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Limitations of the Short Waves

SOMEONE has said that all the broadcast programmes of the future will be transmitted on wavelengths of less than 100 metres, making the 200 to 500 metre waves of the present day obsolete. While the natural optimism which was associated with early short-wave work perhaps justified this prediction, in the light of present knowledge such a happening seems unlikely. Nobody doubts the efficiency and value of the short waves, but a point that often is overlooked is the fact that they are restricted in their application to certain well-defined fields.

The difficulties which accompany the progress of short-wave broadcasting are more numerous than is generally realised. Large numbers of people are listening nightly to concerts radiated by European and American short-wave stations. The fact remains, nevertheless, that none of these concerts so far have been worth listening to—that is, if we may judge them in the critical light in which we view the excellent transmissions of our "A" class stations. By some caprice of that little-understood medium through which radio waves travel, the impulses which leave the transmitting station practically perfect in form do not remain so during their passage through the ether.

Some items are received with relatively good clarity; others, again, are sadly distorted, and bear little resemblance to their original beauty. Some nights are known to be "good" nights—nights when music and speech from stations 12,000 miles distant are received with almost incredible intensity. Then comes a "bad" night when, for no apparent reason, the same stations are barely audible. It will be seen, therefore, that "reliability" scarcely is a word that can be used in conjunction with short-wave broadcasting as we know it to-day. To most people, the great attraction of the short waves lies in their novelty; it is enough to think that they are listening to a voice which has traversed thousands of miles of space, without reflecting that, as far as quality alone is concerned, the time undoubtedly would be more profitably occupied in listening to the local broadcaster.

So we arrive at a striking parallel with the early days of broadcasting. People at that time were content to tolerate very poor reproduction just because it was "wireless," and the novelty amply compensated for its many shortcomings. Will history repeat itself? We think so. Just as the uncritical listener of yesterday has graduated into a highly exacting individual, so will the short-wave enthusiast of to-day become more and more critical as the novelty wears off and the art progresses. For the present, he will do well to accept the novelty as the *piece-de-resistance* of his entertainment, and should not expect too much from what, after all, is a very youthful science.

The Screen-Grid Short Waver

Single control – no shielding – one screen-grid stage, detector and one Penthode audio stage

DESCRIBED BY THE TECHNICAL EDITOR

SINCE the introduction of the screen-grid valve last year, some very efficient short-wave receivers have been evolved. The "Globe-Trotter Screen-Grid Four," featured in our September, 1928, issue was the forerunner of many similar types, and we believe that, as far as efficiency is concerned, this splendid receiver has not, up to the present, been surpassed.

In the following article is described a new type of screen-grid receiver—the Screen-grid Short-waver. It has been designed with a careful consideration of the requirements of 1929—that is, the requirements of the average non-technical listener of the day. It is not intended to compete with the "Globe Trotter," for it caters to a different class of listener. First, last and all the time, the dominant note of its design is simplicity. It has but one tuning control, supplemented, of course, by a reaction knob. Beyond the use of a metallic panel, it is innocent of shielding. It utilises standard factory-made coils, incorporates very few components, is non-radiating, and is extremely easy to operate. Taking all these things into consideration, the degree of efficiency obtained is remarkably high, and it is no uncommon thing to tune-in short-wave broadcasting stations situated on the other side of the world with the Screen-Grid Short-waver—on the loudspeaker.

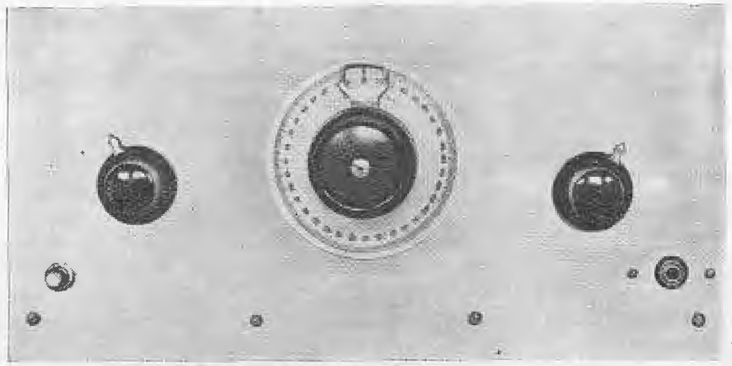


FIG. 1.—Front view of the Screen-Grid Short-waver. The centre dial is a friction vernier type, driving the main tuning condenser. On the right is the reaction control, while the knob on the left controls a miniature vernier condenser which permits extremely accurate tuning. The battery switch may be seen on the extreme left, and the output jack on the right.

It is quite an easy matter to design a highly-efficient radio receiver if efficiency is the only thing to be aimed at. It is a totally different proposition to design a receiver in which due consideration must be given to perhaps four different points—all of them of about equal importance, and each one exerting a conflicting influence on the others. The broadcast receiver of the present day is, essentially, a compromise between the desideratums of efficiency and simplicity. Of what use is it to place a highly complicated piece of apparatus, no matter how efficient it may be, in the inexpert hands of a person with little or no mechanical or electrical knowledge? Obviously, the possibilities of such an instrument would not be exploited to anything like the fullest extent, and the results would fall far short of those that would be obtained with an instrument in which a certain amount of efficiency was sacrificed in the interests of simplicity.

The introduction of the screen-grid valve undoubtedly conferred a great benefit upon short-wave enthusiasts. Up to the present, however, the screen-grid short-wave receiver has been somewhat complicated in construction and operation, and this has probably been a serious deterrent to many set constructors. Say what you will, two interlocking tuning controls on the short waves are one too many for most people. To those who are accustomed to operating all sorts and conditions of receivers, the inconvenience occasioned by the additional control is considered worth while on account of the high operating efficiency of such a receiver. To very many, however, the two dials are a great worry, and even, in many cases, the direct cause of failure to obtain satisfactory results.. So far, no really practicable method has been found of "ganging" two tuned circuits of a short-wave receiver in order to centralise the tuning control. Especially is this so in the case of a set incorporating a screen-grid valve as a radio-frequency amplifier, for it is impossible to eliminate the influence which the aerial system exerts upon the tuning characteristics of the first tuned circuit, or to make this circuit line-up accurately with the tuned input circuit feeding the detector valve. The natural recourse was to employ separate controls for the two tuned circuits, both of which had to be rotated at the same time when "searching" for a station, but seldom or never could be rotated in synchronism.

In the Screen-Grid Short-waver, the problem was attacked from a new angle. Instead of seeking some means of linking these two circuits together, one of them was eliminated entirely, making the receiver to all intents and purposes a single-control affair. It is, perhaps, superfluous to say that some method of coupling had to be provided to take the place of the tuned circuit that was eliminated, and here we had the choice of two alternative systems. One was the choke-coupling system, and the other resistance-coupling. We decided in favour of the resistance, mainly because one was readily available, and also because it was thought that the use of a choke might introduce "dead spots" in the tuning range. Accordingly, it was decided to replace one tuned circuit with a resistance, utilising this as the coupling medium. It was decided also to introduce this untuned circuit between the aerial and the grid of the screen-grid radio-frequency valve, since theoretical and practical considerations indicated that in this position it would be more successful than if it were located between the r.f. and detector stages. The principle involved is the drop in voltage which occurs across the resistance R (Fig. 3), this potential being applied to the grid of the screen-grid valve. The output from the plate of this valve flows through the primary coil of the r.f. transformer L1 and induces a similar current in the secondary L2. This coil (L2) is tuned to the wavelength of the incoming signal by the variable condenser C1, the tuned circuit thus formed acting as a rejector and passing on the signal impulses to the grid of the detector valve V2. Reaction is provided at this point by feeding the radio-frequency output from the plate of the detector back through the reaction coil L3, which is inductively coupled to the secondary L2. The degree of back-coupling or reaction is regulated by means of the variable by-pass condenser C3. The audio-frequency output from the detector is fed through the primary winding of the audio transformer T, inducing a corresponding impulse in the secondary winding. The voltage thus generated is applied to the control grid of the Penthode audio valve, is amplified by it in the usual way, and the resultant audio-frequency energy used to operate a loudspeaker or pair of headphones—whichever the constructor prefers.

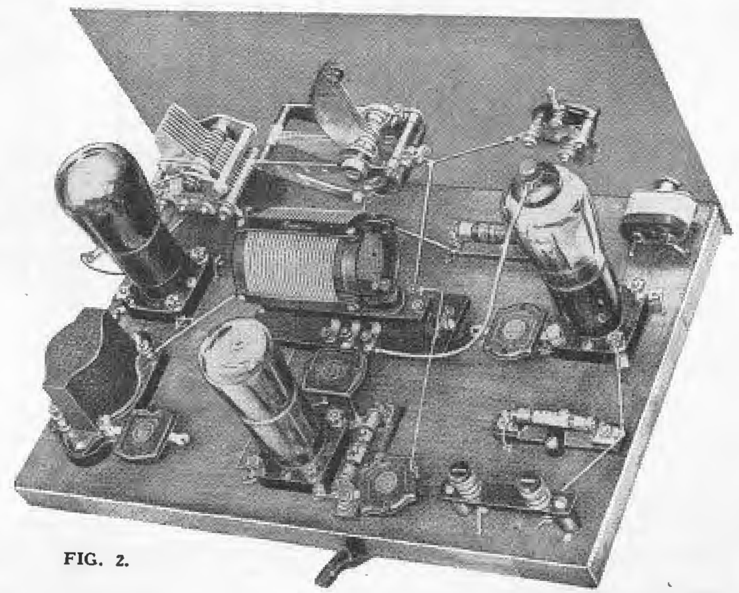


FIG. 2.

As might be expected, in actual practice the amplification contributed by the radio-frequency stage is somewhat less than would be obtained by the conventional tuned stage. It is still quite high enough, though, to justify the inclusion of this stage, especially as its use adds no extra tuning control, and it is absolutely stable in operation. A valuable feature of the Screen-Grid Short-waver is that it is non-radiating, the untuned r.f. stage acting as an effective baffle between the oscillating detector and the aerial circuit. In this regard, the receiver complies with the request of the Commonwealth Authorities that as many as possible of the new receivers be of the non-radiating type, in order to minimise the "howling-valve" annoyance, which is particularly troublesome in the country districts of Australia.

In the Screen-grid Short-waver will be found two features not usually incorporated in short-wave sets. Across the tuning condenser C1 is shunted another variable condenser of very small capacity. This condenser, C2, is in reality a vernier tuning control; it plays no part in the actual selection of stations, but is used as an ultra-fine tuning device, enabling the adjustment for maximum volume to be easily found after a station has been tuned in roughly by means of the main tuning condenser C1. Another noteworthy feature is the fixed resistor shunted across the secondary of the audio transformer. This is for the purpose of eliminating fringe howl, a nuisance that manifests itself in the form of a howl just as the circuit is in its most sensitive condition—on the very verge of oscillation.

Construction.

Reference to the illustrations will show that an aluminium panel is employed, mainly for the purpose of eliminating hand-capacity effects, which are apt to be troublesome at the short wavelengths. This panel is cut from 16-gauge stock to the measurements specified in the list of parts at the end of this article, and it may be obtained from any dealer, already cut by machine. It is not worth attempting to cut the panel by hand, for the finished job is likely to be anything but satisfactory, and the amount of money saved is negligible. Particulars for drilling the panel are given in Fig. 4. Note that the hole in the right-hand bottom corner is much larger in diameter than any of the others. This is essential, because of the fact that the jack must on no account come in contact with the metal panel. It is mounted on a piece of bakelite, which is bolted to the panel in such a way that the bushing and face-nut of the jack project through the enlarged hole. This hole should be drilled with the largest size of bit available, and then enlarged by means of a rat-tail file. It must be large enough to give a safe clearance all round the face-nut of the jack when the latter is in position. The two small holes on either side of the large one are for the purpose of accommodating the bolts which secure the bakelite insulating strip to the panel.

All the variable condensers used in the Screen-Grid Short-waver are of the single-hole fixing variety, and the Utility vernier dial needs no extra holes for anchoring it to the panel. The sizes of the various holes can best be gauged by the instruments themselves, so no sizes are given here. In this receiver, we have departed a little from the usual method of assembling the panel and baseboard. Instead of the baseboard lying flat on the table, with the bottom edge of the panel screwed so that it is flush with the bottom of the baseboard, we have screwed four rubber feet on the underneath side of the baseboard, so that it is elevated above the table a matter of three-quarters of an inch or so. The panel is then screwed to the baseboard in such a way that its lower edge just clears the table. This scheme has proved very convenient, as the rubber feet not only act to a certain extent as vibration-dampers, but the space thus provided enables much of the wiring to be carried out underneath the baseboard, out of sight.

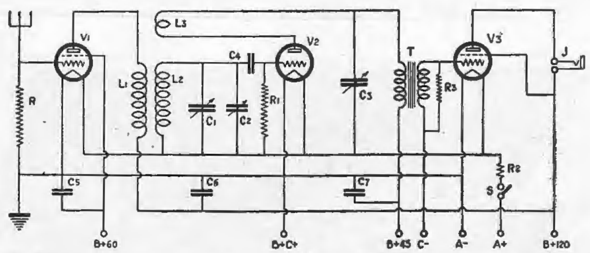


FIG. 3.—Conventional diagram of the circuit used in the Screen-Grid Short-waver. The indicating letters correspond with those in the list of parts.

Assembly.

The Jackson .00015-mfd. tuning condenser (C1) is mounted in the centre of the panel, and the Utility Micro-dial securely attached to it, the instructions accompanying the dial providing all the information necessary for this purpose. The Cyldon Bebe reaction condenser C3 is mounted on the right, and the De Jur midget condenser C2 on the left. Before mounting the latter, however, it is necessary to remove all except one moving and one fixed plate, this being easily accomplished with the aid of a pair of pliers. Notice that all three condensers are mounted directly on the aluminium panel, with no insulation between; all the rotors are thus at earth potential, which is highly desirable.

The battery switch (S) is next mounted, no insulation being demanded here if the Cutler-Hammer switch is used. Mention already has been made of the necessity for insulating the jack (J) from the panel by means of a small piece of bakelite; this is most important. The remaining parts are screwed down to the baseboard, the coil mounting having small spacers underneath it to raise it slightly above the surface of the baseboard. The fixed condensers C4, C5, C6 and C7 do not require any fixing screws, as they can be conveniently attached directly to the terminals of the sockets and transformer, as shown. The aerial and earth terminals are mounted on a small bakelite strip, which is screwed to the baseboard with spacers interposed. Make sure that the valve sockets are placed so that the white spot indicating the position of the pin on the valve-base lies in the position shown in the pictorial diagram. The Philips transformer is mounted with its "G" and "P" terminals towards the panel.

Wiring.

All of the filament and "B" battery wiring is carried out underneath the baseboard in the Screen-Grid Short-waver, small holes being drilled adjacent to the terminals where necessary, in order to pass the 18-gauge tinned copper wire employed. It is unnecessary to insulate these wires where they pass through the baseboard, as all are at a low radio-frequency potential and, provided the baseboard is composed of dry varnished timber, there is no danger of leakage. All those leads which are at a radio r.f. potential with respect to earth—the grid and plate connections—are placed above the baseboard, and are run by as short and direct a route as possible. Above the baseboard there is no need for spaghetti sleeving or any similar insulation on the wiring; underneath it, however, many of the wires cross one another, and here it is advisable to use sufficient spaghetti sleeving to ensure that there will be no risk of short-circuits. The wiring underneath the baseboard should be run direct from point to point and the joints securely soldered. It does not matter in the least how close the various "A" and "B" battery leads lie to one another; in fact, it is all the better to "bunch" them where convenient. All the connections show plainly in the pictorial diagram so we need not mention each connection in detail. Notice, though, that there are two short flexible connections equipped with lugs, these being marked "F" and "G" in the diagram. "F" connects to the plate terminal of the screen-grid valve V1—the terminal which protrudes from the top of the valve. "G" is attached to the auxiliary-grid terminal of the Penthode valve V3, this terminal being located on the side of the valve, just above the base. Both these flexible connections should be measured with the valves in place; they should be no longer than is necessary to permit the valves some freedom of movement in the cushioned sockets. Thin single flex is ideal for the purpose.

It will be seen that no battery terminals are provided for in the design. In their stead, a seven-wire battery cable is built into the receiver, this being a far preferable scheme in the writer's estimation. The cable is clipped to the underneath side of the base board, and its various wires are attached either to the sub-base wiring or to the terminal of the transformer, as the case demands. As different makes of battery cable employ different colour schemes, we have not mentioned any colours in the pictorial diagram. The constructor is free to use his own judgment in this matter, but it is suggested that the black and red wires with which most cables are fitted be used for "A" battery negative and "A" battery positive, respectively.

Battery Connections.

A 4-volt accumulator "A" battery, 120 volts of "B" battery, and 13½ volts of "C" battery will be required for the Screen-Grid Short-waver. The wires marked "A—" and "A+" are to be connected to the negative and positive terminals, respectively, of the "A" battery. Two 60-volt blocks will supply the "B" power. Connect the "B—" wire to the "—" clip of one 60-volt block, and take a wire from the same terminal to the "+" terminal of the "C" battery. Connect the wire marked "B+45" to the 45-volt tapping of the same 60-volt "B" battery, and "+60" to the "+60" clip of the same battery. From the same terminal take a short wire to the "—" clip of the second "B" battery, and connect the "B+120" wire to the "+60" of the same battery. The three 4½-volt units which may form the 13½-volt "C" battery are connected in series —that is, the "—4½" terminal of the first to the "+" terminal of the second, and the "—4½" terminal of the second to the "+" terminal of the third. The wire marked "C—" goes to the "—4½" terminal of this last. Check these connections over very carefully before inserting the valves in their sockets, as a mistake may quite easily result in the demise of three valuable valves.

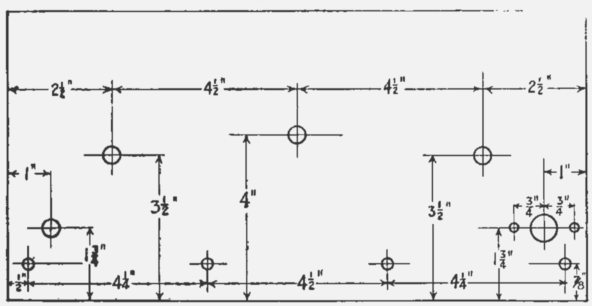


FIG. 4.—Drill your panel from this diagram.

If they are available, it is preferable to use 135 volts of "B" battery instead of 120, three 45-volt blocks being used for the purpose. In this case, the wire marked "B+60" is connected to the 67½-volt point of the "B" battery, while the "B+120" wire goes to the maximum voltage (135). The voltage of the "C" battery will, of course, have to be increased proportionately; another 3 volts, making about 16½ volts in all, will be about right.

The Philips A-442 screen-grid valve is placed in socket V1, the A-415 detector valve in V2, and the B-443 Penthode in V3. Aerial and earth wires are attached to their respective terminals (marked "ANT" and "GND" in Fig. 5), and the headphones or loudspeaker, which must be fitted with a plug, inserted in the jack J. Four coils are supplied with the Radiokes screen-grid coil kit, but it will be found that the majority of overseas telephony stations are tuned-in on one of the two smaller coils. Try the smallest size first.

Operation.

With the battery switch in the "on" position, the set should go into oscillation with a light "thump" when the reaction knob is turned towards the right (plates into mesh). The small vernier condenser C2 should be set with its single moving plate just halfway into mesh with the fixed plate. With the circuit just oscillating, the main tuning dial is rotated slowly until a carrier or whistle is picked up. For rough tuning, the Utility Micro-dial may be grasped by the larger knob, which gives a direct drive; for careful "searching," it is advisable to use the smaller knob, which permits a 55 to 1 reduction ratio. When the carrier has been tuned in, retard the reaction condenser until oscillation ceases, and then swing the vernier condenser C2 backwards and forwards until a point is found at which music or speech is heard. For fine tuning, this vernier condenser will be found invaluable. It does away completely with the need for hair-splitting adjustment of the main tuning control, and makes it much easier to hold on to a station which is swinging badly, as frequently happens on the short wavelengths. Should it be found that the circuit goes into and out of oscillation with a low moan or howl—generally referred to as "fringe howl" or "threshold howl"—the value of the fixed resistor R3 (shunted across the secondary of the audio transformer) should be reduced. Instead of the 150,000-ohm resistor used in our model, try one of 100,000 ohms. The use of a lower value than 100,000 ohms results in a noticeable falling-off in signal strength.

Any available type and size of aerial may successfully be used in conjunction with the Screen Grid Short-waver, but a long, high wire will, naturally, give superior results to those obtainable with an indoor aerial. At the same time, it is remarkable what one can pick up with a small indoor aerial at times, and the Screen-Grid Short-waver gives quite a good account of itself when used with this form of antenna. Normally, it is found that the addition of the earth wire makes little or no difference to signal strength. Indeed, it is often advantageous to dispense with the earth connection entirely, as a quieter "background" usually will be obtained in this way.

Two Stages Possible.

Now, the Screen-Grid Short-waver will give loudspeaker strength on many of the overseas short-wave broadcasters, but it must not be thought that there is sufficient volume to dance to; this can scarcely be expected with such a set. Should the volume prove inadequate for the constructor's requirements, a second stage of audio-frequency amplification may be added quite easily. There is plenty of room for the extra transformer and valve socket if the transformer T and socket V3 are moved as far as possible towards the rear edge of the baseboard. The extra stage is connected up in the orthodox manner, and a valve such as the Philips A-415 or A-409 will give good results if it is used in socket V3 and the Penthode transferred to the extra (fourth) valve socket. When two audio stages are used, the Penthode may, if desired, be replaced by an ordinary three-electrode power-valve, although a certain amount of amplification will be sacrificed by so doing.

There has been a great deal of talk about the "impossibility" of using a Penthode in the final stage of a two-stage amplifier, many people finding that a high-pitched whistle appears, and cannot be eliminated.

In view of this, it may be of interest to mention that the writer has used the Penthode in a two-stage amplifier on many occasions—one, in fact, is now permanently used in a standard Model 20 Radiola—with no trouble. It is true that trouble has been encountered when using some makes of transformers—transformers of high quality, but whose characteristics evidently were unsuitable for the purpose—but the combination of Philips transformers and Philips valves, including the Penthode, invariably has yielded excellent results. The only precaution to be observed when using the Penthode in a two-stage amplifier is to connect a 100,000-ohm. fixed resistor across the secondary terminals of the second transformer; this has the effect of damping the secondary circuit, thus promoting stability, and also somewhat reduces the input to the Penthode, with the net result that any tendency to oscillate is effectively checked.

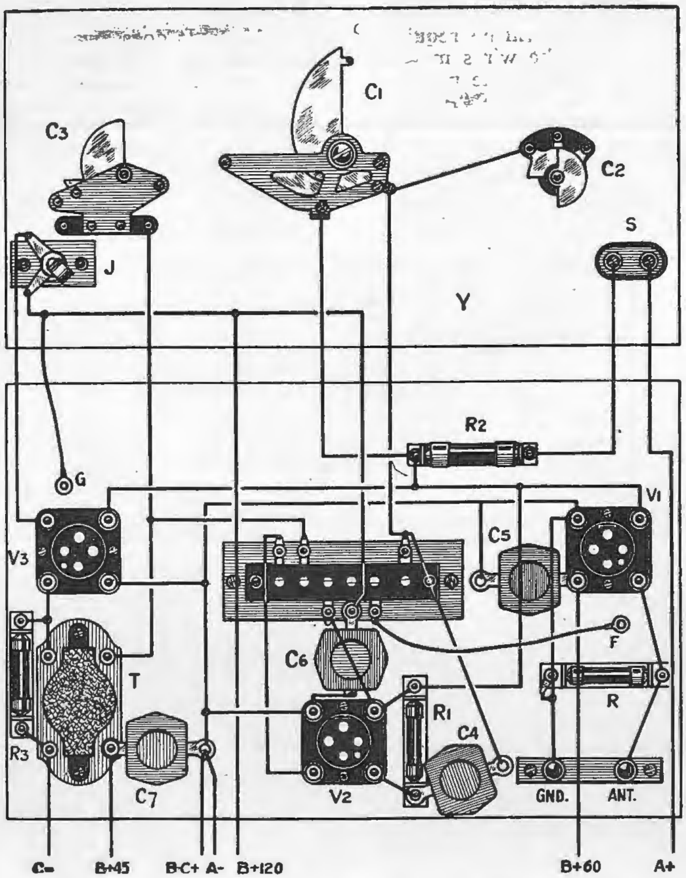


FIG. 5.—Pictorial wiring diagram. Much of the wiring is carried out below the baseboard, as explained in the text.

Should the constructor already be in possession of a Radiokes radio-frequency choke-coil, this may be connected in place of the resistor R, thus coupling the aerial by the choke method instead of the resistance system. In practice, little difference is noted, although we believe the resistance might give more uniform coupling over the entire wavelength range of the receiver. With the Philips transformer utilised in the Screen-Grid Short-waver, it was found that a radio-frequency choke in the plate circuit was not called for, and this will be the case with any of the higher-grade transformers which have a high primary impedance with low distributed-capacity. With some transformers, however, it may be necessary to include a choke in order to obtain oscillation; if this is so, the r.f. choke is connected to the "P" terminal of the transformer T, the wire which is already connected to that terminal being transferred to the opposite terminal of the choke.

Suitable for Broadcast Waves.

One more interesting item concerning the Screen-grid Short-waver: By the time this article is in print, there will be available an additional coil which, plugged into the existing mounting, allows almost the entire broadcast waveband—245 to 555 metres—to be covered. Judging by tests which we have made using hurriedly-calculated and roughly-wound coils, the Screen-Grid Short-waver gives excellent results on the broadcast waves, and the additional Radiokes coil is the only thing needed to make the receiver complete.

Just at this point it will not be out of place to mention one or two features of the new Radiokes Screen-Grid Short-wave coil kit. No doubt most of our readers are familiar with the products of this famous Sydney factory, and the accuracy and high finish of Radiokes coils and kits is a byword among radio enthusiasts all over the Commonwealth. This latest product, however, truly is a masterpiece of expert design and precision manufacture. It eclipses anything we have ever seen in the coil line, and is a great credit to the factory responsible. First and foremost among the mechanical features is the plug-in system employed. No split brass pins here, with their uncertain contact and harsh action! Instead, the six round pins with which each coil is fitted, slip with velvety smoothness into six miniature jacks, silvered phosphor-bronze fingers providing a positive wiping contact which is reliable under all conditions. The coils, wound with brilliant green silk-covered wire, are only 2 inches in diameter, thus reducing the extent of the magnetic field to a minimum. Each of the four coils consists of a primary (plate coil), secondary (grid coil) and tertiary (reaction coil). In order to meet the requirement of the screen-grid valve for a high coupling-impedance, the primary contains the same number of turns as the secondary, and is wound turn-for-turn with it to a slightly smaller diameter. The reaction coil in each case is wound with fine wire in a slot, directly under the filament end of the secondary. The number of turns in the reaction coils has been chosen with great care, and the Screen-Grid Short-waver oscillates very smoothly over the entire wavelength range which it covers. In a receiver of this type, it is essential that good quality components be used, otherwise one may just as well not be over-optimistic with regard to the results which will be obtained. Remember that "cheap" parts are a waste of money—they are

are not really cheap, as anyone who has tried them knows to his cost.

Simple though this modern short-wave receiver undoubtedly is, it is the most efficient receiver we have tested so far, with the single exception of the "Globe Trotter Screen-Grid Four." We believe the Screen-Grid Short-waver will be a very popular receiver, and we shall be interested to hear from readers who build it according to the directions outlined.

PARTS REQUIRED.

1 Utility Micro-dial.
1 Jackson .00015-mfd S.L.F. variable condenser, C1.
2 Bakelite knobs.
1 De Jur midget variable condenser, C2.
1 Cyldon Bebe .00025-mfd. reaction condenser, C3.
1 De Jur-Amsco .0001-mfd. fixed condenser, C4.
3 De Jur-Amsco .006-mfd. fixed condensers, C5, C6 and C7.
1 Electrad single-circuit jack, J.
1 Radiokes screen-grid short-wave kit.
1 Electrad 100,000-ohm fixed metallised resistor, R.
1 Electrad 7-meg. metallised leak, R1.
1 Amperite, type 112, R2.
1 Electrad 150,000-ohm fixed metallised resistor, R3.
3 Single leak mountings.
1 Cutler-Hammer battery switch.
1 Philips audio transformer, T.
3 Emmco balanced sockets, V1, V2, V3.
1 Aluminium panel, 14 x 7 x 16-gauge, Y.
1 Stained pine baseboard, 14 x 9 x 7/8-inches, Z.
1 Bakelite terminal strip, 3 x ½ x 1/8-inches.
1 Bakelite insulating piece, 2 x 1 x 1/8-inches.
7-Wire battery cable.
18 Gauge bare tinned copper wire.
Spaghetti sleeving. Screws.

Accessories.

1 Philips A-442 screen-grid valve.
1 Philips A-415 valve.
1 Philips B-443 Penthode valve.
1 4-Volt "A" battery.
2 60-Volt "B" batteries.
3 4½-Volt "C" batteries.

THE PICTURE ON THE COVER.

No doubt the apparatus illustrated on our front cover this month will be foreign to the eyes of many of our readers. There will be some, though, to whom the picture will bring pleasant recollections of radio as it existed in this State some eight years ago, and will form a reminder of the tremendous changes that time has made in the design of radio apparatus.

Illustrated in our picture is the universal-range receiver constructed and used by the Queensland Wireless Institute, at that time the only body of wireless experimenters in Queensland. The weekly meetings of the Institute were held in the tower room of the old Central Fire Station, at the intersection of Ann and Edward Streets—the present headquarters of the Traffic Branch—at which rendezvous a gathering of perhaps 20 or 30 enthusiasts assembled every Friday night.

To return to the subject of our cover picture. From left to right, the apparatus illustrated represents: A tuner of the "loose-coupler" type, which was the proverbial "last word" in those days. It covered a wavelength range of from about 200 to 2,500 metres. Next to this is the two-valve detector and audio unit—the pride of the members' hearts, and a very model of up-to-date construction. Two "Audiotron" valves were used at the time the picture was made—old-type tubular valves with two filaments, the idea being to have a spare in readiness for the demise of the other!

Mounted behind the three-ply panel were two rheostats, a variable grid condenser, variable tuning condenser, and, if memory serves correctly, a home-made iron-core choke, used in place of a transformer for coupling the audio amplifying valve to the detector. The grid leak was simply a series of pencil-lines drawn on a piece of cartridge paper—the usual thing in those days. On top of the receiver cabinet stands a mounting carrying three long-wave honeycomb coils, wound by members. These were used for listening to the long-wave overseas arc stations operating on wavelengths lying between 8000 and 25,000 metres, the morse transmissions of which invariably held a peculiar fascination. These coils contained anything up to 1500 turns of 30-gauge wire and were wound by hand on a specially-made spider, a copious application of shellac varnish serving to hold them into their honeycomb or cellular formation.

On the right-hand side of the picture may be seen portion of a Navy-type loose-coupler, supposedly an improvement on the conventional loose-coupler. This "improvement," it may be mentioned, consisted really of the elimination of the slider by tapping the primary coil in the "units and tens" arrangement, bringing the tappings out to two rotary switches mounted on a panel screwed to the end-cheeks. Any one of these three tuners—loose-coupler, honeycomb-coil or Navy coupler—could be hooked up to the receiver at will, this feature being considered of vital importance.

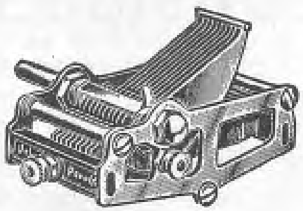
On the bench in front of the receiver lies a pair of Brown headphones—then, as now, one of the most sensitive headsets made, and standard equipment in all British Government wireless undertakings. Hanging on the wall is a Baldwin headset (the cherished property, it is believed, of Les. Moore, who ultimately entered into partnership with Syd. Colville in the formation of the well-known Colville-Moore Wireless Supplies, Sydney). These were, and still are, considered to the best American headset, and in that country enjoy a similar reputation to that held in England by the Brown phone.

To the left of the receiver, but not shown in the photograph, is the aerial change-over switch—a huge affair, used for connecting the aerial alternatively to the transmitter or to the receiver. Immediately below it is the two-valve radiophone transmitter, which used two Marconi "Q" valves as oscillators with 220 volts D.C. from the lighting mains on the plates. At the time the picture was taken this had not been tested, but it afterwards did some very good work in the transmission of speech and gramophone music. By the way, the "call" of the Institute in those days was "Q-250"—somewhat reminiscent of an early motor-car license!

Much more could be written on the subject of the early days of Queensland wireless activity, but the limitations of space may not be ignored. Another time, perhaps . . . . !

TESTED AND RECOMMENDED

A Department of Investigation, conducted for the benefit of our readers. Every piece of material featured on these pages is subjected to a rigorous and searching test before publication. No remuneration is received for the publication of these paragraphs.



The De Jur Variable Condenser

The De Jur variable condenser is a very finely-finished instrument of excellent mechanical construction. Electrically, it is well-designed, having only two small bars of insulating material located well out of the strong electrostatic field which surrounds the plates of a condenser. This insulation is of moulded bakelite, a material which combines the property of good insulation with that of great mechanical strength. The two end-plates are stamped out of 1/16-inch hard sheet brass, highly nickelled, and are connected together at three points by heavy pillars of the same material. The hard brass plates are correctly shaped to give a satisfactory tuning curve, and are swedged into solid brass blocks. The bearings are large in area and provide an automatic take-up to compensate for wear. Supplementing the single-hole mounting bushing is a countersunk head screw, which serves to hold the condenser securely in position where additional rigidity is required. Tinned soldering lugs are fitted to the terminals, and a ¼-inch spindle is standard. The motion provides for an increase in capacity when the rotor is turned in a counter-clockwise direction. Under test, the De Jur variable condenser gave every satisfaction and can be thoroughly recommended. Our sample came from Messrs. Edgar V. Hudson, 53 Charlotte Street, Brisbane.

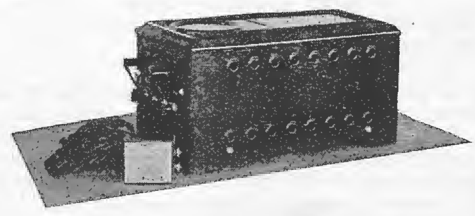
* * * *

Siemens Heavy-Duty "B" Battery

The well-known firm of Messrs. Siemens (Australia) Pty., Ltd., have forwarded to us a sample of their 45-volt heavy-duty dry "B" battery for test and report. In England, where it is possible to buy dry batteries of very many types, none is more popular than the Siemens product. This statement is substantiated by the fact that Siemens batteries are standard equipment with a large number of the higher-grade English receivers, the manufacturers of which evidently have some good reason for their choice.

A battery is a device which cannot really be tested within a period of days, or even of weeks. To subject it to a thorough test obviously would entail its use under average receiving conditions over a period of months. However, what we did do was to connect it to an artificial load consisting of an adjustable resistance, and to include in the circuit an accurate milliammeter for measuring the discharge rate. Very few receiving sets of the battery type consume more than 20 milliamperes of plate current, but for the purpose of our test we regulated the resistance so that the current dissipated by the resistance amounted to the comparatively high value of 50 milliamperes. Under these abnormally severe conditions the battery showed, at the end of a ten-hours' continuous discharge period, a voltage of only two volts lower than the initial reading. and after a "resting" period of three hours, this had regained its normal value. The result gives some indication of the recuperative power of the Siemens "B" battery—a property that is of extreme importance in a dry battery. It may be mentioned that the firm of Siemens is the same that is responsible for the manufacture and installation of the automatic telephone system which is nearing completion in Brisbane—surely a sufficient guarantee of the quality of their product.

* * * *



The Lewbury Battery Eliminators

From Messrs. Trackson Bros. Ltd., Elizabeth St., Brisbane, we have received samples of the Lewbury range of battery eliminators, comprising an "A" Battery Eliminator, a "B" Battery Eliminator, a "B & C" Eliminator, and a "B" Eliminator for use on D.C. mains. The Lewbury battery eliminators are wholly manufactured in Australia by Messrs. Tilbury and Lewis Pty., Ltd., Richmond, Victoria, and a careful inspection and test serves to convince one that they attain to a standard that is not surpassed by any similar instruments of either foreign or Australian manufacture. Each type of eliminator is assembled in a pressed metal case of pleasing design and finish, and is fitted with a heavy cast base with rubber feet High-grade transformers and resistances are incorporated, adequate ventilation is provided, and the filter condensers are of the best paper-dielectric type. In the "A" battery eliminator, which is intended for use on A.C. mains, the Westinghouse "dry-electrolytic" rectifying element is employed, this unit being of the well-known cuprous-oxide type, sold abroad under the names of "Elkon" and "Rectox." This rectifier has proved to be extremely efficient and reliable under operating conditions, and may be expected to have a useful working life of upwards of 1000 hours under the maximum load of 2½ amperes. At the end of its useful working life, when the efficiency of the unit begins to diminish, it is an easy matter to secure a new rectifier and insert it into the clips provided. In the A.C. "B" and "B & C" eliminators, the "BH" Raytheon tube is utilised, this being a valve of the gaseous conduction type having a maximum current-carrying capacity of 85 milliamperes, and a very long useful life.

The "A" battery eliminator delivers a maximum current output of 2½ amperes (sufficient for the needs of ten 201A-type valves), and tappings are provided which permit a voltage regulation, variable in one-volt steps from 1 to 6 volts. Used with a standard five-valve receiver equipped with ordinary "point-one" valves, there was no perceptible hum under ordinary operating conditions. Only by placing the ear within a foot of the loudspeaker while no station was being received was it possible to distinguish the difference between the Lewbury eliminator and a battery power supply.

The same remarks apply to the Lewbury "B" and "B & C" eliminators, these units operating with almost a total absence of hum—a **total** absence under ordinary receiving conditions. A simple means is provided on each for regulating the output voltages in order to suit the requirements of the receiver, variable resistors being entirely dispensed with. The maximum "B" voltages available are in the vicinity of 180, and the minimum about 22½. This low voltage is a distinct advantage, for it is often found with "B" eliminators that it is impossible to obtain a sufficiently low plate voltage on the detector to permit a smooth control of reaction.

As an experiment, both the "A" and the "B & C" eliminators were attached to the same five-valve receiver, dispensing with batteries altogether and making it, in effect, an all-electric set. No detail of the set itself was changed, but the results certainly were excellent in every respect. The addition of the "A" and "B & C" eliminators effectively solves the problem of adapting an existing battery receiver to light-socket operation, and solves it with a minimum of trouble.

A very ingenious feature of the Lewbury Battery Eliminators is the special plug which allows the instrument to be used on any line voltage between the limits of 200 and 250 volts with maximum efficiency. This is accomplished without switches of any kind, and is one of the cleverest ideas of its kind we have seen.

We have subjected the Lewbury Battery Eliminators to almost every conceivable test, and they have emerged in every case with flying colours. For that reason, we recommend them to the attention of our readers with the full assurance that they may be depended upon to fulfil their particular functions with a very high degree of satisfaction to the owner.

THE SILVATONE B.L. COIL.

One of the most useful and flexible coil units that has come under our notice is the Silvatone B.L. Coil, forwarded for test by Messrs. J. B. Chandler & Co., 45 Adelaide Street, Brisbane. It consists of one spaced-turns coil wound with 24-gauge enamelled wire on a 3-inch bakelite tube, and tapped in the centre; into this coil slides a celluloid tube, on the outer end of which is secured a small bakelite collar carrying a second winding of 30-gauge green silk-covered wire. Flexible leads connect this second coil with the terminals located at the bottom of the large bakelite former, and serve also as a means of limiting its extension.

The flexibility of the coil unit may be judged by the number of purposes to which it may be applied. For instance, it serves with equal efficiency as the tuning unit of a simple crystal receiver and in a modern screened four-valve set. In a one- or two-valve set it gives excellent results, and it may even be used as the foundation of a highly efficient wavetrap. The movable coil may be used as an aerial coil, a reaction coil or a plate coupling-coil in a radio-frequency amplifier, and the fact that the coupling between the two coils is so smoothly yet so simply variable is a tremendous advantage in many respects. The beauty of the idea lies in its simplicity; there is nothing to get out of order and the amount of material in the field of the coil is reduced to a minimum. The Silvatone B.L. Coil is highly finished, is provided with nickel-plated mounting feet and also with milled-head terminals for connection. As far as we can see, it would be impossible to improve on it in any way, and it carries our highest recommendation.

The MIDGET Short Wave Adapter

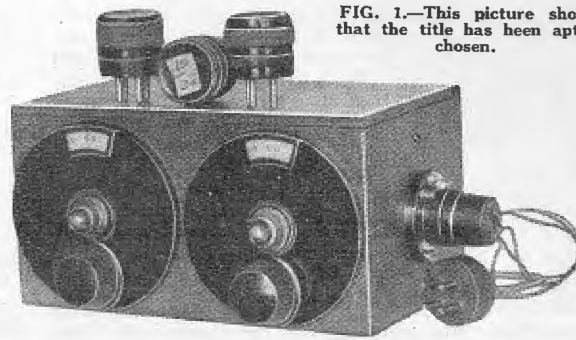


FIG. 1.—This picture shows that the title has been aptly chosen.

By the TECHNICAL EDITOR

MOST owners of radio receivers are interested in the short-wave transmissions about which one hears so much nowadays, but it is not always feasible to build up a special set for their reception. It has always seemed to us that if it were possible to evolve a small unit which, attached to an existing broadcast receiver, would enable it to respond to the waves below 100 metres and, above all, could be assembled by the average man at a cost of "next-to-nothing," the success of that unit would be assured. Many short-wave adapters have been described in the past, but, without exception, all of them involved the expenditure of a fair sum of money—a fact which probably had an adverse effect on their popularity.

A few weeks ago, a small parcel was brought to the offices of the "Queensland Radio News" by a Mr. Lachlan, of Toowong, Brisbane. On examination, it proved to contain one of the neatest little devices we have seen. In the narrow confines of a cigar-box had been assembled all the instruments necessary to form a complete short-wave adapter, and the components had been chosen with such care that they were not "crowded" in any way. In a unit of this size one would not expect to find too many "refinements"; but here was a shielded panel and base, interchangeable coils, variable grid-leak, and vernier dials for the tuning and reaction controls !

Mr. Lachlan assured us that this midget adapter would pass any test to which we cared to subject it, and we took him at his word. The Midget Short-wave Adapter was tested on many different receivers, with several different aerials, and in each and every case it gave a very creditable account of itself. It operates with an almost complete absence of hand-capacity, and the reaction control is beautifully smooth in action. With the seven coils which Mr. Lachlan included with the Adapter, a wavelength range of 10 to 130 metres is efficiently covered, a small over-lap being provided between the various coils.

The Circuit.

In the Midget Short-wave Adapter, use is made of the original "Schnell" circuit which was popularised by Lieut. Fred H. Schnell of the American Radio Relay League some four years ago, when he accompanied portion of the American Fleet on a cruise to Australia. This is really a modification of the Waegant arrangement with capacity-coupling between the aerial and grid circuits, and it has proved to be a very good performer on wavelengths below about 100 metres. The utter simplicity of the circuit will be realised after glancing at the diagram, Fig. 4. There could not well be fewer parts, and each is used in such a way that it operates at maximum efficiency.

The midget variable condenser C serves to furnish the coupling link between the aerial and the tuned circuit L1-C1. C1 is the grid tuning condenser, and L1 the grid coil or combined primary and secondary, the coil acting really as an auto-transformer. C3 is the fixed grid-condenser and R the grid-leak, V the detector valve, and L2 the reaction coil. This coil is inductively coupled to L1, so that the radio-frequency energy which it receives from the plate of the detector induces a corresponding oscillatory current in L1. This is the fundamental principle of reaction or feed-back, energy from the plate (output terminal) of the valve being fed back to the grid (input terminal), and so acting as a "booster" and adding greatly to the sensitivity of the valve. Some means is required for regulating the amount of energy thus fed back to the grid, and this is provided by the variable reaction condenser C2. This last acts as a variable by-pass condenser; when it is at minimum, radio-frequency energy, after passing through the reaction coil L2, cannot find a way back to the filament, where it must return to complete the circuit. As the capacity of C2 is increased, more and more energy can flow back to the filament and the circuit approaches closer to a state of oscillation. The radio-frequency choke coil X is included in order to prevent this plate-circuit energy from passing back to the filament via the audio transformer and batteries, thus giving it no alternative path other than the condenser C2. No filament rheostat is incorporated, as it is not essential with the modern valve and would only be an unnecessary complication.

Construction.

Now, having thus briefly outlined the action of the circuit, let us pass on to the actual constructional details. The parts used in Mr. Lachlan's Midget Adapter illustrated here are listed at the end of this article, and it might be advisable to adhere to the particular brands specified in order to ensure an exact duplication of the unit.

First of all, a cigar-box is required measuring approximately 8½ inches long, 4¼ inches high, and 5¼ inches deep. Of course, a box may be built to these dimensions, or even one of aluminium or copper may be used, but in this case an ordinary cigar-box has been pressed into service and it fills the bill admirably.

A piece of aluminium is then cut to such a size that, when bent at right-angles, it fits inside the box and serves to shield both the panel (front of the box) and base (bottom of box). It is cut with a small extension which, when bent up at right-angles, makes contact with the earth terminal, indicated by "G" in the pictorial diagram (Fig. 5).

The tuning condenser C1 is a De Jur midget condenser from which all excepting 6 moving and 5 fixed plates have been removed. C2 is a similar condenser, but may be the largest sized midget condenser procurable—its capacity is not critical. Both of these condensers are mounted directly on the metal shield and wood panel, it being essential that their mounting bushings make firm contact with the aluminium. They are placed exactly 4½ inches apart.

A piece of bakelite or Radion measuring 6 x 2 x 3/16 inches is screwed down to the base shield in the position shown, this being indicated in the pictorial diagram by the letter "B." The two valve-sockets V and M are mounted on it, and these must be placed so that the arrows moulded on them point in the direction shown in the drawing. "M" indicates the socket which does duty as a coil mounting, while "V" is the detector valve socket. The grid condenser C3 is simply supported by the wiring itself and the grid-leak is, of course, held by the clips on the condenser.

In the pictorial diagram, the interior of the box is drawn as though it were opened and the front (panel), bottom (base) and two ends laid out flat, this being the best way of showing every instrument clearly. On the right-hand end will be seen the aerial coupling condenser C and the aerial terminal A and earth terminal E. The aerial coupling condenser is an Advance 3-plate neutralising condenser, and it is mounted with its regulating knob on the outside of the box. If desired, this condenser and the aerial terminal may be bushed, so that they are insulated from the wooden end-piece. In Mr. Lachlan's model this precaution has been taken, but we believe it is not necessary if the box is given several coats of varnish beforehand and allowed to dry thoroughly.

On the left-hand end will be seen the Airzone radio-frequency choke, this being held in position by an aluminium saddle. On the **outside** of this end-piece is mounted a valve socket O. This acts as the output connecting group of the Adapter, but if desired, three terminals may be used instead. This socket, if used, should be mounted with its arrow pointing upwards—that is, the two "F" terminals will be at the bottom.

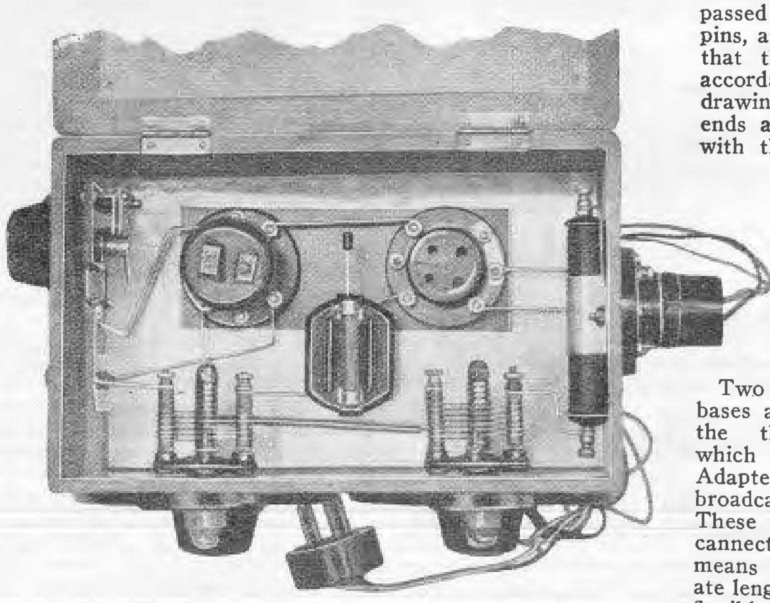


FIG. 2.—Although the Midget is so small in size, the components are not unduly crowded. The left-hand socket is the coil-holder, while the detector valve fits in the other socket.

Wiring.

The wiring in this Midget Short-wave Adapter is so simple that it scarcely need be mentioned; indeed, there is practically nothing of it. Note carefully that no connection is made to the rotor (moving plates) terminal of either of the midget condensers C1 and C2. This connection is automatically made when the condensers are mounted on the aluminium shield. The two outside terminals of each condenser are both connected with the stator (fixed plates), a connection being taken from each terminal merely for the sake of convenience. Notice also that the wire running from the "F+" terminal of the output socket O to one filament terminal of the detector socket V is also joined to the shielding. Do not attempt to solder this connection; just clamp it under the head of a small screw.

The Coils.

In the Midget Short-wave Adapter, all the interchangeable coils are home-made—wound, in fact, on old UX valve bases. It is not a difficult matter to procure a few old, defunct valves fitted with UX bases, and it is quite easy to prepare them for their duty of coil formers. The glass is first broken away from the base, and the base cleaned out with a pocket-knife. The brass contact pins are then held over a gas flame until the solder inside them melts, and the connecting wires are withdrawn from them with a pair of pliers. While the pins are very hot, the valve-base is shaken smartly in order to drive out the remnants of solder from the pins. When this has been done, it should be possible to see through each pin.

After the bases have thus been prepared, the coils are wound in accordance with the table printed on this page. The coils **must** all be wound in the same direction, and small holes are drilled through the bases through which the ends are passed. Inside the valve-bases, the ends are bared of insulation and passed through the pins, and it is essential that this be done in accordance with the drawing, Fig. 3. The ends are cut off flush with the bottom ends of the pins, the pins heated again and a blob of solder run into each prong—with a very small amount of Fluxite.

Two extra valve bases are required for the three-wire link which connects the Adapter with the broadcast receiving set. These two bases are cannected together by means of three separate lengths of insulated flexible wire, the length depending entirely on the distance between the Adapter and the broadcast receiver when they are in use. The shorter these flexible leads can be made the better. One wire connects the "F—" pins of the two valve bases together, another joins the two "F+" pins, and the third wire connects the two "P" pins together. The "G" pin of each base is left blank. Of course, if three terminals have been used on the Adapter in place of the output socket O, one of these valve bases will not be needed, the three wires being taken directly to the terminals at the Adapter end. In some ways the 3 terminals are the better proposition, as it may be necessary to transpose the two wires joining the "F" pins after the Adapter is in operation —that is, reverse the "A" battery connections to the Adapter. In the case of the valve-base at each end of the flexible leads, it would be necessary in that event to unsolder the leads to the pins. The choice may, however, be left with the constructor, since this is only a minor detail and has no effect on the operation of the unit.

Operation.

To use the Midget Short-wave Adapter with any broadcast receiver having one or two stages of audio-frequency amplification, remove the detector valve from its socket in the broadcast set and insert it in the socket V of the Adapter. Now connect the two units together by means of the flexible link already mentioned. The valve-base on one end is inserted in the detector socket of the broadcast receiver, and the other end connected to the Adapter, as we have explained. One of the valve-base coils is plugged into the socket M. Remove the aerial and earth wires from the broadcast set and connect them instead to the "A" and "E" terminals of the Adapter. Now, with the broadcast set switched on in the usual way, proceed to tune as follows:

Turn the reaction condenser C2 towards maximum (plates into mesh) until oscillation is indicated by a soft "thump," followed by a faint hissing sound. If the circuit refuses to oscillate, reduce the capacity of the aerial coupling condenser C by turning the moving plate out of mesh with the fixed plates until it does. With the set just oscillating, slowly rotate the tuning condenser C1 until the carrier or whistle of a station is picked up. Retard reaction until the set is just below the oscillating-point and the whistle disappears, and retune slightly with C1, when music or speech will be heard. Note that the receiver is in its most sensitive condition when it is just about, but not quite, oscillating.

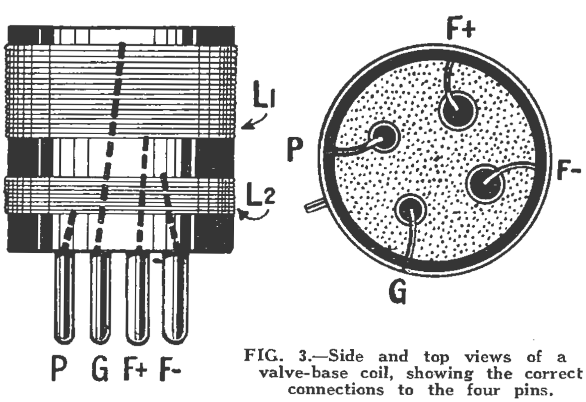


FIG. 3.—Side and top views of a valve-base coil, showing the correct connections to the four pins.

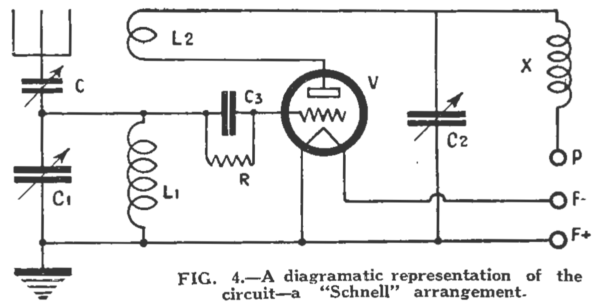


FIG. 4.—A diagramatic representation of the circuit—a "Schnell" arrangement.

The tuning dials of the broadcast set do not enter into the matter at all, and if the broadcast receiver is fitted with any stages of radio-frequency amplification, the valves belonging to these stages may be removed in order to conserve battery current. For instance, in a five-valve set only two valves would be used (the two audio valves)—in addition, of course, to the detector valve which was transferred to the Adapter.

Should it be found that the Adapter goes in and out of oscillation with a howl or moan—"fringe" or "threshold" howl—this may usually be cured by connecting a 100,000 ohms fixed resistor across the secondary terminals of the second audio transformer in the broadcast receiver. This condition is brought about through no fault on the part of the Adapter, but it frequently causes a great deal of annoyance on the short wavelengths.

The aerial coupling condenser C should be set to as high a capacity as possible consistent with the Adapter oscillating smoothly over its entire tuning range. This is not by any means a tuning control, but its adjustment is influenced by the dimensions of the aerial used. It will be found that the loudest signals are obtained with the condenser set at the highest possible capacity, but above a certain point the load imposed by the aerial will damp the grid circuit to such an extent that oscillation is completely suppressed.

In the Midget Short-wave Adapter illustrated, a Durham variable grid-leak is used—merely, Mr. Lachlan tells us, because one happened to be handy. It will be quite in order, however, to use a fixed leak of something between 6 and 10 megohms resistance. Seven megohms is a fair average value, but it is generally well worth-while to experiment with different values.

In the table of coil dimensions, we have specified the use of double-silk-covered wire for both grid and reaction coils. Because of its hydroscopic properties, which cause it to absorb moisture during wet weather, cotton insulation is not advised, although cotton-covered wire may be pressed into service if desired. In this event, it will be just as well to treat the finished coils to a coat of collodion, a colourless preparation which forms a hard water-proof coating immediately on coming into contact with air.

In the case of coils Nos. 7 and 8, it will be found necessary to wind on the turns in two layers; one need not go to the trouble of bank-winding them, although that would be preferable if the constructor is familiar with the process involved. Make sure that the pins of the valve-bases are bright and clean at all times, so that they will make good contact with the socket-springs.

After the Midget Short-wave Adapter is connected to the broadcast receiver, and is found to oscillate satisfactorily, the effect should be tried of reversing the "A" battery wires to the Adapter. As explained previously, this is done by transposing the two wires joining the "F" pins of the two valve bases on the connecting link together. If terminals have been used at the Adapter end of this connecting link, it becomes simply a matter of changing these two wires round.

As far as results are concerned the Midget Shortwave Adapter will gladden the heart of the short-wave enthusiast. Our tests were carried out under rather adverse conditions, static being troublesome throughout. In spite of this, 5SW (London) came in at fair loudspeaker strength, 2ME (Sydney) at full speaker strength and various other short-wave stations, including PLE (Java) were heard at fair to good speaker volume. Considering the time of the year, this performance is eminently satisfactory, and it speaks well indeed for the efficiency of the Midget Shortwave Adapter, and for the skill of its constructor.

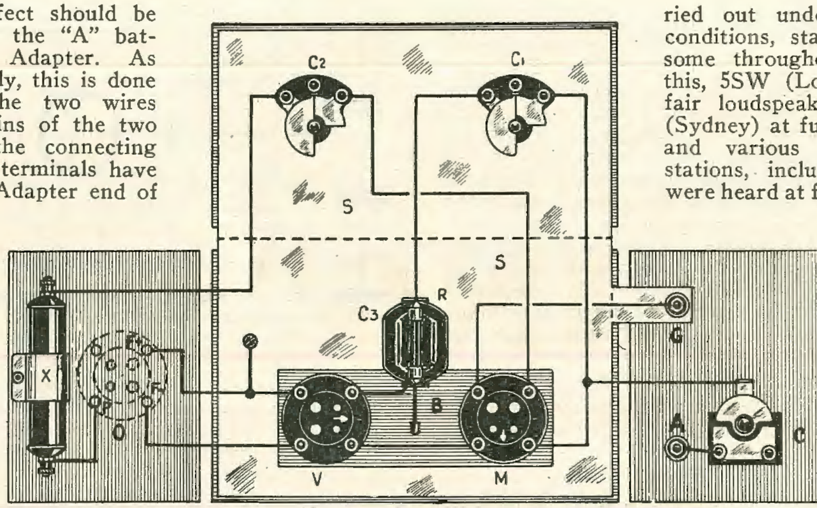


FIG. 5.—Pictorial diagram. The unit is shown as though the front, bottom and ends were laid out flat.

DETAILS OF COILS:

Coil No.	Wave Range Metres	L1 Grid Turns	L2 Reaction Turns
1	10-19	4	3
2	19-25	7	7
3	25-35	10	10
4	35-45	15	15
5	45-64	22	22
6	64-110	40	40
7	110-130	62	62.

Grid Coils—24-Gauge D.C.C.

Reactions—28-Gauge D.C.C.

LIST OF PARTS.

1 Piece bakelite, 6 x 2 x 3/16-inch, B.

1 Advance 3-plate neutralising condenser, C.

2 De Jur 19-plate midget variable condensers, C1 and C2.

1 Sangamo .0001-mfd. grid condenser with cilps, C3.

2 Large phone terminals, A and E.

3 Buffalo UX valve sockets, V, M, O.

1 7-meg. Electrad metallised gridleak, R.

1 Airzone radio-frequency choke, X.

1 Aluminium shield, S.

2 Emmco metal vernier dials, clockwise.

1 Cigar-box, 8½ x 5¼ x 4¼-inch.

9 UX valve bases.

3 Lengths single insulated flex.

24 and 28 Gauge D.S.C. wire.

18 Gauge tinned copper wire.

Screws.

PHI ON HIGH POWER

Reports Welcomed

We have received advice from Messrs Philips Lamps Ltd., that their short-wave station, PHI, at Huizen, Holland, is now transmitting on greatly increased power, and is now one of the world's biggest short-wave stations.

Experimental transmissions were carried out each night from the 25th to 28th February on 16.88 metres, and any readers who were successful in receiving this station are asked to advise Messrs. Philips Lamps (Aust.) Ltd., Box 2703-c, G.P.O., Sydney, giving information as to reception, strength, etc. This station will carry out further experiments, and short-wave enthusiasts should endeavour to receive their transmissions.

Amateurs Temporarily Regain 80 Metres Band

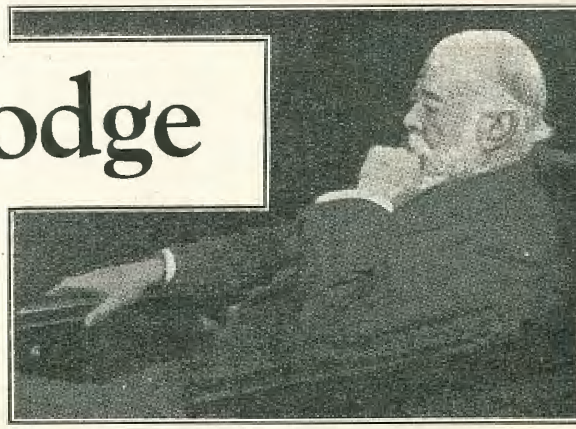
Great jubilation is felt in amateur circles regarding the notification from the authorities that permission has been granted for the use of the wavelengths between 75 and 85 metres until July of this year. There was much heart-burning concerning the loss of this highly-prized wavelength channel, as it has proved to be ideal for Interstate communication—particularly at night.

When the question comes to be reconsidered next July, let us hope that part, at least, of this waveband will be preserved for amateur use, as the 42-metre wave is hopelessly overcrowded and the 21-metre channel is most unreliable for Interstate working after dark. "80 metres" used to be the Mecca of the short-wave phone enthusiast, for it is possible for the amateur with limited equipment to transmit telephony of much higher quality on that wavelength than on the lower waves, and the distance covered is far in excess of that which would be the case with a similar power input on 200 metres.

A Most Remarkable Man

Sir Oliver Lodge

A Study



BY NORMAN EDWARDS

Some intimate glimpses into the private life of one of the world's greatest scientists

IT may be truly said that there is no living scientist better known to the public than Sir Oliver Lodge. And it may also be said with truth that besides his scientific eminence, there are few men to-day who can command such respect and admiration because of qualities of heart equally as great as those of mind. Many men have attained to greatness in the world of science, but very few have attained to equal greatness by the practice of those qualities which entitle a man to be termed not only great but lovable.

It is not my intention in this article to write about Lodge the Scientist; the details of his scientific career and especially the many contributions he has made in the course of his pioneer investigations in connection with wireless telegraphy would fill many pages; but about Lodge the Man much can be written which should prove of interest, for by his books, and equally by his extraordinary personality, he is one of the outstanding figures of the age we live in, and a man who, throughout his long life, has always devoted himself unsparingly and unselfishly to what I can only term the furtherance of the progress of civilisation.

To-day, at the age of seventy-seven, Sir Oliver Lodge is still a fine, imposing figure of a man. Well over six feet in height, his upright carriage and noble, intellectual head stamps him out at one glance as no common man.

Indeed, I do not think he has ever been really ill or seriously unfit in his life, and his capacity for work and for the enjoyment of life in the full sense of the word is still that of a vigorous young man in his early thirties. He was born in June, at Penkull, near Stoke-upon-Trent, in 1851, and at eight years of age went to the Newport Grammar School. At fourteen he went into business to help his father, but his love of science was great, and in the evenings he prepared for the London University Matriculation Examination. Finally, he gave up the idea of going into business and, in 1872, at the age of twenty-one, went to University College, London. His progress and the growth of his reputation from that date were rapid. He was made a Doctor of Science in 1877, and was made the First Professor of Physics at Liverpool University in 1881.

In 1887 he was elected a Fellow of the Royal Society, and in 1900 the Crown appointed him the First Principal of the University of Birmingham. He was knighted in 1902.

Since his retirement in 1919 he has lived at Lake, a delightful village close to Salisbury Plain.

Supremely Human.

It is about this period of his life that I intend writing, and although I am at least fifty years younger than he is, and have known him but six years, our acquaintance has ripened into a friendship which has given me, among other things, the opportunity of knowing him well, and gaining many glimpses of aspects of his character about which, unfortunately, all too little is known by the general public.

Many people have a preconceived idea about scientists, which is usually founded upon ignorance. They imagine beetle-browed Olympians of intellect, moving aloof from the common herd and always mentally on a plane far above the comprehension of laymen. Scientists, of course, are always supposed to be absent-minded; that is, their minds are "absent" in the sense that mundane things occupy no place in their thoughts.

But how that preconceived idea crashes to the ground when you meet Sir Oliver Lodge! The first time I met him he walked into my office to discuss some business. Scientists are usually supposed to be ignorant of business, but I soon found out that Sir Oliver Lodge has excellent business ideas, and his knowledge of the intricacies of the Income Tax is surprising! And could anything be more mundane than the Income Tax!

He is extremely fond of the theatre, and one evening we both paid a visit to "St. Joan," in which our mutual friend, Miss Sybil Thorndyke, was playing the title role. As we had both seen Shaw's masterpiece before, we discussed the play at dinner. I remember we sat at the famous corner table in the Athenaeum, and I was prompted to suggest to my host that Joan probably went to the stake in a state of ecstasy, and consequently she may not have felt very much pain.

But Sir Oliver disagreed. "No," he said. "I don't think she was an ecstatic. She went to the stake with her eyes open." He shuddered, and then smiled whimsically. "I don't think I'd have gone to the stake if I'd been her," he said, as we discussed her famous recantation.

"I'm sure I wouldn't," I said bluntly; and then, curiosity impelling me, I asked: "But imagine yourself in Joan's position to this extent—that if you did not deny your belief in personal immortality, you would go to the stake. Would you recant?"

He thought deeply, and then a look of determination passed over his face.

"I'd go to the stake!" he said shortly. And he meant it.

Not Easily Convinced.

That is where so many critics of Sir Oliver's known interest in psychic matters make a great mistake. They believe, for example, that "Raymond" was written as the outcome of a great grief, and that personal sorrow has made him susceptible to belief in psychic matters.

But great as his grief was at the tragic termination to his brilliant son's career, no sentiment or personal sorrow could ever lead him into the bypaths of snares and delusions. His long training as a scientific investigator would inevitably prevent him from accepting psychic manifestations unless supported by evidence and by hard facts.

That evidence has been obtained and is still being obtained few intelligent students of the subject will deny. Many cases of psychic phenomena we have discussed at various times and often he would conclude a discussion on some particular case by saying:

"But I don't know about this; it's not a good case, and is second-hand evidence . . ." and so on, and so on.

I remember the first time I paid a visit to Sir Oliver's country home commenting on the fine old church door in front of the house, and, later, the interest with which I listened to my host as he told me of the curious and indeed, extraordinary history connected with the ground and with the house; and how he and Lady Lodge came to live there.

An Interesting Prediction.

I believe this story has been told by Sir Oliver in his latest book, but it will not be out of place to repeat it in brief in this article. It is, in fact, a most extraordinary example of pre-vision, or prediction, which, being completely authenticated, is of considerable importance and interest.

In 1913, Lady Lodge met a lady who was clairvoyant. Lady Lodge made verbatim notes of the medium's remarks at a sitting, and these were copied out by her son, Raymond. This was, of course, before the war. This is exactly what was written:

"A house in the country, a happiness, a stream or river that runs at the bottom of the garden. The house seems long and low-built, straggling; a piece that leads down to water. A happy condition; a happy period. On a height; the garden goes down to water, a feeling of good luck. Old fashioned; a church door. The room are old fashioned; no two rooms alike. Low steps, very funny, up a step and down a step. Some rooms long and narrow—all shapes. Something that will be associated with your life. Hall not large, house low, old oak. This house is where you are going to be. Large pictures hanging, old pictures. Wall opposite more like stone. It is in the country and hilly. Long way from the station. A summer house, large, that goes across, inside there is a table and chairs; the front is glass."

As Sir Oliver said when he told me of this incident: "We were all interested at this description of an imaginary home. But a house with a church door and so far from a railway station seemed unlikely features for any house we should take."

But now for the sequel. In 1914, Sir Oliver and Lady Lodge visited Australia for the British Association meeting; war broke out, and in 1915, Raymond was killed.

Years later, in 1919, on retiring from the Principalship of Birmingham University, Sir Oliver and his wife began looking for a house. Lady Lodge searched everywhere; in fact, she began house-hunting with a vengeance.

About this time a message was obtained through a medium from Raymond. The message was as follows:

"Tell mother to stop house-hunting. I have found one and am only waiting to push it to you."

The End of the Search.

Lady Lodge was abroad at the time this message was received, and Sir Oliver was staying with his friends, Lord and Lady Glenconner, at Willsford Manor, eight or nine miles from Salisbury. One afternoon, when walking with Lord Glenconner, they stopped to look in at an old farmhouse in the Avon Valley, which Lord Glenconner had purchased. It had barns and a kitchen garden and was surrounded by a thatched wall, such as one sees in Wiltshire. At the bottom of the garden ran a stream, and Lord Glenconner said he would like to let if he could find the right sort of people.

The upshot was that Lady Lodge and her daughters saw the house and liked it, and, on an understanding that certain alterations could be made the Lodges took the house. The roof was lifted and a spacious library built in. Eventually they entered into occupation in 1920.

Later on, looking through some of Raymond's papers, they came across his copied-out record of the imaginary house described to Lady Lodge by the clairvoyant in 1913. It was then noticed how extraordinarily well the description fitted in with their new house, Normanton.

As Sir Oliver explained: "It is a long way from the station—eight or nine miles from Salisbury. The River Avon runs close by, there is oak panelling in the entrance hall, and certainly no two rooms are alike. The dining-room, which used to be the hall, is long and narrow, and some of the old pictures still remain."

There is also a step out of the sitting-room and one along a corridor in most unusual places. Many other features correspond exactly with Raymond's record, but most amazing of all is the fact that the porch, built to protect the entrance, has a real church door studded with bolts and rivets!

As Sir Oliver has remarked: "How to explain the pre-vision of the clairvoyant, if it was pre-vision, I do not understand; nor can I understand the foreseeing of the church door which, in 1913, was not fitted to the house"!

The door, in fact, had for a long time been stored away in a barn on Lady Glenconner's estate, and was not fitted to the porch until just before the Lodges took over the tenancy!

A "Delightful Experience."

It is all very strange. The materialist may talk of coincidence, and, although coincidence has admittedly a long arm, it seems to have been stretched to an extraordinary length if we are to explain this curious story by reference to coincidence. In fact, the more one looks at it the more ridiculous it seems to attempt to explain it as a coincidence; and to attempt to explain it at all is not the intention of the writer. My readers may draw their own conclusions, and if they are any the wiser afterwards they will be very clever people.

To stay at Normanton is a delightful experience. I shall never forget how, on the morning of my first visit, I woke up at about half-past six to find the hot July sun pouring into my bedroom, and how, for once in my life I was impelled to get up early. Glancing out of the window, who should I see on the lawn smiting most lustily at a dummy golf ball but my host, Sir Oliver Lodge.

Later on that day, after luncheon, he put on a large and comfortable Panama hat, gripped two substantial walking-sticks from a stand, and led the way through the hall out into the kitchen garden and so up the steep road which leads to Salisbury Plain and Stonehenge. Despite the heat, Sir Oliver had invited me for a walk. I had been lounging about in the garden watching the cows contentedly cooling themselves in the stream which flowed nearby, and, frankly, I had agreed to the walk with some misgivings. It was really very hot, and before we had gone half a mile—we were making for Amesbury—I began to wish myself back in that cool garden.

An Informal Evening.

But Sir Oliver breasted the steep hill with ease and, swinging his sticks, expatiated on the beauty of the day, upon the rabbits which sometimes scuttled in front of us, and upon the birds which shrilled around our heads as we climbed higher up the hill; and, later, when we espied the majesty of Stonehenge, on the mysterious rites of the Druids and the possible mechanical and engineering methods they employed in raising those huge blocks of stone into upright positions.

Perhaps the best time of all when on a visit to Normanton is in the evenings, when he will sometimes pick up a favourite book and read aloud.

There is a great art in reading aloud; beauty of voice and diction are essential; and Sir Oliver has been blessed with both.

And, later, with one of his favourite cigarettes neatly inserted in its holder, his feet up on a stool, he will discuss the book he has been reading aloud, and those present who do not find it easy to talk eloquently will gradually find themselves joining in the informal debate and speaking with an ease and enthusiasm which, later on, surprises them.

Yes, an evening at Normanton is an experience not to be forgotten; the memory of it is something to treasure; and the thought of a repetition a keen sauce to the palate of anticipation.

THAT THRESHOLD HOWL.

Of all the various "cures" for that disaster of disasters in short-wave work, threshold howl, perhaps the most generally successful is the fitting of a potentiometer to control the bias on the grid of the detector valve.

It usually happens that if the grid leak is taken to filament positive the howl is bad; if taken to negative the howl is done away with, reaction is smooth, but signals drop about 10 per cent in strength.

By using the potentiometer an intermediate position can be obtained and a compromise effected so that you can get as near the positive end as is consistent with smooth reaction and sensitivity, as well as allowing the operation to be quite free from the howling trouble.

Alteration of grid leaks, of audio transformers, output chokes (audio-frequency in the 'phone leads, or filter choke of the usual audio-frequency type), bypass condensers here and there, and alteration of spacing all assist at times, but one of the best methods —not infallible, but with perhaps a majority of "successes" to its credit—is the old potentiometer method, and if you are troubled by threshold howl you should certainly try it.

YOUR "B" BATTERY.

Howling, crackling, and distortion can all be caused by batteries which are running down.

Just as the strength of a chain is that of its weakest link, so the effect of many good cells can be ruined by their being connected to one faulty one.

In general, the more "B" voltage on the plate the less is the risk of distortion.

Like all accumulators, rechargeable "B" batteries can easily be ruined by over-discharge, so the capacity of the battery should always be adequate for the plate current taken by the set.

Insufficient "B" voltage is one of the commonest causes of distortion.

If your house is fitted with electric light, remember that one of the best and cheapest methods of "B" supply is a "B" eliminator.

High-voltage accumulators should not be moved unnecessarily, and they should always be kept clean and covered, to prevent surface soakage.

An important part of the correct care of "B" accumulators is to maintain the acid at its proper level.

AN UNLICENSED STATION.

The owner of the amateur station signing 4JW and later, 4AW, which has been heard on several recent Sundays, will be wise to take a friendly tip and restrain his enthusiasm until he has obtained his license. His identity is well known, and it is only a matter of time before the Powers-That-Be will be called in to take a hand. The practice of using another man's call-sign is not very sporting, to say the least.

How to Avoid Distortion

An informative article intended for the more advanced experimenter. A careful study of the facts outlined will reveal the chief causes of distortion in the average broadcast receiver and their remedy.

By J. A. COOPER (Eng.), A.M.I.E.E.

IT is an undoubted fact that the first serious source of distortion met with in the radio receiver is reaction. This may be brought about intentionally by coupling back a plate circuit to the grid circuit of a preceding detector or radio-frequency valve in the receiver (so that the resistance of the circuit is reduced and its decrement lessened), thus increasing selectivity by making the circuit only resonant to a limited band of frequencies. It may also be brought about accidentally by capacitative coupling between wiring, and between the component parts of the valve.

There is also a possibility of coupling between coils and between wiring and shielding. Accidental capacitative coupling can be made negligible by careful layout, and the modern tendency is probably to avoid this source of trouble. It is the unintelligent use of reaction that causes most trouble. If reaction is over applied, tuning will be so sharp that the full effect of the side-bands is lost and hence only part of the radiated frequencies are adequately reproduced.

Response and Cut-Off.

The ideal broadcast receiver should give equal resonance to the carrier frequency, plus and minus 10,000 cycles to allow for the side-bands, and should cut-off sharply at these limits.

If too much reaction is applied the resistance of the tuned circuit is so reduced that oscillation takes place and not only the one listener suffers, but also his neighbours, owing to radiation. This must result in frequency-distortion, and the usual evidence is that speech and music becomes low toned. Such distortion may occur without the usual heterodyne whistle or "howl" being audible.

Assuming that our electrical impulse has survived the aerial circuit undistorted and that radio-frequency amplification is used, it has now to pass to the detector valve via some form of coupling.

The detector, whether crystal or valve, is probably the weakest link in the chain. For perfect reproduction the characteristic of the detector should be a straight line with a sharp bend at the bottom. Some crystals are very good, but for best results their curves should be studied. Such curves show rectified current (in micro-amperes) plotted against potential difference (in fractions of a volt) across the detector. These curves also indicate if a polarising potential difference would improve sensitivity with weak signals, as is the case with the carborundum and "Perikon" detectors.

Alternative Detectors.

The valve can be made an equally good detector. The shape of its plate-current grid-volts characteristic can be made to have almost any slope we wish, and thus by careful design one can make a detector valve which will work on a part of its curve that is nearly straight, and at the right part of the curve. Two methods are available, plate rectification and cumulative grid rectification.

The former introduces least distortion because the valve is working on the best part of its curve and incidentally is not taking appreciable energy from the oscillatory system. Unfortunately, the amplification of the valve is less than its maximum when so used and signals are correspondingly a little weaker than with cumulative grid rectification.

Cumulative grid rectification may readily, with strong signals, introduce sensible distortion. Perhaps the easiest way of understanding this is to think of the electron flow. Electrons flow on to the detector valve grid at a given impulse and before they have all had time to leak off via the grid leak, more electrons have come on to the grid. There is thus a time lag and the voltage of the grid cannot vary in exact step with the transmitter impulses.

Too Much Reaction.

The less the resistance of the leak, of course, the better the detection, but reducing the leak values also reduces signal strength, and so many people are led to introduce deliberate distortion into their receivers because they must have loud signals with few valves.

We now pass on to the audio-frequency amplifier. Distortion is often caused here more than anywhere else in the circuit, apart from that caused by reaction. We have already seen that coupling through wiring and shielding may introduce distortion, but the more noticeable causes are due to the valves used and to the methods of coupling. The valves themselves should be used with correct plate voltages and the grids should be so biased that the valves work always on the straight part of their characteristics. They must never work on either bend, and grid current must never be allowed to flow. If either thing happens distortion creeps in.

As amplification increases, the grid voltage changes are greater and the sweep on the characteristic lengthens, therefore one must use valves suitable for each stage of amplification. Power is required in the last stage to operate the loudspeaker. Now we know power depends upon ampere turns. There is a practical limit to the number of turns so that the signal current in the loudspeaker winding needs to be as large as possible.

The Main Factors.

Since $E = IR$, then power which $= EI = I^2R$.

I depends upon seven main factors:—

(1) The voltage E of the "B" battery.

(2) The emission of the filament (since the electron flow is I).

(3) The mesh of the grid (the more open it is the more room there is for electrons to pass).

(4) The internal resistance of the "B" battery (the less this is, the greater the current it can deliver).

(5) The impedance of the loudspeaker (R).

(6) The impedance of the valve (this depends largely on 3).

(7) The applied voltage swing (depending on the radio-frequency amplification).

(7) Should be large in order to obtain a large signal current flow from the valve (a consideration of a plate-current grid-volts characteristic will make this clear). It should never cause the valve to work off the straight part of its characteristic. An open mesh grid implies a low impedance valve. (1) implies that it must be capable of taking a high plate voltage; and (2) implies a "power" valve. Incidentally (4) and (1) point to the desirability of using accumulators or the mains as a source of supply.

Forms of Coupling.

In an audio-frequency amplifier we require to reproduce faithfully all notes having a frequency of from about 50 to 10,000. This can readily be done with resistance-capacity coupling. The value of the coupling condenser should be calculated for a frequency of 50 cycles, and the impedance of the condenser at this frequency, together with the resistance of the grid leak, should be greater than that of the preceding plate resistance. It should be remembered in this connection that grid-leaks should have a relatively low value of the order of about one megohm, otherwise feed-back through the inter-electrode capacity of the valve will in effect shunt the grid leak, and so cut down the reproduction of the highest frequencies.

We will now return to the audio-amplifier and consider forms of coupling. There are three methods in general use—resistance, choke, and transformer.

Resistance coupling is usually considered to introduce least distortion because the voltage drop across the plate resistance is independent of frequency. It must, however, be remembered that to prevent the "B" battery affecting the audio valve grids, a condenser is introduced in the grid circuit. This condenser passes radio-frequency impulses better than low ones, for its impedance varies inversely as the frequency, so that the higher the frequency the less the impedance.

Choke coupling is becoming popular because it needs less "B" voltage. The impedance of the choke varies as a function of the frequency, being greater with the greater frequencies. Low frequencies are therefore liable to be lost unless we use a choke of very high inductance, and so we get frequency distortion. We also still need a capacity in the grid circuit and further frequency distortion may occur here.

Turning now to transformer coupling we see that the transformer primary may act as an audio choke, and if its inductance is too low it will omit the lower frequencies. The self-capacity of the windings may also complicate matters.

Effect of Iron Core.

Transformers are now being built with negligible self-capacities and high primary impedances. From the published curves it may be seen that amplification below 500 cycles is still often unsatisfactory.

It should be noted here that the iron core also introduces a source of distortion. It is well-known that iron is non-linear in its action. Some slight distortion must, therefore, result from its use, but this can be reduced to a very small quantity if the iron used is very permeable and is used unsparingly.

Radio in the Pacific Islands

It is not generally known that radio plays a very important part in the lives and in the trading operations of the people living on many of the numerous Islands dotted about the south-western Pacific Ocean

By F. W. LARKINS.

THE adaptability of radio to serve the communication needs of people living in regions thousands of miles distant from large centres of civilisation, is well illustrated in the case of the islands of the south-western Pacific. Radio is the only means of inter-communication, other than the postal facilities, between island and island; between a particular island and Australia, and—through the Australian Beam Service—with Europe and America.

Amalgamated Wireless (A.'asia.) Ltd., have established three large centres in the south-western Pacific—at Fiji, New Guinea and Papua. The Station at Suva, Fiji, collects and distributes the traffic to and from all radio-equipped islands in the north and south Pacific. The daily broadcasting of weather reports from Suva has proved of great value to ships and to the islands in range of the Suva station, especially during the hurricane season. Suva Radio, besides being in communication with the three other A.W.A. controlled stations in Fiji—Labasa, Savu Savu, and Taviuni—maintains communication with Samoa, the Friendly Islands, Gilbert and Ellice Islands, New Caledonia and the New Hebrides.

The second centre is in the Mandated Territory of New Guinea, where the Company's chief station is located at Bita Paka (near Rabaul), on the island of New Britain, and is connected by direct land-line and telephone with the headquarters of the Commonwealth Administration at Rabaul. This modernly-equipped station not only maintains direct radio communication with A.W.A. Radio Centre, Sydney, but also is in constant communication with the following A.W.A. owned stations: Aitape and Madang, New Guinea; Manus, Admiralty Islands; Kavieng, New Ireland; Kieta, Bougainville Island; Marienberg Radio on the New Guinea Goldfields, and Bulolo and Salamoa on the New Guinea Goldfields. The Rabaul station also communicates with the Gilbert and Ellice Islands, the Solomon Islands and the Santa Cruz Islands.

The third important centre is at Port Moresby, in Papua. This station is in communication with Samarai, Papua, and also with Thursday Island, and the Australian stations at Cooktown and Townsville. In addition, there are two private stations, one at the Oriomo oilfields at Oriomo, Western Papua, and the other at Popo, on the Anglo-Persian oilfields.

The development of these Australian-owned stations in the Pacific is largely due to Mr. E. T. Fisk, Managing Director of Amalgamated Wireless (A'sia.) Ltd., who, in 1922, interviewed the Rt. Hon. L. S. Amery, then First Lord of the Admiralty, and suggested that A.W.A. should take over from the Imperial Government all the British radio stations in the Pacific, with the object of modernising them and connecting them direct with the Australian wireless network. It was pointed out that other nations were becoming active in the installation of radio stations on islands owned by them in the Pacific and, in Mr. Fisk's opinion, these enterprising activities of other nations would not be effectively met under the existing method whereby a number of isolated stations in the Pacific, with limited range, were operated and controlled from England. As a result of negotiations, an agreement was completed between the Imperial Government and A.W.A., and on January 1st, 1928, the Company took over the radio stations in the Fijian group.

The development of this network of commercial radio stations in time of peace gives assurance that they will be up-to-date and available for defence purposes in time of war, and that a trained personnel and equipment will be available at short notice for the extension of the services, or for the replacement of existing equipment that might be damaged or destroyed.

The re-organisation of the radio communication system of Fiji is now being carried out by A.W.A., and it shortly will be possible to link up all the British possessions which come under the control of the High Commissioner for the Western Pacific—also to link up Fiji with the territories administered under the Australian mandates and under the New Zealand mandates.

Australia is rapidly becoming the radio centre of the Southern Pacific. With the opening of a direct service between Australia and Fiji, a link will be provided whereby messages, transmitted from the islands adjacent to Suva, will be re-transmitted to Australia and thence to England, the continents of Europe and North and South America, via the Beam Wireless Service. For some time past the New Guinea and Papuan radio centres have acted as collection and distribution centres for traffic destined for Australia, and from Australia to Great Britain, the Continent and America.

Specially designed short-wave radio equipment has been installed at many of the Company's island stations, and it is proving of immense value in the interchange of island traffic. At the present time, Sydney radio short-wave station is in daily communication with the short-wave stations at Rabaul, Suva, Noumea and Honolulu.

ELIMINATE INTERFERENCE.

If your receiver is not sufficiently selective to permit reception of the Interstate stations while the local broadcaster is on the air, build the "Q.R.N." Wavetrap, described in the August, 1928, issue of this journal. It is highly efficient, costs little to construct, and may be used with almost any type of receiver. Copies of the issue may be obtained by sending 6d. in stamps to Box 1095-N, Brisbane.

How to choose a Battery Eliminator

A Battery Eliminator is far too expensive an instrument to choose at random. The following article mentions some of the more important details which must be considered.

RECENTLY I have had occasion to investigate the subject of battery eliminators, particularly in relation to their safety when used on the lighting and power mains for the operation of wireless receivers. This generation has grown so familiar with the convenience of electric light and power for domestic purposes, and the safety of the apparatus available, that it accepts almost without question all apparatus offered for a specific purpose.

Such implicit confidence is reposed in the manufacturers in respect of the safety of their apparatus that when buying an electric iron, an electric fire, or a vacuum cleaner, the first question asked is: "What does it consume?" Very seldom does anyone ask: "Is it perfectly safe?" This confidence in the electrical manufacturers and their apparatus is not generally misplaced, and it can be said that such apparatus as the leading electrical manufacturers place before the public is designed by experienced engineers with full knowledge of the electrical conditions to which the apparatus wil be subject. Very liberal safety factors are allowed, and very stringent tests are imposed.

Nevertheless, dangers exist in the use of improperly designed, inadequately insulated, or otherwise unsuitable apparatus on the electric-light mains. So long as the making of the apparatus is in the hands of manufacturers with the necessary knowledge, experience, and facilities, little exists to worry about; but the growth of wireless has introduced a very different state of affairs.

Inexperience Dangerous.

A considerable amount of apparatus is now in use on the mains constructed by people with very little electrical knowledge. They merely assemble so many components to a given diagram, which may be right or may not; they do not know and have no means of ascertaining.

Many have no experience to guide them as to the safety factors which are necessary. This experience is gained only by exhaustive tests under service conditions, sometimes extending over long periods. They have no facilities for submitting the apparatus to proper tests, such as insulation and breakdown tests, to mention two only.

A great danger arises from the use of factory-manufactured apparatus produced on a large scale at a low price by manufacturers no better fitted to produce the apparatus than the uninformed home-constructor except that they have production facilities.

The home-constructor does at least invariably use components on which some reliance can be placed, but the manufacturer of the "junk" apparatus builds up his eliminator of components that on inspection by any competent authority would receive instant condemnation.

Need of Adequate Dimensions.

It is well known even to those with only a limited electrical knowledge that the paths along which current has to flow must be of adequate dimensions. For example, in the case of resistances carrying any appreciable current, they must, in order to be safe and satisfactory, be wound with wire of a gauge ample for the current they have to carry.

I was recently shown by one of the large supply undertakings in this city, an eliminator which has been in use on their mains, and the resistances consisted of lines made very crudely with what appeared to be Indian ink on strips of cardboard. The choke and the condensers—equally necessary components in an eliminator—were very little better, being of crude and inferior construction.

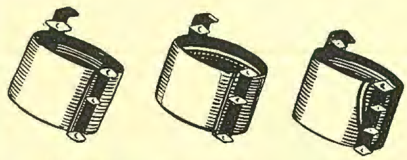
It is not difficult to appreciate that the quality of an eliminator both in respect of safety and performance is very largely dependent upon the components of which it is constructed. A high-grade eliminator cannot be built from low-grade components. High-grade components are essential, and high-grade components cannot be manufactured from low-grade materials. Consequently, high-grade components and high-grade eliminators cost more because they embody the best materials made by expensive machinery installed to do each particular operation in the best possible way, and the assembly is carried out by skilled labour under the best possible conditions because only under good conditions can good work be maintained. All this is beneficial to the ultimate user who needs the best apparatus for his purpose.

A battery eliminator is very largely an electrical problem and will, no doubt, best be dealt with by one or more of the leading electrical firms.

A Step in the Right Direction.

One, if not more, prominent English manufacturer is already taking steps to submit his apparatus to the principal supply authorities throughout the country with a view to having it approved by them and, concurrently, the supply authorities are taking steps to prohibit the use on their mains of apparatus which does not comply with certain specified requirements.

Sooner or later, definite legislation will come. Meantime, the owner of a wireless receiver contemplating the use of a battery eliminator should consider firstly the safety of himself, his family and his servants; secondly, the performance of which the eliminator is capable, its efficiency and reliability; and thirdly, and then only, its price.



AIRZONE CELLULOID NEUTRODYNE KIT.

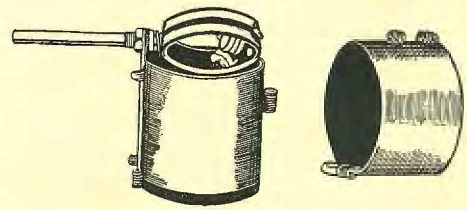
This kit is noted throughout Australia as a "distance getter." Windings are spaced on celluloid. Volume and selectivity will satisfy the most critical. Blue print supplied gives full wiring instructions.

Price 22/6

AIRZONE UNIVERSAL TUNER.

A general purpose coil of new design and construction for one-hole panel mounting. Former is bakelite; windings of coloured silk enamel wire.

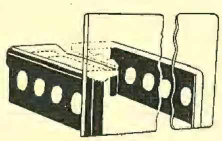
Price 17/6



AIRZONE MIDGET BROWNING DRAKE KIT.

For those who wish to keep their set as small and compact as possible, this kit is ideal. Although of small dimensions, this unit gives excellent results.

Price 15/-



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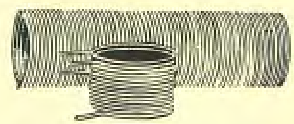

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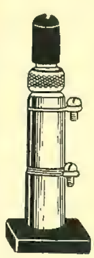

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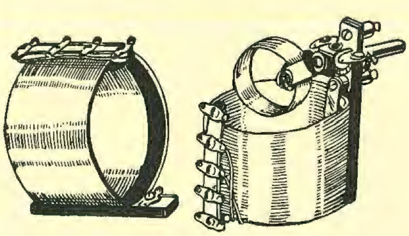

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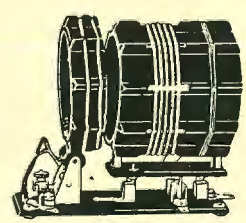

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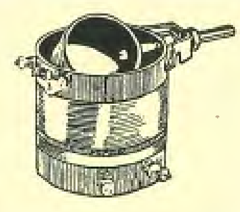

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The FUTURE of the VALVE

By Dr. J. A. FLEMING, F.R.S.

John Ambrose Fleming was born in Lancaster on November 29th, 1849. Educated at University College, London, Royal School of Mines and St. John's, Cambridge, he worked for some years under Clerk-Maxwell at Cambridge. In 1882 he joined the staff of the Edison Electric Light Co., and was made Professor of electrical engineering at University College, London, in 1885. It was following upon his researches into the mysterious "shadow" in the electric light bulb that Fleming made the epoch-making invention of the thermionic valve. He was elected Fellow of the Royal Society in 1892.

IT is always a difficult matter to forecast the development of any invention. A safe rule to follow is, never to prophesy unless you know. Any attempt to foretell the future, whether in history, politics or invention, is generally doomed to failure, and the only certainty is that the unexpected will happen.

Nevertheless, in this article the writer has endeavoured to let scientific speculation exercise itself for a few moments on the subject of the future of the thermionic valve. First of all, casting a glance backward, we find five or six well-marked stages in the evolution of this truly remarkable invention—the thermionic valve. It is an invention which has required the ingenuity of many minds to bring it to its present state; but as an electrical appliance it holds its place for utility and importance in the front rank with the electro-magnet and the voltaic cell.

The First Step.

The first step in the creation of the valve was taken in 1904, when the writer discovered that the emission of electrons from an incandescent conductor in vacuo could be used to convert high-frequency alternating currents into a direct current; in other words, could rectify an electric oscillation.

This was done by surrounding the carbon or metallic filament in an incandescent electric glow lamp by a cylinder of metal carried on a wire sealed through the glass bulb. The rectifying valves of the present day are made in exactly this form, and chiefly used to rectify low-frequency high-voltage alternating currents to provide direct high voltage.

The second stage in the evolution came when it was found that the electronic current to this cylinder could be controlled by the interposition of a spiral of wire or metal gauze cylinder, which third electrode, when made to change slightly in electric potential, fluctuated the electron current in accordance with the electrostatic potential of this grid.

Thus the three-electrode valve or triode came into existence, and its theory and characteristics began to be studied. The third stage seems to have been reached when it was discovered that the fluctuation of the grid potential of one valve could vary proportionately the plate current of that valve, and this again, either by the use of a two-coil transformer or resistance-capacity coupling, could be made to fluctuate the grid potential of a second valve, and so on for several valves in series. It was thus found possible to construct an amplifying apparatus of enormous power to multiply very feeble high-frequency currents thousands of times.

This combined with the method of rectification called "plate-bend rectification" due to the form of the characteristic curve gave us the electric wave detectors of the present day of astonishing sensitivity. No other detectors—crystal, electrolytic, or magnetic—can thus be coupled in series so as to augment sensitivity. Without this power long-distance wireless and broadcasting, except on a small scale, would have been impossible.

Discovery of Reaction.

The fourth important step forward was taken in the discovery that by the inter-coupling of the grid and plate circuits of a triode in a certain way the valve could generate continuous electric oscillations, or convert the direct current from the high-tension plate battery into a high-frequency alternating current.

This was done about 1913, or before, and we thus became possessed of an appliance of enormous flexibility for creating pure sine-wave continuous electric oscillations, the frequency and amplitude of which, within limits, were under perfect control.

This solved the problem of wireless telephony for which the electric arc generator had only been an imperfect solution.

The inter-connection of grid and plate circuits or reactive coupling enable a still more sensitive receiver or amplifying detector to be constructed; a plan which had been suggested by Captain Round and Mr. C. S. Franklin even before the use of the valve as a generator of oscillation had been fully achieved.

Then the next or fifth stage of invention was the construction of valves with external water- or oil-cooled plates. As long as the plate was inside a glass bulb and surrounding the filament it could only get rid of the heat produced in it by electronic bombardment by radiation.

Powerful Generators.

The discovery of a method of sealing metal to glass in the form of a tube or thimble of Invar, a nickel iron alloy having the same coefficient of thermal expansion as lead glass, rendered it possible to produce valves in which by water or oil cooling a jacketed plate could form part of the exhausted bulb. Hence, power to the extent of kilowatts could be expended on it without risk of overheating the plate.

This invention at one stroke gave us powerful generating thermionic valves which rendered antiquated all other methods of producing continuous oscillations, as by the Poulsen arc or high-frequency alternator.

No new large transmitting stations for wireless telegraphy or telephony would at present be equipped with any other type of generator than this metal-glass bulb valve. Lastly, we may say that the shielded plate or four-electrode valve marks a definite and sixth stage of advance.

The Screen Grid Valve.

In this valve there are two grids interposed between the filament or incandescent cathode and the metal cylinder which forms the plate. One of these grids is placed very close to the filament and is the control grid. The other is placed in front of the plate and is kept at a certain positive potential.

The purpose of this last grid is to destroy the capacity which would otherwise exist between the plate and control grid or plate and filament. Any such capacity, as Captain Round shows in his book on this shielded valve, tends to reduce the impedance of the external plate circuit, and therefore the voltage magnification of the valve.

We have, therefore, in these shielded valves, a great increase in the amplifying power, and can, therefore, dispense with reaction.

Turning, then, to possible improvements, the first thought which occurs is, naturally, whether we can do anything to increase the thermionic emission from the filament, or effect it at a much lower temperature; in other words, produce the desired cold valve.

Electron Emission.

The emission of electrons from hot bodies has been the subject of an immense number of researches, but, even yet, fundamental questions are not settled.

The source of these electrons is still in dispute. In the case of pure tungsten, heated by an electric current in a good vacuum, the conclusion of Professor O. W. Richardson is that these emitted electrons do not come from the break-up of tungsten atoms thrown out, but are brought into the filament from the filament-heating battery and escape from its surface in virtue of the great kinetic energy they acquire when the metal is heated, that is, when its atoms and electrons are in very rapid vibration or motion.

Certain substances, such as thorium and the oxides of barium, strontium or calcium, have the power of increasing this emission when placed in a layer over the heated tungsten, so that it is greater at a given temperature or equal at a lower temperature to that of uncoated tungsten.

"The Cold Valve."

This has given us the so-called dull-emitter filament. The increased emission, due to a coating of the oxides of calcium, barium and strontium, was first observed by Wehnelt. Very much research has been expended on testing the emission from all kinds of salts of metals when electrically heated on a platinum strip, but the phenomena are very complicated and consist not only of the emission of electrons but of positive or negative ions.

It has not yet been shown that we can improve permanently the emission from a tungsten or metallic filament by the use of any other coating material than the oxides of the alkaline earthy metals. The only possibility of approaching the desired "cold valve" would be by the discovery of some material for coating a metallic filament or sheet which would increase the emission so much that the metal need not be even visibly hot.

But what is required in a valve is constancy of operation and manufacture. Thus it is possible to make a "soft" valve, that is, one with a not very high vacuum, extremely sensitive, but we cannot in general repeat the manufacture. The only satisfactory valve so far made is the "hard" valve with pure tungsten or thoriated tungsten filament, if we except the oxide-coated filaments of the Western Electric Company.

Endless Possibilities.

I have sometimes thought that the valve of the future might consist of a metallic thimble, welded to a glass extension, the thimble containing a small quantity of some material resembling barium iodide, which emits electrons at a low temperature below red heat, the heat being supplied, in this case, by a spirit-lamp flame so as to get rid of the filament-heating battery.

The possibilities of research in this direction are endless, and we may find some mixture, compound, or alloy, which, when slightly heated in a high vacuum, will emit a copious torrent of electrons and not merely atomic ions.

At present this copious emission of free electrons can only be obtained from tungsten at a high temperature, or from the oxides of earthly metals or thoriated tungsten at a red heat.

The great improvements made lately in photo-electric cells by the use of the hydrides of the alkali metals, and the discovery that a thin layer only a few atoms thick is just as effective as a thick one for photo-electric emission, indicates that perhaps the same may be true for thermionic emission, although the two phenomena are different in nature.

Short-Wave Transmission.

The combination of photo-electric emission and thermionic amplification is necessary for the construction of a light-sensitive cell for television purposes, and this is one very promising line of research.

Another very important direction in which investigation is and should be taking place, is in the construction of valves for generation and reception of very short waves, 5 to 10 metres or less in length, but of great power.

The very remarkable qualities of these short waves for propagation round the earth, even more than once round, point out their great advantages. It is well known that the flat-grid aerial of Mr. C. S. Franklin projects not only a main beam but certain lateral beams as well.

If, however, strong waves are used much shorter than the 16-metre wave at present in use in some beam stations, it may be possible to return to the use of skeleton parabolic mirrors at the transmitting and receiving stations which will employ a more defined beam of radiation focussed on a particular point, and so secure greater privacy and freedom from disturbances.

The high-power short-wave transmitting valve capable of making waves 5 to 10 metres or less in wavelength will, no doubt, be an article of commerce in the future, even if not at present. There will be no departure from the usual construction, but great and minute attention to the relative capacities and impedances of the various paths and parts.

A Complete Revolution.

If we turn then to the uses of the valve we find that in addition to effecting a complete revolution in the arts of wireless telegraphy and telephony, replacing all other forms of generator and detector, rendering wireless telephony and therefore broadcasting practical and possible, the valve has rendered almost equal service to telegraphy and telephony with wire circuits. It gave us the only really useful telephone relay or repeater, thus enormously extending telephonic range, and in the form of carrier-wave telephony it created multiplex telephony.

But outside these arts of telephony and telegraphy, the rectifying valve, exactly in the form in which it was invented by the writer, has very numerous technical applications. By rectifying high-voltage low-frequency alternating currents we can provide high-tension direct voltages which are necessary in cable testing, and many manufacturing operations; one such application being the precipitation of solid particles from smoke.

It is possible it may yet have great uses in the dissipation of fogs, which are so disastrous to traffic in large cities.

Application to Agriculture.

I have a strong conviction that the valve rectifier will yet have important applications in agriculture, in providing direct electric currents for stimulating plant growth or more rapid growth of cereals or greater returns for a given seed expenditure.

In its three-electrode form, the valve has given us a means of measuring changes of length or mechanical movements of extraordinary minuteness, and also small motions, such as the vibrations of bridges under traffic or earth tremors.

It can be used to maintain mechanical vibrations as of tuning forks and pendulums and to synchronise motions in distant appliances.

In its amplifying form it provides means of detecting extremely small changes of temperature and illumination, and has given the astronomer a new weapon of research.

Measuring Minute Quantities.

In physics its applications are most numerous, in fact, wherever we can generate a very feeble and otherwise undetectable alternating electric current, we can amplify it so as to make it possible to detect and measure it.

The valve enables us to measure the electric field or force due to radiation from a distant antenna, and in association with the cathode ray tube has given us a large amount of information about "atmospherics" due to distant lightning, and also as to the electrical condition of our atmosphere at great heights.

When two oscillating valves having capacity and inductance in their external plate circuits are coupled together, any small change in the capacity of one circuit makes itself evident by the change in the "beats" produced by the joint action of the two oscillations on a tertiary circuit containing a telephone receiver.

If the capacity of one valve circuit is formed of a pair of parallel metal plates, one of which is fixed and the other displaceable, we can construct in this way a means of measuring the most minute changes of length or small changes of pressure or a micro-balance capable of weighing small masses beyond the reach of any other form of balance.

Wonderful Properties and Powers.

The valve has, in short, a perfectly endless number of applications in physics and engineering, and no experimentalist in any department of physical or biological science can afford to be ignorant of its wonderful properties and powers.

The modern receiving valve, with its silver-coated glass bulb and four-prong base, is such a familiar object that few people pause to wonder at the miracle of it all, or at the years of research of which it is the result.

Wooloowin Radio Club (VK4WN)

Crash! Bang!! Wow; that sounds like a pistol shot! Hey! Lieutenant, bring out the reserves—we're going to be attacked. Put out that light—darn yuh! Who's got that 18 pounder? Where's that Kenna death-ray? !!—?—!???!!

Whew! No, dear readers, it's not a recurrence of the 1914-19 hostilities. Oh, no—just 4WN's week-end camp being attacked by what was thought at the time to be a bunch of hobos. This is how it all came about:

Radio treasure hunts and week-end outings being a little over-popular, some of the gang thought it would be a good idea to start something novel; so, after much discussion a scheme was evolved wherein it was agreed that, on a given date (Saturday afternoon for preference), several of the gang were to proceed to a place called Leich's Crossing, there to establish an official headquarters station with 4MM in charge, their object being to test out all gear to be used next day in a grand mock battle, wherein portable radio transmitters and receivers were to play a very prominent part.

Camp being made early in the afternoon, the aerial and main H.Q. station erected, Commander MM settled down to a quiet rest, and lazily passed the time away by swatting a few mozzies. 4RG (Harold), who was signed on as one of the official ops., donned the cans and became enraptured by what he thought was an orchestral number from RFM Siberia.

Such wonderful music he had never heard before (this, however, turned out to be merely a fleet of curious mosquitoes, assisted by a vocal refrain from our worthy president who, I believe, often sings in his sleep). However, everything was going along nicely; MM had counted up to 5010 dead and 25 wounded, when suddenly a loud report rent the air, followed by several others.

Our worthy commander jumped to his feet in a flash and electrified the whole camp by shouting out orders to everyone to prepare for defence. In the excitement the radio op. left his post for about 10 seconds. When he returned in order to send out a pathetic call for assistance, the actual valves he had been using had disappeared. Poor Hal! Everything was going wrong. Shots were being fired all around them, the aerial was carried away, his valves were gone. The other op. was—well, Hal did not know or care where the other op. was; all he wanted was his valves. Poor fellow!

Meanwhile, the sudden shock of the first attack was wearing off and our fighting forces were being rallied by our junior op., 4LJ—he was just about to show the attackers that it was 4WN they had attacked, when such a roar and a rush as had never before been heard on the flying field smote their tender, quivering ears, and put them to further panic. The commander was struck dumb, likewise the two RG's, JL and the rest! For lo and behold! who should the new arrivals be but the 4TC gang! (You know—the crowd from Thumbul Ridge) racing at the terrific speed of 5 m.p.h. on those iron things they call mobikes.

You could have pushed 4WN fellows over with a feather. However, 4WN are always pleased to welcome visitors, so they promptly invited the dusty riders to a round of toast and a cup of coffee, which they devoured with the speed and skill of hard-pressed bushrangers. Meanwhile, Harold of RG fame was quietly nosing around and discovered a bulge in one of the visitors' pockets, which proved to be one of his long-lost valves. Whoop! he pounced on it in an instant and would have chewed the other fellow's ear off had not our worthy president intercepted him and ordered him back to his tent post.

The TC fellows departed in the early hours of the morning, and at daybreak 4WN members began to look around to see what gear was missing, but discovered that they had sufficient wire, etc. to carry out the scheme as arranged.

A little later the scouts and other members of 4WN began to arrive from town, and when all details had been fixed up, a start was made on the big move. The NME party were allowed 20 minutes in which to make themselves scarce, the idea being to manoeuvre from headquarters, two parties called BN1 and BN2, respectively, in an endeavour to capture the complete outfit of NME. NME had instructions to report their position and direction of advance, etc., once every half hour in code, known only to their operator stationed at headquarters. This op. would decipher each message and hand same to the O/C in charge of HQ, who would issue orders to both BN1 and BN2, instructing them where to move in order to cut NME off and surround them (General Army manoeuvres, hi!). NME carried a portable transceiver and BN1 and BN2 had oscillating receivers with which to keep in touch with headquarters. The results, however, proved conclusively that most of the apparatus was not altogether suitable for active portable work, and the members are now working hard on the information gained during the day, in order to make our next test a complete success.

For instance, one member suggests that leather breast-plates be supplied to NME as our hon. sec. and 4JL both complain about thorns and sticks, etc., when trying to do the snake's jazz in order to keep under cover. Another complaint is about the public bar at Cash's Crossing. Vic says that it has not enough juice to even quench our dawg's thirst, which, by the way, is not what it used to be since drinking the electrolyte from our old slop-jars. Nuff said, gang! Here's to a better trip next time.

We have not seen any notes from other radio clubs lately. Why, gang? Come on, you fellows—don't let 4WN run all the good things; what about scrapping your press corres. and getting a new one? No, I don't want it! One's enough, thank you, but honest, you are behind the times. The Editor told me that he keeps a clean page for club notes, so fill it up and save him all this stuff from 4WN!

(Club Activities Continued on Page 50.)

Short Wave Activities

Another Instalment of these highly interesting notes on the Short Wave Transmissions, contributed by

F. W. NOLAN

SPEAKING for the average listener, one must say that there are only three overseas short-wave broadcasting stations which can be termed a success. They are: Radio Paris, PLE Java and PCL Holland. Radio Paris, taking everything into consideration, is a success, while PLE and PCL operate on wavelengths in which there is not much pleasure for the average "working-man" to come home and struggle with. Strictly speaking, it isn't a struggle at all, for an hour's practice gives one the knack of things. Still, any telephony station operating below 20 metres is not worth going after unless he has plenty of power. It must be remembered that all of the short-wave stations are still experimenting, and I suppose we must acknowledge the fact that they are not working expressly for us in Australia; but why not endeavour to cover **everywhere** successfully?

Time, power, wavelength, etc., are factors to be taken into consideration. 5SW at night here is not really good; you must take him as you find him. The wavelength is OK, but I really think he transmits too late to be received well here. Berlin, Germany, working with 2ME on February 7th, came in at fair, clear speaker strength at 5.50 p.m. (I think I have mentioned before that I listen to nothing that can't be received on the loudspeaker.)

Getting back to 5SW: In my opinion, an increase in power during his present working hours is just as likely to make matters worse as it is to make them better. However, surely everything is worth trying once! 5SW's signal-strength over 4 months' working averaged R3, fading fair, surging bad. There is interference from KTN on morse occasionally, and also from one of the beam stations.

PLE Java, on 15.74 metres, averaged R6 over 4 months' working, with steady signals, the only fault being in his low wavelength. PCL averaged R4 on his lower wave; sometimes I can't hear him for static and interference on his 38.8-metre wave. There is one thing that the radio engineers cannot give us, and that is good atmospheric conditions! I do think, though, that they can help matters by increasing their power.

The same thing must be said about PCJ in its night reception here as I have said about London. The best I've heard this station was when he made a special test with Java a few weeks back—about January 15th. PCT, a Dutch code station, calls PKX about midnight and was R7 on 27 metres, while PHI, the new Dutch station, on 16.88 metres, was only R2 on February 6th. However, here is a brief log:—

January 16th was the weakest I've heard 2ME; I can't tell one thing he said, as his carrier was only R1 to 2. PLE, on the other hand, was good speaker volume. In Java, they are using rectified A.C. power supply practically throughout. 2ME still has a pronounced hum in his transmission. PCJ was R2 to R3, transmitting an operatic number. PLE and PCL were heard on duplex phone, Holland R3 to 4 and Java R5 to 6.

January 17: PCL and PLE Java; the latter played selections from "No, No, Nanette," which was for Holland. PLE was R6, PCL R2. RFM Russia was R3 on speech, and 5SW London R2.

January 18: RFM R5 on orchestral items; 5SW weak; PCL and PLE R7, both on duplex phone.

January 19: PCL R3 to 4 and PLE R6 to 7, on duplex phone; RFM R3 on a choral number; Japan R2.

January 21: 5SW R4 to 5 ("Girl of My Dreams"); RFM R6; PCL and PLE R3 and R6 respectively; 2ME maximum; VPD Suva surging from R5 to 8. Suva will have completed his phone work with Sydney on the 25th.

January 22: RFM R6 to 7 ("William Tell"); 5SW R3 to 4, surging badly.

January 23: 2ME and PLE Java testing with ordinary telephone microphones, owing to the fact that they cannot give every subscriber a good "mike" in the telephone service. Java wants Sydney to test through the land-lines; they want an announcer at a public telephone in the suburbs to speak through the exchange to the transmitting station, and then be placed on the air. A little while back, neither 2ME nor AGB2 were receiving one another very well, but 2ME told Java that they had letters from English and German listeners saying that they received both stations perfectly on the loudspeaker.

On the 23rd 5SW was R4 to 5, PCL R4 on 38.8 metres, and PLE R6 on 15.74 metres.

January 24th: 5SW R4, RFM R3, PCL R3 and PLE R6, these last two on duplex telephony. On the 25th 2ME and VPD carried out their final test; 5SW was R2 to 3, and RFM also R2 to 3.

January 26th: PCL R2 and PLE R6; RFM R3.

January 27th: RFM R2, 5SW R3, PCL R2, and PLE R5, duplex phone. On the 28th RFM was R2 at 7.30 p.m., while PCL and PLE were R3 and R7 respectively.

New Calls.

AGB Germany is now DHA on 26 metres, while AGJ has become DHE on 40.2 metres.

January 28th: 5SW weak. On the 29th 5SW was R5 to 6, transmitting a soprano solo, organ solo, harp solo and orchestral items. RFM was very weak. PCL was R4 to 5 and PLE R5 to 6.

In case some readers are not familiar with the "R" audibility scale used throughout these notes, here it is: R1, faint signals (just readable); R2, weak signals (barely readable); R3, weak signals (can copy OK); R4, fair signals (easily readable); R5, moderately strong signals; R6, good signals; R7, good strong signals; R8, very strong signals; R9, extremely strong signals.

The system of determining the strength is based upon the strength of the carrier-wave, the strength of music or speech depending on the depth of modulation—that is, how deeply the music or speech is impressed on the carrier.

January 30: 5SW R5 with bass, soprano and operatic numbers. PLG R7 and 2ME maximum on phone tests. PLG wants Sydney to arrange tests with W2XAF or KDKA, the object being this: Java wants Sydney to relay Java to America, when Java will relay Holland. Thus Holland will be heard in America through Java and Sydney. (We will endeavour to let listeners know when this interesting test is to take place.—Tech Ed.) 2ME says W2XAD and W2XAF have been busy on their wavelengths. KDKA Pittsburgh works at about 9 a.m. our time on 26.3 metres, but is inclined to be weak here.

PHI, Philips new 100-k.w. station, tested on 16.88 metres on Monday, January 28th and Wednesday 30th. At present he is using from 40 to 60 kilowatts.

Fringe Howl.

In connection with the annoying fringe or threshold howl which often causes a lot of trouble on the short wavelengths, the writer is in complete agreement with the author of "Hints for Short-wave Enthusiasts," an article published in the "Broadcast Bulletin" of February 18th. He says, among other things, that a great deal of trouble can arise from the use of faulty or partially run-down "B" batteries. On the higher waves this is not so important, but when working below 25 metres your "B" battery must be in perfect condition, otherwise howls will almost certainly result when coming off reaction. Generally, best results are obtained when the set is operated with the lowest practicable voltages.

January 31st: PLE R6, PCL R4. No sign of RFM.

February 1st: A foreign station was heard on phone on 42 metres at R2 to 3 surging so badly that all of the call was not heard. It appeared to end with "RR"—has anyone else heard it? On February 4th 5SW was R4 to 5, transmitting jazz music, to the accompaniment of interference from KTN and a beam station. PLE was R6, playing "Charmaine"; nothing was heard of RFM.

February 5th: PLE R6 and PCL R3. On the 6th: PHI tested on 16.88 metres from 1 a.m. to 6 a.m. DHG and 2ME were on duplex phone, DHG Germany being R5 to 6. 2ME spoke to the Director of Posts and Telegraphs, Berlin. Germany receives 2ME best when 2ME is not using a reflector. Although 2ME has great faith in reflectors, they are only using ordinary aerials for reception at present. PCL uses a reflector aerial system. On the 6th PLE and 2ME were heard on duplex phone, and also 6AG Perth surging badly. 5SW came in at R2 to 3, surging badly also. PCL and PLE were R4 and R7, with slight fading in the case of Holland. PHI, the Philips new Dutch high power station on 16.88 metres, was heard at 11.50 p.m. transmitting an orchestral item; the strength was R2, with slight surging. It may interest 2ME to know that the bad hum that Java was complaining about is very often in evidence, but happened to be a little stronger than usual on February 6th at 9.10 p.m.

February 7th: 2ME again tested with Germany, and at 6.30 p.m. Germany said he couldn't understand Sydney too well. Germany was R5 to 6. Readers probably will be interested to know that the telephone service between Berlin and Buenos Ayres was opened on December 10th, the charge being £9 for a three-minutes' conversation. It is rumoured that the Dutch Government shortly will build a 600-k.w. short-wave station in Java with five circuits for telegraphic communication and three telephony circuits. The telephone service between Austria and America was opened on November 3rd; this service utilises the trans-Atlantic link between Rugby and New York.

February 8th: PHI was heard from 6.50 p.m. to 8.5 p.m., the average strength right through being about R4, with very severe surging. At 8 p.m. a Dutch announcer spoke, followed by an English announcer thus: "Hello! This is PHI of Philips Radio Service on a wave of 16.88 metres. We would appreciate reports with regard to reception. We are going to close now."

February 9th: PCL R4, PLE R6. February 10th: PCL and PLE, and RFM R6 on orchestral items. On the 12th, 2ME and Germany carried out duplex telephony tests. 2ME was maximum at 5.45 p.m., but faded right out at 6.30 p.m. Germany was R4 to 5. PLE Java came in at 10 p.m., transmitting ukelele music on the dual wavelengths of 17 and 15.74 metres. The strength was R6 to 7.

AMATEUR NOTES.

The Australian amateurs seem very determined to endure QRM, QRN, spacer-waves and band-saw notes on 42 metres in their efforts to hear and reach DX stations. "K" (Philippine Islands), and "PK" (Dutch East Indies) stations seem, as yet, to be the best DX consistently obtainable. There are plenty of "W's" (United States of America) on the air, but the obstacles mentioned are against proper contact being made. I haven't heard anyone calling "VE" (Canada) yet, but have heard several calling "G" (Great Britain). "AC" (China) and "J" (Japan) get a call from us occasionally, as also does "AS" (Siberia). VK5HG ("VK" stands for Australia) must be in a very good locality, as he hooks a great many Yanks. Heard him tell a Yank that he worked 25 of them in five nights! This is interesting, because dozens of other stations which clicked with ease on 32 metres are not heard in the States on 42 metres. VK5HG's spacer-wave is annoying, though. VK2AW/2NO connects with "W" quite often, and VK4BB is another station that doesn't do too badly in this line. Heard him QSO W1PFI recently. VX7DX is in communication a good deal with U.S.A., too.

VK7LG has schedules with LG (a ship) and WFAT, the Byrd Expedition. 4CG is back again on 230 metres, and put out some good phone on Sunday, January 10th. For gramophone work he has given up the microphone in favour of an electric pick-up, with the result that his modulation is good, and is impressed on the carrier to a depth of 40 to 45 per cent.

4AB has been an amateur experimenter since 1914, but has now decided to give brass-pounding the "go by" for good—so he says. But we know! He is going to transfer his affections to 240, and hopes to put out some good phone on that wave. The loose-coupled shunt-fed Hartley is his favourite, and he uses a UX-210 with 400 volts on the plate—a power input of 15 watts. The plate supply is derived from a half-wave Penatron rectifier. A half-wave Zeppelin aerial is used.

VK4AB hooked up with Captain Wilkins of the Signal Company at Fort McKinley, U.S.A. recently. 4RA is busy building a crystal-controlled transmitter. Let's hope it gives plenty of DX! 4WA put out some splendid copper-plate morse on 80 metres a few weeks back. He has been making adjustments on 21 lately, and has worked some of the Interstate stations on that wave.

4LJ hopes to be going in a month's time. In last issue it was stated erroneously that 4LJ put out phone on 220 metres. 4AW has been QSO India on 21 metres lately. He puts out a fine D.C. signal on 42 metres, with maximum strength here. 4RG has been transmitting phone on the 42-metre band. He was QSO ZL1FX on the 10th. 4PN, 4BH, 4RO and 4GH have all been busy on 42.

4BB, after his A.O.P.C. arrived, seemed to get a touch of the "Clicks." Everything he went after turned up trumps, figuratively speaking. He worked "F," "W," "OI," "OP," "OZ," "OH," "OD," "VK," "SC," "SU," "AI," "AC," "J," "EK," "FB," "AS," and "OM" with no trouble at all. Taking things all round, I think 4BB can claim to have been the most successful Australian amateur during the last twelve months. With OZ3AR, he holds the Australasian record for 10-metre communication. This is the more noteworthy because 4BB uses only one measuring instrument—a milliammeter! Some say "locality"—others "fluke"; but I think it is safe to say that the reason lies in proper adjustment more than anything else. He calls "CQ" on 10 metres occasionally at night. An ultra-audion receiver is used at this station for 10-metre reception, and an inductively-coupled shunt-fed Hartley for transmission, putting 420 volts on the plate of a 210 or a 201A.

VK4NW was heard in contact with AI5VK and PK4AZ on 21 metres. 4CN is going away for three months, measuring the telephone lines between Warwick and Cairns. Some job! 4AL is on 220-metre phone, doing very well.

OH2NM (Finland) connected recently with VT2KT (India) on 10 metres, which is something of a record for this wave.

"Q.R.N." Question Competition

This is the third question in a novel competition for our readers, for which good prizes are being donated by Messrs Trackson Bros., Ltd. Each month a question relating to some usual trouble experienced with a radio set will be given, the prize being awarded to the sender of the correct or most nearly correct answer:—

As we wish this competition to become popular with our readers, the questions will be kept as simple as possible, so that those with only an elementary knowledge of radio may compete.

The following are the conditions governing the competition:—

(1) The closing date of the competition will be the 20th of the month in which the question appears.

(2) Answers must be forwarded to the "Queensland Radio News," box 1095N, G.P.O., Brisbane, the envelope being marked "Question Competition."

(3) Competitors may send in as many answers as they wish, but each answer must be accompanied by the coupon printed below.

(4) The prize will consist of an order on Messrs. Trackson Bros., Ltd., for the radio apparatus mentioned each month as the prize.

(5) The decision of the Technical Editor of the "Queensland Radio News," who will act as judge, will be final.

COMPETITION COUPON.

This coupon must accompany each answer sent in for the MARCH competition.

NAME ....

ADDRESS ....

....

LAST MONTH'S COMPETITION.

In connection with the February "Q.R.N." Question Competition, the prize-winning entry was received from

W. B. HEPPLE,
C/- J. Carr, 50 Merton Street,
South Brisbane.

Mr. Hepple's solution of the problem is a model of completeness and technical accuracy, and although several other answers were substantially correct, it was impossible to ignore the prize-winner's claim.

Briefly, the correct diagnosis is as follows: A high resistance at some point in the grid oscillatory circuit —possibly caused by poor connections in the tuning condenser or in the coil, dry joints, a break in the wiring, etc. Mr. Hepple substantiated his theoretical reasoning with a graph illustrating the damping (or reduction of selectivity) which a high resistance introduces, and proved his contentions with the aid of several mathematical examples.

The prize of one Wetless Reinartz Tuner, donated by Messrs. Trackson Bros., Ltd., will, therefore, be awarded to Mr. Hepple.

THIS MONTH'S QUESTION:

In a five-valve Solodyne receiver, all distant stations are tuned in at two distinct positions on the tuning dial. 2BL, for instance, is strongest first of all at 40 degrees on the dial; as the dial is turned further towards maximum, the strength first diminishes and then increases again, until the station is heard with almost the same intensity on 44 degrees. None of the distant stations are very loud, although reception of the local station is quite satisfactory and free from the effect just mentioned. The set uses a three-gang tuning condenser, all three sections of it being rotated in unison by the one dial. What are the possible causes of this phenomena?

PRIZE: One "Formo" Three-gang Variable Condenser

List of Short Wave Stations

Here is the list you have been looking for! The principal Short Wave Broadcasting Stations of the world, together with their wavelengths and time schedules, are given in the following list, compiled by—

F. W. NOLAN

Station.	Location.	Metres	Time.
PLG	Java	17	One of these stations will be found working about 10.30 p.m.—our time.
PLF	Java	17.4	
PLE	Java	15.7	
PCL	Holland	18.0	Almost every night from 10.30 p.m. onward.
PCL	Holland	38.8	
PCJ	Holland	31.4	Friday 4 a.m. to 6 a.m., and 9 a.m. to 1 p.m. Saturday 4 a.m. to 6 a.m. Sunday 10 a.m. to 4 p.m.
5SW	London	25.5	From 10.30 p.m. every night, and from 5 a.m. to 7.30 a.m.
RADIO PARIS	Paris	24.5	Intermittent—7 p.m. and 11 p.m.
DHG	Berlin	26.2	5.30.p.m. to 7 p.m.—intermittent.
2XAF	New York	31.4	9.30 a.m. to 11.30 a.m.
2XAD	New York	21.9	10 a.m. to 11.15 a.m.
6AG	Perth	42	Variable—about 12.30 a.m.
RFM	Tabolsk (Russia)	60	From 7.30 p.m.—except Wednesday.
KDKA	Pittsburgh	26.3	9.30 a.m.
3LO	Melbourne	31.6	Sunday 5 a.m. to 6 a.m.
VK2ME	Sydney	28.5	Tests with Java Wednesday, 8 p.m. to 10 p.m.; with Germany any afternoon agreed on by these stations. Monday, Wednesday, Thursday, 5.30 p.m. to 7 p.m. as a rule.

Australian amateurs may be heard testing any time on 42 metres. Some very interesting information can be gained from the amateur conversations at times.

A QUESTION OF EFFICIENCY.

In no other branch of engineering, electrical or otherwise, are technical men apparently so regardless of efficiency as in radio practice. Motor engineers, in particular, are very keen on efficiency, as expressed in terms of the energy put into and obtained from a car. Radio engineers, on the other hand, are rather naturally apt to discourse more on volume and purity than on actual efficiency.

As a matter of fact, the efficiency of many radio components is distinctly poor, loudspeakers being particular offenders in this respect. Even the best horn-type loudspeaker can rarely boast of a better efficiency factor than 2 per cent., and many cone speakers are even less efficient. The major part of the power is wasted in setting up eddy currents and in hysteresis losses, while mechanical losses, caused by unnecessary movement of the diaphragm or cone, are considerable.

It must not, of course, be assumed from this that by careful manufacture present-type loudspeakers could be improved by about 98 per cent!

Unless some epoch-making invention comes to light, and methods of loudspeaker reproduction are completely revolutionised, present efficiency factors are not likely to be improved. It is almost inevitable that in the search for "naturalness"—which means something more than purity—volume, the practical symbol of loudspeaker efficiency, should be reduced.

A badly constructed moving-coil loudspeaker is capable of being very much inferior to a cone instrument from the point of view of reproduced volume, while even the best moving-coil instruments are apt to be a little "soft" in comparison with moving diaphragm loudspeakers. Any power losses, however, are more than made up for by vastly improved reproduction; and with a good-quality instrument there is so little difference in volume from a given input between a moving-coil and a moving-diaphragm instrument that the ear cannot detect it.

And that is what matters!

—AND HERE IN THE LAST STAGE YOU MUST USE A POWER VALVE!

YES, the last stage is the place for a Philips Power Valve—mighty Miniwatts that use little if any more current than any other economical Philips Tube.

Good reproduction depends on several things, but without a valve in the end socket capable of handling the current, REAL music is impossible to obtain. Of course ample grid and plate voltages must be used but you'll find all that information inside the carton.

B605	13/6	B403	15/-
C603	15/-	B405	20/-
		B409	15/-

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Five Million Volts

According to Sir Ernest Rutherford, the problem of radium shortage would be solved if we could develop 8,000,000 volts. Five millions have been produced; shall we ever see the former figure reached?

By W. K. CASTLETON.

SCIENTIFIC progress may be slow, but it is sure. Many readers will remember reading of the remarkable results achieved by Dr. W. D. Coolidge, of the General Electric Company of America, with a cathode ray tube. It will be recalled that the tube was said to be a vacuum in which it was possible to generate as much electricity, or as many electrons, in one second as it was calculated could be produced by one ton of radium.

The word "calculated" was used advisedly, because the productivity then, as now, of a ton of radium was a matter of theoretical multiplication, rather than of practical proof, there being, so far as we know now, only about a pound of radium in existence in the whole world. In any case, with the cathode ray we had a bombardment of the atmosphere which caused crystals of mineral calcite to assume the appearance of red-hot coals and remain a glowing mass of incandescence whilst being perfectly cold.

We were told of acetylene gas being transformed into a solid yellow mass when subjected to a short exposure, of bacteria withering under the influence of the rays, of small animal bodies being disintegrated without sign of burning or charring. These and other wonders were effected by a tube operating on 300,000 volts.

Dr. Coolidge at that time declared that he had by no means said his last word in regard to this tube or its possibilities. A few months later Dr. Coolidge produced a triple-cascade cathode ray tube operating not on 300,000 volts, but on no less than 900,000 volts, and capable of sending out into the air a stream of electrons at the almost incredible velocity of 175,000 miles per second!

Increasing the Voltage.

The tube was a sort of three-in-one arrangement of the first. After his work with the 300,000-volt tube, he commenced to build larger individual tubes, but he soon discovered that there were limitations in the voltage which could be applied.

He then conceived the notion of adopting the cascade arrangement whereby the rays from one tube could be fed into another, which would speed them up and feed them along farther to still another tube. The plan worked, and in this way Dr. Coolidge succeeded in applying the 900,000 volts.

The electrons expelled from the tube appeared, as in the previous case, as a purplish haze ball. The velocity of their expulsion was so stupendous that it can only be comprehended by a trite comparison. The figure of 175,000 miles per second, probably the fastest speed ever attained, is about three hundred and fifty thousand times faster than the speed of a bullet shot from an Army rifle.

But even the 900,000 volts was held to be insufficient. To the scientist there came another alluring possibility. If the laboratory could produce just as high-speed electrons as the highest velocity beta rays of radium, and just as penetrating radiations as the shortest wavelength gamma rays from radium, then the enormous limitations created by the scarcity of radium would be at an end.

The World's Highest Voltage.

According to Sir Ernest Rutherford, a force of 2,000,000 volts would be sufficient to produce X-rays as penetrating as the most penetrating gamma rays, whilst 3,000,000 volts would produce something equivalent to the beta rays. The deduction from those calculations of Sir Ernest Rutherford were that if these figures could be augmented to 8,000,000 volts, we should be able to produce positive rays possessing the energy of the highest alpha rays derived from radium. The problem of radium would be solved!

From 900,000 volts to 8,000,000 volts seemed a long journey, but in a few months much of it has been accomplished. From the Carnegie Institution at Washington comes the official, but none the less amazing, statement that Dr. Breit and Dr. Tuve have developed an electrical pressure of more than 5,200,000 volts! Thus has been superseded the stupendous voltage figures which we have watched developing and mounting up from month to month.

For example, the Stanford University's 1,000,000-volt installation, the California Institute of Technology with its 1,500,000 volts, the General Electric Company installation at Pittsfield with a voltage of 3,600,000, to say nothing of the huge European equipments. But it is clear that the Carnegie Institute's apparatus has achieved the highest artificial electrical voltage in the world.

The first question which will now naturally arise will be as to the purpose for which this new voltage—this more than half-way house to the realisation of Sir Ernest Rutherford's dream—can be serviceably employed. First and foremost, the scientists are anxious to further their knowledge of the structure of matter, and stupendous voltages become their willing tools. Furthermore, it is hoped by means of high voltages to produce in the laboratory, although on a small scale, radiations of the type which at present are supposed to be accountable for the observed phenomena of terrestrial electricity.

Scientific investigation reveals that matter, in all its forms, is made up of different kinds of atoms (more than ninety kinds in all) grouped into molecules which, combined in countless numbers, constitute the objects we see about us. The atoms themselves are extremely, almost inconceivably, small. They all have similar structures, being built up of fundamental separate unit-particles of positive and negative electricity, called protons and electrons.

According to a recent theory of the nature of matter, these fundamental particles are "wave-packets," and matter, accordingly, wave motion. It is convenient however, to use the older particle picture, even though the behaviour of the "particles" may suggest that of ripples of wavelets.

Incredibly Minute Particles.

Each atom has a central positively-charged nucleus which is surrounded by an atmosphere of electrons whose number and configuration determine the kind of atom it is, whether oxygen, sodium, platinum, radium, or some other of the ninety-odd chemical elements.

It is known that almost the entire mass of the atom is located in this central nucleus, which is very much smaller than the atom itself. The heavy part of an atom occupies only about one-hundred-millionth of the total volume of the whole atom. To express this volume in cubic centimetres the decimal point and 36 zeros must precede the digit. Such magnitudes defy the human imagination, even though they are arrived at and accepted by the human mind.

Modern microscopes are very powerful, and can magnify several thousand times, but in dealing with objects of such extraordinarily small diameters the microscope fails the scientist long before this degree of minuteness is reached, because atomic dimensions are thousands of times smaller than the wavelengths of ordinary light. Indirect methods must be employed.

The brilliant successes achieved in the study of the atom are due to the fact that instruments have been devised and methods evolved by means of which atoms can be disrupted into their constituent particles, the protons and electrons. The results of the breakdown of the structure can be seen. Thus positive conclusions are reached about the nature, behaviour, and composition of a thing which is far too small ever to be seen.

Inside the Atom.

Scientists succeeded very well in the study of the external structure of atoms with the tools at their command, but difficulties presented themselves when they attempted to learn about the nucleus of the atom. They discovered that here was a thing that remained totally unresponsive to such agencies as high temperatures, extreme cold, enormous pressures, chemical explosions, and the like.

Not until Sir Ernest Rutherford began bombarding the nuclei of atoms with the projectiles fired off from radium, which move at tremendous velocities, did anything happen. He found, however, that when a hit was scored the nucleus broke up, producing, in so doing, certain effects which he was able to observe.

Thus through employing certain high-speed particles given off by radium as it spontaneously disintegrates, a method was hit upon of shattering the nuclei of atoms, thereby enabling the scientist to learn about the nuclear structure. Indeed, what knowledge we now have of atomic nuclei, has been gained solely through the study and use of this wonder-working element, radium, and its by-products.

Only a beginning, however, has been made in this fascinating study. The door to the mysteries hidden in the atomic nucleus has been but barely stirred. Scientists are on the tiptoe of expectancy, for they feel that they have come close to fundamental secrets of matter.

Old Dream Coming True.

Indeed, Rutherford already has accomplished on a very minute scale the artificial transmutation of one element into another, a thing that the alchemists of old dreamed of doing. Scientists realise, however, that before the door to these mysteries can be opened wider, vastly more powerful tools than as yet they can marshal must be at their command.

The hope for a suitable and even more satisfactory substitute for the rare, expensive and uncontrollable radium lies as we have seen, in the development of methods of securing high electrical voltages and of handling them safely under laboratory conditions once they are obtained. It is to the solving of these problems that Dr. Breit, Dr. Tuve, and their associates have made a notable contribution.

If the electrically-charged particles of which an electric current is composed are released between two metal electrodes to which a high voltage is applied, the particles will move toward the electrodes with tremendous speeds due to the electrical attraction. If the particles are to attain full speed and maximum energy, they must be prevented from colliding with atoms of the air in their travel toward the electrodes.

Speed and Hitting Power.

These electrodes, therefore, must be enclosed in a tube which is exhausted to a very high vacuum. When electrons are released at one electrode of a vacuum tube to which a high voltage is applied, they bombard the other electrode with high speeds.

It is fairly easy with this method to knock electrons out of their normal positions in the atoms of a given element used as a target. Comparatively low voltages suffice to give a stream either of electrons or of positively-charged atoms, which used as projectiles, have sufficient energy to accomplish this.

But in order to penetrate the central massive structure of the atom, the nucleus, and disrupt it, the speed of these projectiles, and consequently their hitting power, must be increased enormously. This can be accomplished only by increasing the electrical pressure applied to the tube until it is of the order of several million volts.

Atomic Projectiles.

Such voltages would give to the stream of electrons or atomic projectiles speed and energy comparable to the alpha-particles of radium which Sir Ernest Rutherford used. Not only would the speeds and energies of radium particles be duplicated, but the number of projectiles would be far greater than that obtained from any radium source.

Even though the current through such a high-voltage tube were no larger than that used in an ordinary X-ray tube, if the voltage were continuously applied to the tube as many high-speed particles would be produced as would emanate from several tons of radium.

However, now that a practicable method of securing such high voltages has been developed, another serious difficulty is encountered, the difficulty of obtaining vacuum tubes which will withstand the terrific strain which is produced.

At the tremendous voltages the glass is subjected to very great electrical stresses. Stray electrons bombard it and unwanted electrical charges accumulate in unexpected places, with the result that the glass breaks down and a puncture results. A still greater difficulty lies in the fact that it is almost impossible to produce a vacuum tube which does not discharge violently, thereby preventing the voltage across the electrodes from being increased above this discharge point.

The immediate quest of the future, therefore, is not the means of increasing the already gigantic voltages, but of a vacuum tube which will withstand the strain the present voltages impose.

Because the efficiency of X-ray production increases very rapidly with increase in voltage, such tubes would produce very intense X radiation of an extremely penetrating kind. X-ray pictures could be taken through a whole building with such tubes and the X-rays obtained from them could probably be used in revealing flaws in castings many feet thick, whereas the effective range at present is but a few inches.

In addition to these uses, which can be foreseen, entirely new effects may be revealed when such powerful tubes are operated; the biological effects of such radiation, for instance, can hardly be predicted.

♣ ♣ ♣ ♣ ♣

Resume of

4QG Programmes for March

Friday, March 1st.—The Federal Band. Annual dinner of the St. David's Society of Queensland, relayed from the Jenolan Cafe.

Saturday, March 2nd.—A radio comedy, "The Dead Brokes at the Cafe." Concert by the Orpheans interspersed with speedway races.

Sunday, March 3rd.—The complete morning and evening services from St. Stephen's Cathedral. Excelsior Band and Brisbane Municipal Concert Bands concerts.

Monday, March 4th.—The Studio Orchestra. The Citizens' Band.

Tuesday, March 5th.—Two comedies, "The Baggage" and "Off for the Holidays." The Studio Instrumental Quartette.

Wednesday, March 6th.—A dance night by Alf. Featherstone and his dance orchestra.

Thursday, March 7th.—Studio programme.

Friday, March 8th.—Enoggera camp concert.

Saturday, March 9th.—Orchestral music from the Savoy Theatre, interspersed with speedway races and vocal items from the studio.

Sunday, March 10th.—Complete morning and evening services from Albert Street Methodist Church. Federal Band and Municipal Concert Band concerts.

Monday, March 11th.—The Studio Orchestra. Radio play, "The Return of the Prodigal." Brisbane Citizens' Band.

Tuesday, March 12th.—A programme by Mr. Sydney May's party.

Wednesday, March 13th.—A dance night by Alf. Featherstone and his Orchestra, interspersed with vocal numbers.

Thursday, March 14th.—A programme arranged by Mr. Eric Hayne. Studio programme.

Friday, March 15th.—The Federal Band.

Saturday, March 16th.—The St. Patrick's Day dinner arranged by the Queensland Irish Association will be relayed from the association's rooms.

Sunday, March 17th.—The complete morning and evening services from St. Andrew's. Brisbane Citizens' Band and Brisbane Municipal Concert Band concerts.

Monday, March 18th.—Arthur Sharman (pianist) and Ivy Plane (soprano), in a short recital. The Studio Orchestra. Citizens' Band.

Tuesday, March 19th.—Plantation sketch. Gramophone recital.

Wednesday, March 20th.—A dance night by Alf. Featherstone and his Orchestra, interspersed with vocal numbers.

Thursday, March 21st.—Mystery play, "X." Studio programme.

Friday, March 22nd.—A special studio programme by Mr. Erich John's party.

Saturday, March 23rd.—Orchestral music from the Savoy Theatre. Studio numbers interspersed with speedway races and dance music from Lennon's Ballroom.

Sunday, March 24th.—Complete morning and evening services from St. Barnabas' Church of England. Usual band concerts.

Monday, March 25th.—A concert arranged by the Bundamba Methodist Sunday School, relayed from Bundamba. Studio programme.

Tuesday, March 26th.—Stainer's "Crucifixion," rendered by the Choir of St. Andrews Church of England, relayed from St. Andrew's. The Anglo Male Quartette.

Wednesday, March 27th.—A dance night by Alf. Featherstone and his Dance Orchestra, interspersed with vocal numbers.

Thursday, March 28th.—A classical entertainment by The Richmond Party. Gramophone recital.

Friday, March 29th.—Albert St. Methodist—morning; St. Barnabas—afternoon and evening.

Saturday, March 30th.—40th Queensland Eisteddfod, relayed from Rockhampton.

Sunday, March 31st. — Complete morning and evening services from St. Stephen's Cathedral. Brisbane Excelsior Band and Municipal Concert Band concerts.

This department is conducted for the benefit of our readers. We cannot answer queries by mail.

Questions Answered

By the TECHNICAL EDITOR

Questions received before the 20th of the month will be answered in the following issue.

"G.G.," via Nanango.—"Having had such splendid results with the '£5 Three,' I am thinking of building the 'Pontynen Three,' as featured in the February issue. Would a Penthode valve improve volume without distortion? If so, does that valve need a special socket, and what is its cost? (2) Failing the above, would the following three valves suit: A-615, A-609, and B-605? With regard to the Penthode, I can place 135 volts on the plate."

Answer.—Using the two stages of audio, I think you would be wise to keep to the ordinary three-electrode valves in the Pontynen Three. Although I have had no trouble in eliminating the high-pitched whistle which often appears when the Penthode is used in a two-stage amplifier (by connecting a 100,000-ohm fixed resistor across the secondary terminals of the second audio transformer), I have known of several cases in which much trouble was experienced. The Penthode is really at its best when used in a single-stage amplifier. The Penthode fits the standard UX socket, the extra connection to the auxiliary grid being made to a terminal located on the side of the valve base. It costs 35/-. (2) The valve combination you mention is an excellent one, and will give every satisfaction.

DROP the Technical Editor a line if your set is not "perking" as it should. Be brief and to the point—ten-page epistles strictly prohibited!

"Victory," Toowoomba.—"Would the 'Victory Two,' described in your January issue, give me good loudspeaker results on Southern stations in my locality—five miles west of Toowoomba? (2) Which do you consider the better set—the 'Victory Two' or the 'Improved Reinartz Three'? (3) Which would be the more economical set to run regarding 'A' and 'B' batteries? (4) What other valve could I use in place of the Philips B-443 Penthode? (5) Would I require the wavetrap in my locality? If not, would I gain anything by incorporating it? (7) Would the M.P.A. speaker be suitable for either set? (8) Do the terminals of the loudspeaker go to both 'Output —' and 'Output +'? (9) How long would two 60-volt 'B' batteries last, at an average of 18 hours a week?"

Answer.—Yes; the "Victory Two" will give you good speaker results on the main "A" class stations, and fair strength on the smaller stations. (2) The "Improved Reinartz" will give you better signal strength. (3) Nothing to choose between them. (4) If you like, you can use the new Mullard Pentone, which is very similar. See the details in this issue. (5) No; you will not need the trap, and can gain nothing by using it. (6) Quite. (7) Quite correct. (8) This is very hard to answer, but I should say that anything from 6 to 9 months would be a fair average life under these conditions.

"W.J.D.," Mount Isa.—"With my Gilfillan 5-valve Neutrodyne I got Radiotron UX-201A valves, but found that Mullard PM-5's give better results, only the volume rheostats make no difference. I was thinking, therefore, of using a 500-500,000 ohm. potentiometer as in your 'Air Master Five' (instead of neutralising with condensers), this being used as a volume control. Please let me know if this is possible with my Neutrodyne."

Answer.—This scheme will work very well if the variable resistance is connected in the "B" battery wire which feeds the two radio-frequency amplifying valves.

"J.H.B.C.," Kelvin Grove.—"I am at present using a two-stage amplifier composed of —— transformers and valves. I am using 90 volts 'B' and the correct 'C' voltages on both valves. A Gecophone gramophone attachment is connected across the secondary of the first transformer, and a Rola loudspeaker supplies ample volume for a fairly large room. Now I am very particular about tone quality which, in this case, though very fair to the average listener, is not quite up to the standard I would like it to be. Would the following arrangement show a marked improvement in tone quality:—Push-pull, using Ferranti AF-5, AF-5C and OP-3C, and Philips valves—A-609 for the first stage and two B-605's for the push-pull stage? (2) Are large capacity by-pass condensers necessary, or may they be omitted? I would be prepared to buy another 45-volt 'B' battery if the extra quality justified the expense. Scrapping such an amplifier is rather a drastic step to take, but if you think the push-pull will really do the work better, I would be pleased to do so. What I really require is an amplifier that will operate satisfactorily on comparatively low voltages (90 to 135 at most), and supply moderate volume of perfect quality to a medium sized room. (3) I intend building a screen-grid short-wave adapter to work in conjunction with this amplifier, which will, of necessity, be at least two yards from the adapter. Will this be OK, or will it be necessary to build it all into one unit? Would it be any advantage to use a shielded wire as a lead from the plate of the detector valve to the input terminal?"

Answer.—I would not hesitate about building the push-pull amplifier for your requirements. For operation on relatively low plate voltages, this class of amplifier stands pre-eminent. You can use the two B-605 valves in the push-pull stage, or, better still, two B-403's; the best way will be to try the 605's first, as you already have one of them. (2) It is possible to do away with the 2-mfd. by-pass condensers while the "B" batteries are new, but you will be running a risk by doing so. As you are so particular as regards tone quality, I think it would be false economy to save in this direction. Use the extra 45-volt battery by all means. You can then expect very fine reproduction for a considerable time to come, for the amplifier will continue to operate satisfactorily, even when the plate voltage has dropped to 100 volts or so, provided the grid bias or "C" battery, voltage is adjusted from time to time as required. The best way to use an electric pick-up is to connect it to a volume control resistance, and thence to the input terminals of the amplifier, using all three valves. I am sure you will find the expense of this amplifier fully justified by the results obtained, and confidently recommend it as being an ideal unit for your needs. (3) You can use the scheme mentioned, although two yards means rather a long plate lead. I would not build it into the same unit as the amplifier, and the use of a shielded lead is not called for. By a "screen-grid short-wave adapter," I presume you mean a unit having one stage of screen-grid radio-frequency amplification and a detector. Be sure to have a good radio-frequency choke in the plate lead, inside the adapter unit, so that there will be no danger of r.f. currents being fed into the amplifier.

"A.W.S.," Hawthorne.—"As I have procured the jars for making your 'Inexpensive "B" Battery,' could you tell me where I can procure the sheet zinc? (2) What are the capacities of the following condensers: Ormond, 32 plates; Ormond, 13 plates; and Ormond, 21 plates?"

Answer.—From Messrs. Peter Fleming, Tinsmiths, Albert Street (near the T. & G. Building), Brisbane. (2) .001-mfd., .0003-mfd., and .0005-mfd., respectively.

"W.H.," Coorparoo.—"Can I use the 'Victory Two' as a short-wave receiver by putting a .00025-mfd. fixed condenser across the tuning condenser. If so, what coils would I use? (2) I have built the 'Victory Two' and have got good results from it. These are some of the stations I have tuned in, most of them at loud-speaker strength: 2FC, 2BL, 3LO, 3AR, 5CL, 4RM, 4CN, 4NW, and several other Sydney stations and amateurs. On the head-phones I get a station right on 4QG's reading on the dial, after that station has closed down. Could you tell me the name of this station, and also of one which comes in on 2BL's wavelength?"

Answer.—No, you cannot change the "Victory Two" into a short-wave set as easily as that! The action of connecting a fixed condenser across (in parallel with) the tuning condenser would have the effect of increasing the wavelength to which the set will tune—not reducing it. The only way you can convert it will be to replace the present tuning condenser with one of .00015-mfd. capacity (variable) and substitute different coils. For the main short-wave broadcasting band—15 to 30 metres, a grid coil composed of 3 turns, 3 inches in diameter, and a reaction of 4 turns, would be OK. The aerial coil would need to have about 5 turns. I would not advise you to attempt the alteration. Why not build the "Midget Short-wave Adapter" described in this issue, and use it in conjunction with the "Victory Two?" JOHK (Sendai, Japan), and JOFK (Hiroshima, Japan) respectively.

"W.F.," Babinda.—Replying to your query re the transmitting aerial by mail. (2) The list of short-wave stations and their schedules appears in this issue.

"N.W.A.," St. George.—"Re my 'Globe Trotter' short-waver, can you solve this problem for me: When I am using the 3-turn Radiokes coil to tune in 5SW London, I set both tuning condensers at zero and adjust the Bebe reaction condenser for oscillation. It oscillates alright, but the trouble is that directly I rotate the detector tuning dial, there is a terrific crackling sound, just like intermittent contact, which sometimes cuts me out and the set goes dead till I move the dial a bit further round, then it is alright. This crackling noise occurs only when I am using the smallest coil, but perhaps the following will help you to solve the mystery: I noticed last night, when I was tuning in, in the dark, that when I moved the detector dial it sparked between the edge of the dial and the aluminium every time it crackled. This seems strange, considering that the rotor plates are earthed to the aluminium, being connected to the end plates of the condenser. This is a Cyldon, with Gee-Haw dial, and all the parts are as recommended by you."

Answer.—That is rather a puzzle, but I should say that one of the plates of the detector tuning condenser is bent and touches a fixed plate at times. I cannot understand any sparking occurring between the dial and the aluminium panel, as these should both be at the same potential. Test the insulation of the fixed condenser C9, or better still, replace it with another. Evidently there is some leakage of "B" battery current at some point, and you will just have to experiment until you find it. I found that the metal dials were inclined to be productive of noises when the set was oscillating—not because of any leakage, but simply by virtue of the minute change of capacity when the dial made contact with the panel. I remedied it by pasting a disc of paper, slightly larger in diameter than the dial, in such a position that it prevented contact being made between the two. I cannot help you further, but perhaps if you pay careful attention to the three points I have mentioned, you will locate the fault. Yes; I suppose the adverse weather conditions are to blame; in Brisbane we have entertained the next-door neighbours many a time with music from 5SW, and the announcements could be clearly heard, too. Several other experimenters, living in Brisbane and the surrounding districts, have told us of the same results with the Globe Trotter. Of course, this was several months ago.

"A.H.," Finch Hatton.—"I am in a fix about my 45-volt 'B' batteries. I have only had them in use 4 months and they are completely run out. I know this must be due to the abnormally hot weather, because the static has been so bad that it was impossible to use the set to any extent of late months. What can you do to help me out of this difficulty? The last batteries lasted only 8 months. I live 50 miles away from the nearest charging station, so it is not convenient to have accumulator 'B' batteries."

Answer.—Afraid I cannot help you here. As you surmise, the hot weather is to blame, and I don't think an asbestos overcoat would help matters much. You should be satisfied with a life of 8 months, but 4 months is not nearly long enough. During the hot weather, when, as you say, you do not use the set, it would be a good idea to disconnect the batteries and place them in the coolest spot you can find—if you lived in the city I should say the ice-chest! There is one more alternative—use the extra-heavy-duty type of 45-volt "B" batteries. These are expensive, but usually repay the initial outlay by a much longer life than the standard heavy-duty type. As regards the brand, I would recommend either Siemens, Yale, Deal or Columbia—all are very good.

"A.L.," via Cairns.—"How many turns should there be on the primary of a Nentrodyne transformer? (2) How many on the secondary? (3) What is the correct place for the tapping? (4) How many turns on the aerial tuning inductance, primary and secondary? (5) What gauge of wire should be used?"

Answer.—15 turns. (2) 50. (3) 15 turns from the filament end of the secondary. (4) Primary 20 turns, tapped at 10 and 15, so that the aerial coupling may be varied to suit local conditions. The secondary has 50 turns. (5) Use 26-gauge double-silk-covered wire for the secondaries and 32-gauge double-silk-covered for the primaries. The secondaries are 3 inches in diameter, while the primaries are 2¾ inches, so that they may be slipped inside the secondaries at the filament end. Sorry we find it absolutely impossible to answer questions by mail. If you require a more prompt service, the "Broadcast Bulletin" has an "I'd Like to Know" section and is published weekly.

J.B.," Ipswich.—Going into this matter, and will let you know the result at an early date.

Important Sporting Event

4QG VERSUS ELECTRICAL FEDERATION.

A very happy function was held on the afternoon of the 21st February, when the radio and electrical traders of Brisbane met a team representing Station 4QG in a golf tournament. The event was played off at the Wynnum Golf Links, thirteen pairs taking part. A splendid spirit of camaraderie existed between all the players, and many of them indulged in good-natured "criticism," especially to those who were making their "debut." On the other hand, several rounds were played in a very serious manner. The heaviness of the course, owing to the recent rains, was not conducive to good scoring; nevertheless, some very creditable cards were returned. When the match was first announced in our columns, we predicted that the Director of 4QG (Mr. J. W. Robinson) might prove to be a "dark horse." He was, but on his return to the pavilion, he did not seem to appreciate the reward offered for his efforts—a glass of water!

The 4QG team included some very good players, and it was not altogether a surprise that they won by the handsome score of eight to three. The "ditch" was found by many of the players, and caddies had a busy time looking for "lost" balls. However, nothing mattered, for all were out to enjoy themselves, and the tournament did much to further cement the excellent spirit of friendship existing between the trade and 4QG.

The members of the trade also played for a bogey tournament trophy, which was presented to the winner—Mr. E. G. Anthon—by the President of the Wynnum Golf Club, Mr. G. W. Watson. The following are the scores:—

4QG.		Electrical Federation.	
Hon. W. McCormack, 3 & 1	1	J. J. Pearse	-
G. L. Beal, 2 & 1	1	R. Percy	-
J. A. O'Connor	0	E. G. Anthon	0
G. W. Watson, 3 & 2	1	P. J. Ross	-
Dr. Grey, 4 & 3	1	A. A. Ewing	-
H. Macaulay Turner, 7 and 5	1	C. F. Fitzgerald	-
J. W. Robinson, 3 and 2	1	—. Galloway	-
R. Byrne	-	F. Broad, 1 up	1
C. Moran	-	W. Peterman, 6 & 5	1
T. Clouston, 3 & 2	1	G. Faine	-
M. Davies	0	L. King	0
A. Sharman, 7 and 5	1	R. B. Jay	-
W. O. Burch	-	T. H. Nash, 1 up	1
	8		3

Wireless as Human Agent

Urgent Attempt to save Life

Broadcast Appeals for Blood Transfusion

THOSE people who were listening to Station 4QG during the early part of Sunday evening, February 24, were more than a little interested when a very urgent appeal was broadcast by the announcer for volunteers to submit themselves to a transfusion of blood.

In very anxious tones, the announcer stated that at the time a young woman was lying in the Mater Misericordiae Private Hospital at the point of death. He stated that her condition was very low and that the only hope of saving her life was for some young person to give a quantity of blood in order that a transfusion might be carried out. Listeners who had heard the call and were quite willing to submit themselves for the test, were asked to communicate with 4QG.

MR. ALF. BAUER,
Operator at 4QG, who volunteered for a blood transfusion in an unsuccessful attempt to save the life of the wife of his colleague, Mr. R. Wight.

At the time the appeal was made, the young lady's name was not mentioned, and it came as quite a shock to a number of listeners the next morning to find that the lady in question was none other than the wife of Mr. Robert Wight, a member of the staff of 4QG—familiarly known to listeners all over Australia as "Market Reports."

The response to the appeal was amazing. Immediately after it had been broadcast, the telephone at 4QG rang continuously, and it would have been possible to have secured more than 100 volunteers had their services been necessary.

After about 15 people had volunteered, however, arrangements were made for them to be taken across to the Mater Hospital and later to be tested by the doctor in attendance on the case, with a view to finding whether they were suitable.

Amongst those who volunteered was Mr. Alf T. Bauer, an operator on the staff of 4QG, who is also well known to most wireless listeners and who is often seen operating at one of 4QG's outside points. Mr. Bauer is a strong, healthy young man, and it was found that he was the most suitable subject for the blood transfusion.

Accordingly, Mr. Bauer was relieved of his duties in connection with the operating of outside apparatus at the band concert at Wickham Park, and was taken across to the Mater Hospital, where he was placed in the theatre with Mrs. Wight, and the blood transfusion carried out.

At first it was hoped that the patient would pull through, but unfortunately she seemed too weak to stand the ordeal, and a few minutes after Mr. Bauer had given a quantity of his blood in an attempt to save her life, she very peacefully passed away. The late Mrs. Wight, who was only a young woman of 32 years of age, was known to all members of the staff. Her husband, "Market Reports," is probably the most popular member of the staff at 4QG, and certainly is well liked by everybody. On numerous occasions, when his work at night had kept him in the station till a late hour, Mrs. Wight had been in the habit of calling to see him and perhaps sitting in his office waiting until he concluded his market session, so that she could join him in some outing during the latter part of the night. When she paid these visits to the station, she invariably had a friendly smile and a word of greeting for all members of the staff and was an exceedingly popular girl.

Mr. R. Wight with his daughter at the graveside.
—From a Photograph Supplied by 4QG

Consequently the news of her death came as a big shock to the whole of the members of the staff at 4QG, and on Monday, February 24th, when the funeral took place, there was a very large attendance. The funeral was a splendid illustration of the deep sympathy which was extended to Mr. Wight in his very sad bereavement.

The cortege moved from K. M. Smith's funeral parlour, Wickham Street, Valley, to the Church of England section of the Toowong Cemetery. The Rev. Canon Garland, of St. Barnabas' Church (a clergyman who has also been very closely associated with 4QG in religious broadcasting) officiated at the graveside. Station 4QG was very well represented, and in addition to quite a number of Mr. Wight's personal friends, there was a very large and representative atendance of members of the produce trade.

Mr. Wight's duties carried him into the produce markets throughout Roma Street every morning for the past few years, in addition to which he was, before becoming associated with 4QG, closely identified with agricultural movements both in the Department of Agriculture and Stock and in the Council of Agriculture. Evidence of his popularity in this section of his work was given by the large number of produce traders and merchants who attended the funeral, and after the painful ceremony, expressed briefly their deep sympathy with Mr. Wight in his very sad loss

The late Mrs. Wight was a native of England, and it was while serving as an officer with the A.I.F. during 1918 that Mr. Wight was wounded, transferred to a hospital, and there met Mrs. Wight, who at the time was a V.A.D. During Mr. Wight's recovery from his injuries, he and his late wife were brought together and, before returning to Australia, they were married at one of the London Churches of England and then came out to Queensland where they settled down. Mrs. Wight leaves one daughter, a little girl 8½ years old.

Following the funeral on Monday, Mr. Alf Bauer, of 4QG, was the recipient of many messages of congratulation on his endeavour to save the life of Mrs. Wight. The members of the staff of 4QG were, perhaps, more enthusiastic in their congratulations than outsiders, it being felt that it was quite a credit to the station to think that one of 4QG's own staff should have been selected as the most suitable volunteer to attempt to save the wife of another member of the staff. On the following day Mr. Bauer felt the effects of his ordeal somewhat, and was compelled to rest during the day. As this issue goes to press he is still slightly feeling the effects, but the wound made in his arm is now healing very satisfactorily.

Mr. Wight has asked the "Queensland Radio News" to publish a few lines, expressing his deepest appreciation of the actions of those listeners who, hearing the call for help on that quiet Sunday night, volunteered and took the trouble to come specially into town.

We have very much pleasure in acceding to Mr. Wight's request, and would ask all listeners who did volunteer to take this paragraph as an expression of appreciation.

Radio Waves Reflected from Moon Sphere

Remarkable Discoveries

What had been described as one of the most interesting discoveries since that of the Heaviside Layer, has recently been made and part-explained by the eminent German scientist, Professor Carl Stormer.

Professor Stormer had been informed by Engineer Jorgen Hals, of Bygdo, that he had picked up echoes of radio signals broadcast from the well-known Philips radio station PCJ. First came the usual echo caused by the waves which travel round the earth and return within one-seventh of a second. Three seconds later, a period long enough for radio waves to travel over half a million miles, another echo was audible, though weaker than the first.

The second echo must have been caused by the reflection of the waves from the outside universe—from regions beyond the sphere of the moon.

The Professor was greatly impressed by this remarkable discovery and, writing to Messrs. Philips Radio, requested that signals should be sent out at five-second intervals from PCJ so that he could investigate the phenomenon.

This was done, but without the expected results. Later, during his sojourn in Holland, Professor Stormer visited the Philips Station, and it was agreed to continue the experiments, this time with twenty-second intervals. Again results were negative, but after several more attempts, during which the experiments were almost abandoned, success came at a time considered most favourable.

It had been resolved to release three successive shocks in certain tone heights, and a remarkable succession of echoes was received from 3 to 17 seconds after the signals were first picked up. In this instance the signals were so loud that there was no shadow of doubt as to their identity as echoes.

The Professor wired PCJ at once, telling of the success, and received the reply that the echoes had also been heard in Holland. Later than this signals were not heard by Professor Stormer and, although Engineer Hals advised that he had picked up echoes again, by the time the Professor arrived they had disappeared on account of atmospheric disturbances.

Professor Stormer marked the discovery as a very rare phenomenon, and the experiments are to be carried on.

The scientific explanation was given as due to rays of the North Light and the fact that there are certain parts of the universe which are impenetrable to electricity, and others that will admit it. The region at which it becomes impenetrable fluctuates to a great extent, thus explaining the varying times at which the echoes were audible. The influence of the North Light is an admitted fact, for with a strong North Light it sometimes happens that communication over long distances is cut off. Further details of the explanation are deeply scientific and too lengthy to do justice to here.

If the echo really exists, it would be exceedingly interesting to continue with the experiments. The study of the movements of North Light rays within the universe is of the utmost importance; the tropics will probably offer the best conditions for such research.

The lecture greatly stirred the interest of a large scientific audience, it being one of the most remarkable heard. Prof. Bjerkens congratulated Professor Stormer, and expressed the hope that he might succeed in entirely clearing up the phenomenon.

(To the Editor, "Qld. Radio News.")

Sir,—Just a few lines to say I have been taking the "Radio News" for the last three years and have had a lot of fun out of them.

I have built the "Air Master Five" out of the "Broadcast Bulletin," but I get a lot of trouble with the Japanese stations. I am not the only one in the North who does; take a look at the list of Jap. stations on page 48 in your January number and then at our own "A" class stations.

In Cairns we are 900 miles air-line from Brisbane, so we get it where you don't. Sometimes they are so bad as to blot 4QG right out. Last year I did not mind so much because I was using a three-valve P-1. As you know, a P-1 is very broad, but with a wave-trap it is one very nice set, and, while I am on the subject, I have had a P-1 for a long time and also a lot of other three-valve sets, but I have yet to find one to give me the power of the P-1. This year I am going to make a P-1 short-wave adapter. I have tried one, and they are "the goods."

Yours, etc.,

D. G. GRAHAM, Cairns.

* * * *

(To the Editor, "Qld. Radio News.")

Sir,—I read your leader, and don't for a moment think radio will slump. Something is always coming in new. The world is stirred about it, many enthusiasts will stick to it, and, finally, laud it as the motor car and the gramophone, etc.

I don't for a moment think with the Technical Editor "Sans static—sans radio." I thought of the beam being used that would give each receiver a beam of his own to receive. The trouble would be the same if a larger aerial had to be used to trap the beam.

I found that by passing the current through the body the statics are reduced after the set has dealt with the signals (before they are passed on to the loudspeaker). One wire "+," if broken, and the two ends held one in each hand, will give the same effect as the indoor aerial, but it is wavey in effect, like fading, only more frequent. Placing one dial five degrees ahead of its right place will also have the same effect.

If you have two wires attached to the leads of the loudspeaker and put them in a solution of acid and water, it will short-circuit the loudspeaker. Will sulphuric acid do the same? I used hydrochloric acid.

If we have rustless steel, we can surely get statics out of radio.

Cheerio, Mr. Editor—radio won't die.

Yours, etc.,

"A. READER."

P.S.—We had statics without the radio, and we'll have the radio without statics.

CLUB ACTIVITIES—(Continued from Page 36.)

TOOMBUL RADIO CLUB.

The fifth annual meeting of the club was held at the club rooms on Wednesday evening, February 13th, a fair attendance of members being present. The treasurer reported that the total receipts during the year had been slightly over £33, whilst an expenditure of £29 odd left the club with a very satisfactory credit balance. The election of officers resulted:—

President, E. H. Coulter, Esq.; vice-presidents, H. E. Hannington, Esq., F. Collins, Esq.; secretary, Mr. G. E. Ham; treasurer, Mr. A. E. Walz; executive committee, Messrs. Coulter, Ham, Walz, Hubner, Collins, Siegman; technical committee, Messrs. Hubner, Walz, Starkie, Ham, Whitworth; auditors, Messrs. Macpherson and Hannington; librarian, Mr. Macpherson.

After the date of the next meeting of the club had been fixed, the meeting was declared closed at 10.15 p.m. The club's transmitter has been unusually silent during the past month or so, but this may merely be "the silence before the storm," so listeners may be well advised to keep a sharp look-out for 4TC during the coming winter.

Last week-end, we are told, the Wooloowin Radio Club, who were enjoying themselves at Leitch's Crossing, were awakened at midnight by a gang of alleged "thugs" who broke the stillness of the night by wild shrieks and packets of crackers, not to mention rattling kerosene tins and other noise producing contrivances. We also understand that when the subject is mentioned to any Toombulite he will smile knowingly as though enjoying a great joke. It is understood, however, that the Wooloowin Club is to be commended on its very military-like methods of defence and on its subsequent interesting manoeuvres on the morrow. Interest in the Morse code class is quickening, and no doubt Toombul will soon have some more amateur transmitters to break the stillness of the night, though in a different sense from the manner in which it was broken at Leitch's Crossing.

* * * *

"SHORT WAVE ACTIVITIES" APPRECIATED.

The following is the text of one of the many letters received by our contributor, Mr. F. W. Nolan, concerning his monthly feature: "Short Wave Activities." The letter speaks for itself—

Sir,—Just a few lines in appreciation of your most interesting column appearing in the "Q.R.N." each month. It no doubt must appeal to all short-wave enthusiasts. I have a two-valve myself, and do quite a lot of it at all hours. I have had the undermentioned:

5SW, R6 at times; ANE, R7; Amsterdam station, R6; Kootwijk, R2 (3 at times); W2XAF (testing with 2ME), R4; RFM, R5.

This is received on an indoor aerial 8ft. long; but my drawback is my earth—approximately 13 or 14 feet. However, I don't suppose I can growl at these results.

I would be very grateful to you if you would let me have some information regarding other experimental or broadcasting stations on the lower wavelengths, and times of broadcasting. Is Paris on the air regularly?

Thanking you in anticipation,

"L.J.," Windsor, 3/2/29.

[The information requested will be found elsewhere in this issue.—Ed.]

The Transmitting License

By Q.R.N.

Article No. VI.—Dealing with Various Types of Rectifiers.

IN this article attention will be given to the action of rectifiers—that is, of devices intended to change the to-and-fro nature of alternating current into a uni-directional pulsating direct current. One realises that direct current is as essential in the plate circuit of a transmitting as of a receiving valve. Though the filament of a transmitter is preferably run from an alternating current supply—as explained in an earlier article—such an A.C. supply is not feasible in the plate circuit. The reason for this is not hard to find. One knows that the ordinary thermionic valve consists of three elements inside a more-or-less evacuated glass bulb. These elements are: the filament, surrounded by the grid (usually a spiral or mesh of fine wire), and both in turn enclosed by the plate or anode, which is usually of nickel, cylindrical or oval in shape. Such elements are common to both transmitting and receiving valves.

The filament is heated—whether by direct current or alternating current matters not—and the heat causes a certain amount of decomposition in the material of which it is formed. All the atoms that go to make up the filament are themselves composed of small nuclei of electricity—infinitesimally minute particles of positive and negative electricity known respectively as protons and electrons—and under the stress of the applied heat the atoms break up and the electrons are thrown from the surface of the filament.

So long as the filament is heated there will be a state of stress within the valves, for the heat is causing the rejection of electrons while the superfluity of protons on the filament, due to such rejection of electrons, has made it positive compared to its usual condition, and this positive state naturally tends to counteract the effect of the heating by attracting the free electrons.

Suppose now that a battery—the familiar "B" battery—be connected in circuit with the valve so that the positive pole of the battery is linked with the plate of the valve and the negative pole with the filament. Then the plate of the valve will be of positive polarity in respect to the filament, and all the electrons emitted by the heated filament, being negative particles of electricity, will be attracted to the plate. Under such circumstances the "B" battery circuit will be complete, for a current will flow from the negative terminal to the filament, thence by the escaping electrons across the filament-plate gap and thence to the positive terminal of the "B" battery.

From such a consideration it becomes obvious that, if the plate be made negative, the valve will not function, for the free electrons around the heated filament will be repelled by the plate, and there will be no means of completing the "B" battery circuit, and if the "B" battery circuit be inactive the valve is useless either as a receiver or a transmitter.

To apply alternating current to the plate of such a valve would cause it to function only for the instants when the plate was positive—that is to say, the plate circuit would only respond to the positive alternations of the current, and for half the time (during the negative alternations) it would be dead. The disadvantages of this are so obvious that recourse is had to devices which will rectify the cheap alternating current supply into a direct current.

Rectifiers are of three chief types. Firstly there is the chemical or electrolytic rectifier, wherein the unidirectional passage of an electric current flow through certain chemical solutions is utilised. By reason of its relative cheapness, this type is the one usually used in amateur stations. Secondly, comes the thermionic or valve rectifier, of which the action has been largely traversed in the earlier part of this article. The thermionic type is highly efficient, though more expensive than the chemical rectifier, both in initial outlay and in upkeep. The third type is the mechanical rectifier, wherein the vibration or rotation of a current carrying conductor is made to perform the desired rectification.

The Chemical Rectifier.

A chemical rectifier consists of a battery of containers—usually, be it said, a dozen or two of the cheapest kind of Japanese glass tumblers—filled with a strong solution of borax in water. Ordinary household borax will do; chemically pure borax is reputedly better, though practical results do not always confirm this. Amateurs throughout the world, however, clamour for the stuff known as "20 Mule Team" borax, obtained from certain localities in the United States, and packed out on mule teams—hence the name. Readers who have come across the expression in various papers have often been at a loss to understand what sort of commodity this particular expression denoted. However, the jars are filled with "20 Mule Team" and aluminium and lead electrodes are inserted. The aluminium electrode in one jar is connected to the lead of the next, and so on throughout the series.

Refer to Fig. 1—wherein the aluminium is shown as the bigger, and the lead as the smaller electrode. The terminals A-B represent the input terminals of the alternating current, and the terminals X-Y the output terminals of the direct current.

A description of the action is as follows:—Imagine that, for an instant, the incoming current flows in the direction AP. When it reaches P it may choose either of two directions. It may, theoretically, flow towards the upper row of jars; in practice, however, it will flow towards the lower row. The reason for this explains the action of the rectifier. Currents can pass through the borax electrolyte from the lead anode to the aluminium cathode without hindrance, but as soon as the reverse direction is attempted chemical action causes a number of oxides and other salts of aluminium to form upon the surface of this metal, which causes a tremendous resistance to the flow of current in the aluminium-lead direction.

A reversal of the current, however, dissolves this coating almost at once and allows the flow from lead to aluminium to pass virtually unhindered. Of course, if the frequency of the applied A.C. be too high, there will be no time for the dissolution of the salts round the aluminium electrode, and the rectifier will be paralysed. However, it is found that the common municipal A.C. supply at 50 or 60 cycles per second can be handled quite comfortably by the rectifier.

Therefore, to return again to Fig. 1, the full direction of current flow from A through P to B is as shown by the plain arrows—note that it flows through any external circuit connected to XY in the direction from Y to X. But during the next alternation the direction of the incoming current is reversed, and it will flow from B to Q. Consideration of the action just described will show that the path during this alternation will be traced by the feathered arrows, wherein the direction from Y to X remains unchanged. Trace the diagram out until satisfied that this is so. Therefore, it is seen that no matter what the direction of the current applied at AB the direction of the current flow at XY is unchanged—that is to say, the chemical rectifier or Noden valve, as it is commonly named, changes alternating current into direct current.

The diagram (Fig. 1) illustrates what is known as full-wave rectification—that is to say, both alternations of the incoming current are utilised to send a pulsation of direct current through XY. Very often, however, half-wave rectification is used, wherein one of the alternations of the A.C. is utilised and the other alternation wasted. Such a half-wave rectifier as connected to a step-up transformer is shown diagramatically in Fig. 2. The current may flow through an external circuit in the direction AB and DC, but not in the direction of BA and CD.

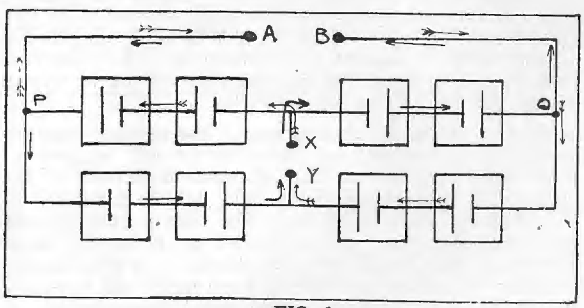

FIG. 1.

In amateur full-wave rectification, a centre tap is usually taken from the secondary winding of the transformer so as to give, say, 500 volts on either side. This centre tap acts as the negative pole of the resultant direct current, while Noden valves are connected

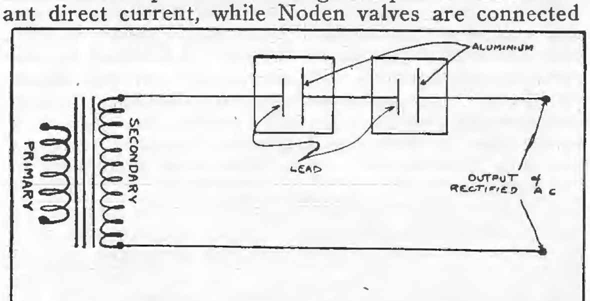

FIG. 2.

on both sides of the transformer and brought to a common lead, as shown in Fig. 3, which acts as the positive terminal. The output voltage from this system will, for any given transformer, be half that of half-wave rectification, similar to that in Fig. 2.

In constructing a chemical rectifier it is usual to allow one jar to every 50 volts input, though the ratio is not arbitrary in any sense, and throughout Queensland amateur stations the number of jars in use varies probably between 10 and 40 for inputs of similar voltage. Other electrolytes than borax may be used, such as ammonium phosphate, but in Queensland borax is usually more readily available and is very cheap, and

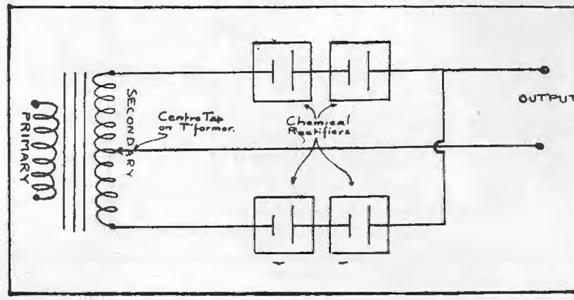

FIG. 3.

so comes in for greater attention.

It is unfortunate, however, that before a Noden valve rectifier will work properly its electrodes must be put through an action known as "forming." This is done by connecting ten or a dozen of the jars in series across the 240-volt A.C. line, together with a lamp in circuit, and leaving them for five or six hours until no current, as indicated by the lamp, passes through the jars.

Valve Rectifiers.

Now we will continue the discussion of the thermionic or valve rectifier, and deal with the operating characteristics of mechanical rectifiers.

In general a two-electrode valve—or diode—may be connected in the output circuit of a step-up transformer in exactly the same manner as the chemical cells. That is to say, one can use diodes in one or both "legs" of the transformer secondary to give either half-wave or full-wave rectification. Special arrangements may be made for lighting the filaments of the rectifying valves from a separate battery or a third (filament) winding on the transformer may be utilised. It is obviously desirable that, for reasons of cheapness, the filaments be lighted by the available A.C.

Fig. 4 shows the connections of a full-wave single phase rectifier with the filaments heated from an alternating current source. In practice, however, it is generally found that the use of a filament winding on the high-tension transformer is not absolutely satisfactory, by reason of the fact that when keying the transmitter the load impressed upon the transformer—and especially is this so if the morse key be in the usual power leads—causes a varying output to the filament winding. This in turn causes a flicker both in the rectifying and in the transmitting tubes, leading to a noticeable "chirp" in the transmitted note.

To obviate such trouble most Queensland amateurs run their filaments from a separate transformer—often part of the station's home-made battery charging equipment.

A two-electrode valve will rectify so long as there is sufficient heat to cause electronic emission from the filament, and so long as there is attraction between filament and plate. From a consideration of this it is obvious that there will an "optimum" point at which the rectification will be at its best. An increase in filament heat will, of course, result in a greatly increased electronic emission, and consequently a greater plate current.

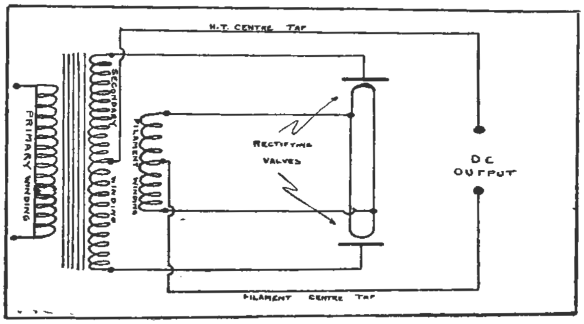

FIG. 4.

The above statement, however, only holds true so long as the saturation point is not exceeded. That is to say, for every given value of filament current and plate voltage, there is a maximum number of electrons which will be attracted to the plate and absorbed thereby. An increase in filament current without a collateral increase of plate voltage will cause inefficiency in the working of the valve since many of the emitted electrons cannot be absorbed by the plate and will only serve to eat away the filament and shorten the life of the valve.

Acting as a rectifier, it has been found that an ordinary UX-201A receiving valve with its grid and plate legs connected together will upon occasion stand up to an applied voltage of 500, under a current drain of 50 milliamps; but such extreme treatment is not recommended. Two or three of such valves in parallel, however, will give all the current required to work an ordinary 7½-watt transmitter of the UX-210 type.

Use is also made, for rectifying purposes, of the "B" eliminator type of valve, more especially the full-wave Raytheon. Such a tube has no filament, but works on the gaseous conduction principle. That is, the current passes from either plate (there are, of course, two in the valve to procure full-wave working) to a central electrode connected to the output circuit by reason of the conductivity of the gas within the tube, due to the ionisation of its atoms. A large potential difference across the electrodes is sufficient to break down or ionise the gas between them and set up a path of conductivity. Working up on a similar principle is the American "S" tube, which is unfortunately practically unobtainable in Australia. This tube, built for the rectification of high voltage current for transmitting purposes, is reputed to stand 2000 volts in the reverse direction without breakdown.

Mechanical Rectifiers.

These are divided into two chief classes—that class in which use is made of a vibrating reed or armature and that class in which rectification is caused by suitably mounted contacts and brushes upon an electric motor running from the A.C. supply. A diagram (Fig. 5) will illustrate the action of the first type.

The coil R is the centre-tapped secondary of a step-up transformer. The ends of this winding are brought out to two contacts A and B. A vibrating arm V,

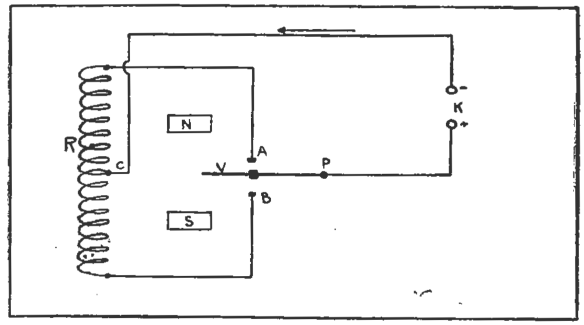

FIG. 5.

pivoted at P, is so arranged as to be free to swing into contact at A or B. In practice the vibrator and pivot are mounted upon the projecting part of one leg of the transformer core, and so receive changes of polarity in time with that part of the core, due, of course, to the electro-magnetic effect of the superimposed windings of the coils. A permanent magnet of the horseshoe type is rigidly mounted with its north and south poles at N and S. The output of the rectifier is at K and its operation is as follows:—

Suppose that at any instant the core to which the vibrating reed is pivoted is of north polarity. Then the free end of the reed will be of north polarity and will be promptly attracted by the magnetic pole S. This movement causes contact with the point B and the output circuit is complete by way of the centre tap C, the circuit at K, and the contact at V-B. The current flow, from positive to negative, will be as shown along the lead C.

But at the next alternation of the applied primary voltage the free end of the vibrator will become of south polarity, due to the changed direction of the current in the coil windings, and will be attracted to N, making contact with A. The output current will, however, still flow in the circuit at K in the same direction—that is, as already shown. A mechanical rectifier of this type is not of very much use in rectifying the plate current of the usual transmitting set because of the pronounced sparking at the contacts. It is, however, used in some type of battery chargers, wherein both voltage and frequency are low.

The second type of mechanical rectifier is generally known as the synchronous rectifier or "sync." The A.C. motor used is of such type as to revolve in time with the frequency of the applied A.C.—that is, the motor is synchronous with the applied current. Upon the shaft of such motor is mounted a disc carrying two semi-circular metal segments around its edge with small gaps between the segments—in other words, a two-pole commutator. A.C. from the secondary of the step-up transformer is applied to these segments, and brushes carrying the rectified current—the D.C.—make contact upon the segments as they revolve with the disc. These two brushes are arranged exactly 180 deg. apart, so that, for instance, each brush passes over one of the gaps at the same moment. The apparatus is so balanced that when the brushes are passing over the gaps the current flowing in the A.C.

circuit is zero—the instant between any two alternations of the alternating line current.

As the current rises to its next maximum, one of the segments of the commutator will reach its maximum positive value, and its fellow its maximum negative value; and as the applied current falls to its next zero so does the current on the commutator segments fall to zero. But . . . . during the time this alternation has taken place the rectifier disc has spun through 180 deg. of rotation, and at the moment that the alternation has died down to zero the two brushes are once more passing over the gaps between the segments. The current begins to rise again, but in the reverse direction, and the commutator disc continues to spin, but the segment which was formerly negative is now positive, and the brush which was formerly contacting with the positive segment has bridged the gap and is now contacting with the other segment which is now positive itself. Thus, this one brush will always be in contact with positive segments, and its fellow with negative segments. The result is that the applied alternating current is rectified into a semi-smooth direct current.

Synchronous rectifiers are in fairly common use among the U.S.A. and Canadian amateurs, but have have not found general favour with the Australian ham, by reason probably of their heavier cost when compared with the commoner chemical or thermionic rectifier.

Filters.

The output from any of the described types of rectifier is of a pulsating nature. It is obvious that such variations in D.C. voltage due to the incomplete action of the rectifier should be removed before the plate of the tube is reached. Usually some system of

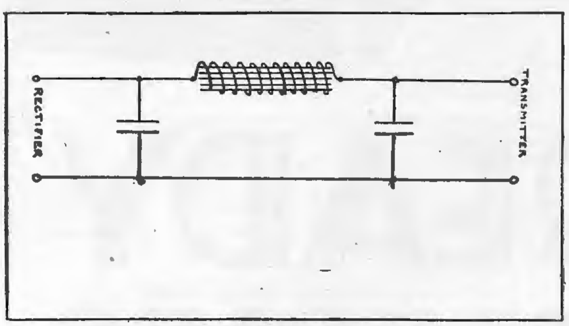

FIG. 6.

filter is used—such as a combination of choke coils and condensers. Many Australian transmitters simply shunt a capacity of 12 to 30 microfarads across the rectifier output, which has the effect of minimising the voltage variations. It will be remembered that in an earlier issue the reactance of a condenser—its resistance to alternating current—was given as:

$$\frac{1}{2.p.f.c.}$$

where p is our old friend "pi"—and f and c represent the frequency of the applied current and the capacity of the condenser. In a perfect rectifier the output would be pure D.C.; that is, there would be no "frequency" to it, and the expression given above would have a definite value, while any variation in the frequency—as would occur if stray A.C. voltages leaked into the D.C. output—would be by-passed by the filter condenser and kept out of the valve circuit.

For a similar reason a choke—of which the reactance is 2.p.f.c., where 1 is the inductance—is often used in series with the rectifier output.

The ideal arrangement for ordinary continuous wave signalling would appear to be that shown in Fig. 6, whereby the rectifier output is fed through or across both condensers and choke. In general a value of 40 or 50 henries in the choke coil and 4 or 6 microfarads in each condenser will work satisfactorily.

Output to the Loud Speaker

No modern receiver, unless it be for headphone reception only, is complete without some kind of choke-condenser output circuit for the loudspeaker. Such circuits are, of course, a development of transformer coupling of the loudspeaker, but as a choke and condenser (a relatively cheap arrangement) is as efficient for most purposes as the rather more expensive transformer, the former has largely taken the place of the latter.

It is necessary only to ensure that the condenser is large enough to by-pass all A.F. impulses, that the choke has sufficient inductance and is capable of carrying the D.C. current in the plate circuit of the last valve. Usual values are 2 microfarads and 25 or 50 henries respectively.

Suitable choke circuits are frequently published, and will also be found at the output end of most loudspeaker receivers. There are, in general, three distinct arrangements, one of which is the best for nearly all purposes as it enables one side of the loudspeaker to be at earth potential. This is an obvious advantage when high "B" voltages are used and it is desired to carry the loudspeaker leads a considerable distance away from the set.

The connections are simplicity itself. The choke is connected between the plate of the last valve and the "B" supply—that is, in the position normally occupied by the loudspeaker. The loudspeaker is connected on the one side to earth, and on the other—through the 2-microfarad condenser—to the plate of the valve.. As no D.C. flows in the loudspeaker side of the circuit it is, of course, quite immaterial which way round the windings are connected.

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Ships Use Radio for Medical Aid

Have you ever stopped to think of the terrible predicament of a seaman who meets with an accident or falls seriously ill when his ship is hundreds of miles from the nearest medical aid?

AT one time his case would have been perilous indeed, and one can easily visualise the demoralising effect which the realisation of his helplessness would naturally have. Nowadays radio brings swift relief, sometimes from a point miles away over the horizon. Surely the world has known no more humane service than this—the saving of life on the high seas!

To-day every large passenger ship of any importance carries one or more surgeons, and some of the larger liners have hospitals of their own, complete with operating theatres and everything necessary for emergencies.

Although the list of vessels carrying a medical officer may seem a large one, however, there are many ships that do not carry a doctor. What of those small tramps which are found on every ocean, or those cargo vessels which sometimes take weeks on a voyage, and are sometimes out of sight of land for most of the time? Very often the captain or mate of such a vessel is also the acting doctor, and with his sometimes small knowledge of medicine is able to attend to the minor ills of his crew.

But there are certain radio stations from which free medical advice may be obtained from any ship of any nationality. In Denmark there are two stations giving free medical service and in Sweden one. Blaavand (CXB) and Copenhagen (OXA) are the Danish stations, while Goteborg (SAB) is the Swedish station. In the case of a ship calling up Copenhagen and asking for advice, the message would be at once passed on to the Seamen's Hospital in that city, from which the doctors would pass the necessary advice direct to the ship.

Public Health Service.

The United States Public Health Service provides a radio medical service from five stations, four of which are on the Atlantic coast and one on the Pacific coast.

Imagine a vessel hundreds of miles out at sea; for many days no other ship has been passed, but the radio operator has been in touch with several ships, which are miles and miles away beyond the horizon. Suddenly a passenger or a member of the crew is taken seriously ill; there is no doctor on board and medical advice must be had at once.

The captain writes a message and in a few minutes the radio operator is calling one of the many ships he knows to be within range. The medical officer on the ship replies, giving carefully worded directions for treatment. These directions are always sent in plain language without any technical terms, so a layman has no difficulty in following them.

For several hours the two vessels may exchange messages giving details of the patient's temperature and general condition. Should it be considered that the case is extremely urgent, the distant ship may change its course and later come alongside the vessel which has called for assistance; the doctor then goes aboard.

Leg Nearly Blown Off.

A single case on record, but one that is the exception rather than the rule, tells of the case where a member of the "black gang" in the stokehole aboard a tramp steamer was injured in the explosion of a steam pipe. His right leg was almost blown off, and after a day or so of amateur medical attention by the captain of the ship, gangrene set in and the man was in a bad way.

Medical aid was requested by the radio operator, but the nearest ship was over 200 miles away and the sailor's condition demanded immediate attention. Unable to secure other aid, the captain wirelessed the doctor on the nearest ship for instructions.

A thorough examination of the patient was made by proxy, and, as a result, it developed that an operation would have to be performed. Following instructions to the letter, the captain amputated the seaman's limb and that individual lives to-day to tell the tale.

Hardly a day passes without ships asking for medical advice, and instances have often been reported in the Press. Nevertheless, there are many cases which are not reported in the newspapers, and so the public does not get all those little dramas of the sea.

Grid Leak Position

In sets having grid leaks for the R.F. and detector valves connected between the grid and one side of the "A" supply, it is rather important to keep the grid leak and condenser close to the valve socket. The position of the condenser is very frequently determined by the position of other components, and for convenience it is usually placed near the socket of the valve concerned.

The reverse is the case with grid leaks, however, and in quite a number of amateur-built sets it is common to see one tag of the leak soldered direct to the positive "A" terminal, for example, and a long lead trailing round the set to reach the grid terminal of the socket.

This is quite contrary to the best practise for it means that the minute impulses in the grid circuit are liable to be affected by the much stronger impulses in the plate circuits of other valves.

The New Mullard Five-Electrode Valves

"Pentone" gives equivalent results to two ordinary Valves

ON every receiver intended for really good loudspeaker reproduction, it has been found necessary to incorporate at least two stages of audio-frequency amplification in order to take care of the requirements of adequate volume with satisfactory quality. With the advent of an entirely new type of power valve with five electrodes, it is now possible to work a loudspeaker at full volume from a simple receiver consisting of a good detector and only one of the new power valves. This valve is a development of the Mullard Wireless Service Co., Ltd., whose widely used "PM" series of receiving valves were the first of their kind in Australia and whose research activities in collaboration with the British Navy Wireless Department at Portsmouth, have resulted in such tremendous strides on the transmitting side.

Known as the "Pentone," because it contains five electrodes, the new valve contains the usual filament and plate, between which are placed three grids. That nearest the filament is the ordinary operating or "control" grid such as is employed in the ordinary three-electrode valve, while the next grid (that is, the central electrode) has applied to it the same high voltage as is fed to the plate. The third grid (nearest the plate) is connected internally to the filament.

This combination produces a valve with remarkable characteristics, and constitutes one of the most interesting developments of recent months. Indeed, it is no exaggeration to say that these new valves will revolutionise receiver design. Moreover, a point that will particularly appeal to the home-constructor is that this new Mullard valve can be used in the standard UX socket, the connection to the auxiliary grid (which carries a high potential) being brought out to a terminal at one side of the valve base. There will, therefore, be no constructional difficulties about the use of these Pentone valves.

At first only two-volt and four-volt Pentones will be produced, and these will be known as the Mullard PM-22 and PM-24 respectively. We are able to give here, for the benefit of our readers, the first details of the new valves:—

Mullard PM-22.—Filament voltage, 2; filament current, 0.3 ampere; maximum plate voltage, 150; auxiliary grid voltage, same as plate; plate impedance, 62,500 ohms; amplification factor, 82; mutual conductance, 1.3 milliamperes per volt. (The impedance, amplification factor and mutual conductance quoted are those measured at 100 plate voltage, zero volts on control grid, and 100 volts on auxiliary grid.)

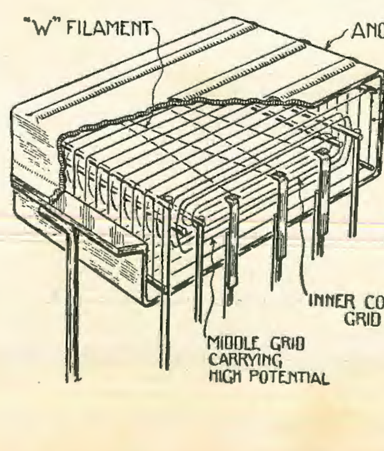
Mullard PM-24.—Filament voltage, 4; filament current, 0.15 ampere; maximum plate voltage, 150; auxiliary grid voltage, same as plate; plate impedance, 24,600 ohms.; amplification factor, 62; mutual conductance, 2.3 milliamperes per volt. (The impedance, amplification factor and mutual conductance are measured under the same conditions as the P-22.

The remarkable nature of the new valves is evident from these details. Particular note should be made of the enormous amplification factor of these valves, for that of a standard three-electrode power valve is in the neighbourhood of only 3 to 5. The high impedance is no drawback because of the large plate current output that is available—as much as 33 milliamperes at zero grid volts in the case of the PM-24, with 125 volts on the plate and auxiliary grid.

It will be evident that with its high amplification and large anode current, one Pentone will give results equal to those at present obtained from an ordinary two-valve amplifier comprising a medium-impedance and a low-impedance power valve, but there will be a great saving of filament current and one inter-valve coupling will be obviated. This will, of course, greatly simplify receiver design, and is a point that will at once make a strong appeal to the home-constructor who wants the best possible reproduction with the least amount of trouble in building and operating.

The case for developing four-volt valves rather than abolishing them (the latter course has been strongly advocated in some quarters) is well emphasised by these PM-22 and PM-24 characteristics. It will be noted that while the two-volt valve has a slope of only 1.3 milliamperes per volt, the four-volt valve has 2.3, which means, of course, that it is a very much more efficient amplifier. Moreover, the filament current required by the four-volt valve is only half that needed by the two-volt type—a point worthy of note.

Both valves are available at all radio dealers, the factory agents for Australia being A. Beal Pritchett (Aust.) Ltd., of 17 Parker Street, Sydney.



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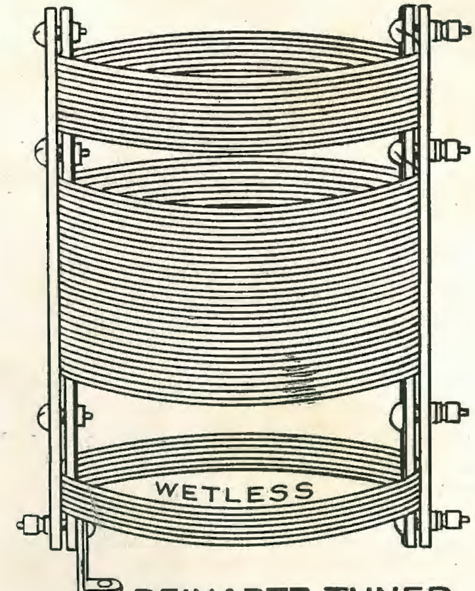

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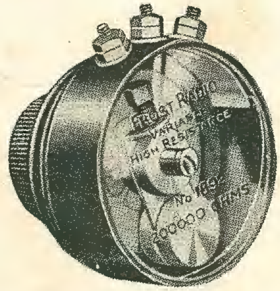

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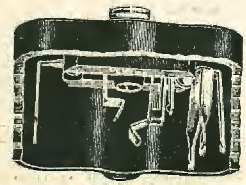

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