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SECOND WEDNESDAY

SIXPENCE

# RADIO

## IN AUSTRALIA & NEW ZEALAND

*Incorporating* "Sea Land and Air"

VOL. I. MAY 30, 1923 No. 5

—"Wide World" Photo.

The smile of a deaf man who hears for the first time through radio receivers.

Registered at G.P.O., Sydney, for transmission by post as a newspaper.



# RADIO
IN AUSTRALIA & NEW ZEALAND
Incorporating "Sea, Land and Air"

Managing Editor: S. E. TATHAM Associate Editor: M. DIXON


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Volume I. MAY 30, 1923 Number 5


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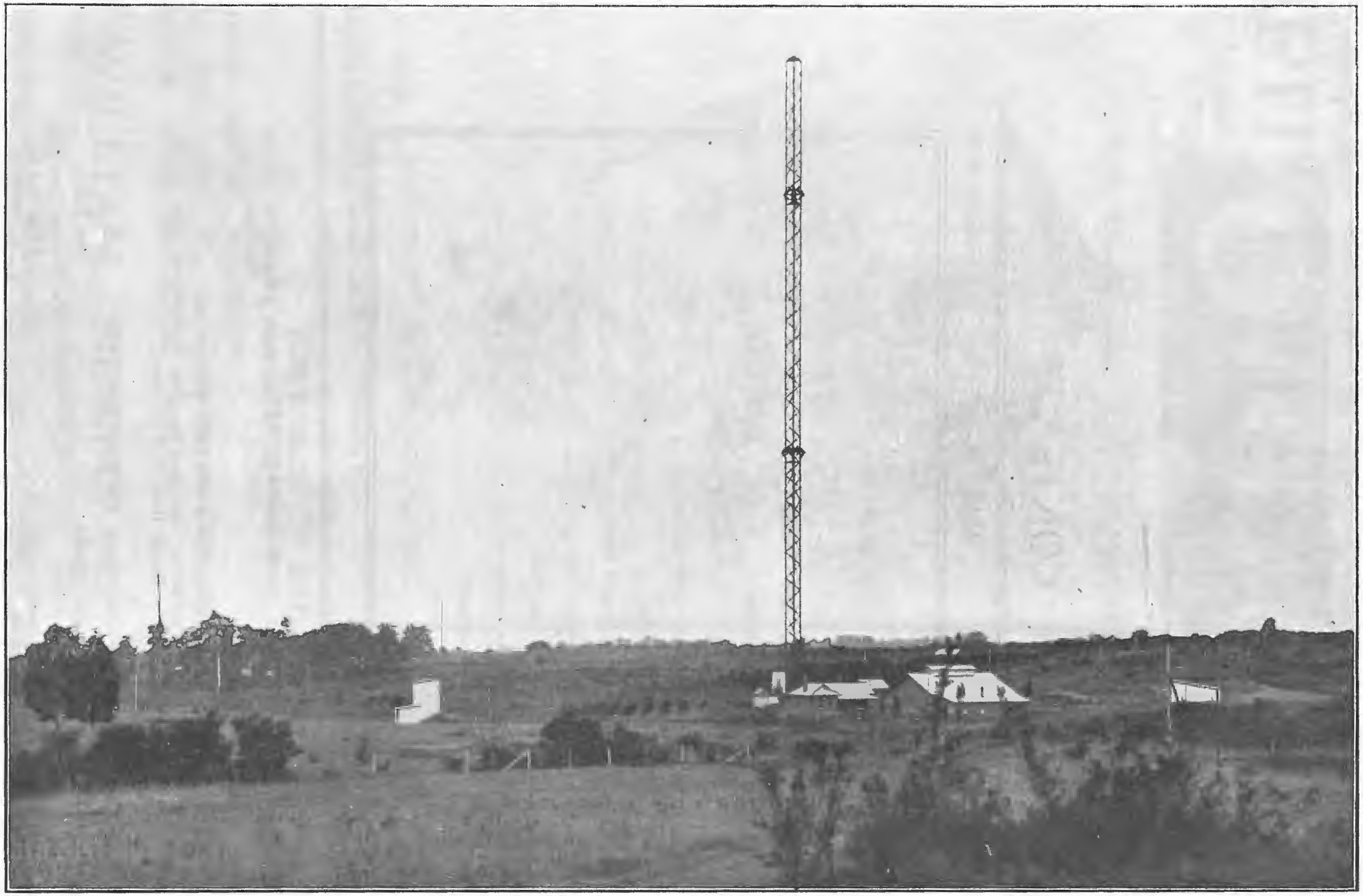


View of Sydney Radio Station at Pennant Hills, showing mast and buildings. The station grounds cover 40 acres.

(See Special Article on page 100.)


## Australian Experimenters Succeed

IT SPEAKS volumes for the skill and enthusiasm of Australian experimenters, and the efficiency of their stations, that wireless signals sent from America on low-power have been received in Australia during the past few weeks.

That one or another experimenter received the signals first may be a matter of individual moment, but from a national viewpoint it is not nearly so important as the fact that the signals *have been received,* and by an Australian.

To prevent interference from experimenters who were not actually taking part in the test it was necessary to preserve secrecy regarding the arrangements. This probably explains the fact that outside of a limited number no mention was made that a private test had been arranged between a well-known Australian experimenter, and one of similar standing in America.

This private test commenced almost simultaneously with the more widely advertised one, and was responsible for the first signal being recorded in Australia. It is a matter for regret that the need for secrecy prevented the public being more fully acquainted with the nature and importance of these long-distance low-power tests. To have advertised them widely would have defeated the very object for which the test was held. It is apparently asking too much of human nature to expect the hundreds of experimenters throughout the various States to suspend part of their activities over a limited period during which a number of men, more highly qualified, are seeking to establish an hitherto unattempted record. Accepting that as the position, the trans-Pacific test had to be conducted under a veil of secrecy which, while regrettable, was necessary.

It is, however, gratifying to know that success was achieved, and there can be no question that in this instance, at least, the end justified the means.

It is probable that a few years hence the receipt of low-power signals over a distance of 7,000 miles will be quite an ordinary event. That, however, will not rob the recent performance of any of its merit. On the contrary, it will enhance it. History teaches that no matter what advances may be made in any particular science or industry, the pioneers who laid the foundation stone upon which later successes were built are the men whose achievements never die.

It says much for the whole-hearted enthusiasm with which experimenters in Australia have applied themselves to the task of receiving low-power signals from their fellow-amateurs in America that such marked success has been achieved at so early a stage in the attempt. There need be no fear regarding the future of radio in Australia when such excellent performances can be pointed to. We have all the material here upon which to work, and he would be a pessimist, indeed, who would hold any doubts regarding the ability of those interested in radio, whether technically or commercially, to make the most of the opportunities which the future unquestionably holds.

## Radio Association of N.S.W.

A COMMENDABLE spirit of enterprise has been shown by the various radio bodies in New South Wales in forming an association to assist the Minister in charge of Wireless in administering the Act to the best interests of all concerned. The point has frequently been stressed that if radio is to reach the peak of its possibilities in Australia there must be the closest co-operation between all who are anxious to see that point reached. In other undertakings we are all too frequently treated to the spectacle of associations being formed which hinder rather than help the future of an enterprise in which they are directly concerned. It may not be that they deliberately set out to work harm, but in the course of destructive criticism harm is nevertheless wrought.

It can be confidently assumed that the Minister will meet the association in the same spirit as it approaches him. Harmony should thus prevail, and the way be paved for the accomplishment of much useful work.

It is no libel on the great body of experimenters in Australia to say that there is a limited number who will always cause sufficient annoyance to provide scope for the activities of the Radio Association. It would be surprising if it were otherwise. Human nature is impulsive and the desire to do things without giving a thought to the possible interference we are causing others frequently leads to transgressions, which, at heart, the offender has no wish or intention to commit. Hence the need for supervision, such as the Radio Association will exercise. In addition to this it will safeguard the legitimate interests of radio experimenters, and so pave the way for smooth and satisfactory working. The immediate and lasting effect of this will be to promote goodwill amongst all concerned, and, incidentally lay a solid foundation for the future of radio in Australia.

# How Sydney Radio Works

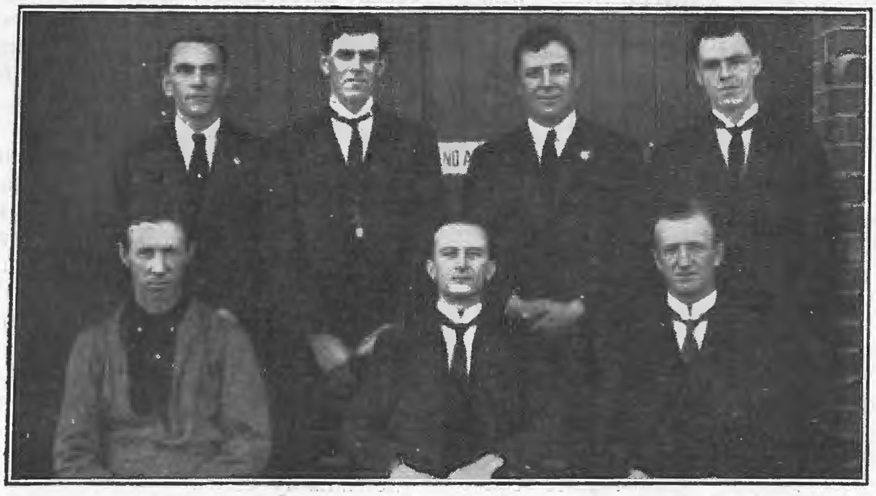
## A Peep Behind the Scenes

### Up-to-Date Station—Efficient Staff

FEW people in Australia and New Zealand are unfamiliar with the name of Sydney Radio. Oversea and inter-State ocean travellers know it well. To them it represents one of the links in the chain of communication along which flash the messages of greeting or farewell, business communications, and in time of trouble the call for help. To the layman it has always been known as Pennant Hills Wireless Station, and as such it will probably remain. The name does not matter greatly, after all, for nothing can rob the station of the credit which justly attaches to it for the consistently splendid service it renders to the shipping and commercial interests of the State.

Those who have had actual experience of the work done by Sydney Radio need nothing further to convince them of the valuable part it is playing in our everyday life. Others know of it only through reading the daily papers, which from time to time feature incidents of outstanding importance in which Sydney Radio figures, but the time has arrived when the "inside" story of the Station and its work must be given to the wide, wide world.

The Radio Station is situated at Carlingford, about 17 miles from Sydney, and stands in grounds covering an area of about 40 acres. One side faces the Pennant Hills road—a thoroughfare well patronised by motorists. The huge steel lattice mast, which towers to a height of 400 feet, is a conspicuous landmark for miles around. Standing in silent and impressive majesty, it dwarfs to insignificance the buildings which stand adjacent, and when we viewed it at close range for the first time we instinctively prepared for the further eye-opening facts and sights which were to follow.



**STAFF OF SYDNEY RADIO.**
Front Row (left to right): J. G. Cookson (Mechanic), G. F. Chilton (Officer in Charge), J. D. Reynolds, Acting First Operator.
Back Row (left to right): W. C. H. Hodges, P. W. Brown, J. R. Clifford, and C. F. Dale.
Messrs. G. H. Brown (Senior Mechanic) and C. E. Lemmon (Chief Operator) were on Leave of Absence at the time the Photo was taken.

A ladder is built inside the mast, and runs to the top, where a small platform is erected. If one has the energy and nerve to climb that ladder to its very peak a wonderful sight is unfolded. On a clear day Sydney Heads stand out quite distinctly, and no matter in which direction one gazes a splendid view is presented. If it were possible to feel sufficiently at home at such a giddy height (it would be necessary to be closely related to the ill-fated "human fly" of America to do so) the intrepid climber might well say: "Not only am I half way to heaven, but I have the world at my feet."

The main mast, or tower, is not fastened in any way at the bottom, but rests on large glass insulators of a special quality and design. This is hard to realise until it is actually seen, particularly when it is remembered that the mast weighs about 50 tons. Heavy iron guys, which are made fast to steel girders in concrete anchorages serve as stays for the mast. These girders do not bear directly against the concrete, but pull against flat glass insulators similar in pattern to, but smaller than those underneath the mast.

From the extreme top of the tower is suspended the aerial system for high-power transmission. There are six legs in this aerial, which is of the "squirrel cage" type, similar to those seen on battleships. The legs of the aerial—three on each side—are supported by steel rope halyards from small ladder masts in the four corners of the station grounds. The feeders for the aerial are also of the "squirrel cage" type, and run almost vertically from a position outside of the operating buildings to the top of the mast. The whole system resembles a huge umbrella, and it has a very neat and symmetrical appearance, owing to the spreader discs inserted every few feet to keep the wires evenly spaced and taut throughout their length. During last August this aerial was used for the transmission of press messages to ships at sea, and the *Niagara,* en route to Vancouver, received the messages from this station each day until two days north of Honolulu, when transmission ceased.

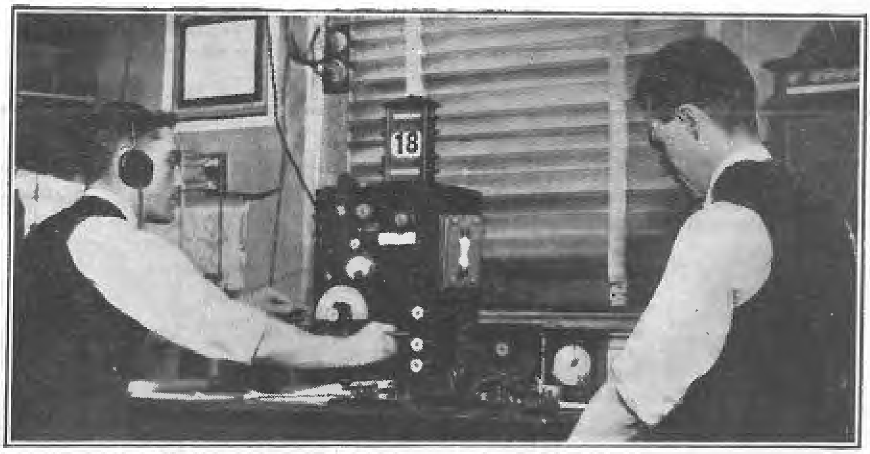
Just above the first section of the mast at a height of about 150 feet from the ground is suspended the "T"-shaped aerial which is used for communication with ships at sea on wave lengths of 450 and 600 metres. In comparison with the larger system this aerial appears very small, and, indeed, it is relatively so compared with some used elsewhere for the same purpose. Nevertheless, it is very efficient, and communication has been established at various times, when using this aerial at distances over 4000 miles.

Sydney Radio is probably the busiest station in the Southern Hemisphere used for communicating with ships at sea. A similar station is erected at Applecross, W.A., a small settlement on the banks of the Swan

**High Tension Room VIS. In the foreground are six banks of sixteen "quenched" gaps in each. In the background the Leyden Jar Condensers (12,000 cms each), with provision for using a number of series—parallel groups, according to power used. To the right the 35 K.W. transformer, and behind it the 5 K.W. transformer, with switch (controlled from operating room), for changing from low-power to buzzer; a glimpse of the latter is seen between Leyden Jars and small transformer. The bottom ends of coupling and variometer helices are seen at top of photograph.**

River, close to Perth. The traffic handled by these two stations runs into many thousands of words per annum, and the operators at both stations must needs be experienced men skilled in both Radio and Landline telegraphy.

After we had a good look over the grounds, and tried to summon up sufficient courage to climb the mast, we were taken in hand by Mr. G. F. Chilton, officer in charge, and conducted to the engine-room, a large building standing some yards apart from the operating quarters. A



**Main Operating Room VIS Operator on left (Mr. Hodges) is seen "tuning in." Special Receiver has a range of from 300 to 14,000 metres. The well-known Expanse "B" is being used for reception. On the right is Mr. Dale despatching radios received from ships by telegraph to the G.P.O. for delivery. During certain periods of rush traffic two operators are on duty together. The four manual keys on operating table from left to right are high-power key (operating relay key), low-power key, telegraph key, and buzzer key.**

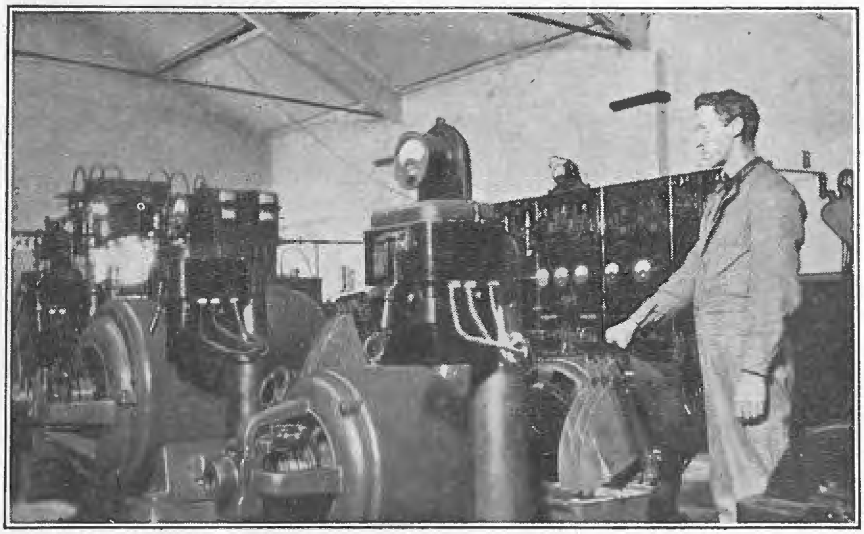
notice board hanging on a cage-like screen just inside the engine-room sliding-doors with the significant word "Danger" thereon first met our eyes, but we were assured that such a warning was necessary only to the uninitiated. Inside the cage is housed the H.T. Transmission gear, consisting of the oil switches built in brick cubicles, transformers, and other apparatus for reducing the 6000 volts 25 cycle 3 phase current from the N.S.W. Railways sub-station at Clyde to a pressure of 440 volts for driving the various electrical machines.

Outside the cage is the switchboard with Voltmeters, Ammeters, Wattmeters, Time-limit overload relays, oil switch levers, and main switches for distributing the 440 volts to the various circuits. Close to, and at right angles to this switchboard, and running almost the entire length of the engine-room is the controlling switchboard for operating the different machines. This board is a magnificent piece of work, and consists of five panels, on which are mounted voltmeters, ammeters, circuit-breakers and rheostats. Side by side, and facing their respective panels, are, first, two large motor generators made by G. Weymouth Pty., Melbourne. These machines are duplicates—each set consisting of a 100 h.p. 440 volt 3 phase induction motor, direct-coupled to a 60 K.W. 800 volt D.C. generator. The third set, also supplied by Weymouths, is a motor-generator—a 20 h.p. 440 volt induction motor direct-coupled to a 12 K.W. 100 volt D.C. generator. This set is used for charging the 100 volt 600 ampere-hour set of Tudor accumulators from which the low-power machinery is operated. Facing the motor end of each machine is its respective starting pillar and water resistance starter.

At right angles to this charging set is first the motor-alternator set which supplies single-phase at 400 cycles for low-power spark transmission. This unit consists of a G.E. 4.5 h.p. D.C. motor direct-coupled to a Weymouth 2.K.W. 400 cycle alternator. Alongside this unit is a D.C. Motor-Generator set, made by the Randwick Wireless and Electrical Works. It consists of a 10 h.p. 100 volt D.C. motor direct-coupled to a 7 K.W. 460 volt generator. This set is used for supplying D.C. to the low-power arc set. The Tudor accumulators supply the power for driving either of these machines, and both are stopped and started from the operating room by means of the automatic starter on subsidiary switchboard on their right. The solenoid for operating the starter handle is actuated by the operator closing a small switch in operating room. A dash pot exercises an antagonistic pull against the attracting force of solenoid, and so ensures an even motion. The solenoid is necessarily subjected to a heavy current for a few seconds, until the handle is full on, by which time a spring contact is forced open, thereby inserting a lamp in series with the solenoid, and enabling it to remain in circuit for an indefinite period without risk of burning out. The starter arm, once in position, also closes the blocking relays and other protective devices, so that the machine cannot be subjected to load until at full speed.

The last set on this end of the engine-room is a 20 h.p. Maritime Internal Combustion engine direct-coupled to a 11 K.W. D.C. Generator. This engine is started on benzine, and by an ingenious arrangement can be run on kerosene after a minute's running. This is an auxiliary charging unit, and can be started up within a few minutes for charging the accumulators, thus making the station independent of a breakdown in power supply. The station is thus able to communicate with ships at sea, despite strikes, lockouts or other industrial troubles.

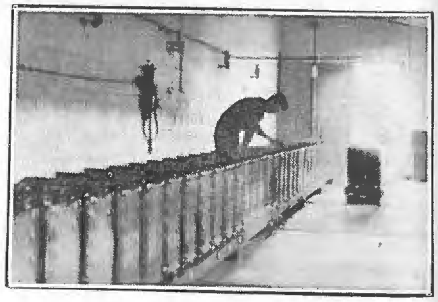
On the other side of the engine-room, and occupying almost the whole length is the 35 K.V.A., A.E.G. Alternator, belt driven by a 75 h.p. 4 cylinder Gardner Kerosene engine, or alternatively by a G.E.C. 60 h.p. 3 phase induction motor. The starting pillar and water resistance starter for the latter are facing the motor end. The alterantor can be driven by either engine or motor within a few minutes by simply changing the belts. Thus, as in the case of the smaller set, a strike or a breakdown in power supply would not prevent high-power transmission from being carried out. The Gardner engine is started by compressed air, and at the end of the shaft is a fast and loose pulley arrangement for driving a small air compressor to feed air reservoir after each start. This set is used for high-power spark transmission.



**Engine Room and Power House VIS shows Mechanic (Mr. Cookson) starting up 12 K.W. Weymouth Generating Set. The two Machines to the left are 60 K.W. Weymouth Motor Generator Sets. To the right is the main D. C. Switchboard. In the background, marked "Danger," is the High Tension Supply Cage wherein is contained the transformers, etc., converting 6000 volts 3 phase 25 cycle to 440 volts for use with high-power machines.**

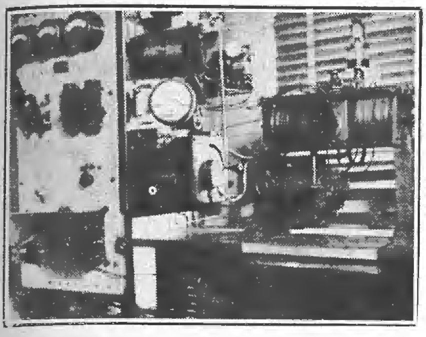
Before passing out of the engine-room attention was attracted by another switchboard, on top of which was a frequency meter. This indicates the frequency in cycles delivered by the alternator, and is operated by an eccentric piece of iron on the end of the alternator shaft. The revolutions of the eccentric cause fluctuations in the magnetic field of a small solenoid close to it, and the resultant pulsations are conveyed to the interior of the instrument, and caused to act inductively on a series of small reeds, each of which has a definite natural period of vibration. The frequency corresponding to each reed is marked in regular progression on a horizontal scale, above which is a longitudinal aperture through which each reed is plainly visible. When the frequency coincides (allowing for a factor, of course) with each reed according to the speed of the alternator, these reeds vibrate, and a demonstration which was given afforded a clear illustration, and showed how sensitive and reliable the instrument is, and how the engineer is able to control the frequency to a nicety, a vital point in this system of spark transmission. Queer, bottle-shaped standards, which were lying close to this board, turned out to be bottle screw-jacks, used for raising the mast, if necessary, to replace or renew the glass insulators underneath the mast. One is inserted under each of the three legs of the huge mast, concrete pillars being built at the correct height for the purpose, and by using long spanners on each of these jacks the mast can be raised.

Next we looked over the battery-room, adjoining the engine-room, where two rows of double Tudor cells (50 in all), making a 100 volt set, are symmetrically arranged, with both sides of each row easily accessible for inspection or repair. This set was installed in 1913, and to the credit of those responsible for its upkeep, is still in first-class condition, and by no means exhausted. In a shed adjoining this room is the plant for distilling water, it being necessary to add pure water to the accumulators from time to time to compensate for evaporation.



**100 Volt Storage Battery, 650 ampere hour capacity. Type J18 Tudor cells. This battery supplies power for all the low-power machines and equipment, and the lighting system for the station buildings and staff's quarters. Installed 1913. Mechanic is seen taking readings after charge.**

The last portion of the engine-room building is a workshop and store. Here are stored the various spare parts for renewing the different apparatus. The ticking of a telegraph sounder aroused curiosity, and it was explained that a local practising set was being operated from the main



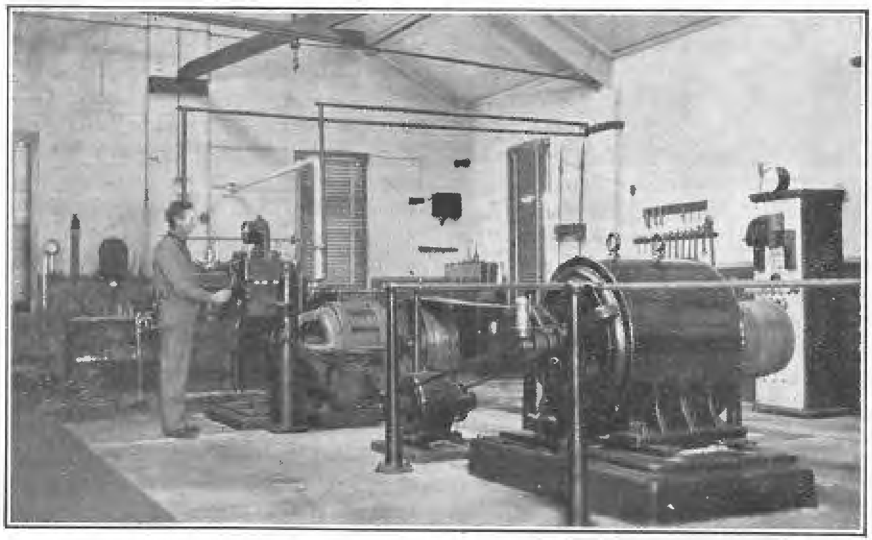
**Auxiliary Operating Room VIS 3 K.W. arc transmitter on right. Central panel on left for regulating speed of generator and output. Just underneath the radiation meter is the starting resistance which also connects up relay key, solenoid for methylated bon, and pump for water circulation, spirits drip, motor for revolving carand on last contact has connected arc to aerial.**

telegraph instrument by the mechanics during lunch hour. The senior mechanic already holds his first-class certificate as operator, and the other mechanic is going strong with the same end in view.

Passing out of the engine-room we entered the operating building, which is divided into three rooms. At one end of the adjoining verandah is the O.I.C.'s office, and at the other end a bathroom. The first room contains the 3. K. W. Arc transmitter, and a receiving panel for use in conjunction therewith. This set can be started up in a few minutes, and has a range of several thousand miles. The manual key operates a relay, which, when the key is depressed, connects the arc circuit to the aerial, and when released, to an artificial circuit having the same period as "aerial and earth." This method of signalling is sometimes known as the "back shunt system," and when transmitting by same the "marking wave" only is radiated, and the "back wash," or spacing wave, usually characteristic of the arc system, and sometimes found difficult to tune out, is absent. A spacing coil is provided, and can be connected up in a few minutes if desired. A small variometer in the aerial circuit, the variation of which makes a small change in the emitted wave length, is used to form a kind of "attention" signal at the receiving station by a heterodyne effect in case the receiving station is not tuned exactly to the proper adjustment. Alongside the arc set is the controlling switchboard for same with meter circuit-breaker, etc. Before leaving this room we were shown the starting device, which by reducing starting resistance after "striking the arc" finally on the "out" position, disconnects the receiver and connects the aerial to arc circuit. The receiving panel on the right of the arc transmitter has a tuning range from 250 metres to 18,000 metres, and it performed excellent work during the war in regularly intercepting signals from European, Asiatic and American stations.

The next and middle room is the main operating office where the operator is kept busy exchanging traffic with ships. The switchboard on the left hand side is for controlling the high-power transmission, and is fitted with main switch blocking relays, occupying a prominent position. This receiver does excellent work, and communication with ocean-going vessels, particularly the *Niagara, Tahiti,* and other trans-Pacific ships has been maintained up to distances of 4000 miles. Night after night traffic is exchanged with ships over a thousand miles distant, whilst the reception of signals from ship stations west of Perth is a common occurrence. Recently signals were received clearly from the *Sophocles* when that vessel was 3500 miles distant. To the left and just above the operator is the radiation meter, and just below same is a handle for changing from low-power spark to buzzer transmission, the latter being used for working ships at close range. Close to this is the telegraph sounder, and on the operating table to the right of the operator are the manual keys. First the key operating high-power relay key, the telegraph key, lower-power key, then key for operating buzzer transmitter. In a convenient position just above the table on the left is the send-receive switch handle, which opens and closes the transmitting circuit, and on the table near same is the voltmeters, ammeters, fuses, etc., for D.C. and A.C. circuits.

On the operating room table is the valve receiver, with a range of from 400 to 14,000 metres, and the well-known "Expanse B" Valve is seen switch for closing the automatic starter circuit in the engine-room. The send-receive switch also closes one side of the transformer primary in addition to closing the transmitting circuit and opening the receiver circuit, but



**Engine Room and Power House VIS. Shows 35 K.V.A. Alternator, 500 cycle, separately excited and belt-driven by 60 h.p. 3 phase G.E.C. motor. Mechanic is at starting pillar. To the right is the switchboard with main supply switch, frequency meter and H.F. protectors. In the background is 75 h.p. 4 cylinder Gardner engine, an auxiliary for driving alternator in case of power supply being cut off. This is the generating set used for high-power transmission.**

the latter is further protected by means of a small micrometer gap across aerial and earth leads.

Everything is arranged for rapid and reliable working, and to see the set in operation convinces one that communication with mobile stations, such as ships at sea, has, indeed, reached a high standard. A message is lodged at any post office in Australia, and if the ship for which it is intended is in touch with Sydney Radio the message passes over the land line, and is received by the operator on duty there, who must, of necessity, be a skilled telegraphist, in addition to being qualified as a radio man. Whilst inspecting the operating room the telegraph instrument commenced clicking, and instantly the operator started writing rapidly. The sounds would be meaningless to the uninitiated, but to the operator they represented a message of perhaps vital importance. A second after the message is received the operator half-wheels in his chair, pulls a lever, moves a switch, and presses the sending key. A series of muffled squeaks distinguishable to the initiated as dots and dashes, discloses that a message is being sent to one of the Australian ships. A moment later the ship responds, and gave the "go ahead" signal. The vessel was the *Ulimaroa*, a day out from Auckland. The message transmitted to her came over the land line from somewhere in West Australia, and was addressed to a passenger on the ship. One wonders if the recipient was able to visualise the route traversed by his message. First it was flashed over the trans-continental telegraph line, thence through the post offices in the various capital cities to Sydney Radio, from where, in a fraction of a second, it was transmitted to the ship. To the operator it was all part of the day's work, but to onlookers it provided food for wonder and admiration.

From the operating room we were conducted to the high-tension room, so called because everything there is subjected to high voltage. We were first shown the transformers, in which the voltage is stepped up in the ratio of perhaps 100 to 1—that is, to the alternating current supplied by the respective machines in the engine-room, whence it is conducted through underground cables. It is then passed through the primary windings of transformers, at, say, 200 volts, and is delivered from the secondary terminals at, say, 20,000 volts. The need for good insulation is aptly illustrated by the large porcelain pillars on the top of the transformer. This voltage is applied to the leyden jar condensers arranged in banks of six series-parallel. Only three such banks are used for low power, but the whole system is put in circuit for high-power transmission. The spark gaps of the "quenched" type are arranged on racks in six banks of sixteen each, and underneath the racks are motor-blowers for cooling the gaps when on high power. Immediately above the gaps are the helices for tuning and coupling, and also the variometers, provision being made to change to various wave lengths very quickly by simply plugging into certain sockets marked with the corresponding wave length. By means of a pulley control from the operating room the coupling can be varied, and fine adjustments made in aerial tuning to correct the wave length and effect the best transmission. A change from the normal wave length, 600 metres, to several other wave lengths up to 2,500 metres can be made in a few moments.

The send-receive switch, magnetic relay for closing transformer circuit, and low frequency chokes are in one corner of the room, and close to them are the relay keys operating high power. In another corner of the room is the small rotary buzzer transmitter, and also the low-power transformer.

Sydney Radio holds a rather unique receiving record in having a long-distance transmitting range. When the present officer in charge was previously at this station—from 1912 to 1915—as senior operator, he intercepted a message from the *Australia*—a German cargo boat—at a distance of 4190 miles west of Sydney. In those days valves were unknown, and the signals were received on a crystal. So far as is known, this was the world's record for low-power spark reception on 600 metres, and we have not heard of it having been beaten. In these days of valve reception, especially with multi-stage audio and radio amplification, such distances may not be regarded as unique, but the incident mentioned serves to show that a crystal receiver intelligently operated is not to be despised.

Before leaving the Station we were shown over the quarters provided for the staff, these being situated at the top of the station grounds facing the road. Each house is comfortable, and contains all possible conveniences, including electric light, which is supplied by the station battery. Each occupant has a telephone connected to a miniature switchboard in the operating room, and the whole arrangement makes for comfort and convenience.

Readers of this article who know Sydney Radio by reputation will, henceforth, have a new conception of the Station and its work. The thousands of amateurs who hear VIS working every night will unquestionably be glad to learn something of the equipment of the station, which to them, represents the highest standard of efficiency, so far as N.S.W. is concerned at the present time.

# Radio and Reflex Amplification

By JOSEPH G. REED
(Radio Engineer)

IN the days before radio telephony and short wave low power C.W. transmitters were brought to the state of efficiency of to-day, the experimenter was content to do most of his work with one valve, and if necessary to make the signals nicely readable in the telephones to use at the most one stage of audio frequency amplification.

During the writer's first experiments in connection with audio and radio frequency amplification the only valve available on the experimental market was the "soft" Oscillaudion and Audiotron. When the correct adjustments, which meant separate high tension batteries, and individual grid potential and filament current control were found, excellent results could be obtained. Within the last few years the three electrode valve has been improved greatly, and with the modern hard type the stability is such as to allow the operation of multi-stage amplifiers both for audio and radio frequency currents with the minimum of associated regulating apparatus.

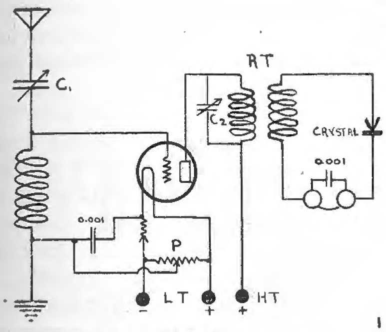



Fig. 1.

After once having used the hard valve in the role of an amplifier, the writer would not willingly use a soft one again.

The regenerative valve receiver in which the grid and plate circuits are coupled either inductively or electrostatically to make the valve oscillate, gives rise to radio frequency amplification within the valve itself, and for the reception of moderately strong signals is quite satisfactory. This regeneration causes a decrease in the effective resistance of the valve oscillatory circuits, and because of this lowering of decrement, makes the tuner very selective when adjusted near to the point of oscillation. For the reception of telegraph signals this is a great advantage, but for telephony distortion becomes apparent as soon as the reaction is increased above a certain point. It will be noticed that as the reaction coil coupling is increased the signals increase in strength, but at the same time lose some of their original clearness and seem to hang on with a bell-like effect. The reason for this is that the wave train persists after the initial oscillation has died away, and in the case of speech and music where the wave form is forever varying in a most complex manner, any electrical inertia will give rise to distortion. To overcome this and obtain an excellent purity of tone, radio frequency amplification by means of separate valves should be used.

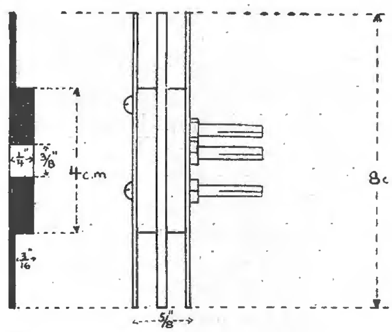



Fig. 2a.

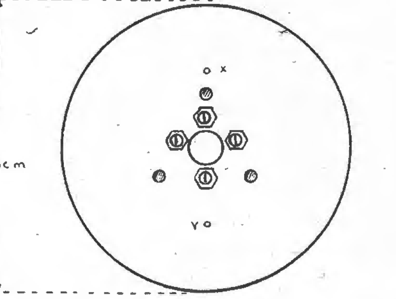
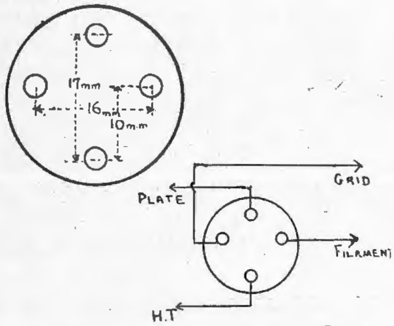


Fig. 2b.

A very simple form of radio amplifier is shown in Fig. 1. In the plate circuit of the valve is connected an air core transformer "RT," which when tuned to the same frequency as the incoming wave, passes the amplified energy on to the detector "D" which in this case is an aperiodic coupled crystal detector. It is well worth the trouble to experiment with a crystal as a detector in place of the usual valve, because of its excellent rectifying property, and freedom from distortion. The circuit is adjusted as follows: Connect up a buzzer and dry cell near the crystal detector circuit, and adjust the latter in the orthodox manner by poking around on the surface of the crystal with the cat-whisker until the loudest sound is heard in the telephones, and then tune the aerial and plate circuits to resonance with the desired wave by means of the condensers $C_1$ and $C_2$ respectively. This will cause the valve to break into oscillation; the symptoms being a dull click in the telephone receivers whenever the oscillations start or stop, and in addition the usual clear-cut crackling of static will change to a smoother and more persistent noise somewhat like that produced when steam is commencing to escape from a valve. It has been assumed that the potentiometer "P" has been kept towards the negative end during these adjustments. As soon as a signal is heard turn the potentiometer gradually towards the other end, and the oscillating of the valve will cease. The reason for this is that the grid has been made slightly positive, and the decrement of the circuit increased to such an extent that the excess energy generated by the internal reaction of the valve is dissipated. In place of the crystal detector a valve can be used, but this application will be deferred for a while until the design and construction of radio frequency transformers have been dealt with.

The range of wavelengths experienced in connection with experimental radio work covers a fairly wide band, to wit, 150 to 25,000 metres. As in the case of the primary and secondary tuning units, this will necessitate the use of a number of transformers, each covering a small band and overlapping slightly to provide continuous tuning from the lowest to the highest wave length, The function of the transformer is to extract the maximum amount of energy from the plate circuit of the amplifying valve, and transfer it with the highest efficiency to the detector or other apparatus connected to the secondary winding. If the impedance of the primary winding could be made of infinite value, it would enable a one hundred per cent. transfer of the amplified signal current, but as all windings possess resistance to some degree, this theoretical maximum is not possible of attainment. The tuned anode circuit consists of a parallel combination of inductance and capacity, and when tuned to resonance with an alternating current which is being passed through it acts like a very high impedance. This impedance varies directly proportion to the inductance, and inversely as the product of the Resistance and capacity. Expressed as a formula, $R_1 = L/CR_0$, where $R_1$ = the impedance in ohms at resonance, L=the inductance in henries, C = the capacity in farads, and $R_0$ = the ohmic resistance to a direct current. It will be seen that for a given frequency—assuming the resistance to remain constant—the impedance is directly proportional to the square of the inductance. As a result of practical experimentation it has been found that for short wave work up to about 1000 metres, a shunt condenser of not more than 0.0005 micro-farads should be used, but for the longer band of wavelengths up to 25,000 metres the effect of additional capacity is not so noticeable, and a condensor of 0.001 microfarads is allowable.




Figs. 3 and 4.

In most radio frequency transformers on the experimental market the gauge of wire used and the physical dimensions are very small with the result that the ohmic resistance is high and the effective impedance is lowered. The writer has carried out considerable experimentation with various types of radio frequency transformers and has found none to equal those built after the following design.

The former is constructed from hard rubber sheet, and can be either turned out from a solid piece five-eighths of an inch thick to the dimensions given in Fig. 2, or built up in sections from two ¼ and one ⅛ inch discs. The latter method is to be preferred—although it is a longer job as regards the machine work required—because of the ease with which the winding spaces can be turned exactly to size and finished off smooth. From a piece of ¼ inch hard rubber cut out two squares 8.5 centimetres square, and with a pair of dividers mark off two concentric circles of 8 and 4 centimetres for a guide when turning the disc in the lathe. A mandrel with a ⅜ inch shaft was available for the purpose of holding the ebonite in the lathe chuck, therefore a ⅜ inch hole was drilled through the centre to accommodate it. After the disc has been turned circular proceed to take off sufficient material to give it the shape shown in Fig. 2a. A separation disc is turned out of ⅛ inch material to the same diameter. When turning the shape in Fig. 2a it is well to have something solid such as a piece of wood or a solid ¼ inch disc at the back as a support or the thin flange will spring away from the lathe tool and very likely cause damage to the piece being turned. When these three discs are screwed together the former is complete. For connection to the windings, four terminals can be provided which are screwed into the solid centre of the former, or for greater ease in interchanging the transformers when different wave-lengths have to be tuned in, four split pins can be fitted in the same position as those used on the sockets of standard "R" valves. The relative position of these pins is given in Fig. 3. For each transformer four brass pins ⅛ inch in diameter and one and a half inches long are used. These are threaded for ¾ inch with a ⅛ inch Whitworth thread, and a brass hexagonal nut run on as shown in Fig. 2. The other end is slotted for half an inch with a saw blade $\frac{1}{32}$ of an inch wide. The writer fitted up a small circular saw in a lathe for this, but if a suitable sawing attachment is not available it is hardly worth the trouble to do it this way, as a hack saw will do the job quite as well as if used with care and a straight cut made. Three round head brass machine screws spaced 120 degrees each are used to hold the three sections together. Clearance holes 9/64 of an inch are provided for these screws in one side piece and the centre, while the other is tapped with a ⅛ inch thread. The slotted brass pins pass through the former in the opposite direction to these screws as shown in Fig. 2. This doubly strengthens the construction of the whole outfit. To accurately locate the holes and make sure that those in the component parts will be in alignment, make a template from a piece of $\frac{1}{16}$ inch brass or iron sheet, and use it for spotting the positions where they are to be drilled. This will save a lot of trouble later on when assembling is commenced. When the formers have been assembled with the exception o the contact pins, they are ready to be mounted on the mandrel and winding begun.

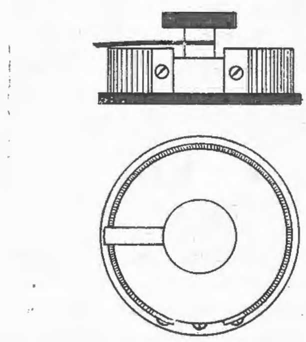


Fig. 5.

The primary winding is wound on the side nearest to that where the contact pins are fitted, and for the lead in and out wires drill a 3/64 inch hole opposite those used for the grid and plate connection in the case of a valve socket. The location of these holes is given in Fig. 2, and they must enter at the bottom of the winding space. Before the wire is put on

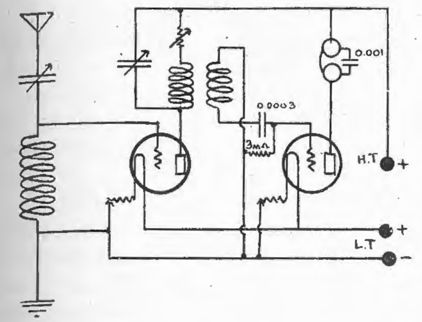



Fig. 6.

a lead must be run through the hole "x" to connect to the outside portion of the winding. This wire must be double cotton insulated and impregnated with paraffin wax to guard against the remainder of the winding forcing through part of the insulator and causing a short circuit. It is led up the side of the former, and tied back out of the way while the winding is in progress. So that it will not cause a bulge in the winding where it passes up the side it is a good plan to file a very shallow groove along the inside of the former and stick the wire in place with a little wax. The lead out wires must not be smaller than No. 26 d.c.c. owing to the likelihood of mechanical injury to smaller gauges if the transformer is thrown about on the operating table. Insulate the joint between the main winding and the lead out wire with a piece of oiled silk or waxed paper, and cut off the sharp pieces of solder and wire which are liable to project through the insulation and cause short circuits with the other wires. For the output winding which is put on the other slot the lead in and out holes are placed opposite the other two pins and the connecting wires brought through the hole provided for the mandrel, and soldered in place. Now to proceed with the windings. These must all be put on in the same direction to obtain uniformity of action as regards coupling when different coils are used. The windings are as follows:

| Coil | Range | Turns | Gauge | Inductance |
|---|---|---|---|---|
| A | 200- 500m. | 50 | 26 d.c.c. | 100 m.h. |
| B | 500- 1,500m. | 150 | 30 d.c.c. | 900 m.h. |
| C | 1,000- 3,000m. | 300 | 30 d.s.c. | 3,500 m.h. |
| D | 2,500- 7,500m. | 600 | 32 s.s.c. | 14,000 m.h. |
| E | 5,000-15,000m. | 1,250 | 40 s.s.c. | 65,000 m.h. |
| F | 10,000-30,000m. | 2,500 | 42 s.s.c. | 250,000 m.h. |

The turns and inductance specified are or each winding—two being put on for the primary and secondary with the outside terminals going to the plate and grid respectively. A tuning condenser with a minimum of 50 and a maximum of 1000 micro-microfarads was used to obtain the ranges in the above table.

To guard against the possibility of sulphur compounds in the hard rubber former acting upon the copper wire of the finer windings and causing subsequent open circuits the wire on its original bobbin should be boiled in hot paraffin wax until all bubbles cease to rise, and then drained thoroughly to remove the excess wax.

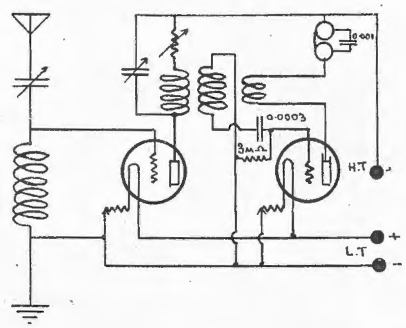



Fig. 7.

When winding the wire on the former run it through a small piece of cloth held in the fingers to rub off any pieces of wax which may have solidified on it. The wax treatment also improves the insulation, and the coils do not become unstable in humid weather owing to moisture condensing in the windings.

On the amplifier panel mount a standard socket, as used for an "R" valve, and connect it up to the circuit as in Fig. 4. Take care that the pins connected to the outside turns of the primary and secondary enter the sockets connected to the plate and grid or crystal respectively.

The usual method of controlling the self oscillating property of the valve when the plate circuit is tuned to resonance with the received wave is to apply a slight positive potential to the grids of the amplifier valves. This is quite satisfactory when the valve acts as a radio frequency amplifier only, but when it is called upon to work in the dual role of a radio and audio amplifier in the reflex connection to be described later, the distortion and loss of signal strength caused by the conducting grid-filament path becomes a serious matter.

These self oscillations can be controlled without resource to the inefficient positive grid potential by connecting in series with the transformer primary winding, a variable resistance of about 250 to 500 ohms as described in the article on "The Trans-Pacific Tests" in the No. 2 issue of Radio. This resistance can be easily constructed as follows:—Obtain a piece of $\frac{1}{8}$ inch fibre, one inch wide and nine inches long and commencing half an inch from the end wind on closely a single layer of silk covered Eureka wire of No. 36 gauge. Bend this around and screw it to a three inch circular wooden block similar to those used for mounting ceiling roses in electric light work as in Fig. 5. In the centre of the block mount a rotary switch which is capable of making contact with the wire. With a piece of very fine sand paper remove the silk insulation on the top portion of the wire where the switch arm makes contact, and when all is ready a layer of thick shellack varnish brushed on the outside holds it in place and prevents movement due to the raking action of the rotary contact. Be careful and do not allow the varnish to get on

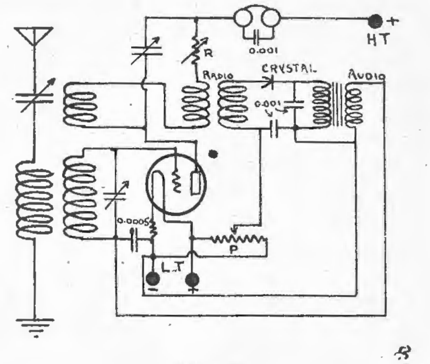



Fig. 8.

the bare portion of the wire. The 36 inch gauge winding will provide a resistance unit of approximately 600 ohms, and if other sizes of wire are used the following values of resistance may be expected. No. 26, 70 ohms; No. 30, 180 ohms; No. 40, 2000 ohms.

A circuit employing two valves making use of this method of oscillation control is given in Fig. 6. The operation of more than two valves in a tuned radio frequency circuit, while possible from a technical standpoint and when it is desired to concentrate on one narrow band of wavelength, is a tedious job owing to the multiplicity of control necessary, and the inter-action of the components. If multi-valve amplification is desired, however, the additional valves can be connected ahead of No. 1 in Fig. 6, when the secondary of the radio frequency transformer of the preceding valve takes the place of the coil and condenser S and C.

No tuning of the secondary winding is necessary because of the tight coupling employed.

To obtain local oscillations without radiation of energy, connect up the apparatus as in Fig. 7. Here the reaction coupling is made to the radio frequency transformer instead of the secondary winding of the receiver as is the usual practice. Local oscillations are confined to the detector circuit, and are unable to excite the aerial owing to the unilateral conductivity of the amplifier valve.

The operation of a radio frequency amplifier produces less disturbance in the telephone receivers due to local battery fluctuations and electric light induction picked up by the aerial, owing to the selectivity of the tuned primary winding of the inter-valve radio transformer. The impedance offered to currents of audio frequency is very small, and is insufficient to transfer any appreciable energy to the following circuit. Its value is equal to the geometric sum of the ohmic resistance and the inductive reactance. This property of the radio frequency transformer is made use of in the Reflex circuit, which will now be described.

The simplest combination is that employing a single valve as an amplifier and a crystal as a detector as in Fig. 8. In the place of the telephone receivers in the crystal detector circuit the primary winding of an intervalve audio frequency transformer is connected. Complete details of how to construct a suitable transformer for intervalve and telephone work were given in the January issue of *Sea Land and Air*, but for those new readers who may not have this information available, the more important details are as follows:—Bobbin, $\frac{1}{2}$ inch internal diameter for the core; end flanges, $1\frac{3}{4}$ in. diameter $3\frac{1}{2}$ inches apart. Primary winding 10,000 turns of No. 44 Beldenamel wire, and secondary 40,000 turns of similar wire. The resistances are approximately 2000 ohms and 9600 ohms respectively. The telephone transformer has a secondary winding of 10,000 turns of No. 40 Beldenamel (resistance 1000 ohms). Reflex amplification of the audio component of the signal is secured by connecting the secondary of the transformer to the grid circuit of the valve where shown. Across the winding is placed a small radio frequency by-pass condenser of not more than 0.0005 micro-farads, to carry the high frequency signal currents which enter the valve for radio amplification. Note well the connection of the transformer winding to the negative end of the filament battery and the inclusion of the filament resistance in the negative leg of the filament wiring. This enables a negative potential equal to the voltage drop across this resistance to be impressed on the grid of the valve. The remarkable effect of this slight negative potential is made very apparent if the connections are reversed and a positive potential applied. Almost all crystals are improved in their operation by the passage of a slight current through them from a potentiometer. No additional battery will be required for this purpose if the connection shown in Fig. 8 is employed. For additional reaction where that due to the inter-electrode effect is insufficient, the tickler coil "T" is connected in series with the primary winding of the radio transformer. If used in a reverse direction, the negative reaction obtained can be made to control the self-oscillating property of the valve on the shorter wavelengths. The telephone receivers are connected in the plate circuit of the amplifying valve, and pick up the audio frequency component of the plate current, while the radio frequency fluctuations pass through the by-pass condenser C. A valve can be used as a detector in place of the crystal, but if two valves are available it is better to employ them in what is known as the inverse reflex connection, whereby both act as combined radio and audio frequency amplifiers, and in conjunction with the crystal detector amplification equivalent to two stages of radio and two stages of audio are obtained. In the usual reflex connection for several valves the rectified audio currents are fed back into the first valve for reamplification with the result that the second valve is over-loaded in that it has to handle fairly strong radio and audio currents. An equal load is placed on each by the employment of the connections shown in Fig. 9. The secondary of the iron core detector transformer is connected to the grid circuit of the second valve, and the amplified signal from the latter is then handed over to the first valve for attention. The telephone receivers are connected in the plate circuit of the first valve. In addition to equalising the load on the valves, this connection has the advantage of only giving one stage of audio amplification to any stray disturbance or induction which the tuning windings may pick up. The radio frequency transformers act as barriers against the low frequency impulses and confine them to one valve. The use of single circuit tuners is not satisfactory with this type of circuit, as will

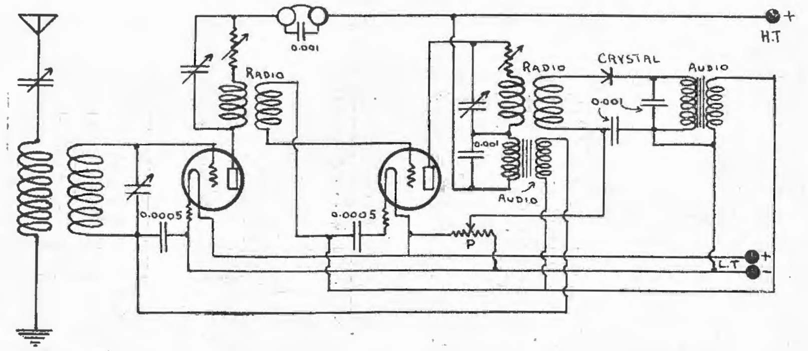



Fig. 9.

(*Continued on Page* 120.)

# Commonwealth Controller of Wireless

## Mr. Malone's Distinguished Career

IT MAY be confidently asserted that there is not one out of the thousands of experimenters in Australia to-day who is not familiar with the name of the Controller of Wireless (Mr. J. Malone).

To many of them he is known personally, and all who can claim his acquaintance are unanimous in the opinion that no better man could have been chosen for the important and responsible position which he now fills.

Mr. Malone possesses an accurate and sympathetic understanding of the many problems with which at times he is faced.

Those who know the volume of work he is called upon to perform are able to appreciate the difficulties he is frequently up against. It is only reasonable to expect that the administration of an Act dealing with such a new and technical subject as wireless should present many difficulties at the outset. That these difficulties have not been greater is a tribute to Mr. Malone's ability as an administrator, and the sterling service rendered by his assistants and deputies in the various States.

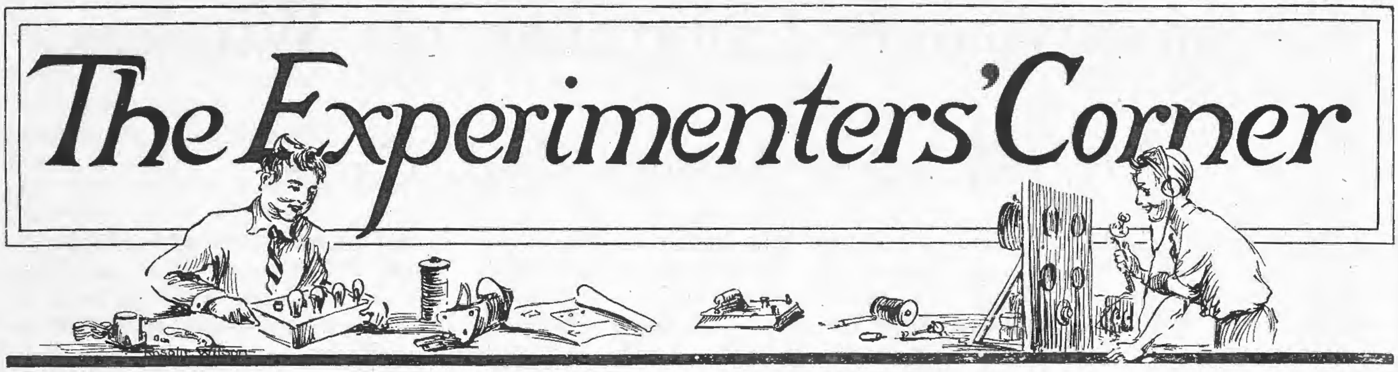
A brief sketch of Mr. Malone's career appears herewith, and it affords convincing proof that by temperament, ability and experience, he is well fitted to occupy the position of Controller of Wireless:

Mr. Malone joined the Post & Telegraph Department at Lismore, New South Wales, as Telegraph Messenger in 1898. Two years later he was appointed as a Relieving Officer. In 1906, as the result of a competitive examination, he joined the Engineering Branch of the Postal Department in Sydney. Between that time and 1915 he occupied various engineering positions in Sydney, and also acted as District Engineer at Goulburn. Later on he was Engineer for Lines in Queensland. Shortly after the outbreak of war he enlisted, and was immediately appointed Instructor in Wireless at the Wireless School at Moore Park, Sydney. During his period of active service he was in charge of all A.F.C. Wireless activities in France, and was awarded the M.C. After the Armistice was signed he undertook the study of wireless and other kindred engineering subjects for 12 months in Europe. During that time he was at the R.A.F. Wireless Experimental Establishment at Biggin Hill, and also at the Signals Experimental Establishment at Woolwich. He returned to Australia, via the United States of America and New Zealand. Shortly after his return he was appointed Deputy State Engineer at Perth; and, later, when the Postmaster-General's Department took over the Radio Service from the Navy Department he was brought from Perth to take charge of it. He continued in that position until May, 1922, when by reason of the agreement entered into between the Government and Amalgamated Wireless (A'sia) Limited, the commercial activities were handed over to the control of the Company. During the time Mr. Malone was in charge of the Radio Service he prepared and obtained approval for a re-organisation scheme to be applied to all Coastal Radio Stations. This was not proceeded with, however, owing to the transfer already mentioned. Mr. Malone's next appointement was as Controller of Wireless in the Postmaster-General's Department, and when a short time ago the administration of the Wireless Act was handed over to the P.M.G.'s Department he was elevated to the position of Chief Manager of Telegraphs and Wireless for the Commonwealth. In that capacity he acts as adviser to the Commonwealth Government on all wireless matters, and is the officer responsible for the Wireless Act and Regulations. During the negotiations leading up to the agreement between the Government and Amalgamated Wireless Limited, Mr. Malone acted as technical adviser to the Parliamentary Committee which investigated the proposals prior to the agreement being signed.

AUSTRALIA'S CONTROLLER OF WIRELESS—
Mr. J. Malone, M.I.R.E., M.I.E.E., M.A.I.E.E.

The present Wireless Telegraph Regulations were prepared by Mr. Malone, subsequent to his appointment as Controller of Wireless.

He is a member of the Institute of Radio Engineers, the Institution of Electrical Engineers, and the American Institute of Electrical Engineers,




**How to Grain a Bakelite Panel.**

MANY experimenters who construct their own apparatus, have wanted to grain their bakelite panels, so that the finished instrument might compare favourably with the manufactured article. It is rather risky to experiment on a new panel, because the result might not be all that is desired, and bakelite costs money. If the following directions are observed success is assured:

Lay the panel on a flat table or work-bench; take two pieces of wood of the same thickness as the panel, and lay one at each end, in the direction that the grain on the bakelite is to run. Fasten the wood with a couple of countersunk wood screws. The end pieces serve in two capacities; first as a clamp to hold the panel in position, and second, to keep the edges from becoming rounded. It is advisable to drill the panel before commencing this work, as the rough edges around the holes are taken off during the process of graining.

Now spread a film of olive, or other good grade of oil of medium consistency over the panel, and with a sheet of medium-grade sandpaper on a block of wood; rub all over the panel in one direction, commencing at the end nearest you.

When the sandpaper begins to bite in, it will be found that it is covered with particles of bakelite, which render it useless, and, as a consequence, a fair amount will be consumed befor the job is finished. The quality of the grain, as with everything else, is proportional to the work expended upon it.

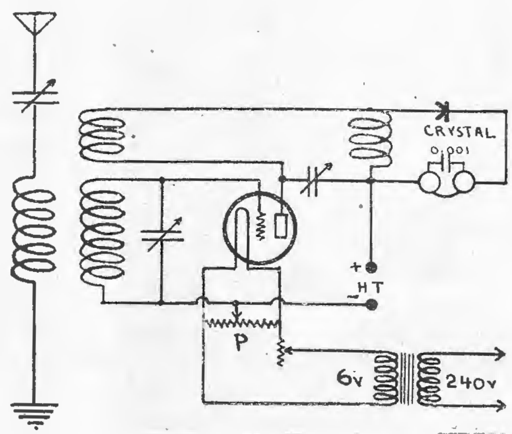



Fig. A.

**An A. C. Valve Receiver.**

The experimenter who operates a valve receiver is, indeed, fortunate if he has never experienced a failure of the filament "juice" supply at some critical time, such as in the middle of a radiophone entertainment. Most of us have an electric light supply of alternating current in our homes, and to charge a storage battery a rectifier of the vibrating, thermionic, or electrolytic type must be available, or else a trip to the battery charging station is the alternative. It is possible to make use of the alternating current direct in the valve circuit if a few small alterations from the standard connection are made.

The filament is supplied with current by means of a small low voltage transformer of the toy or bell-ringing type, with the usual resistance to regulate the current strength, as in direct current sets. If the lead from the secondary of the tuner is brought direct to one of the filament leads a fluctuating potential will be impressed on the grid through the leak resistance, and a loud, humming noise will be heard in the telephone receivers. A potentiometer across the filament leads enables the exact electrical centre of this alternation of potential to be located, and, as a consequence, the hum is reduced to a minimum. This potentiometer is connected where shown in Fig. A. Its resistance can be of any value up to 1000 ohms, and the winding, preferably, non-inductive. A secondary voltage of about six volts should be used on the transformer. With the filament burning at normal brilliancy move the slider up and down the potentiometer until minimum sound is heard in the telephones. There will be a slight residual hum in the telephone receivers which it will be almost impossible to do away with when the receivers are connected directly in the plate circuit. This is due to the slight cooling of the filament during the alternations of current, and as the electron emission is very sensitive to temperature, a pulsating current will flow in the plate circuit, even when the potentiometer is accurately adjusted. The residual hum can be entirely eliminated by the use of the radio frequency filter circuit shown in Fig. A. The inductance and condenser combination are tuned to the same frequency as the received wave, when they will offer a very high impedance to resonant currents, while allowing those of lower frequency to pass easily. The higher the inductance and the lower the resistance the greater will be the filtering effect of this circuit. To detect the signal or speech, a crystal detector and telephones are shunted around the tuned circuit in the orthodox manner. In place of the choke coil a radio transformer similar to those described elsewhere in this issue, may be used.

### A Simple Vario Coupler.

The vario coupler described herewith can be constructed in a very short space of time at practically no expense. The tools needed to construct this vario coupler are found in every home; these are a screwdriver, a pair of scissors, some glue, a bit of sealing wax, and a piece of brass or iron rod. Ordinary cardboard tubes should be used for the stator and rotor forms, making sure that the one used for the rotor is of such a size that it will rotate freely within the stator. A four-inch and a three-inch tube are good sizes to use.

The rotor shaft is an ordinary smooth, round lead pencil about six inches long, to which a dial or other indicating device is attached.

Make a thin cardboard cylinder by wrapping a strip of cardboard about four inches wide several times around the pencil. Glue the layers together thoroughly, and remove it from the pencil to dry; then cut off a piece equal to the inside diameter of the rotor tube. This will be the central piece in Fig. B; the two small end washers are cut from what is left. With a piece of red-hot metal, the same size as the pencil, used for the rotor shaft, "drill" the holes through the rotor and stator where shown. These holes

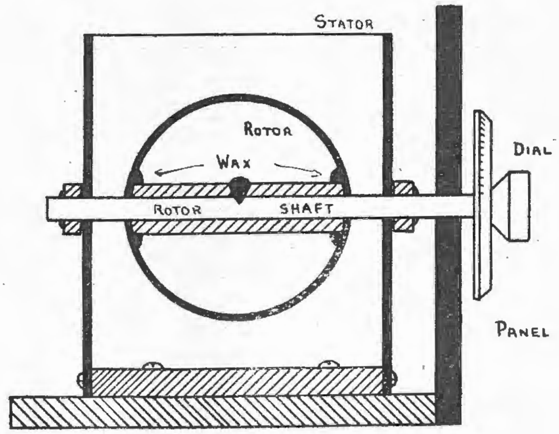



Fig. B.

should not be too large, and must provide a friction fit for the shaft. Wind the two tubes with the wire necessary for the circuit in which the vario coupler is to function, and mount as follows. Place the tube inside the rotor, and glue it in place between the two holes. The pencil should be passed through the tube while this is being done to ensure perfect alignment. Secure the rotor to the shaft by burning a notch through the tube into the shaft by means of the red-hot rod, and fill up the space with sealing wax. After adjusting the rotor nice and central, so that it can rotate without rubbing against the stator; fix the end washers, in place with a few drops of wax. These prevent the rotor from moving laterally. The lead out wires from the inner tube should be single pieces of miniature electric light flexible, and to prevent them being twisted loose a stop should be provided to allow of not more than 360 degrees rotation.

This suggestion should prove useful to those experimenters who are building short wave amplifiers for the trans-Pacific radio tests.

**A SERIES OF ARTICLES**
**written expressly for the raw beginner who is anxious to gain a knowledge of wireless experimenting, simply and quickly, will begin publication in "Radio" at an early date. Watch for them.**

# Patents Section

By GEORGE APPERLEY
RADIO ENGINEER

THE following are abridgements of Complete Specifications of Wireless Patents notified in the Official Journal of Patents, as accepted at the Commonwealth Patents' Office, Melbourne, during the month of March, 1922.

No. 5993/22. Inventor: Dr. W. Dornig, Germany, describes an invention relating to high frequency transformers for use in wireless telegraphy and the like.

To improve the efficiency by the reduction of iron losses for the purpose of selecting the high multiples of the fundamental frequency, the core is wound with very thin insulated iron wire. The absence of metallic contacts between windings and high ohmic resistance, therefore reduce the heat due to short circuit currents to practically zero.

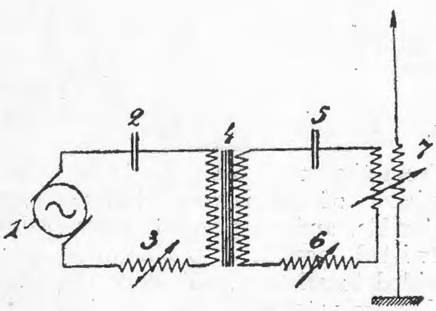


Figure 1.

Fig. 1 shows a circuit arrangement employing such a transformer. 1 is a high frequency generator, 2 and 3 primary tuning devices, 4 the transformer, and 5 and 6 tuning devices on the secondary side for tuning to a multiple of the fundamental frequency. By adjusting 5 and 6 any desired harmonic can be selected and transmitted to the antenna through the coupling transformer 7, unaccompanied by other vibrations.

No. 9385/22. Inventor: Dr. Hellmut Simon, Germany, describes an improved cathode suitable for use in electronic discharge devices comprised of an oxide or other compound of a metal of the alkaline group (calcium, strontium, barium), and also an oxide or other compound of a metal of the rare earth group (lanthanum to thulium) carried on a platinum or iridium wire. It is claimed that a cathode so formed will have long life without alteration, and require only a small amount of energy to bring it to the desired temperature.

No. 10199/22. Inventors: Norman William McLachlan and Archie William Langridge, England, has for its subject a method of protecting Wireless Telegraph Receiving Apparatus from alternating currents. The received signals, after being heterodyned and rectified to give oscillations of audio frequency are introduced into circuit A, Fig. 2., electromagnetically coupled to a coil B, connected to grid C and filament D of a valve, whose plate circuit contains a battery, E, and a resistance, F, shunted by a condenser, G. The potential of grid C is adjusted so that the oscillations are rectified, producing a series of unidirectional impulses in the plate circuit, the steady current of the impulses passing through F, and the superimposed alternating currents of various frequencies through G. The ends of the resistance F are connected to a second valve, the potential of the grid H, of which is adjusted in respect to the filament J to the rectifying point. In the plate circuit of this second valve is connected a rejector circuit, K, which, in order to prevent the alternating current from passing through the recorder, M, is adjusted to the frequency of the current applied to the first valve. It therefore offers a high impedance to this frequency, while acting as a short circuit to the direct current component. The alternaing current through the recorder may be further reduced by employing additional rejector circuits, O.P., tuned to harmonics of the main frequency.

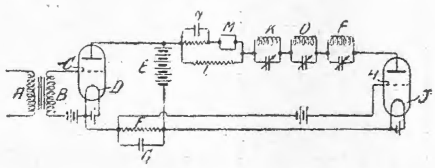


Figure 2.

No. 6636/22. Inventor: H. J. Round, England. For the best working of apparatus employing valves it is frequently necessary that the relation between the space current and the voltage applied to the valve should be linear over a large range. This is usually not the case. According to this invention a resistance large, as compared with the resistance of the valve, is joined in the anode circuit, the voltage current relation then being mainly controlled by the resistance. Several such combinations may be connected in parallel, and it is found that the result is a characteristic which has its curvature reduced in proportion to the number of valves used, and to the resistance placed in series with each, and the greater the number of valves, and the larger the resistance, the straighter the characteristic. Fig. 3 shows such an arrangement suitable for the magnification of speech currents.

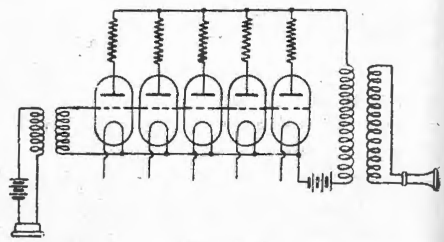


Figure 3.

No. 8358/22. Inventor I. Langmuir, United States of America, describes a method of increasing the electron emissivity by employing a valve filament formed of tungsten, and about 3 per cent. thoria-heated to incandescence in a carbonaceous vapour. The vapour is then drawn off, and the filament again heated in the presence of a non-oxidising agent. Electronic bombardment and exhausting operations are carried out during the second heating of the filament.

# Mr. J. H. A. Pike's Station

## Set on which American Signals were heard

THE complete receiver about to be described was designed and built in an endeavour to provide an instrument for the reception of very weak signals, such as one would expect in the Trans-Pacific Test.

As the time at my disposal is very brief, I will not attempt to give a detailed description. but will reserve constructional details for a later article.

The instrument is a universal receiver that can be used for all wave lengths simply by changing different standard plugs in the coils. Since signals from Major Mott, U.S.A., were received, two additional stages of high frequency amplification have been added, and it now consists of eight valves—five amplifying at high frequency, detector and two low frequency amplifiers.

An advantage of this instrument is the easy means whereby it is possible to change from one combination of valves to another; either one or any combination up to five high-frequency valves with detectors may be used, or detector alone, or with one or two stages of audio or low frequency amplification.

The instrument was commenced less than three weeks before the Tests were timed to commence, and it was only finished after working well into the small hours of the morning, with the valuable assistance rendered by Mr. A. L. McCredie, of Epping. To make sure of completion on time it was decided to use as many standard parts as possible, and with the exception of the vernier condensers for tuning anode circuits of H.F. valves, and other small fitments, most of the apparatus consists of standard articles.

For coupling the H.F. valves the tuned anode circuit was adopted as from past experience. I have found this method far superior to many others tried. This method of coupling has many advantages to recommend it; there is no trouble regarding the design of transformer, and tuning is easily attained by means of a single variable condenser in each circuit, the inductance being varied by different plug-in coils.

Few experimenters seem to realise that when reaction is introduced into a circuit its selectivity is greatly increased, and, therefore, the tuning is much sharper. In H.F. amplifiers a certain amount of reaction takes place between the inter-valve circuit and the grid circuit of the next valve, this being due to the small capacity existing between the grid of plate of each valve. It open happens when reaction is introduced into the tuned anode or plate circuit that unless a means of accurately tuning that circuit is provided, signals are weakened instead of being strengthened. This explains why many so-called H.F. amplifiers weaken incoming signals when they should strengthen them.

By consulting the photographs accompanying this article, it will be observed that a standard three-coil holder is used, different wave lengths being tuned by substituting various duo-lateral or other coils. A series parallel switch is provided in the secondary circuit instead of the customary primary circuit, so that a direct coupled circuit can be used when condenser is in series and loosely coupled when in parallel, a small two-way switch being provided to the left of the series parallel switch to throw aerial into either circuit. Vernier condensers are provided in both primary and secondary circuits. This is essential in short wave work, as less than a degree on the dial of an ordinary condenser will often cause signals on short wave lengths to disappear. Kellogg condensers are used owing to their sound design of bearings, and also being noiseless in operation, an inherent fault in many so-called variable condensers. Bakelite is used for the panel, which measures 38 inches by 15 inches by ¼ inch thick. This is far superior to ebonite, both in rigidity and absence from warping tendencies. A plan showing the disposition of the various components was prepared, and the position of all holes marked. These were then drilled and tapped where necessary. The next step was to remove the shiny surface of the bakelite with fine emery or glass paper, and a final rubbing with stone. When this operation is completed it will be found to have a smooth, even finish without scratches, its insulating qualities being also improved. It can be easily imagined that a panel of the above dimensions is very unwieldy and difficult to hold while squaring-up operations are being executed, so the method adopted of fastening it to the bench by means of wood screws through any suitable hole may be of interest.

Mr. J. H. A. Pike at his Experimental Radio Station at Epping.

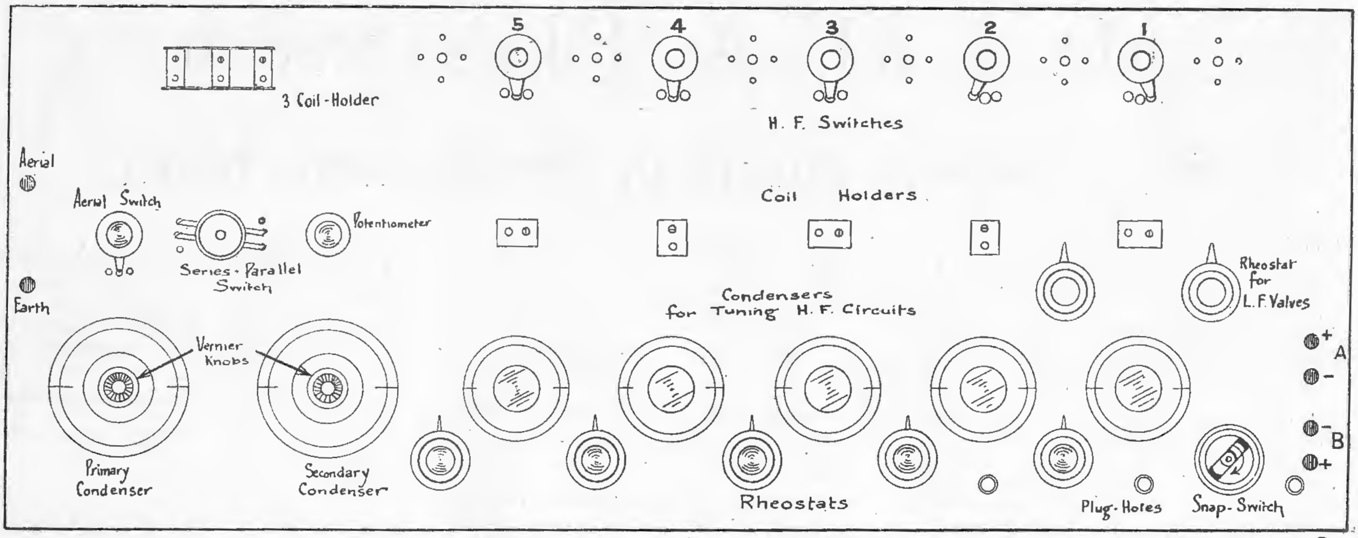
The valves are placed at the rear of panel, so that their glare when in operation will not bear directly on the operator, as this is very detrimental to the eyes and also has a marked tendency of making one very drowsy, especially when searching for weak signals on the "midnight patrol."

Near the top of the panel will be noticed five two-way switches with a dead stud in the centre. These are used in conjunction with their respective rheostats for switching in or out the various H.F. stages.

To use detector valve alone the four switches from left to right are put in central position, the last one is turned to left; when one stage of H.F. is used the second switch from right is moved to the left, and last switch (marked No. 1) is moved to right and so on, as each stage is added. On paper it seems a lengthy operation, but in practice it takes far less time than to describe. The plug and jack method of putting the 'phones in either detector first or second stage of audio-frequency amplification is used. as the operation is very quickly accomplished.

Separate rheostats with an off position are provided for each H.F. valve, and a vernier rheostat for detector, this being a very useful acquisition; one rheostat controls the two low frequency valves and a plug is used to cut in or out filament of second stage.

A potentiometer of 400 ohms resistance is provided as a means of putting either a negative or positive potential on grids of H.F. valves, the ends of winding being connected across "A" battery and sliding contact being connected to grid of fifth stage H.F. valve and to grid leaks of the remainder, this refinement having been




**Plan showing Panel Arrangement used by Mr. Pike.**

found necessary to the successful operation of the instrument.

Along the centre of the panel will be noticed five standard coil-plug holders for the necessary coils being used in tuned anode circuits, each holder being mounted at right angles to preceding and following ones, so that any tendency to "howling" may be illustrated, as a minimum of coupling is obtained between each circuit.

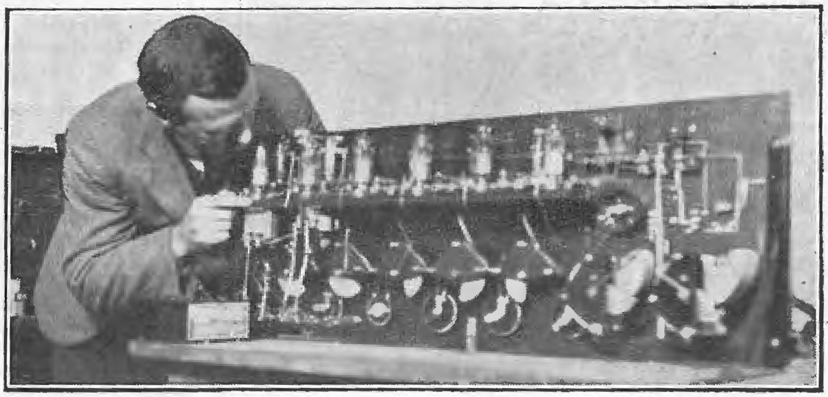
Underneath these coil holders are found the dials which control small variable condensers of about .0002 mfd. capacity for tuning purposes. Each coil will cover a certain fixed range of wave lengths. The coils in this set for a range of 200-460 metres consist of De Forest duo-lateral of 25, 50 and 75 turns. Other makes are sometimes used, but a coil of one make varies considerably in its inductance value to that of another make, so one pattern throughout is usually adopted. A reversing switch is provided for the re-action coil, as when each further stage of H.F. amplification is added the reaction coil must be reversed.

A double pole single throw snap switch is used to cut in or off "A" and "B" batteries in one operation.

Naturally the chief feature in a set of this description is the class of valves used, for high frequency valves having low capacity and noiseless operating characteristics are necessary. Both V24's and Mullard K.A. types give every satisfac-faction, Mullard being used at present, as they function on 3.5 volts on filament, thus giving them preference, as my chief source of filament supply is 4 volt storage batteries.

A Mullard "ORA" is used for detecting and V24's for low frequency amplifiers.

In operating a set of these dimensions it must be clearly understood that no more valves than necessary for reception of clear signals should be used as with all valves burning, 6 amps. are drawn from battery, and as I don't possess a "Homecharger" the task of heavy weight lifting is not indulged in more often than necessary.



**This Photo shows Back of Panel Receiver made by Mr. Pike.**

# West Australian Work

*(By Our Special Representative.)*

After much pioneering work Radio has at last found a lodging place in popular favour amongst the people of West Australia.

It will be interesting to indulge in a brief but comprehensive survey of the progress made by local enthusiasts who have been carrying out transmitting work. There are about half a dozen of these in and around the city; but for this issue comment will be confined to the installation owned by Mr. W. E. Coxon, of 306 Bulwer Street. Gauged on radio movements in this State, this is a pretty powerful plant, and being of a style all its own, is the result of the owner's several years experimental work.

After overcoming the usual initial difficulties and adapting his set to local conditions, Mr. Coxon commenced transmitting, and in the stilly watches of a certain night several months ago local enthusiasts received a tremendous shock when, in operating their tuning-in gear they suddenly picked up the strains of music Excitemen ran high, and many attempts to guess its origin were made, some even suggesting New York, but everybody was agreeably surprised when next morning they discovered that the music came from Mr. Coxon's experimental station.

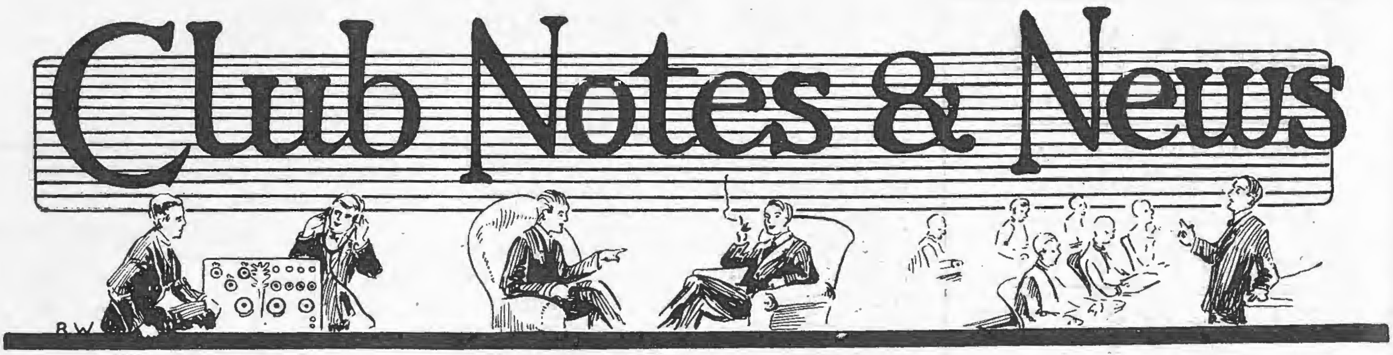
A few nights ago the writer visited the station, and was conducted to a room containing a maze of plugs, valves, condensers, switches, and a tangle of wires, meters, telephones, and other apparatus. Experiments in the transmission of music, speeches, etc., were in full swing.

Mr. Coxon uses 10 watts on a wave length of 420 metres, and his music is received clearly on crystal sets at a distance of fifteen miles, while those possessing single valve receivers get good results up to 50 miles. Even at this distance, however, interference is experienced from VIP signals on 600 metres.

Only one valve is used as a radiator, modulation being covered on a method devised by Mr. Coxon. The regulation is good, either expanded or softened sound being always under control, so that "listeners-in" receive anything from almost a whisper to a large-sized shout without trouble. No iron core coils are used, and this gives perfect reproduction.

The source of power is a motor generator giving up to 100 watts, and there are two windings, each on separate commutators. One winding generates 15 volts, and is used for excitation, while the high tension is wound over the first and insulated with oiled silk, to withstand 1,000 volts.

The armature, however, only measures 3 inches in diameter and 3 inches in length, and it is scarcely creditable that such a baby is capable of providing power necessary for the transmission of signals over a thousand miles.




## WIRELESS INSTITUTE OF AUSTRALIA

### N.S.W. Division.

THE business at the last general meeting of the above Division was a lecture on "The Co-relation of the various forms of Energy," by Mr. Alec. Hector, Sydney Manager of Messrs. Burroughs, Wellcome & Co. A *precis* of this lecture will appear in next issue.

The meeting was held in the Lecture Hall at the Education Department, and the attendance numbered 170. Invitations had been sent to twenty-nine Radio Clubs, and the response was such as to draw congratulatory references from the secretary, Mr. Phil Renshaw, at the conclusion of the lecture.

He also welcomed Mr. Shaw, of Goondiwindi; Mr. Ohlsen, of Newcastle; and Mr. Williams, of Wollongong.

Prior to entering on the business of the evening a ballot was conducted for two new Institute members, the following being elected: Member Geo. A. Taylor, 20 Loftus Street, Sydney; Associate Member L. H. Taylor, 41 Henry Street, Leichhardt.

At the conclusion of the business the secretary, in emphasising the need for the closest co-operation between the various Clubs, propounded the following ten methods of killing a society:

(1) Don't ever come to the meetings.

(2) But if you do come, come late.

(3) If the weather does not suit you, don't come.

(4) If you do come, find fault with the work of the officers and other members.

(5) Never accept office, as it is easier to criticise than to do things.

(6) Nevertheless, get sore if you are not appointed on the Committee, but if you are, don't attend the meetings.

(7) If asked by the Chairman to give your opinion on some matter, tell him you have nothing to say, but after the meeting tell everybody how things ought to have been done.

(8) Do nothing more than is absolutely necessary, but when members roll up their sleeves and get to work, howl that the Society is run by a clique.

(9) Hold up your subscription as long as possible, or don't pay it at all.

(10) Don't bother about getting new members—Let George do it.

### South Australian Division.

Keen interest and enthusiasm characterised the well-attended May meeting of the above Division.

A large amount of business, including the election of six new members, was disposed of.

An extract from the Presidential Report of the N. S. Wales Division was read by the secretary.

Much interest was displayed in Mr. H. L. Austin's new 3 valve amplifier, which he exhibited. The workmanship, appearance and efficiency is up to his usual high standard.

The assistant Secretary, Mr. R. T. Edgar, made a preliminary announcement regarding the forthcoming social and demonstration, which is to be held in the near future. One of the principal features of this entertainment will be a Radio Dance, which will be the first of its kind ever held in South Australia. Every effort is being made to ensure the event being a great success.

Mr. H. L. Austin announced that Station 5BG had been heard in New Zealand, a record for South Australia using low power.

A most instructive and interesting lecture on the valve as a generator, was delivered by the Vice President, Mr. J. M. Honner. Mr. Honner went to great pains to illustrate his subject with diagrams and mathematical calculations, and explained the functioning of the circuits under review. After a general discussion Mr. Honner was warmly thanked for his able and instructive discourse.

Several members mentioned having received the signals transmitted by Melbourne amateurs.

These signals are heard regularly every evening on one valve; Mr. Maclurcan's station in Sydney has also been successfully received, but owing to heavy static his Sunday evening concerts are somewhat marred. It is hoped, however, to secure better results during the winter months when static will be less prevalent.

### Queensland Division.

The monthly meeting of the Queensland Division was held in the Institute Lecture Room on Friday, May 4.

The correspondence included a notification from the Controller of Wireless (Mr. J. Malone) of the appointment of Mr. William Finney as Honorary Radio Inspector for Queensland.

At the conclusion of the meeting Mr. W. I. Monkhouse (Vice-President) gave an interesting lecture and demonstration on the construction and electrical action of Aerials, describing chiefly the "T," inverted "L," and Umbrella types. By special request the lecturer repeated portion of his previous demonstration on inductance and capacity. A hearty vote of thanks was accorded Mr. Monkhouse, who stated he would be pleased to assist in a similar manner whenever his services were required. A vote of thanks was also accorded the Queensland University authorities for the use of the apparatus used in the demonstration.

### Bondi Radio Club.

A good attendance of members greeted Mr. R. Shaw, who delivered a lecture on the general aspects of wireless at a recent meeting of the above Club. The lecture was keenly appreciated.

Quite a large number of members were present at the lecture arranged by the N.S.W. Wireless Institute at the Education Building on May 10.

Efforts are being made to secure a club room in a more centrally situated position than the present one, and in the meantime no further meetings will be held at 276 Birrell Street. Any enquiries regarding Club matters should be addressed to Mr. A. H. Callaway, 33 Ocean Street, Bondi.

### Balmain Radio Society.

This Society is making steady progress. A transmitting and receiving license has been granted in the name of the Director, Mr. P. G. Stephen, and it is hoped to commence transmitting in a few weeks. The call sign is 2ZB.

Several members are now receiving the concerts on crystal. Buzzer practice is carried out regularly, and those undertaking it are making good progress. Mr. G. Every has been appointed delegate to the Radio Association of N.S.W.

The Society meets every Tuesday evening at No. 71 Louisa Road, Balmain, where every facility exists for the technical education of members in Radio Science. Any information will be gladly supplied by the Acting Hon. Secretary, Mr. F. W. Riccord, 77 Grove Street, Balmain.

### Box Hill Radio Club.

A fortnightly general meeting was held at the Club Room, Box Hill, early in May. In the absence of the President (Mr. Howden) Mr. Lusty was voted to the chair.

The Secretary stated that the Club had been granted a transmitting license, the wave length allotted being 220 metres. The Secretary is to act as trustee of the license. Radio experimenters generally will benefit as a result of the license being granted, as approval has been given to transmit Morse at slow speed.

The Club has received generous assistance from various quarters, two fifty-foot poles being supplied by Birds' Sawmill, a five watt tube by Mr. Beattie, a transformer by Mr. Howden, and several cash donations.

At the conclusion of the general business Mr. Beattie spoke of his recent trip to Sydney, and detailed the result of his observations there.

The Club's call sign is 3XU.

All enquiries relative to the Club's activities should be addressed to the Hon. Secretary, Mr. H. Hurst, No. 3 Wellington Road, Box Hill (Vic.).

### Metropolitan Radio Club.

At a Committee meeting held on May 14 it was decided that this Club should take upon itself the task of organising a test between amateurs in New Zealand and New South Wales.

Mr. D. McIntyre, the well-known New Zealand experimenter, who is at present residing in Sydney, and is a member of the Committee of the Metropolitan Club, was allotted the task of getting in touch with well-known amateurs in New Zealand. The test will be run on totally different lines to that of the trans-Pacific test. The Club proposes to take into its confidence all genuine experimenters, and it is hoped in passing this compliment to them that they will give those who enter a fair chance of getting the signals through. It is proposed that the test shall last over a period of one week, that period being considered long enough to decide whether it is possible to do both ways transmission in daylight and dark between the two countries. The entrance fee will only be nominal—just sufficient to cover stationery and postage and allow a surplus for the presentation of prizes to those who are successful. It is proposed that this test shall be carried out within the next two months, and the hour selected for testing each night will be such as will not in any way interfere with the business efficiency of those who have to go to work the following day.

### Radio Association of N.S.W.

Chairman: Mr. Phil Renshaw (Kuringai).

Vice-Chairmen: Mr. L. R. Hewitt (Ilawarra), Mr. B. Symes (Manly).

Hon. Treasurer: Mr. J. O'Brien (North Sydney).

Hon. Secretary: Mr. A. E. H. Atkinson (Metropolitan).

Auditors: Mr. F. B. Wade (Western Suburbs), Mr. R. C. Marsden (Metropolitan).

Institute Official: Mr. R. C. Marsden (Metropolitan).

The Radio Association was formed primarily with the object of assisting the Minister for Telegraphs and Wireless in carrying out the Wireless Telegraph Act in reference to amateur wireless. The idea originated several months ago amongst a number of radio amateurs, and after a lot of spade work by several of the better-known Clubs the Association was eventually formed. A large percentage of the Clubs in the metropolitan area are affiliated with the Association.

At the Broadcasting Conference in Melbourne the Association is doing its best to see that the interests of the genuine experimenter are safeguarded. It is the Association's intention to assist as much as possible in putting down illicit wireless stations, and also in trying to curb the activities of owners of perpetually howling valves. Another phase of the Association's activities is in trying to arrange with the P.M.G.'s Department for the issuing of licenses in Sydney, thus obviating the long delay that has occurred during the past few months.

The Association is formed by all the Clubs, the office-bearers being elected by delegates of the different Clubs. There is no honour and glory attached to the holding of any of these offices. Every delegate has an equal vote, irrespective of what office he holds.

### Northbridge & District Wireless Experimental Society.

The inaugural meeting of the Northbridge and District Wireless Experimental Society was held at Mr. L. Forsythe's residence, Sailor Bay Road, Northbridge, on Wednesday, May 11. There was a large and enthusiastic attendance.

The following officers were elected: President, Mr. L. E. Forsythe; Vice-President, Mr. R. W. L. Woolridge; Hon. Secretary, Mr. A. H. Vincent; Hon. Treasurer, Mr. R. Larsen; Executive, Messrs. E. Mills, E. Beard, J. Figgis; Technical Committee, Messrs. Scrivener, Forsythe and Beard.

Commodious club rooms have been acquired through the courtesy of Mr. L. E. Forsythe, where it is proposed to instal the very latest in wireless equipment.

The general meeting of the Society is held each Wednesday, when new members and visitors are welcome.

Particulars concerning the Society may be obtained from the Hon. Sec., Mr. A. H. Vincent, "Abbeville," Sailor Bay, Northbridge.

### Entertainment at Auburn.

At the third Annual Show of the Agricultural Bureau of Auburn, held in the Auburn Town Hall some time ago, a very successful demonstration in Telephony was given by the courtesy of the Burwood Radio Club and Mr. Geo. R. Challenger, of Western Suburbs Amateur Wireless Association. There were 350 people present, and speech and music was heard all over the hall.

The set used in receiving was a three-valve one, designed and constructed by Geo. R. Challenger, who also operated it. A single wire aerial, 120 feet long, was erected, and a magnavox was used to magnify the speech and music.

## "Iron Prince" Incident

It is a singular fact that no less than three of the operators at Sydney Radio participated in the excellent performance recorded in the quick despatch of messages when the *Iron Prince* went ashore near Cape Howe. The first call was received by Mr. Reynolds at 1.55 a.m. At 2 a.m. he handed the work over to Mr. Hodges, but remained on duty until 3 a.m. At that hour Mr. Chilton (Officer-in-Charge) was called, and from thence until 7 a.m. he assisted Mr. Hodges in creating what might well be regarded as a world's record in the quick handling of messages.

The whole staff of V I S feel proud of the achievement, but not nearly so proud as they are entitled to feel.



# Queries Answered

*G. L.* (Woollahra) asks: (1) Whether an aerial, as per his drawing submitted, would be suitable. (2) For a circuit to use with this aerial of a Dull-emitter D.E.F. Valve and Expanse B.

*Answer*: (1) You will need to employ radio amplification with sc small an aerial.

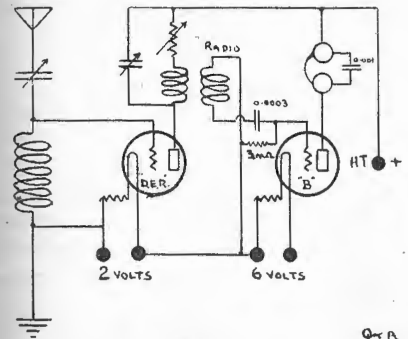



**Fig. 1.**

(2) A circuit for a D.E.R. and Expanse B Valve is given herewith, in Figure 1.

*Novice* (Manly): The diagram you sent is quite O.K., except that the fixed condenser should be connected across the telephones, and not across the secondary, as you have shown. It is the simplest form of crystal receiver and you should get fairly good results with Brown's telephones. The whole of your inductance should tune to just about 2,000 metres, but you will find no stations to listen-in to on that wave.

*Radio* (Haberfield) asks: (1) What sort of an aerial could be used in an attic. (2) If it would be efficient with crystal or valve for the reception of telephony.

*Answer*: (1) Almost the only type that would give results of any use would be a closed frame aerial.

(2) Such an aerial would give good results using a circuit with not less than three valves. Results on crystal would be nil.

*J. B. C.* (Griffith) asks (1) whether a Crystal set using a twin wire aerial 90 feet long, height 40 feet one end and 30 feet the other would receive signals from Sydney and Melbourne at Griffith, which is situated 400 miles by rail from Sydney. (2) If so what type will be needed.

*Answer*: (1) and (2) using the best crystal and phones you would receive faint spark signals on a loose coupler tuned to 600 metres, but for this purpose you would get far more satisfactory results with a valve receiver. To receive telephony you would require at least one stage of amplification.

*W. T. M.* (Corowa) asks: What is a suitable non-conducting pigment for the colouring of sulphur when the latter is used as an insulator; and where it can be obtained.

*Answer*: A suitable pigment with an intensely black colour known as Nigrosine can be obtained at any paint or colour store. It is soluble in alcohol and when added to shellac solution provides a black varnish which closely imitates the polished surface of Bakelite and hard rubber.

*A. B. L.* (Drouin, Victoria) asks: (1) What capacity (number of turns) is necessary for 3 honeycomb coils P.S. & T. to bring in wavelengths between 400 and 1,500 metres.

(2) For a circuit diagram for 1 Stage Radio Frequency, 1 Detector and 1 Stage Audio Frequency using the above-mentioned coils and the one "A" and one "B" Battery.

*Answer*: (1) For the secondary and Tickler coils two 100 turns honeycomb coils should be used, but for more efficient operation on the 400 metre wave we suggest that you sacrifice a few hundred metres on the top end of the range and use 75 or 80 turns on both coils with a secondary shunt condenser of 0.001 microfarads. The primary should be of the same size with a tap midway on the coil or preferably two interchangeable coils of 35 and 75 turns.

(2) For circuit see diagram Fig. 2.

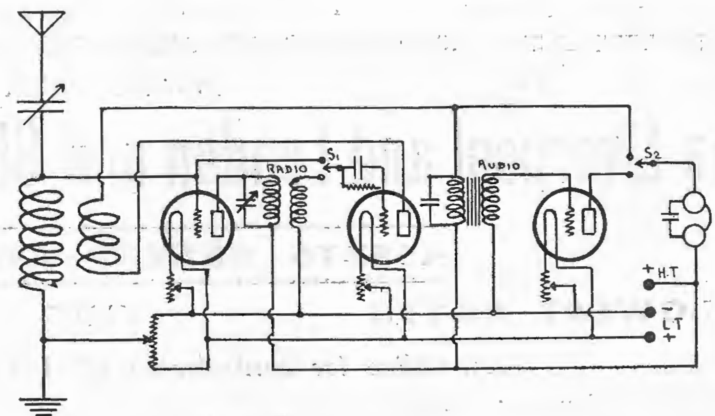



**Fig. 2.**

*Mica* (Milson's Point) asks: (1) If he can erect an aerial over the flat lead roof of his house? (2) If the leading-in wire must be taken from one end of the aerial, or whether it can be takn from the centre? (3) How are signals affected by the nearness or distance apart of the wires in a two-wire aerial.

*Answer*: (1) The aerial, to be efficient, should be well above the lead.

(2) With a short aerial, a lead from one end is much preferable, but the middle arrangement can be used if unavoidable.

(3) Two wires close together give results very little better than a single wire. Increasing the spacing up to, say, 10 feet, improves the results.

*H. L. G.* (Moreland, Vic.) submits diagram of his crystal receiver, and asks for particulars as to the reason why it does not function properly?

*Answer*: The trouble appears to be due to lack of tuning in the secondary circuit. A condenser of 0.0005 microfarads should be used in parallel with this winding. For satisfactory operation on 400 and 600 metre work the winding is too high, and it should be reduced to 100 turns 22 D.C.C. for the primary and loading coil, and 120 turns, No. 30 S.S.C. for the secondary.

*W. L. B.* (Randwick) submits two diagrams of a loose coupler set, showing in No. 1 a variable condenser shunted across the primary, and in No. 2 in series with the aerial. He asks: (1) Which method is most suitable for a set having a primary coil 6¼in. x 4¼in., wound with 260 turns of wire, and a secondary coil 7¼in. x 3⅜in., wound with 390 turns of wire? (2) What capacity variable condensers would be necessary?

*Answer*: Assuming an aerial of 0.00033 microfarads the series connection of the condenser (0.0011 microfarads) would tune from 1,300 to 2,000 metres, and in parallel 2,000 to 4,000 metres. Primary inductance = 3,200 m.h. without taps. The secondary (5,000 microhenries) with a similar condenser would tune from 950 to 4,500 metres.

*C. S. G.* (Byron Bay) submits diagram of hs crystal receiver, and asks for criticism and advice concerning various points.

*Answer*: Three terminals only are essential when connected as you state. The 0.0008 m.f. condenser should be in parallel with the aerial and earth terminals. Connect the aerial to one slider, the lead to the crystal to the other, and the earth and second wire from the detector circuit to the remaining terminal. It is impossible to estimate the range, but if everything is in order VIS and VIB should be received.

*Q. S. A.* (or *Q. S. N.*) (Mosman Bay) asks for particulars of an apparatus for recording wireless signals on the post office system of the Morse Inker, and whether broadcasted speech and howling valves would affect such an instrument?

*Answer*: The simplest and most reliable method for you to adopt is to rectify the amplified audio frequency currents received, and change them into direct current impulses by means of a carborundum or other robust crystal detector. The crystal detector and sensitive polarised relay should be connected in series with the secondary of the valve output transformer. Unless tuned directly to a radiophone wave, no interference is likely from this source, while howling valves are too weak to cause trouble.

*A. E. C.* (Darlington Point) sends a diagram of his receiver, and asks for particulars concerning certain points affecting it.

*Answer*: (1) The use of a series condenser will reduce your wave length sufficently to allow a reasonable coupling inductance to be used. The natural wave length of an aerial is, approximately, four times the length in metres. (2) You should use a 100 turn honeycomb coil for 600 metre work, and tune it to resonance with a variable condenser. Certainly, if you used a coil with a natural wave length of 600 metres the distributed capacity of the remainder of the circuit would cause an increase. (3) Without further information as to the length and height or capacity of your aerial we are unable to answer this question. (4) The reaction coil should be of the same size as the secondary coil for short wave work, and slightly less for long waves.

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be made apparent if an earth is supposed to have been put on the lower end of the tuner secondary. If the filament battery is not highly insulated from earth it will seriously affect the potential difference at the terminals of the feed-back audio transformer owing to leakage.

Experimenters desiring a very compact set of high amplification are recommended to fit up one of these two valve and crystal amplifiers, using the dry battery valves known as the Marconi D.E.R. (Dull Emitter). These valves consume only 0.25 to 0.3 amps and operate from a single dry cell. Their characteristics in other respects are approximately equal to the V24 vave.