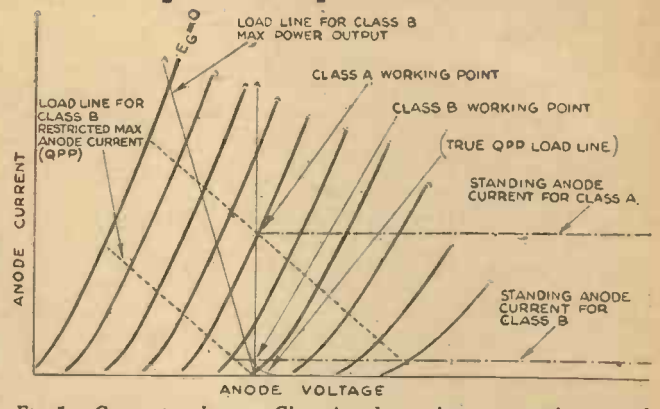
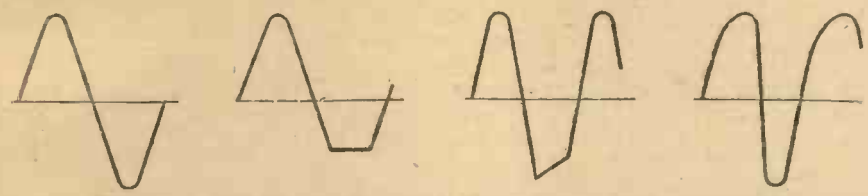
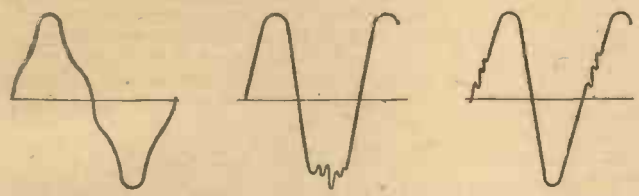


Fig. 5.—Comparison between Class A and two alternative applications of Class B, the one alternative for maximum economy in average anode current ("Q.P.P."), and the other alternative for maximum power output (low impedance loading "Class AB1")



Pure sine wave free from distortion. — *Distorted wave due to grid current or excessive load-resistance with tetrode.* — *Distorted wave due to grid current (inductive load).* — *Distorted wave due to anode bend rectification.*



Distorted wave due to push-pull amplifier with excessive bias, or insufficient anode voltage. (Third harmonic distortion.)

Fig. 4.

Intermittent oscillation.

Spurious oscillation introduced as in Class B (positive grid current) amplifier with incorrect components.

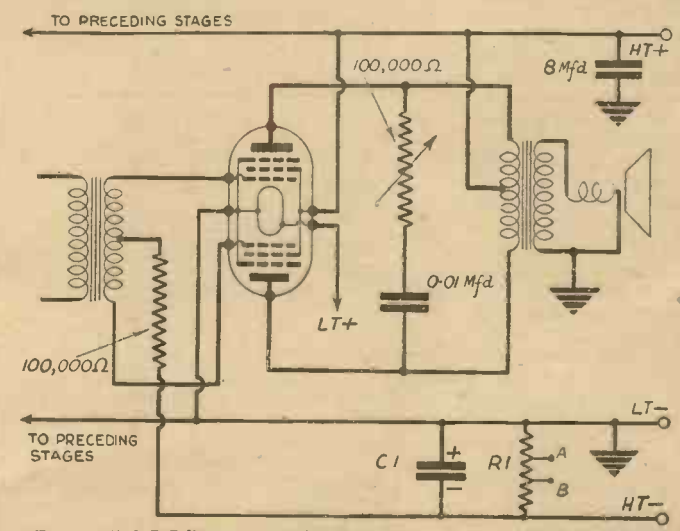


Fig. 6.—"Q.P.P." stage with "automatic" grid-bias. Bias is produced by the flow of H.T. current through the resistance R_1 via the filament circuit. Various values of bias may be tapped from R_1 for the preceding valves. The electrolytic condenser C_1 must be at least 50 mfds. capacity. C_1 smoothes out considerably the variation in current through R_1 due to change in output volume level.

Distortion

The question uppermost in most minds in connection with power amplifiers of the domestic variety is probably how distortion of the signal may be avoided—it is usually easy enough to produce adequate power, but difficult enough to do so without mutilating the waveform in the process.

There may be said to be three causes for waveform distortion:

1. *Phase distortion*, in which the phase relationship of the several components of the complex wave are altered. This is of small practical importance except for the highest and lowest frequencies.

2. *Amplitude distortion*, in which a non-linear relation exists between the instantaneous output current or voltage and the instantaneous input voltage. Amplitude distortion leads to the introduction of frequencies in the output not present in the input and is normally caused by curvature over the operating portion of the valve characteristic, or by some characteristic of the output circuit.

A non-linear amplifier introduces harmonics of all frequencies present in the input, together with additional components of the resultant waveform having frequencies equal to the sum and difference to each pair of frequencies in the input. In audio-frequency amplifiers the "even" harmonics, such as second harmonic giving the octave of the original frequency, are usually permissible to a larger extent than the "odd" harmonics, third, fifth, etc.

In all "Class A" amplifiers, the load impedance and the D.C. operating potentials on the valve must be correctly chosen, and the input signal must be restricted so that its peak voltage seldom, if ever, exceeds the region of undistorted

(Continued on next page)

THE POWER AMPLIFIER IN PRACTICE

(Continued from previous page)

amplification. Fig. 4 shows some oscillograms indicative of what happens to a sine wave input as a result of amplitude distortion.

Frequency Distortion

Frequency distortion, in which variations of input at different frequencies are not equally amplified. This form of distortion is not due to the valve alone, but to the characteristics of the input and output circuits when allied to the equivalent input and output valve impedances.

Frequency distortion may in certain cases deliberately be introduced to produce certain desired effects—so called "tone control," but at all times it should be under control.

Let us now consider some of the more important points to watch in using valves as power amplifiers, first under the Class "A" condition, and secondly Class "B"; or its variations.

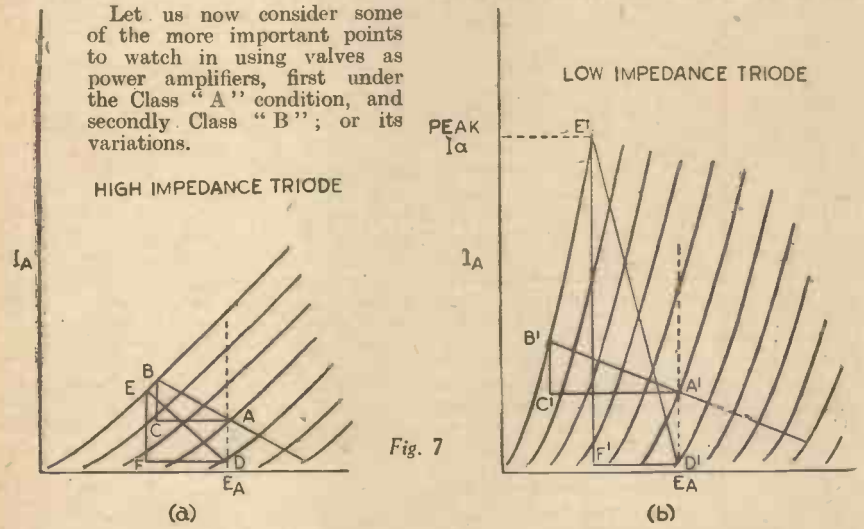


Fig. 7

Power output proportional to areas of triangles:
ABC ... ... Class A (bias at A)
DEF ... ... Class AB1 (bias at D)
In this case the anode impedance is high and the increase in power output by operating in Class AB1 push-pull is approximately double.

Power output proportional to areas of triangles:
$A^1B^1C^1$ ... ... Class A (bias at A^1)
$D^1E^1F^1$ ... ... Class AB1 (bias at D^1)
In this case the anode impedance is low, and the increase in power output by operating in Class AB1 push-pull is considerable.

In Class "A" the output stage may conveniently consist of either a single valve or a pair connected in a push-pull circuit. Push-pull under Class "A" audio-frequency condition is often favoured, because it enables the D.C. component of the anode current to be balanced in the output circuit and so reduces the chance of "saturation" of the iron in such a component as an output transformer, and avoids the necessity for an air gap core which always causes loss and distortion at high frequencies.

In addition, when the output valves are directly heated and fed from A.C. for filament heating, the effects of H.T. hum and "magnetic hum" introduced in the filament circuit are minimised by push-pull working. Small non-linearity in the operating characteristic may be balanced, and it is generally claimed, with some justification, that push-pull Class "A" circuits are capable of achieving high quality amplification without undue precautions or expense. What must be realised, however, is that Class "A" push-pull in no way increases the *efficiency* of the output stage—it may be that twice the power output is obtained, but only at the expense of twice the standing anode feed and twice the grid input (signal) voltage.

It is with Class "B" circuits that we can get increased efficiency in the output stage owing to the fact that the standing anode current or watts dissipation, when no signal is being fed to the valve, may be kept quite small, and the valve only functions to its full capacity and the full H.T. current is only taken when the signal is applied.

Class "B" takes on roughly three forms in practice—the zero bias type, in which the valve impedance is made so high that the anode current taken may be exceedingly small, even though no negative grid bias is applied; the heavily biased type, in which the anode current is very small at some high negative bias and an intermediate between the two, which, as has been seen, is sometimes called Class "AB" (AB1 and AB2).

Operation under Class "B" conditions can be further subdivided, first when the value of the signal-input voltage is not permitted to be so great as to drive the valve into grid current, and, secondly, when the signal voltage "oversteps the mark," as it were, and encroaches to a more or less degree on the side of positive grid voltage. This latter always must apply with the zero bias type of Class "B."

The method of heavily negatively biasing to keep down the standing anode current is also termed "Q.P.P." or "Quiescent push-pull."

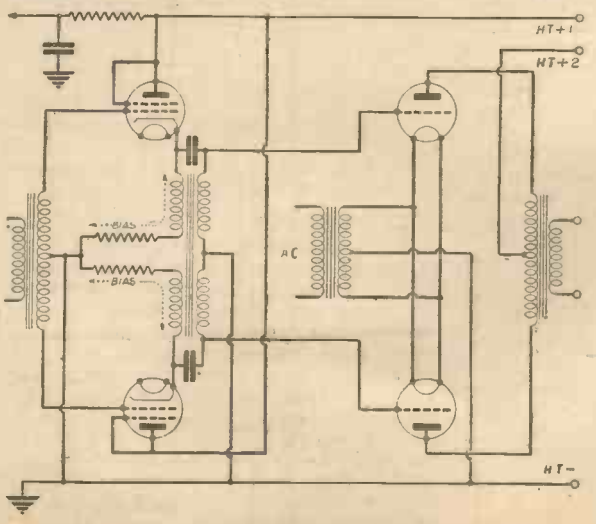


Fig. 8.—Typical example of cathode coupling to positive grid drive "Class B" push-pull stage.

The choice of any of these applications is largely one of expediency and different characteristics are called for in the valves to meet each case.

It must be realised that Class "B" necessarily always calls for push-pull circuits, and a single output valve could not so be used.

Let us now examine the merits of the various methods (Fig. 5).

1. The "Q.P.P." System

This is normally used in cases where the prime necessity is to keep the standing anode current as low as possible for economy's sake—as in battery sets. It enables two or three times the power output of a normal triode or pentode to be obtained for about the same average H.T. consumption. As the valve is not driven into the positive grid voltage region, no special "driver" stage is required. To obtain the most satisfactory results, however, fairly close matching between the two valve systems is advisable, particularly if the bias is increased practically to "cut-off" point and hence it is preferable not to approach this point, but to be satisfied with an economy which permits a small anode current to flow on "no signal." Any normal step-up intervalve transformer may be used, but too high a ratio is not recommended, as this tends to give a poorer frequency response.

Fixed grid bias is preferable, but "automatic" or "free" grid bias methods may be used with a reduction in the maximum power output.

2. Class "AB1"

This is commonly used in cases where a large power output is required, such being more important than the maximum economy in standing anode current. The requirements for this method are the use of valves (if triodes) with a low internal anode resistance or impedance, because the greatest increases in output are obtained when much lower values of anode loading are used than would be in the case of Class "A."

Low Impedance Loading

For this reason the term "low impedance loading," or "low loading," is often applied to the method.

Valves so used must be constructed so that the cathode emission is adequate to satisfy a large peak anode current, as, with a reduced load impedance, the peaks of anode current may rise to several times the "no signal" value.

This is shown clearly in Fig. 7. It can be established that the maximum power output is realised when the slope of the load line (assuming push-pull operation) is the same as the slope of the anode current/anode voltage characteristics. As the load is reduced the slope of the load line becomes steeper and so for maximum power output a steep I_a—E_a curve is required, which represents a valve of low anode impedance. Hence, as the anode impedance of a triode is reduced to the limit imposed by its cathode emission, so the increase in power output in "low loading" push-pull

(Continued on page 467)

Midget Receiver Design

The Essential Features are Discussed in this Article by the Technical Staff

A typical commercial midget, the Invicta 4-valver, for A.C./D.C. supplies.

AS there appears to be considerable confusion around the expression midget receivers, it would be advisable to clarify the exact definition before discussing the more practical considerations. Too many readers are under the impression that the term denotes a small, self-contained portable receiver, while others have applied the twist in the opposite sense, and think that any small portable is entitled to the term midget receiver, whether it has a self-contained aerial or whether it is for battery or mains operation, or not. While there is not any official definition of the term, it is now generally recognised that when a midget receiver is mentioned one has in mind the *very* small and compact sets, embodying their own moving-coil speaker, designed for operation off A.C./D.C. mains, and relying for their signal pick-up on a rather short throw-out aerial.

These receivers first became popular when they were introduced into this country from America, but quite a number of British models are now available which differ from the early American products by covering the long waves in addition to the medium. When one notes the overall dimensions of some of these sets, and then reads the technical specification, it hardly seems possible that all the necessary components could be located in such a small space and, after further examination of the completed article, one has to agree that considerable praise is due to the designers, especially bearing in mind the performance usually obtainable.

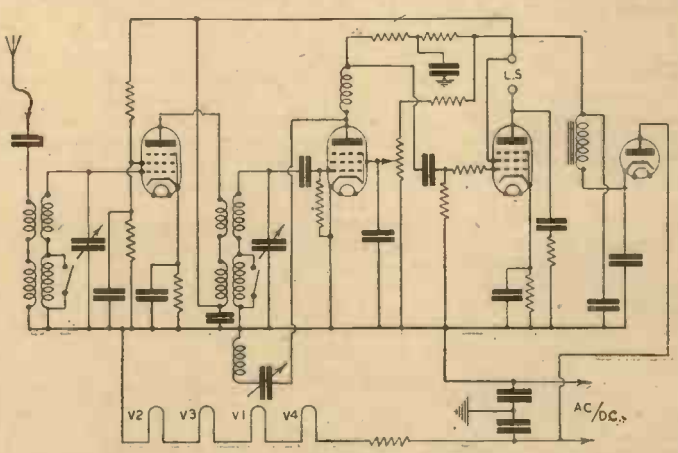
What are the secrets of the design and production of these remarkable little sets? That is a question which is widely asked by interested constructors, and we give the essential considerations and mention, in passing, that we have already been instructed by the Editor to get busy producing a model to satisfy the majority of our readers.

A.C. or A.C./D.C.

It will be noted that battery operation has not been considered. A few moments thought about the size and weight of the essential batteries should soon explain the reason. With that point eliminated, the next consideration is, shall the set be for A.C. operation only or, to make its appeal more universal, shall it be of the A.C./D.C. type of circuit.

If the receiver was for use on A.C. mains only, then improved results would, no doubt, be obtained by designing the set for that type of supply but, if we bear in mind the limitations imposed, by the term midget, as regards available space, then we would have to sacrifice a little of desirable efficiency to constructional considerations. The fact that an A.C. circuit would require a mains transformer, which, in itself, cannot be reduced beyond a certain bulk, introduces very annoying problems as regards chassis construction and size, therefore, one is more or less compelled to use the now familiar A.C./D.C. type of circuit.

From the point of view of weight, component area and cost, this form of receiver scores every time over its A.C. counterpart but, one has to admit that the design of the circuit, and the resultant power output, is governed by the ultimate rectified or smoothed voltage available, when it is used on normal A.C. or D.C. supplies in this country. In this direction, British designers are more fortunate than their American competitors who have to contend with a supply voltage usually in the region of 110 volts. For normal domestic purposes, however, ample volume can be obtained with an A.C./D.C. circuit of good design, and the quality of the output is not so displeasing as one might be led to anticipate, when operating conditions and the size of speaker and baffle are observed.



A three-valve circuit of the H.F., Det. and Pentode output class for universal mains operation. A throw-out aerial is used.

Type of Circuit

Multi-electrode valves, and high gain figures have allowed designers to produce four- and five-valve superhets in an incredible space and, although details of such circuits look very nice in specification form, many manufacturers are still producing sets making good use of the tried and trusty three-valve (plus rectifier) H.F., Det. and output arrangement. While such a simple circuit cannot hope to compete with the more complicated types as regards range and selectivity, it is quite capable of providing all that is required for ordinary domestic entertainment, especially during the present conditions and, bearing in mind the fact that midget receivers generally are looked upon as the second or stand-by set, to be used in rooms other than those fed from the permanent radio installation.

Components

In spite of space restrictions, very few special midget components are required, for example, standard half- or quarter-watt resistances can be utilised quite widely, and modern tubular condensers or ordinary and electrolytic types, according to their work, can be so arranged in the general layout that they will occupy very little room.

Such things as the loudspeaker, ganged tuning condenser and barretter, or mains dropping resistance do, however, call for special consideration, but as suitable types are now readily obtainable, they do not cause any special worries or delays.

A suitable simple circuit, of the H.F., Det. and Pentode type is shown in the accompanying diagram, and it will be seen that resistance/capacity is used for the L.F. coupling, thus eliminating a comparatively bulky L.F. transformer and, apart from the two coils the only other component demanding special attention, from the space point of view, is the electrolytic smoothing condenser block.

It will be noted that the more usual reaction condenser has been dispensed with by using the potentiometer shown, which acts very effectively as reaction and volume control, plus "on-off" for the mains supply.

For the mains voltage dropping there is the choice of a standard British type of barretter, or a wire-wound resistance or, if we resort to American products, the rather compact voltage regulator type. This term is actually a misnomer, as the component is nothing more than a resistance wire network, but in appearance it is certainly like some of the American valves, and is approximately the same size. It also has the advantage of fitting into an American valve-holder, which simplifies fitting and replacing.

Comment, Chat and Criticism

More About Dance Rhythms

The Influence of Dance Tunes on Orchestral Music is Discussed by our Music Critic, Maurice Reeve

BETWEEN the sixteenth and eighteenth centuries dance tunes were the most conspicuous feature of instrumental music. This was largely owing to the two reasons that a large number of itinerant musicians used to enter the various European countries leaving their tunes behind them; and to the frequency of war which also left its trail of marching tunes and rhythms behind. They naturally became acclimatised. This is easily imaginable when we recall the devastating effect certain imported dance rhythms have exercised in our own day, and the less baleful influence that marching songs like "Tipperary" and "Madelons" have exercised in countries other than those of their origin. Only last year a Hungarian composer wrote a brilliant set of orchestral variations on the tune "Under the Spreading Chestnut Tree," which he first heard in a cinema, watching films of the King singing it at his summer camp.

Orchestral Music

Orchestral music owes far more to dance rhythms than choral; in fact, it is no exaggeration to say that it owes its very existence to them. It is under the most paramount obligation. All orchestral music could be divided into two main groups—the cantabile and the dance. Dance music has been the origin and fount of all orchestral music, and during its rise from humble beginnings in the early seventeenth century the dance was its inspiration. The earliest instrumental pieces were two contrasting dances played together, such as a pavan and a galliard. Therein lies the origin of the suite as brought to perfection by Bach and Handel a century later. As with all vital things, it only took the humble combination of two such dances to show that by stringing three together, and then four, and after that five, something splendid and monumental could be achieved, far bigger than anything thought of before. And as with the collection of movements, so with the individual. From the simple statement of a theme in more or less two equal parts came the repetition of the first half after the second, giving us a "threesome" with corresponding increase of interest. Then when the repetition contained melodies and figurative embellishments, the work soared several flights higher still.

Sonata Form

With the maturing of sonata form—to become the foundation plan for all the great orchestral music that was subsequently poured out by the eighteenth- and nineteenth-century masters—other forms were also ripening which were destined to be swallowed up by the orchestra's voracious appetite. Madrigals were imitated for solo instruments. Movements for solo voices were copied by solo instruments, and were rapidly developing into movement forms. Most of these were combined with, or founded on, dance forms in the early stages of the sonata. The balancing of movements of a singing order with dance rhythms was an early problem, and all the great masters of later times owe their gratitude to the pioneers who solved it. The violin profoundly influenced their early development, and largely helped to crystallise the style. Its capacity for cantabile playing, plus its ability to produce a crisp rhythm, rendered it an admirable medium for their experiment—much more so than the early harpsichords and spinets. But it was the invention and subsequent rapid development of the piano—in the beginning of the eighteenth century—with its infinite capacity for making harmony, and with its easy manipulation by one pair of hands, which sent music careering and skyrocketing on to the heights it reached at the end of that memorable epoch. The suites J. S. Bach and Handel and the sonatas of Haydn were being written and played within a decade of its invention—sure proof of the propulsion it gave. Whilst Bach's "Well-tempered Clavichord"—the immortal forty-eight Preludes and Fugues—was written to prove the necessity for the "equal temperament" of the strings, its triumph laid down the laws of pitch and key for all time.

This use of the piano quickly led to profound changes in writing and style. A slow movement was at once added, a memorable event which led to the rise and development of sonata form first movement. So far it was known as a "Symphonia" or "ouverture," which contained at least one dance rhythm. This developed into the modern symphony, in which one dance movement at least is obligatory, to wit, the Scherzo, evolved from Haydn's "Menuet and Trio" and thought by Beethoven to be the dance movement *par excellence*. Most symphonic finales, too, are dance movements, the most illustrious being Beethoven's from his seventh symphony, which Sir Donald Tovey calls a "bacchic orgy," and the apotheosis of the dance!

Influence of the Waltz

Perhaps the most profound influence on classical music has been exercised by the waltz, and its forerunner the Landler; Beethoven, Schubert, Weber, Dvorak, Brahms, Chopin and Strauss incorporated it in their works with masterly effect.

Many composers have introduced bona fide national rhythms into some of their master works. A notable example is the Russian dance in Beethoven's Russoumossky Quartet. Other writers, such as Schubert, Brahms, Dvorak, and Albeniz, go even farther and write whole works, in one movement, based on one specially-selected rhythm, the movement, of course, being fashioned on classical proportions.

Between the seventeenth and nineteenth centuries, dance tunes are the most conspicuous feature of classical music, a clear refutation of the widely held but very inaccurate belief that classical music is inevitably dull and uninteresting. It had become almost completely divorced from its original partner—gesture—and had been toned down and refined in the crucible The twin elements—inseparable in all music—of time and sound coupled with a blending of all the other ingredients of the musical Christmas pudding, especially the vast developments of harmony and form, might tend to overshadow its one-time pre-eminence. Instead of the reiterated drumming out of a rhythm on a hideous piece of parchment or lion's skin without scarcely any relief to the awful monotony from any other influence—an effect successfully imitated by some modern dance bands—it found itself at the dawn of the nineteenth century a fully-fledged partner in a going concern, always lending a helping hand, and giving the best advice, but never tyrannising over its colleagues. It could be rightfully proud of its influence on all concerned without wanting to usurp what was not its rightful own. It had been refined and purified—could the "Blue Danube" have possibly been written otherwise? The dross had left it, and what was handed on to posterity was the fascinating and compelling rhythm as a malleable thing easy of combination with other elements for the greater glorification of music.

Future of Dance Rhythms

And what of the future of dance rhythms in music? Is it possible to have a whole work built on classical "first movement" lines, wholly given over to any one particular rhythm, and with that rhythm acting as the chief inspiration and begetter of the composition? Many serious musicians are asking this question, and many are striving to find a satisfactory solution. But I think the answer is an unqualified "No." Variety must always be the chief object aimed at by serious musicians, a masterly blending of all the elements that a good piece of music should contain. Rhythm is only one of them. The most completely satisfying works are those which provide sustenance for the whole of our musical bodies. Just as our corporal selves could not lead a healthy existence on any one item of food—no matter how choice or rare that food may be—so would it be impossible to live a satisfactory musical life trying to diet on one particular dish, especially rhythm. In conjunction with other elements rhythm yields to none in importance; in fact, it comes first when taken with its twin, form. But alone, it is far too monotonous in a long work. It palls and satiates very quickly. Gershwin's "Rhapsody in Blue" proves that. This interesting work is perhaps the best attempt yet made to solve this problem. But in spite of much charming writing, the total effect to the serious musician is one of sameness and monotony. By far the most satisfactory way is to collect three or four rhythms as Liszt did in his Spanish Rhapsodie, building up each section of the movement on one of them. But best of all is to treat dance rhythms as the great symphonists treated them—as part of their musical raiment and not as the *raison d'être* for everything.

ON YOUR WAVELENGTH

By Thermion

QSL Exchanges

I OBSERVE the growing practice of readers inviting other readers to exchange QSL certificates. One or two clubs have been formed with the specific object of obtaining QSLs on an exchange basis. The situation has now become almost farcical. You may wander into an amateur's den and find his walls plastered with QSL cards, with the evident idea of giving the impression that he has received programmes from these stations, and has himself obtained the verifications. In discussing this matter with the Editor the other afternoon, I found he was of the same opinion.

Before anything is done, however, I should like to take the opinion of my readers. We do not want the QSL card to have no greater value than the cigarette picture. The present system of exchange is reducing the QSL card to that.

I cannot see the purpose of a reader wishing to plaster his den with QSL cards which he has not obtained in the legitimate way.

The Midnight News Bulletin

ONE or two readers have criticised the fact that the B.B.C. broadcasts a news bulletin at midnight. They think it should be earlier. I think this criticism is unfair, for this bulletin is designed for those who are unable to listen in to the ordinary 9 o'clock bulletin, and also it enables the B.B.C. to tack on any important item of news which comes to hand after this 9 o'clock broadcast. I consider the midnight news an important feature of B.B.C. service, and I much appreciate it. Quite often I arrive home after 9 o'clock at night, and by the time I have had my steak and chips I like to repose and listen to the news. The B.B.C. in my view is doing a great national service, and has designed some of its programmes absolutely in tempo with the times.

Television—No Hope

THE Postmaster-General stated in Parliament that he could not hold out hope for an early resumption of the television service. He acknowledged that such services were being carried out in other countries, but stated that he was without information as to whether such services were anything more than experimental.

It is here that I cross swords with the Postmaster-General. There is no valid reason why there should not be a television service during the day-time.

I agree that at night it is possible that with the black-out the television signal might be used for direction-finding purposes. but in the day-time we should have ample warning of any air attack, and the enemy would not need to use radio signals to find direction.

Are You an Inventor ?

DURING the last war, invention was one of the key industries of the country, and is still more so to-day, both for the promotion of victory and for the speedy revival of trade afterwards.

I am anxious to make it known, therefore, that inventors with ideas of any kind, either for the fighting services or for peace-time trade, will be given full support by the Institute of Patentees if they will apply by letter and state the nature of their work.

Their object is to collect "war" and other inventions which may be of use to the country, and launch them by submission to the proper authorities and firms, as this organisation has for its primary purpose the protection of inventions, and they are ready to give them every assistance in carrying out their aims of National importance. Inventions of any kind, however simple, are welcome, and they will receive the earnest attention of a competent technical committee.

The Amateur Wavebands

IT has been internationally agreed to allot the following bands of frequencies for amateur use. These are popularly referred to as the 5-, 10-, 20-, 40-, 80-, and 160-metre bands :

Frequency in in Megacycles.	Equivalent Wavelengths in Metres (approx.)
56.000 to 60.000	5.357 to 5.000
28.000 to 30.000	10.714 to 10.000
14.000 to 14.400	21.428 to 20.833
7.000 to 7.300	42.857 to 41.095
3.500 to 4.000	85.714 to 75.000
1.715 to 2.000	174.635 to 150.000

Æsop at the Microphone

ÆSOP is here. The old familiar slave with his bulgy forehead and thick negroid lips, his bow legs and humped back, has, somehow or other, found his way back to the world. And not only has he come to earth but he is on the air. Every Thursday morning, Æsop is at the B.B.C. microphone.

He gathers the children together, makes them sit quietly, and begins his story. Of course, it is a fable, and one which everyone knows, but there is a difference. The fable is not as it has come down through the ages from the printing press of old Caxton, not in the grand seventeenth-century phrases of l'Estrange, nor even in Croxall's elegant brevity. It is told to the children. And because they are listeners, Æsop is less terse than his wont. He gives his stories a background which his listeners can recognise, paints his scenes in greater detail, and allows his animals to converse more freely. The whole assembly of talking beasts comes to life with an astonishing variety of accents.

The themes are the themes of Æsop, but the voices are the elastic vocal chords of John Glyn-Jones, whose gift of mimicry on the stage and at the microphone has delighted many audiences. But if grown-ups, wanting to be "in the know," have found this out, for the children—the "under nines"—only one thing matters. Æsop is here.

S O S and Police Messages in 1939

MORE than a thousand S O S and police messages were broadcast by the B.B.C. in 1939, and nearly five hundred were successful. As usual, the majority were concerned with cases of illness, in which broadcasting was called upon as a last resort to discover the whereabouts of absent relatives. In the 580 cases of this kind, broadcasting was successful in 341 cases, or 53.2 per cent.

An important side of this special service is the tracing of persons who have witnessed street accidents. The B.B.C. was instrumental in finding witnesses in 36.51 per cent. of such cases last year.

Records in the R.A.F.

THE staff of an R.A.F. training station have rigged up a novel device for observers' ground training. With the idea of getting nearer to actual flying conditions, a gramophone recording was taken of the noises inside a bomber in flight. The observer does some of his work against this background of noise, sitting in an old fuselage which is slung from the roof. An amplifier is used to get a fuller effect. Another station uses an old car engine with an open exhaust.

The airmen who sang "The Blue Danube" while flying on reconnaissance recently over Vienna emphasise the fact that in war-time if you want music up there you have to make your own. Things are different on the ground. Many R.A.F. stations have their own amateur bands, and there is no lack of talent. Instruments are bought with funds raised by concert parties, boxing displays, and so on. In leisure hours R.A.F. men are not dependent solely on wireless and gramophone. All the same, gramophones are very popular and stores of gramophone records are eagerly compiled. Anyone with records to spare (especially jazz) might remember that they would be welcome in R.A.F. stations. They can be sent through the Comforts' Fund. The R.A.F., which has a reputation for smashing records, can be trusted to handle this sort, at any rate, with care.

"Practical Engineering" — Great Success !

FOUR issues of our new companion weekly, *Practical Engineering* (4d. every Thursday), have been published and each has rapidly gone out of print. The demand has been enormous, no doubt owing to the wide range of engineering subjects which it covers. If you are an engineer, or interested in engineering, you should obtain a copy. The Editor is Mr. F. J. Camm.

The "Skyrider 23"

IN the range of American communications receivers, the Hallicrafters models are probably the best known. There have been various models in this range, and the Skyrider 23 is the latest to be available in this country. It possesses all those details which to the amateur are essential in a receiver which is to be relied upon for real DX work, and is a development from the original Skyrider sets. The tuning dial, unlike that in many receivers, has been reduced to a very small area, as its function is purely to give an indication as to the setting, the main tuning being carried out on the bandspread dial which is calibrated with an arbitrary scale for easy logging. The four general dials, used in conjunction with the range-setter switch, are accurately calibrated in megacycles. The receiver incorporates an S meter designed on the same style as the tuning dial and placed on the other side of the main dial.

The controls are, in addition to the main band selector, tuning, selectivity, crystal phasing, H.F. gain, L.F. gain, tone control and pitch control. The selectivity control provides six separate settings, providing 4 degrees of selectivity, with and without A.V.C. The receiver is provided with an improved noise limiter, which is automatic in action and reduces the noise level on the higher frequencies. There are 11 valves in this particular receiver and the output is rated at 5 watts.

Waverange

Unlike some so-called communication receivers, this particular model has very sensible ranges or wavebands, and the bandspread arrangements have been specially designed to provide accurate and simple tuning over the amateur bands. The normal coverage is divided into four bands, from 540 to 1,700 kc/s, from 1.7 to 5.2 mc/s, from 5.2 to 16.5 mc/s and from 10 to 34 mc/s. The bandspread tuning is then arranged to cover from 27.5 to 32.5 mc/s for the 10-metre band; from 13.85 to 14.55 mc/s for the 20-metre band; from 6.93 to 7.37 mc/s for the 40-metre band; and from 3.45 to 4.05 mc/s for the 80-metre band. Each of these amateur bands is spread out over the entire scale of the large dial (which measures 5½in.in diameter) and as there is no separate bandspread adjustment to be made, each station always comes in at the same place on the dial.

A view of the Skyrider 23 showing the control layout.

To overcome troubles from frequency drift or instability due to circuit changes arising from external temperature changes, special components compensated for frequency stability at normal temperatures have been produced and are incorporated in the receiver, thus providing a very high degree of stability and reliability. For those who prefer it, the S meter is calibrated in decibels, as well as in arbitrary "s" units, the two scales being one above the other and indicated by a single meter pointer.

The valve combination used is a 6SK7 as 1st H.F.; 6SA7 as 1st detector; 6SJ7 as H.F. oscillator; 6SK7 as 1st I.F. with a similar valve as 2nd I.F.; a 6SQ7 as 2nd detector and 1st L.F.; 6B8 as amplified A.V.C., 6F6G as power output and 6SJ7 as beat frequency oscillator. The rectifier is a type 80 and for the special noise limiter circuit there is a 6N7. This thus gives a total of 11 valves. The price of this receiver, complete with valves, is £33 10s.

A speaker is available in a separate metal cabinet designed to match the receiver cabinet, and the price of this is £4. Readers who are interested in further details should write to Webb's Radio for a copy of the leaflet which has been produced by the Hallicrafters Company, describing more fully the various details of the receiver.

NEW SERIES

RADIO ENGINEER'S POCKET-BOOK

No. 10

Valve Base Connections for Continental Valves. See p. 6.

Type	Base	Pin Connections. 1	2	3	4	5	6	7	Top Cap
H.F. Pentode	1	G2	H	H	C	A	G3	—	G1
H.F. Pentode	2	G2	H	H	C	A	M	G3	G1
Triode ..	2	—	H	H	C	A	M	G1	—
Double-diode	2	G2	H	H	C	D1	—	—	D2
Freq. Changer	2	G2	H	H	C	A	Ao	Go	G1
O. Pentode ..	1	G2	H	H	C	A	G1	G3	—
O. Pentode ..	2	G2	H	H	C	A	G3	G1	—
Rectifier ..	1	C1	H	H	C2	A2	A1	—	—
Rectifier ..	2	C1	H	H	C2	A2	—	A1	—

Valve Base Connections for Hivac Midget Valves.

Type	Base	Pin Connections 1	2	3	4	5	Top Cap
Tetrode (S.G.) ..	1	A	G	F	F	—	—
Triode	1	G2	G1	F	F	—	A
Output Pentode ..	2	A	G1	F	F	G2	—

Mullard Universal Side-Contact Valves

Valve Type	Base	Contact Connections 1	2	3	4	5	6	7	8	Top Cap
Triode ..	P	M	H	H	C	—	—	—	A	G
H.F. Pentode	P	M	H	H	C	G3	—	G2	A	G1
O. Pentode ..	P	—	H	H	C	—	—	G2	A	G1
Octode ..	P	M	H	H	G3 C, G6	G2	G1	G3 G5	A	G4
Double-diode	V	D2	H	H	C, M	D1	—	—	—	—
Double-diode	V	M	H	H	C	D1	—	—	—	D2
Rect., Half-wave ..	P	—	H	H	C	—	—	—	A	—
Rect., Volt. Doub. ..	P	C1	H	H	C2	A1	—	—	—	—
V. T. Indicator (TV4) ..	P	—	H	H	C	—	G	Target	A	—

No. 11

DIELECTRIC CONSTANTS.—The following table gives the specific inductive capacities of various materials. These figures represent the dielectric constants.

Material.	S.I.C.
Air	1
Paper	1.5
Paraffin Wax	2.5
Ebonite	2.75
Shellac	3
Presspahn	3
Flint Glass	4 to 6
Plate Glass	4.5
Mica	5 to 8

DIELECTRIC STRENGTHS.

Material.	Dielectric Strength per Mm.
Glass	8,000
Shellac	10,000
Presspahn	6,000 to 15,000
Porcelain	16,300
Rubber	18,000
Mica	17,000 to 28,000
Ebonite	30,000
Micanite	40,000

No. 12

TABLE OF DECIMAL EQUIVALENTS

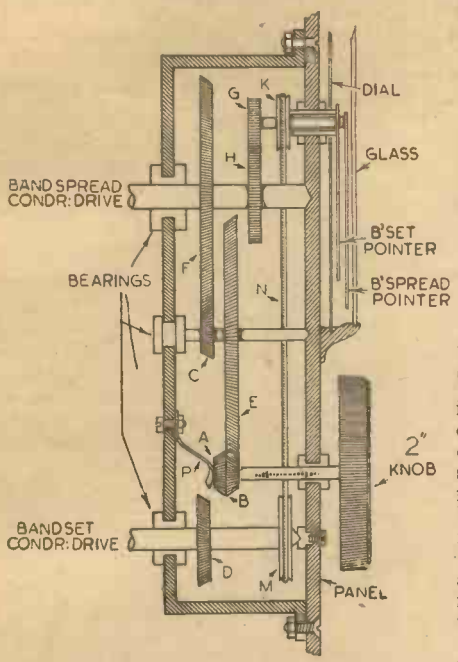
1/64	.015625	9/64	.140625
1/32	.03125	5/32	.15625
3/64	.046875	11/64	.171875
1/16	.0625	13/16	.1875
5/64	.078125	13/64	.203125
3/32	.09375	7/32	.21875
7/64	.109375	15/64	.234375
1/8	.1250	1/4	.2500
17/64	.265625	41/64	.640625
9/32	.28125	21/32	.65625
19/64	.296875	43/64	.671875
5/16	.3125	11/16	.6875
21/64	.328125	45/64	.703125
11/32	.34375	23/32	.71875
23/64	.359375	47/64	.734375
3/8	.3750	3/4	.7500
25/64	.390625	49/64	.765625
13/32	.40625	25/32	.78125
27/64	.421875	51/64	.796875
7/16	.4375	13/16	.8125
29/64	.453125	53/64	.828125
15/32	.46875	27/32	.84375
31/64	.484375	55/64	.859375
1/2	.5000	7/8	.8750
33/64	.515625	57/64	.890625
17/32	.53125	29/32	.90625
35/64	.546875	59/64	.921875
9/16	.5625	15/16	.9375
37/64	.578125	61/64	.953125
19/32	.59375	31/32	.96875
39/64	.609375	63/64	.984375
5/8	.6250	1	1.0000

Practical Hints

A Geared Dual Drive

THE accompanying sketch gives details of a dual drive I have devised for short-wave tuning. It is accurate, and can be reset to any reading, repeatedly, with the minimum of adjustment and trouble.

An old clock-face is used for the dial. The hour and minute hands are used for the bandset and bandspread condensers



Sectional view giving details of a geared dual drive.

respectively; "A" "B" and "C" are half-inch bevelled gears, "A" and "B" being set back to back as shown. Wheel "D" is a one-inch bevelled gear driven by "A" when the tuning knob is pushed towards the panel. A small piece of clock spring "P" normally keeps the band-spreading gear in mesh, while "E" and "F" are 2½in. bevelled gears, "E" being driven by "B," and "F" by "C," which is set on the same shaft as "E." Wheel "F" is set on the bandspread extension shaft. The total reduction from "B" to "F" is 25 to 1, and can be increased if desired. The half-inch cog "G" is driven by "H," a one-inch cog. A one-inch pulley driving "M" drives a half-inch pulley "K" by means of a band of whip-cord "N." Thus both pointers are turned through 360 deg. for the 180 deg. of the condensers, giving a longer scale. The bevel gears, in this case, are more easily meshed, and give a better drive than ordinary spur gearing. The whole system is positive in action, and remarkably free from back-lash.—IAN T. HAYNES (Montrose).

THAT DODGE OF YOURS!

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

SPECIAL NOTICE

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

A Handy Clip Connecting Bar

ON a test board which I recently made up, I adopted the rather novel idea of utilising the clips from some discarded braces as a "Crocodile" type clip connecting means. Having procured four such clips, I decided to make two connecting bars as illustrated, the mounting strips being of ebonite. From the inset sketch, it will be seen that each clip is fitted to the bar by means of countersunk 8BA bolts and nuts "B," the nuts being sufficiently recessed to permit the fixture of soldering tags "A."

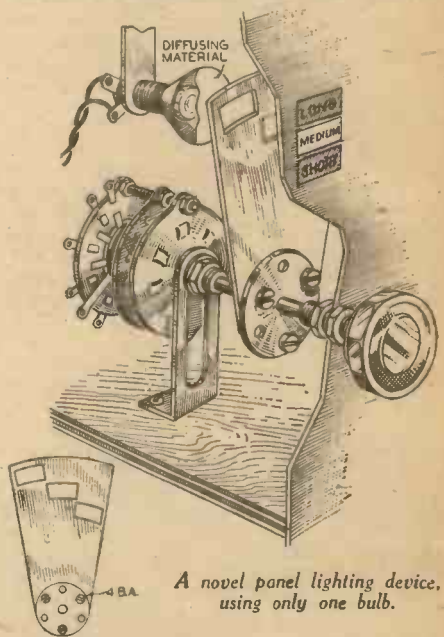
To facilitate opening the clips, I cut some lengths of ebonite rod, drilling and tapping these to take 6BA csk. screws "C," the screws securing the rod handles through each clip. This arrangement has since proved its worth, using one bar for speaker and 'phone connections, and the other for earth, and as a commoning terminal for fly leads.—P. J. CHADWELL (Stoke Newington).

Improved Panel Lighting Device

TO obviate the necessity of obtaining and ganging extra switching for wave-change panel lights, I devised the following simple but efficient idea. Only one bulb and holder is needed, this being controlled by the on-off switching. The accompanying sketch is self-explanatory, but, briefly, this is the procedure.

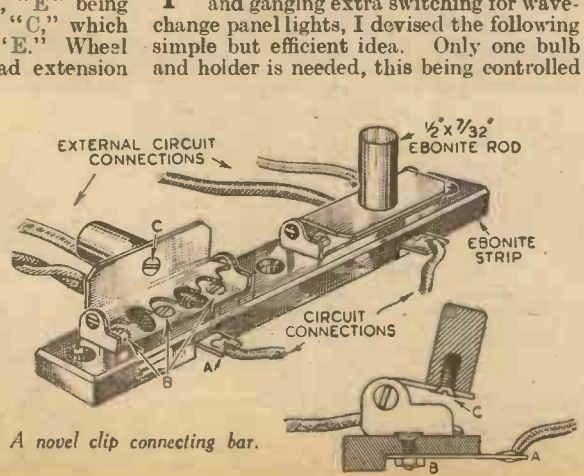
The shape of the mask is carefully scribed on sheet aluminium, and the position of the holes and slots are marked out. The next item is a small perforated wheel from a well-known constructional toy. This is drilled out to take a standard ¼in. spindle. The holes in the aluminium having been drilled, the slots are then made with the aid of a cold chisel. The shape is then cut out, and bolted to the wheel with three 4BA nuts and bolts.

Three slots are cut in the panel, and the words LONG, MEDIUM and SHORT are inserted on pieces of translucent material. The wave-change switch is remounted on a bracket set back from the panel, and the



A novel panel lighting device, using only one bulb.

aluminium mask inserted in between (see diagram). All that remains to be done is the final adjustment of the mask to illuminate the correct apertures at the appropriate band.—D. GUERIN (Lambeth).



A novel clip connecting bar.

Conversion For Small Shafts

IN our issue dated February 3rd we published a hint illustrating a method of adapting small shafts. Owing to a draughtsman's error the grub screw was shown on the wrong side of the packing piece. The shaft and the special V-shaped piece should be inserted into the collar of the drive in such a manner that the grub-screw bears on the shaft, not the adjusting collar. This will ensure that the shaft is held centrally in the bush or collar of the drive.

PRACTICAL TELEVISION

February 17th, 1940. Vol. 4. No. 190.

Colour Television

COLOUR television may seem a remote but pleasant anticipation when considered in the light of present-day restrictions, but during this lull period, slow but steady progress is being made towards that condition which will lift the television service on to an entirely different plane. It may have been overlooked that only about six months ago Mr. Baird gave the first demonstration of projected television pictures in colour using a cathode-ray tube as the picture-reconstituting device for back projection on to a translucent screen. One of the latest improvements is aimed at producing a better colour contrast between different objects, or coloured sections of the same object. A reference to the accompanying illustration shows the colour television camera, and it will be seen that the person being televised is flood-lit by carefully positioned spot-lights. The scanning system, which in this case is mechanical in form, is housed inside the padded and screened case mounted on the dolly truck, so that panning and tracking shots can be undertaken readily. Under normal working conditions it is found that if infra-red rays are present these tend to spoil the true colour contrast. It has been found, for example, that a blue surface may reflect almost the same proportion of infra-red rays as a red object, and the result, as far as the photo-electric cell is concerned, is that when transmitted to the receiving end of the system both colours would be reproduced as a kind of grey. To prevent this, quite a simple expedient is resorted to, namely, to insert a filter before the photo-electric cell. This filter is of such a character that both the ultra-violet and the infra-red rays are removed from the light reflected from the object being televised, and a closer approximation to the true colour contrast is obtained. Prior to the introduction of the mobile camera unit shown, colour television was undertaken by using spot-light scanning, and the scope of the subjects which could be televised was greatly restricted. There is no doubt that when conditions permit the next demonstration, material improvements will be recorded.

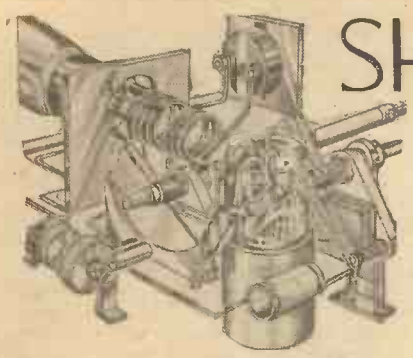
A Storage Effect

CONTINUAL effort is being applied to different schemes which have as their object the production of a storage effect either at the transmitting or receiving ends. That associated with the iconoscope type of camera is, of course, well known, and details are now revealed of one method which gives a form of storage with cathode-ray tubes for use at the receiving end. The main section of the equipment is, in appearance, like two flat faced cathode-ray tubes whose faces are fixed together so that separate electrode systems are positioned at the neck ends remote from each other. At the flat face juncture the glass is removed and a circular mosaic screen is mounted in position. The incoming television signals are applied to one end of this device so as to modulate the beam of electrons which is made to scan one side of the mosaic, and so build up a television picture on that face. Another electron scanning beam from the remote end of the tube is used to discharge the electron image, the resulting signal currents being fed to an amplifier coupled to any normal picture-reconstituting device. To give the storage effect, which is only existent for a period of time less than that taken for one frame scan, the line and frame scanning sections of this double cathode-ray tube are fed from pulses generated in a common time base generator. A phase shifter is inserted in the feed circuit, however, and by adjustments of a simple character the phase relationships between each pair of line or frame pulses can be increased or decreased at will. Picture discharge is, therefore, always lagging by any amount within limits on picture charge or the build up of the initial electron image. The action is therefore very similar to a gramophone or steel tape recorder, where the removal of the sound recordings becomes operative at some known time interval after the recordings have been made.

The mobile television camera used for colour transmission in which a better colour contrast is obtained by the use of filters.

An Improved Pick-up Device

SOME time ago details were given in these columns of a new television pick-up device which had been developed by the Radio Corporation of America, and named the Orthicon. In many respects this represented a radical departure from the iconoscope, and continued work is being applied to develop this device to a service standard. It is known that the relatively low efficiency and spurious signals present in the iconoscope can be traced to the fact that the signal plate or mosaic is operated at a high anode potential. These troubles have been removed in the Orthicon by arranging the mosaic to work at the cathode potential. This has naturally introduced many secondary problems, for it is obvious that the scanning beam of electrons will approach the signal plate at a very low velocity, while the number of electrons which actually strike the plate will be dependent on the degree of illumination of the optical picture focused on to the mosaic face. In the designs which have undergone development it was necessary to ensure that the electron beam reached the mosaic in a properly-focused condition, coupled with an absence of scanning pattern distortion and no focus alteration introduced by the scanning process. In this connection it is interesting to note that success was obtained by employing a magnetic field perpendicular to the target plate as is the case with the image dissector tube form of electron camera. Furthermore, special types of vertical and horizontal deflecting systems had to be devised so as to be capable of carrying out their correct functions in the immediate neighbourhood of a strong magnetic field. These new cameras have the distinct advantage that no spurious signals are present, as is the case with the standard iconoscope, while the signal-to-noise ratio is of the order of 300 to 1, a distinct advance on anything previously developed. The resultant signal is truly proportional to the light and shade of the optical image and is capable of resolution within the 400 to 500-line limit, although there is no doubt that this will be improved upon once it is decided to increase the line definition of radiated pictures so as to give greater detail, and permit big screen picture demonstrations of a large scale.



SHORT-WAVE SECTION

AN A.-W SUPERHET UNIT FROM SPARE PARTS

Some Alternative Suggestions for a Single-valve Converter for Use with H.F. — Det. — P. Broadcast Receivers

by The Experimenters

IF it is required to increase the range of a simple H.F.—Det.—L.F. receiver, by far the most satisfactory method is to add a unit which will convert the receiver into a superhet. There are various ways in which this can be done, and the additional unit can be of fairly simple design if there is no objection to using two separate tuning condensers. But if a superhet unit is to be made, it might just as well incorporate a short-wave tuning range, for this will not add very much to the complication of the unit.

A Basic Circuit

A basic circuit for an up-to-date unit of the type referred to is shown on this page. It will be seen that a triode-hexode frequency-changer is shown, but this could be replaced by a pentagrid or triode-pentode if preferred. Since a new valve will probably have to be purchased in any case, we suggest that the triode-hexode be used. This has certain advantages, especially for short-wave working, but it could not be used in battery sets until recently, because only mains models were available. There are now two types in the Osram range, and the X.24 is indicated in the circuit; this has a filament-current consumption of .2 amp., whilst the total H.T. current passed when using an H.T. unit of 120 volts will not exceed about 3.5 mA.

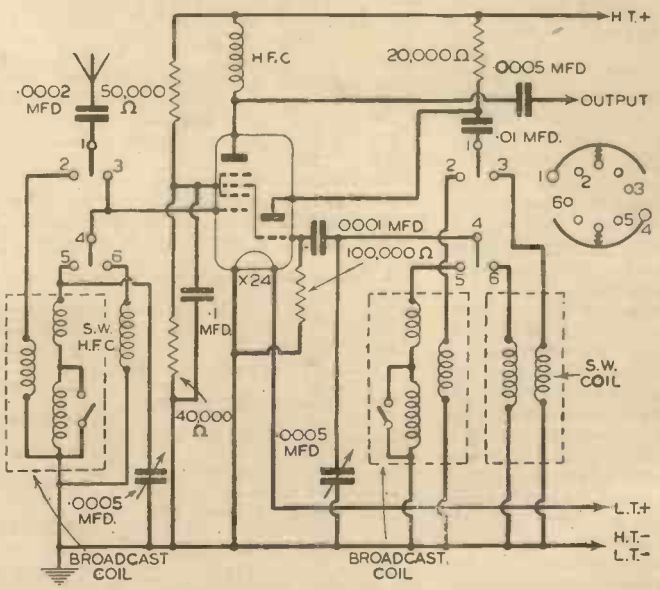
The I.F.

Since the object of the arrangement to be explained is to make use of existing components as far as possible, especial consideration must be given to the intermediate frequency. In general, we favour the use of 465 kc/s, but this cannot easily be employed when building a unit to work in conjunction with an existing broadcast receiver. The reason is that the H.F. valve of the receiver is to be used for I.F. amplification, and 550 metres is about the maximum wavelength that can be reached on the medium-wave band. The long-wave band usually starts at about 900 metres, whilst 465 kc/s is equivalent to approximately 650 metres. An intermediate frequency of 150 kc/s, on the other hand, is equivalent to 2,000 metres, the highest wavelength on the long-wave band

It is therefore a convenience to use 150 kc/s, unless one is prepared to increase the maximum wavelength on the medium-wave band by adding loading coils or parallel pre-set condensers. There is another advantage in using 150 kc/s, which is that an ordinary tuning coil with reaction can be employed in the oscillator circuit—preferably after slight modification. Thus, in the circuit shown, it is assumed that two standard tuning coils be used, along with a short-wave coil, of the four-pin plug-in type, and a S.W. high-frequency choke. The last-mentioned component is for use in the aerial-grid circuit on short waves. It gives aperiodic tuning, with the result that it is necessary to tune only the oscillator circuit. That effects a great simplification of tuning on short waves.

Tuning Circuits

The different coils shown in the diagram are enclosed by broken lines for ease of identification, and the general arrangement will be quite clear. Since the aerial circuit of the receiver will be pre-tuned to the intermediate frequency, tuned-grid coupling can be used. That explains the use of the ordinary H.F. choke in the anode circuit of the hexode section of the frequency-changer. Somewhat better results—due to sharper I.F. tuning—could be obtained by replacing this choke by a pile-wound coil consisting of about 250 turns of 32-gauge enamelled wire on a 2in. former. This should then be pre-tuned by means of a .0005-mfd. pre-set condenser wired in parallel with it. By using this system of tuning in the I.F. circuit we should obtain a band-pass effect similar to that provided by a good I.F. transformer. However, it will be realised that the two output or coupling arrangements mentioned are optional.



The basic circuit diagram and, inset, connections to one side of the S.212 rotary switch. Connections are duplicated on the other side.

Method of Use

To use the unit it is necessary only to transfer the aerial from the broadcast receiver to the appropriate terminal on the superhet unit, to connect the lead marked output to the aerial terminal of the set, and connect the battery leads to the corresponding leads inside the set. The L.T. leads could be joined to the terminals of a valveholder so that the switch in the receiver would also control the converter. Incidentally, the on-off switch in the receiver should be of the three-point type, due to the use of a fixed potentiometer to supply the screening-grid of the frequency-changer. If a two-point switch were used it should be replaced by a three-point one, of which one terminal should be wired to the earth line, another to L.T. — and the third to H.T. —.

Oscillator Coil

To ensure that the whole of the broadcast range is covered, it would be necessary to remove about 20 per cent. of the turns from the medium-wave winding, and about 50 per cent. of the turns from the long-wave winding of the coil used in the oscillator circuit; the reaction winding can remain unaltered. If a 150 kc/s oscillator coil were on hand, this could be used without alteration, of course, and that would be the most convenient arrangement.

Two separate tuning condensers are indicated, for a two-gang unit could not well be employed unless the aerial and oscillator coils were obtained as a matched pair. And 150 kc/s is not now used to any appreciable extent, so it is unlikely that new coils could be bought for this frequency. Some constructors may, however, have suitable coils available from an old receiver, in which case a gang condenser would be preferable.

Wave-change Switching

The most important practical point concerns the switching arrangement. It will be seen that two double-pole change-over switches are used to change from the broadcast coils to the H.F. choke and S.W. tuning coil. Toggle switches of the Q.M.B. type could be employed, but these are not ideal for wave-changing. The only other type conveniently available is the four-pole, four-way rotary switch. This is inexpensive and perfectly satisfactory if the coils are mounted fairly close together so that short leads can be taken to the switch contacts. Although, as stated, the type of switch suggested is a four-way one it can be used as a two-way simply by ignoring the centre contacts, and using the two end ones. A switch of this kind in the Bulgin range is List No. S.212; this is of the double-sided pattern and is used in conjunction with a snap locator unit and flat operating shaft. Connections are shown inset in the circuit diagram, and the connections can be followed by the figure references; it should be understood that these figures have no other significance.

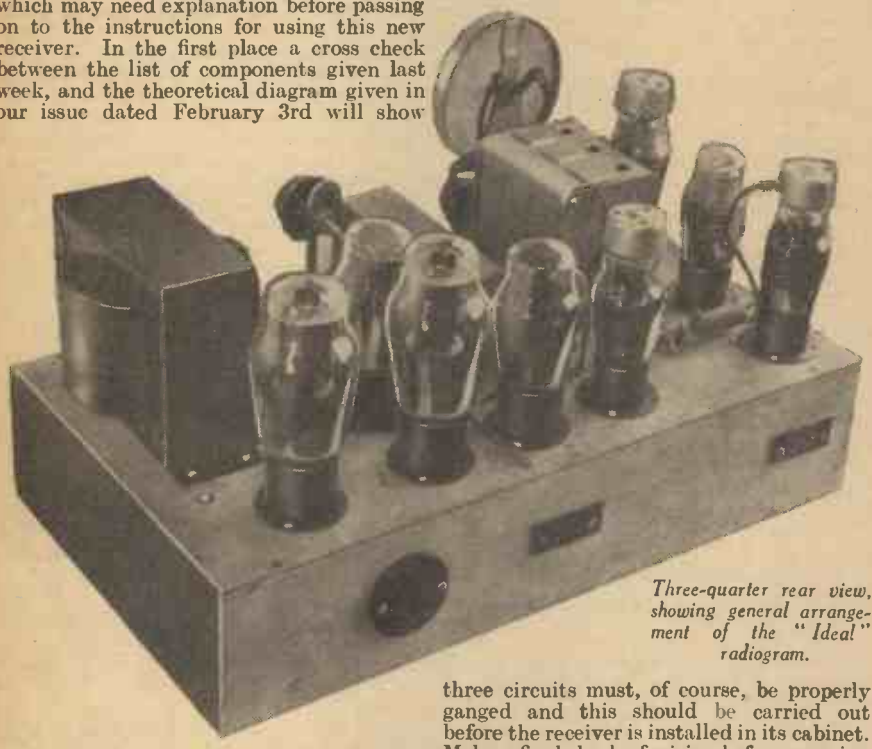
(Continued on page 465.)

The "Ideal" Radiogram

Notes on the Completion of the Receiver and Hints on Operating It

By W. J. DELANEY

LAST week the main constructional details and wiring plans were given, and there are just one or two points which may need explanation before passing on to the instructions for using this new receiver. In the first place a cross check between the list of components given last week, and the theoretical diagram given in our issue dated February 3rd will show that there is apparently a .0002 mfd. fixed condenser unaccounted for, and confusion between a .5 mfd. condenser in the list of parts and a 1 mfd. condenser in the theoretical diagram. The latter is marked C14 and is given as 1 mfd. although such a value does not appear in the list of parts. This condenser is not critical in value and any capacity from .1 mfd. upwards may be used. In the original model a 1 mfd. was included, and the artist illustrated the theoretical diagram with that value, but a .5 mfd. condenser is quite satisfactory, and thus was specified. There is a .1 mfd. condenser in the component list which may not be traced in the theoretical diagram, and this particular condenser may be omitted if desired. It has, however, been included in the wiring diagram in last week's issue but has not been given a reference number, as it is not in the theoretical diagram. It is connected between earth and the screening grid of the H.F. valve, and is only needed if the valve in question shows any sign of instability—which was not the case in the model as originally made up.



Three-quarter rear view, showing general arrangement of the "Ideal" radiogram.

Selectivity

With regard to the .0002 mfd. condenser mentioned, this will only be required if you are situated close to a main B.B.C. station, and normally experience some difficulty from the point of view of selectivity when searching for distant stations on wavelengths close to the local. In that case, the condenser should be included between the aerial lead, and the F terminal on the first coil. In all other cases the band-pass circuit provides adequate selectivity. The three circuits must, of course, be properly ganged and this should be carried out before the receiver is installed in its cabinet. Make a final check of wiring before carrying out the first test and when satisfied that everything is in order the loudspeaker may be connected. As already mentioned, a good speaker or combination of speakers should be used, and the output transformer should be chosen to match the valves to the speaker accurately. If a tweeter is used, this should be fed in the usual way from the two anode terminals of the transformer primary, through a small fixed condenser—the most suitable value being found by trial and error. Connect your mains to the appropriate pair of leads on the primary side of the mains transformer and, if desired, include a mains on/off switch in one of the leads, and mount it on the cabinet to avoid switching on the mains switch each time the receiver is wanted. When satisfied that all is correct connect aerial and earth and switch on. There will be no hum from the receiver, and if not tuned to a station you will probably be unable to ascertain at first when the valves have reached maximum emission. However, set the H.F. and radio L.F. gain controls to maximum and sweep round the dial. If you use the dial and condenser combination specified the North Regional setting (Home Service programme on 449.1 metres) will be found at 130 on the left-hand side of the dial. This should come in extremely loud, and it will be necessary to decrease volume by means of the H.F. or L.F. volume controls, or both. If the station is very close, then, to avoid distortion due to overloading the detector, the H.F. control should be adjusted, whilst for normal purposes the L.F. control should be operated.

LIST OF COMPONENTS

	£ s. d.
One 3-gang coil unit, type BP113 (Varley)	1 1 0
One 3-gang condenser, type 2122 (J.B.)	0 15 0
One airplane drive, dual ratio, type 2131 (J.B.)	0 6 6
One mains transformer, type SP352A (Premier)	0 13 6
One smoothing choke, type C150 185 (Premier)	0 11 6
Thirty fixed resistors (Erie): Two 150 ohms, One 2,000 ohms, One 1,500 ohms, Three 20,000 ohms, Three 50,000 ohms, Two 100,000 ohms, One 250 ohms, Two 5,000 ohms, One 15,000 ohms, Four 100,000 ohms, Four 250,000 ohms, One 500,000 ohms, One 1 megohm (1 watt type RMA8); One 150 ohms, Two 4,000 ohms (½ watt type RMA9); (5 watt type RMA0)	0 17 0
Eighteen fixed condensers (Dubilier): Two .0001 mfd., type 690W, One .0002 mfd., type 690W, Two .01 mfd., type 4601/S, One .05 mfd., type 4602/S, Three .1 mfd., type 4603/S, Three .5 mfd., type 4608/S, Two .1 mfd., type 950A, One 25 mfd., type 3016, One 50 mfd., type 3004, Two 8-16 mfd., type 3115	2 5 9
One .25 meg. volume control, type B (Dubilier)	0 3 6
One 1,000 ohm wire-wound potr., type VG.42 (Bulgin)	0 5 0
Two 1 megohm volume controls, type B (Dubilier)	0 7 0
Eight Octal chassis type valveholders (Clix) (X.218)	0 6 8
One 4-pin chassis valveholder (X.111)	0 0 5
Two 2-socket strips (A.E. and Pick-up) (Clix)	0 0 10
Seven component mounting brackets (Peto-Scott)	0 2 4
Two couplers, type 2005 (Bulgin)	0 0 6
*Two shaft rods, 9in. long x ¼in. (Bulgin)	0 1 0
Two Panel bushes, type 1048 (Bulgin)	0 0 6
One Junior H.F. Choke, type HF.8 (Bulgin)	0 3 0
One S.P.C.O. Switch S. 135 (Bulgin)	0 2 0
One .0003 mfd. reaction condenser (Polar)	0 2 6
Three top-cap connectors, type P.103 (Bulgin)	0 1 6
Eight valves—Triad Octal: One 6K7G, One 6C5G, One 6L7G, One 6C8G, One 6N7G, Two 6L6G, One 5V4G (Premier)	2 4 3
One wooden chassis 16in. by 9in. with 3½in. runners.	
Connecting wire, insulated sleeving, screened sleeving, screws.	

*One Loudspeaker.
*SEE TEXT.

THE "IDEAL" RADIOGRAM

(Continued from previous page.)

Record Reproduction

The three-gang condenser should then be adjusted by carefully manipulating the trimmers on top until the three sections are balanced, and stations may be tuned in at each end of the scale, preferably using the Home Service and the "For the Forces" broadcasts in order to obtain a good strong signal. As adjustments are made the signal strength should be reduced to a minimum by the L.F. control, so that accurate final settings may be made. The set may then be tested on records and a good pick-up should be used for this purpose. As built this arrangement is not suitable for a crystal pick-up, and a modification of the input arrangements would have to be made. However, with a good magnetic type of pick-up the signal strength will be sufficient to fully load the output stage and the gramo. volume control will have to be used, in conjunction with the normal L.F. control. This is because with some very loud records the input to the expander section may result in distortion due to overloading of the mixer valve, and thus one or two tests should be carried out to find a suitable position for this control, after which it may be left there and the normal L.F. control then used to regulate the output from the speaker.

Try first a really good symphonic record, or one which has considerable variations in volume. Set the expander control to minimum (maximum movement anti-clockwise) and note the results. This will be practically as the record would sound played with a straight type of amplifier. Now turn the expander control to maximum and play the record again. It should be immediately apparent that the contrast between loud and soft passages has been expanded, and under some conditions the loud passages, such as a climax on a full symphonic orchestra, might be too loud to listen to in the home, whilst the quiet passages on the same disc might be practically inaudible. Obviously this would be unsatisfactory, and thus the expander control will have to be set back slightly to reduce the degree of contrast. If the contrast as given by the set in its present form is not sufficient for your particular requirements, or an increase in volume is needed (due to the particular type of pick-up which is employed) the expander circuit may be modified by reducing the bias and delay voltage on the expander valve. For this purpose the two resistances, R21 and R22, will have to be modified, and on test it was found that the two values could be reduced to 200 ohms and 150 ohms respectively, without impairing quality or the effectiveness of the expansion action, but with considerable increase in volume. There is a delay action in the expander, of course, as otherwise the changes in contrast on a record would be too staccato and the music would sound jumpy. For those who are interested in this type of circuit and who wish to experiment in this direction, changes in the value of R22 and R30 may be tried. Finally, for those who wish to make up the receiver for use as a radiogram but without the expander circuit, all that is necessary is to rearrange the change-over switch so that the coupling condenser is on the other side of the switch, and the pick-up is then joined between earth and the gramo. side of the switch. In this way the pick-up will be switched across the normal L.F. gain control in the usual manner, and the receiver will then become a straightforward five-valve arrangement.

SHORT-WAVE SECTION

(Continued from page 463.)

Layout

In mounting the components, care need be taken only to see that valveholder, coils and S.W. choke, and the switch are placed close together. The aerial coil and S.W. choke may be placed side by side to the left of the valveholder, with the oscillator coils on the right. It would be best to mount the switch across the front of the set with the operating knob on the right of the baseboard or chassis. The two tuning condensers should be placed in front of the coils to which they are connected. To avoid instability the S.W. choke should be mounted horizontally (this can best be done by using a horizontal choke) and by employing a good screened choke or coil in the anode circuit.

It will be seen that the tuning condenser for the oscillator circuit has a capacity of only .0003-mfd., by comparison with the .0005-mfd. condenser used in the aerial circuit. This will cover the tuning range with the coils modified as mentioned above when using an I.F. of 150 kc/s. Both condensers should, for preference, have a slow-motion drive, but if drives of the double-ratio type are available so much the better. This simplifies tuning on medium and long waves, when both condensers have to be operated together. It will be found that tuning is not as difficult as may at first be expected, because stations can be received by tuning the oscillator circuit if the aerial circuit is brought roughly into tune. On short waves the aerial condenser is out of circuit and all tuning is carried out on the .0003-mfd. oscillator condenser.

It will be appreciated that the arrangement described is a basic one only, and that it would be impossible to give a complete design because this depends largely upon the exact components used. We do not suggest that a complete set of new components be bought for this unit, because if all new parts were to be bought they could better be employed in a circuit specially designed for them.

NEWS AND NOTES.

Lost Mails

THE Postmaster-General regrets to announce that certain mails for Denmark have been lost at sea owing to the sinking of the S.S. *Vidar*. The mails concerned included some of the letters and parcels posted in London and the Provinces on January 22nd and 23rd.

Big Response to Wireless Appeal

THE British "Wireless for the Blind" Fund has received £13,381 in response to the Christmas Day appeal by an "unknown blind man." This was the figure at the end of January, but further sums continue to arrive at the rate of about £12 a day. In expressing the committee's gratitude, an official of the Fund said that such generosity at such a time was highly significant. In spite of their own burdens, the public still wished to help their fellows who had a heavier load.

B.B.C. "Uncle" With R.A.F.

ONE of the members of the R.A.F. in France is the original "Uncle" of the B.B.C. Children's Hour when it was first started at Savoy Hill, London, the old studio headquarters, known as 2LO.

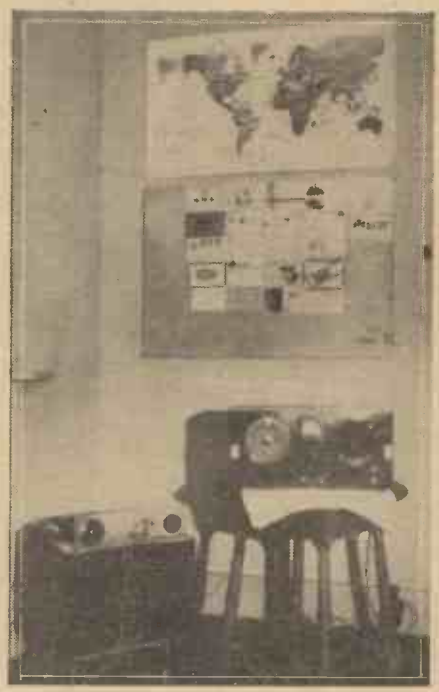
Open to Discussion

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).

A Fine DX Log from Dorking

SIR,—I enclose a photograph of my shack. The station has been in operation for just a year, and I did not take up short-wave listening seriously until a year ago. In this time all continents have been received and verified, and altogether 78 countries have been heard. My best QSLs include PK4JD, PY2BH, VU2FQ, VS7RA, HI3N, CO2JJ, VE1CR, VQ2PL, OK1SZ, and various Europeans. Altogether my QSLs and letter verifications amount to 26, and I am expecting a dozen or more from short-wave broadcast stations soon. The receiver is a Hallicrafters Sky Champion, an 8-valve communications type receiver. The antenna is an 18ft. vertical wire coupled with a Vee-beam directed on the U.S.A., which gives a gain of at least two R points when connected. I have a one-valve short-wave set as a stand-by receiver, which is a PRACTICAL WIRELESS circuit, and works very well. The latest DX heard include:

13-metre band, WCBX; 15.77 metre-band, HS6PJ, Bangkok, Siam; 16-metre band, WNB1 (very well received); 19-metre band, WGEA, TGWA (Guatemala City, Central America), WPIT, WCBX; 25-metre band, XGOY (I believe this station has returned to its old call after being XGX for some time), WCBX, MTCY (Manchukuo), WRUL (Boston); 29.24-metre band, PMN (Bandoeng, Java); 31-metre band, VLW2 (Perth, W. Australia), VLQ (Sydney, Australia), KZRH, Manila ("The Voice of the Philippines"), ZBW3 (Hong Kong), WGEO, VLR, CR7BE, Lourenco Marques, Mozambique (19.00-21.00), frequency 9.640 mc/s); 31-metre band, WCAB, WBOS, VUD3 (Delhi, India), TAP (Ankara, Turkey); 41-metre band, JVW (Tokio, Japan); 49-metre band, ZAA (Albania), CHNX (Halifax, Nova Scotia), VP3BG (Georgetown, British Guiana); 60-metre band, VUD2 (Delhi, India).



A corner of Mr. J. Greenwell's shack.

Exchanging QSL Cards

SIR,—Since this war began, at least, I have noticed that some readers' letters have been published in which they say they are willing to exchange QSLs with anyone, or SWLs for QSLs.

Does this mean that anyone who does a bit of listening on amateur bands, and who is keen on getting a collection of SWLs or QSLs can now do so by simply "swapping" cards? If this is so, the value of a SWL or QSL will rapidly disappear, even if it has not done so already.

Until I read these letters I always understood that a QSL or SWL was only obtainable when the station, where QSL is sought, has been legitimately received on a wireless receiver by 'phone or C.W.

This, as all genuine short-wavers know, is sometimes tedious work, especially when working on DX, and when a card is received it is prized to some extent, because it verifies without question the station it represents.

If, now, it is just a matter of begging of any amateur on earth to send his QSL by post on the promise of one in return, the value of a QSL is nil, and the whole spice of amateur work on DX is dead. If this goes on we shall soon see pictures of readers' "Dens" just covered with these cards when it may be quite likely that not a single station they represent has ever been received on the set we should undoubtedly see in the collector's "Den." Have they replaced the now absent cigarette cards, which boys are so fond of?

To my mind, as a genuine SWL, those who make requests for QSL by an exchange through the post, without having even heard them on a receiver, are a class by themselves, and should not be included as short-wave fans at all, but just "collectors" of cards, as one might collect stamps, cigarette cards, and tram tickets. In addition, their requests for exchanging cards should be printed in a boy's paper and not in a sensible and useful paper like PRACTICAL WIRELESS. I am in possession of VKs and ZLs obtained "lawfully" on my 0-v-2 battery receiver.—F. W. J. COOPER (Belmont, Middlesex).

[*Whilst we fully agree with the sentiments expressed above, it must be borne in mind that there are many people who collect QSL cards from the point of view of the collector, rather than as verifications of stations received. The artistic point of view of these cards is now fully realised, and some of them are extremely well produced, but they do not rank in a similar category to cigarette cards. On the other hand, the unscrupulous listener may, of course, collect the cards to create a false impression of the efficiency of his apparatus and his ability.*—ED.]

The Australian Broadcasting Commission have two more stations on the air. Sydney, VLQ (31-metre band) (frequency 9.61 mc/s), transmission Europe, 07.00-09.00 G.M.T., and Perth, VLW2 (31-metre band) (frequency 9.650 mc/s), around 16.00.

CR7BE, new station located in Mozambique, programme for Europe, 19.00-21.00. QRA, Radio Club de Mozambique, P.O. Box 594, Lourenco Marques, Mozambique, frequency 9.640 mc/s.

KZRH, "The Voice of the Philippines," is well heard from 14.00 G.M.T. until close down, 16.00 G.M.T. All announcements in English, request programme called "Nighthawk," 15.00-16.00 G.M.T. Reports should be addressed to KZRH, "The Voice of the Philippines," Manila, Philippines. Call is given as KZeeRH (American pronunciation of Z is Zee).

I should like to correspond with any short-wave listener in the world, and exchange QSL card.—J. GREENWELL, 7, Sondes Drive, Dorking, Surrey.

Logged at Leicester

SIR,—Other readers of your very fine paper may be interested in the following list of QSLs received since I first started as an SWL last February. All stations were received on an Eddystone AW2, and an indoor "T" aerial, 9ft. by 8ft.

W8XK, VK2ME, MTCY, TGWA, FET1, W1XK, VLR, XGOY, SP48, CHNX, W2XE, VUD2, HI1N, SP31, YV3RD, W4XB, OAX4T, TAP, SP19, HAAQ2, W3XAU, LRA1, TAQ, SPD, VONG, W6XBE, JZK; CXA6, TJF, and others.

Anyone who lives near me would be made welcome if they called, and all letters will be answered.

As you can see, I only want a QSL from Africa to qualify for my ACR certificate.—T. H. PLATER, 14, Littlegarth, Saffron Lane, Leicester.

Prize Problems

PROBLEM No. 387.

DICKSON had a three-valve battery set which, although it gave good results, was not sufficiently selective to enable him to receive distant stations on wavelengths close to that of the local. He therefore decided to fit a wavetrap, and found a spare two-gang screened coil unit in his spares box. This was perfectly in order, and he selected the terminals corresponding to the grid winding of one of the coils and connected a .0005-mfd. condenser (variable) in parallel with this, joining the aerial to one side and the other side was connected to the aerial terminal of his set. He switched the coil unit to medium waves, and to prevent any interaction or instability he connected the screens of the unit to earth. He then switched on, but found that he could not obtain any signals, not even the local. The coil unit was faultless and correctly connected to the receiver. What was wrong? Three books will be awarded for the first three correct solutions opened. Entries must 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. 387 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, February 19th, 1940.

Solution to Problem No. 386.

The grid-bias battery in Melborne's receiver had run out, and consequently the use of higher H.T. only increased the distortion.

The following three readers successfully solved Problem No. 385 and books have accordingly been forwarded to them: R. Proctor, 8, Chilcott Road, Watford, Herts; W. Tozer, 15, Bramble House, Devons Road, Bow, E.3: R. J. Carter, c/o, La Chine, West Coker Road, Yeovil, Som

THE POWER AMPLIFIER IN PRACTICE

(*Continued from page 456*)

becomes more marked as compared with the "Class A" condition. This is the reason for the introduction of triodes of very low impedance, such as the PX25A type, higher impedance triodes of similar operating anode voltages not being capable of the same proportionate increase in maximum power.

Pentodes or tetrodes may be used as successfully as triodes under these conditions, but with both triodes and pentodes an essential is that the valves must be capable of enough cathode emission to enable them to be driven into high peak currents with full signal applied to the grid. The large variation between "no load" and "full load" anode currents usually calls for a low resistance power supply—that is, one with good regulation—and the greatest benefits are only obtained with fixed grid bias, although automatic bias is often used for economy's sake, giving a reduction in maximum efficiency. (Fig. 6.)

3. Class "AB2"

This may be taken to include both zero bias Class "B" and the biased type, since in both methods the grid is driven positive by the signal voltage. The biased system can often make use of the same type of valve as for Class "AB1," provided it is tested by the makers to withstand more or less heavy grid currents without overheating and other detrimental effects. The zero biased system may be said to have an advantage in that it saves the necessity for providing a grid bias arrangement, but set against this is an increased difficulty of overcoming parasitics and distorted wave forms.

A necessity for all positive drive conditions is an adequate power input to the grid. It must be remembered that under Class "A" and "AB1" conditions the grid requires *voltage* only, and the previous valve in the amplifier need only be a voltage amplifier with suitable coupling to match its anode circuit. When Class "AB2" positive grid conditions are applied, a "driver" valve is required in the previous stage to provide power and should therefore be of low impedance; further, the coupling must be such as can transfer that power to the output valve grid. The design of coupling transformer if used, is therefore of great importance, or a "rasping" distortion (sometimes called "Class 'B' jangle") is introduced due to oscillation at the point at which grid current ceases to flow. Again, unless the impedance of the "driver" stage is very small, harmonic distortion results, and the point at which grid current commences to flow is very apparent to the ear. To overcome these two effects in large Class "AB2" amplifiers the drive circuit is often coupled to the output valves by means of chokes, or carefully designed transformers in the driver cathode circuit. Such a circuit in simplified form is shown in Fig. 8.

There remains the question as to choice of triode or pentode (including power tetrodes with pentode characteristics) for the power stage. The subject of this is best left for the concluding article.

(*To be concluded.*)

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.

SLOUGH AND DISTRICT SHORT-WAVE CLUB

Headquarters: Toc H Headquarters, William Street, Slough, Bucks.

Secretary: K. A. Sly (G4MR), 16, Buckland Avenue, Slough.

Meetings: Alternate Thursdays at 7.30 p.m.

AT the meeting held on January 18th, 1940, the chief item of interest was a talk by Mr. Houchin (G3GZ) on Aerials. He illustrated the principle of resonance by means of a light rope, showing in turn one, two and three half-waves. This was followed by a very lively discussion on current and voltage distribution in the Hertz antenna.

Due to the bad weather conditions, the next meeting was an informal one. Mr. Baldwin (2BWV) put forward an interesting theory that the earth forms the rotor of a dynamo of which the ionised layers form the stator. This theory was discussed, but no general agreement was reached. There was also a discussion on the nature of electro-magnetic waves, and other types of radiation. The next meeting is to be held on the 15th of this month.

BRITISH SHORT-WAVE LEAGUE

Hon. Sec.: F. A. Beane (2CUB), Ridgewell, Halstead, Essex.

Hon. Publicity Manager: G. Musk (2FPA), 449, Central Drive, Blackpool.

AFTER slight adjustments to meet war-time conditions, such as the evacuation of certain departments to "Somewhere in England," the club has again settled down to its normal routine. The club magazine which is issued monthly gives news on short-wave broadcast and amateur stations, calls heard, and many other items. Two of the main features are the QSL Bureau and the "Comforts Scheme." The latter is an original idea of our members to see that all our serving members are kept supplied with cigarettes, etc.

Very handsome certificates are issued by the League for the following DX feats: number of countries verified, heard all continents, and for the verification of the British Empire, which at the present time is a certificate worth treasuring.

The war-time subscription to the League is 4s. per year, or 2s. per half-year, which, considering all the benefits derived, is most reasonable.

LATEST PATENT NEWS

Group Abridgments can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, either sheet by sheet as issued on payment of a subscription of 5s. per Group Volume or in bound volumes price 2s. each.

Abstracts Published.

WIRE TERMINALS.—Disney, A. L., and Belling and Lee, Ltd. No. 503084.

A terminal for a flexible wire is formed by bending half-round metal strip to a U-shape (Fig. 1) and compressing the closed end of the U to form a circular stem 5 which is screw-threaded. The stud is screwed into an insulating hexagon-headed cap 10 having a transverse hole 13 in which the wire is clamped by the stem.

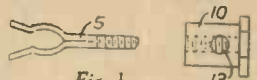


Fig. 1.

MAKING ELECTRIC CONDUCTORS.—Chiffey, E. No. 505935.

A method of making a connecting lead, more particularly for condensers and resistances for wireless apparatus, comprises forming a head or enlarged portion 2, 3 (Fig. 2) on the end of a length of wire 1 and then flattening the head to form a connecting lug 4. The flattened ends may be annealed if brittle and the leads are preferably tin-plated to prevent corrosion and facilitate soldering.

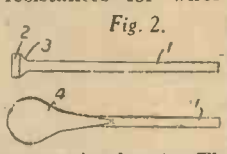


Fig. 2.

SOUND-REPRODUCING APPARATUS GRAMOPHONES.—Fabbrica Italiana Magneti Marelli. No. 504418.

A portable sound-reproduction equipment comprises casings A, B (Fig. 3) independent of a suit-case C, which include a loudspeaker and valve amplifier and are so shaped that one of the casings forms a cavity for the accommodation of members projecting from the other casing when the casings are placed on the case C. Both casings are formed with compartments for housing accessories. The casing A including the loudspeaker 2 (Fig. 4) is constituted by a box 1 provided with hinged shutters 7 forming a space for a turntable 15 and gramophone records and formed with a recess for enclosing a gramophone pick-up 10 mounted on the upper surface of the casing B containing the amplifier. The box 1 has compartments 4, preferably provided with shutters 5, which form storage spaces for equipment, such as a microphone, and which communicate with the space at the rear of the loudspeaker 2 through holes 6 (Fig. 5). The casing B enclosing the amplifier is formed with a compartment 17 for housing additional accessory equipment, and the pick-up 10 is held clear of the top surface of the casing during transport by means of a pin 14 which engages in an inclined slot 13 (Fig. 6) formed in a bracket 12 (Fig. 7) fixed to the top surface of the casing B.

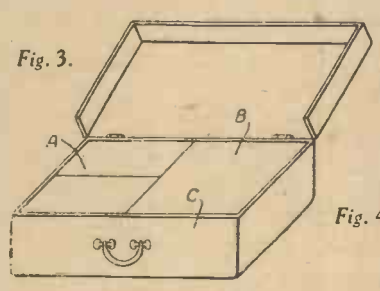


Fig. 3.

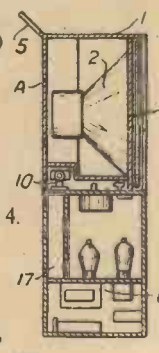


Fig. 4.

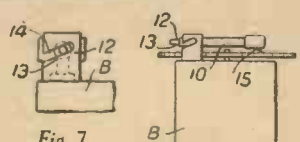


Fig. 6.

Fig. 7.

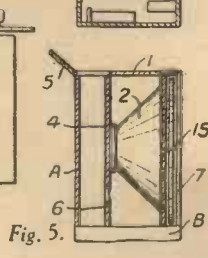


Fig. 5.

LOUDSPEAKERS.—Leevers, F. N. G. No. 506042.

A loudspeaker cabinet has one or more flared passages extending from the back of

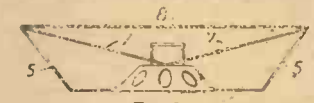


Fig. 8.

the diaphragm of the loudspeaker unit in a direction substantially at right angles to the axis of the diaphragm which passes therethrough at right-angles to the plane of the periphery of the diaphragm. As shown in Fig. 8, the cabinet having front and back walls, 1, 8 is provided with vertical partitions 7 forming passages from the rear of the diaphragm to apertures 5 in the side walls of the cabinet. In a modification (Fig. 9), the partitions 7 are inclined to the vertical and passages terminate in openings 5 in the top and bottom walls of the cabinet which has a horizontal cross-section of triangular shape. In a further modification the loudspeaker is mounted near the base of the front wall of a cabinet having sides which diverge upwardly and provided with an opening in the top wall.

Fig. 9.

NEW PATENTS

These particulars of New Patents of interest to readers have been selected from the Official Journal of Patents and are published by permission of the Controller of H.M. Stationery Office and the Official Journal of Patents can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- weekly (annual subscription £2 10s.).

Specifications Published.

517068.—Marconi's Wireless Telegraph Co., Ltd.—Radio receivers.

516993.—Automatic Telephone and Electric Co., Ltd., Taylor, R., and Baker, G. T.—Broadcast diffusion systems.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at the uniform price of 1s. each.

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	PW68
PORTABLES		
Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen)	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	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	—	AW444
150-mile Crystal Set	—	AW450
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans.)	—	AW388
Full-volume Two (SG, det, Pen)	—	AW392
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.

A New Record Material

AS is well known in the resin record industry, commercial gramophone records are pressed from the resins, either natural or synthetic, while they are in plastic form, and various fillers and plasticizers are incorporated therein in order to control the consistency thereof and to impart wear resistance to the record. Among the fillers most commonly employed are slate, various clays, certain metal oxides, and silicates, etc., all of which are relatively coarse, and therefore result in high surface noise when the records in which they are incorporated are played. Also, many of the fillers heretofore employed are comparatively so coarse as to impart to the records which include them relatively short life.

Titanium Dioxide

It has recently been discovered by the R.C.A., however, that these disadvantages can be overcome by incorporating into the resin moulding composition one or more compounds of titanium. It is found that very fine titanium dioxide, when used as a record compound filler, imparts an extremely low surface noise to the finished record and also produces a record with exceptionally long-wearing properties. Further, lead titanate may not only be used as a filler, but also as an excellent stabiliser in moulding compounds, made especially from vinyl resins which have been made of polymerised vinyl halides, such as vinyl chloride. Such resins are comparatively easily decomposed by heat, and in the decomposition thereof, where vinyl chloride forms the resin base, hydrochloric acid gas is given off. The hydrochloric acid gas acts as an accelerator and hastens the further decomposition of the resin. Lead titanate, when added to a resin of this type, readily reacts with the hydrochloric acid gas to form insoluble and relatively unreactive lead chloride. In addition to acting as a stabiliser, it was found that it also acts as an excellent filler when used in extremely fine particle size. Large quantities of this material may be used as a filler, and this, of course, enhances its stabilising value in contrast to calcium stearate and lead stearate, only small quantities of which may be employed because of the plasticizing action of these.

Both titanium dioxide and lead titanate may be readily obtained on the market and, for best results, should be of a particle size of not over approximately one micron in the greatest dimension. Preferably, the particle size should be between 0.1 and 0.5 micron. Any suitable resin may be employed as a base for the record material, such as shellac, phenolic resins, vinyl resins, resins derived from acrylic acid and its derivatives, urea resins, etc., as may other compositions which become plastic under the action of heat, either with or without pressure, such as cellulose acetate or cellulose nitrate. Examples of typical formulas are as follows :—

FORMULA I.

Vinyl resin..	90 lb.
Titanium dioxide	61 ,,
Carbon black	25 ,,
Calcium stearate	1 ,,
Carnauba wax	1½ ,,
Chlorinated naphthalene ..	4½ ,,

FORMULA II.

Vinyl resin..	90 lb.
Titanium dioxide	50 ,,
Lead titanate	10 ,,
Chromium oxide	5 ,,
Carbon black	25 ,,
Calcium stearate	1 ,,
Carnauba wax	1½ ,,
Chlorinated naphthalene ..	4½ ,,

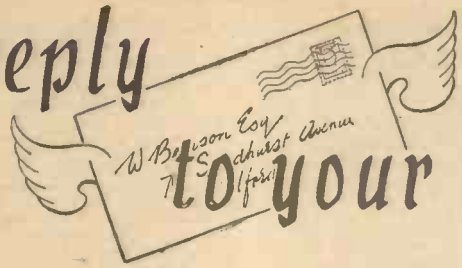
Materials having the above and other similar formulas may be readily compounded on rolls, as used in the production of rubber compounds, for example, or they may be made in a Banbury mixer. It has been found that up to 75 per cent., by weight, of titanium dioxide may be used to advantage, and that from approximately 1 per cent. to over 50 per cent., by weight, of lead titanate may be successfully used.

Varying the Ingredients

Of course, the above formulas are merely illustrative and the particular ingredients employed and their percentages of these materials can be varied. Not only can the resin base be varied, but also the specific plasticizers and mould lubricants may be varied. Furthermore, in place of titanium dioxide, other oxides of titanium, such as titanium sesquioxide or titanium peroxide, may be employed, and in place of lead titanate, it is possible to employ calcium titanate, magnesium titanate, or the like. These materials may be employed alone as fillers, or, if desired, additional fillers, such as barium sulphate, chromic oxide, iron oxide, calcium carbonate, Sienna filler, or any other suitable fillers may be employed also, depending upon the nature of the resin employed. As a stabiliser, lead titanate may be used alone or together with a small amount of suitable stearate.

When writing to Advertisers please mention "Practical Wireless"

In reply to your letter



Loudspeaker Switching

"My home-made set has a standard output circuit, with a speaker mounted inside the cabinet. Owing to the weather we have been using the set in another room, and I have found some little difficulty in arranging the extension speaker for use in this room. I have to disconnect the speaker and connect up the other, and I should like a plug-in arrangement. I seem to remember seeing such a scheme illustrated in one of your back issues, and I should be glad if you could give me the date so that I could order the issue."—H. E. T. (Hornsey).

WE think you refer to the standard Clix Loudspeaker Control panel, which is a small insulated panel carrying sockets and a two-pin plug. The output circuit is wired to the contacts on the panel and the extension speaker is wired to the two-pin plug. This is movable, and when in one position the internal speaker is in circuit, and by merely sliding the plug the extension speaker is brought into action. This component costs 1s.

Tuning Dials

"I am using an old set in which I have a fairly large dial marked only in degrees. I often get stations which I cannot identify for certain, and I wonder if it is possible to get hold of one of the large scales like the big set makers fit to their sets. If so, could you tell me a firm which will supply me? I am really only interested in the medium wave-band."—L. A. P. (Harrogate).

IT is possible to purchase a number of dials with station names, in addition to dials as used by set makers. The latter are obtainable from firms who specialise in manufacturers' surplus. The only point is that all these dials are obviously designed for use with a certain type of variable condenser and coils of a definite inductance value. If the combination is not correct then the dial indications will be useless. Provided, therefore, you know the inductance of your coils and the law followed by the condenser in use, you should be able to obtain suitable dials. Failing this, the only solution is to purchase new coils and condenser with a dial to suit from firms such as Polar, J. B., etc.

Cabinet Resonance

"I have been using one of your receivers for some time, but there is a point which I am not very satisfied with. When the announcer is speaking there is an unnatural deepness about the voice, and this has now become uncomfortable. I should like to remove it, but do not know whether to use any particular tone control arrangement as I do not want to spoil the musical quality, which is quite satisfactory."—P. C. (Herne Hill).

WE would point out that if speech is boomy, due to faulty circuit or cabinet design, then music must also suffer from the same trouble. You probably prefer a "round" tone to music and do not notice the effect, which is obviously more noticeable on speech. However, there are one or two announcers whose voices are naturally deep, and this may be only slightly accentuated on your equipment. The most likely cause of the trouble is cabinet resonance, due to the use of a cabinet which is too small, or which is too deep or boxy. One way of overcoming the trouble, if you do not wish to obtain a new cabinet, is to line the existing cabinet with felt and if possible pack it with kapok or similar material. Alternatively you may find the desired results may be obtained by cutting holes in the back, if a back is used, or by moving the cabinet further from the wall if the back is open.

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.

Fuses

"I have just finished my first home-built set, a 5-valver built from your designs. I am extremely pleased with this, and before installing it in a new cabinet and making it a permanent installation, I should like to fit it with fuses. You did not specify any, and I want to avoid any risk of blowing the valves. If possible, I would like the fuses to be part of the battery, rather than try and fit them on the set, as there is not a lot of room and it will be rather awkward to get at when the set is in the cabinet. Please let me have your recommendation."—K. F. (Walsall).

NORMALLY it is only necessary to include a fuse between the H.T.—lead and the receiver. It is possible to purchase small wander-plugs carrying a fuse to avoid fitting a fuse-holder on the set, and one of these should prove suitable. You can also obtain small fuse-plugs which may be mounted on the panel, and these permit a fuse to be removed and replaced without removing the set. In addition to the fuse in the H.T. negative lead you might also desire to protect the valves from accidental short-circuit across the G.B. battery and filaments, and for this purpose a fuse in the G.B. positive lead may also be included.

Measuring Condenser Capacity

"I have a number of old fixed condensers in my spares box, but unfortunately the majority of them have no markings, or they have become defaced. What is the easiest way of finding their value?"—C. R. (Milford).

ACTUALLY a bridge is necessary in order to find exact condenser capacities, but you can probably find the values of your components by simple replacement tests in a standard receiver. For instance, if you connect a fixed condenser of known capacity in parallel with your tuning condenser and then tune to a given station, upon replacing the known fixed condenser by an unknown the variation in the tuning setting may give you an indication as to the value. Or you may find its exact value by this substitution method. If you wish to build a good bridge for measurement purposes you will find a suitable design in our Service Manual.

Resistance Rating

"I have a resistance of 900 ohms which from its size would appear to be a 1-watt component. I wonder if you could tell me the maximum current rating for this. Does it mean that the current which may be passed should not exceed a value which will cause such a voltage drop that this, multiplied by the current, will give one watt?"—K. W. (Belfast).

YOUR method of working out the current is quite correct, and in the case of a 900-ohm 1-watt resistor the maximum current would be 34mA. This would produce a maximum voltage across the ends of 30 volts. These figures are, of course, approximate to the nearest whole number.

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.

P. J. H. (Clonakilty). The mains aerial as mentioned is perfectly standard. The mains wiring acts as the aerial pick-up device. A.C. is regarded as double the equivalent D.C. for the test purposes mentioned.

N. B. (Clifton). Write to the Premier Supply Stores whose advert. appears in these pages.

S. D. (Bideford). We have no details of the coils which were produced specially for a receiver designed by a contemporary not now on the market.

R. C. C. (Shrewsbury). Normally, there is no risk. The point is, however, that in view of lightning striking a set there might be some danger, and with a mains set arcing might take place at a joint.

T. D. C. (Shiplake). There is no book, but a collection of the catalogues of various valve manufacturers will assist you in comparing the various types.

D. W. F. (Falkirk). The lead in question carries a resistance and the heat is a normal function. You must on no account dispense with it or try substitutes.

W. H. D. (Highworth). We have no details of the coils. We think, however, in view of their origin, that they would be unsuitable for incorporation in the circuit in question.

D. J. W. (Cardiff). Premier Supply Stores may be able to supply you.

G. P. N. (Dun Laoghaire). We would suggest one of our blueprints, kits for which are obtainable from Premier Supply Stores or Peto-Scott.

E. G. (Horwich). A kit may be obtained from T. W. Thompson, of 176, Greenwich High Road, S.E.10.

J. A. W. (Wolverhampton). We do not know of any firm now selling the items mentioned, as these are obsolete. You could use any modern combination in the set in question.

H. V. (Wokingham). Two 9-volt G.B. batteries in series will be quite in order.

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

Notes from the Test Bench

Another Soldering Hint

SOME constructors experience difficulty in picking up the right amount of solder to make a sound joint, too little making the joint insecure, and too much making an untidy joint. One way to avoid this is to hold the solder in one hand and the iron in the other and apply both to the joint until the desired amount flows, but it is not always possible to use both hands in this way. A good idea is to hold the solder against the hot iron over a stone floor or well above a sheet of metal and let the solder drop down on to it. The drops will flatten out and form thin discs which may be picked up easily and wrapped round the joints or places which are to be soldered, and owing to their thinness they melt rapidly when the iron is applied and run to form a really neat joint.

Pick-up Counterbalance

SOME pick-ups of old make, whilst giving very good results, may be found to be unduly heavy and this wearing the records out quickly. One way of overcoming this is to fit a counterbalance. A threaded rod is attached to the carrier arm and extends beyond the pivot point at the rear, and a threaded weight is then screwed on the rod and adjusted so that the pick-up bears lightly on the record. An alternative scheme is to fit a spring to a threaded rod at the projecting part of the rear of the carrier arm and attach the other end of the spring to the fixed mount of the pick-up arm. The threaded rod is provided with a nut which may be adjusted to put the spring under tension and provide the desired lift to counterbalance the pick-up head.

Screening a Valve

IT is not often realised that interaction can take place between the electrodes of a valve and other valves or components, and it is for this reason that valves are metallised or screened. Some constructors have endeavoured to screen unmetallised valves by using old tins over them but these may introduce trouble on account of the fact that they are made from iron. Aluminium valve screens may be obtained from 1s. upwards, according to design, and these are easily fitted and provide perfect screening without the introduction of other troubles. For screening the top cap of metallised valves smaller screens may be used and these clip on the valve cap. They cost about 6d. each.

Classified Advertisements

Advertisements are accepted for these columns at the rate of 2d. per word. Words in black face and/or capitals are charged double this rate (minimum charge 2/- per paragraph). Display lines are charged at 4/- per line. All advertisements must be prepaid. All communications should be addressed to the Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, Strand, London, W.C.2.

RECEIVERS, COMPONENTS AND ACCESSORIES

SOUTHERN RADIO'S BARGAINS.

ALL GUARANTEED. POSTAGE EXTRA.

5/—Parcel of useful Components, comprising Condensers, Resistances, Volume Controls, Wire, Circuits, etc. Value 25/-. 5/- per parcel.

15/—Service Man's Component Kit. Electrolytic Condensers, Volume Controls, Resistances, Tubular, Mica, Paper Condensers, Valve Holders, etc. 120 articles contained in strong carrying case, 9" x 7" x 7", 15/- the Kit.

21/—Small Trader's Parcel of Components. 150 Articles comprising all types Condensers, Valve Holders, Resistances, Chokes, Coils, Wire, etc. Value 85/-. 21/- the parcel.

5/—100 Wire-end Resistances, assorted capacities, ½ and 1 watt, 5/- per 100.

ORMOND Loud-speaker Units, 2/6; Crystal Sets, 5/6; Westectors Type W2, 2/6; 8 mfd. Electrolytic Condensers, 500 volts, 1/8. Crystal Detectors, 2/-; Crystals, 6d.; Marconi V24 Valves, 9d.

2/—Tool or Instrument Carrying Cases, ex Government Stock; Wood, 9" x 7" x 7", 2/-.

SOUTHERN RADIO, 46, Lisle Street, London, W.C. Gerrard 6653.

VAUXHALL.—All goods previously advertised are still available; send now for latest price list, free.—Vauxhall Utilities, 163a, Strand, W.C.2.

5/- **BARGAIN PARCEL comprising Speaker Cabinet,** Drilled steel Chassis, condensers, resistances and many other useful components. Worth £2. Limited number. Postage 1/-.—Bakers Selhurst Radio, 75, Sussex Road, South Croydon.

ARMSTRONG

Apologise for delay in delivery of some models, this unfortunately has been unavoidable owing to the present great difficulty in obtaining raw materials. However, we are pleased to announce that we are now in the position to give immediate delivery of our popular model, AW38, illustrated below.

MODEL AW38. 8-valve All-wave Superheterodyne chassis. This All-wave Radiogram chassis has resistance capacity coupled push-pull output capable of handling 6 watts, and gives good quality reproduction on both radio and gramophone, for an economical price of 8 gns. Plus 5% war increase.

Armstrong Push-pull Speaker to match AW38 chassis, £1 : 1 : 0. Plus 5% war increase.

We suggest Model AW38 together with matched speaker at £9 : 9 : 0, plus 5% war increase, complete, represents the most outstanding value on the market to-day.

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ARMSTRONG MANFG. Co.
WARLTERS ROAD, HOLLOWAY, LONDON, N.7.
(Adjoining Holloway Arcade)
'Phone NORth 3213

RECEIVERS, COMPONENTS AND ACCESSORIES

BANKRUPT BARGAINS. Brand new 1939 models, makers' sealed cartons, with guarantees, at less 40 per cent. below listed prices; also Midgets, portables, car radio. Send 1½d. stamp for lists.—Radio Bargains, Dept. P.W., 261-3, Lichfield Road, Aston, Birmingham.

COULPHONE RADIO, 22, Grimshaw Lane, Ormskirk. Collaro A.C. Gramophone Motors, 12in. turntable, 25/-. Midget and Portable Receivers. 1½d. stamp list.

BANKRUPT BARGAINS. Good stock of new receivers, Mains, Battery portables. Keenest prices. Please state requirements. Full stock of valves, battery, mains, and American types.—Butlin, 6, Stanford Avenue, Brighton.

LOUDSPEAKER REPAIRS

LOUDSPEAKER repairs, British, American, any make. 24-hour service, moderate prices.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

REPAIRS to moving coil speakers. Cones/coils fitted or rewound. Fields altered or wound. Prices quoted, including eliminators. Pick-ups and speaker transformers rewound, 4/6. Trade invited. Guaranteed satisfaction. Prompt service. L.S. Repair Service, 5, Balham Grove, London, S.W.12. Battersea 1321.

NEW LOUDSPEAKERS

3,000 SPEAKERS from 6/6 each, P.M. and energised 4in. to 14in., including several Epoch 18in.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

CABINETS

A CABINET for Every Radio Purpose.

SURPLUS Cabinets from noted makers under cost of manufacture.

RADIOGRAM Cabinets from 30/-.

UNDRILLED table, console and loudspeaker cabinets from 4/6.

INSPECTION Invited.

H. L. Smith and Co., Ltd., 289, Edgware Road, W.2. Tel.: Pad. 5891.

COMMUNICATION RECEIVERS

THE famous HALLICRAFTER SX23, released by the makers only in July, 1939, can still be supplied by Webb's Radio at
PRE-WAR PRICES.
We fortunately had good supplies delivered in August. NO price increase on present stock of this model only, £33 10s., H.P. terms available. Write for descriptive booklet.—P. Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

RADIO MAP AND GLOBE

WEBB'S RADIO MAP of the World enables you to locate any station heard. Size 40" by 30" 2-colour heavy Art Paper, 4/6. Limited supply on Linen, 10/6. WEBB'S RADIO GLOBE—superb 12" full-colour model. Radio prefixes, zones, etc. Heavy oxydised mount. Post Paid, 27/6.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

MORSE EQUIPMENT

FULL range of Transmitting Keys, Practice Sets, Oscillators, Recorders and other Radio Telegraph Apparatus, designed and manufactured by T. R. McElroy, World's Champion Telegraphist. Sole distributors: Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

MORSE TRAINING

WIRELESS CODE COURSES. "Book of Facts" Free.—Candler System Co. (L.O.), 121, Kingsway, London, W.C.2.

COMPONENTS FOR SALE

SCRAP your H.T. battery with Mallory vibrator converter, 6/12v. 150v, 30m.a., 18/9; listed £5/5/0. Or Genemotor, 12v, 250v, 50m.a., 25/-. Postage 1/3.—Aeronautical Radio, 47, River Road, Littlehampton.

MAINS TRANSFORMER DESIGN— See page 474

A NEWNES PUBLICATION

Practical Wireless and PRACTICAL TELEVISION

3D. EVERY WEDNESDAY

Edited by F. J. CAMM

Vol. 15. No. 388.

Feb 24th, 1940.

Contents

Practical and Wireless
PRACTICAL TELEVISION
EVERY WEDNESDAY
Vol. XV No. 388. Feb. 24th, 1940.
EDITED BY F. J. CAMM
Staff: W. J. DELANEY, FRANK PRESTON, H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Valve Testers

MANY listeners use their receivers year after year and never give a thought to the question of valve life. Modern valves operate so well that in many cases they will give years of satisfactory reception, but if a valve which has been in use for a considerable time is checked properly it may be found that it has deteriorated and the replacement of a set of valves might rejuvenate many a receiver. The gradual deterioration is not noticed as a rule, and many receivers are thus failing to give the results of which they are capable. Many dealers have a small type of valve tester which, on plugging in a valve, indicates the condition of it—weak, good or replacement. This alone is sufficient, but the real experimenter or amateur serviceman is interested in ascertaining the exact characteristics of a valve and for this purpose a properly designed valve tester is necessary. This will give the various anode current readings with varying H.T. and G.B. voltages; will indicate the amplification factor, goodness factor and other details, but is obviously not a very simple instrument. A set of valveholders must be incorporated so that any desired type of valve may be instantly tested, and in this issue we describe the first part of such a combined instrument, which is built in three sections. Most of the necessary apparatus will be found in the average spares box and the complete installation will be found of great value to the serious experimenter.

G.E.C. and "Graf Spee"

AT the request of the British Embassy at Buenos Aires, the Anglo-Argentine General Electric Co., Ltd., has loaned a G.E.C. radio receiver to British sailors who are in hospital there recovering from wounds received while on board H.M.S. *Achilles* during the recent battle with the *Graf Spee*.

War Cabinet Speakers

THE Prime Minister will broadcast to the country on February 24th from Birmingham Town Hall, closing the series of speeches made up and down the country by members of the War Cabinet.

Command Performance for Children

THE Scottish Children's Theatre Company of Bertha Waddell will present a programme in Children's Hour on February 22nd. Their first performance was given in 1927 in a small Glasgow hall, but since then these entertainers have travelled all over the country, playing in schools, in colleges, theatres, halls and private houses. They have even been invited to Glamis Castle and Balmoral to give command performances before Princess Elizabeth and Princess Margaret Rose. Since the war broke out, Bertha Waddell's company has done special work among evacuated children.

A Play from Michael Arlen

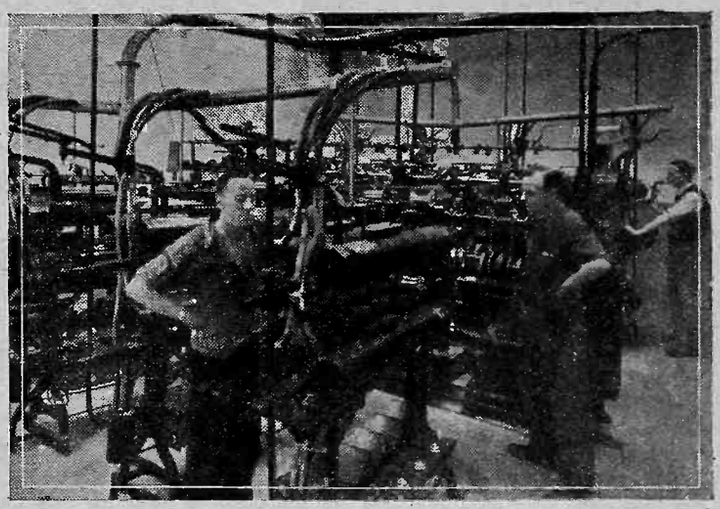
"RED ANTHONY," which listeners will hear on February 23rd, is a play adapted from Michael Arlen's story of the roistering gigantic Anthony Poole. Red Anthony tries to solve the mystery of how his brilliant brother came to kill himself by reconstructing the crime in his brother's own room. The mystery is solved at last in an exciting final scene. Hugh Stewart, who has adapted and dramatised this story for broadcasting, has succeeded in keeping much of the author's witty dialogue and sophisticated wisecracks.

Uncle Remus

FIRST of what is sure to be an intriguing series is in preparation for broadcasting on February 22nd. This is called "Uncle Remus." The broadcasts will be founded on a group of stories under the same title by Joel Chandler Harris, which has gained an immortal status in America, if not quite so well known in this country.

Uncle Remus, an old darkie who lived in Georgia, had innumerable fascinating legends to tell of a host of queer and kindly animals living in the dark African jungle. In these broadcasts listeners will soon become acquainted with the Tar Baby, Brer Rabbit, Brer Possum, Brer Terrapin and many other delightful creatures. Altogether the series presents remarkable opportunities for radio production.

The distinguished negro actor and singer, Robert Adams, will play Uncle Remus. James Dyrenforth will adapt the stories for radio and David Porter will produce. Henry Reed will be responsible for the music, which will be after the style of the scores which he wrote for "Æsop's Fables."



Some of the electric ovens used for the process of enamelling copper wires.

Edward Isaacs

EDWARD ISAACS, the well-known Manchester musician, is all the more remarkable because he is completely blind. He was a student of the Royal Manchester College and protégé of Charles Hallé, studying in Germany and Austria after leaving Manchester. He was one of the founders of the Midday Society Concerts in Manchester. On February 23rd he will broadcast a Bach recital.

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Designing Mains Transformers—1

Many Important Considerations Connected with the Design and Construction of such Transformers are Often Ignored, and they are Dealt With in this Article

By L. O. SPARKS

THE design and construction of voltage transformers can prove most interesting as it provides a hobby which calls for a reasonable amount of practical skill and, at the same time, just the right amount of theoretical work to make it more intriguing than straightforward constructional activity.

Most amateurs, whether through financial reasons or the desire to add to their knowledge, wish at one time or other to build up a mains transformer to suit their own individual requirements. This, together with all other forms of constructional work, is to be encouraged, but, and the beginner, will do well to note this proviso, it is absolutely essential in the interests of the constructor that particular care and consideration must be given to the making and testing of such components, otherwise such work can become a source of danger.

Parts of a commercial mains transformer which has been dismantled to show construction. Note insulation between layers of windings.

When transformers are used in conjunction with A.C. mains, it must be appreciated that a little careless work or faulty calculation can result in short-circuits, excessively high voltages and, of course, some very nasty shocks, so unless the would-be constructor has a fair working knowledge of such apparatus and of A.C. supplies, it is very advisable not to undertake the design and construction of mains transformers unless they work to a reliable design or under the guidance of a competent person.

General Considerations

The Query Service receives a great number of letters from readers who have a certain number of stampings or laminations, requesting full information concerning the number of turns required for a certain output and the gauges of wire necessary for the various windings. Such readers appear to be under the impression that these details are known by heart, and that it is not necessary to consider any other factors. It is hoped that the details given below will help to dispel such inaccurate impressions.

Wattage

This is one item which receives scant consideration from the average amateur transformer maker, but, nevertheless, it is one which *must be understood* and appreciated if satisfactory results are required. It is not sufficient to take a set of stampings and provide it with windings to produce any voltage and current according to requirements. Such items as heat generated, iron and copper losses, and saturation have to be borne in mind; therefore, unless a certain amount of metal is provided by the stampings for a given wattage, the temperature of the transformer will rise above a safe factor. A certain working temperature is quite permissible, but if this is exceeded, then the excessive heat will cause serious harm, possibly complete breakdown of insulation, with dire results. For this reason also, it is always advisable to see that a mains transformer is provided with sufficient ventilation to assist it to maintain a satisfactory even temperature.

It is not possible to give a complete list of stamping sizes and their suggested wattage ratings, these will be found in "Coils, Chokes and Transformers," price 2s. 6d., but to give a slight guide, a core area of 1in square is satisfactory for say, 30 to 40 watts, 1¼in. square, 50 to 60 watts, while for 100 watts, it would be advisable to use a core of 2ins. square.

Determining Wattage

To determine the wattage of a given transformer, one has to appreciate that the finished article is not perfect. There are bound to be certain losses which will prevent its output being equivalent to its input, i.e., as regards power or, in other words, it is not 100 per cent. efficient. A well-designed transformer will have quite a good percentage efficiency figure which will increase as the size or wattage rating of the component increases, therefore, with the comparatively small types used for average radio work, and bearing in mind amateur construction, it would not be advisable to calculate on an efficiency higher than, say, 75 per cent.

For the sake of simplicity, let us take a widely used type of transformer, that which has an output of 250-0-250 volts at 60 mA's across the H.T. secondary; an L.T. winding of 4 volts at 3 amps and another at 4 volts 1 amp.

The wattage loads are:

$\frac{250 \times 60}{1,000}$ which equals 15 watts.

4×3 " " 12 "

4×1 " " 4 "

31 watts

Note.—The division by 1,000 in the first calculation is because the current is quoted as milliamps.

Now, assuming that the transformer has an efficiency of 75 per cent., this will mean that the primary input wattage will be $\frac{31 \times 100}{75}$ which equals 42 watts to the nearest whole number. It is this value which will govern the size of the core area required and not the figures obtained by the first calculation.

Turns per Volt

This is the problem which causes so many headaches amongst transformer constructors, but, if one is wise, practically all the worry can be eliminated by using a reliable guide, such as that given in the book previously mentioned.

If one wishes to calculate the number of turns per volt, then there are many factors to be considered as the formula given below indicates,

$$T = \frac{10^8 \times E}{4 F f \Phi}$$

Where T=Number of turns per volt.
F=Form factor of E.M.F. wave.
f =Frequency of supply in cycles per/sec.
E=R.M.S. value of E.M.F. induced in the secondary.
Φ=Total magnetic flux through core.

For a sine wave form, i.e., normal A.C. supplies, the factor F can be taken as 1.11.

After noting the above, it will, no doubt, be appreciated that a reliable table will prove the easier and, so far as amateur requirements are concerned, such will prove quite satisfactory. There is, however, a handy simple relation, which will always enable one to make an accurate check on one's calculations, which can be expressed as

$$\text{Turns per volt} = \frac{8}{\text{Area of cross section of core.}}$$

The Power Amplifier in Practice—3

In this Concluding Article Considerations of the Output Circuit are Discussed

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

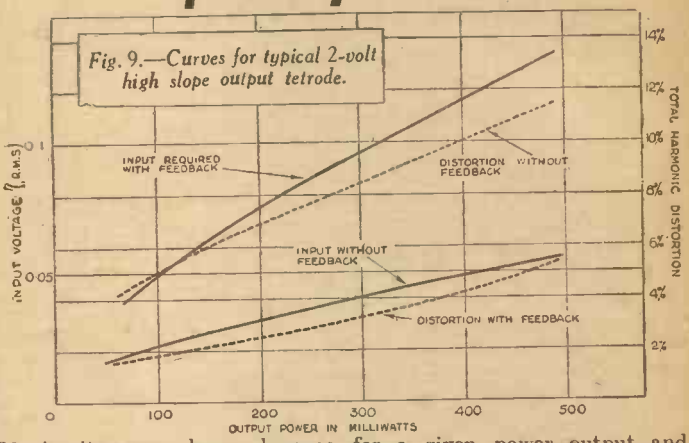

Fig. 9.—Curves for typical 2-volt high slope output tetrode.

MOST home constructors and designers of power amplifying apparatus have been faced at some time or other with the question—triode or pentode output valve? In this article some aspects bearing on the question will be discussed.

In the first place, it is probably true to say that it is simpler to obtain a given power output with low harmonic content, or distortion, by using triode output valves, but quite erroneous to condemn the pentode or tetrode valve because of an impression that high distortion is inevitable with this type.

Many considerations must weigh in making the decision, which usually becomes a compromise between cost, sensitivity, H.T. supply available, individual requirements in the nature of the load and complexity of circuit, and components.

Let us try to sort out the effect of each of these considerations—the pentode and power tetrode being assumed to have similar characteristics, which is substantially true for the purposes of this comparison with the use of triodes. Some output valves are true pentodes; others designed to give "pentode" characteristics—the difference in performance between these two varieties being usually negligible in practice.

Cost

In this category must come the purchase price of the valve, the associated components, and the supply of H.T. required in each case—a higher H.T. voltage being very often required to obtain a given output power with a triode than with a pentode, which may necessitate higher cost of mains transformer and smoothing condenser.

To continue the debit side on the triode account, the decreased sensitivity as compared with a pentode may be serious enough to warrant an additional stage of amplification, with its attendant cost also, but this loss in sensitivity is not always serious if the amplifier design already includes a sufficiently high L.F. gain. When triodes in push-pull are used, particularly in a Class AB1 circuit, a very large grid input voltage is required, sometimes amounting to over 100 volts, and under such conditions considerable L.F. amplification prior to the output stage is essential. Hence the use of high power pentodes and tetrodes is tending to increase because for a given power output and supply voltage, the grid input voltage need only be comparatively small.

As has already been explained, high efficiencies can be obtained with modern valves of this type by "aligning" the control and screen grids so as to minimise screen current, high values for which imply a limitation both to the power handling capabilities of the valve, and to the possible simplification of the circuit.

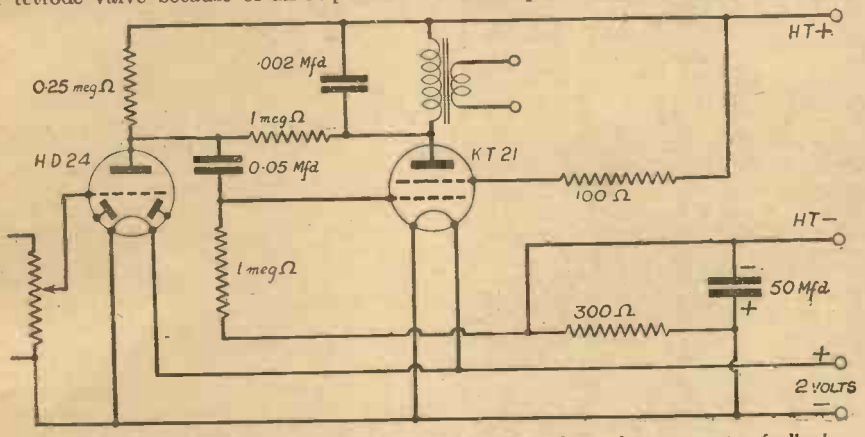

Fig. 10.—Typical circuit for a 2-volt battery power tetrode employing negative feedback.

Precautions in Use

Increased valve sensitivity brings the necessity for extra precautions to prevent instability, and many a complaint of unsatisfactory performance, and poor life of pentodes or tetrodes in push-pull, can be traced to high-frequency oscillation set up in the associated valve circuit.

Grid circuits should be kept well away from anode circuits in a practical layout.

The first necessity, therefore, is to see to the provision of adequate "stopping" resistances in the grid and screen or anode leads to the valve. Such resistances should be mounted as close to the valve holder as possible, and it must be remembered that

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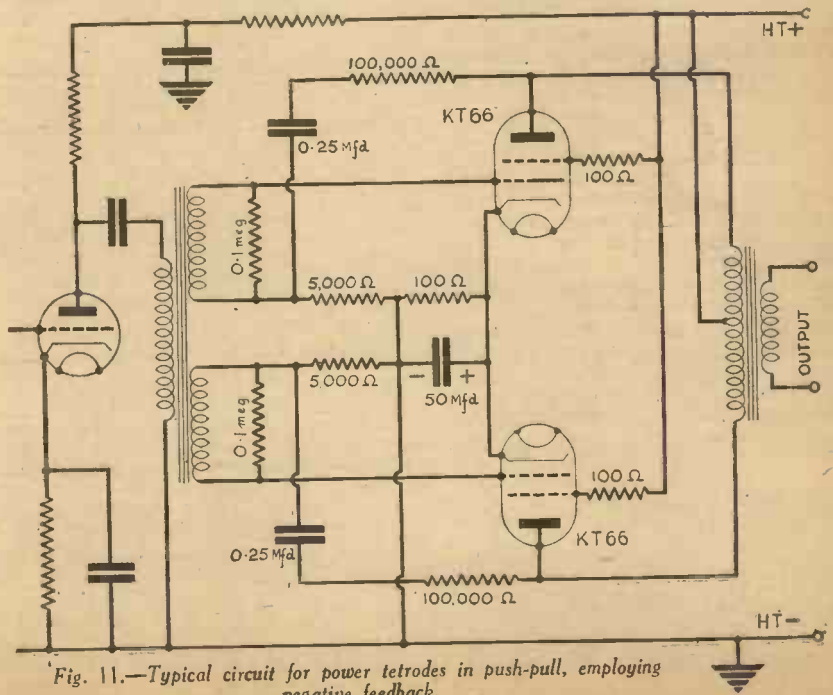

Fig. 11.—Typical circuit for power tetrodes in push-pull, employing negative feedback.

THE POWER AMPLIFIER IN PRACTICE

(*Continued from previous page*)

the screen or anode stopper is to carry substantial current. Often a screen stopping resistance is preferable to a resistance in the anode lead.

Suitable values may be from 5,000–50,000 ohms for the grid stopper and 50–100 ohms for the screen stopper.

Parasitic oscillation or "squegger" may cause a flash-over between the valve pins if of high enough H.F. voltage, particularly if the grid and anode leads of the valve follow parallel paths, in which the conditions are closely similar to those of an ultra-short-wave self-oscillator. Precautions as above are therefore the first essential.

Distortion

The next point to consider in our choice of triode or pentode is the much discussed one of *distortion*, or percentage of harmonic content superimposed on the waveform of the input signal by the complete output stage. To be comprehensive, this must also take into account the characteristic of the loudspeaker, which may vary over a very wide range depending on the nature of its design.

When a triode valve is used, the most common form of distortion is that caused by the introduction of second harmonic, or the "octave" of the original frequency. Fortunately, the ear can stand a good deal of this form of distortion before it becomes distressing, but as the degree of second harmonic introduced may vary widely over the frequency scale, increasing as the load impedance becomes reduced at the lower audio frequencies, an unpleasant result often occurs when music is being received, consisting of a mixture of very low and high frequencies simultaneously. The provision of a push-pull circuit with triodes may be designed practically entirely to overcome this defect, and hence the popularity of the push-pull triode output stage for "quality" amplifiers.

The design of a power triode for minimum second harmonic content does not, however, lend itself to the use of indirectly heated cathodes, for the reason that a large surface area for electron emission, such as obtaining with a tubular cathode of diameter approaching that of the grid, leads to lack of grid control as the anode voltage is increased. This leads to what is known as a "taily" characteristic, decreased output, and increased second harmonic, unless a very expensive electrode design is adopted.

Most power triodes, therefore, are found to have directly heated filaments. The application in a push-pull circuit, however, largely overcomes this disability, and the pentodes wired as triodes are often so used. In many cases the benefits of an indirectly heated cathode in simplification of automatic bias arrangements, hum reduction, etc., point to the use of a pentode or tetrode (in which the effect described above is not of prior importance). The form of distortion most commonly introduced with pentodes is introduction of "odd" harmonics such as 3rd, 5th, etc., which rapidly become much more unbearable to the ear as the percentage increases, and moreover cannot be balanced out on a push-pull circuit. It is to reduce those harmonics, among other reasons, that circuits called "*Negative or Reverse Feedback*" are employed, and many varieties of the basic principle involved in this are used in practice.

Negative Feedback

"Negative feedback" is simply a reversal of our old friend of the early days of knob-twiddling wireless which we called "reaction" and which was in effect "positive feedback" applied to H.F. circuits. "Re-generation" or positive feedback now becomes in our audio frequency amplifier "de-generation," and just as reaction *increased* the sensitivity of our H.F. stage, so negative feedback *decreases* the amplification of our output stage.

This decrease in sensitivity of course tends to bring the effective gain of an output pentode down to that possible with a triode, the amount of decrease in sensitivity depending on the percentage of the amplified voltage which is fed back into the input in reversed phase.

A set of curves (Fig. 9) shows clearly how the introduction of feedback affects the input required to produce a given output power, and the distortion. The circuit used to produce these results is shown in Fig. 10. The example is for a battery amplifier, but would apply equally —and possibly with more force—to a mains driven amplifier (Fig. 11).

Feedback circuits are also used to improve frequency response, and reduce objectionable effects of loudspeaker resonance at certain frequencies. The whole subject is one of wide scope and space does not permit further discussion here.

"Matching" of Output Circuit

We must now turn to what is probably the most important aspect of a successful output stage—namely, correct "*matching*" to the "load" or loudspeaker.

It is seldom that the loudspeaker can be connected with its "speech" winding directly in series with the output valve anode circuit. For one thing, heavy direct currents are undesirable, and—most important—it is unlikely that the relative impedance of the valve and loudspeaker winding are such as to produce the maximum transfer of audio-frequency power, or the minimum distortion of the waveform. Further, it is often assumed that the loudspeaker behaves as a resistance load—constant at all frequencies, and that all that had to be done was to calculate the ratio of valve load to loudspeaker resistance, take the square root and wind a transformer with a turn ratio corresponding to the result of this arithmetical exercise.

An additional assumption often made is that the full output of a valve under Class A or AB1 conditions, with any anode load, is given by applying a grid voltage input just insufficient to cause flow of positive grid current.

While these assumptions may apply to some extent in the case of triode valves, they cannot do so in the case of pentodes or tetrodes.

Fig. 12 shows a family of curves for a pentode with a high impedance load-line superimposed. In this case, although the grid swing is restricted such as to avoid positive grid current, the "crowding up" of the grid voltage curves at the region of low anode voltage produces a form of distortion which is indistinguishable from grid-current distortion. The extent of grid swing is, therefore, quite useless as a guide in assessing the undistorted output in this class of valve. The "optimum load" becomes a factor of the highest importance, and hence the necessity for accurate

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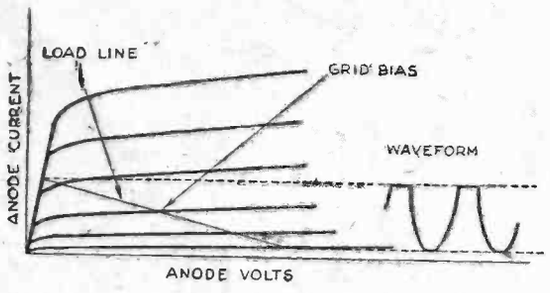

Fig. 12. (Left)—Form of distortion with pentode, resembling current distortion.

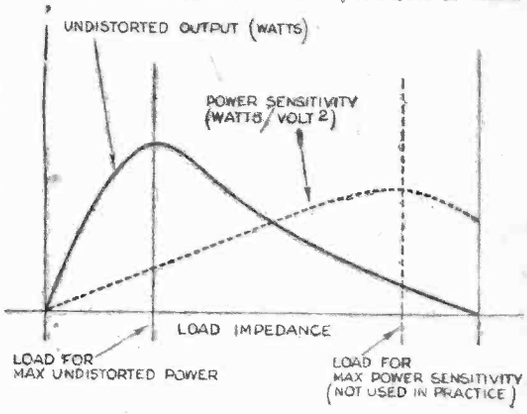

Fig. 13.—Curves showing how undistorted output varies with the load for a given pentode valve.

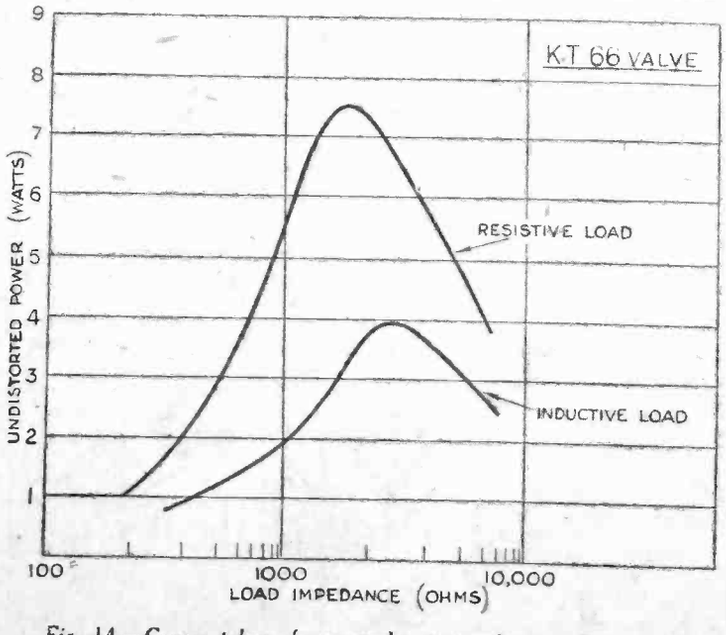

Fig. 14.—Curves taken of measured output voltage and varying load impedance.

ON YOUR WAVELENGTH

By Thermion

The Effect of the War

THE war has had its inevitable effect on the design of commercial radio receivers, and also upon the prices of them. Many models, it will be observed, have been withdrawn, whilst some of those remaining have been advanced in price. The usual release of new models which normally takes place in the spring is this year on a greatly reduced scale.

An examination of the programmes which have been sent to me so far indicate that manufacturers have used their ingenuity in making the best possible use of materials which, in most cases, are now only available under the permit system. Munitions are absorbing a great deal of the materials which are used in the manufacture of wireless sets, especially aluminium and the non-ferrous metals. Thus, the wireless trade must face the fact that as the war goes on the supply to them will be even more restricted than it is now.

One of the things you will notice about the new 1940 receivers is that they are getting smaller. I do not think that this is entirely due to the desire to economise in material, but because it has been found that greater efficiency can result from the use of less material. Portables figure largely in the lists. This is understandable when we remember the large numbers of people who are evacuated, the large numbers of A.R.P. workers, and the enormous number of people who have joined the Forces and desire to have radio wherever they may be located. Undoubtedly, there is more listening being done to-day than ever before, not only because the public is compelled to spend most of its evenings indoors during the black-out, but also because they are taking a keen interest in the News Bulletins.

There has been a distinct shortage of portables and long delay in delivery. The trade is, however, catching up. There are several sets of the mains-battery type, which will operate either on batteries or on A.C./D.C. mains.

Push-button sets, as I forecast when they were first introduced, are not so popular, and I do not think that they will remain as part of British design. There will not, of course, be a Radio Show this year, and so the new releases will be launched in the ordinary way by press announcements and by local displays.

War Fun

THE good humour of the British soldier is proverbial, and in each successive war it wins the admiration of a world astonished that in face of dangers, privations and discomforts, Tommy is always ready to crack a joke himself and to laugh at those of his fellows.

This incurable sense of fun and the lighter side of war generally are admirably illustrated in a new publication called *War Fun*, which is now obtainable through all newsagents and bookstalls, price 6d. The jokes reproduced are by the most famous artists of the day—Bert Thomas, Lees. Wallis Mills, A. C. Barrett, Treyer Evans, G. S. Sherwood, Peter Probyn, Hynes, Batchelor, and Arthur Ferrier, to name but a few.

This book of "war jokes" is a unique record of the British sense of humour in war-time. It will be appreciated in every home and every mess, either here or overseas.

What's In a Name?

WHY all the fuss about the identity of "Onlooker"? He gave us a good talk, was interesting and to the point, even if he had a rather "bedside" manner. Surely it is not of the slightest importance to us what may be the name of the gentleman? For all I know, the "talk" might have been written by Winston Churchill and delivered by an announcer or an actor. All that matters is the interest which the talk conveys and the accuracy of the facts set forth.

From my own enquiries it seems that "Onlooker" was very popular with many listeners, and his talk was certainly free from bombast and silly exaggeration.

Personally, I prefer a rather more vigorous type of speaker, but I found our new friend stimulating, and his quiet manner far more refreshing than "Haw-Haw's" silly blather. Incidentally, why do not the B.B.C. give us a few alternatives to Sir Ernest Swinton? He's not very interesting, and I should like to have his talk only once in three weeks. On one of the other weeks we could have a naval man (Vice-Admiral Sir James Somerville was excellent), and on the other, one whose interest centres chiefly in the R.A.F.

Incidental Music

DESCRIPTIVE talks can be very interesting; but why must they, in so many instances, be rendered unbearable by the introduction of music which, to my melodious ear, apparently bears no harmonious relation to the subject being enacted or described? If there is one thing which makes me "blue-pencilled" wild with the B.B.C. producers it is to have the picture which is being built up in my mind by the skill of the narrators and their script blasted to fragments by the blare or wail of some hideous noise produced, apparently, by an otherwise perfectly good orchestra.

While I will not pretend that I know all the technical details of production, I do most certainly know what pleases and appeals to a vast number of listeners, and I find that I am not alone in my views on this item. If music is essential for descriptive items, and I suppose it does form a useful media with which to link together the script and help to create the correct atmosphere—well, please Mr. Producer, do make such music harmonious to the whole idea, and more so to our ears, which have to suffer from an overload of discordant noises during our working day.

One feature item alone will be sufficient to emphasise the nerve-shattering stuff to which I refer. The "Shadow of the Swastika," an item which, so far as the acting parts are concerned, can create an interesting diversion to the usual run of things, but the incidental noise, sorry—music, forces me to keep my hand on the volume control so that I can cut down on it as soon as it starts to shatter the peace of my study.

A Musical Threat?

WITH the introduction of various mechanical musical (?) instruments during the past few years I have often wondered whether there would be any limit to the type of apparatus which might be inflicted on us in the future. I am not at present thrilled at some of the so-called musical instruments which have been produced in this way, although some of them admittedly have musical possibilities. I now see that the radio industry in America is looking to new developments to increase its volume of sales, and Mr. B. F. Miessner, a pioneer in electronic musical instruments, points out the opportunities in this home application of wireless valves and amplifiers in opening up new fields for manufacturer, distributor and dealer.

Electronic musical instruments, explains Mr. Miessner, (1) extend the tonal range of traditional instruments, (2) provide new types without the limitations of the traditional instruments, (3) give the composer more varied and beautiful tonal colourings, with more expressive means for reproducing them and a wider dynamic range, (4) afford the artist more complete and intimate control, and (5) make the larger instruments smaller, cheaper and more efficient producers of musical tones.

With the greater interest in music on the part of the public, as the result of eighteen years of broadcasting and the greater amounts of general leisure, Mr. Miessner feels that the field of electronic or radio-valve musical instruments is one which radio men should get into without loss of time—in this way adding millions in sales to present radio-set volume.

Comment, Chat and Criticism

The Music of Sibelius

A Brief Account of the Life and Work of Finland's Great Composer, by Our Music Critic, MAURICE REEVE

A FEW weeks ago I took the opportunity, afforded by the invasion of Poland, to write about one of her great sons, Chopin. Unfortunately, another chance presents itself, tragically similar in many details, of writing of another great man—greater, in fact, than even Chopin. Whilst the heel of Russian tyranny was stamped upon Polish freedom for a hundred and fifty years—a period covering the whole of Chopin's life—it is again the grisly bear that is threatening the existence of another and smaller nation, Finland. This remote little country, of fewer than half the souls that occupy the county of London, was, together with Poland, also under the conquering heel of the Czars. In fact, the heir to the "Czar of all the Russias" possessed the title of Grand Duke of Finland, among many others. Now, after a brief respite of twenty-two years, its independence is again challenged by the same terrible agency so that it would seem as if, whether of the right or of the left—Russia is always to be the bane and the nightmare of both nations.

The magnificent, or as Mr. Churchill recently called it the sublime, courage and fortitude now being shown by Finland in the face of well-nigh overwhelming odds, brings to the mind of those interested in the very finest music the grand name of Sibelius. For, make no mistake about it, Sibelius is one of the very greatest of the world's musicians, and is in the direct line of succession in the dynasty of the symphonists. The facts of his life can be briefly told.

He was born in 1865, so that for longer than Chopin's whole life—fifty-three years—he was the subject of Russia. His father was a doctor and his mother a clergyman's daughter. He differs from other Finnish composers in that he is bred from the purest Finnish peasant stock. He was given a classical education and studied law at Helsingfors (Helsinki) University. But before these studies were completed he found that music was his true *métier*, and he went to the Conservatoire under Wegelius, then the leader of the Finnish Nationalist movement in music. He then continued his study in Vienna and Berlin, and returned to his native land in 1893. One of the chief reasons for Sibelius's dominating musical personality is probably to be found in the fact that he never came wholly under the sway of alien or extraneous musical influences. Thus his native genius began to ripen, like Brahms's, very early, and to reach its magnificent fruition in some of his first works.

First Major Work

His first major work was Kullervo, the first of many that were inspired by the national legend of the Kalevala. The University awarded him a life grant in 1897, on which he retired to devote himself to composition. He has paid many visits to London, that in 1921 being at the invitation of Sir Henry Wood. He has also visited the United States, and taught at the Boston Conservatoire. His 50th, 60th, and 70th birthdays were treated in Finland as events of national importance.

Sibelius, as much as any composer who-ever lived, is known to millions of people whose circumstances or inclinations prevent their recognition of his great contribution to music, by two small works. Just as "1812" or Lohengrin's "Bridal March" are known wherever an ensemble plays in a cinema, or restaurant, to people who know little of their authors' other works, so are Finlandia and Valse Triste applauded by countless myriads who know naught of the mighty symphonies, the Karelia Suite, or Tapiola. Finlandia, though stirring, is certainly no better than 1812 or William Tell, whilst Valse Triste is one of those curious blendings of sentiment and foreboding which I discussed at length in my article on Musical Taste, and which are so beloved by the English public. Compared to the "Alla Marcia" from the Karelia Suite, Finlandia is like cold rice pudding. It will be recalled that the Finnish people's heroic deeds in the present war are mainly being performed in the Karelian peninsula, and round about the Mannerheim Line there. Get a record of this magnificent pulse-quickening work (H.M.V. C2985), and you will no longer be in any doubt as to why the Finns are putting up the show they are.

Symphonic Music

Sibelius's work might be conveniently divided into two main groups. Whilst it is as a symphonist that he will be most revered by future ages—he has enriched music's biggest and noblest form with eight magnificent examples each teeming with originality and masterful, gorgeous music—it is for his patriotic music that he is venerated in his own country to-day, Finlandia, The Origin of Fire, the Kalevala Suite, The Swan of Tuonela, The Return of Lemmenkainen, Pohjola's Daughter, En Saga, Night Ride at Sunrise, etc., have enshrined Finland's Saga and Folk Legend as few have ever been by a musician. The Finnish people listen to this music in awe and rapture as the Germans do to Wagner's Niebelungen Lores, and they worship the man who wrote them. They preserve for them, and picture to them, those very qualities which the Russians are now finding so stubborn and disconcerting.

Sibelius's symphonies have shared with Beethoven's and Brahms's the honour of being performed in their entirety at the Promenade Concerts in recent seasons. Consequently they are rapidly becoming familiar to the widest circle of music-lovers. At the first few hearings, their uncompromising forthright nature is rather apt to "hit one in the eye," and to cause one to think that he has been given a nut to crack which may be a little too hard for his teeth to manage. Something of the same effect is doubtless obtained on a polar explorer when he first confronts the might and majesty of an iceberg, a glacier or the midnight sun. But similar effects were produced on their audiences by Beethoven and Wagner, and many another giant, and almost all the first wild anathemas that were poured on their "new" music by the detractors who usually are found lurking about the wings whenever "new" music is down for production, have long been swept aside. There is a glow and a passion in Sibelius's work as there is about Tschaikowsky or Mussorgsky, which is far removed from the zero temperature of their native lands. The majestic and irresistible sweep of his pages whirl us up in their tumult and set our pulses throbbing, as only great music can. It is intensely exciting, the bold themes send out a challenge, whilst the thematic work, and the marvellous orchestration, create in us an urge to go along with him as long as, and wherever, he cares to take us.

Varying Moods

His chief qualities may be defined as an intense love of his native soil—which, however, never degenerates into a vulgar patriotism. A brooding melancholy and a quality of sternness and obstinacy seem to suggest that the extreme rigours of his native soil and the limitations which its sub-arctic civilisation and climate must place upon its inhabitants are hemming him in—a kind of struggle for existence which at times looks like winning. But then he will blaze out into great fits of passion and bravado, hurling defiance at polar bears and icebergs, and proclaiming his complete victory over such forces. A dreary sadness passing to almost utter despair can alternate with a reckless enjoyment or a fierce anger. The symphonies are noted for an absolute freedom from convention, and a refusal to be tied down by any convention for mere convention's sake. It was the same with Beethoven and all great men. He refuses, like his great predecessor, to merely conform to tradition but insists on giving complete expression to the many vital things he is always wanting to say. An absence of the decorative and transitional type of passage, which have so endeared the works of Beethoven and Brahms to posterity, is sometimes apt to make Sibelius's work appear rather brusquer, and more uncompromising than it is seen to be on closer acquaintance. The violin concerto, closely modelled on Tschaikowsky's, is a splendid work and enormously difficult. Strangely enough, he is a very indifferent writer for the piano, and has so far contributed nothing to the stock of the most popular instrument. Here, he forms, with Elgar, a striking exception to the run of the great symphonists.

Although Sibelius has not written anything of much consequence during the last few years, it is perhaps premature to ask whether his muse has yet left him. But, even though his life's work may now be completed, he has added sufficient treasure pieces to music's storehouse to insure him an immortality among the greatest of his art.

The Modern Frequency-changer

A Brief Review of the Types of Circuit Most Widely Employed, with Some Notes on the Prevention and Cure of the More Common Faults and Troubles Likely to be Experienced

by The Experimenters

OF the many frequency-changer circuits which have been adopted during the past few years, those employing a pentagrid (or heptode), an octode, or a triode-hexode valve are probably most generally employed to-day. It should be mentioned in passing that an octode is fundamentally the same as a pentagrid or heptode, with the exception that there is an extra grid—a screening grid between the other screens and the anode.

Another type of frequency-changer which is still used to a certain extent, mainly as a short-wave converter, has an H.F. pentode or similar valve wired in a circuit similar to that of a single-valve regenerative receiver.

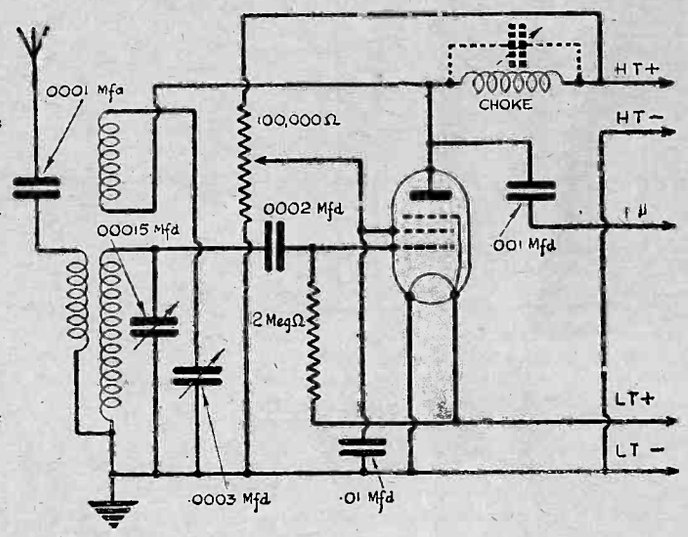

Fig. 1.—The simplest form of frequency-changer is an H.F. pentode used in a short-wave-converter circuit. There are many disadvantages inherent in this arrangement, but it has the advantages of simplicity and convenience.

H.F. Pentode

A circuit of this type is shown in Fig. 1, where it will be seen that it could be used equally well as a single-valve receiver, or as a short-wave adapter. Although very simple and convenient in many respects, this arrangement is by no means a good one when compared with other modern circuits. This is principally because it has only one tuning circuit; this circuit is not tuned to the frequency of the signal to be received, but to a frequency higher or lower by the intermediate frequency to be employed. As a result of this, any transmission can be received on at least two different settings of the tuning condenser. One of these represents a wavelength which is higher, and the other a wavelength which is lower, than that of the signal.

Additionally, the circuit is not selective when judged by present-day standards, and is not suitable for other than short-wave work. Even then it is liable to cause interference with other receivers, and even to introduce interference in the receiver with which it is used. It is customary, when using this system of frequency-changing, to include an H.F. choke in the anode circuit to provide the load, and to act in conjunction with the .001-mfd. condenser shown as an output coupling. A better arrangement is to employ a tuned coil in place of the choke, so that the I.F. can be shifted if necessary to avoid interference, and so that there is a band-pass effect between the F.C. and the broadcast receiver with which it is used. The component values shown in Fig. 1 are average ones which are generally satisfactory. As for the tuner, this can be the usual six-pin S.W. coil, but the reaction condenser might well be of rather more than average capacity to ensure that the valve can oscillate readily.

Pentagrid and Octode

The pentagrid or octode circuit shown in Fig. 2 is very widely employed, and is fairly satisfactory for use on all wavelengths down to about 20 metres. It can often be used on still lower wavelengths, but there might then be some difficulty in ensuring that the oscillator section will provide sufficient output over the waveband. Any difficulty in this respect can usually be overcome easily enough by connecting a small-power valve in parallel with the oscillator section. Actually, the best procedure is to connect both oscillator grid and the triode grid to the end of the oscillator coil, through fixed resistors of about 50 ohms, and to connect the oscillator anode (another grid in practice) to the screening grids of the pentagrid. The anode winding of the oscillator coil is then included in the anode circuit of the extra triode.

Oscillator Tuning

It will be seen from Fig. 2 that the tuned winding of the oscillator coil is in the grid circuit, but there is seldom any objection to including it in the anode circuit, as shown in the case of the triode-hexode illustrated in Fig. 3. Generally, however, the tuned-grid arrangement is most effective for the pentagrid. Values given in Fig. 2 are average ones only, and the resistors and condensers should be chosen to agree with the recommendations made by the makers of the particular valve employed. Another point which will often arise in practice concerns the application of A.V.C. to the frequency-changer. Connections for this can be made as indicated by broken lines in Fig. 2. When the receiver is to be used for short-wave reception only, it is generally better to replace the by-pass condensers marked as having a capacity of .1 mfd. by others of .01 mfd.; this is not of great importance if good-quality non-inductive condensers are fitted.

The Triode-hexode

The triode-hexode frequency-changer, shown in Fig. 3, is coming into increasing use, especially for S.W. and all-wave receivers. It is generally more effective on the S.W. bands, due to the oscillator

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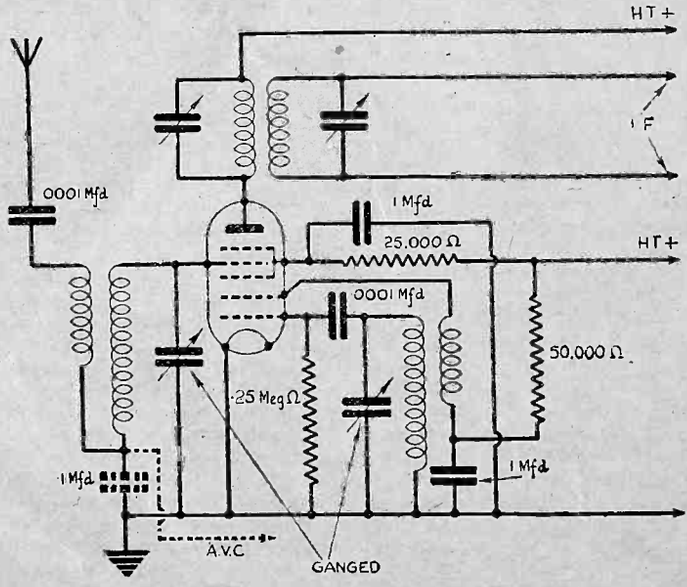


Fig. 2.—The pentagrid or heptode frequency-changer is probably used most extensively at the present time. It is efficient on all wavebands down to about 20 metres, but in some cases an additional triode should be used as separate oscillator.

THE MODERN FREQUENCY-CHANGER

(*Continued from previous page.*)

output being steadier than with the pentagrid. In addition, there is less trouble, due to the oscillator tuning "pulling" the input tuning. The circuit used for this valve is similar in all major respects to that required for a pentagrid, but it is nearly always desirable, if not essential, to tune the anode circuit of the oscillator section, and to parallel-feed the anode winding, as shown in Fig. 3. Thus, the high-tension current for the oscillator anode is supplied through a fixed resistor (50,000 ohms is a good average value) and to feed the H.F. to the coil through a .0001-mfd. fixed condenser. By following this method of connection there is little damping of the tuned circuit, and the oscillator output is "evened out" over any particular waveband.

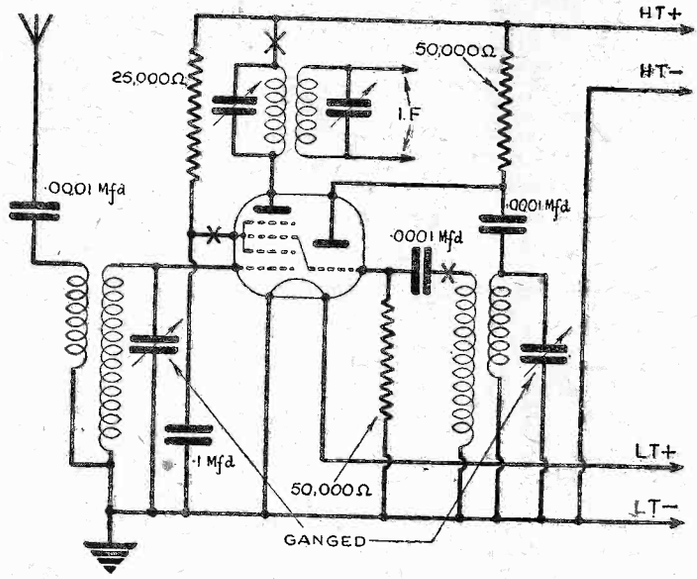


Fig. 3.—In the case of the triode-hexode frequency-changer one grid is common to both portions of the valve. This type of frequency-changer circuit is coming into increasing use for all-wave and short-wave receivers.

In those rare instances when the output from the oscillator section is insufficient on very short waves it is necessary to wire a small triode as separate oscillator, following the connections mentioned above in respect of a pentagrid. This is seldom required, and the extra valve should be resorted to only after carefully checking up on the circuit as a whole.

Nowadays, it is almost standard practice to employ 465 kc/s as the intermediate frequency. This is not just an arbitrary figure, but one which has been arrived at by many designers as being the most satisfactory for all-round use. It is not necessary to go into the reasons here, but it can be taken for granted that it is best to use this frequency unless there are important reasons for deciding otherwise.

Input Tuning Circuits

One advantage of 465 kc/s is that it is not necessary to employ a band-pass input filter to avoid second-channel and other forms of interference. When using 150 or 110 kc/s a band-pass filter is desirable, although it is possible to compromise in this respect by making use of an aerial loading coil, which is connected across the input circuit in series with a fixed condenser. Coils of this type are available for about 2s. 6d. and often improve selectivity and thus minimise interference although not being tuned by means of a variable condenser.

Audible Oscillation

A well-planned superhet is inherently stable and seldom gives any trouble due to self-oscillation and parasitic oscillation. At the same time minor troubles may often be experienced. They may be concerned with the I.F. circuits, and these should certainly receive attention first. In some instances, however, the frequency-changer is responsible. One form of trouble is that of audible oscillation, which sounds like a cross between a squeak and a groan, and is often described as "squegging," at the bottom end of the tuning range, or on the lower wavelengths only. It can generally be stopped by replacing the oscillator grid-leak by one of lower value, but this will not always be effective if the valve is old and in need of replacement. A value down to 25,000 ohms can be used; the average value is about 100,000 ohms for a triode-hexode and 150,000 ohms for a pentagrid.

Cures for Parasitic Oscillation

Sometimes parasitic oscillation is experienced, this often having the effect of rendering the receiver "dead" at certain frequencies. There are two or three methods which generally prove effective in preventing this, one being to insert a 50-ohm resistor between the grid condenser and the top end of the oscillator-grid winding. Another method is to include a fixed resistor of about 3 ohms, or a S.W. choke, in the screening-grid lead as near to the valveholder as possible. Yet another method is to fit a small S.W. or U.S.W. choke between the primary winding of the I.F. transformer and the H.T.+ line. These three points are indicated by crosses in Fig. 3, but the connections mentioned are also applicable to the pentagrid circuit shown in Fig. 2.

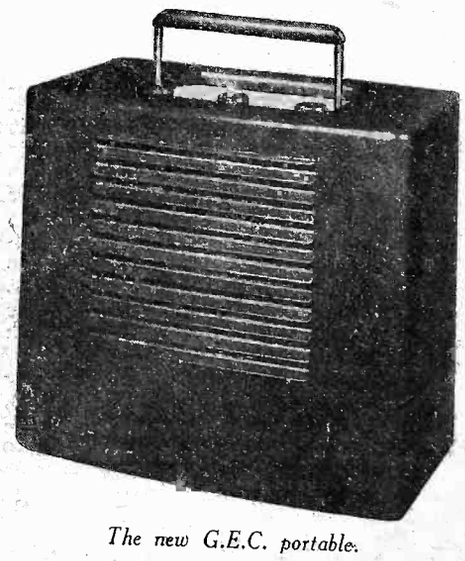
The circuits shown in Figs. 2 and 3 are intended to be diagrammatic, for in practice two- or multi-range tuners would probably be used instead of the S.W. coils indicated. Additionally, with some coils padding and tracking condensers would be required in the oscillator tuning circuit. These are omitted because their use is dependent upon the particular coils and tuning condensers used and because the values of the condensers, if required, are governed by the components chosen.

NEW G.E.C. BATTERY PORTABLE

THE General Electric Co., Ltd., recently introduced a new four-valve portable radio receiver, built to stand the strain of alternate use in A.R.P. shelters, in the train or car, and in the user's home. The casing, which is specially shaped for easy portability, has a grained leather-like finish and looks smart enough for anywhere indoors. Reliability for all kinds of outdoor work is ensured by the rubber mounting on which the components are assembled, and the generally sturdy chassis construction.

Battery problems are minimised by use of G.E.C. BB395 combined H.T./L.T. dry battery, which is connected by a fool-proof non-reversible four-pin plug. High efficiency is obtained by superhet circuit, incorporating frequency-changer, I.F. amplifier, double diode triode, and power output—all new 1.4 volt dry battery economy valves.

Other details of the specification are: Three control only—volume, slow-motion tuning, combined on/off and wavechange switch; dial, calibrated in wavelengths and station names; speaker, 6½in. P.M. moving coil, acoustically matched to cabinet; frame aerial; valve complement, Osram X14, Z14, HD14, N14; sockets for connection of external aerial and earth when extreme range is required. A useful easy-service feature that dealers will appreciate is the fact that the casing comes completely away from the base when two fixing screws are removed from the side of the cabinet. The dimensions are 11½in. x 12½in. x 7⅞in., and the price £8 18s. 6d., complete. Supplies will be available from March 2nd.



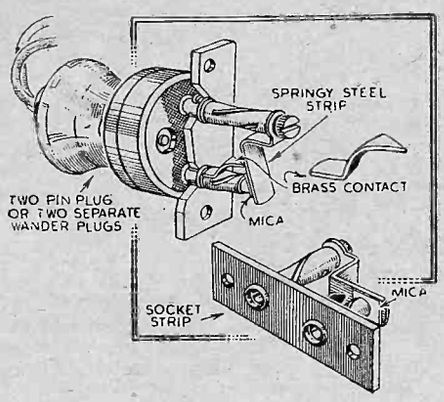
The new G.E.C. portable.

Practical Hints

A Simple Meter Jack

THE accompanying sketches give details of a simple meter jack which I have found to be very efficient in practice and much cheaper than a jack and plug.

The socket strip can be purchased for a few pence, and the type having screw connections should be used as this enables the spring steel strip to be screwed to one



A simple meter jack contrived from plugs and sockets.

leg. The other leg is cut short enough to allow the plug (which may be of the two-pin type or two separate wander plugs) to protrude and push the spring away from the brass contact which is soldered to the short leg. A small piece of mica must be stuck to the underside of the spring strip to insulate it from the socket when the jack is open circuited.—V. W. BUDD (Portsmouth).

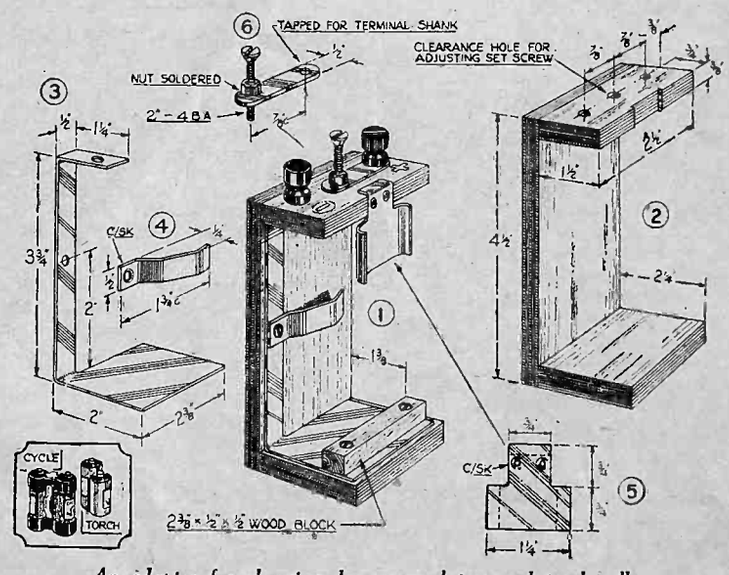
An Adapter for Charging Dry Accumulators

ALTHOUGH the adapter illustrated was made and constructed by the writer primarily for holding the cycle type dry accumulator during charging, it was also designed to take the "torch" type models, and as it is quite possible the latter may become popular for grid-bias and other wireless purposes, the adapter will no doubt be of interest to home constructors.

Owing to the special purpose for which the above-mentioned models are designed, terminals could not of course be incorporated, so for safe and easy charging some such adapter as above is useful.

All the models made by Messrs. Varley specially for wireless purposes are fitted with suitable terminals. The sketches of the adapter are self-explanatory, but in brief, its use is as follows: The cycle type accumulator is slipped in from the right-hand side of the adapter (Fig. 1) when the negative contact strip of the accumulator engages with the springy contact strip of the adapter, which contact strip is connected to a terminal at the top. This is the negative terminal. A central set screw is adjusted to engage with the lead top of the accumulator (positive) which set screw is connected by a metal strap to a second terminal at the opposite end. This is for the positive connection to the charging apparatus. In the case of the torch type models, these are placed on the metal platform, which is of course in connection with the springy strip and negative terminal, and the set screw is adjusted to connect with the top (positive) cap as before.

The main parts are shown in Figs. 2, 3, 4, 5, 6. The frame (Fig. 2) was constructed from ⅜in. plywood and is quite simple. The 2⅜in. x ½in. x ½in. wood block is screwed down on top of the metal connecting plate (Fig. 3), and acts as a guide for the accumulator at the bottom, whilst the small shaped plate (Fig. 5) serves a similar purpose at the top, as shown. The springy strip (Fig. 4) can either be soldered or screwed as shown, according to the metal used. The adjusting set screw (Fig. 6) should be about 2ins. long, and if an insulating type terminal is fitted at the opposite end, care should be taken to see that its shank is in good electrical contact with the connecting strap.—R. L. G. (Essex).



An adapter for charging dry accumulators and torch cells.

THAT DODGE OF YOURS!

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

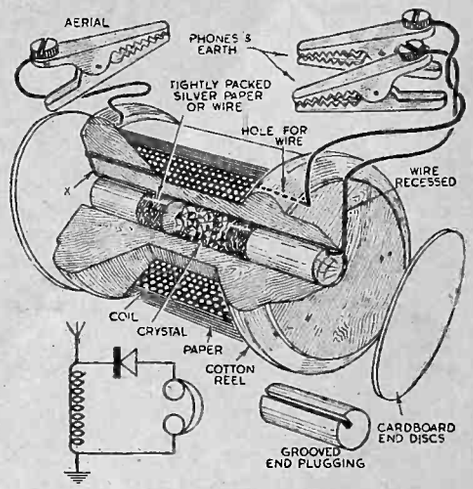
SPECIAL NOTICE

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

A Miniature Crystal Set

WE have had occasion to build this miniature set between us, and think that it might be of interest to those who require a midget and portable crystal detector, which will work from a water-pipe earth and a bed spring aerial. The accompanying diagram gives a section of the finished article. The requirements are few and inexpensive. They include a cotton-reel, three crocodile clips, about 4 yards of different coloured flex for aerial, earth and 'phones, an old 75-turn plug-in coil, and a crystal.

First insert the crystal, the contacts being established by wire springs or silver paper wedged in at each end. The wire from the crystal is let into the wood (see end X) and a flat cardboard disc is glued over both ends to keep out all dirt, etc., and to give a finished appearance to



A cotton-reel crystal set.

the set. The coil is next wound on the cotton reel, one end (X) being taken to the crystal and to the aerial; the other end is taken to earth and the 'phones. The other 'phone contact is made from the crystal, with a short piece of flex. The coil is covered with paper and then varnished. The set is, of course, automatic, and needs no adjustment to find the sensitive spot. We think that 70-80 turns of wire are enough, the wire being taken from the old plug-in coil. — J. N. PHILLIPS, R. P. ALEXANDER (Taunton).

A Universal

Constructional Details By Experimenter

WHEN dealing with the testing of valves most radio engineers and keen experimenters long for the super valve-tester which will do this work with the least trouble and sure results, but it is the experience of most that the modern valve-tester, expensive as it is in most cases, nearly always leaves something out which is needed, and is not flexible enough in its tests to satisfy the ardent experimenter. As two examples of this, what tester will give a positive indication of noise in a valve, and when switches become faulty in a tester, can the readings be any longer taken as correct?

But this is not intended to be a comment on the present ranges of valve-testers, which are in most cases very good instruments, but rather an introduction to the snags which the designer of the tester about to be described has tried to avoid. This tester is based on the requirements of the radio engineer and experimenter alike, and the question of cost has been carefully considered.

The instrument, for the purposes of construction, is divided into three separate sections, and these can be used quite separately and independent of one another.

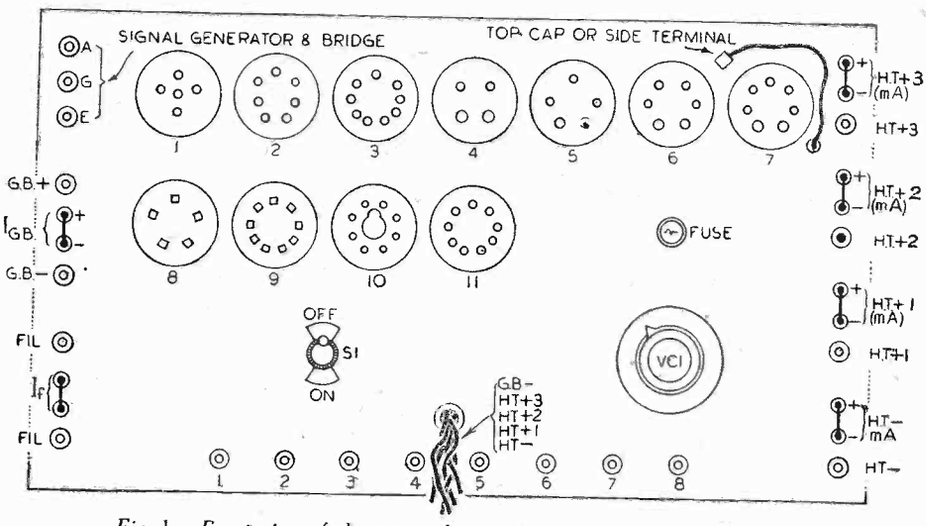


Fig. 1. Front view of the tester, showing layout of valveholders and sockets.

The reason for this is very simple. The constructor can commence with the main section first, and then add the other parts as he requires them; and furthermore, some of the parts may be already at hand.

While no claim is made that this is the perfect valve-tester (which would involve again the question of cost) it is said that it is very simple to construct, is not expensive, is quite accurate, has great flexibility, and can be adapted for numerous other uses besides the testing of valves. There are no complicated switches to cause possible trouble, and the tests can be verified in more than one way on the one instrument.

The three sections which constitute the complete tester are the Main Valve Panel, the Bridge Unit, and the Power Supply Unit.

These will be described under their separate headings, and the use of each for the complete testing of valves, etc., will be outlined.

Main Valve Panel

This is the main part of the whole instrument, and it consists of a number of valve-holders suitably wired to take the various types of valves on the market. There is provision for the testing of current in the filament, anode, grid, screen-grid, and extra grid or oscillator anode. The voltage across any parts can also be determined. The connections to the various electrodes of the valve under test is by plug and socket connections, and not by switches (for reasons already mentioned). This makes it possible to test any new valves which may appear in the future without in any way interfering with the circuit. All the power supplies are applied externally, and in this way the constructor can commence with simple battery valves only requiring battery voltages, and later he can add the Power Supply Unit which will give any combination of voltages.

The tester will operate with British, Continental or American type valves, and an extra holder is left in case a new panel is ever needed in the future, and this can be connected with a multiple cable. Separate meters are necessary, and these can be used as required or where the voltages are known to be correct, then they may not be needed at all (when using the Bridge Unit). The grid-bias supply is always battery operated, as this is found to be better than incorporating it in the filament and H.T. unit. A few 9-volt batteries in series are needed.

It may appear from the above description that the tester is slightly involved, but actually, when the user has become proficient with it the various tests can be made very quickly; and let the reader remember that it is primarily for experimental purposes that it is designed. This means that it has advantages which other testers do not possess.

The Panel

The panel can be of good plywood, well varnished, or ebonite. It can be made to the constructor's own taste, but to give plenty of room for working it is suggested that it measures 2ft. long by 1ft. wide. The lay-out of the various parts is shown in Fig. 1. It will be seen that there are 11 valveholders, and these are mounted on the panel by drilling holes in the panel to take the socket pins of the holders. This is to avoid cutting out large holes which only weaken the panel, and in the case of ebonite, may eventually break it. A needle pushed down the socket when the holder is in place will mark the panel for the hole.

The holders are for valves: British 1, 2, 3, 8, 9, 10, American 4, 5, 6, 7, 10, and Continental are much the same as British or American bases. One to 7 are for valves with pins of ordinary type; 8 and 9 are for side contact types such as universal valves; and 10 is for octal bases.

The other parts are placed as shown, and consist of the plug sockets at the sides and bottom for the various voltage supplies, and it will be noticed that jumper leads are across various sockets when no meters are being used. A.G.E. are the sockets for the bridge unit, and sockets 1 to 8 are the electrode sockets. A hole is bored at the top right-hand side of the panel for a lead to the valve tops or side terminals, and another hole at the bottom as shown for the electrode leads to come through.

A fuse-holder is placed above the grid-bias potentiometer VC1, and a shorting switch is shown at S1 for the purpose of testing battery valves as distinct from mains types. This is placed at the "on" position for battery valves and connects H.T.— to the filament.

The various sockets for the meters should preferably be of a smaller type than the other sockets to avoid confusion, and they will need to be marked by placing white cardboard or celluloid discs underneath, suitably engraved.

Mullard P.M.22A., Marconi P.T.2, Mazda Pen 220, Cossor 220P.T.
Output Pentode
Filament voltage—2v. If .15 amp.
Anode voltage—100-150. Ia 4.5-9.5 mA
Screen voltage—100-150.
Grid bias—3-4.5 volts.
Optimum load—20,000 Ω
Base—4 or 5 pin.
4 pin. Holder 1, H.T.— to O; H.T. + 1 to 1; H.T. + 2 to 8; G.B. to 3.
5 pin. Holder 1, H.T.— to O; H.T.+ 1 to 1; H.T.+2 to 2; G.B. to 3.
(S1 closed.)

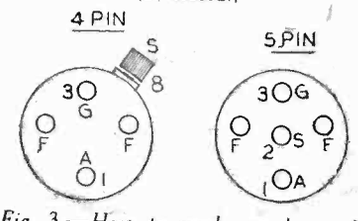


Fig. 3.—How to mark out the cards when calibrating.

Circuit and Wiring

When the parts have been assembled on the panel the wiring can be commenced. The wiring diagram is given in Fig. 2, and from this it will be seen that the holders have been placed in order of the number of pins, 5-pin first, 7-pin second, etc. First the filament pins of all valves are wired in parallel, and to the filament supply sockets.

Valve-tester—I

A Useful Unit for the

DAY-LEWIS, A.M.I.R.E.

Then from electrode socket 1 a continuous lead is brought to the first pin socket on the valves, reading anti-clockwise where possible, and commencing at the filament pins. The same procedure is adopted with socket 2, and subsequent sockets, until all have been wired as shown.

The wiring is best carried out with long lengths of tinned copper wire cut approximately to the length measured from the electrode socket to the last point to be wired. As one part is completed a short length of sleeving can be slipped over the wire. Good, soldered joints are recommended as the sockets will get a lot of movement when valves are being tested.

The rest of the wiring needs little explanation, and can be followed from the diagram. The resistance R1 is 3,000 ohms fixed and VC1 is 100,000 ohms variable. S1 is an ordinary panel mounting single pole switch. The fuse is in the H.T. negative line and should be rated to carry 100 mA. The leads from the voltage supply terminals end in flexible wire, such as flex, and terminate with plugs for the sockets on the bottom of the panel.

Final Details

The cabinet is best made of wood, and the back should be made to open for the occasional inspection of the panel back. The whole panel and cabinet should be made as rigid as possible, and particular attention should be paid to the wiring and connections, as in places around the valve pins various wires will pass very close to one another, and their insulation will be touching. These wires under operating conditions may be carrying different signals, and may be at widely different potentials, and any bad insulation may result in a failure of the test being conducted.

The electrode leads are marked H.T. neg., G.B. neg., and H.T. 1, 2, 3, and the latter are for anode, screen, and extra screen or electrode. This should be remembered when calibrating the instrument. The same applies to the power supply sockets.

The extra valveholder 11 is for a plug and multiple-way cable to additional valve panels which may be later wanted. It can also be used to test between the various voltage points of the valve under test, as at least some of its pins will be in contact with those of the socket being used.

Calibrating

For this obtain a number of valve makers' catalogues and also a quantity of "card index" cards, or ordinary postcards. Then looking at the base connections of any one valve in the catalogue (looking at the bottom of the valve) obtain the positions of the various electrodes. Draw the base on the card, and mark in the electrodes. Now from the circuit of the tester find the corresponding valveholder, and also where the electrodes on it are connected to, then these sockets will give various electrodes; mark these down by their numbers on the card. This is shown in Fig. 3, which represents a simple pentode valve. By further reading of the valve manuals the equivalent types of other manufacturers can be determined, and these can also be marked on the card.

As the various valves are identified and marked on separate cards, it will be found that a complete card index of all types of valves is made, and when using the instrument it is only necessary to consult the card required to determine the voltage requirements of the valve, what socket it is placed in, and where the electrode plugs are placed for correct operation.

Operation

For the present we will suppose that the experimenter is only starting to use the instrument with a few valves of battery type, then only batteries are needed for the power supplies. We will also assume that the bridge is not yet being used, and meters are available; a simple multiple voltmeter and milliammeter are all that are necessary.

Supposing that we wish to test the valve given in the example. Then we connect up a milliameter in the sockets marked I H.T. pos. 1, and connect up the H.T. neg., H.T. pos. 1 (anode), H.T. pos. 2 (screen) and L.T. battery to the corresponding sockets, removing, of course, the jumper lead where the milliammeter is connected.

We then close the switch as instructed for battery valves, plug in the valve (a 5-pin one), and place the electrode plugs in the numbered sockets shown on the card, *i.e.*, H.T. neg. left unconnected, pos. 1 to socket 1, pos. 2 to socket 2, and G.B. to 3.

The milliammeter should now give a reading, and we then apply the G.B. battery voltage. By measuring across the next, or some other valve socket, we can obtain the exact voltages on the various valve electrodes, and correct, if wrong, until makers' figures are arrived at. The G.B being adjusted by the potentiometer VC1.

When this condition is arrived at the milliammeter should give the correct anode current or be within very close limits to the maker's figures, if the valve is perfect.

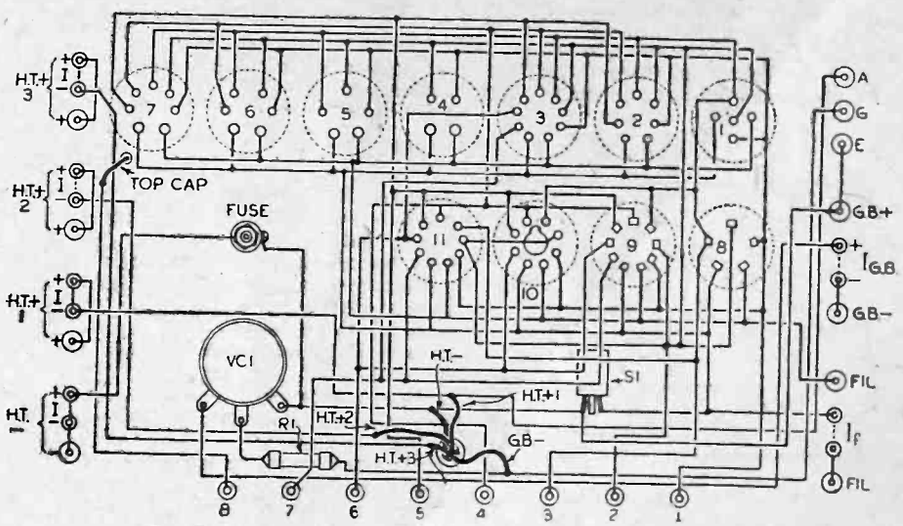


Fig. 2. Wiring diagram of the universal valve-tester.

The current in the other parts may be similarly measured, and when doing this always tap the valve to see if there are any loose electrodes causing a change in the current values.

The mutual conductance of the valve is obtained by changing the grid bias by one volt, and noting the change of anode current, which is expressed as so many milliamps per volt. The impedance can likewise be determined by altering the anode voltage and noting the change of anode current, and the impedance is given by

$$\frac{\text{change of anode voltage} \times 1{,}000}{\text{change in anode current in mA}}$$

equals ohms.

And from these the amplification factor can be determined, for amplification factor equals impedance multiplied by mutual conductance or:

$$M = \frac{\text{Mutual conductance} \times \text{Impedance}}{1{,}000}$$

This, briefly, is the method adopted when testing with meters, and in the next article we shall deal with the testing of valves without the need of emission tests with a milliammeter (fundamental check in keen experiments).

COMPONENTS REQUIRED FOR UNIVERSAL VALVE-TESTER.

- 5-, 7-, 9-, 9-pin British valveholders, flush mounting.
- 5-, 9-pin Universal valveholders, flush mounting.
- 8-pin Octal type valveholder, flush mounting.
- 4-, 5-, 6-, 7-pin American valveholders, flush mounting. (All by Clix.)
- Nineteen large banana type plugs and sockets.
- Twelve small split pin wander plugs and sockets.
- One panel-mounting fuseholder, and 100 mA fuse for same.
- One toggle on-off switch (Bulgin).
- One 3,000 ohm fixed resistance.
- One 100,000 ohm volume control.
- Tinned copper wire for connecting and short lengths of good flex.
- Sleeving and solder.
- Nuts and bolts.
- Celluloid name discs if required.
- Ebonite or plywood panel 2ft. by 1ft. and fairly thick.
- Cabinet with open back if required.
- Batteries for L.T., H.T. and G.B. supplies.
- Milliammeter and voltmeter if not already possessed, and if not at hand. If batteries whose voltages are known are being used, then these are hardly necessary.

A.-C. Two-valve Receivers

Points of Design in Economy Sets Based on the A.C. Twin - - - By W. J. DELANEY

IN April, 1933, I described a simple two-valve A.C. mains receiver, for which Blueprint No. P.W.18 is still available. A receiver of this type is ideal for modern conditions, embracing the simplest possible form of circuit for mains operation, resulting in low costs of both construction and maintenance. The original coil is not now available, and one or two of the other components have now been withdrawn from circulation, but any constructor can build a similar receiver from parts on hand. Apart from this, however, there are several interesting points in design which are worth discussing in these days of economy. Firstly, the circuit included two valves acting as detector and output, with a third valve in the mains section. To ensure maximum gain the two valves were both of the pentode type, and as permanent-magnet loudspeakers were not in those days so sensitive as energised models the receiver was designed to utilise the latter model and thus the mains section was designed to deliver 350 volts. To-day a good P.M. speaker is just as sensitive as a mains model, where the energising current available is only small, as it will be in a simple two-valver, and therefore the mains section could be designed to take a 250-volt rectifier.

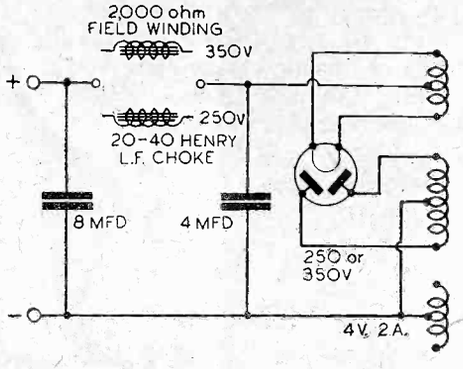


Fig. 1.—Arrangement of the mains section to suit a P.M. or an energised speaker.

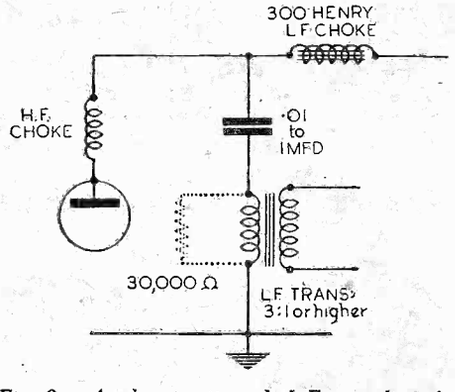


Fig. 2.—Anode circuit and L.F. coupling for high-impedance detector valves.

Mains Unit

Therefore, the requirements on the mains side are a transformer delivering 4 volts at 2 amps for the two valves, and an H.T. winding at 250 volts 60 mA. or 350 volts 60 mA., if an energised model is to hand. Fig. 1 shows the essential parts, with the alternative smoothing arrangements according to the speaker in use. In the original model this mains unit was separately built and housed on a shelf in the cabinet, leaving the receiver chassis complete so that modifications could be made if desired. Any mains transformer could be used in a receiver of this type, additional unwanted mains secondaries (for heaters) being ignored and left unconnected. Care should be taken to guard against short-circuits by wrapping the ends of such a winding, where flex connections are provided, and insulating them against all possible contact.

On the receiver side there are several interesting alternatives available, and those who are interested in experimenting will find such a circuit very instructive in this connection.

Coupling

When a pentode or S.G. valve is used as detector, the normal rectification follows much on the lines of a straightforward triode, but it is important to remember that the impedance of such a valve is very much higher than that of a triode, and thus to obtain the increased amplification of which the valve is capable special steps have to be taken with the anode coupling component. If an ordinary L.F. transformer is connected in the anode circuit the gain is bound to be low—probably no greater than if a simple triode is used. A resistance could be used so that either resistance-coupling or a resistance-fed transformer circuit could be employed, but the drawback with this is that the anode voltage which can be applied to the valve will be lowered, and if the 250-volt mains unit is employed the valve will probably receive a very low H.T. The useful value of resistance in the case of a good mains pentode is of the order of 100,000 ohms, and thus this is ruled out for practical purposes.

A high inductance choke will, however, afford a more equal load to the valve and will not give any appreciable voltage drop, as the D.C. resistance of a good choke of this type is only about 2,000 ohms. In the original circuit, therefore, this was used and a standard L.F. transformer was then parallel-fed to provide a good step-up to feed the output valve. A tone corrector, in the form of a 30,000-ohm resistance across the primary of the transformer also compensated for the effect of the L.F. choke and gave very good low-frequency response. It is, therefore, recommended that this method of coupling be retained in a simple receiver of the type mentioned, and all that then remains is to take steps to see that the detector operates in the most efficient manner.

The Detector Stage

Any standard coil and tuning circuit may be adopted, but a single waveband (medium waves) will probably be selected at the present time, and thus only the reaction circuit is available for experimental purposes. There are two alternatives. Firstly, the normal reaction winding with standard reaction condenser may be used, in which case the capacity of the usual anode by-pass condenser is the only really critical component, or secondly, the electron-coupled circuit may be used. This was not adopted in the original design as a commercial coil was used. If, however, a simple coil is made up for medium waves it will be possible to tap this so that the cathode may be joined to the tapping and then reaction controlled by varying the screen voltage, and this forms a very effective reaction control which is a great improvement on the original circuit from the point of view of obtaining one or two distant stations. The receiver is, of course, primarily intended for use as a home-station receiver, but with a good reaction circuit, and a good speaker, the combination will bring in quite a number of continental

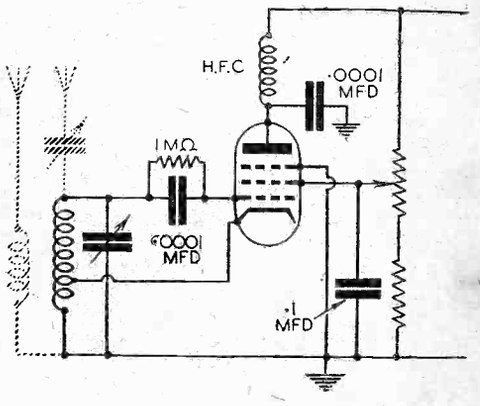


Fig. 3.—Detector circuit utilising a very effective reaction system.

stations, and it is recommended that the reaction arrangements be built up on the lines shown in Fig. 3.

The position of the tap on the coil will no doubt have to be found by experiment in order to obtain the best effect, but approximately one-tenth of the total number of turns on the coil should be permitted between earth and the tap. The variable resistance should have a value of about 50,000 ohms, and the resistance in series with it may be from 15,000 to 25,000 ohms, again the most effective value being found on trial with the particular valve in use. If a simple coil is employed the selectivity necessary to permit station separation may be obtained by the series aerial condenser, although if a commercial coil is used the aerial coupling coil could be used. The receiver was originally employed in the London area with an indoor aerial and gave full volume, although naturally in some districts it will not be possible fully to load the output stage with a simple detector—in spite of the high gain of an H.F. pentode. The valves recommended are Cossor MS/PEN/A or equivalent for the detector stage, and MP/PEN or equivalent for the output stage.

Notes from the Test Bench

Lightning Arresters

THE main feature of a lightning arrester is a small spark gap, across which a static charge could pass, but which would not permit radio signal currents to pass. If the latter point is not complied with there will be a loss of signal strength (weak reception of distant stations), whilst if the former point is not attended to there may not be a discharge and damage might arise to the receiver. A favourite idea is to use two pieces of hacksaw blade facing each other and this is quite in order, although brass or similar material might prove preferable as it will not rust and the H.F. resistance is lower. A disc of mica, with a small hole punched in the centre, and two brass square-ended rods bearing against the disc on opposite sides is a very good arrester, but whatever type is used it should be remembered that one side of the arrester is joined to aerial and the aerial terminal of the receiver, and the other side is permanently connected to earth—preferably a completely different earth from that used with the receiver.

Chassis Coupling

WE have before mentioned the fact that instability can be caused by the coupling of different parts of a circuit through the metal of a chassis. Although connected to earth, probably at only one point, there is sometimes a difference of potential existing across various parts of a chassis and this may result in the ability of the chassis to carry various additional currents, thereby introducing instability. It is thus a good plan to earth the chassis at two or three points if such instability is experienced, and furthermore to complete the screening of certain components which rely upon the chassis as part of such a screen.

Ganged Circuits

WHEN a set of ganged coils is tuned by a ganged condenser it is sometimes found that the ganging will not hold throughout the scale. It is well to remember that if the ganging becomes more out of step as the condenser is advanced, the fault is most likely to be due to the coils, whilst if the ganging is erratic, that is, it goes out of gang at one or two points in the scale but comes back into gang at others, then the condenser is most likely in need of alignment. The split-end vanes provided on a gang condenser will need adjustment in the latter case.

THE POWER AMPLIFIER IN PRACTICE

(Continued from page 476)

"matching" of load and valve impedances.

Undistorted Power and Power Sensitivity

This may, however, be looked at in two different ways—first, the load for *maximum undistorted power*, and secondly, the load for *maximum power sensitivity*.

Power sensitivity may be defined as the power for unit grid-signal, at such small inputs that the distortion factory may be neglected. It is a maximum at a given load impedance, and is expressed in terms of watts per (volt) ^{2}. Power sensitivity may be increased or decreased at will by pre-amplification, and is therefore of little importance in determining the best condition for output matching.

Undistorted power may be defined as the power for an agreed percentage of harmonic content or distortion. Its optimum load is that which enables the maximum power, including such distortion to be obtained with a suitably chosen grid input.

Fig. 13 shows how the undistorted power, and power sensitivity, vary with load for a given pentode valve.

A question often arises: How much distortion should be tolerated in expressing the "undistorted" power output of a valve as so many watts? Fortunately, the cathode-ray oscilloscope helps us here, for it has been found that those kinds of distortion, which are just audible in the average loudspeaker, are also just visible on the cathode-ray tube.

Fig. 14 shows the nature of a curve taken on a given valve in which the measured voltage output is plotted against varying load impedance, the input grid voltage being adjusted at each value of loading until visible distortion is just apparent on a cathode-ray oscilloscope.

Complications are introduced because, in practice, a loudspeaker load is *reactive*, and its impedance varies widely over the audio-frequency range and, further, that imperfections in the output transformer also modify the effect of the loudspeaker impedance as "looked at" by the valve.

Most loudspeakers exhibit two marked resonance peaks, and it has been found that the primary of an output transformer should be so designed as to present a load for maximum "undistorted" power at the bass impedance peak.

Under constant current conditions, which could be the case with an ideal pentode or tetrode of infinite impedance, and operated with correct loading, a desired frequency response could be obtained by deciding on the optimum load and constant signal voltage. It might be thought, therefore, that modification in frequency response could be obtained by modifying the transformer, i.e., the "optimum loading." However, such a modification of tone-quality by mis-matching is accompanied by a considerable reduction in available undistorted power output, and hence the desirability of a fixed loading—that is, a fixed output transformer of correct ratio and design—determined on the basis of maximum undistorted output only. Numerous methods, both electrical and mechanical, are available for modifying the overall frequency response if so desired, but the subject of "tone control" is another story.

NEW SERIES

RADIO ENGINEER'S POCKET-BOOK

COIL-WINDING TABLES

No. 13

(LONG-WAVE COILS)

Diameter of Former	Inductance 1,600 Microhenrys. No. of Slots.	Wire.	Turns per Slot.	Inductance 2,100 Microhenrys. No. of Slots.	Wire.	Turns per Slot.	Inductance 3,000 Microhenrys. No. of Slots.	Wire.	Turns per Slot.
1 in.	4	36 enam.	80	4	36 enam.	92	5	38 D.S.C.	95
	5	36 D.S.C.	69	5	36 enam.	80	6	36 enam.	85
1½ in.	3	36 D.S.C.	71	3	36 enam.	81	3	36 enam.	97
	4	36 D.S.C.	57	4	36 D.S.C.	65	4	36 enam.	78
	5	34 D.S.C.	53	5	34 enam.	60	5	36 D.S.C.	72
2 in.	3	34 enam. or 36 D.S.C.	56	3	36 D.S.C.	65	3	36 enam.	77
	4	34 D.S.C.	45	4	34 D.S.C.	51	4	36 D.S.C.	61
	5	34 D.S.C.	38	5	34 D.S.C.	44	5	34 enam. or 36 D.S.C.	53

No. 14

(MEDIUM-WAVE COILS)

Diameter of Former	Inductance 175 Microhenrys. Wire.	Turns	Length in inches.	Inductance 200 Microhenrys. Wire.	Turns	Length in inches.	Inductance 230 Microhenrys. Wire.	Turns	Length in inches.
1¼ in.	32 enam.	84	1.01	32 enam.	93	1.11	30 D.S.C.	115	1.71
	30 D.S.C.	93	1.38	30 D.S.C.	102	1.52	32 enam.	102	1.22
1½ in.	30 D.S.C.	74	1.10	30 D.S.C.	82	1.22	30 D.S.C.	90	1.34
	28 D.C.C.	94	2.24						
1¾ in.	30 D.S.C.	63	0.94	30 D.S.C.	68	1.01	30 D.S.C.	76	1.13
	28 D.S.C.	67	1.16	28 D.S.C.	73	1.26	28 D.S.C.	80	1.38
2 in.	30 D.S.C.	54	0.805	30 D.S.C.	59	0.88	30 D.S.C.	65	0.97
	28 D.S.C.	58	1.01	28 D.S.C.	64	1.13	28 D.S.C.	70	1.24
2¼ in.	26 D.C.C.	70	1.96	26 D.C.C.	78	2.18	26 D.C.C.	86	2.40
	28 D.S.C.	52	0.925	28 D.S.C.	57	1.01	28 D.S.C.	62	1.10
	24 D.C.C.	65	2.08	24 D.C.C.	72	2.30	24 D.C.C.	80	2.56
2½ in.	28 D.S.C.	47	0.835	28 D.S.C.	51	0.91	28 D.S.C.	56	1.0
	24 D.C.C.	58	1.85	24 D.C.C.	64	2.04	24 D.C.C.	70	2.24
3 in.	26 D.S.C.	41	0.86	26 D.S.C.	45	0.95	26 D.S.C.	49	1.03
	22 D.C.C.	50	1.90	22 D.C.C.	55	2.09	22 D.C.C.	61	2.32

No. 15

TWIST DRILL GAUGE SIZES

No. Drill.	Decimal Sizes.	No. Drill.	Decimal Sizes.
1	.2280	31	.1200
2	.2210	32	.1160
3	.2130	33	.1130
4	.2090	34	.1110
5	.2055	35	.1100
6	.2040	36	.1065
7	.2010	37	.1040
8	.1990	38	.1015
9	.1960	39	.0995
10	.1935	40	.0980
11	.1910	41	.0960
12	.1890	42	.0935
13	.1850	43	.0890
14	.1820	44	.0860
15	.1800	45	.0820
16	.1770	46	.0810
17	.1730	47	.0785
18	.1695	48	.0760
19	.1660	49	.0730
20	.1610	50	.0700
21	.1590	51	.0670
22	.1570	52	.0635
23	.1540	53	.0595
24	.1520	54	.0550
25	.1495	55	.0520
26	.1470	56	.0465
27	.1440	57	.0430
28	.1405	58	.0420
29	.1360	59	.0410
30	.1285	60	.0400

LETTER SIZES OF DRILLS

A	.234	H	.266	O	.316	U	.368
B	.238	I	.272	P	.323	V	.377
C	.242	J	.277	Q	.332	W	.386
D	.246	K	.281	R	.339	X	.397
E	.250	L	.290	S	.348	Y	.404
F	.257	M	.295	T	.358	Z	.413
G	.261	N	.302				

No. 16

RESISTANCE WIRE DATA

S.W.G.	Eureka. Resistance per yard.	Yards per lb.	Current Capacity.	German Silver. Resistance per yard.	Yards per lb.	Current Capacity.
18	0.37	48	3.5	0.117	51	3.5
20	0.66	85	2.5	0.315	90	2.5
22	1.10	140	1.5	0.520	147	1.5
24	1.77	227	1.0	0.844	238	1.0
26	2.65	340	0.5	1.26	349	0.5
28	3.91	502	0.25	1.85	527	0.25
30	5.58	714	0.2	2.65	750	0.2
32	7.35	943	0.15	3.50	984	0.15
34	10.13	1,300	0.1	4.82	1,360	0.1
36	14.84	1,905	.05	7.06	2,000	.05
38	28.81	3,060	—	11.83	3,295	—
40	37.18	4,761	—	17.70	4,920	—

CURRENT-CARRYING CAPACITY OF WIRE

S.W.G.	Current Capacity (Amps.).	S.W.G.	Current Capacity (Amps.).	S.W.G.	Current Capacity (Amps.).	S.W.G.	Current Capacity (Amps.).
10	19.305	19	1.8855	28	.258	37	.0545
11	15.855	20	1.527	29	.218	38	.0425
12	12.7425	21	1.206	30	.1812	39	.0318
13	9.872	22	0.9237	31	.1586	40	.0272
14	7.5405	23	0.6786	32	.1374	41	.0228
15	6.108	24	0.5702	33	.1178	42	.0189
16	4.8255	25	0.4703	34	.0998	43	.0153
17	3.6945	26	0.3818	35	.0831	44	.012
18	2.715	27	0.3168	36	.0681	45	.0093

No. 17

Copper Wire Data

Standard Wire Gauge.	Diameter in Inches.	Resistance in Ohms per Yard.	Resistance in Ohms per Pound.	Pounds per Ohm.	Weight in Pounds per 1,000 Yds.	Yards per Pound.	Turns per Inch. Enamel Covered.	Single Silk Covered.	Double Silk Covered.	Single Cotton Covered.	Double Cotton Covered.
10	.128	.001868	.0120	83.3	148.8	6.67	↓	7.64	7.55	7.35	7.04
11	.116	.002275	.0200	50.0	122.2	8.16		8.41	8.30	8.06	7.69
12	.104	.002831	.0280	35.7	98.22	10.23		9.35	9.22	8.93	8.48
13	.092	.003617	.0550	18.1	76.86	13.00		10.5	10.4	10.0	9.43
14	.080	.004784	.0820	12.2	58.12	17.16		12.1	11.8	11.4	10.6
15	.072	.005904	.1400	7.14	47.08	21.23		13.3	13.1	12.5	11.6
16	.064	.007478	.2021	4.95	37.20	26.86	15.0	14.9	14.6	14.1	13.2
17	.056	.009762	.3423	2.38	28.48	35.00	17.1	16.9	16.5	15.9	14.7
18	.048	.01328	.6351	1.56	20.92	47.66	19.8	20.0	19.4	18.5	17.2
19	.040	.01913	1.315	.757	14.53	68.66	23.7	23.8	23.0	21.7	20.0
20	.036	.02362	2.012	.497	11.77	85.00	26.1	26.3	25.3	23.8	21.7
21	.032	.02990	3.221	.309	9.299	107.6	29.4	29.4	28.2	26.3	23.8
22	.028	.03905	5.498	.181	7.120	140.6	33.3	33.3	31.8	29.4	26.3
23	.024	.05313	10.14	.098	5.231	191.6	38.8	38.5	36.4	33.3	29.4
24	.022	.06234	14.38	.069	4.305	228.3	42.1	42.1	40.0	35.7	31.3
25	.020	.07653	21.08	.0471	3.632	275.3	46.0	46.0	43.5	38.5	33.3
26	.018	.09448	32.21	.0309	2.942	340.0	50.6	50.6	47.6	41.7	35.7
27	.0164	.11138	46.55	.0215	2.442	410.0	55.9	55.1	51.6	44.6	37.9

No. 18

DRILLS AND DRILLING

WHITWORTH THREADS

Diameter	1/8in.	5/32in.	3/16in.	1/4in.	5/16in.
Tapping size	3/32in.	No. 31	9/64in.	3/16in.	Letter D
Clearing size	7/64in.	11/64in.	13/64in.	17/64in.	21/64in.

B.S.F. THREADS

Diameter	1/4in.	9/32in.	5/16in.	3/8in.
Tapping size	No. 5	Letter B	Letter G	Letter O
Clearing size	17/64in.	19/64in.	21/64in.	25/64in.

B.A. THREADS

Diameter ..	0	1	2	3	4	5	6	7	8
Tapping size	No. 10	No. 17	No. 24	No. 29	No. 32	No. 37	No. 43	No. 46	No. 50
Clearing size	Letter B	No. 3	3/16in.	No. 19	No. 27	No. 30	No. 33	No. 39	No. 43

WOOD SCREWS

Size No. ..	00	0	1	2	3	4	5	7	7	8
Clearing size ..	No. 52	No. 51	No. 50	No. 44	No. 40	7/64in.	1/8in.	9/64in.	5/32in.	11/64in.

New Trade for the R.A.F.

Recruiting for Radio Mechanics Starts

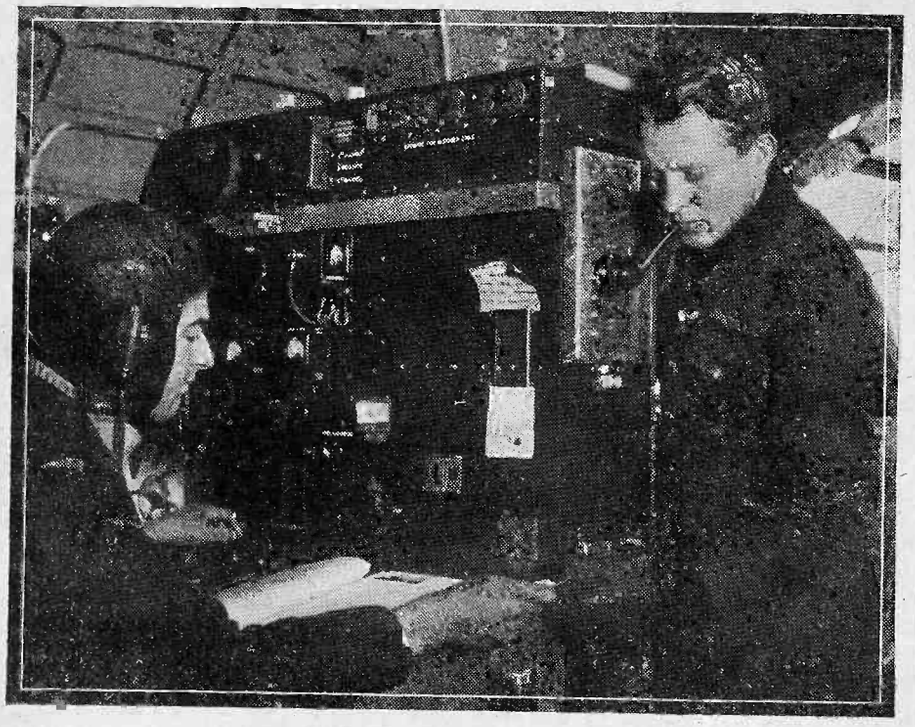
THE Air Arm is the most mobile and quick-striking of all the weapons of modern warfare. The air war is one of rapid actions and counter actions, which call for quick decisions from Air Staff. These decisions can neither be made nor carried out without a rapid and efficient communication system.

That system is provided for the R.A.F. by a vast radio organisation.

As the tempo of aircraft production gathers greater speed and the front line strength of the Air Force attains ever greater proportions, it becomes necessary to expand the radio communication system which welds that multitude of individual aircraft and crews into one mighty unit for the prosecution of the war.

Radio mechanics will first undergo a short course of disciplinary training, after which they will be sent for special training without delay.

The type of man required for the new trade must have a sound knowledge of radio and above all the keenness and intelligence to "reason why." He may be found among professional radio engineers or in the ranks of the enthusiastic radio amateurs. A knowledge of morse is not required. He should be between 18 and 50 years of age, and will be required, with few exceptions, for ground duties only. Flying will be voluntary, and although required mainly for Home Defence, service in various parts of the world under the R.A.F. may be obtained.



The captain on one of our Coastal Command flying-boats, takes a code message. Radio mechanics are needed at once in connection with the installation, maintenance and upkeep of the R.A.F. radio equipment.

The time for an expansion of the radio organisation of the R.A.F. has arrived.

Last week the Air Ministry announced the inauguration of a new specialist trade category in the R.A.F.—that of "radio mechanic." Recruiting is now open for men with the right qualifications for this new trade.

Promotion in a Day

Recruits of the highest quality are required in considerable numbers. Applicants will have to undergo a fairly stiff examination. If accepted they will enjoy the unusual privilege of being reclassified, the day after enlistment, as Leading Aircraftmen with pay at the rate of 5s. 6d. a day plus allowances.

How to Apply

1. Application for the post of radio mechanic should be made to the candidate's nearest Combined Recruiting Centre, or to the Air Ministry Information Bureau, Kingsway, London, W.C.2.

2. If the candidate is considered suitable by the Recruiting Officer, he will be sent to a Receiving Centre for a technical test by the Trade Test Board (a free travelling warrant will be issued for this purpose).

3. In no circumstances should candidates give up their civil employment until they have passed their trade test and been given definite instructions to report for duty.

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.

PROPOSED RADIO CLUB FOR WATFORD AND DISTRICT

AT an informal meeting held in Watford recently it was decided to consider the possibility of forming a local radio club. It was suggested that an open meeting should be held on Wednesday, the 21st inst., at 7.30 p.m., at No. 8, St. John's Road, Watford, to elect members for Committee. Will all those interested please communicate with Mr. J. Norwood, 173, Hampermill Lane, Watford, Herts.

ASHTON-UNDER-LYNE AND DISTRICT AMATEUR RADIO SOCIETY

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

Hon. Secretary: K. Gooding, 7, Broadbent Avenue, Smallshaw, Ashton-under-Lyne, Lancs.

AT a recent meeting, G3BY demonstrated a new audio amplifier which he has constructed. The combination was rather unique, consisting of a 6C5 push-pull transformer-coupled to the two halves of a 6F8 (twin triode). Direct connections were used for the coupling, without any condensers. The output valves work with positive bias on the grids all the time, and consequently are always working on the straight part of their curves. By this method of coupling, a certain amount of negative feed-back is also obtained. With 250v. H.T., 9-watts output was obtained with a very low percentage harmonic distortion.

The Chairman, W. P. Green, and J. Phillips have constructed a professional-looking signal generator for the club, and there is a long waiting list of members who wish to line up their I.F.'s.

The morse classes are also very busy, and it is prophesied that the club will soon be able to boast of a 100 per cent. C.W. membership.

THE SURREY RADIO CONTACT CLUB.

Hon. Sec.: S. A. Morley, 22, Old Farleigh Road, Selsdon, Surrey.

THE February meeting of the above club was in the form of a "Query Bee." Each one present was given a slip of paper upon which was written a subject, and each person had to give a short talk on the subject which was written upon the paper.

(Continued in next column.)

Many of the speakers raised debatable points which were open for discussion, and quite an appreciable amount of knowledge was gained in this way.

The March meeting will be the annual general meeting.

A NEW ELECTRON MULTIPLIER DESIGN

THE number of designs used for practical examples of electron multipliers using secondary emission is increasing at quite a rapid rate, and in each case claims are put forward emphasising the advantages associated with the new models when compared with their earlier prototypes. In this class is one of the new successive impact forms of electron multipliers whose design is very ingenious. The main or first emitting cathode, together with the secondary emissive or target electrodes, is made in the form of rings which are mounted at regular intervals one below the other so that they are concentrically displaced to a wire running down the centre of the tube. To this is applied a high positive potential, while the final collecting anode is a concave-shaped metal surface at the end of the tube. Surrounding the outside of the glass tube is an electro magnet which serves to produce a magnetic field along the axis of the tube. When electrons are released from the initial cathode the dual action of the coil's magnetic field and the centre rod's static field force the electrons to impact each of the hollow cylindrical target electrodes in turn. As a result of secondary emission at these electrodes it is claimed that there is an amplification factor of between six and ten at each stage, and obviously the overall magnification is in direct proportion to the number of target electrodes incorporated in the device.

BOOKS RECEIVED

SHORT-WAVE RADIO. By J. H. Reyner, B.Sc. (Hons.), etc. 174 pp. 93 illus. Published by Sir Isaac Pitman and Sons, Ltd. Price 10s. 6d.

THIS is the second edition of a book first published in 1937, dealing with the entire subject of short waves—both from the transmitting and receiving points of view. The book first discusses what short waves are, then passes on to the propagation of wireless waves. Subsequent chapters deal with Aerials and Feeders; Aerial Arrays; Receiving Aerials; Short-wave Transmitters; Modulation; Short-wave Receivers; Ultra-short Waves and Micro Waves. A moderate amount of mathematics is included, and illustrations make the various explanations perfectly clear. The book is invaluable to those who are interested in the short waves.

THE SUPERHETERODYNE RECEIVER. By A. T. Witts, A.M.I.E.E. 183 pp. 114 illus. Published by Sir Isaac Pitman and Sons, Ltd. Price 3s. 6d.

THIS is the fourth edition of a valuable treatise on the modern superhet receiver which has been previously reviewed by us. It covers every phase of the superhet from the principles involved to explanations of several modern commercial receivers and includes a section on the maintenance of this particular type of receiver. The final chapter now deals with the superhet as applied to the reception of television.

PROBLEMS IN RADIO ENGINEERING. By E. T. A. Rapson, M.Sc.(Eng.), etc. 123 pp. Published by Sir Isaac Pitman and Sons, Ltd. Price 5s.

THIS is the seventh edition of a popular volume of problems which have been collected and classified to facilitate the class work in Radio Engineering. The problems are drawn from past examination papers of the City and Guilds of London Institute in Radio Communication, the Institution of Electrical Engineers in Electrical Communications and the University of London in Telegraphy and Telephony.

PRACTICAL TELEVISION

February 24th, 1940. Vol. 4. No. 191.

Early Scanning Experiments

THE death, a short time ago at the age of 75, of Mr. L. B. Atkinson served to recall the little-known fact that this very versatile electrical engineer produced as far back as 1882 models for demonstrating the analysis and synthesis of images by the use of revolving mirrors. The simple principles which his fertile brain conceived were shown at a television exhibition a few years ago. As photo-electric cells were almost unknown at that period, these scanning devices were designed to work in conjunction with selenium which, as readers know, was later abandoned for television purposes because of the inherent sluggishness of its reactions to changes to light. According to the claims of the inventor, revolving mirrors were employed for analysing the image, that is, projecting every part in turn on the light sensitive cell, and another set of mirrors for integrating the image from the light pulses. Bearing in mind that the inventor was under 20 years of age when conducting his experiments, it is interesting to record the suggestions made nearly sixty years ago and see how they differ so radically from present-day equipment, which is based primarily on wholly electronic methods of synthesising. Some of the receiver suggestions depended on the use of telephone receivers to which the mirrors were attached, and the varying currents caused the mirrors to produce a combined line and frame-scanning action. No records appear to be available showing what degree of success was obtained with these models, but they serve to show the enormous progress which has been made in recent years in perfecting a service which the rigours of war has temporarily removed from everyday life.

Television Aerial Considerations

WHEN consideration is given to the frequency-band width of a modern high-definition television signal, it is realised that fairly stringent requirements have to be met in the case of aerials, both transmitting and receiving, together with their associated transmission lines. Unless this is done there is a loss of power transference coupled with the annoying ghosts or multiple image effects which are all too evident in the received picture built up on the home-set screen. If it is possible to so design the input circuit of the television receiver that it presents a pure resistance to the feeder line, and is equal to the characteristic impedance of the line over the whole band of picture frequencies involved, then the difficulties associated with the design of a satisfactory receiving aerial are minimised very considerably. Many experiments are being conducted in America to find the most satisfactory solution of the aerial problem in so far as it relates to practical equipment. In one case what is termed a folded dipole has been developed. This is really a pair of closely-spaced half-wave aerials which are connected together at their ends. One of these dipoles is broken at its mid-point where it is fed by a balanced transmission feeder cable. Yet another scheme is to use a double-cone aerial, that is, two copper cones with their apexes joined at the centre. Since all television transmissions in America are horizontally polarised there is no difficulty in supporting such a device, but in this country a scheme of that character would not find favour. It satisfies the most rigid of requirements in respect to the band width of frequencies which the aerial has to deal with, but for most general purposes the simple half-wave dipole seems to meet normal conditions. Mechanically there is everything in its favour, and judged on performance with the majority of good-quality home receivers and using efficient feeder cable connections, it would appear that this will be the most popular device for some time to come.

Noise-level Problems

ONE of the most important problems which beset the engineer responsible for the design of a television receiver is that associated with what has commonly come to be known as noise level. Without any previous knowledge of the nature of the location at which the set is to be employed, the reduction of noise level to an economic figure cannot be properly assessed. If refinements of an elaborate character are introduced to reduce the noise level of the set to a very low figure, all this work is nullified if the viewer is situated in a locality where interference noises are of a very high order. These are the conditions which American television receiver manufacturers are called upon to face. That continent is the home of multitudinous domestic electrical appliances, flashing signs, lifts, countless motor-cars, and so on. All of these are potential sources of electrical interference, the effects of which manifest themselves all too prominently on the cathode-ray tube receiver screen. These electrical disturbances in their various forms are found very frequently to exceed the internal noise level of the receiver, and satisfactory pictures cannot be obtained unless the received signal has a value of several millivolts. In places free from interference it has been found an advantage to employ a radio frequency stage in the set, as this has the effect of reducing the noise level of the set, and in consequence the observed picture is relatively free from overall mush. Of course, there are other considerations to be borne in mind when considering the desirability of incorporating a radio frequency stage. For example, there is the question of reducing the interference effects from strong signals which might be present on an adjacent carrier channel. In any case, various practical factors have to be taken into consideration in addition to the fundamental theoretical ones, and it is for this reason that the set-designers' task is far from being the sinecure that many people imagine.

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).

"The Rapide 3"

SIR,—I have been a reader of your excellent journal for the past eighteen months, and have derived much pleasure and knowledge from its pages. Other readers may be interested to know that the "Rapide 3" which I built from instructions given in PRACTICAL WIRELESS is still giving admirable service. I have not constructed any receivers since that one, but I hope I shall have the pleasure of making your new 1940 set when it is released in March. If any beginner reads this letter who is looking for a straightforward set to build, I thoroughly recommend the "Rapide Straight 3," as it gives good results, and is quite cheap to construct. I understand that the blueprint is still available. If any reader would like to correspond with me I should be highly delighted, and will endeavour to answer all letters received. In fact, if J. A. Blandon, of Horsham, reads this letter I hope he will write to me. Also, if any reader has any second-hand "Telsen" L.F. choke of 100 henries or 20 henries, would he please communicate with me? The 20 h. choke is the most important. I would also like to purchase a blueprint or circuit of the "Telsen Empire Screen Grid 4." I wish your paper every success in the future, and hope it will continue to keep me interested in radio for many years to come.—J. PARKER, The Nautical Training School, Heswall, Cheshire.

Correspondents Wanted

SIR,—I would like to correspond with any young reader of PRACTICAL WIRELESS who is a beginner in wireless. I am a fairly new reader of your excellent paper, and hope to read it for many years to come.—F. DUMBILL, "Windyridge," Congleton Road, Talke, Stoke-on-Trent.

SIR,—I am wondering if there is any reader in this district who is thinking of learning the Morse Code, and who is interested in short-wave listening. If so, I would like to communicate with him. I have been a keen short-wave listener for two years now, but I was evacuated recently and have not a short-wave receiver here, at present. My set is the Economy One-Valver, with an L.F. stage added.

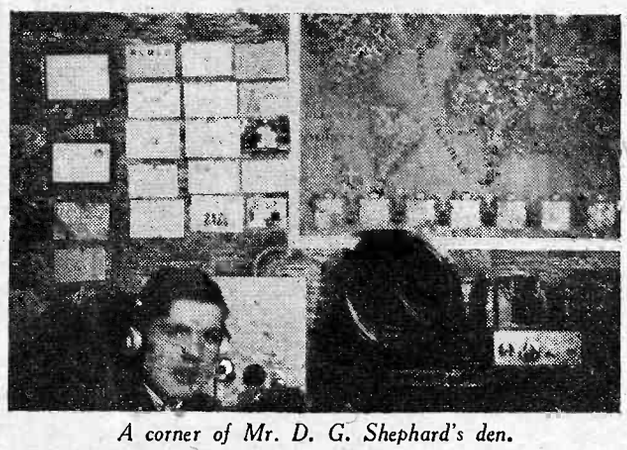
All my knowledge of wireless has been gained from PRACTICAL WIRELESS, and I am very pleased that I can still get it under present conditions. With best wishes for the continuation of your good work.—PETER HORN, c/o Mr. Howard, Warwick House, Long Road, Carlton Colville, Nr. Lowestoft.

The "Admiral Four"

SIR,—I would be greatly obliged if any reader who has built the "Admiral Four," would kindly get in touch with me—G. BROWNLOW, "Avoca," Ballinderry Road, Lisburn, Co. Antrim, Ulster.

A Reader's Den at Tottenham

SIR,—I have always been very interested in photos of readers' dens which have appeared in PRACTICAL WIRELESS from time to time, and I enclose a photo of my den which may interest other readers. My



A corner of Mr. D. G. Shephard's den.

receiver is an o-v-1, which is fed into the D. D. pen section of a mains set. I have a vertical aerial on the roof and a 20-metre doublet in the loft; also a small experimental doublet in my room.

It may interest readers to know that when taking the photo I used "Selo" ultra-rapid film, and gave it 20 seconds exposure at f.8.8. I used three lamps for lighting, one 150w. and two 60w. lamps. I should like to exchange my S.W.L. card with anybody at home or abroad. I Q.S.L. 100 per cent. In closing I should like to wish your fine journal every success in these difficult times.—DENNIS G. SHEPHARD, 82, Brentwood Road, Tottenham, N.17.

Full-wave Detection

SIR,—I was interested in reading the article on Old Circuits in your issue dated January 6th, and particularly the *full-wave detector* circuit using two crystal detectors, one at the "top" and one at the "bottom" of a centre-tapped coil. It is noted that the writers of the article were never successful in obtaining any better reception than could be obtained from a single crystal.

I have not proved it, but am of the opinion that full-wave detection of radio frequencies is impossible—or, in other words, that there is no such thing as full-wave detection of radio frequencies by any method. If anyone challenges this statement will he please forward full experimental proof to the contrary?—D'ARCY FORD (Exeter).

Frost and Radio

SIR,—I was very interested in a recent paragraph in your journal under the heading "Frost and Radio," and think that my own experience may help to solve the mystery.

I had an A.C. receiver working quite normally on my test bench when it was switched off for the night. Next morning, however, when it was switched on the set was dead except for a hum that shrieked smoothing trouble. On examination I found small beads of ice had formed on top of the electrolytic condensers, which were of the wet type. The condensers were also cold to touch and I came to the conclusion that they were frozen.

I placed my 60-watt bench lamp close up to them, and left it for about half an hour. When I switched on again the set was quite normal.

I have never heard of this trouble before, so perhaps some reader can inform me of the freezing point of this type of condenser.—VICTOR T. RUSSELL (Chingford).

Exchanging S.W.L. Cards

SIR,—I have been a reader of your fine paper for nearly a year now and take this opportunity to thank you for such a useful paper. I am particularly interested in the "Impressions on the Wax" page, which I think is a useful guide. I would like to exchange my card with any other S.W.L.s, A.A.s or "hams" either at home or overseas, and will Q.S.L. 100 per cent.—F. H. POYSER, The Hospital, Debden Road, Saffron Walden, Essex.

SIR,—I offer my congratulations for your excellent journal. I would like to exchange cards with any S.W.L., A.A., or full ham anywhere.—J. E. CHARLESWORTH, 35, Town Terrace, Leeds Road, Huddersfield.

Prize Problems

PROBLEM No. 388.

JEROME had a three-valve battery receiver employing S.G., Detector and Pentode stages. He connected a new pick-up to the detector stage, with correct connections and bias, but although it worked, it did not give sufficient volume. He therefore decided to add a further stage, and thought that the H.F. stage could be converted for the purpose. He broke the grid circuit of this stage and connected the change-over switch so that the pick-up would be correctly connected, and a 1.5 volt grid-bias tapping was tried. He failed to obtain any signals, however, and in spite of cutting out bias entirely, no results could be obtained. Why was this? 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. 388 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, February 26th, 1940.

Solution to Problem No. 387.

The coil in Dickson's coil unit was internally connected to the screening can and, therefore, when he earthed the latter he was actually short-circuiting the input circuit of the receiver, as the lower end of the wave-trap coil was connected to the receiver aerial terminal.

The following three readers successfully solved Problem No. 386 and books have accordingly been forwarded to them: F. G. Alison, 149, Bravington Road, Maida Hill, W.9. D. King, Stalham Hall, Norfolk. Sgm. Cockill, E. G., 11, Park Terrace, Glasgow.

In reply to your letter

Motor Tuning

"I have a mains set which is fitted with a motor-tuning device, and this has been giving a bit of trouble lately. Sometimes when trying to get a new station the dial keeps going and does not stop, or else it runs for a little while and then stops. After this, pressing the button does not have any effect until the set has been switched off for a time and then it will work properly. I wonder if you can explain the cause of this trouble and how I may cure it."—L. K. (Colindale).

WE think that the instrument is quite in order, but that in pressing the button for a station you accidentally depress the next to it. On some motor-tuned sets the operation of two buttons at once may make the motor run continuously, or until some automatic switch device fitted to the motor comes into action and prevents the motor burning out. The effect of the motor running for a period like this will result in overheating, and thus you must switch off for a time to permit it to cool before it will become effective again. Make certain, therefore, that only one button at a time is pressed.

What Is An Abac?

"I was reading one of your back numbers and you said that it was possible to get the number of turns for a coil from an abac. I should be glad if you could tell me what this is and where I can obtain one for coils. Perhaps you could also give the price."—C. E. S. (Harrogate).

AN abac is a form of calculating table generally consisting of three vertical lines placed in definite positions in relation to each other. In the case of coil abac one line would carry the inductance values, one the wavelength and one the capacity required, and then by placing a straight-edge across the three lines so that the desired wavelength and the capacity being used are in line it would be possible by following the straight-edge to see what inductance is needed. A similar table could be prepared to show the number of turns per inch for a given inductance and any other factor. We have not published any sets of these.

Superhet Oscillator

"I am very interested in the superhet receiver, and I have been studying the principles of this from the various articles you have written. There is just one point about which I am in some doubt, and I should be glad if you could assist me in ascertaining the reason for the grid condenser and leak in the oscillator grid circuit. Does this perform the same function as in a grid leak detector?"—S. R. (Penge).

THE combination of the condenser and leak acts as a smoothing device to ensure constant oscillation in the oscillator circuit. Should excessive oscillation take place grid current will flow, and this will produce an increased voltage drop down the grid leak, increasing the negative bias and thereby reducing anode current and thus restricting the oscillatory voltage.

A.V.C. Circuit

"I have been trying to fit A.V.C. to my set with parts which I had on hand. I enclose a circuit which I have been trying to use, and have marked out one or two parts which I do not think are essential and should be glad if you could explain why this will not work. I am only interested in obtaining the basic arrangement and wish for a start to cut out all refinements."—K. S. E. (Kettering).

YOU have apparently attempted to cut out the decoupling components, but in doing so have overlooked the fact that one of the resistances in the circuit is the load resistance, across which the A.V.C. voltage is developed. Without this there is no voltage for application to the early stages for volume control purposes. The resistance in question is that joined direct from the diode to earth and the A.V.C. line may then be taken as at present from the diode. You may find, however, that it will be necessary to include one decoupler for the I.F. stage.

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.

Condenser Discharge

"I have made a four-valve A.C. set and enclose the wiring herewith. The set is perfectly good except for one small detail, and that concerns the switching. When I switched on for the first time everything was good. I switched off after a short period of listening in order to place the chassis in the cabinet. When I touched the electrolytic condenser on the mains side I got a shock. I did not trouble about this at the moment, but I have since found that if I switch off for only two or three seconds and then switch on there is a tremendous hum and distortion, but if the set is switched off and left for two or three minutes it performs perfectly when switched on again. Perhaps you can explain this."—E. T. C. (St. Albans).

WE think the effects mentioned are merely due to the method of connecting your electrolytic condensers on the mains side. These are correctly joined on each side of the smoothing choke, but we note that you have connected the negative side of these two condensers direct to the centre tap of the secondary winding instead of to earth (chassis). The on/off switch you have included breaks the centre tap lead and thus the condensers cannot discharge in the usual way as they are isolated when the set is switched off. Incidentally, it is not usual to place a switch in the H.T.— lead and this is only included in sets of the communications type for "send" and "receive" switching, and it is not necessary to use this switch in addition to the ordinary on/off switch in the mains primary leads. We therefore suggest you ignore this section of your multi-switch and connect H.T. negative (centre-tap) direct to earth and this should cure your trouble.

A.C. Hall-Mark 4

"I have obtained a blueprint for this receiver, but on applying to the firm you recommend I am told that the mains transformer has been discontinued. I should be glad if you could give me full details of the transformer so that I can obtain one elsewhere or wind one myself. Also, where could I obtain a substitute for the mains dropping resistance in the Universal Model of this receiver?"—C. P. (N.10).

THE transformer in question was designed with two secondary windings, one delivering 4 volts at 4 amps. for the four valves, and the other 150 volts at 300 mA for use with an H.T.10 rectifier in a voltage-doubler circuit. This rectifier is also discontinued but is replaced by the H.T.17, of similar characteristics. The voltage dropping resistance for the other model may be obtained from Messrs. Bulgin.

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.

M. J. R. (St. Albans). Several firms make the type of set mentioned. We suggest you write to Stratton & Co., Ltd., of Eddystone Works, Bromsgrive Street, Birmingham, 5, and the G.E.C., of Magnet House, Kingsway, W.C.2. The latter firm make a special set for tropical use, whilst the former can supply details of a home-made receiver.

R. L. H. (Rawcliffe Bridge). We have not published a design of the type you require. There is one commercial model, we believe, although it is not certain at the moment that this is on sale in this country yet.

A. B. (Luton). The trouble may not be due to the ratio but to L.F. instability. Try reversing the connections to the secondary of one of the transformers, and if this is unsuccessful decouple one of the stages.

I. J. T. (Harrow). We do not recommend the set now as the valves are not obtainable. With regard to the other set the coil is not now obtainable, but plug-in coils could be used. The transcoupler may be obtained from Bulgin, type L.F.10, price 11s. 6d.

F. A. (Barrow-in-Furness). Messrs. Dubilier can supply a component of the type mentioned, under the name Fadover. The price is about 7s. 6d. We do not know of an L.F. transformer with the ratio mentioned, but a mains transformer with a 2.5 volt secondary would give a ratio of 100 to 1. Would this suit in your case?

J. W. W. (Lewisham). Write to the Hon. Sec., E. A. Gibson, New Eltham Ratepayers' Association (Radio Section), 87, Montbelle Road, New Eltham, S.E.9.

T. W. Y. (York). We regret that we have no details now available concerning the particular speaker mentioned.

A. S. B. (Luton). The trouble may be threshold howl or some other form of instability, and is no doubt due to the general design on the short-wave section. We are unable to advise more definitely without a circuit or other details.

P. N. (Barbourne). Write to the Recruiting Officer, R.A.F., Air Ministry, Kingsway, W.C.2.

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

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.		
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The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve: Blueprint, 1s.		
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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
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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.		
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A.C. Twin (D (Pen), Pen)	—	PW18
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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
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D.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
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F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four	16.1.37	PW73
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The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve: Blueprints, 1s. each.		
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The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)	1.10.38	PW68

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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.

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PRACTICAL WIRELESS, 24/2/1940

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With heavy-duty Pentode Speech Transformer **17/6** each
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