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Specifications similar to Model 3466 but operating from A.C. Mains. Complete with four Cossor A.C. Mains Valves, etc., MVSQ mfr., 41 MH mfr., 41 MF and 44 RLU. Illuminated tuning dial. Evergreen Moving Coil Speaker. For A.C. Mains only. 200/220 volts adjustable. 4/100 cycles.

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As Model 3964, but for D.C. Mains only. Complete with three Cossor D.C. Mains Valves, etc., DVSQ mfr., Variable-Mu SO, DHL mfr. Treble and HP Output. For D.C. Mains only. 200/220 volts adjustable.

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Legs are detachable on all Console Models, and the receivers can be used as table models with legs detached.

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To A.C. COSSOR LTD., Melody Dept., Highbury Grove, London, N.3
Please send me a copy of your photogravure catalogue of Cossor Receivers (B.30)

Name

Address

B.20 FRAG NAIL

[Stamp]
OUR bold move in starting a cheaper home-conducted radio campaign met with an immediate gratifying and almost overwhelming success. It is fitting that Practical Wireless, which always takes the lead, should do so upon the theory of price. For many months our readers have complained of the competition of the cheap commercial receiver, and it was with the sincere desire to remedy this state of affairs that we embarked upon the vigorous policy of designing our receivers on a low-price-high-efficiency basis. The Leader Three, and the A.C. Leader are the first receivers to be designed on this system, and it is pleasing to us to learn that so many thousands of these receivers have been made up, notwithstanding fierce competition from other sources. Our thanks are due to the several manufacturers who co-operate with us by designing special components at a low price, but of their usual high standard of efficiency. We shall continue this campaign with unabated enthusiasm, and welcome letters from all our readers as to the style of receiver they would like so that we can plan well ahead.

Cash Prize of 20 Guinea, and 200 Other Prizes

As an earnest of our desire to serve our readers in the widest interpretation of our terms, it is with extreme pleasure that we announce on another page of this issue, preliminary details of the fascinating competition with a first prize of 20 guineas and 200 other prizes. The object of this competition is to provide both ourselves and the manufacturers, namely, Messrs. Varley, Ltd., with data concerning their new device for overcoming the interference problem—we refer to their new bifocal coils. We feel sure our readers will appreciate our sincere motives in instituting a nation-wide test of this remarkable component. We want our readers to help us by testing these coils in their own receivers, and next week we shall give full details showing how they may be incorporated in a few moments into any of the usual circuit arrangements. As an inducement to the many thousands of readers who have already purchased these coils to send us this information (which we shall afterwards place at the disposal of the manufacturers)—

Messrs. Varley, Ltd.—we offer a first prize of 20 guineas to any 200 consolation prizes already referred to.

New Broadcasting Stations for Rumania

Two new Marconi transmitters have recently been ordered by the Romanian Broadcasting Company. One is of the “super-power” class, with an aerial energy of 150 kilowatts, and the other of 20 kilowats less. The aerial power, and both incorporate several interesting features such as “series modulation,” aerial icing-melting plant, and specially developed water-cooled transmitting valve.

STILL LEADING THE WAY!

We are proud to be able to announce that we have secured the whole-hearted co-operation of a large number of important manufacturers in the production of cheaper high-class components for home-construction. As a result of our campaign, it is now possible for any reader to make up an efficient receiver at a fraction of the cost of the cheapest commercial receiver.

Read also the preliminary details regarding our TWENTY GUINEAS Cash Prize Competition with 200 other valuable prizes, on PAGE 67.

Russia extends Her Wireless Net

A NEW decree issued in the Soviet Union calls for the construction of thirteen high-power transmitters, to be brought into operation before the end of 1935. As some of these are to be installed on the western and south-western frontiers, it is anticipated that their official opening will coincide with a wave of broadcast propaganda destined to neighbouring States.

Egypt Calling!

THE 20-kilowatt transmitter, which the Marconi Company is erecting on behalf of the Egyptian State Broadcasting Service at Abu Zabal, near Cairo, is rapidly nearing completion, and may start its initial tests during April on 483.9 metres, a channel which it will share with Brussels (No. 1). In addition to broadcasts of a nature to interest the native population, special programmes will be transmitted for the foreign communities as well as daily news bulletins in Arabic, French, and English. Broadcasts are to be made of both Oriental and Western European dance music. Little use will be made of gramophone records, of which, so far, listeners in Egypt have had a surfeit through the small privately-owned stations. It is also hoped to make arrangements by which performances may be relayed from the Cairo Opera House.
**ROUND the WORLD of WIRELESS (Continued)**

**The Musical at the Gramophone***

LESLIE HOWARD, conductor of the City of Birmingham Orchestra, embarks on a new venture at the microphone on April 13th. He begins a series entitled "The Musician at the Gramophone," embodying programmes of serious music. The first instalment is of Elgar's symphonic poem, "Falstaff"; it is to be followed by records of Verdi's opera on the same theme.

Strange Music of Other Peoples

"Sweet is the music of Arabia," says the poet. But is it? Listeners may amuse themselves by listening to Philip Thornton, who, starting on May 5th, will play for them on each successive Saturday music gathered from as many strange countries as train, boat, bicycle, aeroplane, or flat feet will permit. They will hear the music of other peoples, who have discovered great beauty in sounds quite unlike those to which we are accustomed in Europe. Music can often speak more effectively than words. Perhaps listeners will decide at the end of the series that differences are between individual as much as between nations, even though they be separated by the width of the world.

Old Time Melodrama from the London Regional

In the London Regional programme for April 9th, for an hour, listeners will have an opportunity of enjoying the full-blooded thrills and horrors of old-time melodrama. From 9.15 to 10.15 p.m., Mr. Tod Slaughter and his famous company of dramatists in most parts of the country, and the broadcast should revive many happy memories. The production of "Sweeney Todd," by W. S. Gilbert, will include full measure of the dramatic musical accompaniments and orchestral effects so much to heighten the atmosphere of the famous old play. Let it be noted, too, that this is no hoary appeal for the highbrows, but a straight production of a really popular old drama.

"Down to the Sea in Ships"

**SOLVE THIS!**

**PROBLEM No. 80.**

*By removing the rectifying valve from the A.C. Amplifier, what happens to the output?*

**SOLUTION TO PROBLEM No. 80.**

Only two readers solved the previous Problem No. 79, and both have been forwarded to...

**Barstommer will present the lurid melodrama, "Sweeney Todd, the Demon Barber of Fleet Street." Mr. Tod Slaughter recently had great success in a Music-hall programme, and this special radio version of "Sweeney Todd" should give him and his company full scope. London playgoers particularly have warm memories of Tod's season of melodrama at the Elephant Theatre some years ago, and he has lately been appearing in the Old-Time Music-hall programmes at the Garrick Theatre. He has played melodrama in most parts of the country, and the broadcast should revive many happy memories. The production, which is in the hands of Lawrence Gilliam, will include full measure of the dramatic musical accompaniments and orchestral effects so much to heighten the atmosphere of this famous old play. Let it be noted, too, that this is no hoary appeal for the highbrows, but a straight production of a really popular old drama.**

**April 7th, 1934**

**PRACTICAL WIRELESS**
PRACTICAL WIRELESS

PRELIMINARY DETAILS OF
OUR GREAT NATIONAL COMPETITION
First Prize: 20 GUINEAS Cash
200 Consolation Prizes of Wireless Valves, Speakers and Books

"Practical Wireless" Readers to Act as Independent Test Experts of a Marvellous New Selectivity Device

NO ENTRANCE FEE!

OUR readers have doubtless noticed recent advertisements of Messrs. Varley, Ltd., of their new bifocal coil, which they have specially produced to overcome in a simple and practical way the interference and the jamming problem. This really efficient and clever device is the result of many months of intensive research work on the part of the Varley engineers, to place before home constructors a really reliable selectivity device which can be incorporated quickly by any constructor in the usual circuit arrangements.

These bifocal coils have been exhaustively tested in various parts of the country, but obviously it is quite impracticable for it to be tried by the manufacturers in every village and hamlet. For one thing this would take up an inordinate amount of time, and, secondly, it would be extremely costly.

We have had one of these coils under test and find that the claims of the manufacturers detailed on this page are amply justified. Many hundreds of these coils are already in the hands of home constructors, and we have great pleasure in cooperating with Messrs. Varley Ltd., by inviting our readers to send in their reports on the results obtained from this coil to enable a nation-wide analysis to be made of them. In other words, we seek the co-operation of our readers as independent test experts on this new and almost epoch-making radio device, which makes its appearance at a time when the selectivity problem has reached its most acute stage.

As an inducement to our readers to act in this way, we have great pleasure in announcing that we shall offer a Cash Prize of 10 Guineas, and 200 Consolation Prizes of Wireless Apparatus, Books, etc., for what the judges consider to be the best reports and circuit arrangements sent in. Full details and rules of this competition will be given in next week's issue, but we can say in advance that there will be no entrance fee and that a special staff of adjudicators will give special attention to every competition entry. Next week we shall show you how to incorporate these new coils in most of the standard circuits arrangements. They may be added to your set quickly and the connections are quite simple, so that if you are not quite au fait you will stand the same chance of winning the prize as the more skilled experimenter. We shall give theoretical diagrams as well as wiring diagrams. A point worthy of note is that it is not necessary to build up a special receiver for these coils, which enable you to focus your set to the station it is desired to receive. We feel quite certain that our readers, who have so enthusiastically supported us in the past, will not hesitate to put their experience with this new device at the disposal of the constructors through the medium of this paper. The judges will be independent, and not associated with the radio industry, and will be presided over by the Editor of PRACTICAL WIRELESS.

We give here some technical details of these coils.

TECHNICAL DETAILS OF THE VARLEY BIFOCAL COIL
Embodying a Novel System of Selectivity Control.

It is unnecessary to stress the point that modern broadcasting conditions demand a degree of selectivity greater than has ever previously been called for in any type of receiver. During the past year or so great strides have been made in the direction of obtaining increased selectivity with even the simplest kind of set, but in many instances a very important fact has been overlooked. It is all very well to make tuning ultra-sharp so that local transmissions can easily be eliminated, but it is useless to do this if the increased selectivity introduces such losses in efficiency that other more distant stations cannot be received. This state of affairs actually exists with certain selectivity arrangements in use, with a result that the systems in question are little more than valueless.

Variable Selectivity

What is actually required is variable selectivity so that a compromise can always be struck between selectivity and sensitivity. There are, admittedly, one or two quite old methods of securing a form of variable selectivity, one of which is to include a variable or semi-variable condenser in series with the aerial lead-in. This method has, however, a serious drawback, because the setting of the normal tuning condenser is affected to a fairly great extent by alterations in capacity of the series condenser. In other words, if a station is tuned in at, say, 30 degrees on the condenser, and then it is desired to increase the selectivity of the set, the condenser reading might have to be altered to something like 50 degrees in order to receive the same station. Besides this, the operation of changing the capacity of the series condenser introduces handicap effects which make accurate tuning very difficult. Another method of varying the degree of selectivity is to transfer the aerial lead-in to various tappings on the aerial winding of the tuning coil. This has the same effect upon tuning as the previous method, in addition to which it is absolutely impossible to secure a gradual variation.

Selectivity "Focusing"

All the difficulties referred to above have entirely been overcome by the introduction by Messrs. Varley of an entirely new and revolutionary system in the form of what they call the bifocal coil. As the name implies, the system involves the use of two coils (one for long, and the other for medium-wave reception) which can be "focused," by means of Nicore plugs, so that the degree of selectivity can be controlled with perfection over a wide range. Both coils are wound on ebonite tubes and have three windings, which are, respectively, the aerial winding, the (tuned) grid winding, and the reaction winding. Normally the first two are loosely coupled together so that maximum selectivity is

FULL DETAILS OF THIS GREAT COMPETITION NEXT WEEK

To 5

Diagram illustrating the method in which the above circuit gives the coupling of the fixed tap.

Diagram of the complete coil and its associated connections.

(Continued on page 82)
THE NEW A.V.C. UNITS

How to Incorporate Them in Your Receivers to Avoid Fading Difficulties,
By HARLAND R. KERRISON

For years we have had to put up with fading, knowing that we were quite
unable to alter atmospheric conditions. But if your set contains at least one
high-frequency stage, a few simple alterations and additions will allow you to
receive all stations with practically no noticeable change of volume. Once you
have handled a set incorporating "automatic volume control" you will never
consider any receiver to be modern without

Fig. 1.—A simple method of controlling bias on an H.F.
indirectly-heated S.G. valve.

its inclusion. There is no necessity to completely rebuild your receiver, and the
additions need not be expensive; yet the outlay will never be regretted owing to the
satisfaction which will follow the alterations.

Much has been written regarding the theory of A.V.C., but a brief résumé referring to its practice will assist readers when making the changes to be described. A variable-mu is preferable, but very satisfactory results can be obtained with an ordinary S.G. stage. The degree of amplification of any S.G. valve, for a given plate and screen voltage, depends upon the applied grid potential. The greater the negative bias the less the valve "mu" and the amplification per stage. The ordinary S.G. valve has a comparatively short grid base, and can only handle weak signals without distortion; a manual volume control must, then, be used to limit the input from strong signals. A variable-mu type will handle larger signal voltages and will allow of a greater degree of control due to its longer grid base. A manual volume control is then not a necessity when using A.V.C.

Fig. 2.—Varying the bias on an indirectly-heated S.G. valve.

Figs. 1 and 2 show how the amplification is controlled by the variable resistance R1 in (a) and (b) for battery and mains variable-mu valves respectively. In order that a signal varying in strength as in Fig. 3, may be audible at moments marked X, the bias must be adjusted in such a manner that at moments of peak signals the amplification would probably overload succeeding valve stages. Any greater bias would tend to make minimum signal voltages inaudible. A.V.C. arranges that the signal itself causes negative bias to be applied in proportion to the signal strength. A loud burst of signal will add to the grid-bias and lower the amplification, so automatically giving a reasonably constant signal output. It also has the effect of leveling up the signal strength from the various stations received.

There are two methods of arranging for A.V.C. One is by substituting one of the "multiple" valves, but first we will consider the simpler way, suitable in both mains-operated sets, by means of adding a diode rectifier. This could be a valve, but the additional to be considered is a Westecor type of rectifier. The output from the detector valve includes a high-frequency component which is normally by-passed to earth as an unwanted form of energy. This can now be suitably employed to control the bias on the preceding S.G. stage or stages without in any way detracting from the set performance. To ensure that no H.F. enters the L.F. usual by-pass condenser CI should be re-wired to the high potential end of the H.F. choke.

A great deal of trouble may be saved by employing the "Auto-

Fig. 3.—Diagram illustrating variation in signal strength.

control" type of A.V.C. made by Wearite or the Varley A.V.C. Unit. The
former is wired as shown in Fig. 5, while the Varley Unit is arranged
as in Fig. 4. The latter incorporates an H.F. choke, hence the one in the set can be removed when this unit is fitted. As the experimenter may wish to try out various resistance and condenser values for himself, approximate values are given for the additional components if added separately.

In Fig. 3, C2 controls the amount of H.F. energy fed through the A.V.C. unit, and may be any value between 0.0001 and 0.001 mfd. In some sets it may be found that the addition of the A.V.C. reduces the available energy for reaction, hence the value of C2 should be chosen with an eye to this, and, at the same time the higher the condenser capacity may be raised by means of a small fixed condenser in parallel. This will only be necessary if it is found that reaction cannot be obtained easily with the A.V.C. attached. The Westecor must be fixed with the positive end to earth. The resistance R1 should be about 250,000 ohms and is together with the condenser C3, the circuit across which the rectified H.F. voltages are built up. C3 need not be less than 0.1 mfd. This is "simple" A.V.C., and any voltage set up across R1 by an incoming signal is automatically applied to the grid of the S.G. valves. As there is a slight degree of control, even with a medium strength signal, the result may be an undesirable reduction of volume of weak stations. Fig. 6 illustrates the method of delayed A.V.C., in which the control only effects comparatively strong signals. The small grid battery of 0.9 or 1.5 volts provides a voltage across R2, also of 250,000 ohms, in opposition to that rectified signal. Westecor, and this delays the control until the rectified signal is of a greater value than the bias voltage. It may also be desired to set a limit to the volume of signal received, and this is done by making the resistance R2 a 250,000 ohms potentiometer in place of the fixed resistance. R1 is then joined to the slider so that we now have a manual control for the bias.

Fig. 4.—How to fit one of the standard A.V.C. units which incorporates an H.F. choke.

Fig. 5.—Adding an A.V.C. unit which does not include a choke.
SOME UNUSUAL H.T. SUPPLY SYSTEMS

Practical Details of a Few Unusual Methods of Obtaining High-Tension Current Are Given in This Article

By BERNARD DUNN

The usual forms of H.T. eliminator are well known to nearly every reader, and constructional details for various types of unit have previously been given in these pages. In this article it is not intended to deal with any of the better-known systems of obtaining the high-tension supply, but to describe one or two simple and unconventional arrangements which will be of interest particularly to the experimenter and to the reader who likes to try out new ideas.

It is not generally realized that a neon lamp can be used as a rectifier—even though it is not an efficient one by any means—and that it may be connected in series with an A.C. supply to provide a small amount of D.C. A neon lamp is thus often very useful as a means of obtaining sufficient H.T. current for the operation of a single-valve receiver, or of a valve oscillator, directly from the A.C. lighting source. In the case of an oscillator, heterodyne wavemeter, or any other device which must be accurately calibrated, a perfectly steady and unvarying supply of high-tension current is essential; a neon lamp provides the simplest method of obtaining such a supply from A.C. mains. The actual output from a neon "rectifier" is very low, amounting to only about 30 volts at something less than 1 milliamp, but this is quite sufficient for many purposes.

Modifying the Neon Lamp

A neon lamp of the arcive pattern is most convenient, and before it is put into use the resistance must be removed from its cap. This does not present any great difficulty. The method is, first of all to soften the cement used for securing the glass bulb to the cap, and this can be done by standing the base of the lamp in a small jar containing methylated spirits. Allow the cap to soak for a few hours, and then wipe away all the surplus spirits. The next thing is to apply a hot soldering iron to the two contacts on the end of the cap, and at the same time to pull the glass bulb away from it. This can most easily be done by holding the soldering iron in a vice so that both hands are free. When the cap has been removed it will be found that one wire from the bulb was connected directly to one of the contacts, but the other may be considered to be about 2 milliamps. Before leaving the subject of the neon rectifier it should be mentioned that the arrangement described is not quite in accordance with the recommendations of the I.E.E., which say that all wireless H.T. circuits should be isolated from an A.C. mains supply by means of a mains transformer. In this case, however, the resistance of the neon lamp is quite sufficiently high to render the arrangement perfectly safe, and if a short-circuit did occur the only result would be that the neon lamp would light up or possibly become damaged. Additionally it might be mentioned that the I.E.E. regulation referred to is widely disregarded nowadays, particularly in the case of "universal" receivers.

H.T. from L.T.

When there is no mains supply available the question of obtaining a high-tension supply without the use of H.T. batteries is rather more difficult of solution but there are one or two ideas that are worth experimenting with, and which have been used with fair success in a number of cases. The general principle of these ideas is the same as that of coil ignition systems used on motor-cars. In other words, a low D.C. voltage—provided by an accumulator—is fed to a high-ratio transformer through a make-and-break. The intermittent current flowing through the primary of the transformer produces a high A.C. voltage in the secondary winding. In the case of a car, this secondary voltage (Continued overleaf)
is employed to produce sparks at the plugs, but for the purpose under discussion it must be rectified and smoothed in the usual way.

Fig. 5.—Showing how a power valve can be used as a half-wave rectifier in a simple form of low output a.c. supply unit.

It is often possible to make use of a so-called spark coil taken from a car and such coils can often be bought from car-breakers for a couple of shillings or so. These coils are generally provided with only three contacts, since one of these serves for one end of both primary and secondary. It is, therefore, necessary to separate the two leads so that the unit can be wired up as shown in Fig. 5. It will be seen that the secondary winding feeds into a rectifier (one of the metal type is represented) and an ordinary smoothing unit. The high-tension output of 10 to 15 volts A.C. output of 2 to 6 volts A.C. may be obtained unless a 2- or 6-volt accumulator is made use of. In any case the output will not be very high, and no more than 90 to 90 volts at

O N E of the questions which the radio expert is frequently asked is "How long should my valves last?" In one way, this question is very easy to answer; in another, it is most difficult. The answer is, in part, that while no manufacturer can be expected to guarantee any definite life for his valves, under normal conditions over which the maker has no control, the user can reasonably expect a minimum life of about a thousand programme hours, provided the valves are not subjected to improper treatment, such as over-racing the filament (i.e., operating on too high a low-tension voltage), or called upon to pass too great an anode current (due to serious under-biasing, or operation without gridbias). Indeed, numerous instances have been reported in which working lives of two, three, or even four thousand hours have been obtained from standard receiving valves.

The difficulty in giving sound advice on this point arises out of two or three facts. In the first place, although the filament may be intact after several thousand hours' life, it by no means follows that the emission of the valve is also unimpaired, or that its characteristics are as good as when the valve was new. In these circumstances, of course, it would definitely pay the user to replace his old valve with a new one.

**NEW VALVES FOR OLD**

A Certain Case

At the same time, it happens frequently that a valve survives three or four years of service, but not quite up to standard. The question now arises, should the listener pension off his old valve and substitute a more modern valve, thus taking advantage of the improvements in valve design which have been brought about since his original valve was made. The answer to this question, again, depends on several factors—the extent of the improvements, the position for which the valve is required in the receiver, and the design of the receiver itself.

At the outset, it may be stated that, in the great majority of cases, a modern valve should be substituted for an old valve whose output may be substituted for one of older date with every confidence that improved volume and quality will be secured. This can be confirmed if a comparison is made between the characteristics of to-day's modern valves and those of "yesterday." It will be observed that the modern valve provides greater improved characteristics which apply to all types of modern valves and will add to the output of all makes. First of all a decrease in impedance will be noticed, and this enables more efficient working, and in practice it will be found that, for equal signal input, the up-to-date valve will give greatly increased volume, combined with vastly improved reproduction. In a few instances it may be necessary to look to the output circuit of the receiver in order to ensure that inductances are correctly set, but, generally, the substitution can be effectuated without altering the set in any way.

Possible Instability

It is when we come to the earlier stage of valves—the detector and frequency valves—that some trouble may be encountered when substituting new and efficient valves in an old receiver. Most modern valves have both lower impedance and higher amplification factors than their prototypes of a few years ago, and when used in the early stages of an out-of-date receiver, these more efficient valves sometimes tend to give rise to a condition of instability. Careful attention to coupling and some reduction in anode voltage frequently puts matters right, but, of course, if the set is hopelessly antiquated, it should really be remodelled or rebuilt.

One other point calls for special mention. Rival old valves should not only be discarded as useless, but they should be used for a new and up-to-date receiver. Modern receivers are always designed with a view of catering for all types of valves and some good design put into the new set is wasted.
THE metal rectifier as a means of rectifying alternating currents for H.T. supply is quite familiar; and during the last year, the difficulties associated with the rectification of high frequencies have been partly overcome. Last March saw the introduction of the type “W” Westector, which is now extensively used as the second detector in superheterodyne receivers (where it works at intermediate frequencies of about 110 kilocycles), for all forms of automatic volume control and battery economy. The chief drawback of this type of Westector when used for detection is its high effective capacity, which throws a heavy damping on the circuit in which it is used, thus making its use impracticable at frequencies higher than about 200 kilocycles. During the last year, however, work has been proceeding in the research laboratories of the Westinghouse Company, with a view to making still smaller rectifying elements, with a corresponding decrease in capacity. This research has culminated in the production of a new type of Westector—the new “WX” which is of “WX” Westector has a very high impedance, and a high load resistance of some 250,000 ohms must therefore be employed. A suitable reservoir condenser for all frequencies is .0001 mfd.

A suggested circuit for using the new “WX” as a detector in a “straight” receiver is shown in Fig. 1, where R is the load resistance and C the reservoir condenser. For satisfactory straight-line rectification the H.F. voltage applied to the Westector should be between 5 and 8 volts peak. It will be appreciated that the H.F. voltage applied to a detector circuit quite naturally varies with the strength of the signal being received. On local reception the H.F. voltage will be high, and the Westector need be preceded by one H.F. stage only. Where a receiver, however, is intended for the reception of foreign programs, two H.F. stages will normally be required, but even this difficulty may be overcome. Just as screen grid valves may conveniently be biased for more efficient working, so may the new “WX” Westector be biased to a point of optimum rectification. At a certain value of input the rectification characteristic of a Westector is a straight line, and there is no practical upper limit to this characteristic. Below this value the Westector works on a curve, and thus distortion will occur in the detector stage. By biasing this stage is removed, and experiments have shown that the point of optimum rectification occurs at a bias current of 16 micro-amps. This result is obtained by a bias of about 2 volts, and Figs. 2 and 3 show biasing arrangements for battery- and mains-operated receivers respectively. With such arrangements it is possible to obtain satisfactory results.
when the peak H.F. input is as low as 0.2 volts, so that distortionless detection with one H.F. stage and receiving very distant stations is possible.

**Circuit Arrangements—" Straight " Receivers**

The application of a "WX" Westector as a detector in a straight receiver is as simple as that of the type "W" when operating as a second detector in a superheterodyne receiver. In order to obtain full advantage from the straight-line characteristic, and thus obtain distortionless detection, the voltage handled should not be less than 3 volts, as explained above. Where a lower H.F. input is applied the Westector must be biased. A suggested skeleton circuit is shown in Fig. 4, where a typical S.G. det. L.F. receiver has been adapted to the equivalent of diode detection by using a "WX" Westector which has been suitably biased. It will be noticed that the detector valve now works solely as an L.F. amplifier, but, if one of the larger pentodes, such as the Mazda 7en, 290A, is used in the output stage in conjunction with a battery economy scheme, the intermediate L.F. valve may conveniently be omitted, and the Westector resistance capacity coupled direct to the output stage. In view of the very high impedance of the Westector it is advisable to use transformer coupling, and the best values of coupling condenser and grid leak are 0.02 mfd. and 250,000 ohms respectively.

**Reflex Receivers**

Reflex receivers have rather fallen into disuse owing to the inefficiency of the old-type valves, limited range of crystal rectifiers, etc., but with modern valves, controlled by A.V.C. and employing diode rectification, the reflex circuit is becoming more popular. This type of receiver employs an ordinary type screen-grid valve for a dual purpose, viz., the amplification of both L.F. and H.F. This is done by feeding back the L.F. output from the detector stage into the grid circuit of the screen grid valve which is used as an H.F. amplifier. This L.F. signal is amplified once more and passed on to the output stage in the usual manner.

**Fig. 5.** A skeleton reflex circuit using a "WX" Westector both for detection and A.V.C. The L.F. output of valve VI passes through the coupling condenser to the Westector, and hence through volume control P and resistance R to the grid of VI, whence it passes to the output valve via the transformer "T". At the same time a negative voltage in respect to earth is generated across R by the H.F. present in this part of the circuit, and this voltage is fed back to the grid of VI to provide A.V.C. in the usual manner. The manual volume control P thus controls both L.F. and A.V.C. voltages to be applied to the grid of VI, and effective control, with complete absence of distortion due to overloading, is obtained. The L.F. fed back from the Westector to the grid of VI could be amplified by feeding back through a transformer, in which case the manual volume control should be placed across the transformer. Otherwise, the grid of VI will have excessive H.F., L.F., and A.C. voltages applied to it when powerful signals are being received.

**Superheterodyne Receivers**

It is obvious that there is no great advantage to be gained by using a "WX" Westector as the second detector of a superheterodyne receiver unless the intermediate frequency is of a high value, such as 400 kilocycles. In fact, the greater power-handling capacity of the "WX" type undoubtedly renders it more useful in this respect; but the "WX" Westector makes an ideal detector when used in the frequency changer stage (first detector). This stage of a superheterodyne receiver presents many snags to the unwise designer. It involves the acceptance of the incoming H.F. signal, with the mixing with the generated oscillation, the rectification, the separation of the particular beat frequency required, and its amplification before passing on to the intermediate frequency stage. It is obvious that this is bound to complicate the stage, but the use of separate detectors and oscillators simplifies matters considerably. Even so, unless this stage has been well designed the bias applied to it in order to get a maximum heterodyne will have a serious effect on the valve employed, and its presence will considerably reduce the magnification of the valve compared with that to be obtained when the particular valve is used purely as a L.F. amplifier. And if, as is usual nowadays, A.V.C. is employed even separate detector and oscillator stages are bound to become complicated.

Here, again, the new "WX" Westector opens up an interesting possibility. A glance at Fig. 6 will show how its inclusion

(Continued on page 84)
Countless simple sets that were satisfactory when first designed are now incapable of dealing with the greatly increased number of stations in operation to-day. The advent of the Varley Bifocal Focussing Coil, with its revolutionary design, means a new life entirely to these sets.

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Preventing Slip in Friction Drives

THE accompanying sketch will interest readers who have suffered from slipping in the friction drive of their condensers. The drawing is self-explanatory, but it is an improvement to rough the fixed washer light spring between loose washer & bracket.

How to overcome slipping and backlash.

on both sides and the loose washer on the side nearest the condenser. The advantage is, of course, that the two discs get a firmer grip on the spindle than one alone does; and if after they have been in use some time slipping should occur again, it is a simple operation to squeeze the edges of the discs together again with a pair of pincers.—W. JOHNSON (West Smithwick).

A Rotary Radio-gram Switch

THE accompanying sketches show an easily made radio-gram switch. A small cylinder of hard wood, about ⅞ in. diameter and ⅛ in. thick, is marked off as shown, and the shaded portion cut off with a fret saw. After cutting the V-notch with a triangular file, a shallow trough is filed on the flat part of the large piece. A brass strip, taken from a used flash-lamp battery, is placed in this, and the small piece of the cylinder is screwed back into place. Other details are given in the sketch.—W. LOWENS (Manchester).

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 2½-10-0 for the best wrinkle submitted, and for every other item published on this page we will pay half-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., 8-11, Southampton Street, Strand, W.C. Post your name and address on every item. Please note that every notion sent in must be original. Thank envelopes "Radio Wrinkles." Do NOT enclose Quotations with your Wrinkles.

Converting a Meter

REQUIRING an ammeter to read up to 1 amp. (not critical), I decided to convert a cheap 3-T. voltmeter into an ammeter. After experimenting with various lengths of wire (to give a certain number of turns), I found that 100 or slightly more turns were required for a full scale deflection. 1 amp. deflection, about 90 for 2 amps., and 80 for 3 amps. Gauge 22 enamel-covered wire was used, 100 turns being wound on a bobbin to fit in place of the existing bobbin of fine wire. Two terminal screws were fixed, one each end of the case, each being insulated from the metal, to which were attached the ends of the coil. The ammeter was roughly calibrated by measuring the L.T. current of the receiver. In my case, 3 volts equaled 1 amp. A combined voltmeter and ammeter can be made by winding the thicker wire over the thinner, with plenty of insulation between the two coils, the ammeter portion having separate terminals as indicated. IT IS ADVISABLE to use as thick a wire as convenient, not less than S.W.G. 24 for 1 amperes, to keep the resistance low.—R. M. Ross (Alness).

Simple Home-made Resistances

A SMALL stock of resistances is useful to the experimenter or home constructor. They are easily made. A length of chine cot is threaded with a chisel to carry a length of resistance wire. The wire is wound into the thread and secured at the ends by the screws which hold the brass strips in position, the ends of the rod being drilled and tapped to take the screws. Two strips of wood or other fastened to the brass strips by wood screws, leaving a gap between for the slider. The slider is made from an ordinary brass screw. A washer is placed at the back, and a small piece of springy brass or copper wire soldered on to another washer is placed on the front. A spring piece is placed on top, and the terminal head finishes the job.—R. BING (Southampton).

A Variable-tone Morse Practice Set

THE accompanying sketch shows an apparatus for the production of sound impulses, the tone of which can be varied. This apparatus will be found useful for the practicing of Morse. The old coil is a centre-tapped one having 500 turns, and this will probably be found in most amateurs' junk-boxes. The valve found most suitable was of the R.C.C. type, but others can be used with every satisfaction. If a centre-tapped coil is not available, it is quite possible to employ two single coils of the plug-in type. Alternatively, a new coil can easily be made by winding 500 turns of 30 s.w.g. enamelled wire on a 2 in. former, and taking a tapping after 250 turns.—W. CROSSLAND (Tankerton).
R.M.S. VALUES EXPLAINED
A Simple Explanation of R.M.S. Values and How they are Ascertained.
By LAMBDA.

There are two kinds of current or voltage, direct and alternating. Direct current flows continually in one direction, whilst alternating current changes its polarity many times per second. That is, it is continuously becoming positive and then negative.

The height lightly, namely, 50 cycles per second that an alternating current changes its polarity, is called the frequency and is usually expressed as so many cycles per second. Fig. 1 illustrates an alternating current wave. The line A—B represents the zero line and the current flows first in one direction, reading a maximum at the point C, and then falls and repeats the same process in the opposite direction, the distance from A to B representing one cycle of events.

Alternating current will therefore generate heat, and this fact is utilized in devising a system of measurement.

Defining the Effective Value
The useful or effective value of an alternating current is defined as the value in amperes, of a steady direct current which would have the same average heating effect as a corresponding D.C. current. In the case of an electric light the useful value of the alternating current would be equal to the value of the steady direct current which would be required to radiate the same amount of energy in the form of heat.

When we take as a basis of measurement the heating effect of the current it does not matter in which direction the current is flowing, positive or negative. Although the actual value is continually changing, an indication will be given by the instrument of the average heating effect, and therefore the magnitude of the current flowing.

Finding the R.M.S. Value
The power expended in producing heat in a circuit is ascertained from the formula PR = Power in Watts, where I represents current and R the resistance of the circuit. This formula is arrived at by the following reasoning. First of all it is known that V = I × W, V representing voltage. Now, according to Ohm's Law, V is the product of I × R, so that in place of V in the formula (I × R) can be substituted; thus (I × R) × I = Watts. This may be written in a simpler manner as PR = Watts. Having briefly considered the formula as applied to direct current we must see what relationship it bears to alternating current. Again consider the curve shown in Fig. 1, which is known as a sine wave. First of all it rises to the maximum point C and then falls, repeating the process in the opposite direction; but although now negative, the shape of the curve is the same. Passing on to Fig. 2, which is one half of the complete cycle shown in Fig. 1, redrawn. If the alternating current be flowing through a resistance of, say, 1 ohm, then PR will be the value at any particular instant. If I is the value of the direct current which would have the same average heating effect, then PR would be equal to the mean value of PR over a complete cycle. Now if PR = PR, then = mean value of I, so that the effective value would be

\[ I = \sqrt{\text{mean value of } I} \]

A complete sine wave is given in Fig. 3, where the base line A—B represents one cycle, and the first half-wave is divided into eight equal parts. The distance from the base to the points where the vertical lines meet the sine wave represents the value at any particular instant; assuming the values in this case to be 1 to 4 amperes, the latter figure being the maximum value.

In order to ascertain the effective (R.M.S.) value it is necessary to square each of these values, and then divide by 8, which will give a new curve about the same base line. In Fig. 4 we arrive at the values 1 to 16 amperes. It will be seen that this is an entirely new curve which is actually half the wavelength, or double the frequency, of the wave shown in Fig. 3. The centre of this new curve falls at a height above the base line which is equal to half the maximum height and is indicated by the dotted line A—B. Two curves are shown in order clearly to illustrate the shape of this new wave, but the calculations only apply to the first curve. From the shape of the half of the new wave it will be seen that there is a new curve about the same base line, and the maximum height is 16 amperes, which is the mean square value.

Root Mean Square
Finally we have to ascertain the root of the mean square value of 8 amperes; this is written \( \sqrt{8} \), and therefore

\[ I = \sqrt{\frac{1}{4}} \times 16 = I \times \sqrt{8} \]

which is 2.83 amperes, the R.M.S. value.

This method of calculation is, of course, a tedious process, especially if it has to be undertaken every time it is necessary to find the R.M.S. value, but fortunately we can simplify the process very considerably by a different method which will also prove that the calculations are correct this is an entirely new curve which is actually half the wavelength, or double the frequency, of the wave shown in Fig. 3. The centre of this new curve falls at a height above the base line which is equal to half the maximum height and is indicated by the dotted line A—B. Two curves are shown in order clearly to illustrate the shape of this new wave, but the calculations only apply to the first curve. From the shape of the half of the new wave it will be seen that there is a new curve about the same base line, and the maximum height is 16 amperes, which is the mean square value.

Calling the maximum value Im, then the mean square value will be one-half of the square of the maximum value, namely, \( \frac{1}{2} \times I^2 \), which is \( I \times \sqrt{2} \). Mean Square Value will be written \( \sqrt{2} Im \), which simplified will be \( \sqrt{2} Im \), which will give us \( \frac{1}{2} \times 0.707 Im \). This means that the effective or R.M.S. value of a sine wave of alternating current is equal to 0.707 of the maximum value, or 1.14 times the effective value.

Therefore the rule is: when the R.M.S. value is given, to obtain the maximum value multiply by 1.14, and when the peak value of the alternating current is given multiply by 0.707 to obtain the R.M.S. value.

THE WIRELESS CONSTRUCTOR'S ENCYCLOPAEDIA
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THE SUPERHETERODYNE FREQUENCY CHANGER

The various methods of producing the intermediate frequency are reviewed and described in this article.

By FRANK PRESTON

The most important part of any superheterodyne receiver is that which serves to change the frequency of the received signals to that of the intermediate-frequency H.F. amplifier. Although the principle of frequency-changing is simple and unvarying, there are many different methods of putting it into practice, and it is the practical side of the question which it is proposed to deal with in this article.

In order to refresh the memory of those who are not very conversant with superheterodyne practice, it might be well briefly to explain the fundamental idea of frequency-changing. The intermediate-frequency amplifier is generally pre-tuned to either 110 or 120 kilocycles, and therefore, in order that the amplifier may be effective, it is essential that the signals passed to it should be of one of those frequencies. Obviously the signals picked up by the aerial circuit are of no definite frequency, generally varying between approximately 1,500 kilocycles (300 metres) to 150 kilocycles (2,000 metres), and they must therefore be modified in some way. The method is fairly simple and consists of "mixing" oscillations of some other frequency with them. For example, if a station working on 300 metres (1,000 kilocycles) were being received, oscillations of 1,110 or 890 kilocycles would have to be "mixed" with the signal oscillations in order to produce a "heterodyne," or intermediate-frequency, signal of 110 kilocycles which could be handled by the H.F. amplifier.

It has been said that the imposed oscillation may be of either 800 kilocycles (1,000 minus 200) or 1,110 (1,000 plus 110), but in practice it is generally found better to employ the higher frequency.

Having obtained a clear understanding of the requirements of the frequency-changer, the next thing is to learn how the system is applied. This clearly hangs upon the method of providing the new set of oscillations. A valve is well known as the best device for producing high-frequency oscillations, and it is this instrument which is used. In some cases a separate valve is used specially for the purpose of producing the required oscillations, when the complete frequency-changer consists of two valves—the first detector, which handles the actual signal frequencies, and the oscillator. Other circuit arrangements are possible.

However, where a single ordinary valve serves the two purposes, this is known as a combined detector-oscillator. Yet again, in other instances a pentode or screened-grid valve is used as combined detector oscillator, but at this time it is becoming more usual to use a special valve for the two functions, thus being of the heptode or pentagrid type.

Grid Coupling

It will be best to make a start by considering a frequency changer of the type which was most commonly employed from two to three years ago, when it was generally necessary to operate a superhet from a frame aerial to obviate the difficulty of interference with other receivers due to re-radiation. A skeleton circuit of a free frequency changer of this type is shown in Fig. 1.

Fig. 1.—The circuit of a six-valve superheterodyne receiver similar to the "Super-sonic Six," described in "Practical Wireless," dated April 1st, 1933.

The circuit actually being similar to that of the "Super-sonic Six," described in PRACTICAL WIRELESS early in 1933. It will be seen that the oscillator valve is connected to a dual-range tuner (referred to as the oscillator coil) of which the anode winding is tuned in the usual way by a 0.0005 microfarad variable condenser, and is close-coupled to the grid winding which is untuned. The oscillations generated by the oscillator valve are fed back into the grid circuit of the first.

(Continued on next page)

Fig. 2.—The frequency changer of an early pattern superhet, using a frame aerial, three electrode first detector, and separate oscillator.

Fig. 3.—A modified and up-to-date arrangement of the circuit shown in Fig. 2. An elevated aerial is used in conjunction with a band-pass tuning circuit and screen-grid first detector.
detector by means of a small winding, which is coupled to the oscillator windings and connected to the centre-tapping of the frame aerial. This system functioned very well when a frame aerial was employed and experimenters soon found that it could be operated from an outside aerial provided that a screen-grid or pentode valve was used as first detector so as to avoid re-radiation. A circuit such as that shown in Fig. 3 was therefore evolved; this arrangement is, as a matter of fact, widely employed even at the present time, particularly in battery-operated sets. It will be noticed that a band-pass aerial circuit is used, this being a practical essential in order to avoid various forms of interference which have previously been referred to in these pages. The circuit shown in Fig. 3 is very similar to that shown in Fig. 2 and is simply a development of it.

Ganging the Tuning Controls

As superhetodynes became more popular it was natural that users should wish to have the advantage of a single tuning control, such as was used with other types of circuits. The use of a three-gang condenser (one section for each of the band-pass coils and one for the oscillator) presented many difficulties because, although the frequency of the oscillator circuit must always differ from that of the signal circuit by a fixed and definite amount, the frequencies of the two circuits must be varied in different ratios in order to receive on various wavelengths. This makes it necessary to use "paddling" and one "tracking" condensers in conjunction with that section which tunes the oscillator coil. An alternative to the "tracking" condenser is to use a gang condenser of special "superhet" type. This condenser, usually a three-gang component, has two main sections for tuning the band-pass circuit, and one special section for the oscillator, whose fixed values are shaped differently from those of the other sections. It is not proposed to enter into the mathematics of the subject of designing the shape of the fixed values in the oscillator section, but reference might be made to an article in which this subject was more fully dealt with, and which was given in PRACTICAL WIRELESS dated October 21st, 1933.

"Tracking" Condensers

A PRACTICAL WIRELESS receiver using a modified arrangement of the circuit given in Fig. 3 is the "Premier Super," described in the issues dated September 23rd and 30th, 1933. A skeleton circuit of the first two valves in that set is given in Fig. 4. A special superhet-type gang condenser is employed for tuning, and this obviates the use of a "tracking" condenser. A long-wave "paddling" condenser is used, however, and is connected between the "lower" end of the anode winding of the oscillator coil and the wave-change switch. This condenser is a pre-set of 0.02 mfd maximum and serves for matching when receiving on the long-wave band.

Another refinement of this circuit is the inclusion of a fixed resistance of 100,000 ohms (R) and a 0.6 mfd. (C) by-pass condenser in the anode circuit of the oscillator valve. This resistance-condenser filter is for the purpose of providing a uniform strength of oscillation over the whole of both wavebands. Incidentally it might be mentioned that it would be possible to use a normal three-gang condenser in this circuit simply by connecting a fixed

(Continued on page 90)

Fig. 5.—The interesting and novel circuit shown above is of the "Practical Wireless " "Luxus A.C. Superhet."

Anode-circuit "Mixing"

An alternative arrangement which avoided the necessity for using a centretapped frame aerial was that shown in skeleton form in Fig. 2, and in this case both detector and oscillator were connected on the anode-bond system. "Mixing" in this case was obtained in the anode circuit of the detector by connecting the anode winding of the oscillator coil in series with the primary of the I.F. transformer. In this arrangement also, separate tuning condensers were required for the two tuned circuits. After the superhetodyne receiver had become more popular, and after more experiment had been carried out with it,
Cossor All-Mains Receiver, Model 435.

A recent arrival in the world of wireless is the Cossor All-Mains Receiver, Model 435. This receiver is one of the very few on the market using the screened high-frequency pentode as a detector; in fact, the whole combination of valves is unusual, since each is of the multi-grid type. A variable-mu S.G. is used in the H.F. stage, a screened pentode as detector, and a power pentode as output valve.

The circuit of the Cossor set under review is more or less conventional. The aerial tuner has the usual tapped winding, but includes a miniature choke, a feature of all Cossor receivers, to stop the tendency for medium-wave signals to break through at the bottom of the long waveband.

Pentode Detector
The MS/PEN screened H.F. pentode acts as leaky-grid detector, and is also arranged to function as the first I.F. amplifier when radio reception gives place to gramophone reproduction.

The "high spot" in the receiver is undoubtedly centred round the MS/PEN, which is resistance-coupled to the Cossor MP/PEN output valve, thus doing away with the low-frequency transformer. This probably explains why the set has such a wide frequency range and such an excellent high-note response.

There is little to be said about the output stage other than to remark on the fact that "stopper" resistances are included in both anode and screen leads, and that the moving-coil loud-speaker is mains energized, the field coil being used as the smoothing choke.

Simple Controls
The controls are few in number and simple to operate. The centre knob controls a two-gang condenser, and has in its centre a small knob that actuates a trimmer across the main aerial condenser which, once set, does not require readjustments on either waveband except in most exceptional cases. This arrangement enables the receiver to give its best on a variety of different sized aerials.

The other two controls are reaction and volume control (variable-mu bias), and the selectivity of the set relies on the independent use of these two controls. The volume control also actuates the mains on/off switch, so that the first few degrees of rotation turn the set on or off as desired.

Wavelength-calibrated Dial
The tuning dial is calibrated in wavelengths, the ranges being 200 to 540 and 900 to 2,000 metres. The "pointer" takes the form of an oval spot of light that illuminates the appropriate dial reading. The long and short-wave scales are not combined, and so two oval spots of light are necessary, one for each scale, the correct one being lit up by the wavechange switch.

When the gramophone pick-up is inserted, both dials are illuminated.

The Castor All-mains Receiver, Model 435, priced at £9 15s. Od., in a walnut cabinet.

The general appearance of the chassis can be seen from the illustration on this page. It is very robust, being made of blue gun-finished steel, a substance which has much to commend it for this particular purpose.

The Set On Test
When the receiver was put on test much was expected from it, and we were not disappointed; the quality of reproduction was equal in every way to that associated with much more expensive receivers, while the reproduction of high notes is possibly not surpassed in any receiver on the market.

The available undistorted output from the MP/PEN was ample (it is about two watts), and the loud-speaker proved itself to be perfectly capable of accepting this input. Selectivity was excellent when the reaction and volume controls were used together; at twenty miles from the Brookmans Park stations the spread on each of the dials was only about 3½ in. of the 5½ in. scale, even without pushing reaction to the limit.

A remarkable feature of this receiver was its performance on a small in-door aerial. Using only about ten feet on the ground floor some dozen stations could be tuned in at a volume level varying between 60 and 100 per cent. of the maximum. This flexibility is due to the wide compromise between selectivity and sensitivity, and to the close ganging made possible by the trimmer. Such an indoor aerial performance is rare with a receiver that is so selective on the orthodox outside aerial.

Gramophone Reproduction
A gramophone pick-up was also tried and the same degree of quality was obtainable. It was found that care had to be exercised when adjusting the pick-up volume-control because, after the optimum setting was reached, quality was impaired without materially increasing volume. This was, of course, due to the detector being overloaded.

The cabinet (illustrated) is made of soft, polished walnut, with black lacquer, tuning window, loud-speaker fret bars, and controls. This gives a modern but not futuristic appearance that blends with any furnishing scheme.

This receiver, Cossor Model 435, is available for A.C. mains only, 200 to 250 volts (adjustable) 40 to 100 cycles, and is sold complete with four valves, including rectifier, and mains-energized moving-coil loud-speaker, in walnut cabinet, 13½ in. high, 17½ in. wide, and 10 in. deep, with pick-up and gramophone motor plug, for £9 15s.
BUILDING THE

The Leader Three which we recently described met with a wonderful and unprecedented reception by the home-constructor public. That set has probably been built in greater numbers than any other which has been offered to the amateur set-builder for many years. Everyone is most enthusiastic about it, not only because it can be built at a remarkably low price, but because it combines the qualities of efficiency, simplicity, ease of construction, and neatness of design with a price quite out of keeping with the high quality of the components around which it was designed. In producing the battery model we had the enthusiastic co-operation of a large number of component manufacturers, and it was this which enabled us to present such a unique instrument to all readers of Practical Wireless. The Leader Three was symbolic of our new and important policy introduced expressly for the benefit of our readers who are anxious to build their own sets, but who insist upon doing so in an economical manner.

The A.C. Leader Three is a further practical example of our careful efforts to encourage the body of amateur wireless enthusiasts throughout the country (judging by the extraordinarily wide circulation of Practical Wireless, we might be excused for saying "throughout the world") to build their own receivers, thereby deriving the maximum amount of interest from their hobby. Ever since the battery model was described we have been receiving shafts of letters from readers who were anxious to construct a similar receiver which could be operated entirely from the A.C. mains. At first we were in some doubt as to whether an A.C. receiver could be made at a price which would compare with that of the battery version. Experiments were taken in hand, all kinds of low-priced components were experimented with until the A.C. Leader which is illustrated on this page was produced. The results of our efforts are before you. It is to be noted, the results of the wonderful co-operation extended to us by component manufacturers, are most gratifying; no reader can fail to be impressed by the performance, appearance, and cost of the A.C. Leader Three.

Special Low-priced Components

Particular mention must be made of Messrs. Hezeyber, who have supported our efforts in no uncertain way by producing a mains transformer to our special design at the remarkably low price of £1. It must not be thought that this component is a "cheap" one in the generally accepted sense of the word, for it is of the same magnificent workmanship which is typical of all Messrs. Hezeyber's products. The smoothing choke which we have used is sold for the low price of 9d. by Messrs. Wright and Walshe, and this is just as effective in this particular circuit as many others on the market costing double the price. The same firm are responsible for the production of the very efficient screened coils which largely helped to make the original Leader Three successful, and which are again used in this A.C. model.

Money has also been saved by using a number of tubular condensers made by Messrs. T.M.C. these cost so little as 6d. each for the 4000 mfd., component and only 1s. 6d. for the I mfd. capacities. Despite their modest price, these condensers are tested at 1,000 volts, and therefore provide a very ample margin of safety. The double 4 mfd. condenser, of 400 volts working, has been specially made for this receiver by Messrs. T.M.C., and the price is appreciably less than that of two single 4 mfd. condensers of similar working voltage.

Even the fixed resistances are low-priced than most, but they are as good and reliable as any on the market; they are actually cost 10d. each, and are supplied by Messrs. Claude Lyons.

An Efficient Circuit Arrangement

It will be seen from the circuit diagram that a simple and well-tried arrangement has been followed, despite such modern features as the high-frequency pentode, coils which cover every important wavelength under the Lucas Plan, and ganged tuning control. The first coil is provided with a loose coupled aerial winding to ensure a

This sub-chassis illustration will assist you in wiring.

Notable "Lead"

The latest coils for the length and an efficient screen-grid reception tuned-transformer H.F. muff selectivity selectivity in excess one and a quarter way metallized chassis con remarkably easy to build equally good on "Rady" costs only eight pounds the most popular circuit ganged tuning control, the ideal set for every absence of mains hum negligible current con
A.C. LEADER

ever which has Revitalized Home Construction

Mains
Q.M.B.
SWITCH

REACTIVE
CONDENSER

Our artist's impression of the A.C. Leader.

TUNING SERS
maximum degree of selectivity, whilst the second coil is used as an H.F. transformer for the same purpose and also to eliminate the necessity for an H.F. coupling choke and its associated condenser. The detector works on the popular leaky-grid system, provision being made for using this valve as an effective low-frequency amplifier when a pick-up is connected to the terminals provided. The output valve is a triode, and gives an undistorted signal output of no less than 1½ watts. Decoupling throughout is generous, but carefully-worked-out lines so that there is no possibility of instability under any circumstances. Hum is removed by the effective choke-condenser network, and also by the use of electrolytic condensers for by-passing the bias resistances in the cathode leads of the detector and power output valves.

Simple Construction
It need scarcely be explained that the construction of the A.C. Leader is as simple as it could be. There is a minimum number of connecting wires, and no awkward corners which are difficult to get into. The 4-volt leads from the main transformer to the filament of the rectifier and also to the heater of the receiving valves are of rubber-covered flex, and come direct from the transformer. A metalized chassis is used, as in the case of all PRACTICAL WIRELESS designs, and this is used for a number of earth-returns, thus simplifying the constructional work.

A number of soldered joints are used, since we know that most of our readers prefer them, but there is no reason why anyone who is not accustomed to soldering should be afraid to make the set on that account. Practically all the soldering could be obviated if desired by attaching the ends of resistances, condensers, and other components to small terminals. Additionally, the larger fixed condensers, although they are supplied with soldering tags, can be adapted for terminal connections by fitting neat little clips which are supplied by the makers, if required.

The chassis can be obtained already drilled, but in case any reader wishes to drill his own, it might be mentioned that the fixing nuts of the two 20-mfd. electrolytic condensers must be recessed by making holes about 1½ in. diameter and ½ in. deep on the underside of the chassis baseboard.

In mounting the components it will be found best to start by attaching all those parts which are fixed on the underside of the chassis, such as the double 4-mfd. smoothing condenser (C11 and C12), low-frequency transformer, H.F. choke, 2-mfd. fixed condenser, and the component bracket which holds the on-off switch. It will be seen from the wiring plans that the tubular (Continued on next page)

Use this diagram when drilling your cabinet front.
conditioners and fixed resistances are not directly attached to the chassis, but are held in place by the wiring; they can therefore be removed until later. The next step is to fit the terminal socket strips to the back edge of the chassis, after which the valve holders can be screwed in place on the top. The mains transformer, smoothing choke, and fixed conditioners can be next be attended to, leaving the tuning condenser and coils until last, so as to avoid the possibility of their being damaged.

It must be noticed carefully that the bracket upon which the reaction condenser is mounted is insulated from the metalized surface of the chassis, because if this point is not attended to there will be a short-circuit between the H.T. positive feed to the detector valve and H.T. negative. The necessary insulation is obtained simply by scraping away a square of metalizing about an inch wider than the base of the component bracket, and this can easily be done by means of the edge of a knife-blade, after scribing a line round the square.

The bracket supporting the wave-change

LIST OF COMPONENTS FOR A.C. LEADER.

One Jackson Bros. Double-quant Condenser "SP 182" Type A (C1 and C2).
Two Wareands "Universal" Screwed Coils.
One Grabham 'Fash 00013 ac-1 Differential Reaction Condenser (C3).
One Hackley 'Graham" "Snip" H.T. Choke.
One Harvey "Leader" Main Transformer.
One Wareands "Smoothing" Choke Type H.T. 2X.
Three 2 in. Component Brackets, British Radio-
gram.
Two Clix Terminal Socket Strips (one marked Aerial and Earth, and one marked L.B. and P.U.).
Six Solid Clix Plugs for use with terminal strips.
One Claude Lyons "B.A.T." Type 7284-1.T.
Switch.
Four W.B. chassis mounting 5 in. valve-holders.
One Claude Lyons "B.A.T." Type 7284-1.T.
Resistor, Type R.1 (R9).
One Claude Lyons "B.A.T." 50,000-Ohm
Resistor, Type R.1 (R7).
One Claude Lyons "B.A.T." 50,000-Ohm
Resistor, Type R.1 (R2).
One Claude Lyons "B.A.T." 30,000-Ohm
Resistor, Type R.1 (R1).
One Claude Lyons "B.A.T." 20,000-Ohm
Resistor, Type R.1 (R4).
One Claude Lyons "B.A.T." 1,000-Ohm
Resistor, Type R.1 (R6).
One Claude Lyons "B.A.T." 150-Ohm Resistor,
Type R.3 (R8).
One Claude Lyons "B.A.T." 750-Ohm Resistor,
Type R.3 (R5).
One Claude Lyons "B.A.T." 1 megohm Resistor,
Type R.3 (R1).
Two Dioders 20 mfd, Electrolytic Condensers,
Type 400 (C8 and C20).
One T.M.C. 1-4 mfd. fixed Condenser, Type 40
(C1 and C12).
One T.M.C. 2 mfd. fixed Condenser, Type 40
(C9).
One T.M.C. 0.001 mfd. tubular fixed Condenser
(C6).
Two T.M.C. 1 mfd. tubular fixed Condensers
(C6 and C3).
One T.M.C. 0.001 mfd. tubular fixed Condenser (C3).
One Peri-Scott Metalized Chassis, 1000 x 1000
with 3112 runners.
One Couree 214 HP Valve.
One Couree 414 HP Valve.
One Couree 414 HP Valve.
One Couree 506 BU Rectifier.

Obtained, but by moving the plunger, which is operated by a nut below, the degree of coupling, and therefore the sharpness of tuning, can be adjusted to any desired extent. As a matter of fact, the Bifocal coils are so designed that when the knob operating the plungers is pushed in selectivity is increased, whilst it is reduced when the knob is pulled out. By this very simple means the degree of selectivity can be controlled without affecting the setting of either the tuning or reaction condenser to any noticeable extent.

Switch, however, must be in direct contact with the metalized surface, since it forms the earth-return from the switch contacts.

The method of adjusting the condenser setting for the receiver will be dealt with in full next week. In the meantime, bear in mind that the A.C.

Theoretical circuit of the A.C. Leader.

Our Great National Competition

(Continued from page 67)

It is worthy of mention that, quite apart from any other consideration, the bifocal coils are remarkably efficient, and that the medium-wave windings consist of Litz wire, and the long-wave windings of single-strand wire of reasonably stout gauge.

There is no doubt that the Varley bifocal coil offers the simplest solution to the problem of bringing practically any type of older receiver entirely up to date. Additionally, of course, the new tuner can be used very effectively in a new receiver, employing any of the circuits given on this and other pages.
ELECTRICAL INSULATING MATERIALS

In This Article the Author Describes the Various Kinds of Insulation used in Wireless Work and their Methods of Manufacture. By C. H. WRAY, F.C.S.

Almost anyone who is interested in wireless is aware of the great importance of insulating materials in the efficient working of wireless apparatus. The name insulators is given to materials which have such high resistances that they can be used as non-conductors. To insulate a conductor is to surround or support it with insulating material in order to restrict the flow of electricity to a desired path, and insulators may be defined as any material which offers relatively high resistance to the passage of an electric current.

Insulating materials may be solid, liquid, or gaseous. The earlier types of insulating substances consisted of amber, glass, paper, silk, shellac, sealing wax, resin, sulphur, paraffin wax, and mineral oils. These have been supplemented by a great number of new ones, including gases at ordinary temperatures, electrical porcelain, varnished materials such as papers and cloth, synthetic resins and moulded compositions, and artificial cellulose compounds, while active research in the insulation industry is resulting in the continual production of further substances. The oldest known insulator is, of course, dry air.

Insulators differ much in their physical properties as well as in their insulation resistance, and many materials which are efficient at ordinary temperatures gradually lose their insulating properties as the temperature is increased. If this increase continues until a chemical change commences in the composition of the insulation, the material may become a conductor of electricity. Other substances, such as glass, act as conductors without chemical change having taken place, when they are heated to softening point, and it may be said that at a temperature of about 1,800 degrees C, insulating materials cease to exist.

Dielectric Strength

The value of a material as an insulator varies according to its dielectric strength, which is the property of an insulating material which enables it to withstand electrical stress. In other words, the dielectric strength of an insulating substance is the maximum difference of potential that it will stand without being penetrated. This is determined by placing a thin layer of the substance between two metal electrodes and gradually increasing the difference of potential between the electrodes until a spark passes through the dielectric. The general suitability of a material as insulation for any specific purpose depends upon its electrical, chemical, and physical properties. All insulating substances have different dielectric strengths, for instance, that of ebbonite is four times as great as the dielectric strength of glass, and insulators may be arranged in the order of their dielectric strengths in the same way that conductors are arranged according to their degree of conductivity.

Ebonite

Ebonite is probably the insulation material best known to wireless users. The term ebonite covers a large number of compounds produced by heating together mixtures of rubber and sulphur. The proportions may vary from between two parts of rubber to one of sulphur to eight parts of rubber to one of sulphur. Mineral matter is often added, together with materials to assist vulcanization. The hardness and electrical properties of the resultant compound are governed by the percentage of sulphur and mineral filling present.

Ebonite has largely been displaced during recent years by synthetic moulded compositions of the bakelite type, which have a wider application and offer greater advantages and facilities for use in wireless manufacture. Composite mouldings are important in that they make possible the use of specialty-shaped articles which, without moulding, would be expensive and difficult to produce. Good-quality mouldings are light and strong, have high insulating properties, and a clean, finished appearance. Mouldings in which the binder is of the synthetic type resist heat much better than those of the shellac, rubber, compound, or bitumen type, because of the liability of the latter class to soften under the influence of even moderate temperatures.

Composite Mouldings

Composite mouldings are produced by filling a mould with a powder consisting of a binder such as a synthetic resin of the phenolic type and a filler such as wood flour (obtained from pine or spruce trees), asbestos fabric or other materials, and subjecting the mixture to heavy pressure at the requisite moulding temperature. Attractively-coloured mouldings can be obtained by adding suitable colouring matter or pigments to the powder mixture. Many alternative substances are used in the manufacture of moulded and composite insulation, including blood albumin and casein, which is the albumin precipitated from milk.

Laminated bakelite sheets and tubes are manufactured chiefly from special paper impregnated with bakelite varnish. For sheets, the paper is first coated on one side with varnish by passing it through rollers, then cut to the size required for the sheets. The papers are then placed one on top of the other on a metal plate and pressed in a steam-heated hydraulic press into a solid sheet.

Composite sheet has taken the place of ebonite for wireless panels, but there is evidence that in its place is being displaced by wood as a material for this purpose. Incidentally, wooden panels usually coated with shellac are employed in early wireless sets, as many readers will remember. Glass was also occasionally used, and the recollections of drilling by means of a copper bit the necessary mounting holes in a thin plate-glass panel for a five-valve set, a task whichshellac is, a far cry from the labour of one of the chief disadvantages in the use of ebonite for panels is its susceptibility to ageing, resulting in a yellow discolouration of the surface. This, of course, easily be removed by means of fine steel wool and a little powdered rouge, but this necessitates removing the panel from the set, and the process of rejuvenating the surface is an extremely dirty one.

Shellac

Shellac still occupies the most important places amongst the natural gums. It comes mostly from India, and is the product of an insect, the lac, the bark of the tree being punctured and the insects. The shells of the insects are coated with lac by the insects, and these twigs are detached and passed through rollers. The shells are afterwards treated with wood spirit and in turpentine, but is insoluble in benzine.

Shellac tape consists of unbleached calico coated with an adhesive of which rubber is usually the base. The adhesive is supplied by the solving rubber in benzine, and resins bodies, together with liquid asphalt, pine tar, and various oils, are added to form a viscous mass which is then spread on the calico (which is in a continuous width) by means of rollers. The treated calico is then cut into strips of the required width by passing it through sharp cutting wheels. Adhesive tape is used in nearly all classes of electrical work, known as shellac tape, in the toolboxes of the majority of wireless amateurs.

Mica

Mica is one of the most important of the natural mineral insulations. It is found in many parts of the world, the chief-bearing areas being in India and America. It is usually mined from the surface, and the vein is opened up to a depth of 200ft. Mica occurs in a form of rock called pegmatite, which is made up of mica, quartz, and feldspar. The mica is broken out of the pegmatite by means of steel wedges, after which it is sorted into various sizes and qualities, and then split ready for the mica market. Most of the splitting is carried out by native workers, who, with the aid of the most primitive tools, such as an old table knife sharpened to a point, or a sharpened piece of hoop iron, can split mica to 1/100th thick. Mica splitting is also done as a spare time work in native homes, where the children take part in the work, and in time become expert mica splitters.

Mica has a high dielectric strength and excellent thermal properties, and there is no substitute for it in the electrical industry.
Short Wave Section

THE BROADCAST QUERY SERVICE

In this article an explanation is given of the data received by the "Practical Wireless" Broadcast Query Department when identifying stations received by readers.

By E. THURWAY.

Regional, or between two other named foreign stations, valuable assistance is provided. If you can give some idea of the language, or describe an interval signal if heard, added to the class of entertainment broadcast at the time, there is every chance that a correct identification will be published. Details of the programmes are useful, inasmuch as if other data points to a transmitter it will permit an actual check-up of the published programme to secure confirmation.

If inquiries sent to the paper are drafted on these lines, readers will greatly assist in facilitating the necessary search and, except in cases where the information is very vague, thorough identification can be relied upon.

Short-wave Signals

In the case of short waves, the matter is somewhat more intricate, as we are dealing, as already mentioned, with other than ordinary broadcasting stations. Where, for instance, the location of amateur experimental transmitters is desired, it is essential that the exact call letters should be given. In the course of their transmissions these stations do not always repeat their international prefix—namely, the two letters denoting the country in which they are situated—but as a rule the full call is given either at the beginning or end of the conversation. Moreover, on many occasions the call letters are replaced by words or names of cities or towns. As an example, a German station once logged a few nights ago, "Hild Victoria Santiago." Here you will see that the prefix was missing but was known by experience to be 'F.' The call, therefore, read FVSX.

The question of wavelength or frequency when dealing with short waves is much more important than with broadcasts on the higher bands; so is the question of language, interval signal, and time of transmission. It is, as a rule, a wise move to note the portions of the short-wave band in which you may expect to hear certain kinds of stations. For instance, amateurs may be heard communicating with each other, either in telephony or Morse, on frequencies between 5 to 25 meters; 55 metres (55 megacycles); 10 metres (28 mc); 20 metres (14 mc); 40 metres (7 mc); 80 metres (5.5 mc), and around 160 metres (1.5 mc). Here will you find no commercial or broadcast transmitters. On the other hand, the latter are allowed to work on the following wave-lengths: 11.27 to 11.77 metres (26.6 to 25.6 mc); 13.9 to 14.0 metres (21.5 to 21.46 mc); 16.85 to 16.95 metres (17.7 to 17.575 mc); 18.55 to 18.85 metres (15.35 to 15.11 mc); 25.5 to 25.6 metres (11.9 to 11.75 mc); 31.2 to 31.6 metres (9.6 to 9.65 mc); and 48.8 to 52.4 (6.15 mc). (The frequencies have been given in megacycles to shorten figures; to obtain kilocycles, add two noughts.)

It will therefore be seen that the commercial stations (whether of telephony) will be found between and outside the enumerated sections of the band allocated to experimental or commercial broadcasting stations. The notice of these facts on most occasions should enable the listener to estimate roughly the wavelength of the transmission he has picked up.

The Language Difficulty

Finally, the question of language. It is not denied that it is always possible to distinguish the language of the broadcast heard; it is evident that definite statement to that effect would greatly facilitate a search. On the other hand, it is always useful to know whether the broadcast was in English or in a foreign tongue. Many correspondents have carefully explained, for instance, that the announcer had mentioned the time or had given out details of an item in a programme, but it was not made clear whether the information was given in English or whether to understand the programme written and was giving a free translation of the words heard.

In sum up, give all the details you can, irrespective of whether or not they may appear trivial; in these searches every particle of data is of valuable assistance.

USING THE NEW WESTECTOR

(Continued from page 79)

The new Westector greatly simplifies matters, and, of course, due to the permanent nature of the Westector, the detector stage cannot be affected in the usual manner, such as by changes of valve characteristics, due to age, or the insertion of a new valve. Coil LI is tuned to the frequency of the incoming signal it is required to receive, and the Westector is condenser coupled to the L.F. transformer. The filter circuit is made up of the usual load resistance R and the coupling condenser C and tuning condenser CI of the L.F. transformer. Note that a tuned anode oscillator stage is employed, which thus becomes independent of the strength of oscillation. By tapping off from the negative end of the Westector part of the D.C. voltage generated across the filter condenser, provision is made for A.V.C. purposes in the usual manner.

Automatic Volume Control from Existing Detector Valve

Another application to which this new Westector lends itself is shown in Fig. 7, where it is used to obtain an A.V.C. voltage from the anode of the detector valve. The Westector is connected to the anode of the valve in place of the usual H.F. by-pass condenser, and the H.F. used to generate a voltage across the load resistance R. This voltage is fed back to the grid of the preceding variable-mu valve to obtain A.V.C. in the usual manner.

The foregoing gives a general idea of the use to which the new Westector may be put; and we hope shortly to put these applications into practice by describing how they are incorporated into new and useful components. Its introduction opens up a new field for constructors, and we shall see to it that our readers are more informed of the results of our experiments.

50 TESTED WIRELESS CIRCUITS

Edited by F. J. CAMM
PENNY-IN-THE-SLOT RADIO

In this Article the Author Describes a Simple Coin-operated Automatic Time Switch Apparatus.

By J. McLeary

To make this device, an alarm clock, an old .0005 variable condenser, a piece of three-ply wood, 7in. by 9in., two spring clips, two small brass strips, four small cubes of wood, a pair small hinges, and a few screws and bolts are required. First of all, get a piece of 1in. plywood 14in. by 9in., and cut a hole in it the exact size of the glass of the clock. Then cut a second piece of plywood into a hexagon with sides about 3in., and in that cut a hole just large enough to allow the minute marks on the dial to be seen from the front when the clock is fixed. Glue this piece on the 14in. by 9in. piece in the exact position, that is, at the other hole. Now screw the clock at the back on to the front piece (the case is off and the feet and the ring holes are bent to allow for screwed in with three screws. Measure along from the winding screw of the clock about 5in., and cut a hole 3in. by 7in. When that has been done, take a piece of wood about 8in. by 7in., and cut two pieces 3in. and two 1in. long, then with them make a box as shown in Fig. 7. Glue that behind the hole in the front piece, leaving the hole flush. Get a small piece of 3-16in. plywood of suitable size to cover the box already made and fix on the spring clips so that the opening at the extreme ends of the clips is slightly narrower than the two brass strips, which are about 11in. long by 7in. wide, and must be slightly thinner than the penny. Bend both ends at right angles to each other, as shown in Figs. 3 and 4. Next take the 7in. by 11in. piece and at the end glue one of the cubes. Reverse the piece and do the same at the other end.

Next fix the small pair of hinges about of the hinge pin. Next take two pieces of jin. elastic, and with drawing-pins fasten them on to the tops of cubes A, leaving about jin. slack between. The old spring used as a guide straightens them up when the clock unwinds itself. Let the drawing-pins overlap the cut just sufficient to make up for the cut. Now try the arm on the clock (the hinged part makes for easy winding up, as when winding one bends the hinged part over to clear the guides) then wind up full. Retard the arm until it is in a straight line with the guides and arrange so that it goes freely through them. When that has been done, fasten the piece of wood with the guides to the box. Then put on a pivot piece below, break the L.T. negative lead as shown in Fig. 5, and fix a singlepole switch as indicated for breaking the circuit of the penny apparatus, when required.

The time indicator, seen just above the switch, consists of two clock hands fastened in place with a small brass screw which passes through a hole in the centre of the dial. The hexagon-shaped surround is cut out of a piece of plywood and glued in place. The hands are set to indicate the time that the set will automatically be switched off.

How it Works

With the apparatus illustrated, it takes 2 hours 30 minutes before the penny is knocked out. Then the brass end takes the penny's place for about seven minutes until the clips drive the brass piece away.

(Continued at foot of page 86)
For the Technical Experimenter.

MAGNETISING THE MAGNET

BY D. F. W. LANCHESTER

In This Article the Author Concludes His Explanation of this Interesting Subject.

The present-day practice appears to be to use the "make" rather than the "break," the sequence of operations being, first closing of the secondary circuit, consisting of one or more complete turns of copper round the pole of the magnet to be magnetized, and then closing the primary circuit. The secondary is then switched off before the primary circuit is broken, otherwise the magnet would be demagnetized by the rush of current in the opposite direction.

Any article which ignores the commercial aspect of the subject with which it deals is liable to be deemed by practical men of only academic interest, and therefore a very brief outline is given of the more important equipments at present widely used.

Messrs. Ferranti employ two alternative methods. Namely: (1) A multiple circuit of some two or three turns cut out in the manner already described (Method D), in which the upper part of the circuit consists in a number of hoops of copper rod, the prongs of which dip into mercury cups when the circuit is closed, the ends of the cups being interconnected in such manner as to provide as many turns as there are loops. Figs. 7 and 8. It has already been pointed out that a weakness of this system is the low conductivity of mercury (about 1/100th that of copper). And (2) a transformer, the construction of which the following figures may be taken as typical—

Primary turns 80.
Secondary turns 1.
Maximum primary current 200 amperes.
Maximum secondary current 25,000 to 30,000 amperes.

It is the latter system that is more generally regarded as the "Ferranti" method. Messrs. W. E. Burnand & Co. market a magnetizing plant which comprises a generator and transformer, diagrammatically represented in Fig. 9. One interesting feature of this installation is the comparatively small size of the generator, which is rated at only 1 h.p. Actually the power required during the period of activity is from 2 to 4 kilowatts, which may be taken as 3 to 6 h.p.; but as this is only required for a second or two, and there is a period intervening—inevitably—of something approaching half a minute whilst the magnet to be operated upon is being changed, the mean or average power required is very small. By means of a flywheel on the generator shaft the generator torque is averaged, and it is due to this that a generator of 1 h.p. is sufficient to supply the energy required. During the active period the flywheel is slowed down, giving its rest up as electrical energy, and during the passive period the flywheel undergoes acceleration. Another feature of the Burnand equipment is the compact arrangement of the transformer casing as a foundation or stand for the magnetizing rig, by which means the massive copper leads required to carry the heavy magnetizing current are made as short and the connections as direct as possible, so that the ohmic resistance is reduced to a minimum. An example of the quick-acting magnetizing rig is illustrated in Fig. 10, and the manner of mounting same on the transformer casing in Fig. 11.

A typical example of the directly-generated-current type of magnetizing equipment is that supplied by Messrs. Canning. This comprises what is virtually a plating dynamo capable of supplying a current of 4,000 ampere from 3 to 6 volts. The current is delivered to the magnetizing jig by massive copper bars, and in order to minimize resistance it is the accepted practice to mount the magnetizing jig on (or in immediate proximity to) the generator, this being analogous to the mounting of the jig on the transformer casing as described above.

Nearly all the magnetizing firms who supply magnet assemblies to the trade use one or other of these systems. Also the majority of manufacturers who build up their own assemblies use some equivalent methods. The method of employing a separate magnet (Method A) is, for the purpose of moving coil-magnet assemblies, entirely obsolete. The Lancashire magnetizing equipment (Fig. 6) is an exception, but this device, which is almost perfect and very economic for magnetos of suitable design and construction, is not universally applicable.

Messrs. Darwin, who use the Ferranti equipments, appear to give each magnet a double dose, the direction of the current in the transformer being reversed, but the magnetic field is maintained in the same direction, the magnet being turned about. The idea of this is that there is always some residual saturation in the core of the transformer, and this is "cashed in" when the field is reversed. According to particulars given by Messrs. Ferranti, they rely on a single "dose," but reverse the field after each magnet has been magnetized, and by this means equally good use is made of the residual saturation of the transformer core.

In magnetizing as above described by "impulse" from a transformer, it is of importance that the current should not be too suddenly built up or quenched. Every magnet electromagnetically excited has a "time constant"—that is to say, it takes a certain time to build up its field to the maximum value, and this applies to a permanent magnet in the act of magnetization, just as much as it applies to any electro-magnet; the field magnet of a dynamo, for example. It is important that the duration of the magnetizing impulse should be greater than the time constant, for otherwise much of the energy is wasted in eddy currents and the magnet is not saturated uniformly through its section. Briefly, this means that the time constant of a transformer must be considerably greater than that of the magnet being operated upon.

Penni-in-the-Slot Radio

From the bottom for easy access of the next penni.

To avoid the necessity for continual winding before use it is worth while to fit a small brake to prevent the clock from working when not required. In Fig. 6 is illustrated a small brake which consists of a brass strip with one end twisted and a hole drilled in the other end. This is attached fairly loosely to the end by the simple method of locking it to the end of a threaded condenser spindle. The knob is then attached to the front (below the clock dial) and a small rotation brings the balance wheel to a stop as the strip comes into contact with it. When required for use, a small rotation of the condenser knob will start the clock.

Fig. 6.—Showing how the brake piece of brass acts on the balance wheel of the clock.

Fig. 7.—Showing a coin held between the contact strip.

Fig. 8.—When a penny is pushed down, the brass strip on the side of the arm takes its place until the arm reaches the second position, when it bends at the hinge, as depicted, and allows room for the next penny to be inserted.
Continued improvement

Continued intensive research work gradually gave greater rein to the studio manager’s art. A more intense spot-light beam from a mirror-drum transmitter gave an even larger area of action, while

A new move which will assist in the development of television is always watched with the greatest of interest, and the change of headquarters for the B.B.C. transmissions from Studio BB to a large converted, old-fashioned Regency drawing-room at No. 16, Portland Place is one of special significance. It is inconceivable to imagine the B.B.C. meeting the expense of the removal unless they intended to associate themselves very intimately with the development of science.

Before dealing with the layout of the new premises, it is interesting to look back and see how material is the progress which has been made in studio technique. The original transmissions sponsored by the Baird Company were of head and shoulder images only. The spot-light transmitter and associated photo-electric cells were fixed in position, and it was necessary to make the artist or subject being televised keep his head within very narrow limits, so much so that a head outline was marked on the back screen to act as a positional guide. This is shown very clearly in Fig. 1, the black silhouette being quite conspicuous and proving a great help in those early days.

Improvements both in photo-electric cells and the amplifiers associated with them have enabled programmes of a slightly more adventurous character to be attempted. With an increase in cell sensitivity the light area scanned became larger, permitting a greater depth for back screen positioning, and consequently a little more latitude was given to artist movement. Occasionally small sketches with one, or perhaps two, characters were experimented with.

A more ambitious attempt materialized in July, 1930, when the B.B.C. co-operated to produce the first play to be televised. It was called The Man with a Flower in his Mouth by Pirandello. Special scenery of bold outline was prepared, and one of these, together with the three artists, is shown in the studio in Fig. 2.

Note in Fig. 2 the four photo-electric cells are housed in a metal screening box mounted above the wall aperture through which the spot-light beam was thrown. They were also tilted towards the artist to bring about the greatest reflected light pick-up. Illuminated signal instructions for the assistance of the artist appeared on the screen below the aperture, while the microphone was in a convenient position to take control of the voice and thus complete the dual transmissions.

Partly rectified by converting Henry Hall’s Studio BB, together with the small adjoining listening room. This did service for a period of nearly eighteen months, and under the able direction of Eustace Bobb quite a procession of notabilities made their début before the camera-like structure of the new mirror-drum transmitter designed specially for the work.

The New Studio

Under the B.B.C.’s able direction the art developed rapidly, and it soon became apparent that greater accommodation was necessary if better programmes were to be the order of the day. No space being available in an already overcrowded Broadcasting House, new premises were leased at No. 16, Portland Place, and after a long preparation these were made use of for the first time on Monday, February 20th, 1934.

All the television programmes will now emanate from this studio, which undoubtedly is a great improvement on the old one. A rough idea of the layout is given in Fig. 3, which is a plan view. First of all the studio is at least 50 per cent. wider, and this factor alone will prove a great asset to the producer in arranging even more attractive programmes. The artists who dance or perform acrobatic feats have greater freedom, and they can be "followed" over a wider area by means of the mirror-drum transmitter, photographs of which have appeared quite recently in this supplement.

At an early date it is hoped to add another improvement to the transmitter. This will be a vertical "tilting device" to enable the scanning beam to move up and down over much wider limits than is now possible. The resulting flexibility will enable "shots" at various angles to be made almost the same as with a movie camera.

Technical Details

Adjoining the studio is the control room, which is at least four times as large as that provided at Broadcasting House. A large plate-glass window set at an angle separates this room from the studio, and against this is positioned the mirror-drum spot-light machine mounted bodily on rails for side movement, while it is also pivoted on a circular runner to allow the operator to turn it through quite a large angle.

Fig. 1.—In the very early head and shoulder transmissions an outline guide was marked on the back screen for positioning purposes.

Fig. 2.—One of the "scenes" and three artists taking part in the first play to be televised. Note the fixed cell positions and small signal indicator.
high-intensity carbon arc serves as the light source, and after emerging from an aperured metal shield, the light beam passes through an optical system to the revolving mirror drum, which traces out the scanned light area in vertical strips side by side.

In addition to one or two individual photo-electric cells placed at vantage points there are four groups of cells mounted on movable stands. Each of these groups connect to a separate "A" amplifier of the two-stage type, a special form of low-capacity cable being used for the purpose. The outputs from these four amplifiers pass to a mixing panel and master control desk at which sits a control engineer. By a careful manipulation of the controls at this stage of the process various fading and lighting effects are produced. In addition, it is possible to switch right over to the "caption" transmitter (see Fig. 3) whereby announcements, small scenes, and objects are scanned to act as links in the complete programme.

After the signals have passed the control desk they are fed to two "B" amplifiers of the three-stage type with double outputs, and this in turn connects with three "C" type amplifiers of three stages. On the input side of these "C"'s is a corrector network designed to compensate for high-frequency attenuation, including the scanning-aperture factor.

It is important to note that in the new studio there is a correction on the lines to Brookmans Park radio transmitter up to 15 kilocycles, whereas before the cut-off occurred at 8 kilocycles. A very marked improvement in high frequencies is thereby obtained, and this is shown in the greatly improved detail present in the television images.

All the inputs and outputs of the amplifiers are brought to the control panel, which, with the mixer and master control, is on a desk-like frame quite separate from any amplifiers, as a precaution against valve microphony due to the handling of the different controls.

An interesting point in the interconnection of the amplifiers is that no transformers are used except those which feed the lines to the main control room.

The line vision monitor receiver (a mirror-drum grid-cell machine) is immediately in front of the control engineer seated at the desk, and in addition a complete radio television receiver is positioned by its side so that an exact radio check on the images is provided.

Whereas in the old studio there was only one microphone, two are used in the new premises. Furthermore, sight and sound are now controlled together, whereas before they were handled quite independently. This is a big advantage, for the dual transmission is under the sole jurisdiction of the director and his staff, the latter being already augmented by another engineer.

The walls and ceiling of the studio have been covered with acoustic board while the orchestra are screened off behind a large curtain in a section indicated in Fig. 2.

Undoubtedly the new arrangement will have a most beneficial effect on the programmes, and this in turn will stimulate interest among a larger number of amateur constructors who will be encouraged to look in solely for the entertainment, quite apart from the scientific and practical fascination.

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(Use black letters please)
ADJUSTING AND OPERATING THE
D.C. PREMIER

Notes on Operating the Set, Trimmer Adjustments, and Setting of the Bias Resistance.

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc., A.M.I.E.E.

In carrying out the preliminary tests, first of all insert the V.P.20, H.L.20, Pen.20, and the barretter into holders V.1, V.2, V.3 and V.4 respectively.

Connect the aerial and earth leads to the pair of terminals so marked, and insert the fuse plug into a convenient mains socket. There is no necessity to test and ascertain which is the positive and negative main. If, after switching on and waiting for a minute the set refuses to function, switch off, reverse the plug, and switch on once more. If it fails to work in either plug position there must be a mistake in the wiring, which should be located and rectified.

The Controls

The four controls of the Linacore unit are conveniently arranged in two concentric groups. On the left are the switches, the smaller knob at the front being marked with a red line to indicate the long-wave position (800 to 2,000 metres), with a green line for the medium waves, which gives the range of 200 to 550 metres, while the white line indicates that the set is switched over for operation in conjunction with a gramophone pick-up. Behind this is a larger knob controlling a quick-make-and-break single-pole on-off switch. As far as the right hand pair of knobs are concerned, the larger knob at the back tunes the triple-gang condenser for normal station selection, while the small knob in front operates a reaction condenser. The bottom left-hand knob serves to alter the bias on the variable-mu high-frequency valve, giving a very smooth and efficient re-detector volume adjustment. The last knob—bottom right—alters the tone of the loud-speaker to suit individual taste or particular transmissions.

The tapping taken to the “transcoupler” unit should be joined to the terminal marked “Low” for the first tests, and the only other adjustment provided is the variable bias resistance in the cathode lead of the pentode output valve. This is in series with a fixed resistance of 300 ohms and, according to the makers, the total bias resistance for the best working conditions should be 450 ohms. With the anode voltage provided in the set this gives an anode current of approximately 25 milliamperes, and where the constructor has a suitable instrument it is advisable for him to connect this in the anode lead and adjust this cathode resistance R1 until the current of 25 milliamperes is registered. When no instrument is available, set the moving arm of the resistance about one quarter of the way round.

First Aerial Tests

Set the range switch to medium or long according to which suits your local station, the reaction at zero and the volume control about one-third forward, and switch on. The cathode will take about half a minute to heat up, but the barretter will show almost immediate incandescence. In normal situations there will not be any trace of mains hum, but if the district in which the set is being used happens to be notorious for its very raw supply, it might be necessary to add a further reservoir condenser of 2 mfd. capacity between the negative main and the junction of the speaker field and barretter. This addition, however, is very unlikely unless there are exceptional circumstances.

Adjusting the Trimmers

Without touching the reaction control, but merely operating the tuning knob and volume control, it will be found possible to tune in a large number of radio stations on both wavelength ranges. To ensure that the Linacore unit is working at its maximum efficiency the trimmers of the ganged condenser may need a small alteration, although this should be very slight. The three trimmer positions were indicated last week, and the first thing is to tune in a fairly loud station broadcasting on a wavelength between 275 and 325 metres. Then reduce this station’s volume so that the signal is only just comfortably audible. With a thin screw-driver turn slightly the middle trimmer in both directions and leave it set at the point where the station is heard loudest. Repeat this process with the rear trimmer and finally adjust the front nearest to the control knobs.

Further Adjustments

Station searching can now be undertaken, and the constructor will be agreeably surprised at the number which he can tune in at comfortable room volume. The selectivity obtainable is a most outstanding feature, while the sensitivity is remarkable when it is remembered that the D.C. Premier is only a three-valve set. Naturally, the user must gain experience in the proper handling of the three main controls—tuning, reaction, and volume—but it will be found that for most purposes the reaction setting can be left alone. It is only on the very distant stations or low-powered transmissions that the value of this control is shown to real advantage, and in any case reaction should be used sparingly whenever the best quality reproduction is desired.

As the valve makers state that the optimum anode resistance for the detector valve is 25,000 ohms, the lead joined to the terminal marked “low” on the transcoupler should give the best results. It is advisable for the constructor to make quite sure, however, and in addition to make a test with the lead on the terminal marked “high.”

Using a Pick-up

Before housing the set in its cabinet it is advisable to try it in conjunction with a pick-up. Set the top left-hand smaller knob to its white marking and the set is then ready for gramophone reproduction. As the H.L.20 detector valve is capable of handling an input voltage of 1.5 v. R.M.S. without distortion, it will handle the output from any quality of pick-up and give a high effective amplification. This, together with the pentode output valve, is ample for ordinary room working, and the quality of reproduction is in the highest class.
Special Headphones for the Deaf

A RECENT experiment carried out by the H.C. Master’s Voice Company shows that deaf persons, who have lost all their hearing in both ears, and whose organs have not been totally destroyed, can hear programmes from this company’s radio-gramophones with the aid of special headphones. A well-known Knight, who, for some years, has only been able to hear music badly distorted through his ordinary hearing apparatus, approached the company with a view to ascertaining whether it would be possible for him to enjoy the programmes provided by the H.M.V. seven-valve radio-gramophone he had bought for his family. H.M.V. engineers, therefore, had a special pair of headphones wound to match the impedence of the radio-gramophones. These headphones employ cones in the earpieces instead of the ordinary flat diaphragms, and are used through the receivers by Navy and Air Force radio installations. Although this gentleman cannot hear speech or music without his glasses, he is now able to enjoy a radio transmission or entertainment from records to the same degree as a person of normal hearing. The sounds of music and speech from the headphones, if worn by a person of normal hearing, would practically deafen him.

Some of the “H.C. Master’s Voice” radio-gramophones are now arranged so that a switch at the back makes it possible for a deaf listener to use these or broadcast entertainment whilst the loud-speaker is in the instrument at the same time disconnected.

Move in the War on Interference

SINCE radio began roughly ten years ago, the reception of programmes, both home and continental, has been marred by extraneous interferences. Radio has passed through many vicissitudes since Marconi first gave the world true home entertainments, and as time has gone on, various experts in the radio world have tracked these interferences to their individual sources and slowly but surely cured many of these into effect. The question of “jamming,” i.e., the overlapping of two programmes, has been thoroughly discussed all intents and purposes eliminated by the Lucerne Plan which has recently come into operation, and situations which the listener commonly meets have been successfully overcome.

Two great bugbears, however, still exist, the first and by far the most serious being the interference experienced from electrical apparatus of all kinds, which can be referred to as “man-made static.” The second is nature’s own interference known as “atmospheric fade” and is the last stronghold to be taken in the war on interference.

The trouble caused by electrical machinery has been thoroughly investigated by Marconi’s engineers and after years of intensive research a system has been evolved whereby those in charge of radio receivers (the users and those maintaining) can bring all the sources of science to bear towards eliminating such undesirable additions to radio entertainment. Scientists, experts, and engineers working at the Marconiphone Factory at Hayes in Middlesex have studied various sources of interference into “cause and effect,” and a series of records has been made, on which are noises characteristic of every type of interference commonly met. Some thirty different types of source of interference have been identified and it is now found how they make in the normal sensitive receiver recorded. With this series of four records made from these six-page manual is being distributed and it is intended to make this a popular as the previous one.

Move in the War on Interference

THE SUPERHETERODYNE FREQUENCY CHANGER

(Continued from page 78)

“tracking” condensers of 0.002 mf, in series with the oscillator section at the point marked X in Fig. 4. It has been shown above that the “frequency mixing” can be provided in either the grid or anode circuit of the first detector valve, and it can now be explained that “cathode coupling” or “cathode mixing” is also possible, this arrangement being made use of in the “Lyric A.C. Superhet,” which was described in PRACTICAL WIRELESS dated October 14th and 21st, 1933. A complete circuit of the latter receiver is given in Fig. 5, and from this it can be seen that the “reaction” winding of the oscillator coil is wired in series with the cathode lead to the first valve, which serves the combined function of first detector and oscillator. Also in series with this winding is the usual bias resistance (R.1), shunted by a fixed condenser (C.4). The primary winding of the intermediate-frequency transformer is coupled to the oscillator coil by means of the fixed condenser marked C.5. By employing this form of coupling the cathode of the pentode valve is connected to both the intermediate frequencies, so that very thorough “mixing” is obtained and the circuit is uniformly efficient over its whole range.

The Penagrid Frequency Changer

The latest, and probably the most efficient, type of frequency changer is the pentagrid or triode valve, a circuit of which is given in Fig. 6. It will be seen that the pentagrid has five grids in addition to the usual cathode, anode and heater. The control grid (C.G.) acts in conjunction with the cathode and anode as a normal anode-grid detector first detector whilst two other grids (marked O.G., and O.A.) act as the grid and anode respectively of the oscillator section. The control grid is screened on one side by two cathode strips which are joined together and marked S. In the pentagrid there is no coupling, in the usual sense, between the detector portions, the “mixing” taking place within the glass envelope of the valve; it is generally referred to as “electron coupling.” The values of components given in Fig. 6 apply to the recently-introduced O.C.D. penentagrid, but the circuit arrangement is applicable to other makes of similar valve,
AN IMPROVED SOLDERING TOOL

The illustration below shows a novel development of the ordinary soldering tool, a device which, whilst permitting the connection of two or more wires to only one but (with consequent reduction in thickness between clamping nuts), also gives a shock-free connection owing to the split-wedge effect. The tags are manufactured and sold by International Standard Radio, Co., 4, Westgate Street, Hoxton, E.8, at 3½d. per dozen, and although they are no larger than an ordinary soldering tag, they are able to accommodate more than one wire without the usual difficulty of twisting two or more wires on the short Shank which most manufacturers provide on their components. The two ends of the tags are bent away from each other to provide the split-wedge effect. Contractors will find these most useful.

SILVER GHOST HELIX AERIAL

FROM London Radio and Wireless, Coventry, we have received a sample of an improved aerial consisting of seven strands of 28 gauge tinned copper wire covered by a weatherproof yellow fabric coating. Without this covering in a widely spaced spiral it is a further wire of 35 gauge (enamelled), and this is staked to act as a resistor system and to eliminate interference. The aerial is erected in the ordinary manner, with the inner conducting surfaces connected to the aerial terminal on the receiver, and the outer wire is used for the two sides of a pair of 15,000-ohm resistors, to be joined either direct to earth or through the medium of a small prover having a maximum capacity of 0.0005 microfarad. Where interference is very bad, then the outer wire is employed as the aerial and the inner wires as the resistor. The device works very efficiently and gives good results with a minimum of interference where an ordinary aerial would give troublesome results. The price of a 6-ft. length of this aerial is 2s. 6d.

NEW MILLWARD VALVES

A NEW, indirectly-heated rectifier is announced by Millard, Millward, and this is one of a type with a 150 ma valve with a 2.4 amp heater. The type number is LW 4, and the price is 50s. The advantage of this type of rectifier, as has previously been pointed out, is the avoidance of a sudden surge when first switching on a mains receiver, and it therefore avoids the necessity of employing a thermal delay switch.

In addition to the above, Millard also announce the introduction of special Universal valves, which, apart from their electrical characteristics, also depart from standard practice in the design of the base and connecting points. So for six types are announced, and a further five types will be added in course. The type heater ratings of 3.1000 watts, at 13 volts, and the plate current has 10 watts. The heater is rated at 20 watts. As may be seen from the illustration, small metal tags project from the base, and are accommodated these valves a special holder is to be employed, and this has springy brass arms arranged down the sides in small circles. Thus the valve is pushed down into the holder so that it is non-rotation, and so rigid and strong that an electrical contact. Most of the valves will be provided with these tags, and they are slightly smaller than existing types of valve, the approximate overall height being only 5 cm, and the diameter 1.6 cm. Full details have not yet been released, and the actual date when they will be available to the public is not yet known.

LETHAM AUTOMATIC

A NEW type of automatic on-off unit which has been received from the Letham Electric Limited, of Brentwood Works, Taunton, Somerset, is illustrated on this page. It is an extremely small device, but is not fitted with the metal rectifiers or the resistance which is required as part of the complete circuit. The unit itself—being a unit may be seen to be twice the size of the other units is interlocked with a similar anode of two or three, and is connected in series, thus ensuring the complete circuit. The Benham Autocontrol clipped in the upper pair of clips and the resistance in the upper pair. Type W.6 Westcoast is required for the first position, and for the second the actual value of resistance is dependent upon the type of valve which is employed. For a normal pentode this would be 100,000 ohms, and for a super power and a small power the value may be 150,000 or 200,000 ohms respectively. When the autocontrol switch is attached to the receiver the grid bias applied to the output valve should be doubled in value to enable the unit to function in the correct manner and thus the down the total current consumption of the receiver. As has been pointed out before, the bias, by being doubled, reduces the amount anode current, and also lowers the limit of the valve, and to remove the distortion—which would be caused by this increased anode potential—a grid is applied through the medium of the metal rectifier and the received signal. Thus a powerful signal will reduce the bias more than a small grid and an excessive anode current consumption over a period of time which would be more than would be the case without the unit. The price is 7s. 6d.

DREX GxzE ELECT BATTERY REDUCTION

A NEW type of battery-operated receiver will undoubtedly be pleased to note that one of the makers of the well-known Dryx battery (The Chaucer) have announced a reduction in the price of the Type H.200 battery. This was originally priced at 10s. 6d., but now costs only 7s. 6d.

20 GUINEAS CASH

And 200 other Combination Prizes! See page 67 for preliminary details.
PRACTICAL WIRELESS

PRACTICAL LETTERS FROM READERS

The Editor does not necessarily agree with opinions expressed by his correspondents.

All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Our Tool Kit in Egypt

Sir,—Am pleased to say I received your tool kit safely and am highly satisfied with it. Being accustomed to using good tools naturally appreciate the quality of material and general appearance of the tools, and shall find them of great use to me. Like your gift, your valuable paper. PRACTICAL WIRELESS is, up to a high standard, and I enjoy reading the many articles, which are clearly stated:—C. Oxen (Mustapha, Alexandria).

Distortion in Amplifiers.

Sir,—I have been a regular reader of your excellent paper for about eighteen months, and in my opinion it is the best wireless paper published. In a recent issue, however, there is a statement which to me does not seem right; I refer to the article by E. G. Rowes, on Distortion in Amplifiers, in the March 3rd issue, in which he says that a 60-hour choke has an impedance of 1,800 ohms at 30 cycles per second, and if understood should be 2 \( \pi fL = 2 \times 3.14 \times 50 \times 60 = 18,840 \). Also, he says an 8000-mf. condenser has an impedance 0.16 at 50 cycles. As I work it out it should be

\[ 1 \times \frac{1}{2 \pi fC} = 1 \times \frac{1}{2 \times 3.14 \times 50 \times 60} = \frac{1}{36,942.6} \text{ ohms} \]

which is vastly different from 0.16 ohms. I would be greatly obliged if you would clear up this point.—H. R. Baur (Hkley).

[Many thanks for pointing out these slips.—Ed.]

A Home-made Photo-electric Cell: A Correction

Sir,—I would like to point out that in the article, "A Home-made Photo-electric Cell," in your March 24th issue, there are some errors respecting the chemical side of the construction. The writer says, "Place the sheet copper in the Bunsen burner so that a film of cuprous oxide is obtained." This, he states later, "is a black film." He suggests that underneath this film is "the cuprous oxide which we require," whilst the black layer of cuprous oxide "must be removed by vinegar paper or dissolving in ammonia." It may interest your contributor and other readers to know that cuprous oxide is red and cupric black. It is not the cuprous oxide on the outside, but it is a film of black cupric oxide, which is removed by dissolving in ammoniac solution. In the finished cell we have a film of reddish cuprous oxide left upon the plate. It may also be noted here that cupric oxide is also affected by the action of emery paper and so this is not to be recommended. It pleases me to add my appreciation of your weekly and my thanks for your "Everyman's Wireless Book."—K. M. Bevins (Liverpool).

[Many thanks for pointing out the slip.—Ed.]

A Reader's Appreciation: Our Data Sheets

Sir,—Since January I have become a regular reader of your journal. It appears to be the most useful "wireless" weekly I have seen, and invaluable to the beginner as well as the advanced explorer in wireless. It has occurred to me, therefore, that you might welcome any intimation as to the needs experienced by "beginners" or those inexperienced—as far as "wireless" is concerned—who desire to construct many of the simpler items required, and, at the same time, to obtain a proper conception and understanding of the reason for "this" or "that" concerning the items at the market place. With this in mind, taking my own case, there is a class of components which I could construct easily, but which, owing to the lack of mathematical ability and the required theoretical knowledge I cannot proceed with. In such an instance as the above, it appears to me that if I had access to a simple set of tables, we would, say, giving in one column rectangular sizes and metal surfaces, from the smallest practical minimum to a large surface, and perhaps in the next column the maximum, as simple as possible, of its particular capacity in relation to I.M.F. In an additional column, the number of metallic rectangles of each particular size required to be assembled, with a specified dielectric, to safely hold the desired content, I should then be able to carry on and experiment with a far better conception of what was being planned than I do at present. If your valuable journal has already dealt with such matters on these lines, I venture to hope that what I here refer to may be deemed worthy of your consideration.—A. W. Langworth (Owring). [The information required has been published in our data sheets.—Ed.]

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REPLIES TO BROADCAST QUERIES.

Editor's Note: Queries must limit their queries to three per letter.

D. Wood (Stoke): WD1W, E. F. Hovey, Sandine Lane, Warwick (Radio Island): W1K X. P. Goodliffe, West Tewkesbury, Gloucest., W. P. Ingrass, 234, East Chestnut Street, Canton (Ohio): Many thanks to Mr. Webster (Germany): Regret cannot trace possible error for an estimate of a certain number of tubes. (Osga.) (1) 2TA1B, Marquand Co. given as 40.5 in. for we believe this station is working on about 40.4 m. (2) 2A3BP, Allied Co. given as 40.5 m. (4) 50.40, Allied Co. given as 40.5 m. In these several channels around 40.5 m. W1K, 20.347 m. W1C, 20.311 m. W1K, 20.27 m. W1C, 20.247 m. W1X, 20.12 m. KD8. (Note: Mutual (Grainger) 2TA1B, Heising, P.C. 10.26, Barco de Salvino Boys, Garrochale, Porto Rico.)

CATALOGUES RECEIVED

In new readers' trouble, we undertake to send out catalogues, or any of our leaflets, free of charge, to any party who writes us on a postcard, the name of the firm from whom you receive wireless, and the number of copies required, e.g., PRACTICAL WIRELESS, S. & B. Ltd., 811, Whitechapel Road, London. We may also supply free of charge, with any order, any product of the firm, should it be required in connexion with the article ordered.

"LEEDS" VIBRANT MICROPHONES

EVERY type of microphone and many others amplifiers to stand instruments, is listed in a folder issue I have mastered, and you can see you are dealing with the best. The Leeds is a range of microphone transformers, telephone, and microphone amplifiers, the Leeds microphone amplifiers can be obtained from 218, Upper Thames Street, London, E.C.4, by enquiring for a postage stamp.

WESTINGHOUSE METAL RECTIFIERS

Whether you are building the All-Metal Rectifier, or the popular and very effective Westinghouse metal rectifiers, the book, which is primarily of interest to home constructors, to help in building their own apparatus, deals fully with rectification, battery eliminator problems, mains conversion, and battery charging. There is also a section devoted to Westinghouse and their new to various circuits. The book is well illustrated with diagrams which should be very useful to the home constructor. Copies of the handbook can be obtained for 3d. each, post free, from The Westinghouse Radio & Signal Service Company, 82, York Road, King's Cross, N.1.

NEW CENSUS "CLASS B" BOOKLET

READERS using battery receivers, and who wish to increase their output, you will find that the "CLASS B" is a great improvement over a "CLASS A." The following page is taken from the N.C. "CLASS B" booklet where the No. 12 type, is shown, the circuits and methods of construction are given, together with the results and output of both. For these reasons, it may be of interest to any constructor who is using a "CLASS B" system. On the other hand, if you are using a "CLASS A" system, it may be of interest to you to see what the "CLASS B" receiver is capable of. A copy of the booklet is available free to readers of PRACTICAL WIRELESS, on application to Messrs. A. C. Cunliffe, Ltd., of Hillbury, N.5.

HEAYBERE MAINS EQUIPMENT

SEND Power for Your Radio." is the title of the new 1934 combined Handbook and Catalogue issued by Heayberes, Heayberes. It contains a comprehensive explanation for the beginner, as well as including a list of their products and prices, together with technical data and circuit diagrams for making up various types of equipment. With the diagram of the complete circuit, together with all the components for those eliminators, with prices, enabling any constructor to make up a mains unit to suit both pocket and technical requirements. Particulars are also given of a range of portable battery sets, including supertone and all-tube type, which delivers an output of 1 or 2 m.a. in its own battery; or a change-over television supplement is included, and this new and enlarged edition should prove even more popular than the previous ones. No constructor should be without one of these valuable handbooks, though copies can be obtained for 3d., post free, from P.C. Heayberes & Co., 10, Embsay Street, London, E.C.2.
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at no extra cost • Here's a 2 mfd. T.C.C.
Type 50 paper condenser — specified for 200v. D.C. Working.
D'you see the initials T.C.C.? . . . they mean perfect safety.
Use it with 200v. D.C. across it (and, unofficially, shall we whisper?—a little more too!) and you know it won't let you down. The condenser plus this security costs you 3s. 6d.—not much to be sure.

It's the same throughout the T.C.C. range; the Type 141 is specified for 2,500v. D.C. Working—and it will—it bears the initials "T.C.C." Look to it that the condensers you buy are rated at the right voltage—then look to it that they carry the T.C.C. initials—then you've got the world's finest condensers.

T.C.C.

THE WIRELESS CONSTRUCTOR'S
WIRELESS NEWS
PRACTICAL WIRELESS
April 7th, 1934

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

The coupon on this page must be attached to every letter or printed envelope containing queries.

If a postal reply is desired, an envelope must be enclosed. Every query and all correspondence which is sent must bear the name and address of the sender. Send your queries to the Editor, PRACTICAL WIRELESS, 26-31 Southwark St., Strand, London, W.C.2.

SPECIAL NOTE.
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, or from articles appearing in our pages, or on general wireless matters. Wherever we can, for our answers, have already been worked out by the designer and the various factors above-mentioned have been taken into account.

CLOCK DIAL TUNING
I have heard of a new kind of tuning dial which acts like a clock. I believe the hour hand is geared to the condenser shaft so that it makes a complete revolution in the condenser's usual half revolution. Meanwhile the tuning knob is connected directly so as to turn the minute hand. Can you tell me if there is such a device on the market, and if so, from whom I can obtain it?—T. H. P. (Napier).

We do not know of such a device obtainable as a separate component. There is a commercial receiver now obtainable in which a clock-face tuning dial is incorporated, but the dial is divided into two parts, one half being used for medium-wave calibration, and one half for long waves. The two pointers are used, one for each band. We have not seen the particular device you refer to where each hand operates separately.

D.C. ELIMINATOR WANTED.
I have a fitted motor to my home in the workshop, but I find that it overheats badly with the radio on. I made up a suppressor consisting of two condensers and connected the two plates between the terminals, but it did nothing to prevent the trouble. Can you suggest any other method?—W. G. B. (Liverpool).

It is probable that the interference is being picked up at the aerial, and therefore it will be necessary to enclose the motor in an iron box and connect the box to earth. Alternatively you could screen the motor lead and connect the screen to earth. You will probably find, however, that it will be easier and more effective to adopt the first-mentioned arrangement and this will do no doubt cure the trouble.

QUESTIONS NOT TO ASK

I have been looking through back numbers of "Practical Wireless" and am rather doubtful regarding certain details relating to mains transformer windings. In one article I am told to wind nine turns per volt, and in another eight turns per volt. Furthermore, different gauges of wire are used, but this does not seem to account for the difference in the turns. Can you please explain?—F. W. P. (London, E.)

The number of turns per volt in a mains transformer depends upon the cross section of the core, the flux density of the material used for the core, the frequency with which it is proposed to deal and one or two other small factors. The usual d.c. mains transformer for a.c. transformer windings has a flux density of approximately 60 kilogauss to the square inch. In...
PRACTICAL WIRELESS

MISCELLANEOUS ADVERTISEMENTS

Advertisements are accepted for these columns at the rate of 5s. per word. The words "AND PAID" must be added to the ad copy and the advertisement must be paid for before publication. No responsibility is assumed for the correctness of advertisements appearing in this section. As a result, communications should be addressed to: E. W. Advertisements, Manor House, 12 Amphion Street, Strand, London.

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ARE BEST
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LAST WEEK we received THOUSANDS of post cards demanding our LEADER THREE, but we
have not yet sent out a single unit. Some Readers have not asked for the LEADER THREE for
radio; they have asked for what we would call our very modest, reliable and practical Design.

LEADER THREE, £11 11s. 6d. Complete, with accessories, to run perfectly from
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Fascinating New Discoveries
Told in Simple Language and Pictures

Amazing invention: seeing your telephone caller

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April 1934

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This monthly magazine caters for those who wish to make things for themselves, and fosters the interest of those whose hobbies deal with matters practical. The range of subjects dealt with is bounded only by the limits of science itself.

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ROUND the WORLD of WIRELESS

The Baird High Definition Television System.

ELSEWHERE in this issue we give
technical details of the new Baird
Television Transmitting System which
is, of course, sent out on the dual
wavelengths of 6 and 0.25 metres. The
Editor of this journal and members of the
technical staff were present at a special
demonstration at Film House, Wardour
Street, to witness the reception of a tele-
vision programme transmitted by the Baird
System from the Crystal Palace. Parts of
talking films were transmitted and other
items in the programme included a manne-
quin demonstration, conjuring, violin solo,
and the demonstration was prefaced by the
quin demonstration, conjuring, violin solo,
items in the programme included a manne-
quin demonstration, conjuring, violin solo,
and the demonstration was prefaced by the
appearance on the screen of Mr. H. J.
Barton Chapple, who gave a technical
demonstration of the new system. The
demonstration proved beyond all doubt
that television in a practical and satis-
factory form is here. The definition was
perfect, the pictures quite steady and
brilliant, and of real entertainment value.
It cannot be long before we look in and
listen in simultaneously.

Italy's Two Programmes

ARRANGEMENTS are being made by
the E.I.A.R. authorities for the
amalgamation of all Italian studios into
two groups, thus giving each city an alter-
native programme. By the end of the
year Bolzano will join the North Italian
transmitters and in the beginning of 1935
Bolzano will join the North Italian
broadcasting system from the Crystal Palace.

New African Station

THE Italian Colony of Tripoli will shortly
possess a wireless transmitter which is
to be used not only as a broadcasting
station, but also for a public wireless
 telephony service with Rome. It will be
erected in the neighbourhood of the city,
and will work exclusively on short waves,
namely, between 15 and 80 metres with
a power of 2 kilowatts (aerial).

Denmark's 500,000 Listeners

RECENT statistics published show that
considerable increase has taken place
during the past year in the number of
Denmark's registered licence holders, as
the figures now prove that one out of
every seven members of the total popu-
lation is a broadcast listener.

New Bulgarian Station

A BROADCASTING transmitter built
by radio enthusiasts at Sofia was
recently formally opened; its power is 5
kilowatts and wavelength 214 metres.

For D.X. Listeners

HERE is an opportunity of hearing
broadcasts direct from Zagreb (Jugo-
Slavia). On the first night in each month
the station will broadcast a special trans-
mision from G.M.T. 00.00-00.30 (midnight
to 12.30 a.m.). The wavelength is 276.2
metres (1,066 kc/s), the power only 750
watts.

Pilsen Demands Its Own Station

FOR some time past inhabitants of
Pilsen have clamoured for a
transmitter and it is now reported that the
Czech authorities are favourably con-
sidering their request. As, however, no
exclusive channels are available, it is
expected that a relay station will be
built at Holoubkai, near Pilsen, to operate
on one of the common waves allotted
to that country. In the same manner,
another small station may be erected in
Olmutz for the broadcast of special pro-
grammes to the German-speaking popula-
tion.

How These Interval Signals are Produced

THE musical notes heard from the Frank-
furt group of stations on 251 metres
are carried out by means of four organ
pipes set into action by a toothed wheel,
the blowing as well as the movement being
done electrically; a near-by microphone
picks up the sounds which are super-
imposed on the carrier wave.

Radio and Geography

AS a rule a broadcasting transmitter
takes its name from the site on which
it has been erected. Some villages in this
manner have become famous, such as
Huizen, Langenberg, Junglinster (Luxem-
bourg). In Switzerland, Munster was se-
lected as the most favourable spot for a
high power regional station and, owing to
publicity given to the name, has now been
authorised to adopt the same appellation
as the transmitter, i.e., Beromunster.
Formerly, the village was known as
Muenster, but it was apt to be confused
with a town of that name in Germany.

Short Waves for Amateur Transmitters

ACCORDING to the International Con-
vention of Telecommunications at
Madrid, the wavelengths to be used by
amateur experimenters have been limited
to the following categories: from 5 m.-
8.33 m.; 10 m.-10.71 m.; 20.89-21.43 m.;
41.1 m.-42.36 m.; 75 m.-85.71 m. (except-
ing 75 and 78 m.); 15 m.-174.9 m. All
other frequencies in the wave bands are
prohibited.

Big Ben Takes a Rest

FROM April 30, for a period of six weeks,
the B.B.C. will broadcast the time
from the clock situated in the south-west
tower of St. Paul's Cathedral; when
required, the chimes will also be relayed.
"Big Tom," the City's big bell, will take
over the duties usually performed by Big
Ben. It is only right that the latter should
be given a rest as it has been eroded for
over half a century and now celebrates the
seventy-fifth anniversary of its birthday!
**ROUND THE WORLD OF WIRELESS (Continued)**

Prince George's Broadcast Speech

PRINCE GEORGE will be entertained by the Radio Evesham House, London, on May 2nd, on the occasion of his return from South Africa. The banquet is to be given by the Royal Empire Society, the British Empire League, the African Society, the Victoria League, the Overseas League, and the British Empire Club. Prince George's speech will be relayed from Grosvenor House in the National programme.

The Beauties of the Vale of Evesham

THREE Beauties of the Vale of Evesham in blossom-time attracts many sightseers. With a countryman's understanding, E. Moore Darling will describe it on April 18th. He is Vicar of St. Chad's, Shrewsbury, and an expert on Midland agriculture of to-day and yesterday. In the autumn he broadcasts twice on this subject.

Two Sketches from the Midland Regional

ON the evening of April 18th, two sketches will be produced by Martyn Webster in the Midland Regional. The first, by John Gill, of the Oxford Repertory, and John Bentley, a young Birmingham amateur, take the chief parts in The Debt, by Colin Howard, a story of a Paris café, which has a surprise ending. The other sketch is Showing up the Juggler, by Godfrey M. Hayes and F. Keston Clarke, authors of This Radio Rocket. The idea is a controversy between two friends as to how far Shakespeare is up to date. Modernist versions of famous scenes—such as the Balcony Scene in Romeo and Juliet—are given to illustrate the argument. Stuart Vinden and William Hughes are the argumentative friends. John Gill and Victoria Marsh act the amusing parodies.

Brass Band Concert from Manchester

ERNES'T BRADSHAW is to conduct the new Baxendale's (Manchester) Works Band when they broadcast from Manchester on April 14th. The Band was originally formed in 1913, but many of its members, including the bandmaster, were killed during the War, and it had to be reorganized in 1920. Their programme, in this instance, includes the march, Mephistopheles, of Shipley Douglas, and the Egyptian serenade, Amines, by Hayes and F. Keston Clarke, authors of This Radio Rocket. The third of "The Master's Voice." "Superhet Five-Forty": Radiogram.

**Yvonne Printemps, the Star of "Conversation Pieces," about to play one of her own H.M.V. records from the show on her "His Master's Voice."" **

**SOLVING THIS!**

**PROBLEM No. 92**

Jackson ordered the parts for the Fury Four Super, but in order to save expense he made his own changes. He constructed this from ordinary plywood, but covered it on both sides with aluminium foil. When finished results were very poor, the volume control and volume control working at different levels in any manner, and only the very faintest of signals being obtained. What was wrong? Three books will be awarded for the first three correct solutions opened. Address your attempt to: The Editor, Practical Wireless, 70, Strand, London, W.C.2.

**SOLUTION TO PROBLEM No. 81**

Broadman overlooked the fact that the H.F. valve had the metal-coating connected internally to its cathode, and that the cathode was connected to earth via a biasing resistance. Consequently, when he connected the metal-coating to earth he was short-circuiting the bias resistance, and this made the receiver still more unstable.

The following three readers successfully solved Problem No. 81, and books have accordingly been forwarded to them: A. Warrington, 25, Norwood Road, March; A. Cameron, Roberts' Monks Bridge, Naford; R. F. Walker, 70, Askeenden Road, Clifton, E.S.

**WHither Fécamp?**

S O far Radio Normandie has faithfully stuck to the channel allotted to it by the French authorities; it is well heard on 206 metres. Difficulties, however, are looming up on the horizon, inasmuch as this wavelength has also been chosen for Eiffel Tower, when this station leaves the long-wave band in June next.

**Ireland's Lonely Listeners**

ROUGHLY speaking Irish numbers only one hundred thousand inhabitants, of which a mere 8,300 are registered listeners to the Reykjavik programmes. With the exception of dwellers in the capital, most of them are situated in distant and almost inaccessible districts of the island. Broadcasting to them is not only a source of entertainment, but actually during the winter months their sole link with the outside world.

**French Private Transmitters**

IN view of complaints made by a number of French privately owned stations to the effect that broadcasts on common wavelengths seriously hamper their activities, the Ministry of Posts and Telegraphs is considering the question of permitting the use of channels allocated to these transmitters pending the reconstruction of the latter.
F U L L, constructional details, along with a complete wiring plan, of this new and successful receiver were given last week, and those readers who have already commenced the constructional work have found that it is simplicity itself. Meanwhile, we have been trying the set under varying conditions to find exactly how readers in different parts of the country are likely to fare in regard to receiving a wide selection of stations. It has been definitely proved that when a moderately good outdoor aerial is available the number of transmissions which can be received at really good loud-speaker strength is very great. Even in daylight it is possible to receive, in Central London, the Northern, Scottish and Western stations in addition to Dieamp, Rome, and Toulouse on the medium waves, with Daventry, Radio-Paris, Huiizen, and Eiffel Tower on the long waves. Results were so good that we removed the aerial entirely and connected in its place a length of flex exactly a yard long; on this "aerial" Midland Regional was well received in daylight, whilst North Regional was audible on the speaker.

Dial Readings

There is no need to give a complete dial log, but the following tuning positions for a few of the main stations will enable users to make a few "landmarks," after which it will be an easy matter to compile a complete log. Medium waves: London National, 87 degrees; London Regional, 68 degrees; Midland Regional, 91 degrees; North Regional, 137 degrees. Long waves: Huiizen, 115 degrees; Radio-Paris, 136 degrees; Daventry, 112 degrees.

It is worthy of mention that, despite the absence of mains hum; this must very largely be attributed to the excellence of the special Leader mains transformer made by Messrs. Heayberd to our own design. As we mentioned last week, this transformer is a remarkably good component which is being made expressly for constructors of the Leader. In accordance with our new and popular policy, this transformer is being sold at the phenomenally low price of 16s., from which it can be seen that Messrs. Heayberd, among many other manufacturers, are giving us their unstinted support in our Cheaper Homeconstructed Radio Campaign. This latter has been instituted for the benefit of Practical Wireless readers, hundreds of whom have already expressed their appreciation of our efforts on their behalf.

The finished receiver employed, there is an almost complete absence of mains hum; this must very largely be attributed to the excellence of the special Leader mains transformer made by Messrs. Heayberd to our own design. As we mentioned last week, this transformer is a remarkably good component which is being made expressly for constructors of the Leader. In accordance with our new and popular policy, this transformer is being sold at the phenomenally low price of 16s., from which it can be seen that Messrs. Heayberd, among many other manufacturers, are giving us their unstinted support in our Cheaper Homeconstructed Radio Campaign. This latter has been instituted for the benefit of Practical Wireless readers, hundreds of whom have already expressed their appreciation of our efforts on their behalf.

This Remarkable Low-priced Receiver is Noteworthy for its Excellent Performance. Every Constructor can be Sure of Receiving a Number of Alternative Programmes Even if He is Limited to the Use of a Short Indoor Aerial.

Trimmer Adjustments

Having connected the receiver to the mains by means of a length of flex and a plug appropriate to the wall or lamp socket in use, turn the Q.M.B. switch to the "off" position, set the reaction condenser to zero and wait a few seconds until the valves heat up. Whilst they are attaining their correct temperature a faint hum will be heard in the speaker, but this will fade out again once the cathodes are quite hot. By rotating the main tuning knob there will then be no difficulty in bringing in the local station, and this should be received at really good volume. Signal strength can then be still further increased, if desired, by advancing the setting of the reaction condenser (clockwise rotation).

Once it has been found that the set is working correctly the trimmers on the two-gang condenser can be adjusted. In doing this it is best, first of all, to tune in a station which is received at about 20 degrees on the tuning dial when the wave-change switch is in the medium-wave position (knob pulled out). A good station upon which to make the preliminary adjustment, by the way, is London National. Set reaction to zero and, if the station is still heard very loudly remove the aerial or replace it by a short length of wire until signals are only just nicely audible. After that the star-wheel trimmer on the first section of the

Note the compact assembly of the sub-chassis components.
PRACTICAL WIRELESS

April 14th, 1934

THE recent introduction of very small receivers for Police use, and the increasing use of valves for denf-aid speakers and similar compact apparatus, has naturally led to the development of valves of very small dimensions. There have been several different styles suggested from time to time, and experimental valves have been made for these suggested uses.

Now, from the Marconi Valve Company, comes the news that valves of extremely small dimensions are to be produced and sold to the public, and samples which we have received have quite a number of points which will appeal to the experimenter. As may be seen from the illustration, the height of the complete valve is 60 mm. or 2¾ inches. In place of the usual pin connection (commonly referred to as the "valve leg"), these new valves utilize a side contact, which, in addition to reducing the overall height is also an improvement in that it provides a much more rigid and rigid contact. Standard spacing is employed, or perhaps we should say standard lay-out for the connections, and these, in our view, represent a great improvement on the ordinary type of contact. A feature which has hitherto only been employed in the cathode wiring plan a flexible lead was shown from the aerial-terminal socket to terminal 4 on the first coil. The reason for this is that it is possible to increase signal strength on distant stations by transferring the lead to terminal 1. This reduces selectivity, but still allows of sufficiently sharp tuning on many stations, especially if the aerial in use is very short. Try the two alternative aerial connections.

Using a Mains Lead

The Leader can be made to operate very efficiently from a mains aerial in most cases, although no special provision was made for this in the original design. All that is required is to use the set in this way is a .0005 mfd. fixed condenser, which should be connected between one supply terminal on the mains transformer and the aerial terminal. When this is done it is sometimes worth while to try the effect of reversing the mains plug in its holder, because one position might give better results than the other. If the mains supply is particularly "rough" it might be found that

the mains aerial introduces appreciable hum. If that is so it will be better to use a short indoor aerial if there are no facilities for erecting a good outside one. It will be found that the Wearite coils specified are very selective, and since a loose-coupled aerial winding is provided there should be no need to employ a series- or parallel condenser unless the aerial in use is unduly long, or it is situated very near to a local station.

Gramophone Reproduction

To use any type of gramophone pick-up it is only necessary to connect this to the two terminal sockets provided. Some pick-ups, however, have three leads of which one is joined to the metallic parts and also to a screened lead; in such cases the third wire should be joined to earth or to the metallized chassis. If the pick-up is not provided with a volume control—many of the modern types are, however—one can easily be fitted by joining the centre and one "outside" terminal to the pick-up sockets and connecting the speaker leads to the two "outside" terminals.

NEW MIDGET VALVES
Preliminary Notes of some Interesting Valve Developments

valves is also incorporated in these midgets. We refer to the special seal between the glass bulb and the base. This is shock-proof and much more reliable from every point of view than the usual process.

Characteristics

With regard to the actual electrical characteristics of these valves, they are not so dissimilar from the standard types. We have received two only so far, one of the H type and one of the L, or small power, type. The filament rating is 1 volt at .1 amp, and consequently the type number of these valves is 11. The anode voltage is such as to stress the employment of small batteries. The curves below give the principal characteristics, and the output valve will be seen to be a very good one for its particular use. The price of these valves is £5s., and no doubt an extension of the range will be made in the future in order to include S.G. and pentode types. Supplies will be available shortly.

In addition to the uses which have been mentioned, these new valves will also be found most useful in the design and construction of midget portable receivers, and it is interesting to note that this problem has been engaging the attention of our Technical Staff for some time, as was mentioned in the article entitled "Problems of the Midget Set," which appeared in Practical Wireless dated March 17th, 1934. The photograph which appeared on the cover of that issue also included an advanced sample of one of these midget valves, and its actual size is shown in the illustration...
USING THE NEW VALVES

Useful Information Concerning the Use of a Few of the More Popular New Valves is Given in This Article.

The numerous and rapid improvements which have taken place in valve design and construction during the past year or so have made it very difficult for the amateur to keep pace with all the developments. The many queries received by the Practical Wireless Free Advice Bureau show that there are many constructors who would like to modify their present receivers in order to incorporate new types of valves, but they have refrained from doing so, not knowing what alterations would be necessitated. A few practical notes in regard to a few of the more popular new valves will therefore serve to remove any misunderstanding and to give readers a clearer idea as to how alterations would be necessitated.

Using the New Valves

A number of indirectly-heated L.F. or power pentodes are now made with seven-pin bases, and the method of connecting the electrodes to the various pins is shown in Fig. 1. It will be seen that in this case the suppressor grid is internally connected to the cathode, terminal 1 being left free. The seven-pin power pentode is far more convenient than its five-pin counterpart, chiefly because there is no side terminal, and therefore no "wandering" flexible lead to connect to it. This eliminates the possibility of a dangerous short-circuit due to the lead (which is connected to H.T. positive) coming loose and making contact with the metal chassis. It should be mentioned in passing that the characteristics of the seven-pin valve are generally identical with those of the five-pin type, and that some makers can supply the valve with either kind of base for replacement purposes.

Double Diodes

Indirectly-heated double-diode triodes and double-diode pentodes are also made in seven-pin types. The terminal and circuit arrangements for the triode are shown in Fig. 4, and for the pentode in Fig. 5. The circuit shown in Fig. 4 is suitable for... (Continued on next page)
The Class B battery valve was introduced over a year ago, and it is now well known for its simplicity and efficiency. It has a full filament current consumption of 1.25 amp, and a standing anode current of about 4 milliamps. The average H.T. current for a maximum signal output of 1,000 milliwatts is about 9 milliamps.

The B valve has a seven-pin base and similar connections to those for the standard Class B valve, except that the grid of the driver valve is connected to terminal 5 (which is normally left disconnected) and the anode of the driver is brought out to a terminal on top of the glass bulb. The usual driver transformer is required, and all the connections are shown pictorially in Fig. 6.

A Class B-Plus-Driver Valve

From the above remarks it might appear that all the popular new valves are for the mains user, but that is not quite true. The Class B battery valve was introduced some time ago, and it is now well known and widely used. This valve has many important advantages which have previously been pointed out in these pages, but it also has the rather serious disadvantage that it must be used in conjunction with a "driver" valve, thus making it necessary to have two L.F. stages after the detector. One solution to the difficulty has recently been offered by the introduction of a combined driver Class B valve, the latter actually consists of three valves—one triode driver and two triodes in push-pull— assembled in a single glass bulb. It has a total filament current consumption of 0.3 amp, and a standing anode current of about 4 milliamps, the average H.T. current for a maximum signal output of 1,000 milliwatts is about 9 milliamps.

The driver B valve has a seven-pin base and similar connections to those for the ordinary Class B valve, except that the grid of the driver valve is connected to terminal 5 (which is normally left disconnected) and the anode of the driver is brought out to a terminal on top of the glass bulb. The usual driver transformer is required, and all the connections are shown pictorially in Fig. 6.

The Double Pentode

Another very important addition to the range of battery valves is the double pentode which has recently been placed on the market. This valve is used in the ordinary Q.P.P. circuit, and replaces the two separate pentode valves which were previously necessary. It was rather unfortunate in some respects that a year or so ago when Q.P.P. was first widely adopted in this country its popularity was confined to the "large" Class B valve, and an ordinary Q.P.P. transformer can be used for this purpose. The anode-to-anode impedance of the double pentode is approximately 25,000 ohms, so that it becomes necessary to employ either a special speaker, or else to feed the speaker in some way of accurately matching the two pentodes in Q.P.P. by adjusting the voltages supplied to the priming grids are now entirely removed with the double valve, so that no delicate preliminary adjustments of any kind are required. It should be mentioned that the signal output from the double pentode is only about half that from a Class B amplifier using a large Class B valve, but in any case an output of rather less than 1,000 milliwatts is more than ample for most requirements.

The circuit for a Q.P.P. stage employing the new double pentode with seven-pin base is given in Fig. 7, and it will be seen that it is simplicity itself. The input transformer should have a high ratio (between 7 and 10) in order fully to load the output valve, and an ordinary Q.P.P. transformer can be used for this purpose. The anode-to-anode impedance of the double pentode is approximately 25,000 ohms, so that it becomes necessary to employ either a special speaker, or else to feed the speaker in some way of accurately matching the two pentodes in Q.P.P. by adjusting the voltages supplied to the priming grids.

Making An Output Choke

A suitable output choke can be made in the manner frequently described in PRACTICAL WIRELESS by using a core consisting of six dozen No. 4A stally stampings. The spool should be wound with approximately 3,400 turns of 38 s.w.g. enamelled wire. It should be marked 850, 1,700 (centre-tap) and 2,350 turns. The ends of the winding will be connected to the loud-speaker (preferably through a transformer, or else to feed the speaker in some way of accurately matching the two pentodes in Q.P.P. by adjusting the voltages supplied to the priming grids). The circuit is shown pictorially in Fig. 7, and it will be seen that it is simplicity itself.

Facts About Micanite

Moulding micanite is composed of mica splittings built up to any required thickness by means of an adhesive such as shellac (phenolic synthetic resins are unsuitable), the built-up sheets then being pressed in steam-heated presses, the adhesive content of the finished sheets being about 20 per cent. When warmed the sheets become soft and flexible, and can be moulded to any desired shape in hot moulds, the mouldings regaining their hardness and rigidity on cooling.

Hard micanite, which is employed in the manufacture of commutators for electric motors, etc., is made in a similar manner, but is subjected to greater pressure during preparation than is moulding micanite, and the adhesive content is usually under 5 per cent.

Cellulose compounds are making rapid headway as insulators for electrical work. They are mostly of two kinds, cellulose nitrates or cellulose acetates. They are mostly of two kinds, cellulose nitrate or cellulose acetate, and the adhesive content of the finished sheets being about 20 per cent. When warmed the sheets become soft and flexible, and can be moulded to any desired shape in hot moulds, the mouldings regaining their hardness and rigidity on cooling.

Insulating materials of all kinds depend for their efficiency upon the absence of free moisture, and insulation which is not maintained in a dry condition is subject to electrical leakage, the extent of such leakage being dependent upon the nature of the material and the applied voltage.
RADIO-GRAMOPHONE REFINEMENTS

A Variety of Useful Suggestions for the Improvement of the Radiogram Receiver

Are Given in this Article

Fig. 1.—The Garrard Universal electric gramophone motor.

In the earlier days of broadcasting it was generally considered that the advent of wireless as a source of home entertainment would ruin the gramophone industry. That this idea has proved entirely wrong is evidenced by the tremendous increase in the sales of gramophone records during the past three or four years. In fact, it can truly be said that the use of wireless amplifiers for the reproduction of gramophone records has proved beneficial in many ways. The electrical gramophone provides a useful standby when there are no broadcasting programmes available, as well as when one wishes to hear any particular song or orchestral rendering. Because of the reasons just enumerated the use of combined radio receivers and gramophones has become extremely popular, with a result that probably 20 per cent. of the high-class wireless instruments sold to-day are of the so-called radiogram type; that is, they combine the standard wireless receiver with a gramophone turntable and pick-up. The principle of combining the two instruments in a single unit is a very likeable one, since it makes for economy, compactness and greater convenience.

A large number of readers who always build their own receivers prefer to add the comparatively simple gramophone equipment to their standard sets, and some particulars in regard to the method of doing this were given in a short article in PRACTICAL WIRELESS dated March 24th, as well as in the issue dated December 2nd, 1933, and at various other times. The particulars given in those articles were intended principally to assist those readers who had not previously built a special radiogramophone, but who intended to modify their existing sets so as to convert them into dual-purpose outfits. The present article is intended more to interest those who already have a radiogram of some kind or other, but who wish to bring it more up-to-date or to improve it in order to obtain the best possible results from the excellent records which are to-day available.

The Turntable Motor

It has been explained in previous articles that the motor employed to drive the turntable can have a pronounced effect upon the quality of gramophone reproduction to be obtained, this being especially noticeable when a really good amplifier is used in conjunction with the pick-up. There are very many spring motors of all types on the market, but in buying one it pays to secure the best that can be afforded and it is wise to obtain one of the multiple-spring type which is powerful and capable of playing a number of records for one wind. If strict economy must be practised, however, it is always better to obtain a powerful, short-playing single spring motor than a double-spring one which simply gives a longer playing time. The reason is that uniform speed regardless of the "lightness" or "weight" of the passages being played is very important in the interests of quality.

When an electric supply is available it is obviously better to employ an electric gramophone motor. This not only obviates the necessity for constant winding, but generally gives more silent running at lower cost. Many of the motors available are made for A.C. operation only, and this point should be borne in mind when ordering. In most cases the motors can be supplied for operation from 50 cycle mains having voltages between 100 and 125 or between 200 and 250; see that the correct voltage type is specified. An example of a really good motor at a reasonable price is the B.T.H. "Truspeed" motor shown in Fig. 2, which can be obtained for either A.C. or D.C. operation.

The B.T.H. "Truspeed" electric motor, which can be obtained for either A.C. or D.C. operation.

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models are provided with an adjustable automatic start-and-stop switch and are particularly light in weight, so that they are especially useful in transportable radio-grams. Incidentally, the consumption of the A.C. model is only about 7 watts, so that current costs amount to only about sixpence per year.

**Automatic Record-Changer**

Electric gramophone motors of the type fitted with automatic record-changing devices have become gradually popular during the last two years, and it is interesting to note that prices have been reduced considerably. As an example it might be stated that quite a short time ago a reliable automatic record changer was priced about 30 guineas, whilst the G.E.C. Model V 2000 shown in Fig. 3 now costs only £12 12s. 6d., despite the fact that it is fitted with all modern refinements. It can be obtained for A.C. working only, and is sold in two (high and low) voltage types. This complete electric turntable and record-changer will play eight 10- or 12in. records without any attention whatever, whilst any record can be rejected as desired by pressing a switch on front of the platform. By turning a single handle all the records are brought into position for playing at the same time as the pick-up arm is adjusted.

**Pick-ups and Track Arms**

It is scarcely necessary to point out that the pick-up employed has a very important bearing upon the quality of reproduction obtained with any radiogram. Consequently, those readers who already possess a radiogram instrument equipped with a pick-up made some years ago will find it well worth while to change it for a more modern one of some good make. A wide variety of the pick-ups at present on the market was dealt with in the issue of Practical Wireless dated December 2nd, 1933, and other interesting units are illustrated in Figs. 4, 5, 6 and 7. That shown in Fig. 4 is the Harlie Model 65 with vacuum control which sells at 18s.; it can also be obtained without vacuum control at 16s. 6d. This instrument has what is known as compensated characteristics so that it compensates for the deficiencies in average recordings. In other words it gives emphasis to the bass and slightly increased response to the upper register with a result that practically "straight-line" response can be obtained from the average records when reproduced through a good amplifier and loud-speaker. An additional advantage is that it incorporates a spring tensioning device by means of which the pressure of the needle on the record can be varied.

Fig. 5 shows the popular Belling-Lee "Clip-On" pick-up, which has been specially designed for use in conjunction with existing gramophones of the "mechanical" type. It can be fitted on the side of either a cabinet or portable gramophone in an instant and, being provided with a special counterbalanced track-arm, it is capable of extremely good response. A volume control is provided, as can be seen, so that the instrument can be connected directly to any receiver which is provided with pick-up terminals. The Belling-Lee "Clip-On" is of particular interest at this time of the year, due to the fact that it lends itself admirably for use in conjunction with a portable gramophone and portable wireless receiver. The pick-up head shown in Fig. 6 is the Loewe, and this can be fitted to an ordinary gramophone tone-arm or to a special tracking-arm as desired. It is one of the few pick-ups of this type now available, and sells at the low price of 11s. 6d., whilst a volume control for use with it can be bought for an extra 2s. 6d.

Fig. 7 shows the well-known Columbia pick-up and track-arm which is reputed for the high quality which it gives. This unit has a comparatively low voltage output and is therefore more suitable for use in conjunction with powerful receivers and where perfect reproduction is aimed at.

**Useful Additions**

Quite apart from the "essentials" which have been dealt with above, there are a number of small and generally low-priced units which go a long way towards improving the quality of the average radio gramophone, bringing it into the same sphere as the high-class and expensive commercial instruments. For example, the automatic stop shown in Fig. 8, and which costs only 4s. 6d., is a refinement which is suitable for use with any electric gramophone motor. It comprises an arm which is moved by means of the track-arm when the end of the recording is reached; the movement operates a quick make-and-break switch situated in the lower casing. This little unit is made by Messrs. Harlie.

**Scratch Filters and Tone Controls**

The complete elimination of needle scratch is perhaps impossible, but it can be reduced almost to inaudibility by means of the Bulgin scratch filter shown in Fig. 9. In outward appearance the filter is similar to an H.F. choke and it is simply connected in parallel with the two pick-up leads. The unit actually comprises both a special choke and a fixed condenser and costs 7s. 6d. Fig. 10 shows a combined "fader," or volume control, and tone control; it makes it possible to "fade out" the wireless signals and at the same time to "fade in" the gramophone reproduction. The tone control serves to compensate for deficiencies of the pick-up and of the record, besides being useful as a means of reducing needle scratch. This unit is made by Messrs. Bowyer-Lowe and sold at 10s.

**Turntable Lights and Needle Cups**

An ingenious needle holder is shown in Fig. 11. This delivers a single needle simply by pressing down and releasing the centre cylinder. The container is easily refilled by unscrewing the top flange, but it holds a stock of needles sufficient for many months' use. This device is made by Messrs. British Goldring and costs only 5s.

A turntable light (a Bulgin component) shown in Fig. 12 is of such a height that it throws a clear light over the surface of the turntable, and gives a red warning signal whilst the motor is on or off. The device costs 2s. 6d., as illustrated.
THERE'S A DARIO VALVE FOR EVERY NEED  
AND THEIR PRICE MAY SAVE YOU POUNDS

- A full range of battery valves for 2-volts and 4-volts.  
A complete series of mains valves including H.F. pentodes,  
Diode-tetrodes, and D.C. valves with 20v. heaters. On one  
and all you'll save shillings.

Why! In equipping a 5-valve mains set with DARIO, you'd  
be something like £1.1.0.0 in pocket—and the saving wouldn't  
mean the slightest sacrifice in performance. The full DARIO  
range covers more than 39 efficient, up-to-the-minute valves  
for every position in any set.

Send for a list of popular types and a table showing DARIO  
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EXPERTS INSIST ON 'ATLAS'

For EVERY type of Set

All the leading radio authors specify "ATLAS" Units to give the most  
efficient, most reliable and most economical results with their receiver  
designs. They have proved it, in direct competitive tests, again and again.  
No other units have won the Olympia Ballot for two years running. None  
gives such high reserves of voltage and output—or are suitable for every  
type of set, even " Class B "and " Q.P.P. "—or are made for 25 cycle A.C.  
Mains without any increase in price. Insist on " ATLAS " Mains  
power with an " ATLAS " Unit costs less than one shilling a year.

50 TIMES CHEAPER THAN BATTERIES

ATLAS MAINS UNITS

There is an " ATLAS " Unit to convert  
your Battery Receiver to Mains Operation  
in a few minutes without alteration to set  
or valves; giving more power, improved  
tone, sharper selectivity at one-fiftieth  
of the cost of dry batteries.

Prices 39/- cash or  
from 10/- down.

TRY ONE ON YOUR SET

ASK YOUR DEALER—HE KNOWS

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H. CLARKE & CO. (MCR) LIMITED,  
Atlas Works, Patricroft, Manchester.

Please send me a copy of Booklet 87 telling me  
how to convert my Battery Set to Mains Operation  
with an " ATLAS " Unit.

Name .............................................  
Address ........................................... 61/26

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Name .............................................  
Address ........................................... 61/26
Countless simple sets that were satisfactory when first designed cannot now get the increased number of stations in operation today. The Varley Bifocal Focussing Coil, with its revolutionary design, means a new life entirely to these sets. (A typical circuit of a three-valve receiver incorporating two Bifocal Focussing Coils is shown in diagram No. 206. Diagram No. 202 shows the appearance of the new coil—No. 203 the theoretical circuit of the coil—and No. 204 illustrates the principle by which change of aerial coupling is obtained. Installing these new coils is so simple—the operation being no more difficult than any existing arrangement with a fixed aerial coupling.) Write for full information together with FREE circuit diagrams.

WIN A PRIZE

YOU, any one of you, can add immensely to the selectivity of your set—killing the bugbear of interference—at the same time winning one of the prizes (First Prize: 20 Guineas—200 Consolation Prizes) offered by "Practical Wireless" in their Great National Competition. You will find full details of this simple and interesting competition elsewhere in this issue.

Varley Bifocal Focussing Coil—get one to-day from your dealer.
Can You Answer These Questions?

What steps would you take if the copyright for one of your photographs had been infringed?

How long does the copyright in a cine film and a photograph last?

What are the causes and remedies for the following defects in gaslight prints:
- Black Spots
- Blisters
- Brown Stains
- White Specks
- Yellow Stains

What developer would you use for gaslight paper to give the most brilliant print? What developer would give softer contrast?

When must a cine camera be held upside down in shooting a scene?

When is f/8 stop not f/8?

How do lamps used for photographic studios differ from ordinary electric light bulbs?

What is the difference in lighting an indoor scene for cinematography as distinct from still photography?

What developer would you use for gaslight paper to give the most brilliant print?

What developer would give softer contrast?

What printing process gives prints like oil paintings?

What printing process gives prints like oil paintings?

What printing process gives prints like oil paintings?

What printing process gives prints like oil paintings?

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Produced in the straightforward practical style for which the House of Newnes has become justly famous, this work deals with a subject which is full of fascinating possibilities for the practical man who aspires to a more intelligent photography than that so tersely described by the phrase: “You press the button, we do the rest.” Never before has such a wealth of really practical information on this subject been brought together within such a small compass. Every article has been written by a man who has made himself expert on the subject upon which he writes, and yet the information is conveyed in such a manner that it can be put into immediate use by the reader. It is quite safe to say that, to the man who has a practical turn of mind, each part of this work will be worth many times its cost. Get a copy of Part I and you will fully endorse this statement.
LATEST TELEVISION DEVELOPMENTS.

That Television Has in No Way Been Standing Still was Demonstrated Very Forcibly by the Baird Company a Few Days Ago, and We Are Here Able to Furnish Readers with Details of the Latest High-definition Apparatus.

For some months now it has been common knowledge that intensive research work was being carried out to effect considerable improvements in the realm of high-definition television. The expression "high-definition" is perhaps somewhat of a misnomer, but it has been coined to imply transmission and reception with the number of-scanning lines increased materially above the thirty-line service which is now being transmitted.

The expression "high-definition" is perforce intended to apply in the realm of high-definition television. Out to effect considerable improvements in the quality of television pictures, the Baird Company, through Sir Harry Greer, has disclosed that Baird television has definitely reached an advanced stage, as was made evident by the Baird Company when they sprung their well-planned surprise on Tuesday, March 20th. On that day the chairman of the company, Sir Harry Greer, addressed the shareholders as a television scheme.

He was situated at the Baird Transmitting Studio at the Crystal Palace, but he was seen at Film House, Wardour Street.

Making History
It was a speech that made television history, because of the manner of its delivery, and this method was chosen as the most dramatic way of bringing home the fact that Baird television had definitely reached a stage which was far and away ahead of anything hitherto shown to the Press or public. Furthermore, it was revealed that the Prime Minister, Postmaster-General, and other high Government officials had been given a demonstration a week earlier.

Stated briefly, the demonstration comprised the transmission of living subjects and talking films, the definition in both cases being that of 180 lines with twenty-five pictures per second. Ultra-short waves provided the radio link, while at the receiving end the image was portrayed on the fluorescent screen of a very large cathode-ray tube. The images were bright, clear, and flickerless, and showed a wealth of detail which had hitherto been thought impossible.

Explaining the Scheme
Since this entirely new radio technique represents something so new in the television field, readers of Practical Television will naturally be interested in the technical details. A broad outline of the complete scheme is given in Fig. 1, so this will now be traced stage by stage.

First of all, the spotlight transmitter was built up from a large diameter disc enclosed in a strong metal case. The disc is driven at a speed of 3,000 revolutions per minute and around the periphery is a spiral of holes working in conjunction with an ingenious cam mechanism. Behind the disc at the top is a powerful arc lamp which has its beam of light condensed on to a top section of the disc so that as the holes pass across the beam a thin pencil of light passes through each individual hole. A rectangular scanned area made up from 180 horizontal lines is produced in this way, and by passing the light through a lens combination and then through a small glass window let into the partition separating the transmitter proper from the studio (see Fig. 1), it is focussed on to the subject. Either a short-focus lens for close-up images (head and shoulders) or a long-focus lens (head and body) can be brought into play as desired. In this way a spot of light is made to move over the subject being televised with great rapidity (actually twenty-five pictures per second are transmitted with this apparatus) in a series of 180 horizontal lines in juxtaposition to one another.

Introducing the Photo-electric Cells
During the exploring process different parts of the individual features, clothes or objects reflect differing amounts of light and these are "picked up" or affect three very large photo-electric cells suspended in front so that the varying reflected light is changed to an equivalent form of varying electrical voltages. The cells are shown very clearly in Fig. 2, two of them being positioned so that they are one on each side of the person being televised, while the third (Continued overleaf)

Fig. 1.—A pictorial representation of the complete Baird high-definition ultra-short-wave television scheme.

Fig. 2.—Showing Sir Harry Greer before the large photo-electric cells in the spotlight studio. Note the careful metallic screening.
is above. The cells are adequately screened by metal containers and wire-mesh covers, and with them are associated the "A" amplifiers.

The studio is sound-proof, and elaborate precautions are taken to "insulate" it against any form of electrical interference by using copper sheet as an important point in construction. When it is remembered that in this new process frequencies approaching a million cycles a second are dealt with by the amplifiers, without amplitude or phase distortion. The amplified electrical signals are now passed to the control room "B" amplifiers, as seen in Fig. 1. At the same time a sensitive condenser microphone transmits the sound from the studio to pass through a switchboard, and the sound is picked up from the track at the edge of the film by passing through a standard film head, and this section of the apparatus, together with the television transmitter optical arrangements, are clearly seen in the enlarged section photograph of Fig. 5. The whole machine is mounted on a heavy cast-iron pillar, the base of which is bolted to the floor to ensure rigidity.

A Film Television Transmitter

Housed in the same building at the Crystal Palace is a film transmitter built specially for television, ordinary talking films being used. Hitherto only carefully chosen subjects with very little detail had been televised, but the development and perfection of this new piece of apparatus makes it capable of handling standard talking films such as are used in any public cinema. In a simple way the operation is shown in Fig. 1, while Figs. 3, 4 and 5 illustrate different views of the actual machine. Standard talking films (sound on film type) are passed through the "gate" of a continuously moving film projector. An arc source of light (seen on the left of Fig. 4) projects the individual pictures of the film through a focusing lens and as the disc revolves 50 times per second the 90 holes in the disc pass across each film twice in its travel, thus "breaking" it up into 180 horizontal lines. At the same time a synchronizing signal is generated at another aperture section of the disc casing—seen clearly as a white rectangle in Fig. 4—by means of a small projection lamp forcing light through the rotating disc holes to influence a single photo-electric cell mounted against the side of the disc casing. During this televising process the sound is picked up from the track at the edge of the film by passing through a standard film head, and this section of the apparatus, together with the television transmitter optical arrangements, are clearly seen in the enlarged section photograph of Fig. 5. The whole machine is mounted on a heavy cast-iron pillar, the base of which is bolted to the floor to ensure rigidity.

Ultra-Short Waves

As will be gathered from Fig. 1, the vision, synchronizing and sound signals are transferred to the control-room, where a switchboard enables either the film or spot light signals to be fed to the ultra-short wave radio transmitter situated at the base of the Crystal Palace South Tower. Actually the vision and synchronizing signals are "mixed" and are then made to modulate the carrier wave of the 6 metre vision channel, to be radiated into space from the dipole aerial situated right at the top of the tower and seen in Fig. 6. The structural support for the aerial had to be strong and rigid to withstand the high winds encountered at this height, and the twin wire feed can be observed together with a special radiation-meter check loop. The sound is radiated on a separate channel of 6.25 metres, using its own radio transmitter for this purpose.

Owing to the peculiar nature of these waves—sometimes called quasi-optical waves owing to their dispersion properties resembling those of ordinary light, and in consequence the receiving and transmitting sites should be within sight of one another—an extremely high transmitting situation is required, and it was for this reason that the Baird Company chose the Crystal Palace location, for the top of the South Tower is the highest point in London. The extreme value of this choice has been proved from the results of considerable tests.

(To be continued)
Rubber Feet for a Radiogram Cabinet

**THE accompanying sketch shows a device for eliminating floor resonance in a radiogram cabinet, and, at the same time, preventing slipping on a polished floor. My radiogram used to pick up noises from all loose panels and windows until fitted with this device, which is cheap but efficient. As will be noticed in the illustration the device simply consists of a cupped furniture socket which is screwed to the end of each leg of the radiogram. A sponge-rubber ball is then fitted into each socket as shown in the illustration.**

L. WARBERTON (Levenshulme).

**A Turntable for a Portable Set**

HERE is a dodge for making a turntable for use with a portable wireless set. Particularly those of the suitcase type pre-arranged to cut the depth required, thus ensuring accuracy. If a wider or narrower clip is made the right depth the tool can be used in the ordinary way. If the Saw Blades can be made of any size of blade, the tool can be clipped accordingly.—E. SMART (Coventry).

A Handy Tool for Slitting Coil Formers

**MANY constructors cut the slots in the ribs of coil formers with a file, but the following dodge is quicker and easier. Take a hack-saw blade and break it in three pieces. Place these side by side as shown in the sketch. If the blade is filed the right depth the tool can be arranged to cut the depth required, thus ensuring accuracy. If a wider or narrower clip is required the number of pieces of blade can be varied accordingly.—E. SMART (Coventry).**

A Useful Spanner

**QUIT the usual spanner, a spring clothes-peg, and a piece of thin cork mat. The accompanying drawing shows the arrangement quite clearly.—C. HARNIERS (Fulstow, Lincs).**

A Handy Inspection Lamp

**THIS handy lamp is simple to make and consists of a small fuse-holder, an ordinary spring clothes-peg, and a piece of twin flex. This little device is very useful as it can be clipped anywhere in the set, leaving both hands free to work. The sketch shows the arrangement quite clearly.—G. H. L. (Kenton).**

A Simple Microphone

**THE accompanying sketch illustrates how a cheap but fairly efficient microphone can be constructed at home. The sound box consists of a deep cigar box minus the lid. This is invertd and mounted on rubber strips (to eliminate vibrations). It is advisable to use a box with a thin bottom, as this constitutes the diaphragm. A piece of brass, drilled and bent as shown, is screwed to the diaphragm. A carbon block is fastened 1½in. away from the bracket by means of a terminal. Next a hole is drilled 1in. away from the end of a 3in.-battery carbon. Through this hole a wire axe is passed to suspend the rod from the bracket. With the long portion of the rod touching the block, a coil of thick wire is wound round the short end. By sliding this coil along the rod the carbon can be made to rest very lightly on the block, as it should. A terminal screwed to the brass bracket constitutes the second terminal. The microphone described will be found to be very sensitive, if well made. It is used in the same way as the conventional type of microphone.—B. WILSON (Leeds, 6).**

A Simple but Efficient Home-constructed Microphone.
Rotary battery and wave-change switch for a battery set.

The on-off + wave-change switch (Fig. 1) is of the multi-pole type, and this is modified so that it automatically switches on the L.T. before the mains are connected to the rectifier, and, when switching off, this order is reversed. Blades A, A, are used for filament switching; B, B, C, C, for wave-change; and blades D, D, for connecting mains to eliminator. The contacts of A, A, are bent in until there is only a very small gap between the blades and contacts with the switch in " off " position. The contacts D, D, are bent outwards until blades and contacts only just make satisfactory contact with switch in either " long " or " short " position. The wiring connections are shown in Fig. 2.

When the contacts have been altered, as mentioned above, it is obvious that blades A, A, must make contact before blades D, D, which results in the filament being switched on before the H.T. Although this method introduces mains wiring into the grid circuit of the detector valve, I can detect no trace of hum due to this.—E. ROBERTS (Hythe).

A Gas-heated Soldering Iron

The accompanying sketch shows a form of stand-off insulator which I have contrived. Short-wave experimenters will find many uses for them. The insulator consists of one valve-holder (of the rigid type, with all the fittings removed), one piece of ebonite tubing (cut from old lead-in tube), and one brass terminal. The long screwed portion of the terminal is sleeved by the tubing, which allows the terminal to pass through the small hole drilled in the centre of the valve-holder, nut being screwed on inside the holder. This insulator has a remarkably neat appearance, and has proved quite satisfactory in use. Its efficiency, of course, can be increased by raising it on pillars. — GEORGE D. FORKES (Glascow).

A Novel Automatic Station Log

This handy station log works as follows.—Rod B is free, rotates behind the panel, and is joined by paper through a slit in the panel to Rod A. Rod terminal. The long screwed portion of the terminal is sleeved by the tubing, which allows the terminal to pass through the small hole drilled in the centre of the valve-holder, nut being screwed on inside the holder. This insulator has a remarkably neat appearance, and has proved quite satisfactory in use. Its efficiency, of course, can be increased by raising it on pillars. — GEORGE D. FORKES (Glascow).

A Combined Condenser and Wave-change Switch

A MIDGERT condenser of the type shown in the sketch may be very easily transformed into a wave-change switch, while still being used as an aerial series condenser. One of the fixed plates at the end is removed and in its place is fixed a stout piece of fibre, cut and drilled and with two copper contacts fixed as shown. To the end of the spindle bearing the moving vanes, and which passes through the larger hole in the fibre, is fixed a switch arm which rotates, and makes contact with the copper contacts upon the fibre. The condenser is wired up as shown in the diagram. The strip of copper C is so arranged that when making contact with A, the capacity is at a minimum required for the short waves. When making contact with B the capacity of the conden-

A simple gas-heated soldering iron.
MAKING A START ON THE SHORT WAVES

An Article of Special Interest to those Readers Who Have Not Yet Taken an Interest in Short-Wave Reception. Practical Information is Given in Regard to the Construction of a Simple and Efficient Short-Wave Receiver.

By FRANK PRESTON

Despite the tremendous amount of interest which is to be gained from short-wave reception, it is rather surprising to find how comparatively few amateurs and experimenters there are who take an active interest in short-wave work. It would appear that, in many cases, readers are inclined to fight shy of short waves because they believe that the subject is tricky and abounding with "snags" and difficulties. As a matter of actual fact, however, this idea is entirely wrong, for short-wave reception differs very little from normal broadcast reception except, perhaps, that the receiver required for the reception of stations all over the world is much simpler than that which is generally employed for listening to broadcasting stations on the medium and long-wave bands.

Simplicity is the Keynote

In nearly every case it is true to say that the best possible set for reception on wave-lengths below 100 metres or so is the simplest one that can be devised. Simplicity is, in fact, the keynote of the short-wave receiver, and as soon as amateurs realize this they almost invariably give the short wave-lengths a trial. In too many instances, however, the results obtained are not so good as were anticipated; this is simply due to the fact that the amateur has failed to work on the right lines, or to give a little study to the matter before rushing wildly into it. The purpose of this article is to supply the information which is necessary in making a start, so that would-be short-wave listeners may avoid any of the mistakes that are commonly made and may be successful at the very first attempt.

Before going farther it might be as well to answer a simple question which is of frequent occurrence. The question is: "Is short-wave work really worth while, and are there sufficient programmes to justify the construction of a set to pick them up?" The answer is very definitely "Yes." It is probably no exaggeration to say that there are more stations working between, say, 15 and 20 metres than there are between 200 and 2,000 metres. It is true that all these stations do not give regular programmes for eight to ten hours a day, but there are scores of them which do provide a reliable service in the way of musical entertainment and so on. Additionally, though, there are hundreds—probably thousands—of other stations, many of which are owned and operated by amateurs, which afford more interest to the real amateur and experimenter than do all the broadcasting stations in the world.

Another great feature of the short waves is that even quite low-powered transmitters can be received over incredible distances on the simplest possible type of receiver. It is by no means uncommon to receive a station in Australia, for example, on a single valve set costing no more than a couple of pounds in components. Besides this, it is worth remembering that, on certain short-wave bands, aerial reception is actually better in daylight than after dark. This is contrary to the conditions obtaining on the longer waves, where anything like long-distance reception is well-nigh impossible during the summer months. World-wide reception on short waves can be accomplished the whole year round; this fact will appeal strongly to the "DX" amateur who is inclined to lose interest in his hobby as the longer days draw on.

Inexpensive Experiment

But enough has been said in praise of short-waves, and it is time to get down to more practical aspects of the question. One of the first things that the amateur will want to know before he definitely decides to make a short-wave set is how much he will have to spend. In the following paragraphs it will be shown that a reasonably good short-wave can be made from odds and ends which nearly every reader will probably have on hand. Even if a few new parts have to be bought it is unlikely that it will be necessary to spend more than a pound at the very most.

The best kind of S.W. receiver for either the beginner or the hardened short-wave "fan" is the single-valve of the "straightest" possible kind. A circuit of such a set, accompanied by a pictorial wiring diagram for the benefit of those few readers who still find it rather difficult to read a "tho," is given in Fig. 1. It will be seen that a simple tuner is used, and this...
First Prize: 20 GUINEAS CASH—And 250 Consolation Prizes! No Entry Fee!

Our Readers are Invited to Become Test Experts of the New Varley Bifocal Selectivity Device. Our New Scheme for the Rapid Testing, by Home Constructors, of New Radio Components

Fig. 1.—Here is a simple detector circuit which may be used alone or with L.F. amplification.

Fig. 4.—An H.F. and detector stage which employs two of the Bifocal coils.

Fig. 3.—The Bifocal coils may be used in a band-pass circuit or as detectors, as illustrated.

Fig. 2.—In some cases this detector circuit may prove more useful than that shown in Fig. 1.

A competition for them to send representatives which were obviously a lengthy and expensive process to embark on this competition by virtue of the fact that the selectivity problem has become an urgent matter, and the problem has been by no means easy of solution, for a successful device such as the Bifocal coil had necessarily to be designed so that it could be quickly incorporated in any standard receiver. Additionally, it needed to be reasonable in price, and it is a tribute to the Varley engineers that they have been able to so ingeniously a manner to solve the problem.

As previously mentioned, it is always our policy to act in the best interests of our readers, and we are glad to say that these coils have been thoroughly tested in a number of ways, and in a number of districts, and have passed these tests entirely satisfactorily.

These Bifocal coils have arrived at a time when the selectivity problem has become an urgent matter, and the problem has been by no means easy of solution, for a successful device such as the Bifocal coil had necessarily to be designed so that it could be quickly incorporated in any standard receiver. Additionally, it needed to be reasonable in price, and it is a tribute to the Varley engineers that they have been able to so ingeniously a manner to solve the problem.

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PRACTICAL WIRELESS
April 14th, 1934

A great competition is now on foot to test the selectivity of the new Varley Bifocal Selectivity Devices which we have described in the last week's number. The device is of the so-called Bifocal type, which serve both as aerial coils and grid-coupling coils, and its performance can be tuned to any desired results by adjusting the transformer coupling. Selectivity is thus obtained by means of a variable air-gap, which is varied by altering the coupling. The selectivity is thus proportional to the degree of transformer coupling.

The diagrams on this page show how the device is used to any desired ends. As previously mentioned, the points of interest are that the coils are arranged inside the complete coil, which is made up of a number of turns wound on a core of iron-core material. This is not so long as the core is moved from one end of the coil to the other. It is a principle of operation that the insertion of this material inside the aerial coil will move the inductance of the aerial coil. Consequently, if it is moved so that it does not come within the portion which is utilized for the aerial section it will vary the inductance only of the aerial coil. In this instance, the aerial coupling is increased the load on the tuning circuit will become greater, and the interference feed-back effect will also be increased. The complete coil, therefore, serves both as the aerial coil and grid coil, and its radiation pattern is adjusted until the station it is desired to receive suffers the greatest benefit and the other stations are completely shut out.

It should be noted that if a two-gang condenser is employed, it should be of the type in which the aerial section is controlled by means of a panel-operated switch. This switch is simply a step-up transformer, which is connected directly between aerial and earth, and the transformer primary is connected to the grid of the receiving set. The secondary is connected to the aerial circuit with the grid tapped down a few hundred volts. As the coupling is increased, however, the radiation patterns will also be increased, and the balance is maintained by means of a step-up transformer.

PRACTICAL WIRELESS therefore made the announcement in last week's number, that our readers should act as test experts and thus augment the data they have obtained as a result of the test reports. We would like to emphasize, however, that the best way to test for selectivity is to vary the coupling, as this is the only way that the selectivity can be varied. The diagrams on this page show how the device is used to any desired ends. As previously mentioned, the points of interest are that the coils are arranged inside the complete coil, which is made up of a number of turns wound on a core of iron-core material. This is not so long as the core is moved from one end of the coil to the other. It is a principle of operation that the insertion of this material inside the aerial coil will move the inductance of the aerial coil. Consequently, if it is moved so that it does not come within the portion which is utilized for the aerial section it will vary the inductance only of the aerial coil. In this instance, the aerial coupling is increased the load on the tuning circuit will become greater, and the interference feed-back effect will also be increased. The complete coil, therefore, serves both as the aerial coil and grid coil, and its radiation pattern is adjusted until the station it is desired to receive suffers the greatest benefit and the other stations are completely shut out.

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is provided with a loose-coupled aerial winding and also with a reaction winding. The aerial lead-in may be connected to one end of the loose-coupled coil or to the "grid" end of the grid coil as desired, although the former connection will be found better in the majority of cases. If the usual "broadcast" aerial is to be used, the grid coil is tuned by means of a 0.0001 mfd. variable condenser, whilst reaction is controlled by a second variable condenser of identical capacity. Leaky-grid rectification is employed, but the values of grid condenser and leak are rather different from those generally used in a grid circuit, as a matter of fact, these values are not critical, but they are found to produce best results.

"Throttle-Control" Reaction

An H.F. choke of special short-wave type is connected in the anode circuit of the valve, and particulars will be given later in regard to the construction of this component. Those readers who are accustomed to following circuit diagrams will notice that the reaction condenser is not connected in the usual position, but is between the "H.T." end of the reaction coil and earth. This form of reaction is generally referred to as "throttle control," due to the fact that the condenser is used to "throttle" the oscillation of the valve. In other words the condenser, instead of increasing reaction as its capacitance increases, produces the opposite effect by by-passing the H.F. currents appearing in the anode circuit to earth.

The connections are simplicity itself, as can be seen, so there will be no need to describe them. Instead, attention will first be turned to the construction of the special short-wave coil and H.F. choke. The coil is made on a 2 in. diameter ribbed enionite former as shown in Fig. 2 and consists of three windings, one of which is in 16-gauge bare or tinned copper wire, and the other two in 26-gauge enamelled. Fig. 2 shows that the coil is intended for mounting on the baseboard on two long terminals or lengths of screwed brass rod. Terminals are used to cover these connections, the ends of the windings and these are fixed in a line between two ribs on the former. The numbers of turns indicated in the drawing are the number of turns in one coil or to the grid, for alternative ranges could very easily be made by employing proportionate numbers of turns. As an example, it might be stated that a tuner for a wavelength range of about 15 to 30 metres would require two, three and five turns, respectively, for the aerial, grid, and reaction windings.

Dual-Range S.W. Tuners

It would, of course, be a fairly simple matter to make a dual range type of tuner, but for a start, and where maximum efficiency is the very first consideration, a simple component of the kind shown is strongly recommended. Then again, it would be easy enough to make a range of six-pin plug-in coils to cover the various ranges, but it is considered better to leave that until a later date, and until a little experience has been gained.

The H.F. Choke

The short-wave choke is the simplest component employed in any kind of wireless receiver. It must be made with reasonable care, though, and the details and dimensions given in Fig. 3 will prove useful. A short length of ribbed enonite former, 1 in. in diameter, is employed to take the winding of 25 turns of 28-gauge enamelled wire, although it is permissible to use a length of 1-in. diameter paxolin or glass tube instead. This is more conveniently obtainable. It will be seen that, in order to reduce the capacity between the turns of the winding, a length of thread is wound on the former at the same time as the wire, so as to space the turns of wire.

The Tuning Condenser

After the two components just described, the most important is the tuning condenser. It is preferable to use one specially made for short-wave work, but as an alternative use can be made of any good .0005 mfd. condenser which is on hand, by dismantling this, discarding about one third of the vanes and then re-assembling with double spacing washers between the adjacent vanes. This modification will materially reduce the minimum capacity, thereby increasing efficiency and extending the tuning range with any particular coil. Extremely slow movement of the condenser vanes is absolutely essential on short waves, because of the wide frequency range covered by so small a variation in condenser capacity. It is therefore practically essential to employ a really good slow-motion drive in conjunction with the tuning condenser. The drive should preferably have a range of about 0 to 1, and movement should be perfectly smooth and entirely free from back-lash. There are commercially available worm drive units which are satisfactory, and it is not necessary to pay more than three or four shillings for a really good one.

An alternative to the ultra-slow-motion drive is a double condenser arrangement, whereby a low-capacity (say about 0.0005 mfd.) variable condenser is wired in parallel with the main one. The smaller condenser is used for fine tuning after the set has been adjusted to the approximate wavelength by means of the normal condenser. This system is generally known among short-wave enthusiasts as "band-spread" and it has been fully described in these pages before. The small condenser, like the other one, should be of the air dielectric type, and can be made by rebuilding an ordinary .0001 mfd. component in the manner previously described, by removing some vanes and double spacing the remainder. Even when using the band-spread idea it is worth while to use a drive mechanism giving a fairly low reduction ratio on the lower-capacity condenser, but a plain 0-180 dial will be suitable for the .0002 mfd. condenser.

The Reaction Condenser

Any good air-spaced condenser of about 0.0002 mfd. can satisfactorily be employed for reaction control. A slow-motion drive is preferable, but can be dispensed with if a fairly large dial of the kind generally used for operation of the tuning condenser is fitted in place of the small knob supplied with it. It might be mentioned, however, that one firm of component manufacturers make a special reaction condenser for short wave use, which has a reduction drive of about 10 to 1; this gives an excellent and smooth control.
PRACTICAL WIRELESS

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THE 362 RADIO VALVE

a good H.F. choke of the usual "broad-stages.

Post also be used as an efficient converter in conjunction with any battery set having

This plug will then simply replace the

tied from it to the appropriate points

ing the short-waver as an adaptor is to use

to the positive and negative terminals

is required for operating a loud-speaker.

Detector valve from its holder and take a

on a valve-holder in the set, remove the

or more valves are available it is worth

Detector " or " L.F." type is nearly always

The valve-holder should for prefer-

ce be of the usual chassis-mounting type,

While to try them all, choosing the one with

or more high-frequency amplifying

one or more valves are available it is worth

low capacity between the sockets.

Current drain is reduced.

which the set "slides" smoothly into and

ths be of the usual chassis-mounting type,

The most suitable H.T. voltage will probably be

30 and 70 volts, but experiment in this direction will be well repaid.

As S.-W. Adaptor

The single-valve described can be used

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THE PROBLEM OF LOW-TENSION SUPPLY

With Instructions for Making a Simple Battery which will Operate Valves Direct, or Charge Accumulators, of Special Interest to Country Dwellers.

By ALBERT E. OAKLEY

FOR many users of battery-operated sets the supply of low-tension current is somewhat of a problem. An accumulator is generally used for the purpose, and the question is really, "How shall I charge it?" The answer will depend largely on local conditions. If current from electric mains is available this can be utilized in the following manner.

Charging from D.C. Mains

Supposing it is of the D.C. variety, we can connect the accumulator in series with a resistance lamp, preferably one that is in use for lighting, for if a powerful lamp has to be run specially for charging one or two accumulators the wasted energy will be out of all proportion to that actually utilized. If the supply is at 200 volts or more, the charging of one or two 2-volt accumulators will not dim the light appreciably, as each accumulator only absorbs 2½ volts. It should be remembered, however, that the charging current is low, a 40-watt lamp passing but one-fifth of an ampere at 200 volts, while a 100-watt lamp uses half an amp. For satisfactory charging, therefore, the lamp or lamps in circuit should have a total rating of at least 100 watts. Then there is the commercial "trickle charger," generally combined as part of an eliminator for H.T. supply. This method is wasteful of "juice" because so small a proportion of the voltage paid for is actually used by the accumulator, the difference being wasted in a resistance.

Using A.C. for Charging

If the supply is alternating, several methods are available. All of them require rectification of the alternating current, because, of course, the current passing through the accumulator must be unidirectional. The simplest and cheapest method, from the point of view of the apparatus required, is to use an electrolytic rectifier. Directions for making a charger of this type were given in PRACTICAL WIRELESS dated December 17th, 1932.

The most workmanlike and economical job consists of a step-down transformer, to reduce the mains pressure to either 9 or 11 volts, and a metal rectifier. This plan involves very little waste of energy, for the supply current is transformed from a high to a low voltage in the most efficient manner possible. The transformer preferably has one or two tappings on the secondary winding, the former and rectifier may be conveniently fitted into a small box with switch, resistance and ammeter mounted on the front and two charging terminals at the end for connecting the accumulator leads. (See Fig. 2.)

L.T. from a Primary Battery

There are many country dwellers who are without the convenience of electric power, and who must take their accumulators a considerable distance for charging. There is, too, the consideration that the accumulator has a nasty habit of running down at an unexpected and generally inconvenient moment, and also that charging, as carried out by the local garage, is not always satisfactory. From every point of view it is certainly an advantage to have a home-made supply of current always on tap.

A Special Leclanché Battery

The most suitable primary cell for charging, or for heating valve filaments directly, is a special form of the Leclanché known as the "sac" pattern. Two of the cells to be described will be satisfactory for the operation of a two or three-valve set under average conditions.

If the set is worked for long periods daily, a second set of cells will be advisable, so that one may change over, and thus avoid running the battery too low. The great advantage of this type of battery is that it will work for long periods without attention, is easily and cheaply charged, and does not use acids. Within reason, the larger the cell the better. The

(Continued on next page.)
Do You Know What
This Graph Means?

(Continued from previous page)

size recommended for ordinary service has a capacity of about 34in. square. Referring to the list of materials given below, a few explanations will be helpful. The jars may be of glass, stone, wood, or china—square or cylindrical, but must have a wide mouth—about 4in. in diameter. If a large pickle jar is used it will probably hold a larger quantity of the electrolyte, but this is no disadvantage, as the cell will last longer before needing recharging. The size is determined from a piece of stout calico, duck, or similar strong material seamed into a cylinder 3jin. diameter and 7jin. long. This allows 1jin. circular form, with a diameter of 3jin., so that they encircle the sac, but leave sufficient space between to allow free circulation of the liquid. If the smaller size of zinc are purchased from a metal worker, he will bend them to shape before his rolls. The zinc are purchased from a metal worker, he will bend them to shape before his rolls.

Radio has developed so rapidly throughout the last ten years that it has now greatly outgrown the supply of technically qualified men required for the better posts. Moreover, it continues to develop with such speed that only by knowing the basic principles can pace be kept with it.

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Fig. 5.—Shows connections for operating set from battery and charging accumulator. The dotted portion shows a second battery with change-over switch.
THE OUTPUT VALVE

It is almost true to say that the whole design of a receiver should be worked out with a view to the output valve it is intended to use, and, at all events, the choice of output valve is one of the very first points to be decided. The value of the power output required from the wireless receiver depends, of course, upon the type of loud-speaker which it is intended to employ and upon the strength of the sound expected. In any case, it is as well to be liberal in this respect. Whatever output it is intended to obtain it will be possible to achieve it in two ways—by the use of a three-electrode output valve or by employing a pentode valve. Each kind of valve is available in types suitable for various anode voltages, for battery or A.C. mains operation.

The output triode is characterized by fairly low anode impedance and usually low amplification factor. As a consequence such valves require a somewhat larger grid excitation voltage in order to develop their full output. On the other hand, their comparatively long grid-base results in very uniform and good reproduction, the risk of frequency distortion being very slight provided the correct grid bias is applied. Sometimes it is found that the triode output valves, designed primarily for use in the average broadcast receiver and rated for maximum anode voltages of 150 volts in the case of battery valves, and 200 or 250 volts in the case of mains valves, give scarcely sufficient output for particular purposes, and it is necessary frequently to employ two valves in parallel or push-pull.

Large Valves

Most valve manufacturers, however, produce a series of high-voltage, three-electrode output valves, giving ample reserve of power for those special cases of large outputs. These valves require an anode voltage of between 400 and 500 volts. Some have amplification factors of the expected.

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OSBORN CABINETS

5/- to £10.

Catalogue containing 37 DESIGNS

with amazing Osborn Box Baffle post free.


MAKING A START ON THE SHORT WAVES (Continued from page 118) and take a lead from the negative terminal to the aerial terminal on the set, through a .0001 mfd. fixed condenser. The H.T. + wander-plug on the short-wave must still be inserted into an appropriate tapping socket on the H.T. battery, whilst the L.T. leads should be joined to corresponding terminals on a valve-holder in the set.

When the unit is employed in this way the set is actually converted into a short-wave superheterodyne, of which the high-frequency stages act as an I.F. amplifier. For this reason the broadcast set should be tuned to a wavelength of approximately 2,000 metres, at which setting it can be left whilst all tuning is carried out on the single-valve set which is being used as a converter.

OUR GREAT NATIONAL COMPETITION

(Continued from page 115)

Bifocal Coils in a Tuned-grid Circuit

In Circuit No. 4 a tuned-grid circuit is shown, one Bifocal coil being used for aerial tuning and another for inter-valve coupling. With both coils adjusted for minimum coupling, the overall selectivity of the receiver is very great indeed, and should be sufficient for all requirements.

In this circuit, of course, the reaction is applied to the inter-valve circuit, and since the loading on the coil due to the shunt effect of the preceding screen-grid valve is not quite the same as that of an aerial, the constancy of reaction is not quite as good as with the detector + I.F. receiver. But it is superior to any ordinary type coil.

Another Bifocal Arrangement

The fifth circuit is a variation of the preceding arrangement, in which the input to the detector is taken to the tapping, so that the loading on the circuit due to the detector-grid circuit can be varied. This method can be applied in many other cases, such as a power-grid valve, a screen-grid valve, or for instance, a diode detector, whilst it is, of course, especially valuable when a metal or filament is used as a detector, since with this type of detector damping of the tuning circuit is apt to be rather high, especially at very high frequencies.

The Bifocal coil can be employed with equal success in mains-operated receivers, either of the detector + I.F. type, or with those having a screen-grid stage. A screen-grid valve may be of the ordinary type, variable-mu, or H.F. pentode. It is not recommended, however, that more than one H.F. stage be employed with mains-operated valves.

The wavelength covered by the Bifocal coil is exceptionally large, and it is easily possible to get below 200 metres, thus ensuring good reception of the low-wave station, such as Bournemouth and Fecamp. For this reason the broadcast set should be tuned to a wavelength of approximately 2,000 kilocycles. The dynamic resistance is, approximately, 97,000 ohms measured at 900 kilocycles.

It should be pointed out that the Bifocal coil is intended particularly for use in circuits employing reaction, where, after the necessary balance condition has been obtained by adjusting the coupling, the desired signal strength can be obtained by adjustment of the reaction control.
THE BEGINNER'S SUPPLEMENT

ARRANGING THE COMPONENTS

Having decided upon a suitable circuit for his requirements, the constructor wishes to know how the components should be disposed; this article explains the matter.

The circuit is not all-important. It is now generally realized that the actual circuit that is used for a set has not necessarily any direct bearing upon the efficiency or otherwise of the finished receiver; the circuit is undoubtedly important, but not all-important. We believe that this fact is now clearly understood by examining the typical three-valve A.C. mains-receiver circuit given in Fig. 1. High-frequency and tuning circuits are shown in heavy line,

and must be considered in priority to the other sections. In the case of a set such as that represented by Fig. 1, there are two possible general arrangements of the receiver and power-supply sections. Both sections may be accommodated on the same chassis, or the power unit may be on a separate chassis; in the latter case connection to the receiver would preferably be made by means of a four-pin plug and socket of the type shown in Fig. 2. The plug would take the L.T. supply, as well as the main H.T. supply from the mains unit to the set, but all voltage-dropping and de-coupling resistances would be housed in the receiver portion. As a matter of fact, the idea of having the mains unit separate from the receiver is nearly always to be preferred, unless the constructor is fairly experienced, and is prepared to experiment to a certain extent with various arrangements of the power-supply components.

Use a Metallized Chassis. Having disposed of the question of the mains unit, the other sections of the circuit may be considered. Before going any farther we would say that, if the constructor is strongly advised to make use of either a metal or metallized chassis. This kind of chassis minimizes inter-action, hand-capacity (in short-wave sets particularly), and the number of long connecting wires, besides providing very convenient earth-returns from every component in the set. The best way of arranging the three principal

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receiver circuits which have been mentioned before is to place the H.F. portion near to the panel or front of the chassis and on the left, with the L.F. coupling components toward the right of the chassis and the high-tension, low-tension and capacitors (in mains sets only, of course) circuits beneath the chassis baseboard.

A general idea of what is meant can be obtained from Fig. 3, where the principal items are shown. In this example it is assumed that a pair of screened coils are used in conjunction with a gang-condenser, and quite a different arrangement would probably be necessary in the case of other types of components will allow.

It perhaps more important is that leads provided that some wires are not made and the second it tends to eliminate direct pick-up of the local station. The latter point is worthy of more consideration, especially in respect of more sensitive receivers with which the apparent selectivity might be considerably reduced due to the fact that connecting wires are acting as small aerials and so picking up the signals from the local station. Such signals do not have to pass through the tuning circuits in the same way as the proper "aerial" signals have, and they are, therefore, often heard over a large part of the tuning dial of an otherwise sensitive receiver.

Fig. 5.—It is often a good plan to arrange the H.F. and detector valve-holders beside their associated coils as shown above.

The Valve-Holders

As it is not a very difficult matter to decide where the valve-holders are to be placed on the chassis, but one should not be unduly influenced by the convention of arranging them in a straight line. Such an arrangement does make for simple filament or heater wiring, but it might be bad in other respects. The point to watch is that the H.F. and detector valve-holders are as near as possible to the terminals on the coils which have to be connected to their grid sockets. For this reason it is often useful to place the L.F. coils and the associated L.F. transformer coil at the opposite end of the chassis, so obtaining an almost ideal disposition.

It is generally best to arrange the valve-holders in the same sequence as the corresponding valves appear in the circuit, but this is not an invariable rule. For example, if a pair of ganged coils were being used in which the aerial coil were at the back and the grid coil in front the detector valve would obviously be placed toward the front of this chassis, but the L.F. valve would probably be placed at the back.

With regard to the detector valve-holder it should be mentioned that the grid condenser and leak should, for preference, be placed as near to it as convenient. It is, in fact, frequently an excellent plan to solder the tag of the condenser, as well as the wire end of the grid leak, directly on to the grid terminal of the valve-holder. Another component which should be situated very close to the detector valve-holder is the H.F. choke, and a short wire from the anode terminal of the valve-holder to the choke should in every case be provided. The same rule applies to the lead from the valve to the reaction condenser or winding on the coil. If, however, the latter connection cannot be made very short (as is often the case) it should be screened with a length of metallic braiding.

Pick-up Terminals and Switch

The situation of pick-up terminals is often a matter of difficulty, particularly when a radiogram switch is employed. The reason is that the detector grid-circuit leads, which are often made much too long, introduce serious damping, as well as back-coupling. Because of this it is often worth while to contend with rather inaccessible pick-up terminals and in order to avoid more serious troubles. Another method is to mount the radiogram switch and pick-up terminals close to the detector valve-holder and to operate the switch by means of an ebonite extension spindle.

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See pages 114 and 115.
FOR THE TECHNICAL EXPERIMENTER

THE LAST STAGE

A Practical Article Explaining the Various Characteristics of "Quiescent" and "Class B" Push-Pull Amplification

By F. W. LANCASTER.

MOST readers are aware that the object of the push-pull circuit, or at least one of the objects, is to eliminate distortion due to the curvature of the valve characteristic. In the original push-pull system the fundamental idea is that two valves are so associated that the curvature of the one valve characteristic neutralizes that of the other, the valves being biased much the same as though they were being used singly. This is as illustrated in Fig. 1. One result is that two valves of any given denomination in push-pull take, approximately, twice the anode current of one valve used singly on an ordinary output circuit.

"Quiescent" and "Class B" Push-Pull

In the more modern forms of push-pull, namely, those known as the "quiescent" and "Class B," the same primary object of balancing one valve against the other is present to eliminate the effect of characteristic curvature, but there is a new idea, namely, that of economizing anode current. The ideal case may be represented as in Fig. 2, in which the valve characteristics are assumed to be of hyperbolic form. When two hyperbolae are associated, as in this figure, with common asymptotes, XOX and YOY, it may be shown that if biased to the point O the resultant of the two is a straight line characteristic YY. If it were possible to produce valves having this hyperbolic characteristic, a pair of such valves accurately biased would form a perfect output stage entirely free from distortion. The hyperbolic form is not the only one which is capable of giving perfection. It is quite evident, for example, that any other form of valve characteristic which, suitably paired, will give a straight line in relation, is equally good. A special instance, that illustrated in Fig. 3, in this a portion of each valve characteristic is shown as a straight line, and the two curved portions are of such form as to give as resultant a straight line transition from one to the other.

Both the "quiescent" push-pull and the "Class B" push-pull are attempts to materialize the conditions typically shown in Figs. 2 and 3, and from these figures it will be seen how great a saving there is in anode current in comparison to Fig. 1. Thus the combined static anode current I may be as low as 2 or 3 milliams. When a signal is being received the anode current immediately increases in some relation to the strength of the signal. In this it differs from the old type of push-pull; thus, if a grid current of nearly 4 milliamps in the power circuit, under the old regime, whether it be a single triode valve or two of such in push-pull, a flicker of the milliammeter needle indicates overload, whereas in the new type of push-pull the flicker of the milliammeter merely denotes that reception is taking place, that is to say, a signal is being through.

The difference between what is termed "quiescent" push-pull and "Class B" is that in the former case the intention is to work both valves under conditions of negative grid voltage, thus avoiding grid current; in the latter, namely, that of economizing anode current, there is no applied grid-bias; the grids are normally at earth potential, and, alternately, become positive, and the valves run into grid current at every swing.

The difference between "quiescent" push-pull and "Class B" from the above description may be thought to be a matter of degree, that is to say, it might be imagined possible to arrange anything between "quiescent" push-pull and "Class B" by introducing grid current to greater or less extent, and so, by varying the bias, change by imperceptible gradation from one system to the other. But is not so; as soon as any question of grid current comes in, the character or drive valve and its coupling circuit has to be treated as a power circuit in a small way of business; this is the real distinction between "quiescent" push-pull and "Class B." Thus, in Fig. 1, which is a rough plotting of the characteristics of the Cossor 240B valve, it is clear that with a grid swing ±10 volts there is a grid current of nearly 4 milliamps, which has to be fed from the inter-valve transformer.

Grid Swing in Q.P.P.

When we come to the actual practice and endeavoured to associate a pair of triodes or pentodes in "quiescent" push-pull, we can see at once the limitations that exist, and the causes which prevent a straight line valve characteristic from being attained.

The point at which the characteristic records zero plate current defines a point beyond which the companion valve is acting alone. In the old type of push-pull, this point was commonly beyond the range of grid swing, but in the modern "quiescent" push-pull the grid swing goes far beyond the zero point of the individual valve, and as the characteristics in these regions are never exactly straight the combined characteristic is not straight but good the transition section may be. Thus, in Fig. 5, the combined characteristic is made up of three sections—P1, Q1 and P2, Q2, each of which has a certain degree of curvature, and a transition section, P1, P2, which should blend conformably with the other two sections. The resulting curve may be anything from an approximately straight line to an undulating curve which is far from straight, and everything will depend upon the choice of valves and the adjustment of the grid bias. The pre-dominating harmonics introduced will, generally speaking, be of greater frequency than those due to a single triode valve, but the contrast between the maximum and minimum inclination of the characteristic (which is the determining factor in the distortion which produces "rattle") will be less severe than in the single triode valve.

Whereas in the old form of push-pull the A.C. impedance is twice that of a single valve, the impedance of a pair of valves, either in Q.P.P. or Class B, is four times that of a single valve. Thus the slope of the characteristic at the bias point is approximately half that of one part of the curve where impedance is usually measured, and half the slope denotes twice the impedance.

Using Pentodes in Push-Pull

In quiescent push-pull it is common practice to use pentodes, but it is not all plain sailing; owing to the high impedance the output transformer needs to have a very high inductance. Thus for the two valves the effective impedance will not be less than 40,000 X 4=160,000 ohms, and the optimum external impedance may be taken as 4th of this or 20,000 ohms. The effective resistance is slightly less than this, but the difference is negligible. Now the equation giving the inductance necessary
for 3 decibels attenuation for a given frequency $f$ is:

$$ L = \frac{R}{2 \pi f} \text{ henrys.} $$

If we take $f = 66 \Omega$ (which is the open circuit of a 'coddle') we have:

$$ R = 20 \text{ ohms.} $$

$$ L = \frac{20}{2 \pi \times 66} = 48 \text{ henrys.} $$

For the purpose of comparison we will make the corresponding calculation for a push-pull circuit of the old style; the valves are ordinary triodes, say of 2,000 ohms impedance, or total valve impedance $= 4,000$ ohms. The external impedance may be taken as about twice this—8,000 ohms. Next we calculate the effective resistance, the expression for which is:

$$ R_1 + R_2 \frac{4,000}{8,000} = 5,000 \text{ ohms.} $$

$$ 4,000 + 8,000 = 12,000 \text{ ohms.} $$

$$ L = \frac{12,000}{2 \pi \times 66} = 2,666 \text{ ohms.} $$

Similarly:

$$ R_1 \frac{4,000}{8,000} = 500 \text{ ohms.} $$

$$ L = \frac{500}{2 \pi \times 66} = 7.25 \text{ henrys.} $$

Thus an inductive reactance of 10 to 12 henrys for the interstage or driver transformer is ample.

The output transformer differs little from normal. The effective anode impedance of the 24OB valve is approximately $2,000 \times 4 = 8,000$, and assuming that the external impedance is greater. (It is usually less), the effective resistance is 4,000 and for $-3 \text{ db @ } 66 \Omega$:

$$ L = \frac{3,000}{2 \pi \times 66} = 14.5 \text{ henrys.} $$

$$ 4,000 + 8,000 = 12,000 \text{ ohms.} $$

$$ L = \frac{12,000}{2 \pi \times 66} = 2,666 \text{ ohms.} $$

There is another interesting method of compensating the output stage of an amplifier which is little known and less practised. The idea is to make the curvature of the driver valve characteristic compensate for that of the power valve. The theory of this is made clear in Fig. 6 (diagrammatic). A symmetrical grid swing, fed to the driver valve, that is to say, a change of E.M.F. in equal steps above and below the grid bias, becomes an unsymmetrical swing as fed from the anode circuit to the grid of the power valve. If the coupling is correctly arranged, the lack of symmetry, or distortion, introduced in the pentode stage is corrected, or partly corrected, in the power stage, with the result that symmetry is restored.

PRACTICAL WIRELESS

April 14th, 1934
RADIO CLUBS AND SOCIETIES

Club Reports should not exceed 250 words in length and should be received First Post each Monday morning for publication in the following week's issue.

ANGLO-AMERICAN RADIO AND TELEVISION SOCIETY
Radio Club (Mr. E. T. Gove) demonstrated his all-metal 4-valve (S.G. followed by S.G. det. and two L.F. valves) receiver at the last meeting of the Wingate District Branch of the Anglo-American Radio and Television Society. Results were excellent, and the following stations were tuned in at good loud-speaker strength: YVIBC and 3BC, Canada; 1AX, 3XAL, 8XK, VE-90W, RW59, DJC and GSA. A successful television demonstration concluded the meeting. Full particulars of this branch and Society may be obtained from Mr. Leslie W. Orton, 11, Northwood, Wingate, Uxbridge.

INTERNATIONAL SHORT-WAVE CLUB (LEICESTER CHAPTER)
After reconvening the Leicester Chapter, Mr. Vendy (CAWE) held a meeting of members, of which there was a good attendance. Considerable interest was shown in Mr. Vendy's experimental transmitter. The question of a clubroom in which to hold meetings was discussed, and after a vote of members had been taken it was decided that the club needed a lecture-room and not a lecture-room. Meetings will be held every Wednesday in Mr. Vendy's room, commencing at 7.30 p.m., until a suitable workshop is found. C. Cramp, Hon. Sec., 69, Avenue Road, Leicester.

THORNTON HEATH SHORT-WAVE RADIO AND TELEVISION SOCIETY
Readers residing in the district will be interested to know that the above Society is now being formed and particulars can be obtained from R. J. Rogerson, Hon. Sec., 11, Hawthorn Drive, Willowbank, Uxbridge.

INTERNATIONAL SHORT-WAVE CLUB (LONDON)
The first annual dinner and dance held by this organization took place on Thursday, March 22nd, at Maison Lyons, Shaftesbury Avenue, W.1. It was a great success and was attended by the American Embassy, representatives of the B.T.C., and the radio manufacturers. It was a great honour to have with us at this time Mr. George F. Brooks, one of the pioneers of the I.S.W.C., who had just arrived in this country from the West Indies.-A. B. Bear, 10, St. Mary's Place, Rotherhithe, London, S.E.10.

THORNTON HEATH RADIO SOCIETY
On March 23rd, a lecture took place in Mr. Vendy's room, commencing at 7.30 p.m., at which Mr. Crossley gave another talk on the subject of light as applied to television. It was a great honour to have with us at this time Mr. George F. Brooks, one of the pioneers of the I.S.W.C., who had just arrived in this country from the West Indies. A. B. Bear, 10, St. Mary's Place, Rotherhithe, London, S.E.10.

THE CROYDON RADIO SOCIETY
A lecture on "Coils, etc." was given by Mr. A. F. G. Harrison, writing his "Prac. W. Handbook," at Sewdley, St. Mary's Place, Rotherhithe, London, S.E.10.

SOCIETY FOR THE STUDY OF ELECTRICITY
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ADVT. OF GRAHAM FARISH LTD., BROMLEY, KENT.
- BATTERY SPARES SUPPLIED.
- ALL STANDARD BATTERY SPARES SUPPLIED.
- Catalogue free from actual manufacturers.

115 VOLTS AFTER 12 MONTHS' USE!
Mr. E. G. Harrigan, writing in "Pract. W. Handbook," states: "The battery in the Lechache, which has the advantage of keeping its voltage, taps being at every 1 volt, just right for O.P.P., was installed last March and still shows 115 volts under load, so I am certainly disposed to recommend it for all applications at long intervals that is necessary: 120-1250 m.m. £2 complete, cash paid.

PATENTS AND TRADE MARKS.
- KINGSFORD PATENT AGENCY, LTD., 186, G. Victoria Street, E.C.4, offer "Advice Hardbacked" and "Standardized Trade Marks." Write for quotations.

RADIO SUPPLIES
- Bank of London, Ltd., 154, Hammersmith Road, W.12.
EXCLUSIVELY SPECIFIED

AGAIN a Hayberd Mains Transformer has been exclusively specified for Practical Wireless's latest Set—the "A.P. Leader 3." This Transformer was specially designed to meet the requirements of "Practical Wireless" Technicians. When making up this set, use the model selected by experts, and you will ensure perfect results.

MODEL LEADER 3, PRICE 16/-

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F. C. HAYBERD & Co.,
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LONDON, E.C.2.

EXCLUSIVELY

LONDON, E.C.2.
10, Finsbury St.,

PRACTICAL WIRELESS

HEAVEN & Co.,

" Practical Wireless "

FIT ANY VALVE

Whatever type of pins your valves may have you can be certain that the proper turned resilient sockets of Clix Chassis Mounting Valveholders will give you perfect full-surface contact—the more pins a valve has the more important it is that you should use Clix Valveholders.

The range includes:

FLOATING TYPE.
5-pin with terminals, 1/2... 1/2
4-pin with terminals, 1/2... 1/8

"Popular Valve," said—Efficient contact is assured at each pin—to obtain such a completely successful result with nine pins in an achievement.

STANDARD TYPES.
5-pin with terminals, 9d.
4-pin with terminals, 6d.

AIRSPRUNG TYPE.
5-pin with terminals, 1/2
4-pin with terminals... 1/2

All above models supplied without terminals for 3d. each.

LETTER FROM READERS

The Editor does not necessarily agree with opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

The H.F. Stage

Sir,—For the past year I have been perfecting my det. and L.F. set in range, selectivity, volume, and quality. Now I wish to add an H.F. stage without complications of extra tuning or without ganged condensers. I cannot find much information about this H.F. business and I speak for the average constructor. He knows a great deal about his L.F. amplifier and is greatly interested in the H.F. side, but gets no information whatever about it except tuned-anode, tuned-grid, etc. These involve extra tuning or ganging trimmers with their respective drawbacks. He also feels, as I feel, that when an L.F. amplifier has been perfected it should be added to an H.F. stage, without alteration to any of its parts. Consider the untuned aerial circuit of a short-waver with an S.G. valve. Or the untuned detector stage of a broadcast receiver. Keeping to simplicity more experiment should be made on these and similar lines, and a series of articles about H.F. would be a great impetus to such experiment and would be warmly welcomed by a large number of your readers. (Leith.)

[Various articles on the subjects mentioned have appeared in past issues of PRACTICAL WIRELESS.—Ed.]

A Universal A.C.-D.C. Leader

Sir,—I read with interest in the March 24th issue of PRACTICAL WIRELESS that a large number of readers are desirous of having a "mains" version of "The Leader," and that you have just had many requests for a D.C. version. Why not design a universal A.C.-D.C. circuit? There are many readers like myself who are in the unfortunate position of living in a town, one half A.C. and the other D.C., and the date for a complete change-over to A.C. in very uncertain. Universal valves have reached to a high standard nowadays and compare favourably with A.C. or D.C. standard valves. I am quite sure the "Leader" would be an ideal, inexpensive and reliable "Universal" set. —James Warx (Arothout).

[In the near future we hope to publish a design for a universal set in the "Leader" series which should prove as popular as our "A.C. Leader."—Ed.]

Schedule of W3XAL: A Correction

Sir,—With reference to Mr. Mann's letter in PRACTICAL WIRELESS dated March 24th, might I correct him on the schedule of W3XAL. Their new schedule is: W3XAL, Monday, Wednesday and Saturday, 10.0 p.m. to 6.0 a.m. G.M.T., 10,000 kc/s, 1,018 metres. The above particulars were given out during W3XAL's transmission on Monday, March 19th. Might I also agree with the remarks of "Quest" (Birmingham) in the same issue of PRACTICAL WIRELESS with regard to a special "Short-Wave Supplement."—J. F. Barnes (Foweyham).

Overseas Market for Wireless Receivers

Sir,—I was very interested in a letter signed J. Haynes, Pretoria, published in your issue of March 17th. I am afraid your correspondent will not get very much satisfaction from the British radio manufacturer. As one who has spent a number of years in the East and in Africa (South and East), and who has been in touch with wireless since 1913, I tried to interest manufacturers in the great market awaiting them abroad and, if only they could show a set capable of giving satisfactory reception, and offered to demonstrate sets in South Africa, Rhodesia, and the East African colonies as I was doing a trip through Africa. One manufacturer of receivers, and one of loud-speakers, sent me special overseas models to demonstrate and report on. The overseas listener prefers British receivers if he can get them, and knows they are suitable, but the R.M.A. is too conservative with local markets to enter those abroad, now being captured by American and Dutch competitors.—L. D. Goldie Johnson (Henley-on-Thames).

[We think our correspondent is unduly harsh in his criticism. It is within our knowledge that manufacturers have investigated the possibilities of the overseas market, but we understand that the matter is not so simple of solution as our correspondent seems to think. We think, also, that he has overlooked the fact that quite a number of manufacturers market receivers specially designed for overseas conditions, but the healthy market with which our correspondent seems to think was awaiting them has, we understand, not eventuated.—Ed.]

CUT THIS OUT EACH WEEK.

Do you know

THAT the A.V.C. section of a receiver may be adjusted by removing the back plate and inserting a length of wire in its place. This may then be moved to any position to give a "fading" effect.

THAT all decoupling components should be of the non-inductive type.

THAT bias may be applied directly to the grid of an H.F. valve through the medium of a grid leak and condenser.

THAT an indirectly-heated A.G. valve may be used "spade down," that is, with the cathode as the output side.

THAT an N.F. filter is often advisable in the A.V.C. line of a powerful receiver.

THAT a modern N.F. period may be used as a very efficient power-grid detector.

THAT to increase the harmonics and capabilities of a push-pull amplifier, two valves may be connected in parallel in each "leg" of the amplifier.

NOTICE.

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. 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 will be held under the title "Letter to the Editor," and correspondence from the British radio manufacturer. Ongoing to the rapid progress in the design of wireless sets, and to our efforts of publication in the periodical, we will give no warranty to apparatus described or features mentioned in our columns is not the subject of letters patent.
Components Tested in our Laboratory

EDDYSTONE SHORT-WAVE COILS

A LTHOUGH it is often stated in wireless journals that a discarded valve-base makes a good former on which to wind a short-wave coil, one would not expect to find a coil of such small size produced on a commercial basis. The Eddystone manufacturers (Messrs. Steddon & Co., Ltd., of Birmingham) have, however, produced some highly efficient coils of these dimensions and the illustration below, in which two such coils are shown in conjunction with a low-loss valve-holder, will give some idea of their size. The wires on the base are arranged in a standard 6-pin arrangement and thus the coils are adequately suited to plugging in to small coil-holders. The one shown in the photograph is one of these specially-designed coil-holders for use with these special coils on the short waves. The former on which the coils are wound is ribbed and of high-quality material, thus reducing losses and self-capacity to a minimum. The wire used is of the type and length that are to be found in coil wound with a .00015 mfd. condenser, and for a range of frequencies limited to a few cycles of a sine wave. It is wound on a coil to cover the bars from 22 to 47 metres, and is provided with a male terminal to cover from 4 to 14 metres, and from 17 to 170 metres. The special six-pin base which is illustrated costs 3s. 5d., and it possesses the novel virtue of having the socket and connecting points made from the same piece of material, thus avoiding losses due to a weak joint. The method of bringing out the connecting points in the manner shown enables in reducing losses and renders the holder highly suitable for use on the short waves.

MAGNÚS DUAL-RANGE COIL

A NEW type of dual-range coil of the unrotated type has now been produced by Messrs. Howes & Son, Ltd., and in illustrated below. Unlike many coils this has completely separate aerial coupling coils, which are employed on each wave-band, the long-wave aerial coil being wound in the form of a lattice winding on the lower end of the former. The aerial coupling coil for the medium waves is over-wound on the medium-wave grid coil, and the method of winding, the spacing, and the gauge of wire have all been so chosen that maximum results are obtainable on either band. Connection has to be made to the terminals arranged on the upper edge of the coil and these terminals are numbered for easy reference. We have not yet had the opportunity of thoroughly testing this coil in a receiver, but from the preliminary examination it would appear to be a very efficient component for a home-built receiver. The price is 2s.

"VOY"

THE THEREORE original name is applied to a product which is shortly to be marketed by Messrs. H. P. White & Co., of 14, New Malden, and is intended to be a convenient and inexpensive means of testing inductance values due to internal and external inductance. The inductance is provided with a .00015 mfd. condenser, and for a range of frequencies limited to a few cycles of a sine wave. It is wound on a coil to cover the bars from 22 to 47 metres, and is provided with a male terminal to cover from 4 to 14 metres, and from 17 to 170 metres. The special six-pin base which is illustrated costs 3s. 5d., and it possesses the novel virtue of having the socket and connecting points made from the same piece of material, thus avoiding losses due to a weak joint. The method of bringing out the connecting points in the manner shown enables in reducing losses and renders the holder highly suitable for use on the short waves.

GOLTONE LIGHTNING ARRESTER

IT is always advisable to connect an exposed aerial by fitting some form of static discharger, or lightning arrester, and this device is designed by Messrs. Ward and Goldstone of Pendleton, and has to be made to the terminals arranged on the former on which the coil is wound. The arrester is moulded with a six-sided ridge at the lower end of the former, and is non-rotatable. The base of both of these rods is finished dead flat and before the lower rod is screwed into position, the two central holes are drilled through the base and into the lower rod. The centre hole of the latter is sleeved with a brass tube, which is screwed tightly home it is insulating, and the latter is provided with large wing-nuts to facilitate the connection of aerial and lead. The base and former on which the arrester is mounted is designed to operate with 250 volts H.T. The normal arrester current is 40 ma. The A.C.2/Pen.D1. is a similar valve, with the addition in the same envelope of two diodes. It may thus be used for diode detection, with A.V.C., or without delay action. The makers do not recommend A.V.C. unless a separate valve for the negative grid is provided, as high frequency signals cannot be accommodated by the pentode section of the valve. The sensitivity, for example, is reduced by half in the output stage of the radio-frequency amplifier, and a low efficient H.F. filter should be provided. The 7-pin base of the circuit of the valve for this purpose is illustrated, and when the maximum undistorted output is obtained from the valve, the H.F. filter must be very complete and the makers strongly recommend that the several recommendations to ensure that this may be carried out should be followed. Such schemes as connecting the H.F. choke in series with the load resistance; a 0.001 mfd. condenser between anode and cathode of the output pentode; a resistance of the composition type between grid of the pentode section and the input circuit, etc., are a few of the points which may be noted. The undistorted output is found to be 3.400 milliwatts on the basis of 8 per cent. harmonic condition.

NEW BALDWIN CAPACITY BRIDGE

T HE Baldwin Instruments Co., Ltd., of 91, Belle Grove Road, Welling, Kent, have recently brought out an improved type of bridge which reads from 7 micro-ohm-reading to 5,000 micro-ohms with an accuracy of 0.10 per cent and a dead-beat reading. The accuracy of this instrument is guaranteed 0.10 per cent, and the price is £ 10.

MORE NEW EVER-READY H.T. BATTERIES

T HE Ever-Ready Company have just introduced four new micro-ohm-reading to 5,000 micro-ohms with an accuracy of 0.10 per cent and a dead-beat reading. The accuracy of this instrument is guaranteed 0.10 per cent, and the price is £ 10.

50 TESTED WIRELESS CIRCUITS

Edited by F. J. CAMM

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

By Your Technical Staff

COIL WINDING DATA

"If you have a transportable set made by Pye and using four valves, is it possible to use iron-core coils instead of air-core coils?"

W. J. W. (Horfield).

We would advise you to write to Messrs. Regentone Universal Coils has no connection internally, but is in electrical contact with the screening can.

ELIMINATOR FOR PORTABLE SET

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ELECTRICAL CONTACT..."

N. T. (Garden Town, W.V.1).

You do not state whether coils you have, and we could not therefore, give you the connection details. Furthermore, as we have repeatedly stated, we cannot give instructions for modifying our guaranteed circuits, as we can only give the guarantee when the circuits are built exact to specification.

CHASSIS FOR FURY FOUR

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We would advise you to write to Messrs. Regentone Universal Coils has no connection internally, but is in electrical contact with the screening can.

ELIMINATOR FOR PORTABLE SET

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PREMIER SUPPLY STORES

resistances and diagram, 120v, 20 m.a., 20/- ;
Screen-grid.

primary, 15/-
paper interleaved.

60 milliamps, 80 hys., 2.500 ohms, 5/-.
Super-Power, 2/6.

whether Aerial or H.F. required. Ditto iron core, 3/6.

C:

with screened primary, 15/-.

giving 200v. 30 111.a., 8/6.

L.T., 2/- extra;

26/-.

version kit for above types, 10/.

SPECIAL offer

PREMIER H.T.8. Transformers, 250v. 60 m.a.,
150-0-150v. 60 m.a., 4v. 3-4a., 4v. 2-3a.,
4v. 1-2a. (all C.T.), 10/-.
500v. 120 ditto, 6/6.
Dario Battery Valves 4v.

2,500 ohms, 12/6; D.O. 152 Magna, 2,600 ohms,
all complete with humbucking coils ;

AMERICAN Triple Gang 0.0005 Condensers, with
multi -radio input

Speaker.

With Switch-controlled multi-radio input

CLASS 'B' Drivers and Chokes, 9/6 per pair, with

UNILATERAL Interchangeable Leads

93/11/0.

Cash or C.O.D.

W. B. P. M. C.

MIXING - COIL SPEAKER

SENt ON 7 DAYS' TRIAL
Complete Class B Amplifying Units, Valve
Valve.

only 6/- for 7 days' trial. If accept,

or C.O.D. Paid Cash or C.O.D.

in 8 monthly payments of 4/9.
Cash or C.O.D. Paid

VY

sine no. 5-6.

LI.M.V. Block Condensers, 400v. working; 4 x 4 x
1 x 1 x 0.5, 4/6.

Mains Transformers, Input

transistor. 0-100, 0-10, 0-50,
0-100, 0-50, 250,000

KOLSTER-DRANDES Mains Transformers, Input

3191110.

KOLSTER-DRANDES Mains Transformers, Input

150-0-150v. 60 m.a., 4v. 3-4a., 4v. 2-3a.,
4v. 1-2a. (all C.T.), 10/-.
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500v. 120 ditto, 6/6.
Dario Battery Valves 4v.
It simplifies all Soldering

All transistors sell Fluids in time, 6d.; 303, 9d.; 12d., 1d. 6d. Ask to see the FLUXITE PAGE SOLDERING SET—come with full instructions—1s. 6d. Ask also for our leaflet on HARDENING STEEL.

FLUXITE, LTD. (Dept. W. B.), BERMONDSAY. S.E.1.

For All Repairs!

Absolutely Accurate

Moving Iron Meters.

The unifying standard of all Radio Technicians and Enthusiasts. Easiest to read. New, ingenious interruptor; scaling divisions sharply defined, while cellular division. All parts individually tested and every set guaranteed.

Write for Full Details of complete range.

SIFAM ELECTRICAL INSTRUMENT CO., Ltd.
York Works, Browning Street, London, E.1. E.T.
Telephone: Roman 3073.

UTILITY SALES CO.

27a, Bale Street, London, W.2.

Screened I Core Coils—Guaranteed first class. Cash when ordered or being. We pay no agent’s commission.

For all voltages, 10/6 (list 39/6).


Wanted good Modern Wireless Parts, Sets, Eliminators, Meters, Valves, Speakers, etc. Send or bring. We pay more than any other dealer. Open 9-8. University Radio, 142, Drummond St., Hampstead Rd., N.W.1.

"We're Fluxite and Soldering—like reliable your firm. Fancy "FLUXITE" over your business—"a good spot of work!"

See that Fluxite and Solder are always by you—on the house—garage—workshop—wherever some, speedily working in needed.

ALL MECHANICS WILL HAVE

FLUXITE

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ALL MECHANICS WILL HAVE

FLUXITE
\[
\begin{align*}
\text{THE 'GOLD-MINE STORES'} &
\text{Offer You 'The A.C. Leader III', 49/6, post free, for a week only, with special
\text{words for you and the C.O.D.'s!}}
\end{align*}
\]

Your satisfaction complete or money returned without question.

E X A C T T O SPECIFIED VALU ES T H R O U G H
\text{outstanding \#40921 A.C. Leader III (C.O.D.), model, are made up exact to specified values through use of high class chassis, with usual number of standard.
\text{components.}}

W E G U A R A N T E E Y O U ' S A T I S F A C T I O N \text{so why pay more? We will send on full approval samples at our own cost.'}

B U I L D T H E A.C. LEADER III, KIT A, at 60% \text{fasted. -Complete to the last, with $100,000 worth of PRACTICAL WIRELESS. Post paid 49/6; battery model, 25/6. Please note price first advertised in PRACTICAL WIRELESS, March 3rd, we have not had one battery kit returned, and now for the A.C. model, which is just as good.

B U I L D T H E A.C. LEADER III, KIT B, as above, but with matched set of three (and (3) transformers, all components, sundries, blueprint and copy of PRACTICAL WIRELESS.

It is just as good.

\text{THE 'GOLD-MINE STORES' PRACTICAL WIRELESS, March 3rd, we have not had one battery kit returned, and now for the A.C. model, which is just as good.}

B U I L D T H E A.C. LEADER III, KIT C, as above, but with matched set of three (and (3) transformers, all components, sundries, blueprint and copy of PRACTICAL WIRELESS.

We GUARANTEE YOUR SATISFACTION so why pay more? We will send on full approval samples at our own cost.'

PRACTICAL WIRELESS, March 3rd, we have not had one battery kit returned, and now for the A.C. model, which is just as good.

We GUARANTEE YOUR SATISFACTION so why pay more? We will send on full approval samples at our own cost.'

THE 'GOLD-MINE STORES' PRACTICAL WIRELESS, March 3rd, we have not had one battery kit returned, and now for the A.C. model, which is just as good.

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PRACTICAL WIRELESS

April 14th, 1934

IF your set ought to get Rome - but nearly expires bringing in the local Regional

don't be puzzled find out why

The reason for this lack of ambition may be due to weak valves, run down accumulator or any other cause. Whatever it is - you'll soon find out with a Pifco Trouble Tracker. Every component in radio can be tested quickly and surely by these wonder instruments. Don't endure faulty reception any longer. If trouble starts - solve the problem immediately with a Pifco Trouble Tracker.

Ask your dealer or electrician for a demonstration of a Pifco.

- PIFCO DELUXE "ALL-IN-ONE" RADIOMETER (right). Moving coil model. 150,000 ohms resistance. Tally accurate. For electric radio, mains units or battery sets. Finished mattised bakelite, none plate with leads and case. Price £2 5/6.

PIFCO ROTAMETER. A radio testing instrument on entirely new principles. One needle operates on 8 separate dials. For electric or battery sets. Amazingly handy and accurate. No other instrument in the world like it. In black bakelite. Complete with leads. Price 2/9.

Issued by PIFCO LTD., HIGH ST., MANCHESTER, and 12, Cheapside, Cross Road, London, W.C.2.

INSIST ON A PIFCO AND SAVE TROUBLE.

PIFCO Trouble Trackers

P.W. Gift Stamp No. 15

---

The NEW MAGNET

Send for Catalogue

PR. 1.

CHASSIS PRICE

70/-

The magnetic material is enclosed in four chrome-plated tubes. The high flux density and many other special features give a hitherto unattainable degree of power and quality.

- UNIVERSAL MATCHING
  The transformer is designed on simple and highly efficient lines and is arranged to match ANY OUTPUT STAGE from Power to Push-Pull Pentode and Class B. It can be used under all conditions and with any type of speaker coil without loss of efficiency. Full instructions on back plate of speaker.
  - ON-OFF SWITCH OR REMOTE VOLUME CONTROL
  A switch plug is provided to cut speaker out of circuit when desired. This switch is interchangeable with Blue Spot Remote Volume Control Unit.
  - EXTENSION SPEAKER SOCKET
  A socket is provided for an extension speaker to be plugged into the Blue Spot "Star".
  - DUST PROOF
  The cap in the center of the case and the special dust covers which surround the speaker coil and speaker gap render the speaker completely dust proof.
  - DIE CAST CHASSIS
  Ensuring no loss of magnetism, complete rigidity and absence of chassis resonance.
  - SPEECH COIL
  Low resistance and high efficiency giving minimum variation of impedance with frequency. The entire new design of outside suspension gives great freedom of movement with complete linear fidelity.

Blue Spot "Star" - the speaker with the new magnet will cause a sensation in the Radio World. Its performance is at present a standard to the Moving Coil Speaker on the old balanced armature speakers of a year or two ago.

- NEW MAGNET SYSTEM
  The magnet material is enclosed in four chrome-plated tubes. The high flux density and many other special features give a hitherto unattainable degree of power and quality.

- UNIVERSAL MATCHING
  The transformer is designed on simple and highly efficient lines and is arranged to match ANY OUTPUT STAGE from Power to Push-Pull Pentode and Class B. It can be used under all conditions and with any type of speaker coil without loss of efficiency. Full instructions on back plate of speaker.

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P.W. TOOL-KIT GIFT STAMP No. 7

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BRITAIN'S GREATEST RADIO VALUE

INCORPORATING EVERY WORTH-WHILE RADIO DEVELOPMENT

Variable-mu Screened Grid Circuit for range and selectivity—high-efficiency fully-screened coils—single dial tuning—gun-finished all-metal chassis—these are but a few of the many advanced features of the impressive specification of the Cossor Melody Maker. This fine, up-to-date Receiver will bring you the best European stations free from interference. It costs no more than the bare price of its parts. By assembling it at home you can save pounds. Send at once for Constructional Chart which gives full details—please use the coupon.

To A. C. COSSOR LTD.,
Melody Dept., Highbury Grove,
London, N.5.

Please send me a Constructional Chart which tells me how to build a Cossor Melody Maker.

Model:

State Model No. required.

Name:

Address:

PRACTICAL WIRELESS
April 21st, 1934

FIVE MAGNIFICENT MODELS

BATTERY MODEL
KIT 340
POWER OUTPUT
Moving Iron Cone Type Speaker

Complete Kit of Parts, including Cossor Variable-mu S.G., Detector and Power Output Valves, and all necessary parts. Dimensions: $135\times\frac{3}{4}\times10\$". space for batteries and accumulator. Moving Iron Cone Type Speaker, provision for gramophone pick-up plug and jack. Switches for Long and Short Wave-lengths. Price £5.7.6

Hire Purchase Terms: 10/- deposit and 9 weekly payments of 12/-

BATTERY MODEL
KIT 241
Pentode Output

Complete Kit of Parts, similar to Kit 340, but with Cossor 2W2PPT, Economy Pentode Output Valve. Balanced Armature Loud Speaker. Price £6.7.6

Hire Purchase Terms: 10/- deposit and 9 weekly payments of 12/-

BATTERY MODEL
KIT 342
MOVING COIL SPEAKER

Complete Kit of Parts similar to Kit 341, except that it is supplied with a permanent Magnet Moving Coil Speaker. Price £7.2.6

Hire Purchase Terms: 17/6 deposit and 9 weekly payments of 15/-

BATTERY MODEL
KIT 344
CLASS "B" OUTPUT

Complete Kit of Parts as model 341, but with four Cossor A.C. Mains Valves, Class "B" Output Stage and Permanent Magnet Moving Coil Loud Speaker. Price £8.2.6

Hire Purchase Terms: 20/- deposit and 9 weekly payments of 15/-

Prices do not apply in I.F.S.

ALL-ELECTRIC MODEL KIT 347

Complete Kit of Parts similar to Model 341, but with four Cossor A.C. Mains Valves (incl. Rectifier), Power Unit and Mains Energised Moving Coil Loud Speaker. For A.C. Mains only 200/250 volts (adjustable), 40/400 cycles. Price £8.19.0

Hire Purchase Terms: 20/- deposit and 9 weekly payments of 15/-

Prices do not apply in I.F.S.
Another £5 5s. for Bifocalists!  See Paragraph Below.

Round the World of Wireless

Our Bifocal Competition—Further £5 5s. for the Winner!

The winner of our Bifocal Competition (the details of which are repeated elsewhere in this issue) will receive a further windfall of £5 5s. in the event of his bifocal coil having been purchased from Messrs. Peto-Scott, Ltd., who have very kindly donated this additional amount to augment the Twenty Guineas which we offer as a first prize. So Peto-Scott customers have a chance of winning Twenty-five Guineas! All readers, from whatever source they obtained their bifocal coils, stand an equal chance, of course, of winning our Twenty Guineas, or one of our 200 Consolation Prizes. We tender our thanks to Messrs. Peto-Scott, Ltd., for their friendly gesture, which is a further tribute to the manner in which the radio components manufacturers co-operate with us.

The Making of an Interval Signal

The few notes which may be heard between items of programmes broadcast by the Hamburg station are produced by a cylinder of a type similar to that used in the toy musical boxes. It is studded with pins which, on revolving, strike small metal tongues of which the sounds are picked up by a microphone placed near the apparatus. The cylinder is electrically driven and can be put into action by a switch at the announcer’s desk.

A Shakespeare Play from Stratford-on-Avon

For the first time in the history of broadcasting listeners will be given the opportunity of hearing a Shakespeare play: Love’s Labour Lost, as performed on the stage of the Memorial Theatre at Stratford-on-Avon. It is given in celebration of the anniversary of the Bard’s birthday.

France combats Electrical Interference

In France the Anti-Static Law governing electrical and other similar parasitic interference came into force on April 1st. From that date anyone exercising the reception of radio programmes is liable to prosecution by the police authorities. Is it not a similar move which was made in Great Britain?

New B.B.C. Malda Vale Studio

Work on the Malda Vale studios is proceeding apace, and it will not be long before the B.B.C. will find there a new and possibly permanent home for its National Symphony Orchestra. The main studio to be used for these concerts is much larger than the concert hall originally built for the purpose at Broadcasting House; its dimensions are 116ft. long, 72ft. wide and its height 36ft. When completed, it will be one of the finest studios in the world.

New German Transmitter

Work on the new 1.5 kilowatt Stettin relay station is nearing completion and it is expected that it will be brought into operation in the course of the next six weeks. Contrary to a previous report the station will not work on the German common wave but will share the Hamburg channel, namely 331.9 metres (904 kilocycles), with which transmitter it will be synchronized.

Further Aid to Identification

In future, notwithstanding the similarity of language, it will be possible to discriminate between German, Austrian, and Swiss-German broadcasting as the German call will make the matter perfectly clear. All announcements from that country will be preceded by the call which will include the word Reichsender followed by the name of the city or town in which the studio is situated. You will hear: Reichsender Berlin, Hamburg, Broslav, and so on, as the case may be.

Europe’s First Broadcast Programme

Although many countries have annually celebrated the anniversary of the adoption of broadcasting it was left to Belgium, on March 28th, last, to give listeners a faithful copy of what was, we believe, the first radio programme heard in Europe twenty years ago. As a result of the keen interest shown by the late King Albert of Belgium in radio matters, some Brussels engineers constructed a transmitter in the grounds of the Laeken Palace near the Belgian capital and broadcast their first programme on March 28th, 1914. The entire installation was dismantled and destroyed on the approach of the German Army some few months later. In their faithful copy of this early programme Brussels reproduced the sound of the toy trumpet used as an opening and interval signal preceding the station call and, as was also customary, repeated all announcements twice, very slowly.

Three-quarter Mast Only!

Although signals from the new 100-kilowatt Mühlecker transmitter are much stronger than hitherto, the full benefit of the increased power will not be derived for another month or so. The aerial tower designed to reach the height of 190 metres has not yet been completed owing to stress of weather, and the actual aerial has been connected to the 120 metres mark. The extra additional height to be used later, it is stated, will make an appreciable difference.

What is my Position?

Known as the Marconi-Adcock System, new direction-finding apparatus for aircraft has been installed at Lympne Airport following a three years’ test at Pulham (Norfolk). In the event of an air pilot requiring assistance in regard to his position, bearings on his wireless signals are taken simultaneously at Croydon, Lympne, and Pulham, and the readings are transmitted to the London Airport, where they are plotted on a map. Within a few seconds the Control Tower is able to give the necessary information. Under the new system a much higher degree of accuracy has been obtained, especially at night.

Vol. IV. No. 43    April 21st, 1934

Editor: F. J. CAMM    Technical Staff: W. J. Delany

H. J. Barton Chapple, Wh.Sch., B.Sc. (Hons.), A.M.I.E.E., Frank Preston, F.R.A.
ROUND the WORLD OF WIRELESS (Continued)

PRACTICAL WIRELESS
April 21st, 1934

TWO performances of Lehár's successful comic operas *Friedreich* will be broadcast on April 29 (National) and 24 (Regional). Richard Tauber, the famous German tenor, will sing in German, but for the actual dialogue will use the English language.

Richard Tauber on the Air

**INTERESTING and TOPICAL PARAGRAPHS**

*The World's Highest Aerial Pylon*

ALTHOUGH the new Budapest single aerial mast is higher than the Eifel Tower mast does not set the record as the loftiest construction, which is still retained by the Empire State building at New York. From insulator to summit the Romanian tower reaches 314 metres (1,036 ft.). At roughly 800 kft., it is equipped with an automatic meteorological station with recording instruments for temperature, atmospheric pressure, direction and strength of wind, and rainfall gauge, on a similar principle to the Leningrad installation. This gigantic structure is capped by an illuminated crown consisting of electric lamps of several hundred thousand candle-power, as a warning to aircraft.

**Solve this!**

**Problem No. 83**

March made up a three-valve receiver and operated it from a small house-made mains unit. Unfortunately, the set was unstable, and he traced the trouble to the fact that no part of the circuit was decoupled. He accordingly obtained a 20,000 ohm wire-wound resistance and a two microfarad condenser, and joined the resistance between the H.T. positive terminal of the set and the eliminator, with the condenser joined from the H.T. positive terminal to earth. This did not prevent the trouble. Why? Three books will be awarded for the first three correct solutions opened. Address your attempts to *The Editor, PRACTICAL WIRELESS*, 61, Southampton Street, Strand, London, W.C. 2. Envelopes must be marked Problem No. 83, and must be posted to reach here not later than the first post April 22nd.

**Solution to Problem No. 82**

The underside of the chassis for the Fury Four Super unit was of plain wood, and two component brackets were mounted on this. When Jackson covered this side with aluminium foil he omitted to insulate the two brackets and, consequently, the reaction condenser was shorted, and also the anode circuit of the detector valve. The following three readers successfully solved Problem No. 81. Two books will accordingly be forwarded to them:-

Mr. E. O'Byrne, 14, Carlton Road, Godley, Hyde, Cheshire.
Mr. G. Spencer, 106, Queen Street, Grimsby.
Mr. T. L. Hiles, 45, Gordon Road, Belford, Kent.

**How Unlicensed German Amateurs are Strangled**

NEW licences have been granted to German short-wave experimenters; according to a recent decree, any person transmitting without permit, whether telegraphy or telephony, is liable to a prosecution for high treason.

**Future of Radio Alger**

A recent meeting of the Algerian Broadcasting Committee, a proposal was put forward to install in the neighbourhood of Algiers a high-power transmitter capable, if necessary, of 200 k.w. output. Composed of an aerial system carried by pylons 600 metres in height, broadcasts would be made accessible to the greater part of Southern and Western Europe.

**Radio Exhibitions**

THE dates of the three main radio exhibitions to be held in Great Britain this year have been fixed as follows:--

- Olympia, from Thursday, August 16th, to Saturday, August 25th.
- Glasgow, Friday, August 31st, to Saturday, September 8th.
- Manchester, from Friday, September 14th, to Saturday, September 22nd.

**Technical column**

**Police "Cops"**

POLICE patrols of Los Angeles (Cal.) have been equipped with small portable wireless receivers to permit them to keep in touch with headquarters. The instrument is carried on a belt around the waist, the aerial being fitted in a triangular strap, in rucksack fashion, which supports the equipment.

**A Novel Cabinet**

This illustration shows how a reader overcame the difficulty of building a cabinet to present an unusual appearance. It is modelled on an organ.

**PRACTICAL WIRELESS**

April 21st, 1934

ROUND the WORLD OF WIRELESS (Continued)
AN ULTRA-SHORT-WAVE CONVERTER

Full Constructional Details are Given for an Efficient and Inexpensive Unit for Use in Conjunction with an Ordinary Broadcast Set to obtain Reception on Wavelengths between 5 and 8 metres.

By H. J. BARTON CHAPPLE, Wh.Sc., B.Sc., A.M.I.E.E.

There are many amateurs working on the 5-metre wavelength, and in addition it is public knowledge now that the B.B.C. are conducting ultra-short-wave television experiments on 7.75 metres. Added to this, we have the independent experiments being conducted by the Baird Company from the south tower of the Crystal Palace on a wavelength of about 6.25 metres.

A Simple Scheme

One way of carrying out your ultra-short-wave reception is to make up a special receiver, but another alternative is to add a unit to your own home radio set for the job. It is this latter method which I propose to deal with in this article, the "U.S.W. Converter" being a home-built converter which is linked to the aerial side of the receiver.

Fig. 1 shows the theoretical circuit used. There is really nothing specially novel in the circuit; the prime features are in its method of construction and use. It works on the super-heterodyne principle and must be employed with a radio receiver having at least one stage of high-frequency amplification. First of all, there is a small variable condenser C1 in series with the aerial feed. This not only cuts down the load on the aerial tuning, but is very useful for overcoming any "blind spots" that may be encountered. L1, L2 is the usual tuned-grid feed.

Fig. 3.—This drawing gives all panel dimensions and will be useful in drilling the ebonite.
(Continued from previous page.)

**Constructional Work**

Fig. 4 shows the component lay-out, and by using this in conjunction with the photographs on the front cover the constructional work should prove very straightforward.

One of the golden rules in ultra-short-wave work is to keep all leads as short as possible, especially those in tuning, grid and plate circuits. In consequence the tuning coil is mounted direct on the variable condenser, while to overcome hand capacity effects the operating controls are remote from the condensers. As we are dealing in such extremely high frequencies—five to six million—a very minute trace of stray capacity can materially upset performance.

**Layout and Wiring**

First of all take the baseboard and, after having mounted each condenser on its vertical aluminium screen, position the screens accurately according to the illustration given below. Now mark out the positions of the three legs which support the receiver, is held on a Bulgin right-angle bracket (type E.H.5) as also is the filter condenser. All this is shown in Fig. 4.

In wiring, note that both the grid leak and condenser are soldered direct to the circuit, while to overcome hand capacity effects the operating controls are remote from the condensers. As we are dealing in such extremely high frequencies—five to six million—a very minute trace of stray capacity can materially upset performance.

**The Aerial System**

Join a 2-volt accumulator across the pair of H.T. terminals and a 100-watt H.T. battery across the two H.T. terminals. Disconnect the aerial and earth leads from the radio receiver and join them to the pair of converter terminals so marked.

It will be necessary to link the combined H.T.—L.T.—points of both unit and set, and finally to join the aerial terminal to the aerial terminal of the set. Bear in mind that if the set has a series aerial this should be shorted out when employing this unit.

Between 10 and 15ft. of wire, as a rule, is ample for the aerial, and better results will sometimes be obtained by dispensing with the earth connection.

**Operation**

The Eddystone I.F. coupling unit has a variable tuning range from 240 to 550 cycles or vice versa from the well-known formula:—

\[ \text{Wavelength} = \frac{300,000}{f} \]

Having chosen one setting on the receiver, preferably where no ordinary radio transmission can be heard, turn the I.F. unit knob to about the same setting and switch on the converter by means of the rotary on-off switch at the back. Set the tuning dial at zero and then bring the unit into a state of oscillation, after which turn the reaction control knob on the right. Remember that tuning on the ultra-short waves is exceedingly fine and it is quite easy to miss transmissions.

This was the main reason for including a two-ratio slow-motion dial, the outer knob giving an 8 to 1 reduction for "rapid" tuning (this term is only used in a comparative sense) search, while the inner one gives a one to one reduction for very accurate tuning. Each ultra-short-wave transmission will be heard in the loud-speaker at two distinct settings of the dial (this, as readers know, is usual in the superhet type of reception), and it may be found that one setting gives either better results or greater freedom from interference than the other.

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**LIST OF COMPONENTS FOR ULTRA-SHORT-WAVE CONVERTER**

- One Ultra-Short-Wave valveholder (Eddystone).
- One I.F. Coupling Unit (I.F.U.) (Eddystone).
- One Skeleton Short-Wave H.F. Choke (H.F.C.) (Bulgin).
- One Combined U.S.W. Coil and Reaction Coil (Bulgin).
- One Neutralizing Condenser (Ci) (Jackson).
- Two .0001 mfd. Short-Wave "Special" Condensers (C3 and C4) (Jackson).
- One 4 in. Extension Shaft (Bulgin).
- Two Right-angled Brackets, Type E.H.5 (Bulgin).
- One .0001 mfd. Type 665 Condenser (C1) (Dubilier).
- One .002 mfd. Type 673 Condenser (C2) (Dubilier).
- One Type B Terminals, Aerial, Earth, H.T.—, L.T.—, and L.T.—, (Belling and Lee).
- Three Terminal mounts (Belling and Lee).
- One Rotary on-off switch (H.F.C.) (Bulgin).
- Two Aluminium Screen Brackets (Jackson).
- One Ebonite Panel, 12in. by 7in. by 3.16in. (Peto-Scott).
- One Wooden Baseboard, 13in. by 12in. by 3.14in. (Peto-Scott).
- One Pair Panel Brackets (Peto-Scott).
- One 3-megohm Grid Leak, Wire Ends (R1) (Dubilier).
- One PM 2DN Valve (Mullard).

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March 21st, 1934

PRACTICAL WIRELESS
CONSTRUCTION AND ACCESSIBILITY

Some Considerations and Methods of Achievement

By W. H. DELLER

April 21st, 1934

PRACTICAL WIRELESS

137

Layout of Controls

However well made and finished a set may be, the one thing that can make or mar the appearance is the layout of the controls. For convenience in handling, control knobs should be grouped together, and for appearance they are arranged symmetrically. It is naturally desirable also to cut the number of controls down to a minimum, always bearing in mind, of course, the requirements of the circuit.

Selection of Components

Much can be done in this direction by the careful selection of components. A typical example is to be found in the ganged coil unit incorporated in the set photographed in Figs. 1 and 2, as embodied in this component is a combined wave-change and filament switch. These coils, and the necessary arrangements for switching, are mounted on a channel section metal chassis, screw holes being provided for fixing purposes.

Fig. 3 is a sketch showing the relative positions that the switch and tuning and reaction condenser knobs would occupy if the coils were mounted as originally intended. From this it is apparent that the arrangement would be unsymmetrical, and that to put matters right either the left-hand knob requires raising or the right-hand one lowering. To do the former it would be necessary to raise the coil chassis up on packings, but this would have the disadvantage of seriously increasing the head room required for the screening cans. Owing to the type of construction employed in this instance, it would not be possible to lower the position of the reaction condenser owing to its close proximity to the baseboard.

These difficulties were overcome by mounting the coils as shown in Fig. 4. Two holes were drilled in the web of the channel base for fixing bolts, with large dia. dia. distance pieces between the edge of the chassis and baseboard, to permit wiring to pass between. This arrangement does not hamper the operation of wiring or subsequent inspection; in fact it makes for accessibility.

Baffle-boards

To secure results approaching perfection from a loud-speaker of the moving-coil type it must of necessity be mounted on a large and fairly substantial baffle-board. While this presents no difficulty where the speaker is to be entirely separate from the set, the size of the baffle-board must necessarily be restricted when the speaker is mounted in the cabinet with the set in the usual manner.

The speaker in the set illustrated in Figs. 5 and 6 is mounted in a COILS MOUNTED AS INTENDED

This is an arrangement that is easily adaptable to almost any shape of cabinet, and is one that is worth bearing in mind. The board, by the way, is not attached directly to the framework, but is mounted with rubber buffers at the corners. The effect of these is to damped the mechanical vibration set up by the speaker, and which, if allowed to travel unchecked to other parts of the set, is bound to seriously affect the quality of the reproduction.

Accessibility

The rapidity with which troubles may be traced and rectified as and when they arise largely depends upon the arrangement of components and method of construction adopted. Therefore, for this reason only, it is best to avoid, where possible, an arrangement in which control knobs have to be removed before the complete chassis can be withdrawn from the cabinet.

For ease in wiring and subsequent tracing of troubles components are most conveniently situated if they are all disposed on the upper surface of the chassis.

(Continued overleaf)
OUR GREAT NATIONAL COMPETITION
TWENTY GUINEAS FIRST PRIZE, 200 CONSOLATION PRIZES

MESSRS. PETO-SCOTT LTD. OFFER A SPECIAL PRIZE OF £5.5.0

CONSTRUCTION AND ACCESSIBILITY
(Continued from previous page)

With a battery-operated set one important consideration is that the batteries require fairly frequent attention. Most sets are finally situated with the terminal box built into a wall, and where the only way of getting at the batteries, either for replacement of low tension or adjustment of high tension, is via the back of the cabinet, the set has to be screwed round for this purpose.

To obviate having to do this, provision might be made to house the batteries in wings on either side of the cabinet. How convenient such an arrangement can be is readily discerned by reference to Fig. 7. This method has the added advantage of keeping the accumulator away from the metal work inside the set, but even so it is as well to provide a metal tray for it to stand in.

Where both or several L.T. batteries in use are of the same make and capacity a pair of rigid connectors can be provided. These are made from tin by 16 gauge copper strip. Two pieces are cut and bent L shape, the short ends being drilled for fixing screws, and the long ends slotted to pass under the terminals. These are screwed to the inside of the cabinet in appropriate positions, the distance between the centres being equal to that of the accumulator terminals. The leads from the set should be provided with substantial tag ends and secured under the screw heads holding the copper strips.

Addition or Conversion
This form of cabinet lends itself admirably to alteration for the addition of a gramophone. In cases where such a step is anticipated the top could be made detachable for the purpose.

The battery compartments also would serve to hold a metal rectifier and transformer in cases of conversion to all electric.

CONSTRUCTION AND ACCESSIBILITY

WHILST it is true that the Bifocal coils may be fitted to practically any circuit without alteration, it is necessary, as with all things, to adopt some method which will enable the device to prove its worth. Just as it is useless to fit a good expensive moving-coil loud-speaker to a 4-year-old one-valve set, so it is a waste of time to fit these new aids to selectivity to a collection of old worn-out parts slung together and operated from a run-down H.T. battery. Remember that these coils, with their ingenious method of varying the coupling by means of a simply operated plunger, can show a real improvement on the methods which are at present employed for selectivity purposes. You should, therefore, adopt a circuit arrangement chosen from one of those which were illustrated last week and build up this circuit from really good parts. Do not be tempted to use some old parts which have been knocking about in your junk box, or which are offered at ridiculous prices by second-hand stores.

Using the Coils

It should be unnecessary to give detailed instructions for using these coils, as they make no difference whatsoever to the operation of the receiver. Therefore, the usual arrangement of station selection—ignoring the Bifocal coil adjustment—is carried out so that the accurate tuning point is located, and if necessary the reaction control is adjusted to provide the required strength of signal. Then, if required, the focusing adjustment is made. Thus, if interference is experienced, the plunger is moved until the trouble is overcome, and, owing to the design of the Bifocal coils, this may be carried out without any necessity for retuning or altering the reaction setting. Similarly, if when the station is received it is found that it is too weak, owing to the looseness of the coupling, this may be tightened by operating the Bifocal plunger, the normal tuning adjustment being carried out in the usual manner. It will thus be seen that there is nothing to learn and nothing difficult to do when a new aid is adopted in to augment an existing focusing scheme, and, provided the receiver is of good design, and used in conjunction with a sound aerial and antenna system, the results cannot fail to prove highly satisfactory.

Messrs. Peto-Scott's Offer

In connection with this competition, we have great pleasure in announcing that Messrs. Peto-Scott have made an additional offer of a prize of Five Guineas for the winner of our Twenty Guineas prize, should the Bifocal unit used by him have been purchased from that firm. We are sure that our readers will welcome and appreciate the enterprise and co-operation which is being shown by Messrs. Peto-Scott in this connection.

CAREFULLY READ THESE RULES.

(1) The First Prize of 20 guineas each will be awarded to the sender of what the judges (presided over by the Editor of "Practical Wireless") consider to be the best test report of actual experiences with the Bifocal coil. Test reports must be written on one side of the paper only and must not exceed 250 words in length. Each entry must be accompanied by a query coupon cut from any issue between April 14th and May 5th.

(2) Test reports will be awarded to the senders of the 200 next best test reports. Each entry must be accompanied by proof of purchase of a Varley Bifocal coil, such as the receipt from Messrs. Varley, Ltd., or a receipt from your local dealer.

(3) Competition entries must be received here not later than May 14th. Results will be given in "Practical Wireless," dated May 26th.

(4) Test reports must be written on one side of the paper only and must not exceed 250 words in length. Each entry must be accompanied by a query coupon cut from any issue between April 14th and May 5th.

(5) This competition is only open to readers of "Practical Wireless," and each entry must be accompanied by a query coupon cut from any issue between April 14th and May 5th.

(6) Test reports may be accompanied by a query coupon cut from any issue between April 14th and May 5th.

(7) No correspondence can be entered into regarding this competition.

(8) The Editor's decision is final and legally binding and is an express condition of entry.
Practical application of the static loud-speaker is of comparatively recent origin, but its fundamental principle dates back as far as fifty years. Edison and others were working on the problem without obtaining satisfactory results. The first static speakers which were used in practice were constructed by me and my two friends, Dr. Engl and Joseph Massolle, who produced the first sound films of the world shown in Berlin in the Alhambra Theatre with static speakers. Also, the first "Electric Telecon-" on May 5th, 1923 (before broadcasting was introduced) in "Hochschule für Musik" in Berlin was realized by means of statophones. These first loud-speakers, however, showed several drawbacks, and therefore were ousted very soon by the moving iron and moving coil speakers, developed later on.

The drawbacks were not of a fundamental nature, but were due to imperfect arrangement and construction. After having dropped the sound-film matter, due to the lack of interest shown at that time by the film industry, I could not imagine any object more interesting for investigation than the static speaker. Theoretically speaking, this principle undoubtedly offers the best conditions for constructing a loud-speaker for absolutely faithful reproduction. There is no paper cone, with its inertia and complicated acoustic conditions, and the extremely light diaphragm is impelled on its whole surface directly by the static field, and must therefore strictly follow even the finest shades of tones without distortion.

The Principle of the Static Speaker

The speaker is nothing more than a condenser, one plate of which is arranged in form of a "freely oscillating " diaphragm, oscillating on the whole surface. The other, resting electrode, diaphragm, and resting electrode are all working from one side only, the diaphragm will swing in a distorted, non-symmetrical way. Accurate oscillation of the condenser speaker, therefore, requires constant initial voltage only is required, which is obtained from a very small step-up transformer connected directly to the mains, behind which a cheap half-wave rectifier tube is inserted.

By HANS VOGT
"supported diaphragm" arrangement, a lower modulation voltage and initial voltage is admissible.

The Supported Diaphragm

The difference between the supported diaphragm arrangement and the freely-oscillating diaphragm arrangement is made clear in Figs. 4 and 5. In Fig. 4 is shown a supported diaphragm of rubber or similar material, which is supported by the resting electrode and oscillating in the form of many parallel diaphragms only. Fig. 5 represents a freely-oscillating diaphragm, oscillating over its total surface. The supported diaphragm arrangement offers the advantage that it is easier of operation, and that, as mentioned, due to the small possible electrode distance, the alternating voltage and so the constant initial voltage can be kept rather low. Another question, however, is whether it will be satisfactory from an acoustic standpoint. The fact is that the amplitude motions of the diaphragm are very small in this case, and therefore it will got be possible to get low tones, which require a large oscillating diaphragm surface. Furthermore, the high tones are not so well reproduced, because the diaphragm cannot oscillate freely, as it is prevented from very rapid oscillations by the support of resilient material on which it is resting. The highfrequencies in this respect are of a fundamental nature, and therefore induced me definitely to adopt the freely-oscillating diaphragm system. Although with this system there were many more technical problems to be solved, the fundamental conditions in acoustic respect are much better in principle. The low tones can be reproduced very well, as the diaphragm is oscillating over its total surface with great amplitude. The high tones are, of course, likewise excellently reproduced, as the diaphragm is extremely light and can freely oscillate.

The Difficulties

There were two principal difficulties to be overcome in the material of the diaphragm and the construction of the resting electrode. The attraction force varies inversely with the square of the electrode distance, and therefore, when the diaphragm is attracted, the attraction force will grow more and more and cause the diaphragm to fall against the resting electrode. This must be prevented by a fairly high mechanical initial tension of the diaphragm, which is able to exert an equivalent counter-force. In addition, the diaphragm must be highly elastic to obtain great amplitudes, and it must be very light in weight to prevent inertia. There was no available material found to be suitable. Therefore I developed a special foil alloy, mainly consisting of aluminium and silicon, with small additions of magnesium, iron, and copper. The alloy is rolled out after a special rolling process to improve the tensile strength and elasticity and to obtain foils of 0.016 mm. thickness. Small metal foil has the tensile strength of steel, but one-third of the weight of steel only, and is the most important part of a "freely oscillating type" static speaker, so that it can indeed be considered to be the "heart" of the speaker. The electrode distance, in order to obtain the maximum efficiency, should be about 0.4-1 mm. only, and the resting electrode therefore has to be made with greatest accuracy, and must be free from any shrinking or warping so as to warrant an absolutely constant electrode distance. After many trials, bakelite, which was found to be suitable, if it is submitted to a subsequent heat treatment after pressing to prevent warping. To make the electrode conductive, its surface has been covered with a thin graphite layer. This graphite layer again is covered with a second layer of insulating varnish to prevent air discharge when the diaphragm is approaching the resting electrode. It was a very difficult problem to insulate the surface against such high voltages as 1,500 v., so that the edges tending to spark as the varnish due to the surface tension will draw away from the edges. By a special insulating method, however, it has been possible to obtain satisfactory insulation.

The Original Design

The first speakers were therefore built up as a perforated bakelite plate and a special (stretched) foil diaphragm. But it was found out that, due to the constant initial voltage, the diaphragm will be drawn in a convex form towards the resting electrode, and as the attraction force acts from one side only, the diaphragm does not swing symmetrically, and so distortion will result (see Fig. 5). To overcome this defect, I arranged the diaphragm symmetrically between two resting electrodes (see Fig. 6), thus considerably increasing the efficiency due to the bilateral effect and avoiding the distortion. Moreover, in this way the diaphragm is protected against mechanical injury from both sides. A speaker of this kind, consisting of two resting electrodes and a light metal foil diaphragm between them, is known under the name of "Oscilophone."

In Fig. 7 the two resting electrodes 1 are pressed together at their border by screws 3, and the diaphragm 2 is squeezed between them. To obtain full response, even of the lowest notes, the diameter of this type has been increased to 40 cm. By ring ribs and radial ribs the resting bakelite electrodes are prevented from warping; but even so the plate, because of its great amplitudes, and it must be very light to obtain great swing space in the centre and at two-thirds of the total diameter of the diaphragm, and this is to obtain high air-damping at these points. The diaphragm, although very light, tends to produce resonance points at its first and second natural frequencies, having maximum amplitudes at the centre and at two-thirds of the total diameter (see Fig. 9). By arranging fewer perforations at these points the air cannot escape, and causes additional damping of these diaphragm portions, thus suppressing the resonance effect.

It is possible to compare the goodness of the different loud-speaker systems by objective measurements. The diagram (Fig. 10) shows the results of such a comparative measurement. The better response of the "Oscilophone" to the critical high frequencies beyond 5,000 c.p.s. which are indispensable to give the tone its natural "transparent" sound.

(Continued on page 143)
NEWNES’

PRACTICAL AND HELPFUL

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Please send FREE sample tube Shaving Cream.

Name
Address

(Use block letters please.)
THE ELECTROSTATIC LOUD-SPEAKER

(Continued from page 140)

will be obvious, but also the low notes, which are the weak point of the static speaker in general, are reproduced at least as good as, or even better than, by the moving-coil and moving-iron speakers.

This particular type of speaker has so far found little practical application, on account of the fact that the moving-coil speaker in its present form can be sold at a very low price and very few people will be prepared to pay a higher price for the better sound quality of a good static speaker. Therefore, it is of no use to undertake to introduce the static speaker on a large scale. A construction will, no doubt, be found which, while maintaining its superiority over the moving-coil speaker in acoustical respect, can be offered at the same or even a lower price to overcome the reserve naturally taken up by the public regarding any new development. I am convinced that it will be a matter of time only to overcome these practical difficulties. I am now constructing a new model of a static speaker of the arrangement shown in Fig. 11, but on entirely new constructional lines with a minimum of cost for material and wages, and I expect to have perfected this type in the near future so much that it will be mature for industrial manufacture. This type will be so low in price as to compete with the moving-coil speaker.

Combined Speakers

I am convinced that the static high-tone speaker used in combination with a moving-coil main speaker will be the ideal arrangement for many purposes. Although the static speaker, as explained before, when duly constructed, is absolutely suitable to reproduce the whole frequency band, it will be difficult to produce very high sound intensity as required for special purposes (sound film, cafes, etc.). When combining, however, the high-tone moving-coil speaker and a very small static high-tone speaker to reproduce the high frequencies, high frequencies which are not reproduced by the main speaker, you get full response and a marked improvement of the clarity and faithfulness at very small extra expense. The static speaker in this case may be very small, and can be directly connected to the receiver as it requires low initial voltage. I am about to perfect a speaker of this kind with a diameter of 5 in. only developed in my laboratory for industrial manufacture, and I feel that the static high-tone speaker will be the first step for the introduction of the static principle of sound production in general.

I have also constructed a cinema arrangement which consists of several speakers of different characteristics for bass, medium, and high tone response, but all of them being of the static type. This assembly gave very promising experimental results, but, unfortunately, I was so hindered by the development of the Ferroard coils that I did not go farther along this line. I am, however, devoting full energy again to these problems, and it will be only a question of time before the static principle will play an important rôle in electric sound reproduction.

THE DECIBEL
An Explanation of this Important Unit
By D. P. TAYLOR.

As the use of the decibel as a unit of amplification or attenuation is rapidly increasing, it is not out of place to consider this unit briefly. Due to the fact that the human ear does not perceive simple increases of sound intensity as such, but tends to follow approximately a logarithmic law, the decibel is logarithmic in character and is independent of frequency.

If $P_1$ is the input power to an amplifier or attenuator, and $P_2$ the output power, then the simple power ratio is $P_2 / P_1$. The logarithmic unit, the bel, is the logarithm of the simple power ratio, so that power ratio (bel) is $10 \log P_2 / P_1$. The logarithm unit, the decibel, is $10 \log P_2 / P_1$, which is $20 \log P_2 / P_1$.

The Decibel and Power Output

It is general to use the decibel as a unit when dealing with the power output of apparatus over a range of frequencies. As an example, in the case of loud speakers it is becoming common practice to plot a graph of the power output over the entire audio-frequency range in decibels above and below the output at some standard frequency such as Middle C (256 cycles per sec.). If the output is greater than the standard frequency then the ratio in decibels is positive, whilst if less it is negative.

It is interesting to note that a change of power output of three decibels is the smallest change in intensity that can be detected by the average ear.

TABLE SHOWING THE RELATIONSHIP BETWEEN DECIBELS AND POWER RATIO.

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<td>10^-18</td>
</tr>
<tr>
<td>-19</td>
<td>10^-19</td>
</tr>
<tr>
<td>-20</td>
<td>10^-20</td>
</tr>
</tbody>
</table>

Power Level

In addition to its use in measuring power ratios the decibel is also sometimes used to express power level transmitted in a circuit. To use the decibel in this manner it is necessary to refer it to an arbitrary standard, called zero power level. As it being recognized that this shall represent .006 watts of audio-frequency power. Thus 10 decibels is .006 watts and 20 decibels .00006 watts. The distinction between these two functions of the decibel in measuring power ratios and power levels is of the greatest importance.

CLOSED DOWN BY TROOPS

X ER, Villa Anna (Mexico), the most powerful broadcasting station in South America, with a studio in Texas (U.S.A.), was recently closed down by Mexican troops by order of the Government. Its slogan: The Sunshine Station between the Nations did not bear out its policy, which was that of broadcasting advertisements for quack remedies and other medical articles under the law. Its owner now threatens to install a power transmitter on a steamer outside the twelve-mile limit and thus reach his listeners in the United States. The floating station would contain its own studio.
Further Notes on the A.C. LEADER THREE

These Notes are Given as a General Reply to Those Few Readers who have not been Quite Clear Concerning One or Two Little Points in Connection with This Remarkable Receiver.

THE tremendous number of letters which we have received in appreciation of the Leader Three is clear proof of the extreme popularity of our bold policy of designing a range of receivers to meet the financial needs of our readers. Of the many letters received, nearly all have referred to the utter simplicity of construction of the A.C. Leader and apparently only a very few constructors have experienced the slightest difficulty. It is apparent that the set has been made up by a large number of readers who have never before attempted the construction of even a battery-operated receiver, and this is good proof of the straightforwardness of the design which we followed.

The Component Brackets

One or two minor points have puzzled a few readers who are new to home-construction, so that some notes concerning such difficulties will be useful and will clear away any small difficulties which might possibly exist. In the first place, some constructors have not been quite clear in regard to the matter of the method of dealing with the three component brackets. Actually, one of these—that holding the two-point wave-change switch—is in contact with the metallized chassis and is screwed directly to the upper side. The reason for this will be appreciated when the circuit diagram is examined, because it will be seen that there are actually three contact points, one going to the earth line and one going to a tapping on each of the coils. But by mounting the two-point switch on the metal bracket, the mounting bush, and therefore the spindle, is automatically connected to earth, with the result that the two-point switch gives the same effect as a three-point component which would cost a little more.

The other two component brackets, holding the on-off switch and reaction condenser respectively, are insulated from the chassis. The former is automatically insulated by being attached to the underside of the chassis baseboard which is not metallized, but the latter must be insulated by some other means. The method of insulation recommended is to scrape away a square of the metallized surface a little larger than the base of the bracket. This can be done very simply by fitting the bracket in position and scribing a line round it; after removing the bracket, another line about 1in. away from the first can be scribed round, and all the metallizing within this line scraped away with the edge of a knife blade. Great care should be taken to ensure that the metal coating is thoroughly removed or else there might be a short-circuit between the anode of the detector valve and earth (which is also H.T. negative). It is a good idea to go over the line with the sharp point of a scriber or with the point of a pocket knife so as to make the complete break in the metallized surface. Then, even if any trace of metal should be left it is unlikely that a short will occur.

It should be made quite clear that it is not sufficient to "insulate" the bracket by placing a strip of paper or card between it and the chassis, because there would still be the risk of the mounting screws making contact with the metal surface, thereby causing the short which it is necessary to prevent.

The 1 mfd. Condenser

Here we must point out a slight error which occurred in the list of components given last week, and which "One T.M.C. 1 mfd. Tubular Fixed Condenser" was specified for C5. This condenser should have been listed as "One T.M.C. 1 mfd. Fixed Condenser, Type 60." The condenser in question is that used as an anode by-pass in connection with the S.G. valve, and it is mounted on top of the chassis behind the two coils; it can clearly be seen in the photograph reproduced on this page. We must apologise for this slip, and we might add that suppliers of kits of parts have already been advised, so that there is little danger of readers receiving the wrong component. A correct component specification is given on the left.

LIST OF COMPONENTS FOR A.C. LEADER.

One Jackson Bros. Double-gang Condenser .0005 "Nugage" Type A (C1 and C2).
Two Wearite "Universal" Screened Coils.
One Graham Farish .0015 mfd. Differential Reaction Condenser (C7).
One Bulgin Junior On-Off Switch, type S.86.
One Varley "Nicole" S-1 L.F. Transformer.
One Graham Farish "Snap" H.F. Choke.
One Heysham "Leader" Mains Transformer.
One Wearite Smoothing Choke, Type H.T.25.
Three 2in. Component Brackets, British Radio.
Two Chlorinated Terminal Strips (one marked Aerial and Earth, and one marked L.S. and P.U.).
Six Solid Chlor Plugs for use with terminal strips.
One Claude Lyons "B.A.T." Type 728 R.T. Switch.
With chassis mounting 5-pin valve-holders.
One Claude Lyons "B.A.T." 100,000-Ohm Resistor, Type R.3 (R6).
One Claude Lyons "B.A.T." 350-Ohm Resistor, Type R.4 (R8).
One Claude Lyons "B.A.T." 250-Ohm Resistor, Type R.4 (R13).
One Claude Lyons "B.A.T." 1 megohm Resistor, Type R.4 (R13).
Two Wearite "Universal" Screened Coils, Type 401 (C4 and C3).
One Claude Lyons "B.A.T." 1 mfd. Tubular Fixed Condenser, Type 40 (C7 and C12).
One T.M.C. 434 mfd. fixed Condenser, Type 40 (C11).
One T.M.C. 2 mfd. fixed Condenser, Type 40 (C9).
One T.M.C. 0.001 mfd. tubular fixed Condenser (C8).
Two T.M.C. 1 mfd. tubular fixed Condensers (C4 and C5).
One T.M.C. 1 mfd. fixed Condenser, Type 40 (C7).
One Peto-Scott Metallized Chassis, 16in. x 10in. with 3in. runners.
One Cossor 41.MP Valve.
One Cossor 41.MH Valve.
One Cossor 41.M3 Valve.
One Cossor 41.M4 Valve.
One Cossor 41.M6 Valve.
One Cossor 41.M7 Valve.
One Cossor 41.M8 Valve.
One Cossor 41.M9 Valve.
One Cossor 41.M10 Valve.
One Cossor 41.M11 Valve.
One Cossor 41.M12 Valve.
One Cossor 41.M13 Valve.
One Cossor 41.M14 Valve.
One Cossor 41.M15 Valve.
One Cossor 41.M16 Valve.
One Varley "Niclet" 5-1 L.F. Transformer.
One Bulgin Junior On-Off Switch, type S.38.
One Graham Farish "Snap" H.F. Choke.
One Varley "Niclet" 5-1 L.F. Transformer.
One Bulgin Junior On-Off Switch, type S.38.
One Graham Farish "Snap" H.F. Choke.
One Varley "Niclet" 5-1 L.F. Transformer.

This photograph clearly shows the 1 mfd. condenser referred to.
Fitting Scanning Discs

To overcome the obvious disadvantages that are likely to accrue from the employment of grub screws for the attachment of the boss of a scanning disc to the motor spindle, and to provide a ready means of fine adjustment, the following method might be adopted:

A boss with a central flange is made in two parts. The rear portion is bored a good sliding fit on the motor spindle, and on the face a true register locates the disc. The front part is tapped to suit a thread cut on the end of the spindle. A female register on the face of this ensures that the half bosses are in alignment, and bolts passing through the flanges and disc hold them together. Spanner flats are filed on the outside of the tapped boss as a means of holding while tightening the locking nut, fitted to the end of the spindle.

An efficient method of fitting scanning discs.

W. H. D.

Fixing an Aerial Mast

In spite of the thousands of aerials one sees only a very small number are erected with a view to appearance as well as efficiency. A little trouble taken when the aerial is being installed will be amply repaid by increased service and will result in the aerial being less of an 'eyesore than it otherwise would be the case.

A mast built on the lines of the accompanying drawing (which is self-explanatory) will be found very convenient in that it can be easily lowered for inspection and oiling by removing the bottom bolt and allowing it to swirl on the top one, the stays being loosened and used as guide ropes to assist in this operation. The concrete block, with the mast supports, is buried a few inches deep in the ground, its actual size depending upon the size and weight of the mast. For greater

Two Useful Methods of Holding Wires in Position

Two methods of holding wires in position are shown in the accompanying illustration. The first is particulary useful for spacing flexible leads in portable sets. A piece of thin sheet fibre, about 1/32in. thick is the material to use. Holes are punched opposite to each other near the front and back edges for each wire. The diameter of the holes should be slightly larger than the wire.

The second arrangement may be used in lieu of cleats. The following remarks with regard to material again apply. An angle piece is formed by cutting a strip about 1/8in. wide and scoring it down to clear the rotating plate. This mask plate has a window cut in the upper half and a clear hole to coincide with the central hole in the rotating plate. A short piece of twist drill about 1/8in. diameter is soldered to an arm tapped at the opposite end to screw on to the switch spindle. This is locked in place by the switch knob. A small piece of tube is soldered to the back of the rotating plate to form a bearing in a hole drilled in the panel. The central hole in the rotating plate is sufficiently large to allow the drill to pass through, but two small brass fingers are sweated partly across this hole, and these projections fit into the flutes of

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 wrinkle 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., 811, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every motion sent in must be original. Mark envelopes “Radio Wrinkles.” Do NOT enclose Queries with your Wrinkle.

A useful dodge for holding flexible leads.

W. H. D.

Push-pull Switch Position Indicator

The necessary parts for making this switch consist of a rotating plate marked with the appropriate wording “LONG,” “SHORT,” “OK,” “OK,” “OFF,” etc. There is a mask plate gripped between the switch bush and nut, with a washer underneath to allow the mask plate to clear the rotating plate. This mask plate has a window cut in the upper half and a clear hole to coincide with the central hole in the rotating plate. A short piece of twist drill about 1/8in. diameter is soldered to an arm tapped at the opposite end to screw on to the switch spindle. This is locked in place by the switch knob. A small piece of tube is soldered to the back of the rotating plate to form a bearing in a hole drilled in the panel. The central hole in the rotating plate is sufficiently large to allow the drill to pass through, but two small brass fingers are sweated partly across this hole, and these projections fit into the flutes of
As shown in the section, and wind on six layers of No. 36 D.C.C. wire. Secure the coil in position with a brass strip G, and connect the ends to two terminals. Glue a cardboard scale under the pointer, and the instrument is complete. If desired, it may be calibrated by testing it in conjunction with a standard voltmeter.

Handy Solenoid Switch

A VERY convenient remote control or reverse switch for speakers, motors, bells, lights, etc., is shown in the accompanying sketch. This instrument can be made from two bell bobbins, soft iron tube, brass rod, brass and copper strips, and a piece of steel wire for guide.

First fix the bobbins to a baseboard with copper strips, next push the iron tube through the bobbin, then run the brass rod through the iron tube and fit brass brackets and lock with nuts. Make sure the iron tube moves freely between bobbins. When bobbins are fixed, solder copper strip on centre of iron tube and also fix contacts. Contacts made from a very thin spring copper. Use 4 to 6 volts for working and note that measurements for the brackets depend entirely upon the sizes of the bobbins actually used.—F. W. MARLOW (Wembley).

Measuring Anode Voltages

It is well known that accurate measurements of the actual voltage applied between the cathode and anode of a valve cannot be made by the apparently straightforward method of connecting a voltmeter between the two points concerned. The reason is that the meter is in parallel with the valve itself, with a result that the reading obtained is lower than the true voltage. The difficulty is still worse if the only voltmeter available is of the low-resistance type; in fact, anything approaching accuracy is impossible in such a case.

Amateurs do not always realize that it is possible to ascertain the voltage with almost 100 per cent. accuracy by measuring the anode current by means of a milliammeter and then making a simple calculation. After the current has been measured, the voltage of the H.T. supply and resistance of the anode-circuit components being known, the voltage-drop in the anode circuit can be calculated by multiplying the current reading (in milliamperes) by the anode-circuit resistance, and dividing by 1,000. The figure that is obtained is subtracted from the total H.T. voltage available in order to get the actual anode voltage.

Do not forget that, when automatic biasing is employed, the G.B. voltage must also be taken away from the H.T. voltage.
MAKING YOUR PORTABLE RECEIVER

There are Many Readers who wish to Make Up a Portable from Components which are on hand. Information in regard to the Best Methods of doing this is given below.

By FRANK PRESTON

A Simple Circuit Arrangement

Now that the preliminaries have been considered, a few useful circuit arrangements can be considered. One excellent circuit for local-station reception up to twenty miles or so on a loud-speaker, or over much greater distances with "phones, is shown in Fig. 1. It will be seen that a screen-grid valve (which might be replaced by an H.F. pentode) is used as detector, this being followed by a : L.F. transformer and a pentode output valve. The circuit is similar to that used for an ordinary "fixed" set, except that a frame aerial, with reaction winding, is used in place of the usual aerial and coil. A "stopper" resistance is included in the grid circuit of the pentode, and a .002-mfd. condenser is connected between the anode of the pentode and H.T. negative to prevent L.F. instability. A variable potentiometer is shown for controlling the voltage on the screen of the detector, but this might well be a base-boarding grade instrument, since it need not be touched after the preliminary adjustment has been made, so as to obtain smooth reaction control. A suggested arrangement of the components and frame aerial is given in Fig. 2, but this may be modified consider-

ably so as to accommodate the parts in some available attach-case or other container. There is no need to give constructive details for the frame aerial here, since they were fully dealt with in another article on portable receiver design published in Practical Wireless dated February 4th, 1933.

When the set is to be accommodated in a case separate from that containing the batteries, it will be so small that a frame aerial wound round it would not prove very effective on account of its small size. It would, therefore, be better to replace the frame by a dual-range coil, as shown in Fig. 3, and to employ an external aerial. The latter may consist simply of a short length of wire thrown along the floor or over the branch of a tree, or it might be a connection to an earth point, such as a water-pipe. The idea of using an earth for an aerial might sound rather ridiculous to those who have not tried it, but in practice it often works very well. In the case of the other extemporized aerial systems mentioned, still better results will often be obtained by using an earth connection as well, this being joined to the negative terminal on the accumulator.

It might be mentioned at this point that a fairly effective and particularly convenient "self-winding" aerial can be devised from one of the steel tape measures which can be bought from sixpenny stores. The end of the tape is soldered or otherwise connected to the aerial terminal, so that to "erect" the aerial it is only necessary to pull out the case. After use the "aerial" is wound up simply by pressing the spring-release on the side of the case. A tape measure only a yard long can be used but, naturally, better results can be obtained by employing a greater length than this.

(Continued overleaf)

Fig. 1.—The above is a really good circuit for a simple type of portable receiver using modern valves.

Fig. 2.—A suggested arrangement of a portable of the simplest type using the circuit given in Fig. 1. Dimensions are approximate and will have to be modified according to the batteries employed and if a speaker is to be accommodated.

Fig. 3.—With a very small portable better results can often be obtained by replacing the "frame aerial" by a dual-range coil, as shown, or by a short temporary aerial. The connections given above show how a coil is substituted for the frame aerial shown in Fig. 1.
Fig. 4.—Increased volume can be obtained from the simple portable by using a double (Q.P.P.) pentode in place of the ordinary single pentode. The connections required in making the modifications are shown above.

(Continued from previous page)

Increased Volume with a Two-Valve Set

The circuit given in Fig. 1 is not suitable when good speaker reproduction is required. If you have an aerial and a receiver and it is not giving satisfaction, give all the symptoms. Explain clearly just what it is you wish to ask, we are sure you will receive, and the work of our Technical Department will be greatly facilitated and a more accurate solution will be forthcoming.

To summarize the above points, therefore:

- Use a separate sheet for each problem.
- Do not include other communications with your problem unless a separate sheet is used.
- Be brief.
- Give all the symptoms.
- Explain clearly just what it is you wish to know.

Note: Certain information has not already been published. Attention to these points will help you to obtain a speedy solution of your problem, and if you want a reply by post—don't forget to enclose a stamped and addressed envelope and the query coupon.

More volume can be obtained fairly easily, however, by replacing the single output pentode by one of the new Q.P.P. double pentodes. This would necessitate the use of an 8 or 10 to 1 Q.P.P. transformer in place of the ordinary L.F. transformer shown in Fig. 1, whilst the loud-speaker would either have to be of Q.P.P. type or else fed through a special output chokes. The double pentode circuit is given in Fig. 4, and this is simply added to the detector portion shown in Fig. 1.

Increased Range

Neither of the arrangements described so far is suitable for any other than purely local reception, and when the set is to be used at distances of more than twenty miles or so from the nearest transmitter, it is better to use a stage of H.F. amplification. An excellent circuit for a powerful three-valve portable receiver is shown in Fig. 5, where it will be seen that an H.F. pentode

(Continued on page 160)
WHEN reading through my post to the other evening, it occurred to me that the number of queries dealing with mains-units seems to be steadily increasing, and in view of the doubt which appears to exist regarding the advisability of changing over from battery to mains operation, and of choosing a suitable type of unit, I propose in this article to describe in some detail the principles underlying the design of units, and to allay any anxiety regarding the choice and operation of them.

The current required for the anodes of receiving valves is, of course, direct current, and therefore the design of a unit for direct-current mains is the simplest proposition, and we will take Fig. 1 to illustrate this complete circuit of a D.C. mains-unit for deriving high-tension current from the mains and providing four separate tappings, including a variable one for the S.G. valve. One might think that as direct current is required for the valves, and current supplied through a D.C. mains is already "direct," it would merely be necessary to break down the input to the voltage required by the valves. Unfortunately, this certainly is not so! The mains current is never pure direct current, and in some localities, particularly where the supply is derived from mercury-rectified A.C. there is a very considerable percentage of residual alternating current superimposed on the D.C., which if allowed to reach the anodes of the valves would make its presence felt in the shape of a devastating mains hum! In order to remove this A.C. we have to use a combination of chokes (L) and condensers (C) which filters the alternating current from the direct current, and thus converts the irregular mains current to a smooth direct current suitable for the valves. The choke consists of a large number of turns of fine wire wound on a bobbin, and surrounded by iron laminations (called the core). To explain fully the action of the choke is somewhat beyond the scope of this article, but, in short, it may be said that this component acts on the principle that when an alternating potential difference is applied to a circuit possessing "self-inductance" (as any winding does), the variation of the resultant magnetic flux sets up an alternating electromagnetic force which tends to bore back the current, at the same time causing the current to lag in phase behind the applied smooth direct current for the filament of the valves. Reservoir condensers have the same effect. This filter arrangement therefore converts the mains supply to a smooth direct current, which, however, is still unsuitable for our requirements, owing to the fact that its potential is the same as the mains input of perhaps 230 volts (less voltage drop through the smoothing choke).

Reducing the Voltage

Consequently, we have to reduce the voltage and, at the same time, limit the amount of current flowing in the circuit, and this is done by connecting a resistance (termed the "mains-resistance") in series with the negative side of the unit. In order to compute the value of this resistance, it is necessary, first of all, to determine the maximum voltage and total anode current consumption of the set, which can easily be done by referring to the curves published by the valve manufacturers. Assuming that the output valve requires 160 volts, then that is the maximum voltage required, of course, and it will not require so much. Then from the curves estimate the anode current of each valve and its corresponding resistance. It will be found that at this voltage the S.G. valve takes 3 milliamperes, the detector valve 1 milliamperes, and the power valve 16 milliamperes, making a total current consumption of 20 milliamperes at 160 volts. Having determined these figures, the rest is easily calculated by the above formula in this case is current in milliamperes which in our assumed case becomes: 80 x 1.000 = 4,000 ohms. This, then, is the total resistance required in circuit, but as the smoothing choke also possesses ohmic resistance, say 500 ohms, then this has to be deducted from the above figure, making the correct value for the mains-resistance 3,500 ohms. This resistance must, of course, be capable of carrying the total output from the unit.

Tapping the Output Voltage

We are getting a little nearer, as we have smooth direct current available at 150 volts as required by the output valve, and this current is derived from the total anode current consumption of the set. The S.G. and detector valves, however, do not want so much as 150 volts, and, therefore, our next task is to separate the total output into three or more tappings at various voltages as required by the individual valves. This can be done in two ways, firstly, by the "potential-divider" method which consists merely of a resistance connected directly across the output, this being tapped at various points. This arrangement, as we shall see, is preferable in that each separate H.T. feed is individually decoupled, and this arrangement is in almost universal use. This circuit provides for a separate voltage-
PRACTICAL WIRELESS

ROUND THE WORLD OF WIRELESS

Power Signals from Muhlacker

A DERICAN broadcasting you may pick up tests carried out by Muhlacker with its new aerial system. The station will keep listeners at full power towards the middle of April and will then rank as a full 100 kilowatt.

A Russian Station for Turkey

IT is reported in Continental quarters that the Soviet radio industry is now busily with the manufacture of material destined to the construction of a 150-kilowatt transmitter, to be erected at Ankara (Turkey). For some time past Soviet engineers have been anxious to secure orders for radio apparatus from neighbouring States. The same correspondent states that Riga has been using water-cooled valves of Russian make.

The Other Side

FROM the North Regional, on April 17th, there is to be an exchange of programmes between Northern Ireland and Ulster. "The Other Side," and half of the programme will come from Liverpool and the other half from Belfast. Included in the Liverpool contributions will be a relay of variety from the Argyre Theatre, Birkenhead, and dance music for the E.M.I. orchestra of the Ambassadors Dance Band from the Rialto Ballroom, while from Belfast will be heard a relay of variety, dance music and organ music from the Classic Cinema.

Linking Up Films with Broadcasting

BROADCASTING and film link-up is a growing development. There is a "movie" of the B.B.C. in prospect, and John Watt, B.B.C. producer, is part-author of a film with a Ruritanian background. "Kentucky Minstrels," Harry S. Pepper's microphonic revival, is also being spoken of as a musical film, while Leslie Sarony, broadcasting star, is lead in a recently-completed film with an all-star cast. Sarony is to broadcast a competency show on April 19th (London Regional). He will have the assistance of the ubiquitous Leslie Holmes, as, indeed, is only natural, for the Lees have a reputation as a musical duo.

"The Other Side"

Twenty-four-hour Timing

We are sorry that we are two minutes late with the news to-night. The time is exactly twenty-one-o'clock, or two minutes past nine. This will be the sort of microphonic transmission which listeners will hear after April 22nd next. The B.B.C. announces that the use of both the old and new styles of timing will be continued until listeners have become accustomed to the twenty-four-hour timing; a not very difficult operation for most. In the meantime, we have heard of one long-service naval man with a brilliant record in Higher Mathematics who admits that he has never adapted himself easily to the expression "twenty-four hours" for the more popular "10.0 p.m." His mind persists in thinking in multiples of ten, which causes him to translate 10.0 p.m. into twenty hours—an unfortunate partiality for the decimal system.

(To be continued)
IMPORTANT

MISCELLANEOUS COMPONENTS. Parts, Kits, Finished Receivers or Accessories for Cash, C.O.D. or H.P. for our own system of Easy Payments.

BRITAIN only. OVERSEAS CUSTOMERS CAN SEND TO US WITH CONFIDENCE. We carry a special export staff and save all delay. We pay half carriage—packed free. Send full value plus sufficient for half carriage. Any surplus refunded immediately. Hire Purchase Terms are NOT available to Irish or Overseas Customers.

PILOT CLASS "B" FOUR KIT

GUARANTEED MATCHED

ANY ITEM SUPPLIED SEPARATELY—ORDERS OVER 10/- SENT C.O.D. CARRIAGE AND POST CHARGES PAID

LEADER 3

KIT "A" Author's Kit of specified parts, including Peto-Scott METAPLEX Chassis but less valves. Cash or C.O.D. Carriage Paid.


YOURS FOR PROVED TESTED

LEADER A.C. 3

KIT "A" Author's Kit of specified parts, including METAPLEX ready drilled Chassis, but less Valves and Cabinet. Cash or C.O.D. Carriage Paid.


BIFOCAL-COIL COMPETITION

WIN AN EXTRA £5 5s.

As announced by Mr. F. J. Camm on page 133 of this issue, PETO-SCOTT are giving £5 5s. worth of Radio or Television components, to choose, to the 1ST PRIZE-WINNER in the Bifocal Competition. To qualify for this handsome additional prize you must have obtained your Bifocal Coils from PETO-SCOTT.

Set of 2 Variety Bifocal Coils, Cash or C.O.D. Carriage Paid 21/-1-0. 2/6 or Balance in 3 months payments of 2/-.

TELESE S.G.S. lens Valves. Cash or C.O.D. Carriage Paid, 4/6/0. Balance in 9 monthly payments of 1/2. 2/- or C.O.D. orders value over 10/- sent carriage and post charges paid.

NEW W.B. P.M.A. MICROPHONE PERMANENT MAGNET SPEAKER, complete with switch-controlled multi-range input transformer. Cash or C.O.D. Carriage Paid, £2/11.


NEW R.F. G.A.R.R.I.N.D. Table Cabinet with Shelf and Baffle. Cash or C.O.D. Carriage Paid, £5/16/0.

NEW W.B. BIG SPOT P.M. PERMANENT MAGNET SPHERE SPEAKER. A superior Peto-Scott invention, this latest Class B Battery Kit is suitable for all wave lengths and gives superb quality, with colossal volume. With outstanding performance equal to "mains". Send £1/10/6. Or 12 monthly payments of 1/5/6.


NEW W.B. BLUE SPOT 29 P.M. PERMANENT MAGNET SPEAKER, complete with multi-tube input transformer. Cash or C.O.D. Carriage Paid, £5/10/6.

NEW W.B. BLUE SPOT 29 P.M. PERMANENT MAGNET SPEAKER, complete with multi-tube input transformer. Cash or C.O.D. Carriage Paid, £5/10/6.

NEW W.B. BLUE SPOT 29 P.M. PERMANENT MAGNET SPEAKER, complete with multi-tube input transformer. Cash or C.O.D. Carriage Paid, £5/10/6.

NEW W.B. BLUE SPOT 29 P.M. PERMANENT MAGNET SPEAKER, complete with multi-tube input transformer. Cash or C.O.D. Carriage Paid, £5/10/6.

NEW W.B. BLUE SPOT 29 P.M. PERMANENT MAGNET SPEAKER, complete with multi-tube input transformer. Cash or C.O.D. Carriage Paid, £5/10/6.
UNIVERSE 1934 PICK-UP
"Super " Model. Output, nearly 4 volts-average, 2 volts. Base can be used in any position. Pick-up reed cannot go out of adjustment (pat. applied for). Ball catch swivel head for easy needle changing. Weight on record adjustable. Moulded in smart brown bakelite case. Fully guaranteed. If your dealer does not stock Universe 1934 Pick-ups, write us direct for illustrated folder.

BRITISH 362 VALVES
Why put up with indifferent radio when new 362 valves—which will give you maximum results—are so inexpensive? Every 362 is fully equal in the most expensive of its type. 362 are the only valves sold with a definite guarantee for a minimum period of 6 months. They are entirely British and Non-Microphonie. Post free direct from the makers if unobtainable locally.

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This series covers a wide field and will prove of the greatest value to everyone interested in models and how to make them; woodwork and other crafts. Each book is clearly written and fully illustrated.

ACCUMULATORS
An up-to-date handbook dealing with every type of accumulator, methods of charging them at home, care and maintenance. This little handbook also explains how to erect a charging station.

SIMPLE ELECTRICAL APPARATUS
An excellent little book for those who wish to make simple and useful electrical appliances, such as galvanometers, electric motors, dynamos and Leyden jars.

THE HANDYMAN'S ENQUIRE WITHIN
Hundreds of practical ideas and hints of value to the man who is clever with his hands.

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Varley
(Proprietors: Oliver Pell Control Ltd.)
WHICH IS THE BEST CIRCUIT?
A Review of the Most Popular Circuits.

By "LAMBDA."

BEFORE the introduction of the screen-grid valve, the straight circuit, consisting of a detector and one or two low-frequency stages, held the field. It was a universal favourite. Simple to construct and easy to handle, it could, by the judicious application of reaction, put up a very creditable performance. Selectivity also was sufficient for our needs. It still has many adherents, but gone are the days when it could be considered a universal favourite.

In the early days of broadcasting, neutralized H.F. stages were in evidence, but, owing to the difficulties in operating, they did not attain anything like the popularity of the modest straight set.

With the coming of the screen-grid valve a remarkable change was brought about. Its prototype. Consider Mr. Camm's receiver, recently described in this journal, with a similar circuit evolved when screen-grid valves were first placed on the market. What a revolution! Construction has been simplified, and, in comparison with earlier types of receiver, it has changed almost beyond recognition.

Who thought of automatic volume control a few years ago? Especially for such a circuit as that of Mr. Camm's. Iron-cored coils with their high efficiency were beyond even our wildest dreams. Many would have even asserted that the suggestion was not only impracticable, but impossible.

What about the inter-valve coupling coil? Tuned grid, tuned anode, or H.F. transformer; which do you prefer? All have their advantages and disadvantages. At the present time the two systems, tuned-grid and tuned-anode, appear to vie with each other, and both systems have many adherents. Tuned-anode coupling is the simpler, needing fewer components, but, unless care is exercised in the layout of the receiver, instability may result much more easily than with tuned-grid coupling.

First receivers with one screen-grid and then two screen-grid valves were introduced, and they were undoubtedly a great advance over the earlier types.

Three-valve Circuits
Consider the circuit employing one screen-grid H.F. stage. First of all it included two tuned circuits; ganged tuning condensers then became popular; next the introduction of small-diameter coils and the need for greater selectivity gave an impetus to sets employing a band-pass filter—three tuned circuits with triple ganged tuning condensers. Then we had the introduction last year of Class B amplification for battery circuits and iron-cored radio-frequency coils, so that this type of circuit now bears very little resemblance to its prototype.

If a really good high-frequency choke be employed in the anode circuit of the H.F. valve, tuned-grid coupling is stable and the amplification obtained is very little less than with tuned-anode coupling. As the high-frequency choke is virtually in parallel with the grid coil, it is essential that it should be of good quality.

On the low-frequency side matters are fairly well defined. If a battery receiver is contemplated, then Class B amplification should be employed. With mains receivers we can employ a pentode output valve or two low-frequency stages with a high-voltage output valve giving five watts or more undistorted output, according to our own particular needs.

Four-valve Circuits
Now we come to the tuned radio-frequency receiver employing four or more valves. What is our choice? One high-frequency stage or two high-frequency stages, detector, and pentode output? The writer's choice would be the latter.

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Fig. 1.—Early circuit of H.F. stage receiver employing a screen-grid valve.

Fig. 2.—Circuit of Mr. Camm's receiver.

Compare this with the circuit of Fig. 1.

Fig. 4.—A superhet circuit.

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circuit. With two H.F. stages sensitivity is considerably increased, and the additional tuned circuit provides greater selectivity. Reaction can, of course, be employed, if desired. The fundamental design of this circuit has followed fairly closely on that of the previous circuit discussed. When an additional H.F. stage is added, great care has to be exercised in the design of the receiver, however, in order to minimise unwanted coupling, otherwise instability may occur. The greater amplification of the two H.F. stages permits the employment of really satisfactory methods of automatic volume control, thus compensating for fading. Without the introduction of the variable-mu valve, and the employment of one of the various forms of diode detection, A.V.C. would not have been possible. The diode detector will handle a large input without distortion.

What about the interstage coupling? Here again we have the choice of high-frequency transformers, tuned-anode or tuned-grid coupling. If H.F. pentodes are employed the amplification obtainable is so great that care will have to be taken in the design of the receiver to obtain stability. In this case, the constructor is advised to follow the layout of a well-designed receiver rather than embark on the design himself unless he is really confident that he can evolve a really satisfactory layout.

With the introduction of iron-cored coils, there has been a revival of interest in the tuned radio-frequency receiver. If a band-pass filter be employed, the additional tuned circuit will give a corresponding increase in selectivity—a great advantage situated near a Regional transmitter. The selectivity obtained is practically equal to that of a superhet, and reception is free from the whistles which unfortunately mar the performance of some superhet circuits.

AERIAL SYSTEMS — No. 1

A birdcage-type aerial mounted on a short mast fixed above the roof of a house.

A "sausage" aerial, used chiefly for transmitting owing to its high self-capacity.
A LAMP UNIT FOR TELEVISION

In this Article the Author Describes a Method of Mounting a Neon Lamp for Giving an Increased Lighting Effect. By R. CRAPER

The ordinary beehive pattern neon lamp will no doubt have found its way into many home-constructed television receivers, being so readily and cheaply procurable. Now, owing to the spiral term of diffusing screen between the lamp it has usually been found necessary when using it for television purposes to include some feature of the unit about to be described.

To give a general idea of the scheme, instead of the usual ground glass or waxed paper screen, a condenser lens is interposed between the lamp and scanning disc, and, when adjusted, gives a uniform light over its whole area. This is masked slightly to agree with the picture size, and the resulting light area is then scanned in the usual way.

The disc thus seen is masked slightly to agree with the picture size, and the resulting light area is then scanned in the usual way. In effect, this scheme is similar in principle to that used in the ordinary projection lantern, where a photographic slide is projected on to a screen, only in our case the scanning disc takes the place of the slide and we view the resulting light direct. In order to cut out the spiral in the beehive lamp the latter is mounted in an unusual position. If an ordinary Osram or beehive pattern lamp is taken, and turned about, it will be found there is one position from which the circular plate can be viewed entirely free from the spiral, and this is when holding the lamp at an angle of about 45 degrees to the eyes. The disc thus seen will appear oval in shape, as in Fig. 1. This is the position utilized, and, although the area is quite small, it is sufficient to give a uniform light from the condenser lens.

Fig. 1.—Perspective view of beehive lamp, showing disc as seen when held in an angle of 45°. In this position the disc is not obscured by the spiral.

In this position the baseboard, the lamp should be connected to the wireless receiver, and its position adjusted to give a uniform light when looked at from a distance of about 12 ins. The ordinary broadcast programme will do for this test. The cover can then be fixed, and the complete unit stood up behind the scanning disc and screwed to the baseboard. The televised image should be looked at through the viewing tunnel of the apparatus from a fairly frontal position, as there is a slight directional effect, but the extra brilliancy of the image, compared with that given by the diffused method, is very pronounced.

Fig. 2.—View of lamp fitted in an adjustable holder condenser lens.

The condenser lens should be of short focus (about 21/4 ins. to 3 ins.), and for use with the standard disc should be about 21/2 ins. diameter. A simple method of mounting it is shown in Fig. 4, the aperture in the plywood front being cut so that the lens rests against the sides, and its periphery just comes flush with the front. Four screws hold the lens in place and down. A certain amount of care should be exercised in mounting the lamp in the holder, and the holes in the two blocks should be levelled slightly on the inside if pressure tends to be excessive. The connections to the lamp may be made by aid of a standard socket, or wires can be soldered direct to the lamp's base.

Before fixing on the cover, the lamp should be connected to the wireless receiver, and its position adjusted to give a uniform light when looked at from a distance of about 12 ins. The ordinary broadcast programme will do for this test. The cover can then be fixed, and the complete unit stood up behind the scanning disc and screwed to the baseboard. The televised image should be looked at through the viewing tunnel of the apparatus from a fairly frontal position, as there is a slight directional effect, but the extra brilliancy of the image, compared with that given by the diffused method, is very pronounced.

LATEST TELEVISION DEVELOPMENTS

(Continued from page 11. "Practical Television," April 1st Issue)

Many tests by the company's engineers have revealed that the ultra-shortwave radioteletransmission covers an area embracing the whole of Greater London for good signal strength, this comprising a population of over ten million people.

Why Ultra-short Waves?

Before proceeding to the receiving end it is natural to assume that readers will desire to know why it is necessary to use ultra-short waves for a high-definition television transmission of this character. The answer is linked up with the limitation of side-band spread, which is im-
A many amateurs have shown a keen interest in the television transmissions, but have not built a television receiver, either owing to lack of the necessary tools or owing to the apparent difficulty of obtaining the various parts which are required. Merss. Petoe-Scott have experimented with the standard method of assembling a television receiver, and as a result of their trials have now been able to produce a very simple kit of parts which will enable anyone, without any knowledge of workshop practice or mechanical ability to construct the necessary apparatus in a very short space of time. The illustration (Fig. 1) shows the apparatus assembled, from which it will be seen that, in addition to a baseboard, the complete kit includes the two pole-pieces for the magnets which are required, the magnet coils, which are supplied by Messrs. Peto-Scott in kit form, and Fig. 2 shows the parts from which this part of the apparatus is constructed. The toothed wheel is built up from laminations, and these are riveted together with copper rivets. Similarly, the one mains resistance, an adjustable resistance for regulating the speed of the motor, a motor, and a bracket upon which it may be mounted. To enable the size of the picture to be brought to suit the dimensions of a good lens is supplied, and this is held in a very ingenious and ample mount which is made of brass and is well cut and appears very accurate, the centre plate being moulded from bakelite, which gives lightness combined with great rigidity. A lamp of the beehive pattern, with the resistance removed, is also supplied, so that all the purchaser of one of these kits has to do to receive the television transmissions is to fit the apparatus to a suitable receiver, without the necessity for the purchase of any other apparatus.

**Synchronizing Gear**

Naturally, in this condition it is too much to expect the motor to maintain a constant speed in synchronism with the transmitter, and therefore to avoid the necessity of manual speed control it is worth while to fit a synchronizing gear. This is also supplied by Merss. Petoe-Scott in kit form, and Fig. 2 shows the parts from which this part of the apparatus is constructed. The toothed wheel is built up from laminations, and these are riveted together with copper rivets. Similarly, the two pole-pieces for the magnets are built from laminations held together in a similar fashion. The magnet coils are already wound, and the task of assembling these parts should not take more than fifteen minutes or so.

The price of the television kit is 75s., and the synchronizing kit costs 37s. 6d.

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**THE WIRELESS CONSTRUCTOR’S ENCYCLOPAEDIA**

(2nd Edition)

By F. J. CAMM

(Editor of "Practical Wireless")

This invaluable encyclopedia is written in plain language by one of the most accomplished designers and writers on wireless construction. The whole subject is fully covered, and the volume is remarkable for the number of practical illustrations it contains.

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5/-
THE CROYDON RADIO SOCIETY

The Society's final meeting of this session took place at 84, Peter's Hall, Ledbury Road, Croydon, on Tuesday, March 27th, and was more informal than usual. A member, Mr. J. A. Salt, gave a musical programme with his R.M.O. radio-graphophone and gave moving-into picks-up. After an interesting evening the Chairman spoke of the considerable increase in members during the past session and thanked all concerned for making it such a success, while PRACTICAL WIRELESS share in making their evening the most successful.

E. L. Cumber, Hon. Secretary.

THE CROYDON RADIO SOCIETY

The London Chapter meeting, held at the R.A.C.S. Hall, Wandsworth Road, S.W.8, on Friday, April 6th, opened with a demonstration of reception of short-wave stations. The Allwave superhet installed at the Chapter was used on this occasion. The main feature of the evening was a "Junk Sale" which created much interest, and many fine bargains were obtained by the members.

A. E. Bear, Sec., 10, St. Mary's Place, Middlesex, S.E.16.

INTERNATIONAL SHORT WAVE CLUB (LONDON)

The sixth meeting of the above Chapter was held at the "Clarion Caf6," 50a, Market Street, Manchester, on Thursday, April 19th, at 9 p.m. There was no official business to discuss, and it was announced that the visit to Barton Airport had been postponed for a month. The Assistant Technical Adviser, Mr. F. Fielding, gave a very interesting lecture and many demonstrations of various radio gadgets. He catered for the beginner as well as the expert, and his gadgets and tips were much discussed by members after he had finished. At the conclusion of the meeting the Secretary thanked Mr. Fielding and announced the date of the next meeting as May 1st, at 8 p.m., at the above address. The room will be open for the first 50 members from 6.30 p.m. and more instructions will be given for members interested from 7.15 to 7.45 p.m. All radio enthusiasts are invited to these meetings, and any PRACTICAL WIRELESS reader requiring any further information is invited to write to the Secretary, E. L. Cumber, 10, St. Mary's Place, Middlesex, S.E.16.

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FERRANTI MIDGET LOUD-SPEAKER

A FURTHER addition to the range of Midget components which we have been testing over the past few weeks is illustrated below. This is a Ferranti moving-coil loud-speaker (Type M), and the overall diameter of the front plate is only 6 in., whilst the overall depth is 2.1 in. The front ring is made from a metallic alloy, approximately one-quarter of an inch thick and thus the speaker is a very rigid affair which, besides ensuring constancy of performance, enables the speaker to be very firmly attached to a cabinet or motor-car fitment.

The Ferranti Midget Loud-speaker.

The magnet is of generous dimensions for such a small speaker and ensures good flux density in the gap, thus giving a high degree of sensitivity. The cone has an overall diameter of 6 in., and is of stiff paper material with a corrugated edge. The speech coil has a D.C. resistance of about 8 ohms, and the connections for this are brought out to the two terminals seen on the lower part of the speaker. A transformer is not fitted, but it is a simple matter to arrange for a suitable matching transformer to be included in the output circuit of the receiver with which the speaker is employed. Where required, a model of this speaker may be obtained complete with transformer. This model is known as M.B.T and an extra charge is, of course, made for the transformer. For an instrument of such small dimensions the response curve is remarkably good, and the speaker may be highly recommended for use with car radios. The price is £2 15s., without transformer, and £3 6d. with transformer.

"PEAK" CONDENSERS

We would remind our readers that the business of the manufacturers of "Peak" condensers and condenser blocks, formerly carried on by Messrs. Williams & Co., of Londo, was taken over on April 1st by Messrs. W. Andrew Bryce and Co., of Woodfield Works, Bury, Lancs. This firm intends to improve and extend the range of condensers formerly sold under the "Peak" trade-mark.

RECORD STORAGE CABINETS

EVERY user of a radiogram finds it necessary to employ some kind of storage cabinet in which to house the large number of records which he accumulates, and although there are a number of small cases available, the use of a well-made cabinet, in a design to match the remainder of the furnishing or radiogram cabinet, is at all times recommended. The two cabinets illustrated on the right are manufactured by Smith's Cabinets, Ltd., of 18, Hertford Road, London, N.1.

Each of these cabinets holds 250 records, a shelf being provided in the centre of the cabinet. The cabinet on the left of the illustration costs £2 15s. 6d. in oak; £2 17s. 6d. in mahogany, and 3 guineas in walnut, whilst the other model costs £2 12s. 6d. in mahogany, and 3 guineas in walnut. The latter model supplein in a baleite moulded case, and, although less than two inches in height it possesses very good electrical characteristics. The core is of alloy-steel, and although of such small dimensions the inductance has a value between 75 and 85 henries. The transformer is intended primarily for resistance or parallel-fed coupling, with a condenser having a capacity between 3 and 10 mfd. Under the correct conditions, the amplification curve is practically straight from below 100 cycles to above 8,000 cycles. The turns ratio is 1 to 4, and standard B.A. terminals are fitted for connecting purposes. If the transformer is used direct in the anode circuit of a valve the steady D.C. should not exceed 1 mA. In order to maintain the inductance at a sufficiently high value for good results, the list number of this component is L.F.12, and the price is 6s.

RAY-DIX METALLIZED BOARD

FROM Messrs. Ray-Dix Radio Products, 42, Victoria Street, Cheapside, we have received some samples of a metallized board, prepared especially for radio-circuit construction. This is of stout ply, finished in a matt black surface, with one side covered by a sheet of aluminium foil. This is firmly attached and does not easily come away from the board. It may be obtained in ordinary baseboard form, or as a chassis, the price of a 16in. by 10in. baseboard being £2 3d., and for a chassis of similar size the cost is £2. A 16in. by 8in. baseboard costs 1s. 6d., and a 10in. by 6in. chassis costs 2s. 6d. This material is very useful for receiver construction, as it enables earth returns to be kept to a very minimum and at the same time permits various components, such as variable condensers, etc., to be mounted direct without the necessity of a separate earth lead. Holes may be drilled, and the material may be cut away where necessary without any difficulty.

"B.A.T." SIDE ACTION SWITCHES

THE transformer illustrated is a "M.B.P." transformer, and is too well-known to need description here, but the manufacturers tell us that it is desired to incorporate this type of switch in a receiver in the interest of symmetry, which they consider desirable. The side-action Q.M.B. switch removes this difficulty, and in addition to affording a positive action it enables a standard control knob to be fitted to match any existing control knobs. This switch is made similar to the standard snap switch, but is fitted with a standard one-knob fixing bush and a quarter-inch spindle. The normal method of arranging layers of insulating material with the contacts sandwiched between them is adopted, but the internal construction, in order to accommodate the rotary action, results in a slightly higher capacity than the normal toggle switch, and this prevents the use of side-action switch in H.F. circuits. The switch may be obtained in various types, such as single Pole, single-pole Double-Throw, Double Pole and Double-Pole Double-Throw. The prices of the above types are 1s. 9d., 2s. 6d., 3s. 6d., and 4s. respectively.

MULLARD BATTERY VALVES

THE two valves illustrated are the V.P.2 (left), and the T.D.D. 2, both battery-operated valves of the types which have recently become very popular. The former is an H.F. pentode having variable-frequency characteristic, with a 1 Volt. 18-amp. filament. It is rated for a maximum anode and auxiliary grid voltage of 150, and the impedance is 75,000 ohms. The standard 2-pin base is fitted, and the illustration, in which the grid bulb has been removed, shows the right manner of assembly of the electrodes. The T.D.D. is a double-diode valve in which the triode characteristic are, impedance 12,000 ohms, amplification factor 165, mutual conductance 1.4 mA/Vd. The filament is rated at 2 volts, 1.3 amps, and the maximum anode voltage is 150. The standard 2-pin base is fitted, and the control grid is brought out to the terminal on top of the glass bulb. The diodes may be employed for rectification and automatic volume control, or for any other standard use to which two separate diodes may be put. The prices of these valves are, V.P.2, 15s. 6d.; T.D.D. 2, 4s.

For battery users, two 'one Mullard' valves—the V.P.2 and the T.D.D. 2.
Short-Wave Section

WAVE-METER CALIBRATION DATA FOR SHORT-WAVE ENTHUSIASTS.

An accurately calibrated absorption wave-meter is of great assistance to the short-wave enthusiast, because it enables him to identify stations by wavelength instead of waiting for station announcements—a difficult task during periods of high-speed fading.

By ALF. W. MANN.

The usefulness of an absorption wave-meter is, of course, governed by the accuracy of the calibrations, and to that of the purpose of this article is to place before the reader data which it is hoped will assist him when calibrating their wave-meters to cover the short-wave bands.

To give a complete list of transmitters would be useless, and the writer has therefore selected certain transmitters which are located sufficiently wide apart and within a particular band of wavelengths.

By searching for particular transmissions and checking them, the dial readings of the wave-meter when plotted will provide sufficient points to enable accurate curves to be drawn without difficulty.

Other transmitters, if heard, should be noted and readings checked in order to obtain the maximum number of calibration points.

Various Kinds of S.-W. Transmissions.

There are three types of transmissions receivable on the short waves—i.e., broadcast, commercial telephony, and telegraphy. C.W. transmitters (morse code) are to be heard at all times of the day and, owing to the high power used, are receivable at good readable strength even when adverse conditions prevail for the reception of broadcast and commercial telephony.

Only three of these transmissions, calibration may be undertaken regardless of the prevailing reception conditions. One does not require expert knowledge of the morse code in order to check these transmissions. The ability to read a series of Vs, followed by the letters D, E, and a number is sufficient.

As commercial telephones are now using transmission, the purpose of this article is to place before the readers data which it is hoped will assist them when calibrating their wave-meter when plotted will provide sufficient points to enable accurate curves to be drawn without difficulty.

From 25 to 70 Metres.

The 25-metre band is entirely devoted to broadcasting, with FYA (25.25 metres), RIO (25.40 metres), DJD (25.51 metres), together with ten other transmitters, all of which are consistently received under favourable conditions in summer, and at intervals during the remaining parts of the year.

Within the 26.31-metre band are twenty-five commercial transmitters, seventeen of them working on telegraphy. The wavelengths of the short wave band varies with each edition. For instance, automatic fading compensating apparatus, it is impossible to check them unless they are being carried out on position B—i.e., with scrambler out of circuit, which makes speech intelligible.

During these tests the call letters are usually announced.

The lowest wave-band in general use lies between 13.93 metres and 13.97 metres—two transmitters—WXXK using the former and GSH the latter wavelength.

Within 14 metres and 16.81 metres twenty-eight commercial transmitters are located, the whole band being equally divided between commercial telephony and telegraphy stations. LSL Buenos Aires (14.18 metres) and DRO German (14.49 metres) are two of the commercial telephony stations, whilst amongst the telegraphy group are ORA Belgium (15.19 metres) and PLF Java (16.81 metres).

Details concerning such well-known transmitters as GSO Daventry (16.86 metres), 3XAL (16.88 metres), and DJE (16.89 metres) are almost unnecessary, as they are frequently heard by listeners in the British Isles. LAC, Cilento, Tuscany, Italy, on 16.90 metres, is a commercial telephony transmitter. On 16.48 metres FZR, Saigon (French Indo-China) working telegraphy is to be heard. The total number of stations using various wave-lengths in this band is twenty-eight, only four of which are broadcasting stations.

The writer has therefore selected certain wavelengths, the lowest wave-band in general use being broadcast and commercial telephony. By taking only four of which are broadcasting stations.

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The writer has therefore selected certain wavelengths, the lowest wave-band in general use being broadcast and commercial telephony. By taking only four of which are broadcasting stations.

Within 14 metres and 16.81 metres are two of the commercial telephony stations, whilst amongst the telegraphy group are ORA Belgium (15.19 metres) and PLF Java (16.81 metres).

Details concerning such well-known transmitters as GSO Daventry (16.86 metres), 3XAL (16.88 metres), and DJE (16.89 metres) are almost unnecessary, as they are frequently heard by listeners in the British Isles. LAC, Cilento, Tuscany, Italy, on 16.90 metres, is a commercial telephony transmitter. On 16.48 metres FZR, Saigon (French Indo-China) working telegraphy is to be heard. The total number of stations using various wave-lengths in this band is twenty-eight, only four of which are broadcasting stations.
AMPLION PLASTAIRE INDOOR AERIAL

10 AIR SPACED 15 FEET - 2½-
INSULATED 20 FEET - 2/6
COPPER STRANDS 30 FEET 3/6

AMPLION (1932) LTD.
I have written to you. I would like to congratulate you by producing such a splendid paper, and also to thank you for such items as The Constructor's Encyclopaedia, Data Sheets, and Tool Kit. I also agree with those of your readers who want skeletal components. It is performance that counts and a beautifully made receiver can often house a cheap, shoody component.—T. A. Birtswell (High Wycombe).

[See editorial comment at foot of Mr. Wren's letter in the last issue.—Ed.]

A Set for D.C. Mains Users

Sir,—I am in agreement with J. McRae, of Poplar, re D.C. sets. At Barking I have been on D.C. mains for five years, and yesterday an inspector called to inspect fittings and it is proposed to lay a larger cable, but definitely not with a view of changing to A.C. So you see I have no hope of eventual change. Unless one of the journals brings out a good five or six-valve D.C. set. Therefore I sincerely trust that you will publish a design for a good D.C. receiver in the near future. I have a D.C. amplifier, self-constructed, with 2 D.C. pentodes and 1 D.C. Gen. Purpose valve, together with a number of fixed condenser resistances, etc. The amplifier was a success, so I would like to build a D.C. receiver with a good range.—Geo. Davin (Barking).

[In the issue dated March 31st you will find particulars for building the D.C. Premier, which we think will meet your requirements.—Ed.]

CUT THIS OUT EACH WEEK

Do you know

—THAT the television system recently demonstrated has a frequency response up to 1 million cycles.
—THAT some types of resistance increase in value when measured.
—THAT the reactance of an air-core coil is ascertained by multiplying the inductance by 2π.
—THAT an air-dielectric condenser has a frequency response up to one million cycles.
—THAT ordinary cinema talkies (complete with the sound portion) may one day be receivable in the home by television.

NOTICE

The Editor will be pleased to consider articles of a practical nature suitable for publication in ELECTRONICS, 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 manuscript, every effort will be made to return them if stamped and addressed correctly.

All correspondence intended for the Editor should be addressed to: The Editor, Practical Wireless, Gas, Newman, Ltd., 1 Kingsland Street, Stratford, W.2.

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RADIO SUPPLIES

Send your list of Radio needs for our quotation. Kites, Parts, etc., supplied only to Stockists.

G. TAYLOR, 8, GROVE RD., BIRMINGHAM, S.W.12.

26c at all Dealers
A MODERNISED RECEIVER

"I am in trouble regarding my 3-valve set, diagram of which is enclosed. I have had the set about two years and thought I would take it to pieces and make a few modern alterations, I metalised the white baseboard, made cans for the coils and used ganged condensers. Upon trying out the set on medium waves I found that the only stations I could get were the North Regional and Belfast. Unless reaction was employed nothing was received. On long waves there is nothing but a whistling from the top of the dial right down to the bottom. Can you tell me what is wrong?"—W. A. D. (Liverpool).

If you have rebuilt the set with all of the old components, that is, including the coils, you have probably got it wrong.?—W. A. D. (Liverpool).

A number of firms can now supply a suitable transformer for your purpose, and it is preferable to purchase one with a number of different output tapplings so that the present valve may be more accurately matched, and also so that you may match up to a new valve should you obtain one with different characteristics from that present employed. You will find in our advertisement pages several advertisements by firms who can supply.

CORRECT REACTION CONNECTIONS

"I have a 4-valve set which has been working very well for some time, but now I have bought an eliminator and am experiencing trouble with it. The paint is that the resistance meter gives values which have tried many ways of stopping it, the best being to connect a resistance from the output choke terminal across to the H.T. terminal of the transformer. That stopped the hum, but signals are now too weak, just as they were when my H.T. battery was run down. The hum is due to a hum because of the hum. Can you help me?"—E. J. P. (Edgware).

We are not quite clear regarding the connections of your resistance but it would appear that you are seriously shorting some part of the circuit with consequent loss of signal strength. Unfortunately your trouble is due to instability, and you should insert decoupling resistances and ganged condensers in the circuits of the detector and first I.F. valve, and if this is inadequate, similar steps should be taken with the H.T. transformer.

FREE ADVICE BUREAU

This coupon is available until April 28th, 1934, and must be attached to all letters containing queries and enquires.

PRACTICAL WIRELESS 21/4/34.
PROFESSIONAL SUPPLY STORES offer the following Set Manufacturers’ Surplus New Goods at a fraction of the original cost; all goods guaranteed perfect; carriage paid over 5/- postage 6d. extra (Ireland, carriage forward).

Cash or C.O.D., carriage paid.

PREMIER SUPPLY STORES announce the purchase of the entire stock of a world-famous Continental valve manufacturer. All communications should be addressed to the Advertisement Manager, "PRACTICAL WIRELESS," 5 Southampton Street, Strand, London.

**PREMIER STORES**

**GIVES SEVEN TIMES THE VOLUME OF OUTPUT**

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**NEW 7 DAYS’ TRIAL**

- **SEASONAL** New 7 Days’ Trial. A.C. or D.C. transformers, lists.
- **Elektrol Condensers** 1 mfd. 6d.; 4 mfd, 2/-.
- **WIRE Wound Potentiometers** 50,000 ohms, 2/-; 500,000 ohms, 3/6.

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**NEW 7 DAYS’ TRIAL**

- **ATLAS ELIMINATOR**
- **BLUE SPOT 99 P.M. MOVING-COIL SPEAKER**
- **SENTRY ON 7 DAYS’ TRIAL**

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**MISCELLANEOUS ADVERTISEMENTS**

Advertisements are accepted for these columns at the rate of 3d. per word prepaid; minimum charge 3/ per paragraph. Our efforts reach this effect, therefore, not later than Tuesday for the following week’s issue. All communications should be addressed to the Advertisement Manager, "PRACTICAL WIRELESS."
The Diploma of the National Institute of Radio Engineering is a passport to a well-paid position in the wireless industry.

This book will tell you how to qualify for it.
THE 'RADIO GOLD-MINE'

THE 'RADIO GOLD-MINE' value, postage free.
E.C.1 (telephone: NATional 7473).

T ONDON EAST CENTRAL TRADING COMPANY

Speaker unit, comprising the complete outfit.

against cash or C.O.D.

short of this standard.

to specified values throughout.

components, sundries, blueprint and copy of PRACTICAL WIRELESS.

various colours (list 32/-), 10/-; Colons Universal A.C.

Chokes, 9d.; V -holders, 4 pin, 244.; 5 -pin, 3/d.

(list 10/-), each 2/11; CI. B. Driver, 3/11 ;

Philco, 2, 10, 15, 16, 20 and 32,000 ohms, 31d. ; Edison Bell, 39/-.

II. ADAPTOR KITS : S.W. Adaptor, 8/6; Special Iron Cored (diagrams included), 3/3;

B., 29/8.

CLASS B KITS : 3 -valve, 22/6 ; S.G.IV, 29/6.

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CLASS B KITS : 3 -valve, 22/6 ; S.G.IV, 29/6.

ELMINATOR KITS, complete with full diagrams, 4


D.C. 9/6. (Westinghouse Rectified.)

BROWN COILES CLEARANCE.—All dual range

lautsprecher, and pair of bass horns.

PARTS CLEARANCE.—H.M.V. L.F.

WIRELESS. Motors, with Auto -Stop (list 22/10,0), 35/-.

7 -pin, 60/-; Switches, push-pull, 2 -point, 41d. ; 3 -point,

D.C., 9/6. (Westinghouse Rectified.)

5,000v. for 7 DAYS’ TRIAL.

If satisfied, pay further 2/6 at once,

Full instructions enclosed.

Send to-day for your April number of THE RADIO

Greatest Bargains guaranteed new goods.

SPECIALLY CONSTRUCTED for the “A.C. LEADER 3”

A new design of Heayberd Mains Transformer was exclusively specified for the “A.C. LEADER 3”. This Transformer was specifically constructed to meet the requirements of “Practical Wireless” Technicians. Be sure you use this Transformer when making up the set.

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SPECIAL)

THE "Lincoln Super" Permanent Magnet Moving

Sound Loudspeaker, will support universal tapped transformer for O.P.P., H.M.V., pentode, power and super-power output, will carry 3 watts undistorted output, list price 67/6.

1,000 Volt Test. Block condensers with soldering terminals, 25/-; also screened and parallelised types, 2/-11; 1 mid.; 6/-11. Limited supplies.

SPECIAL SUNDAY BARGAINS (Cash with order only.)

I. Emanuel Screened Dual Range coils, 2/10 each.

S.Y. ELECTRONIC screens and condensers, 3/-10, V.M.P.M.C. speakers, worth double, 12/6 each.

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For the London branches; 100-101, Houndsditch; 11, York Wks., Browsing St...

" The "Lincoln Super" Permanent Magnet Moving

Sound Loudspeaker, will support universal tapped transformer for O.P.P., H.M.V., pentode, power and super-power output, will carry 3 watts undistorted output, list price 67/6.

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What are the causes and remedies for the following defects in gaslight prints:
   - Black Spots, Blisters, Brown Stains, White Specks, Yellow Stains
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   - When must a cine camera be held upside down in shooting a scene?
   - When is f/8 stop not 1/8?  
   - How do lamps used for photographic studios differ from ordinary electric light bulbs?
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   - How would you develop ultra rapid panchromatic plates and films?
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All these and hundreds of other practical questions are clearly answered in this splendid new work.

Get a copy of Part 1 To-day.

WORTH MANY TIMES ITS COST.

Produced in the straightforward practical style for which the House of Newnes has become justly famous, this work deals with a subject which is full of fascinating possibilities for the practical man who aspires to a more intelligent photography than that so tersely described by the phrase: "You press the button, we do the rest." Never before has such a wealth of really practical information on this subject been brought together within such a small compass. Every article has been written by a man who has made himself expert on the subject upon which he writes, and yet the information is conveyed in such a manner that it can be put into immediate use by the reader. It is quite safe to say that, to the man who has a practical turn of mind, each part of this work will be worth many times its cost.

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Obtainable at all Newsagents and Bookstalls, or by post 1/- from George Newnes, Ltd., 8-11, Southampton St., Strand, London, W.C.2.
A powerful combination of FOUR Cossor Valves—Variable-mu S.G., Pentode Detector, Pentode Output and Full-wave Rectifier—gives this handsome Receiver an outstanding performance. Its reproduction is superb. PRACTICAL WIRELESS reports: "...reproduction equal... to that associated with much more expensive receivers... high notes not surpassed in any set on the market." AMATEUR WIRELESS says: "...quality extremely good... as value for money this set is without parallel." Send at once for full details of this remarkable Cossor Receiver. Please use the coupon.

To A.C. COSSOR LTD.,

Please send me a copy of your phonograph catalogue of Cossor Receivers (B.20).

B.10.

SPECIFICATION
Cossor All-Electric Receiver Model 435 as illustrated complete with Four Cossor A.C. Mains Valves, viz.: MVSG Variable-mu Screened Grid, MP/PEN Screened Pentode Detector, MP/PEN Pentode Output and 442 BU Full Wave Rectifier. Mains Energised Moving Coil Speaker, single-knob tuning, illuminated full-vision scale calibrated in wavelengths (200-5,000 and 900-1,000 metres), wave-change switch, combined volume control and on-off switch. Handsome walnut-finished cabinet 13 in. high, 17½ in. wide, 10 in. deep, with Gramophone Pick-up plug and socket, terminals for extension Loud Speaker and plug and sockets for connecting gramophone motor. For A.C. Mains only. 200/250 volts (adjustable), 40/15 cycles.

Hire Purchase Terms: 2 and 30% deposit and 8 monthly payments of 25s.

Prices do not apply in I.P.B.
The Liberty Transmitter

It is reported from the United States that a proposal has been put forward to erect a high-power transmitter on Bedloe’s Island, New York. In view of the intense harbour traffic, it could not be connected by submarine cable to the mainland studio, but would receive the programmes through a short-wave station. The site is the island on which the famous bronze statue of Liberty was erected to commemorate the centenary of America’s independence.

Car Radio in U.S.A.

Wireless equipped cars have attained so great a popularity in the United States that it is estimated that for this purpose 700,000 radio sets were sold last year. Of some twenty million vehicles belonging to private owners it is computed that one in seventeen is equipped for broadcast reception. In New York alone one company running ten thousand taxi-cabs has had them all fitted with wireless sets for the benefit of both driver and passenger.

June 12th and the Lucerne Plan

The world’s largest gathering of broadcasting experts will meet in London on June 12th next to discuss amongst other matters the results of the Lucerne Plan. Some 130 delegates, including representatives from Russia, America, and also from British Colonies and Dominions overseas, will take part in the proceedings. The Conference will be under the Presidency of Admiral Sir Charles Crossland, Controller of the B.B.C.

How Interval Signals are Produced

The short musical phrase heard in the intervals of the Danzig (Germany) programme on 230.2 metres is produced by an electrically driven cylinder furnished with steel pins. The sounds obtained are not reproduced by a microphone, but in a similar way to a gramophone pick-up are transformed into electrical frequencies by means of small coils, duly amplified and conveyed by cable to the transmitter.

German Night Concerts

For some time past a regular series of late concerts starting at 23.00 and lasting until 01.00 has been broadcast by the Langenberg station. Announcements are made not only in German but also in the French and English languages. As the transmissions have been appreciated by foreign listeners, Hamburg has now imitated this example. In view of its close proximity to Denmark, Norway, and Sweden, announcements are also given in the Scandinavian tongues.

Our Great National Competition

Closes on May 14th

20 Guineas First Prize

and 200 Consolation Prizes!

See page 180

We are always first to succeed

Where others fail—Verb. Sep.

by the Langenberg station. Announcements are made not only in German but also in the French and English languages. As the transmissions have been appreciated by foreign listeners, Hamburg has now imitated this example. In view of its close proximity to Denmark, Norway, and Sweden, announcements are also given in the Scandinavian tongues.

Rome’s Second String

ROME III on 238.5 metres (1,258 kilocycles) is now working nightly; it shares a wavelength with San Sebastian (Spain). The station is used for the rebroadcast of the North Italian programmes only.

Radio Lisbon

It is reported that tests have already been carried out by the new transmitter at Barcarena, near Lisbon. The official opening of the station may take place in the course of a month or so. Before final tests can be carried out, it is necessary to await the completion of the laying of the special cable connecting the transmitter to the studio in the Portuguese capital.

Temporary 40-Kilowatt at Rennes

Although work has already started on the high-power station at Thourie (France) to be later known as Radio Ouest, in the meantime Radio Rennes is to be endowed with a 40-kilowatt transmitter which will be formally launched in the course of the summer months.

Broadcasting School in Paris

As complaints have been fairly frequent in respect to the lack of experience displayed by speakers and others in French studios, a syndicate of radio journalists is founding in Paris a broadcasting school, which is to open in October next. Instruction will be given by the best French actors, newspaper reporters, authors, and dramatists.

Aeroplane Transmissions on Long and Short Waves

THE Fokker express aeroplane Rijzheimer, which ensures the regular service between Amsterdam and Batavia (Java), has been equipped with long- and short-wave transmitting and receiving apparatus in order to permit continuous communication with either Bandoeng or with Kootwijk (Holland) during its journey. When the aeroplane is flying over India the connection with the Dutch East Indies is made by means of the short-wave transmitter, whereas when the distance is increased long waves alone are used.

Listen to Leningrad in May

During the period May 20th-30th, a musical festival will take place at Leningrad in which a number of symphony orchestras, conducted by both Russian and other foreign musical directors, will take part. Most of these broadcasts will be relayed to the Leningrad and Moscow high-power stations.
Radio In Police Helmets!

NOT a Utopian idea, but may become a reality within a very short time. Experiments are now being carried out by the Research Department at Scotland Yard with a view to the designing of a new police automobile for the police. The advent of the midget valve now placed on the market will greatly help in solving the problem.

No Radio Tax in Holland

ALTHOUGH suggestions have been put forward to introduce a tax on both wireless receivers and valves, it is reported that so far no measures are to be taken in this respect and that the broadcasting stations must continue to rely on private donations and subscriptions from their listeners.

New Norwegian Relay

THE 10-kilowatt transmitter erected at Vadsø, in the Varangerfjord, will be formally opened on May 17th. This is the Finnmark station to which the Norwegian Plan allotted a wavelength of 845 metres (355 kilocycles). Not only is this channel the last one usable in the Norwegian capital, but with the true Nazi spirit.

Night Transmissions

THE fact that the power of the Zagreb station for its monthly midnight transmissions (night of the first day in each month) is only 750 watts should not deter listeners from an attempt to hear the broadcast. It may be recalled that the Bow Bells signal used by the B.B.C. is only on rare occasions that it is used for the relay of radio entertainments.

Radio Listeners by Order!

A NEW Order in Council published in Germany decrees that all military barrack, to be equipped with receiving sets, and that officers are required to listen nightly to all official communications.

Broadcasting in Siam

ALTHOUGH the mention is seldom made of radio in Siam, there exists a transmitter working on 350 metres in the neighbourhood of Bangkok. It was installed in the old Phya Thai Palace. The programmes usually consist of Siamese music, but an exception is made on Fridays when European and American compositions are given. Unfortunately, although the station transmits a strong signal, it is only on rare occasions that it is used for the relay of radio entertainments.

Solve This Problem No. 83

PROBLEM No. 84

Bradley built up a receiver for operation from the D.C. mains, and obtained 4 2-volt valves for the purpose. He worked out the required resistance of 1,000 ohms to enable him to supply the required heater voltage. He accordingly purchased a standard 1 watt 1,000 volt resistance, and wired it into the correct position, but found that results were extremely poor. After two nights he could obtain no results at all. The circuit was carefully checked and all values were found to be correct. Where had he gone wrong?

SOLUTION TO PROBLEM No. 83

By connecting a resistance between the H.T. positive terminal of the receiver, it was found that the necessary 4 2-volt valves had not decompensated the voltage, but had simply reduced the H.T. applied to the receiver. The decompensating device should, of course, have been inserted in the anode lead of one of the valves.

The following three readers successfully solved Problem No. 82 and books have accordingly been forwarded to them:

A CONDENSER TESTING UNIT

In this article the author describes the construction and uses of a cheap but efficient multi-purpose testing unit.

Of particular interest is the method of leakage indication used. There is only one cheap and efficient indicator, the neon lamp, and it is around one of these that the unit is based. Even so, the usual neon lamp is similar in size to the standard 60-watt bulb, and this presented a rather difficult problem when the factor of compactness was being considered.

This was overcome by using what is known as an "indicator neon" in place of the larger type. This is a small neon, the approximate dimensions being 1 in. by 3/16 in., and the current consumed is only .5 watt. These miniature neons are only made to work between 200 and 250 volts, consequently this pressure will have to be used to operate the unit.

The question of a suitable supply will be dealt with later on in the article.

The neon lamp will be seen projecting through the hole in the raised panel, the holder for this being underneath the enclosed part. This can be seen in Fig. 2. When the correct voltage is applied to the neon it glows with an orange tint. It is essential that the lamp be seen when the lid is shut, so a 1½ in. hole was cut in the lid directly over the lamp and a circular piece of glass fitted in the manner shown in Fig. 2. A 1½ in. hole was drilled partly through from the inside of the lid previous to the 1½ in. hole, this latter hole being then drilled on the same centre to form a recess into which the piece of glass was fitted. It is held in position by the heads of screws inserted around the circumference.

It was intended to use a plain piece of glass in the original model, but a pocket magnifying glass, obtained from a multiple store, was found more suitable as it enlarged the neon.

The second switch, seen in Figs. 2 and 6, is a single pole change-over switch (hereafter referred to as the discharge switch) one connection of which is still "live" with the lid open. This would not matter normally, but the unit can be used on D.C. mains, and so it was considered necessary that both the power supply connections must be capable of being broken. The discharge switch then was wired to disconnect the other power lead, and in the "off" position (i.e., with the knob towards the hinges) to connect a resistance across the testing points.

From the foregoing it will be seen that the unit is as fool-proof as it is possible to make it. The connections to the condenser under test are made with short lengths of flex terminating in crocodile clips (Continued overleaf).
PRACTICAL WIRELESS

April 28th, 1934

(Continued from previous page)

function, and so it can be said that practically all A.C. sets have a potential supply of 250 volts D.C. This is suitable for the unit, so— for convenience in connection—a wall-plug or batten-holder could be fitted somewhere on the set. Choose a place that is convenient but not obtrusive.

Concerning the connections for this, one terminal will be connected to H.T.—, the other to H.T.+. Perhaps the best way of connecting to the latter point is to try the lead on both of the primary connections of the speaker output transformer, or on the L.S. connections of the set. This operation can be carried out with the set switched on, and the unit closed—with the discharge switch in the "test" position—and the test leads shorted.

When the unit is plugged in it will be found that the neon lights with the connection made in either position, but one is definitely brighter than the other. The former is the correct position, and as a further check this position will give the weaker click in the speaker. The connections can then be made permanently, and all that requires to be done is to switch on the set and plug in the unit when testing is to be carried out. The

![Automatic On-Off Switch](image)

![Discharge Switch](image)

![Cardboard Spacer (For Batten Holder)](image)

**Robust and efficient**, the unit can be used for reception in the normal way while using the unit, the only difference being an occasional "click" which will pass unnoticed. By the way, when carrying out the above tests, one might get a "nasty shock!"

If the constructor is not "at home" with mains sets, it would be as well to switch off during the operation of changing from one terminal to the other. The H.T.— connection can be made to any earth point on the set.

For reference purposes a typical smoothing circuit is given (Fig. 3) showing the best point to connect the plug.

**Method of Testing**

When testing the first consideration is the working voltage of the condenser. All condensers of repute should be capable of standing a pressure of 240/250 volts (D.C.) indefinitely, so it is safe to say that any condenser can be tested on the unit.

Those that have a rated working voltage in excess of 240 volts can also be tested, because a condenser with a absolutely sound when tested on 240 volts would in any case be fairly efficient at the higher voltage even if it is not designed for it. It must be emphasized that the unit cannot be used for testing electrolytic condensers, because this type passes a continuous current of a few milliamperes, this current being quite sufficient to light the neon at full brilliance.

Continuing with the testing, a condenser is put in the testing compartment, the test leads connected up, the discharge switch placed in the "test" position and the lid shut. The neon is seen to light for a second and then go out, remaining in this condition indefinitely. This indicates that the condenser is sound. It is the charging current that makes the neon glow for a short time. When the condenser is fully charged the current ceases to flow to all intents and purposes no further current should flow irrespective of the time the unit is left on.

If the condenser happens to be faulty there are two things which might happen. It may be found that the neon gave a continuous (but not necessarily steady) light. In this case the condenser is definitely faulty and should be discarded.

In the other case the neon may flash at regular intervals, there being no glow between the flashes. This would indicate that the condenser was not absolutely useless because it would obviously take a certain amount of the charge. The more charge it takes before leakage takes place (indicated by the neon) the higher would be the safe working voltage.

If the neon does not flash more than once a second the condenser can be used in positions where little or no voltage is applied, such as between band-pass coils and earth, or for bias decoupling. A condenser which "leaks" only once a minute is fairly sound and can be used with voltages up to 200. It requires very little practice to judge the condition of a condenser once the neon has indicated the amount of leakage.

**Additional Uses**

The unit may also be used for insulation tests between the windings of transformers, between the windings and the core, etc.
Choosing and Making L.F. and Output Transformers

An Article Packed with Useful Information for the Home Constructor.

By FRANK PRESTON

In previous issues of Practical Wireless there has been a good deal of information concerning the construction of various components, including mains transformers and chokes. And, despite the rather tedious work involved in the making of such components, readers have shown a tremendous amount of interest in the work. A large number have become so proficient at making their mains components that they have asked for details concerning low-frequency and output transformers, and it is because of this that this article is being written. Incidentally, it might be mentioned that constructional details for transformers of the "hedgehog" type were given in the issue dated January 14, 1933, but since proper stålloy stampings can now be bought cheaply from a number of firms, it is preferable that they should be used and not only are they more efficient than a bundle of ordinary soft-iron wires, but they are more convenient and produce better results.

Size of Core Stampings

Before such details as the numbers of turns on the primary and secondary windings can be decided Upon, it is necessary to know the size of stampings to be used, and also the required specification of the finished component. In the majority of cases it will be found that the most suitable sizes of "T" and "U" stampings will be numbers 5, 30, 30A, 30B, and 4A, and the actual dimensions of these can be obtained from Fig. 1, and the table given at the end of the article. It will be noticed that all these stampings are comparatively large by comparison with those used by component manufacturers, but there are good reasons for this. In the first place, many manufacturers employ core stampings of special alloys which have a higher permeability than stålloy, with a result that a higher inductance can be secured with a given number of turns and a smaller core volume. These special stampings are not generally available to the amateur, however, and if they were available would be found very difficult to wind on the necessity numbers of turns of extremely fine wire.

In order to obtain a high degree of efficiency combined with reasonable ease of construction, therefore, it is much better to use the larger stampings and thicker wire. As a matter of fact, this form of construction has decided advantages because the finished transformer can be used for directly feeding the L.F. valves without there being any danger of core saturation or large voltage-drop across the primary.

So as to simplify the information to be given, it will be assumed that, when No. 5 stampings are employed, the core will be built up from three dozen pairs, whilst with any of the other sizes given in Table 1, only two dozen pairs will be used. By following this rule the numbers of turns for any particular transformer will be just the same regardless of the core size.

Transformer Characteristics

Before deciding which size of stamping will be best one must settle upon the transformer characteristics required for the circuit in which it is to be used. It is desirable that the primary of every L.F. transformer should have a high inductance for any particular transformer ratio with which a sufficient voltage drop is bound to suffer.

A suitable inductance for the primary winding of a normal L.F. transformer, connected in the anode circuit of a medium impedance detector valve taking about 5 milliamps H.T. current, is 35 henries, and approximately this value can be obtained by winding 6,000 turns of wire on one of the cores previously specified. This primary winding can safely be adopted for any L.F. transformer whose primary current does not exceed about 5 millamps, since when the current is increased, as it will be if the preceding valve is of comparatively low impedance, the inductance is proportionately reduced, whilst if the current is reduced (by using a higher impedance valve, for instance), the inductance becomes higher. The result is that reasonably correct matching is obtained with any type of valve.

The Most Suitable Ratio

The number of turns required for the secondary winding depends upon the step-up ratio desired. For instance, if a ratio of 1 : 5 was wanted the secondary should consist of 30,000 turns. On the other hand, a ratio of only 2 : 1 was called for the secondary would require to have only 12,000 turns.

The choice of ratio depends upon two principal factors—the type of valve used after the transformer and the exact to which quality of reproduction is to be considered. As further explained, it point it should be explained that if too high a ratio were used, there would be a danger of overloading the following valve, so that the additional amplification given by the transformer would be more than useless. Moreover, an increase in the number of secondary turns means also an increase in capacity. And capacity necessarily causes a loss of amplification of the higher notes, so that reproduction is bound to suffer. For this reason it is nearly always desirable to use the lowest transformer ratio with which a sufficient degree of amplification can be obtained. This generally means that if two low-Continued overleaf)
frequency stages are to be employed best results can be secured by using two transformers as are about 1:2. When a single L.P. valve of the power type (having a fairly low amplification factor) is being used, a transformer ratio can, with advantage, be about 1:4 or 1:5; it is not generally worth while to exceed the latter number. Only L.P. valve in use is a pentode (giving a high amplification) the best ratio is usually about 1:3.

Choice of Wire

After having decided upon the principal requirements of the transformer the practical details can be considered. The first item is the gauge of wire to be used, and this must depend to a certain extent upon the ratio and, hence, upon the total number of turns to be accommodated upon the core. Wherever possible it will be desirable to use wire of a gauge not finer than 40, because thinner material is by no means easy to handle. Even 38-gauge wire is to be preferred for the primary winding, because it is too thick for the secondary in the majority of cases. However, the matter of wire gauge can best be settled by making reference to Tables 1 and 2 which give, among other data, the number of "Turns per square in." for three alternative gauges of wire, and the "Winding Area" afforded by the different core stampings specified. It should be mentioned that the "Winding Area" given makes allowance for the effect taken by the dimensions of core of the kind shown in Fig. 2, but not for the insertion of insulation between layers of the secondary winding. As the latter is desirable in order to keep down capacity the "Turns per square in." should be reduced by about 25 per cent. in respect of the secondary winding.

The method of constructing the transformer, after all the preliminary details have been settled, calls for little explanation as this matter has previously been dealt with in these pages. A start must be made by either building up or buying a winding spool to fit the stamplings specified. There were several firms who can supply ready-made spools, but there is no difficulty in making them from a strip of stout cardboard or fibre (see Fig. 3). After the tool has been made it should be given a coat of thin glue or shellac varnish to make it rigid and to fix the end cheeks more securely.

Winding the Transformer

Then solder a short length of flex to the end of the wire to be used for the primary and anchor this by passing it through two small holes made in one end cheek. Cover the soldered joint by applying a blob of sealing wax, and wind on the correct number of turns. At the end of the winding solder a second length of flex and anchor it as before. The whole winding should then be covered by means of a strip of oiled silk for insulation purposes. (This can be obtained cheaply from chemists in square sheets.) It is important that no secondary turns should be allowed to slip past the insulation, and it is therefore best to make the spool a little wider than the spool so that it will bend up against the end checks. Solder a length of flex to the wire for the secondary, anchor this, and commence the winding. It is desirable that the turns should be wound as nearly as possible in a spiral and a little care is required to ensure this. After every two layers cover the winding with a strip of thin oiled silk or waxed paper; this is to reduce the capacity. On completion the wire can be terminated as before and the spool covered with a couple of layers of oiled silk or similar material.

Correct Connections

Finally the core stampings can be fitted into the spool, making sure that they are packed tightly, and suitable clamps fitted. The latter can be bought ready-made or constructed from strips of hard brass or iron as described in several previous issues (see Fig. 4). Connection to the transformer can be made either by means of the loose flexible leads already fitted or by means of terminals mounted on strips of fibre or ebonite which are attached to the core clamps. In any ease the connections will be as follows: "Beginning" of primary winding to plate of previous valve; End of primary to H.T. +. "Beginning" of secondary to grid-bias negative; "End" of secondary to grid of following valve.

FROM MOVING IRON TO MOVING COIL

By G. W. Davey

When a moving-coil speaker is to be employed it is especially important that the output valve and the moving-coil speaker must be "matched up," that is to say, the impedance of the loud-speaker must be proportioned in regard to that of the valve. From the early days of wireless up to a year or two ago the loud-speaker was placed directly in the primary circuit of the output valve. The impedance of the high-resistance speakers then used being correct for the average output valve employed, everything was all right. Then came the pentode, the high-impedance output valve, and it was found the matching was not so good, especially as the low-impedance moving-coil speaker was becoming popular. As a result an output transformer had to be employed. This transformer is supplied as an integral part of the moving-coil speaker nowadays, so that correct matching should be possible. In regard to the output valve, make sure that it is not being overloaded. The moving-iron loud-speaker, good though it often was, suffered always from the tendency to cover up distortion caused by the set; this the moving-coil will not do. Any poor quality transformer, a worn-out one, a poor quality transformer, all will show up in a moving-coil loud-speaker in the shape of poor reproduction, so it is advisable to look over the set before buying a new speaker the quality of reproduction which it gives. If the transformer is two or three years old, or of doubtful manufacture, spend five or six shillings on a modern one; you will be surprisingly pleased at the improvement in tone it will give. And the valves—these are the real firms who can supply ready-made spools, but there is no difficulty in making them from a strip of stout cardboard or fibre (see Fig. 3). After the tool has been made it should be given a coat of thin glue or shellac varnish to make it rigid and to fix the end cheeks more securely.

Winding the Transformer

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(Continued from page 188)
A simple instrument of great value to the amateur experimenter is the valve voltmeter: this is an instrument utilizing the rectifying properties of an ordinary receiving valve to measure alternating potentials. It has the advantage that it is extremely easy to construct, in fact, most amateurs will already possess the necessary apparatus to construct this invaluable instrument. It has also the advantages that it can be used on alternating potentials practically independent of frequency, and in one case it is not necessary to have access to alternating-current instruments to calibrate it.

Valve voltmeters can be divided broadly into two classes: (a) Those which operate on the bend in the grid-volts grid-current characteristic of the valve, and (b) Those which operate on the bend in the grid-volts anode-current characteristic of the valve.

A Simple Instrument

The simplest instrument is the anode-bend slide-back valve voltmeter, which is shown diagrammatically in Fig. 1, and this will be considered first. Here a sensitive milliammeter is connected in the anode circuit of a triode valve working with a fixed anode potential, whilst a voltmeter of the direct-current type is connected to measure the variable-bias voltage applied to the grid. If the two input terminals are short-circuited the anode current is, as shown by the curve in Fig. 2, here the grid voltmeter is eliminated and a switch fitted to enable the anode-current meter to perform the dual purpose. The grid voltage is measured by the current which the voltage causes to flow through resistance R. The value of this resistance should be chosen according to the normal bias voltages used.

The negative half-cycles will cause the anode current to fall to zero. Owing to the fact that the valve is being operated at the knee of the curve the rise due to the positive half cycles will be greater than the fall due to the negative half cycles, and the mean anode current will be greater than the normal value.

The negative bias voltage should be now increased until the anode current is reduced to its normal value, then if V1 is the original value of the bias voltage then V2 is the bias voltage required to overcome the increase in anode current. This increase of bias voltage (V2-V1) is, approximately, equal to the maximum value of the alternating potential applied to the grid. This type of instrument can be simplified, as shown in Fig. 3; the anode voltmeter is eliminated and a switch fitted to enable the anode-current meter to perform the dual purpose. The grid voltage is measured by the current which the voltage causes to flow though resistance R. The value of this resistance should be chosen according to the normal bias voltages used.

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a high resistance, whilst the grid is isolated from the steady current by means of a fixed condenser. These instruments can be used at any voltage within the normal voltage range without changing the condensers used in their construction, providing a sufficiently high bias voltage is available.

An Alternative

We come now to valve voltmeters which operate on the bend in the grid-volts grid current characteristic of the valve. This type of instrument is similar in connection to the grid-leak type of detector used in wireless receiving sets except in the values of the components used. The value of the grid condenser should be chosen so that it has a small impedance at the frequencies used normally. If the voltmeter is used at speech frequencies 25 mfd. is a suitable value, whilst, if used at radio frequencies, .005 mfd. is a good value. Care is necessary in the choice of these condensers to ensure that they are non-inductive, and that they do not allow any leakage of direct current to the grid of the valve.

As the valve is operated at the bottom bend of the grid-current curve, as shown in Fig. 2, when an alternating potential is applied to the input terminals the positive half cycles cause grid current to flow. This grid current gives the grid condenser a charge which causes the potential of the grid to be negative with respect to the filament. For the presence of the grid leak the potential of the grid would become so negative as to cut off entirely the anode current, but, as it is, the grid potential becomes steady at a value depending upon the amplitude of the applied alternating voltage. Thus the application of an alternating voltage to the input terminals causes a fall in the steady anode current which is

M Y job as a service engineer brings me into daily contact with many and various types of radio-gear, and not infrequently the motors require attention. In fact, my experience tells me that motors are probably the most neglected part of any radio equipment. It is curious to reflect that many men, who at regular intervals oil a piano, would do as little to their motors with the result that many motors are worn after a long period of use.

This is, of course, a wonderful indication of the reliability of modern motors, but, nevertheless, a little intelligent attention at regular intervals will repay the enthusiast.

Electric motors may be roughly divided into two main types: (a) Universal and D.C.; and (b) Induction and synchronous. The latter type of motor will work off A.C. only. For D.C. mains one of the former types must be used, but a Universal motor is, of course, applicable to either A.C. or D.C.

The Commutator

If you examine a motor in class (a) you will invariably find a commutator, and this sooner or later is certain to give trouble. A commutator is really only a multiple-pole rotary switch and the contacts all have friction surfaces. A commutator takes the form of a copper cylinder which is split up into segments, each of which is carefully insulated from its neighbour with a layer of non-conducting material which is almost always mica (see Fig. 1). On the outer circumference of the commutator, and diametrically opposite, will be found two "brushes" which take the form of oblong carbon blocks.

If, when the motor is running, any sparking occurs at the points of contact it will very probably be picked up by the amplifier and will result in a very unpleasant continuous crackle in the loud-speaker. After a period of use the brushes wear down and a deposit of carbon dust is formed on the commutator. This must be cleaned off by revolving the motor by hand and holding some very fine glasspaper on the commutator. A word of warning is, perhaps, called for here. Under no circumstances should emery cloth be used—indeed, this should be avoided when doing any electrical work. The grade of glasspaper to use is called "flour" and is very fine.

It may be that the brushes are badly worn after a long period of use. In this case they should be replaced with new ones which can be purchased from the manufacturers for a few pence. The method of doing this will be obvious, although it varies with different makes. If it is uncertain whether the brushes require replacement or not, the point to watch is that there must be no danger of the metal holder touching the commutator.

"Skimming" and Slotting the Commutator

Some Useful Hints in Connection with the Maintenance of the Gramophone Motor. By "SERVICE."

The first thing to be done is to take down the motor and remove the armature complete. This should then be revolved in a lathe and a very thin "skim" or cut taken off the surface of the commutator. If there is no lathe handy, almost any garage will undertake this job for a small charge.

Care should be taken to see that no more than a very thin "skim" is taken off the surface of the commutator. A very thin file known as a "rat tail" is used in the next operation. All the small layers of mica should be filed down so that the Universal type of copper (see Fig. 2) is found. Perhaps, here repeat the warning given above: take off very little.

When re-assembly the motor, it should be cleaned carefully with a clean rag and fresh oil should be applied to all bearings.

(Continued on page 188)
THE Class "B" is a special form of valve designed to give a very large maximum output—an output much greater than that obtainable from any single battery valve of Class "A" type—and at the same time to limit the consumption of high-tension current to a value within the capacity of a small and inexpensive high-tension battery.

First of all, it is very important to understand exactly what is meant by the "output" of a valve, and what by the term "maximum output." By "output" is meant that portion of the power taken from the high-tension battery which is available for operating the loud-speaker.

It will be shown later that in the case of an ordinary, that is Class "A," valve, this proportion is quite small, and certainly not reaching 50 per cent.

**Maximum Output**

The useful maximum output of a valve is the maximum power that can be taken from it without introducing noticeable distortion.

In order to give the necessary "light and shade" to a musical item, bands, and so forth, which are playing at normal loudness during most of the programme, sometimes play more softly and sometimes more loudly than the average, and occasionally work up to a fortissimo climax. So that these gradations shall be reproduced in listeners' ears, it is necessary that the programme energy radiated from the aural source varies with the loudness of the music. Thus, while the radio-frequency power radiated remains substantially constant, the "programme energy," or "modulation," as it is termed, varies from moment to moment.

If a receiver is so adjusted that, during normal portions of the programme the output of the valve giving its maximum undistorted output, any loud passages which occur will be reproduced badly, there will be distortion and blasting, so it is necessary to employ a valve which, while giving the desired volume with average programme modulation, has sufficient reserve of output to handle, without undue distortion, the fully modulated passages.

**Somewhat Wasteful**

Unfortunately, with ordinary valves, this is an expensive and somewhat wasteful proceeding. The actual output of a valve comprises variations in the instantaneous value of the high-tension current—usually below a certain mean value, and if the output has to range from a moderate amount during most of the programme to a very large amount at special periods, the mean or average value must be high. Thus, a Class "A" super-power valve may take a steady high-tension drain of 15 milliamperes all the time the set is switched on, irrespective of whether a programme is being received, or what value of the modulation is soft or loud.

Fifteen milliamperes at 250 volts represents the high-tension consumption of 375 watts, and yet, with a fully-modulated signal, the valve would give an output of only two watts more than half an hour, while the average power during an evening's use will be very much less.

The standing current of a Class "B" valve is very small—usually about 3 milliamperes, but it draws more current just as it is needed when the signal input increases. For this reason, the losses in a Class "B" valve are very much less, while the proportion of the total high-tension drain which is available as actual power output is very high, amounting to about 65 per cent. as against some 25 per cent. in the case of a power or super-power triode.

Thus it comes about that it is possible for a Class "B" valve to have a maximum undistorted output of 1½ watts, yet the mean anode current over a representative period of use is less than 8 milliamperes. A similar maximum output from battery-operated triodes would necessitate several valves being used in parallel, and taking a constant drain of about 60 milliamperes, or nearly eight times as much as the Class "B" valve.

**How it is Done**

A Class "B" valve really consists of two complete triode valves contained in a single bulb. These valves have a very high amplification factor, and are so designed that the grid of each is used as the anode of the other. The immediate output valve is thus a self-contained push-pull valve.

The incoming signal is applied through a transformer with a centre-tapped secondary winding which, in the event of the speaker being accidentally disconnected, will give a definite amount of power which must be supplied by the previous valve in the receiver. In practice, therefore, a Class "B" output valve must be preceded by another low-frequency stage, known as the driver stage, capable of delivering an appreciable amount of power.

Referring to Fig. 1, the transformer used for coupling the driver to the Class "B" valve must be considered. This must be a step-down transformer, unlike those used for Class "A," and the ratio must be that recommended by the valve maker. It is also important that the secondary winding shall have a low resistance of between 200 and 400 ohms. It will be seen that the outputs of the two valves of the Class "B" valve are combined in an output transformer with a centre-tapped primary. Alternatively, a centre-tapped choke may be used. The transformer ratio must, of course, be chosen to suit the loud-speaker used, but it is important that the D.C. resistance of the primary winding shall be low—usually no more than 1,000 ohms.

Two other points about the circuit require special attention. In the first place, it is important that means be taken to prevent H.F. oscillation in the grid circuits, and for this purpose two resistances of 10,000 ohms, R1 and R2 connected between the ends of the input transformer secondary and the centre tap are recommended. Then it must be remembered that the characteristics of a Class "B" valve are very similar to those of a pentode, so that, in the event of the anode being accidentally disconnected when the valve is in use, very serious peak voltages may be generated which may damage the valve, or even cause the insulation of the output transformer to break down.

This risk can be avoided by connecting a 10,000 ohm resistance R3 and a 0.005 mfd. condenser C1 in series across the output transformer primary.
INTRODUCING
THE PRIMA MAINS THREE

An Easy-to-build and Cheap Mains Receiver which Incorporates a Ready-made Mains Unit and a Simple Standard Circuit

THERE are a large number of readers, as is proved by our correspondence bag, who, whilst they would very much like to build a receiver to operate from the A.C. Mains, are rather shy of attempting to build up equipment which has eventually to be plugged into the high-voltage house circuit. Whether or not this is because they think there is some danger to be guarded against, or whether they are afraid the apparatus might be damaged with consequent risk of expense for replacements, etc., we do not know, but there is definite proof that such a hesitancy does exist. The object of the Prima is to overcome such difficulties and to present to the home-constructor a complete mains receiver which has all the advantages of the usual simple home-construction and yet confers the benefits of a good mains receiver.

The Circuit

A may be seen from the circuit and the illustrations a complete mains unit is employed, and this is manufactured by Messrs. Mains Power Radio, Ltd. The receiver proper is provided with leads after the fashion of a standard battery receiver, and these leads are plugged into the sockets of the mains unit to provide the H.T. and L.T. supplies. Mains valves are employed, the H.F. and detector valves being of the indirectly-heated type, and the output valve having a directly-heated filament. This is of the type designed to operate with raw A.C. and, therefore, a 4-volt A.C. supply is provided on the mains unit. The circuit is of the standard H.F. detector type which has proved time and time again to provide the best results, combined with simplicity of operation. The aerial circuit consists of a simple tapped coil, the aerial being joined directly to the secondary of the transformer, and the speaker is intended for connection to the variable-mu type, and the output valve a directly-heated filament. This is of the type designed to operate with raw A.C. and, therefore, a 4-volt A.C. supply is provided on the mains unit.

List of Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>One &quot;Prima&quot; Steel Chassis—Peto-Scott.</td>
<td>Steel chassis for the Prima Mains Three.</td>
</tr>
<tr>
<td>One &quot;Prima&quot; Special Two-tone Tuning Condenser—Ormond 8.166 (C1 &amp; C2).</td>
<td>Special two-tone tuning condenser.</td>
</tr>
<tr>
<td>Two Tuning Coils; one Type KGO and one Type KGR—Colvern.</td>
<td>Tuning coils for the H.F. section.</td>
</tr>
<tr>
<td>One 0.001 mfd. Differential Reaction Condenser—Graham Fairish (C3).</td>
<td>Differential reaction condenser.</td>
</tr>
<tr>
<td>One 10,000 ohm Potentiometer—Cosmocord (R1).</td>
<td>Potentiometer for the L.F. stage.</td>
</tr>
<tr>
<td>Three Strip Wire-wound Resistors—Colvern Flat Type (10,000 ohms and 15,000 ohms) (R4, R1, R2).</td>
<td>Wire-wound resistors for bias and screening.</td>
</tr>
<tr>
<td>Two 0.0005 mfd. Fixed Condensers—Graham Farish (C6).</td>
<td>Fixed condensers for bias.</td>
</tr>
<tr>
<td>One 0.0002 mfd. Fixed Condenser—Graham Farish (C5).</td>
<td>Fixed condenser for bias.</td>
</tr>
<tr>
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</tbody>
</table>

(Continued on page 189)
The new Blue Spot "Star" has already aroused an enormous amount of interest and those who have heard its remarkable performance have nothing but the highest praise for this very remarkable speaker. Here are the principal features.

**NEW MAGNET SYSTEM**
The magnet material is enclosed in four chromium-plated tubes. The high flux density and many other special features give a Krinetic maintained degree of power and quality.

**UNIVERSAL MATCHING**
The transformer is designed on unique and highly efficient lines and is arranged to match ANY OUTPUT STAGE from Power to Push-Pull Pentode and Class B and can be used as an extension loudspeaker from the speech coil circuit of an existing loudspeaker without loss of efficiency. Full instructions on back of plate of speaker.

**ON AND OFF SWITCH OR REMOTE VOLUME CONTROL**
A switch plug is provided to cut speaker out of circuit when desired. This switch is interchangeable with Blue Spot Remote Volume Control and a "on" and "off" switch.

**EXTENSION SPEAKER SOCKET**
A socket is provided for an extension speaker to be plugged into the Blue Spot "Star." The controls of each loudspeaker remain completely independent.

**DUST-PROOF**
The cap in the centre of the cone and the special dust covers which surround the speech coil and magnet gap render the speaker completely dust-proof.

**DIE-CAST CHASSIS**
Ensuring no toes of magnetism, complete rigidity and absence of chassis resonance.

**SPEECH COIL**
Low resistance and high efficiency, giving minimum variation of impedance with frequency.

The entirely new design of outside suspension gives great freedom of movement with complete lateral rigidity.

**THE SPEAKER WITH THE NEW MAGNET**

**THE BRITISH BLUE SPOT COMPANY LTD**
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PP.W. 20/4/34. BLOCK CAPITALS, PLEASE

April 28th, 1934
A Midget Loud-speaker

SOME types of motor car electric horns can be used as successful midget loud-speakers by making the small alterations shown in the accompanying sketch. It will be seen that the contacts of the ordinary make-and-break are removed and the winding is then connected to the speaker terminals of the receiver. The resistance of the winding is quite low and it is therefore necessary to connect it to the set through a suitable step-down transformer having a ratio of about 25 to 1 when the output valve is of the small power type, or 35 to 1 in the case of a pentode.

It will be appreciated that a speaker made according to the method described is not extremely sensitive whilst it cannot be considered a “quality” instrument. Nevertheless, it will give fairly good results in most cases, whilst an improvement can often be made by removing the normal winding and replacing it with one of very fine wire such as 38-gauge enamelled.-A. Cox (Alresford).

Gas Heater for a Soldering Iron

WHEN heating a soldering iron over an ordinary gas ring a quantity of gas is usually wasted, and this may be overcome by resorting to the method here illustrated. A tin lid with a centre hole 1 in. diameter is lined around the inside with a strip of asbestos, and the edge of the tin cut away to accommodate the gas feed pipe. After placing the lid over the gas ring, as shown, it will be found that very little gas is required to produce a flame adequate for heating a soldering iron, and no gas will be wasted.-A. G. ACKROYD (Forest Gate).

Improving the Appearance of Control Knobs

MANY knobs and escutcheons on amateur-built sets are of different colours, and although knobs may be purchased of the same colour, the purchase of an escutcheon is a different matter. It is quite easy to make all knobs and escutcheons any desired colour by the following method. Some fancy sealing-wax, methylated spirits and a brush are the only requirement. Break up the sealing wax so that it will go into a 2oz. bottle, just cover the wax with methylated spirit, give it a shake or two and let it stand until next day, when the wax will be dissolved. A small camel’s hair brush will be found suitable to paint the wax on the knob or other article to be treated. In two days the finish will be found to be quite hard and of high polish. Any colour can be obtained, such as bronze, red, green or aluminium. Stationers and art stores supply suitable wax in sticks about 5 or 6in. long.-W. Paxvov (Dewsbury).

A gas-economising device for heating a soldering iron.

A switching arrangement to provide for automatic station selection.

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 wrinkle 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., 81-84, Southamp ton 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 "Radio Wrinkles." Do NOT enclose Queries with your Wrinkle.

A "Low Loss" Valve-holder

AN efficient low-loss valve-holder for an ultra-short-wave receiver can be made in the following manner. Four pieces of copper foil or thin sheet brass are cut and bent around a valve pin, as shown in the sketch. The mounting and insulating washers can be cut from an old ebonite lead-in tube. In mounting, use the valve as a guide to get the correct positions by pushing the four sockets on the pins and screwing down while held in position on the baseboard.-T. H. SKINNER (London, E.C.).

Automatic Station Selection

WANTING a choice of three stations without the trouble of tuning, I evolved the idea illustrated in the accompanying circuit. The stations which were tuned in were: London Regional, 6XX, and Radio-Paris. The switch was then turned to the centre position; condenser C was tuned to Radio-Fiele. The switch was then turned to connect condenser A to earth, and the latter was then tuned to 6XX. The switch was then turned to the third position and London Regional was
tuned in with condenser B. The preset condensers A, B and C were 0.001, 0.003 and 0.002 µfd, respectively. The switch is of course, of the D.P.D.T. three-position type.—C. P. O’CONNOR (Brighton).

An Automatic Gram. Switch

The accompanying sketch shows a simple method of arranging an automatic stop on an electric gramophone. The relay is made from an old electric bell movement, with connections altered as shown. The contact piece B is made from thin sprung brass and can either be soldered on to pick-up arm or, if the arm is made of bakelite, it can be drilled and bolted on. The contact screw A is made from a piece of 2B.A. screwed rod 2in. long, and a brass or aluminium bracket is tapped to take the screwed rod. An old ebonite knob, as used on the early condensers, can be screwed on one end of the rod for adjustment purposes. The battery can be an ordinary flash-lamp battery or an accumulator.

To adjust the auto-stop, put pick-up on the run-off groove of record and turn knob until A and B make contact. Then switch on motor and play record in normal way. When the record is ended the pick-up will run into the groove, close contacts A and B, which will cause relay magnets to be energized by battery, thereby attracting the armature and breaking relay contacts, which will switch off the motor. Upon lifting the pick-up the motor will restart itself and if the gramophone is not required immediately the motor can be switched off in usual way.

The auto-stop never fails to act if properly adjusted, and is more certain in its action than the normal type of automatic stop. The relay and battery should be placed inside the cabinet to avoid the risk of anyone touching the live contacts to the relay.

As the battery will run down if not in use, it is advisable to store the battery, which is not required immediately the motor is switched off, in the normal manner.

A Useful Combination Tool

A HANDY pocket tool, which can be used for wire stripping and several other purposes, is shown in the accompanying sketches. In one end of a piece of steel tubing, 1in. long, two pieces of spring steel, bent as shown, are firmly fixed. One bent-over end is notched and the other filed to a sharp edge. On the side of the tube, at the other end, a small metal block is soldered which holds a short length of a round file arranged to be held in position along the side of the tube when not in use. It is clamped by a small milled-head screw. A short piece of spring steel, notched in the middle, is fixed to the end of the tube, and projects about 1⁄2 in.

For cleaning valve pins the tool is used as shown in Fig. 1, and terminals can be cleaned as depicted in Figs 2 and 4. Wire can be quickly stripped, as shown in Fig. 3, and the tool is used for cleaning the sockets in valve-holders, as shown in Fig. 6. An alternative method of making the tool with one piece of spring steel is illustrated in Fig. 5.—J. W. HORSEY (Wellingborough).

An efficient automatic gramophone-switch.

THE FIRST PAPER TO SHOW

HOW TO FIT UIFOCAL COILS IN STANDARD RECEIVERS! ALWATS FIRST!

Anchoring Multiple Battery Leads

A method of anchoring battery leads.

Micro-condensers

For some types of band pass coupling, and for coupling an additional tuned circuit to early types of receivers that are unsatisfactory under modern conditions, condensers of 20 micro-micro-farads are frequently specified.

These components are not usually stocked, so that it is useful to know that the capacity of two pennies separated by a piece of thin typewriting paper measures just about 20 micro-micro-farads. The dielectric value of paper is approximately the same as air but if mica of similar thickness is used, the capacity will be increased six times, more or less, depending on the particular specimen, which means that two metal plates less than a quarter of an inch square, separated by a thin slip of mica, will give a capacity of 20 micro-microfarads. For such small values it is more practical to use air dielectric.

For calculating still smaller capacities of 5 and 10 micro-micro-farads which are necessary in the aerial lead of ultra-short-wave receivers it is useful to remember that the capacity of a condenser is proportional to the area of the plates and inversely proportional to the square of the distance between them.

For the reception of the 7.75 metre experimental transmission being made from Broadcasting House, an aerial series condenser of about 5 micro-micro-farads is required.

A useful tip for a small coupling capacity is to connect, in circuit, the grid and anode pins of an old type burnt out valve with a solid base. Most of these have a capacity approximating to 20 micro-microfarads.—B. T. WALLACE (Norburry).

The above sketches illustrate several uses to which the handy combination tool can be put.

50 Tested Wireless Circuits

edited by F. J. CANN

April 28th, 1934

An old valve-holder of the terminal type makes a good connector for constructors who use multiple battery cords or flex, as shown, and is a safeguard against any components in the set being damaged through wires being tangled round valves, etc., and then being pulled by accident. The valve-holder can be mounted on the base board to the rear of the other components, and the battery flex taken through a small hole in the back of the cabinet.—C. HEATON (Bolton).
The aerial tuner is exactly the same as that described in the previous article, except that the reaction winding is omitted. Coupling between the H.F. valve and the detector is of the conventional tuned-grid variety, and the lead marked “to Detector” may be connected either to the aerial or grid terminal on the detector tuning coil, according to which gives better results. The H.F. choke used for coupling together the two valves is exactly the same as that described before, and should be mounted with its axis at right angles to that of the tuning coil, and as far away from the latter as conveniently possible. In order to prevent any interaction between the two tuning circuits it is preferable to erect an aluminum screen in the approximate position shown. All components excepting the aerial tuner are shown. The screen should be used, and the H.T. + lead of the detector valve should be connected to the appropriate terminals on the detector valve holder. A 120 volt high tension battery should be used, and the H.T.+ lead from the S.G. stage should receive the full voltage, but the detector lead will require to be tapped down to a voltage between about 30 and 80, depending upon the particular valve used in the detector position.

An Aperiodic Aerial Circuit

If it is proposed to make the amplifier aperiodic, or untuned (and this will be better in most cases), it will only be necessary to remove the aerial tuning coil and its associated condenser, replacing these with either a second H.F. choke or a fixed non-inductive resistance having a value between 100,000 and 250,000 ohms. Most experimenters will prefer to try all three aerial arrangements, especially since it is a very simple matter to change from one to the other.

The complete two-valve S.W. outfit is not only suitable for use as an ordinary receiver, but can be used as an adaptor or converter by connecting the detector as described and illustrated in the earlier article referred to before. As a matter of fact, the two-valve circuit makes an almost
Making a Converter with I.F. Stage

It has been stated several times in these columns that a converter is always much more satisfactory and efficient than an adapter, but it is known that a converter can only be used along with a broadcast receiver having at least one H.F. stage which can act as an intermediate frequency amplifier. Experimenters who favour the det.-I.F. type of broadcast receiver can, however, make a special converter for use with it. The converter must have, in addition to the single-valve detector-oscillator, a valve which can act as an I.F. amplifier, and this should preferably be tuned to a frequency of about 150 kilocycles (2,000 metres).

An excellent unit of this type can be made by employing the circuit arrangement shown in Fig. 2. The only component of the detector valve is shown for simplicity. It will be seen that an intermediate-frequency transformer is used to couple together the detector and oscillator valves, connecting the converter directly to the first I.F. amplifier. A circuit of the type shown in Fig. 2, however, can be used quite successfully with many types of superhet without modifying any of the connections. The idea is that "double frequency-changing" is employed; in other words, the incoming signals are first changed to the frequency of the first I.F. stage, after which they are rectified and again changed to the frequency of the second I.F. amplifier, which forms a part of the complete broadcast superhet. The idea appears somewhat complicated, but it has often been used very successfully in practice, and it is especially useful when working on wavelengths of 20 metres and less. It could be tried very easily by building a unit using the circuit shown in Fig. 2. It will generally be found better, in this case, to use a higher intermediate frequency than 150 kilocycles and, in fact, a frequency of about 600 kilocycles is usually found to be as good as any. A transformer for this frequency can be made in the same manner as was previously described, but by putting only 60 turns of No. 30 wire instead of 150. The pre-set condensers can be reduced from a maximum of 0.0002 to 0.0001 mfd. with advantage.

A Converter with a Broadcast Superhet

A number of readers have asked if it is possible to employ a short-wave converter in conjunction with a broadcast superhet receiver. Generally speaking, the usual type of simple converter is not suitable for use in this way, unless one is prepared to disconnect the detector and oscillator valves, connecting the converter directly to the first I.F. amplifier.

To show how the movement of the plunger will affect the selectivity of the circuit in which it is included. Therefore, if the coils are mounted separately, it will be possible to obtain a very fine degree of selectivity adjustment by moving either plunger, a kind of vernier adjustment being obtained if one is made of a higher degree than the other. In other words, you have two separate adjustments which can be linked together and obtained with excellent results. If, however, these two controls are linked, not only is the degree of adjustment restricted, but it will probably be found that the increased selectivity is too sudden to permit of the accurate setting of the control, as both circuits are varied at once. However, there is no reason why readers should not try out the scheme if they so desire, and the above details will enable them to connect the two coils in the required manner. To prevent any possibility of instability due to interaction, it is suggested that the coils be as far apart as possible, and a thin sheet of aluminium, connected to earth, should preferably be arranged in the centre of the two units.

Disadvantages of Ganging

There will, however, be found to be a disadvantage in coupling the two coils together. It has already been pointed out how the movement of the plunger on one of the coils varies the degree of coupling between the "primary" and "secondary," and thereby increases the selectivity. If two such coils are employed, one in the serial circuit of an S.G. Detector of the detector valve, it will be obvious that the movement of the other plunger will affect the selectivity of the circuit in which it is included. Therefore, if the coils are mounted separately, it will be possible to obtain a very fine degree of selectivity adjustment by moving either plunger, a kind of vernier adjustment being obtained if one is made of a higher degree than the other. In other words, you have two separate adjustments which can be linked together and obtained with excellent results. If, however, these two controls are linked, not only is the degree of adjustment restricted, but it will probably be found that the increased selectivity is too sudden to permit of the accurate setting of the control, as both circuits are varied at once. However, there is no reason why readers should not try out the scheme if they so desire, and the above details will enable them to connect the two coils in the required manner. To prevent any possibility of instability due to interaction, it is suggested that the coils be as far apart as possible, and a thin sheet of aluminium, connected to earth, should preferably be arranged in the centre of the two units.
NEON LAMPS FOR TELEVISION

A Simple Explanation of their Characteristics and Uses

Despite the extensive use in television receivers of the disc type, the average user is inclined to look upon neon lamps as rather marvellous scientific devices. As a matter of fact, they are simple in the extreme and consist of nothing except two metal electrodes supported within a glass bulb filled with neon gas at low pressure. Neon, in common with one or two other comparatively rare gases, has the property of "ionizing," or splitting up into its positive and negative constituents, when a pressure of electricity is applied to it. Thus, when a voltage is applied to the two electrodes in the bulb the gas becomes ionized and then becomes luminous, due to the electronic bombardment which takes place.

No "Time Lag"

The principal feature of the neon lamp, from the television point of view, is its ability to produce an orange-red glow, but to flicker when the voltage applied to it is too high for most purposes. It is a perfectly simple matter to remove the resistance, which form the signal output from the ordinary electric light flickers when the applied voltage is varied over a fairly wide range, but there is a considerable "time lag" in the light of the neon. In other words, the light changes comparatively slowly after the voltage has been changed, due to the charging and discharging of the gas in the lamp. This is because of this that the neon is so well suited for the purpose; it has no perceptible "time lag" or "inertia.

Using Ordinary Neon Lamps

When a disc television machine is used in conjunction with a mains set the difficulty of obtaining a continuous voltage does not usually exist. Unless there is a large surplus of output voltage from the rectifier, the neon lamp is used for the neon of the output valve it is best to parallel-feed the neon lamp (which is usually wired in series with the synchronizing coils for convenience). When there is an excess of H.T. voltage the neon can conveniently be wire in series between the anode of the output valve and H.T. positive. In both instances it is necessary to take into consideration the current carried by the neon lamp and also the voltage-drop which it produces. This point was, however, dealt with rather fully in an article which appeared in this Supplement dated March 3rd, 1934, and anyone who requires further information are requested to turn up a copy of the issue concerned.

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WILL MY SET OPERATE A TELEVISION RECEIVER?

A Clear Reply to an Oft-repeated Question.

In replying to the query contained in the title it is necessary, first of all, to know what type of television apparatus it is the user proposes to use. There is no evidence in the method of operating disc, mirror-drum, mirror-screw, and cathode-ray tube devices, for instance. Perhaps it will be best to start by saying that to operate a cathode-ray viewer it is necessary to have a special time-base apparatus in addition to either of the latter types. Beyond this, however, there is no very great difficulty, and the time-base equipment can be fed from most types of receiver which are capable of delivering an undistorted output of two watts or so.

Minimum Signal Output

The mirror-drum and mirror-screw types of machines, generally speaking, require greater inputs of audio-frequency energy than do disc machines, and it is nearly always found that a minimum of three watts undistorted signal energy is required to operate them at all satisfactorily. Additionally, a polarising voltage of about 400 is required by the mirror machines, and this naturally presents a rather serious problem to the user of an average type of wireless receiver. It is, of course, possible to obtain the required voltage from dry batteries, but this method is both inconvenient and expensive, besides which it is well-nigh impossible to obtain the required audio-frequency current from a battery-operated receiver. Even with a mains set a rectified D.C. voltage of 400 is unusual and necessitates a special rectifier, which gives a D.C. output of 500 volts at 120 milliamps. From the foregoing remarks it will be obvious that mirror machines are suitable only for operation from good quality power amplifiers, where high H.T. voltages are available.

The disc type of television receiver is undoubtedly the most popular, and it can successfully be fed from any moderately good set. A minimum figure for the necessary output should be considered to be approximately 500 milliwatts, although it is sometimes possible to get passable pictures with less audio-frequency energy. In any event it is necessary to take into consideration the current passed by the neon lamp (which is usually wired in series with the original battery) feeds the neon alone.

Neon Connections

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SCANNING DISC TROUBLES
Obtaining the Best From a Scanning Disc.

ALTHOUGH the simplest method of building up a television receiver is to use a disc of aluminium perforated with thirty holes, the picture depends upon the accuracy of the holes. The disc may, of course, be purchased from a reputable firm, but there are one or two points which must receive attention in order to enable a perfectly good picture to be seen. It has been explained many times how each hole to line up with its neighbour, and although when made this point may have received careful attention, dust or paint in the holes will cause dark lines on the received image. The disc should be cleaned with a very fine watchmaker’s file.

When the disc is rotating at speed there should be a clean rectangle of light, any dark or light lines indicating that the individual holes are not out of alignment. This may be remedied in most cases by the following schemes.

Attering the Position of a Hole. A dark line will argue that the edges of adjacent holes are not meeting, and the disc should be turned slowly until the pair of holes lines up and the edges of the pair should be carefully filed with a fine watchmaker’s file. Do this extremely carefully, repeatedly running the disc until the exact amount has been removed from each hole and the dark line has disappeared. If a white line is seen it will indicate that two holes overlap and this may be remedied by marking the holes, and removing the disc. The latter should then be laid on a bright surface and the offenders edges carefully tapped with a flat-ended object to spread the metal. Repeated tests should be made so that only the required amount of spread is given to enable the holes to line up.

Concerning the Wavelength upon which such experiments are being made, nor the hours concerning such transmissions. However, be under the impression that some interesting material for his investigation on the wavelengths between 6 and 8 metres. Repeated tests should be made so that only the required amount of spread is given to enable the holes to line up.

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LOUD-SPEAKER FRETS

The Author Gives Much Practical Information Concerning the Question of Improving the Set's Appearance

By DEREK ARCHER

The appearance of radio cabinets, especially those in which the loud-speaker is also fitted, can be greatly enhanced by the design of the speaker fret. The actual design of the fret is, of course, largely a matter of individual preference, but there are several factors which must be taken into consideration. If the unit employed is fitted to the front of the cabinet, some provision must be made in the design of the fret for securing the unit. Fig. 1 shows such an arrangement. The unit A is secured to the front of the cabinet B by the screws C. The silk, or other material which covers the open parts of the fret, is shown as D. Silk, and other material employed is taken into consideration. But there are several factors which must be largely a matter of individual preference.

The actual design of the fret is, of course, enhanced by the design of the speaker fret. The cabinet is to be designed to the unit,

Replacing the Silk

The best method of replacing or renewing the silk is as follows. Glue along the top of the fret and stretch the top edge of the silk and place it on the glue. Hold the silk in position for a few seconds until it holds, and then firmly press the silk all the way along. It is necessary to see that this edge is holding firmly before proceeding. Then glue down the sides and the bottom edge, stretch the silk and press it into position. Turn the cabinet round so that you can see the front and work the silk down and sideways accordingly, so as to get the warp and warp of the silk straight. This is not important where a well-figured silk is used, but is very important if a good appearance is to be obtained when the material is plain or striped. The replacing of silk in a simple cabinet is rather awkward, and the scheme of using a separate baffle, which holds the unit, is shown in Fig. 2. The material D is glued to the baffle E, which is fixed to the front of the cabinet B by four screws, which can, of course, be easily unscrewed at any time.

The shape of the baffle is shown in Fig. 3, and usually would be made of wood, but a metal strip, as shown in Fig. 4, can also be used, but the material would have to be fitted to the cabinet. An advantage which is to be obtained from the use of a separate baffle lies in the fact that it is not necessary to design the fret to cover the fixing holes for the loud-speaker. Two very simple designs for frets are given in Figs. 5 and 6, the unit fixing holes being shown at C.

The loud-speaker unit can remain fixed to the front of the cabinet B, or can be fitted to a separate baffle. The silk should be taken out of the cabinet and all except the necessary parts of the fret cut out. The new material should then be glued to the new fret, which can then be screwed into position. No allowance need be made for fixing the loud-speaker on this type of fret, and the design can be arranged irrespective of the centres of the loud-speaker unit.

A Neat Design

A very effective type of design for frets, generally known as "prison bars" and employed by a well-known firm of manufacturers, is shown in Fig. 8.

(Continued on page 190)
THE SUPERHET SIMPLY EXPLAINED

The average amateur is inclined to look upon the superheterodyne system of reception as complicated and beyond his understanding. As a matter of fact, however, there is no reason why this should be the case, because the principles underlying the superheterodyne are particularly straightforward and by no means difficult to understand.

In order to get a clear idea in regard to the function of the superheterodyne circuit there are one or two simple points which the reader must first consider.

The first is that it is always easier to design a high-frequency amplifier for operation on a comparatively long wavelength than it is to make it function efficiently on short wave lengths. Another is that the efficiency of an amplifier varies to a certain extent according on short waves.

It is because of these facts that the principal H.F. amplifier of the superhet is always tuned to a definite low frequency, or high wavelength. The particular frequency chosen is generally 110 kilocycles. It corresponds to a wavelength of about 2,700 metres, but intermediate frequencies of 126 and 150 kilocycles are employed in certain instances.

Simple Analogies

The first question which must be answered is "How can the frequency or wavelength of the received signals be changed to the frequency at which the I.F. amplifier works?" Broadly stated, the answer is "By mixing oscillations of other frequencies with the signal frequencies." The idea underlying this will more readily be understood by taking a mechanical analogy. For instance, all readers will have noticed, when travelling in a car or omnibus, that the exhaust note appears to change when another motor vehicle is being passed. The reason is that the note or sound made by the car in which the observer is travelling is "mixed" with the sound made by the other vehicle, with a result that a so-called "beat note" is produced. Generally the note will be of very low frequency and might be heard as a series of "thumps"; as a matter of fact, this often causes a certain amount of discomfort to the driver of a car, because the noise gives the impression that the engine has suddenly developed a peculiar fault.

Another analogy is afforded by the organ. When a low chord is played one can often hear, in addition to the sound of the two or more notes struck, a periodic "bumping" sound. The latter is again a "beat note" and is of lower frequency than any of the notes actually being played. For example, if one note had a frequency of 50 cycles a second and the other of 60 cycles per second, the "bumping" sound would have a frequency of 10 cycles per second or, in other words, the "bumps" would be heard ten times every second.

Superhet dyn.: "Mix. it up!"

And now the "mixing" of high-frequency electrical impulses can be compared with the examples just given. If a signal on a wavelength of 300 metres or a frequency of 1,000 kilocycles was tuned in on the first valve of a receiver, and then mixed with oscillations having a frequency of 1,110 or 880 kilocycles there would be a resultant frequency of 110 kilocycles. On the other hand, if oscillations of 1,150 or 850 kilocycles were mixed with the received oscillations a frequency of 150 kilocycles would be produced.

Once the above points have been clearly grasped it is easy to follow the behaviour of a superheterodyne receiver which consists essentially of the units shown in Fig. 1. First of all there is the first detector, to which the aerial and earth leads are connected. The aerial circuit is tuned in the usual manner by means of a coil and condenser, whilst an oscillator (also tuned) is coupled to the first detector and is used to supply the oscillations necessary to convert the frequency of the received signals to the pre-tuned frequency of the intermediate frequency amplifier. After the two sets of oscillations have been "mixed" they are passed on to the I.F. amplifier in which they are amplified in the same manner before being applied to the grid circuit of the second detector.

The second detector functions exactly the same as the detector in the "straight" set by separating the unwanted high frequencies forming the carrier wave and the audio-frequency vibrations which constitute the sound being transmitted. The latter are then passed through the low-frequency amplifier and to the loud-speaker in the very same manner as in any other kind of receiver.

Fig. 1 shows only the main essential of the superheterodyne arrangement and in practice the first detector is often preceded by an S.G. high-frequency stage whilst the oscillator function is combined with that of the first detector in a single valve of the S.G., pentode, pentagrid, or triode type. It might interest some readers to know that practical problems of frequency-changing were dealt with fairly fully in the article entitled "The Superheterodyne Freency- Changing" which was given in Practical Wireless dated April 7th, 1934.

A diagrammatic illustration of the principle of frequency-changing operation is given in Fig. 2, where "waves" of different wavelengths are drawn to represent the various frequencies, and the underlying principles will be clearly apparent from this.

It will be realized that, in any superheterodyne circuit there must be at least two variable tuning circuits in addition to the fixed pre-tuned circuits of the I.F. amplifier. One circuit is connected between the aerial and earth prior to the first valve, and the other tunes the oscillator section. Both must be operated simultaneously to ensure that the oscillator frequency is greater or less than the signal frequency by the amount of the fixed frequency of the intermediate amplifier. It is possible to gang the two tuned circuits, but when this is done a special ganged condenser must be employed because the frequency of the oscillator must vary in a different ratio to that of the first detector. It is because of this that special superheterodyne gang condensers are made, these having specially-shaped vanes. As an alternative to the special condenser, however, it is possible to employ an ordinary two-gang component and to connect suitable "padding" and "tracking" condensers in the oscillator tuning circuit.

The principal feature of the superhet is its extreme selectivity, this being obtained by ensuring that the pre-tuned circuits of the I.F. amplifier will only "accept" signals of a definite frequency. These signals are obtained by carefully adjusting two preceding circuits it will be seen that the latter have to be operated with great accuracy. Contrary
Series and Parallel Connections

By G. H. Wray, F.C.S.

Two or more conductors are said to be in series when they are so connected that they are traversed by the same current. In the case of batteries, the conductors are connected in parallel when their terminals of the opposite polarity are connected together. In a series circuit, the current is the same at any instant at every point.

Condensers in Series

Series and parallel methods of connection have widely differing results when applied to different components in a set. If it is required to increase the high-tension supply to a battery-operated set, another battery is connected in series with the existing one, and the available voltage will then be the sum of the voltages of the two batteries, but if it is required to increase the capacity of a 2 mfd. condenser by the addition of a 1 mfd. condenser, series connection would have the opposite effect, and the resultant capacity would be less than 1 mfd.

When condensers are connected in series, they will act as one condenser having a lesser capacity than either of them would have separately.

The joint capacity of condensers connected in series is the reciprocal of the sum of the reciprocals of their capacities separately. Where only two condensers are employed in series, their joint capacity may be obtained by multiplying their respective capacity values together and dividing this figure by the sum of their capacities, thus:

\[ R = \frac{1}{r_1 \times r_2} \]

Therefore, in the case of a 2 mfd. and 1 mfd. condenser being connected in series, the resultant capacity would be 0.66 mfd.

Capacity of Condensers in Parallel

If two or more condensers which are connected in series each have the same capacity value, the joint capacity will be half that of one of them separately, thus:

\[ \frac{1}{2} \times \text{mfd.} = \text{mfd.} \]

Parallel, the joint capacity of condensers is the sum of their separate capacities.

Resistance Connections

Exactly the opposite effect is obtained in the case of resistance connections. If two or more resistances are connected in parallel, the total resistance will be less than that of the lowest resistance.

\[ \frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \]

The reciprocal of the combined resistance is equal to the sum of the reciprocals of the separate resistances divided by their sum, and the reciprocal of this figure is the total resistance.

When more than one set of transformer primary windings is impracticable, owing to the fact that any variation in the current drawn from the secondary circuit of one transformer effects the output from the other transformers.

Aerials 2

Aerial constructed as shown in this sketch proves valuable in a confined space and is also non-directional.

SERIES AND PARALLEL CONNECTIONS

By G. H. Wray, F.C.S.

2 x 1 capacity would be \(2 + 1 = 0.66\) mfd. If the two condensers which are connected in series each have the same capacity value, the joint capacity will be half that of one of them separately, thus:

\[ \frac{1}{2} \times \text{mfd.} = \frac{1}{2} \text{ mfd.} = 0.25 \text{ mfd.} \]

Connected in parallel, the joint capacity of condensers is the sum of their separate capacities.

Resistance Connections

Exactly the opposite effect is obtained in the case of resistance connections. If two or more resistances are connected in parallel, the total resistance will be less than that of the lowest resistance.

\[ \frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \]

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When more than one set of transformer primary windings is impracticable, owing to the fact that any variation in the current drawn from the secondary circuit of one transformer effects the output from the other transformers.
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By RALPH STRANGER

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Obtainable at all Booksellers, or by post 3/10 from George Newnes, Ltd., 8-11, Southampton St., Strand, London, W.C.2
THE CARE OF ELECTRIC GRAMOPHONE MOTORS

(Continued from page 172)

Care should be taken to lubricate the bearings with only oil of the grade recommended by the makers. In the case of worm gear, a good quality of oil should be used. In the case of the worm gear on the governor assembly light grease should be used. Vaseline is quite good for this purpose.

One point should receive particular attention, and that is the governor pad. This should be completely sealed with oil until it is soft and pliable. Most cases of erratic running and that troublesome fault, oscillating governors, is caused through the governor pad becoming "dry," and it should be particularly watched at reasonable close intervals. Be careful to remove all surplus oil.

There is one important frictional point that is nearly always missed when oiling, even by experienced mechanics; it is the governor slide. This will be found situated on the main governor spindle between the balls. It consists of a sleeve which slides up and down the spindle, and it is essential that it is absolutely free.

IMPROVING THE SIMPLE SHORT-WAVE

(Continued from page 180)

There is another point which calls for some mention in this article, and concerns the question of whether or not it is satisfactory to operate a short-wave from the mains. In the majority of cases this presents very little difficulty, provided that ample smoothing and decoupling is provided in the H.T. supply unit. But it is necessary to take every precaution in this direction, for otherwise the more powerful stations will be heard above the hum. It is also desirable, when 'phones are being used, to isolate them from the main H.T. source, and this can best be done by using a 1:1 output transformer or a choke-capacity output filter.

CHOOSING AND MAKING L.F. AND OUTPUT TRANSFORMERS

(Continued from page 170)

An excellent output transformer suitable for use with any power valves can be made by using as core 3 dozen pairs of No. 4A malleable stampings. The primary will consist of 50,000 turns of 34 gauge enamelled wire, whilst the size of the secondary will depend upon the ratio required. The number of turns for the secondary can easily be found from the formula:

$$\text{Secondary Turns} = \sqrt{\frac{\text{Optimum Load of Output Valve}}{\text{Speaker Impedance}}} \times 5,000$$

For most purposes, it is very convenient to wind 5,000 turns of 38-gauge enamelled wire for the secondary, and take tappings after every 1,000 turns, so that a number of alternative ratios are readily available.

THE PRIMA MAINS THREE

(Continued from page 174)

If the oscilloscope indicates that the governor holes are still in the frame by means of a small grub screw and are capable of being rotated. It will, of course, be essential to obtain the specified parts in order that the holes will correctly align themselves. The variable condenser is mounted on a small metal plate, and to enable this to be accommodated in a suitable position on the chassis two special distance washers are held in place by two screws provided by the makers of the chassis.

The components which are attached to the front of the chassis have been chosen so that the necessary fitting insulating washers has been avoided, and the chassis provides the connection to those parts of the terminals which have to be connected to earth.
ALL ABOUT MAINS UNITS-2

The half-wave thermionic valve circuit is shown in Fig. 3, from which it will be seen that the rectifying valve differs from the familiar receiving valve in that it possesses a filament and an anode, but no grid. The filament and the anode are connected to two secondaries on the mains transformer, and consequently upon connecting the primary to the mains, current flows in the secondaries, heating the filament and at the same time causing the anode to be at a comparatively high potential. Electrons, attracted by the anode, proceed to flow rapidly from the filament to the anode (positive half-cycle), but anode attempting the return journey (negative half-cycle) encounter very considerable opposition, with the result that the positive half-cycle is allowed to pass, the negative half-cycle being suppressed. The metal-rectifier, consisting of a large number of copper and copper-oxide discs in contact, operates on a chemical principle, but has exactly the same effect in that it offers no opposition to one-half of the cycle, but holds back the opposite half. The half-wave metal-rectifier is shown in Fig. 4.

By using a rectifying valve having two anodes, it is possible to make use of both halves of the cycle, each anode taking care of one-half. The circuit is shown in Fig. 5, the equivalent metal-rectifier circuit being shown in Fig. 6. This form of rectification is called "full-wave" rectification, except for small outputs, is always employed. The metal-rectifier circuit shown in Fig. 6 is the widely-used "voltage doubler" circuit, which has the advantage over other rectifying circuits in that it enables us to use an input voltage actually less than the required D.C. output, and, in addition, the condensers in series with each section of the rectifier minimize to a considerable extent the possibility of damage.

Heater Circuit Supply

As already mentioned, it is possible to wind several secondaries on one mains transformer for the additional windings being used to supply raw A.C. at 4 volts for the heater circuit of an indirectly-heated A.C. valve receiver, or to supply another rectifier to obtain an unsmoothed D.C. for charging accumulators. These windings are shown respectively in Figs. 5 and 6. Various types and sizes of both valve and metal rectifiers are obtainable, depending on the D.C. output required, and the transformer secondaries are, of course, wound to supply the voltages required by the rectifiers used. It will be understood that the output from the rectifier, whatever the type, is not actual direct current, but is a pulsating, unidirectional current which has to be smoothed down by chokes and reservoir condensers as in the D.C. unit. From the rectifier onwards, the A.C. unit circuit is exactly the same as the D.C. unit.

Accumulator Charging Circuit

With further reference to Fig. 6 in which is also shown an accumulator charging circuit, it will be noted that the secondary winding is tapped at three points, rendering the apparatus suitable for 4, 5, or 6 volt cells. The same result can be achieved by using a tapped resistance. It is essential to include in the D.C. side of the charging circuit a small resistance to regulate the flow of current. The value depends on the charging rate.

Automatic Grid Bias

In the case of indirectly-heated A.C. valves, it is a simple matter to arrange for automatic grid bias by utilizing the voltage-drop across a resistance in the cathode lead of the valve. The position of this resistance is shown and marked R in Fig. 7, and it will be clearly understood that the anode voltage of the valve must pass through this resistance and, therefore, a voltage is developed across it. The top end of this resistance is of course at a higher potential than the earth end, and thus, by connecting the grid return lead to the earth-end the grid is negative with respect to the cathode to the extent of the voltage developed across the resistance. Calculation of the resistance value is again computed by Ohm's Law, the formula being:

\[ R = \frac{V}{I} \]

For example, assume the case of a valve requiring a bias of 10 volts and an anode current being 10 milliamps. Hence the value of the resistance is:

\[ R = \frac{10 \text{ volts}}{0.01 \text{ amp}} = 10,000 \text{ ohms} \]

The cathode resistance must always be chosen with a fixed resistor in order to provide a low-impedance path to earth for any unwanted H.F. or L.F. currents. That then is a general outline of the principles and design of mains units.

Now any reputable make of mains unit, used under correct conditions, is an entirely satisfactory proposition, and we do not think that the makers claim for it, but the same unit under incorrect conditions can turn a well-behaved set into a howling horror. The error made by many purchasers of mains units is that they choose the smallest (and consequently the cheapest) model available, regardless of the requirements of the receiver. Literally dozens of instances have come to my attention in which I have found that the owner of a S.G.-Det.-Pentode set requiring some 20 milliamps or more has blithely purchased a unit designed to give 10 or 12 milliamps, the result being that the smoothing in the unit is hopelessly saturated, the valves are trying to work with only a few volts on their anodes, and instability, motor-boating, and a host of other objectionable troubles occur, and very often the poor manufacturer is held responsible. To avert this over the coils—quite undeservingly of course. The safest way of deciding upon a mains unit for use in an existing battery-driven set, is to connect a milliammeter in the negative lead of the set when it's operating from a new 120-volt A.C. battery. The reading obtained will be the total anode current consumption of the set, and a unit having the next highest rated output should be chosen. For example, if your milliammeter reading was 17 milliamps, and there are two units available having outputs of 16 and 20 milliamps respectively, always plump for the larger one! It may cost a bit extra in the first place, but it will certainly save much trouble, annoyance, and expense in the long run.

Eliminating Hum and Instability

However, even though the output from the unit is ample for the set, hum and instability can still occur, due mainly to the excessively high internal resistance as compared with that of a battery in good condition. Instability, often evidenced by motor-boating, usually occurs where two or more anode circuits are fed from one H.T. tapping, none of the anode circuits as compared with that of a battery in good condition. Instability, often evidenced by motor-boating, usually occurs where two or more anode circuits are fed from one H.T. tapping, none of the anode circuits
In the unit is not always sufficient, and in order to ensure a completely phase in the set it is advisable to decouple each stage of the set by means of series resistance and condensers as shown in Fig. 8. If not already done, the loud-speaker should be isolated from the direct current in the anode circuit of the output valve by using an L.F. choke and condenser as shown. Here again, the choke should have a high inductance value, and the capacity of the condenser should not be less than 2 mfd., as otherwise some of the bass is likely to disappear. On D.C. mains it is also advisable to connect another condenser of similar capacity on the other side of the loud-speaker as shown. All decoupling condensers should be of the 2 mfd. variety, except in the case of the screen of the S.G. valve, in which position a 1 mfd. condenser can be used but which should be of the "non-inductive" type. The values of the decoupling resistances can be calculated more or less exactly by Ohm's Law, but so far as the detector and low-frequency valves are concerned, experiment with values between 20,000 and 50,000 ohms will quickly prove which is best. In any event, these values are not at all critical.

The causes of hum are many and varied. Here are some of them. Inefficient earth—try another earth including an entirely new lead, and on D.C. mains try a .004 mfd. condenser in series across the secondary of the mains transformer. Use a Good Voltmeter Always remember, too, not to judge your unit by the readings obtained with a cheap voltmeter. A cheap voltmeter always has a very low resistance, and consequently, a heavy current consumption at full deflection. When connected across the unit, the current consumption is, of course, added to the legitimate valve consumption, with the result that as voltage decreases with increase of current, the output appears to be absurdly low. In order to obtain even approximately accurate readings, a meter having a resistance of 1,000 ohms per volt must be used, and the measurements must be taken under working conditions. Otherwise there will be no current flowing in the circuit, with the result that the readings will be very much higher than they should be.

Another cause of hum is H.F. ripple superimposed on the mains. To overcome this it is necessary to connect a special choke in one or both of the mains leads, also connecting two fixed condensers across the mains, taking the centre connection to earth as shown in Fig. 9.

Other Forms of Interference In addition to these causes, interference similar to hum can be picked up from electrical apparatus used in the vicinity of the receiver, such as vacuum cleaners, hair-dryers, home cinematographs, etc. If you are suffering from interference of this nature, nothing can be done at the receiving end, and the only thing to do is to write to the Interference Dept. of the B.B.C. who may, or may not, be able to help you.

Distortion upon connecting up a mains unit in place of a battery can often be traced down to the fact that the grid-bias values have not been readjusted to compensate for the increased voltages from the mains. Twisting the aerial at right angles to the lead-in from receiver will quickly prove which is best.

In inefficient earth the likely cause is that of silk-suspended frets. The idea allows of an infinite variation of schemes and offers an unlimited scope for the induction of practicality in any design. Normally, design is for frets. The frets must be arranged so that they are attached to the main woodwork of the cabinet, but in this scheme separate pieces of wood, cut to the desired shape, can be attached to the silk without reference to any other pieces. One set of bars wider than the other, as shown in E, and mounted in position as shown in Fig. 10, offers the desired shape, can be attached to the silk without reference to any other pieces. The two fish could be cut from thin ply and painted black on the faces with gold edges, whilst the bubbles can be cut from black card-board. Another scheme is shown in Fig. 10, and the thinness of the supporting pieces has been deliberately emphasized because sufficient support will be obtained when cut-out is fixed to the silk with glue. An inspection of the drawing will show that there are no holes in the design, which can be cut without opening the fret saw.

This type of fret can also be enhanced in appearance by fitting small lamps behind the fret, and details are given in Fig. 11. The ordinary miniature screw-bulb holder is used and can be supported inside the cone on stiff wire, or a strip of aluminium, which forms one of the connections to the holder, can be used. If a metal chassiss is used as shown in Fig. 11, the strip can be clamped under one of the fixing screws, and the second lead brought out and insulated by a piece of sleeving or wrapped round with a piece of black tape. The design of fret shown in Fig. 9 looks exceptionally well if the lamp is fitted near the top of the cone, but the design in Fig. 10 requires the lamp to be fitted directly in front of the centre of the cone for the best effect. The two leads from the lamp are connected to the component terminals of the nearest valve-holder.
FERRANTI RESISTANCES

A NUMBER of new products from Messrs. Ferranti, Ltd., of Holborn Viaduct, London, W.C.1, have been received, and one of the most interesting, is that illustrated on the right. It is an illustration of some neat resistances, which are provided with metal which is to be inserted into a strip of insulating material, and the metal which changes the end of the strip is continued to form a soldering bar. The spindle is mounted on a strip of insulating material, and this is provided with a copper disc and condensing point which, while it is in contact with the resistance element is designed to prevent wear. These little resistances have the advantage, arising at some future date due to a path being cut in the element and poor contact so arising. An interesting and noteworthy feature, which has been arranged so that the spindle is "dead," and thus no special care has to be taken when mounting the component to reduce it. These resistances may be obtained in values of 50,000, 100,000, 250,000, 500,000 ohms, and 1 meg., and the price is 9s. 6d. each.

The resistances may be judged by comparing them with the potentiometers, which are extremely small components, although the manufacturers have made them with the potentiometers, are also extremely small components, than tins. The actual resistance to be ascertained without the aid of a pocket meter, of course, has these scales printed one below the other, and the respective scales have to be read out. In the Rotameter an octagonal knob is provided, and a window is provided just sufficient to enable them to be wired direct. The nuts are tightened. Thus, when the knob is rotated a new scale is brought into view, and the range in which the label is to be viewed. The finish is in black bakelite and the volume is increased. The price of this safeguard is only 1/6/6, and some such device should be included in every aerial system.

PIFCO "ROTAMETER"

In our last dated March 3rd, we illustrated a small meter which we regret was inadvertently described as the Pifco Ah-in-one-meter. This was not, in fact, a Pifco product, the meter to which we referred being produced, in addition to the normal voltage readings, with a special unique valve testing device. The latest pattern of this meter, which is manufactured by the Provincial Insulators Fittings Co., Ltd., of Pirco House, High Street, Manchester, is known as a Rotameter and is a great improvement on the pocket meter. It provides for less than eight different test range, each of which has its own scale. The pocket meter, of course, has these scales printed one below the other, and the respective scales have to be read according to the particular task which is being carried out. In the Rotameter an octagonal knob is provided on the side of the rectangular case, and this knob is inscribed with the various ranges. The readings for the different scales are printed on the sides of an octagonal roller which occupies precisely the whole width of the case, and a window is provided just sufficient to permit the whole of one side of this roller to be viewed. Thus, when the knob is rotated a new scale is brought into view, and the range in which the label is to be viewed. The finish is in black bakelite and the volume is increased. The price of this safeguard is only 1/6/6, and some such device should be included in every aerial system.
MUSIC to suit all tastes, excellently recorded by popular artists, is the keynote of some recently issued discs of the British Homophone Company. It is not often that Charlie Kunz, the popular conductor of the Casani Dance Band, records without his band, but he does so on both sides of Sterno 1342. This record is an excellently played pianoforte solo, which introduces well-known tunes as some of these days, with a song in my heart, and night and day, in instruments are heard at their best. Homochord H.R.57; Moonlight and melody, H.R.59.

Blelors Dance Orchestra on Homochord di-da, and Edie was a lady played by Band on Homochord H.R.60, and lot-di-da, parts 1 and 2, played by Al Gold and his band on Homochord H.R.61; I'm learning to fox-trots played by Al Gold and his band from the film Broadway three a keyhole, tunes of the moment on Homochord H.R.64.

Up, Up, Up the mountain, two amusing tunes played by Billy Hart and his Boys. Other up-to-the-minute tunes, playing of many of the most popular tunes of the day are also played by this band. Snare drum, and toots are well heard on this record.

The Floral Dance and The yeomen of England, Sterno 1351, two songs that will never grow old. Most readers will, no doubt, recollect the popularity of that cowboy ditty Heading for the last round up, and home on the range is a similar type of song that is equally good. On the other side of this record is the Prisoner's song, both tunes being sung by Monte George Baker, the popular baritone who is often heard on the air, has made a fine record for the above company in the floral dance and the yeomen of England, Sterno 1351.

The other record, The elegant 80's, parts 1 and 2, introduces a number of old-time songs that are always popular, played by the Del rio accordeon band. Regina kingdom and his band make a welcome appearance on Sterno 1347. This record is delightfully played as only Regina King and his band can play.

Hawaiian bands have a fascination that is all their own, and the song of the islands and Polikiko blues, played by Val's Hawaiian Players, is a typical record that you should make a point of hearing. None but the weary heart and senatoria, played by mantovani and his band on Sterno 1348, and the hard girl's dance and serenade, played by Pierre Fol and his quartet of strings on Sterno 1349, are two records both of which are excellent fare for the music lover, and I have every confidence in recommending them.

Vocal Records

George Baker, the popular baritone who is often heard on the air, has made a fine record for the above company in the floral dance and the yeomen of England, Sterno 1351.

Review of the Latest Records

This record is an excellently played disc of the above company, recorded by popular artists, and is from the above company, recorded by popular artists, and is directed by Charlie Kunz. Melody of popular songs will certainly appeal to those music lovers who like pianoforte solos. Banjo players, who record on this record, indulge in some fine syncopated playing of many of the most popular tunes of the day. Other up-to-the-minute tunes, all excellently recorded on homochord records, are parts 1 and 2, of the air, we're the given on the speaker, from the film, Broadway three a keyhole, and without that certain thing, two popular fox-trots played by Al Gold and his band on homochord H.R.63; I'm learning to play the guitar, I am and we all went up, up, the mountain, two amusing tunes played by Billy Hart and his Boys on homochord H.R.66; Moonlight done in lover's lane and three of us, played by Dick Rose and his Band on homochord H.R.58; On a steamer coming over and did you ever see a dream walking? played by Archie Mercer's Band on homochord H.R.71, Moonlight and melody, parts 1 and 2, played by Al Gold and his Band on homochord H.R.60, and lots de di-da, and Edie was a lady played by Band on homochord H.R.59.

Light Music

Those who like accordion bands are catered for on Sterno 1330 and homochord H.R.63, two fine records on which these instruments are heard at their best. The former record is a clever piece of recording by Zianos' accordion band, the tunes played being The Ziganos in Spain and Grinoline. The other record, The elegant 80's, parts 1 and 2, introduces a number of old-time songs that are always popular, played by the Del rio accordeon band. Regina kingdom and his band make a welcome appearance on Sterno 1347. This record is delightfully played as only Regina King and his band can play.

Hawaiian bands have a fascination that is all their own, and the song of the islands and Polikiko blues, played by Val's Hawaiian Players, is a typical record that you should make a point of hearing. None but the weary heart and senatoria, played by mantovani and his band on Sterno 1348, and the hard girl's dance and serenade, played by Pierre Fol and his quartet of strings on Sterno 1349, are two records both of which are excellent fare for the music lover, and I have every confidence in recommending them.

Vocal Records

George Baker, the popular baritone who is often heard on the air, has made a fine record for the above company in the floral dance and the yeomen of England, Sterno 1351.
PRACTICAL LETTERS FROM READERS

The Editor does not necessarily agree with opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

A Highly Instructive Work

Sir,—I beg to acknowledge with thanks receipt of my copy of "Everybody's Wireless Book." It is an extremely interesting and highly instructive work. The compilation of the book could not be better, and the unrivalled construction could not have a copy.—Jas. Ferguson (Edinburgh).

Stripped versus Screened Components

Sir,—I am interested in the letters regarding stripped components which have been published in Practical Wireless recently. Among these is the statement that all H.F. Chokes, Transformers, Tuning Coils and Condensers should be shrouded in metal cases, with provision for earthing the same. It is not necessary to quote authorities, but the advantage of screening is evident from the usual atmospherics. With pre-detector volume control full on it becomes absolutely deafening.—J. H. Cleggett (Oughtonhead, C. Galway).

"A Volume to be Proud Of!"

Sir,—I received my copy of "Everybody's Wireless Book" safely, for which many thanks. It is indeed a volume to be proud of, and what I like most is the style in which it is written; it is so easy to read and easy to understand.—E. L. Vernon (Roscrea, Tipperary).

A Satisfied Reader's Appreciation

Sir,—I thank you for the safe return of my wireless set which I sent you for inspection. Also, I have been a constructor of sets for twelve years and find from experience that the all-metal method of construction is the best; this means that all R. and L.F. Chokes, Transformers, Tuning Coils and Condensers should be shrouded in metal cases, with provision for earthing the same. It is now working entirely satisfactorily and is certainly a "gem" of a set. In design and performance it is well ahead of many of the sets on the market. In view of the fact that you have been able to fit the A.V.C. device in this three valve, and have surprised me are you not continuing it with all the models you are now bringing out, i.e., Leader Three, etc., but in any case the readers who build any of these models will have good value for money.—A. A. Frost (Hereford).

CUT THIS OUT EACH WEEK

Do you know

—THAT a milliammeter cannot be used in the output circuit of a Q.P.P. arrangement to identify distortion.
—THAT all types of disc television receivers will be necessary to receive high-definition systems.
—THAT multiplying schemes to enable standard discs to be used may be possible.
—THAT elaborate potentiometer voltage-supply schemes are rendered unnecessary with modern H.F. pentode screening grids.
—THAT separate grid-biasing circuits are preferable for indirectly-heated push-pull valves.
—THAT there are at present four different types of push-pull valves.
—THAT the above four types are Quintet, Paraphase, Duplex, and Ordinary push-pull.

NOTICE

The Editor will be pleased to consider articles of a general 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 correspondents intended for the Editor should be addressed: The Editor, Practical Wireless, Ltd., 5-11, Southampton Street, Strand, W.C.2.

CUTTING TO THE WEST A "PRACTICAL WIRELESS"" cover sheet with this message on the page is inserted into the magazine. All you have to do is cut out each sheet and tear it into strips. You will find the latest developments on the market the following week.

FERRANTI A.C.-D.C. CIRCUIT TESTER

M.E.S.S.R.S. FERRANTI have recently produced a new instrument, A.C.-D.C. Circuit Tester, which simplifies and reduces to a large extent the time formerly taken for checking nearly all measurements commonly required in radio testing and servicing, and having at the same time a wide application in other fields of electrical industry. The instrument is contained in a single metal case and embodies all the various ranges available in the single instrument type. The instrument is designed for use in conjunction with a range of test leads, and is in three basic forms, A, B, and C, the latter embodying all the former ranges. All the test leads are of the portable type, and are supplied with a carrying case.

NEW EKROD ALLOGRAM

A NEW all-electric gramophone, Model R.84, has been placed on the market by J. E. Ekro, Ltd., to meet the demand for a high-class instrument containing all the latest refinements at an attractive price. In an attractive brochures issued to the trade, the new instrument is stated to be the final improved model of the series. The instrument is equipped with a sophisticated tone arm and a powerful mechanical drive, and is designed for use in conjunction with a range of test leads, and is in three basic forms, A, B, and C, the latter embodying all the former ranges. All the test leads are of the portable type, and are supplied with a carrying case.

To raise readers' morale, we undertake to read catalogues of any of our advertisers. Merely send us an envelope and we shall require catalogues, and address it to "Catalogues Received," Practical Wireless, One Newton, Ltd., Southamptons St., London, W.C.3. Where possible, we shall make a charge for this service, and the amount is to be deposited in our cash register. Any correspondence whatever should be enclosed with applications for catalogues. No correspondence whatever should be enclosed.

PROGRAMME OF B.B.C. LONDON MUSIC FESTIVAL, 1934

This year, as in 1933, the B.B.C. has again organized a Festival of Music, to consist of six concerts in the first two weeks of May. These will be given in the Queen's Hall.

The first three concerts (Friday, May 4th; Monday, May 7th; and Wednesday, May 9th) will be conducted by Adrian Boult. Friday's programme will include Brandenburg Concertos No. 2 and No. 5, concerti grossi for strings and bassoon, and Walton's Cello Concerto. Monday's programme will include Mozart's D Minor Piano Concerto, with Vladimir Horowitz as soloist, and Handel's Messiah. The concluding concert of the Festival will be on May 15th.

The B.B.C. Orchestra (leader, Arthur Cattrell) will be heard throughout the Festival. Copies of the prospectus, giving full programmes and tickets, will be available from Monday, April 23rd, price 6d. each, or 3s. for the set of six.

WEARITE POWER STRIP MORTORS

WHERE a modern all-electric receiver derives its name from the fact that all the raw materials used are obtained from the earth, the instrument is now bringing out an instrument of high quality and efficiency under all conditions. The whole instrument is contained in a single metal case, and embodies all the latest refinements at a moderate price. The Wearite motor is employed in connection with the A.C. receiver. The Wearite "transformer" is the result of many years of experience in power transformer construction and design, and embodies all the latest refinements at a moderate price. The Wearite motor is employed in connection with the A.C. receiver. The Wearite "transformer" is the result of many years of experience in power transformer construction and design, and embodies all the latest refinements at a moderate price. The Wearite motor is employed in connection with the A.C. receiver. The Wearite "transformer" is the result of many years of experience in power transformer construction and design, and embodies all the latest refinements at a moderate price.
SUIT YOUR REQUIREMENTS.

It will probably be found worth while for you to obtain a tape recorder for recording Morse messages which I have described in the paper to which you refer. If a dash is being received the pen would be held down by the magnet, to the armature of which the pen is attached. The tape recorder is connected to the rest of the assembly by a top disc. This gives various circuits and you should find one to suit your requirements. The holder was originally supplied in separate parts, and the instructions were given to enable the parts to be assembled in the correct manner as the makers now fix the parts together. You can obtain the holder by sending 1s. 3d. by post from these offices.

A NEW CIRCUIT

I enclose a diagram of my set and shall be glad of some help to try to put it into practice. The number of valve types disappears on reducing the reaction, only to return on further attempts at tuning."—A. W. G. (Isleworth).

There are some points which A. W. G. mentions in his letter, but the diagram which he has sent is of a circuit which is quite new to us. He has apparently mistaken the connections to a valve and has the grid condenser and leak joined to the anode together with the reaction winding and transformer primary. No doubt if he resets the condenser and leak and joins these to the grid in the same manner as they are at present joined, he will find the circuit will function satisfactorily.

BUILDING A TAPE RECORDER

"Can you send me a diagram showing how to build a tape recorder for recording Morse messages which I receive on my set?"—L. S. T. (Pontypridd).

Have you got any doubt regarding the thickness of copper wire?—A. W. G. (Isleworth). I have started to buy components for the 4-valve short-wave superhet, the circuit of which you gave in February. I am doubtful as to whether I make it and use successfully the T.F. transformers, details of which were given in your 'Making Your Own Screened Coils' series. You say the T.F. transformer tuning to 150 kc/s, but these in the coils I have are 110 kc/s. How can I alter them?—A. W. G. (Isleworth). Would you please settle an argument. What is the maximum lightning-proof, reduces static and sharpens reception?—Mr. W. J. M. Bradley, Yorks, who uses one, would like to modernize it. Unless you wish to redesign the layout, the only real improvement that can be made to this particular receiver is the fitting of a new valve in place of the present output valve. To do this you can buy a four-pin pentode, and plug this in place of the present output valve, and take a flexible lead from the terminal to which the shield is connected to E.T.C. positive. Alternatively, you can obtain a five-pin valve-holder and mount this in place of the four-pin holder, connections to the usual four pins being made in the same manner as before. If the terminal is then connected to E.T.C. positive, a five-pin pentode should then fit and the instructions you refer to with the particular valve-holder which you wish to redesign will be adjusted for the new valve and the maker's instructions should be carried out in this respect. If you wish, you could fit modern composition or wire-wound type resistances in place of the components, although this will not improve results other than giving greater security.

LOAD-SPEAKER PROBLEM

"I should be glad if you could help me out of my difficulty. I enclose a photo of my speaker and should like to know the thickness of copper wire and its resistance. My contention is that a thick wire will give a poor resistance as a water-pipe. This a two-inch diameter pipe will permit the flow of a greater quantity of water (at a given pressure) than a tube three-sixteenths inch in diameter, simply because, owing to its greater section it offers less restriction (or resistance) to the flow of water. By way of example, 1/8 gauge copper wire has a length of 35 yds. to the ohm, whilst 28 gauge copper wire (which is nearly one-third of the diameter of the former wire) has a length of only 7 yds. to the resistance of wire.

CORRECT I.F. TRANSFORMERS

I have bought components for the 4-valve short-wave superhet, the circuit of which you gave in February. I am doubtful as to whether I make it and use successfully the I.F. transformers, details of which were given in your 'Making Your Own Screened Coils' series. You say the I.F. transformer tuning to 150 kc/s, but these in the coils I have are 110 kc/s. How can I alter them?—A. W. G. (Isleworth). How can I alter them?—A. W. G. (Isleworth). Would you please settle an argument. What is the maximum lightning-proof, reduces static and sharpens reception?—Mr. W. J. M. Bradley, Yorks, who uses one, would like to modernize it. Unless you wish to redesign the layout, the only real improvement that can be made to this particular receiver is the fitting of a new valve in place of the present output valve. To do this you can buy a four-pin pentode, and plug this in place of the present output valve, and take a flexible lead from the terminal to which the shield is connected to E.T.C. positive. Alternatively, you can obtain a five-pin valve-holder and mount this in place of the four-pin holder, connections to the usual four pins being made in the same manner as before. If the terminal is then connected to E.T.C. positive, a five-pin pentode should then fit and the instructions you refer to with the particular valve-holder which you wish to redesign will be adjusted for the new valve and the maker's instructions should be carried out in this respect. If you wish, you could fit modern composition or wire-wound type resistances in place of the components, although this will not improve results other than giving greater security.

There is no necessity to carry out the instructions you refer to with the particular valve-holder which you wish to redesign. The holder was originally supplied in separate parts, and the instructions were given to enable the parts to be assembled in the correct manner as the makers now fix the parts together. You can obtain the holder by sending 1s. 3d. by post from these offices.

DATA SHEET No. 76.

CLASS B OUTPUT VALVES.

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When ordering please state the name and address of the sender.

Please note also, that all sketches and drawings which are sent to us, should bear the name and address of the sender.

FREE ADVICE BUREAU

This coupon is available until May 5th, 1934, and must be attached to all letters containing queries.

PRACTICAL WIRELESS, 28/4/34.

B.B.C. AERIAL

OVERHAUL AT LEAST

ONCE A YEAR

Saw yourself the trouble with a roll of P.I.X.

INAUGURAL OFFER—FREE! Just send us your back wall or anywhere in the house and it sticks. Ever- lasting shape—reduces static and unbearable tuning. Mr. W. J. M. Bradley, Yorks, who uses one.

"Reception better than it has ever been, and no static on the 4th Aerial."—A. W. G. (Isleworth).
MISCELLANEOUS ADVERTISEMENTS

Advertisements are accepted for the elimination of the rate of 5d. per word prepaid—minimum charge 5/- per paragraph—and must reach this office not later than Tuesday for the following week's issue. All communications should be addressed to the Advertisement Manager, 'Practical Wireless,' 8 Southampton Street, Strand, London.

PREMIER SUPPLY STORES

offer the following sets Manufacturers' Surplus New components, and guaranteed perfect; carriage paid over 5/-, under 5/- pay post. carriage for 5/-.

PREMIER SUPPLY STORES announce the purchase of the entire stock of a world-famous Continental valve manufacturer. All the following types of standard mains valves at 4/- each. H. B. L. Power.

Directly heated 6-Watt Pentodes. Directly-heated, 6-Watt Diode. Single and Double Screen, low magnification Screen-grid, low magnification Screen-grid, Variable Mu Screen, and self-contained, full-wave rectifiers.

The following type 565 each. Indirectly heated Pentodes, with Westinghouse full-wave Rectifier. 500 v. 120 diodes, 6/6. Darlot Stebbins Valves 4v. filament. Set of 6, consisting of Screen-grid, Detector and Power or Super-Power, 6/- the lot. Power or Super-Power.

ELIMINATOR kits, including Transformer, choke, Westinghouse metal rectifier, Dubilier condensers, resistance and diaphragm. 48 in 30 ma. 200 cycle charger 5/- extra; 120 v. 30 milliamps, with 4v. 2.5 amp., 8v. 2.5 amp., 4v. 6.5 amp., 8v. 6.5 amp., 4v. 20 ma. 8v. 20 ma. 250 volt 80 milliamps, with 4v. 3.5 amp., 8v. 3.5 amp. C.T. 500. 9/- 300 v. 10 ma. 6/- C.T. 1500, 12/-; 300 v. 20 ma. C.T. 5000, 18/- C.T. 15,000, 30/- C.T.

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