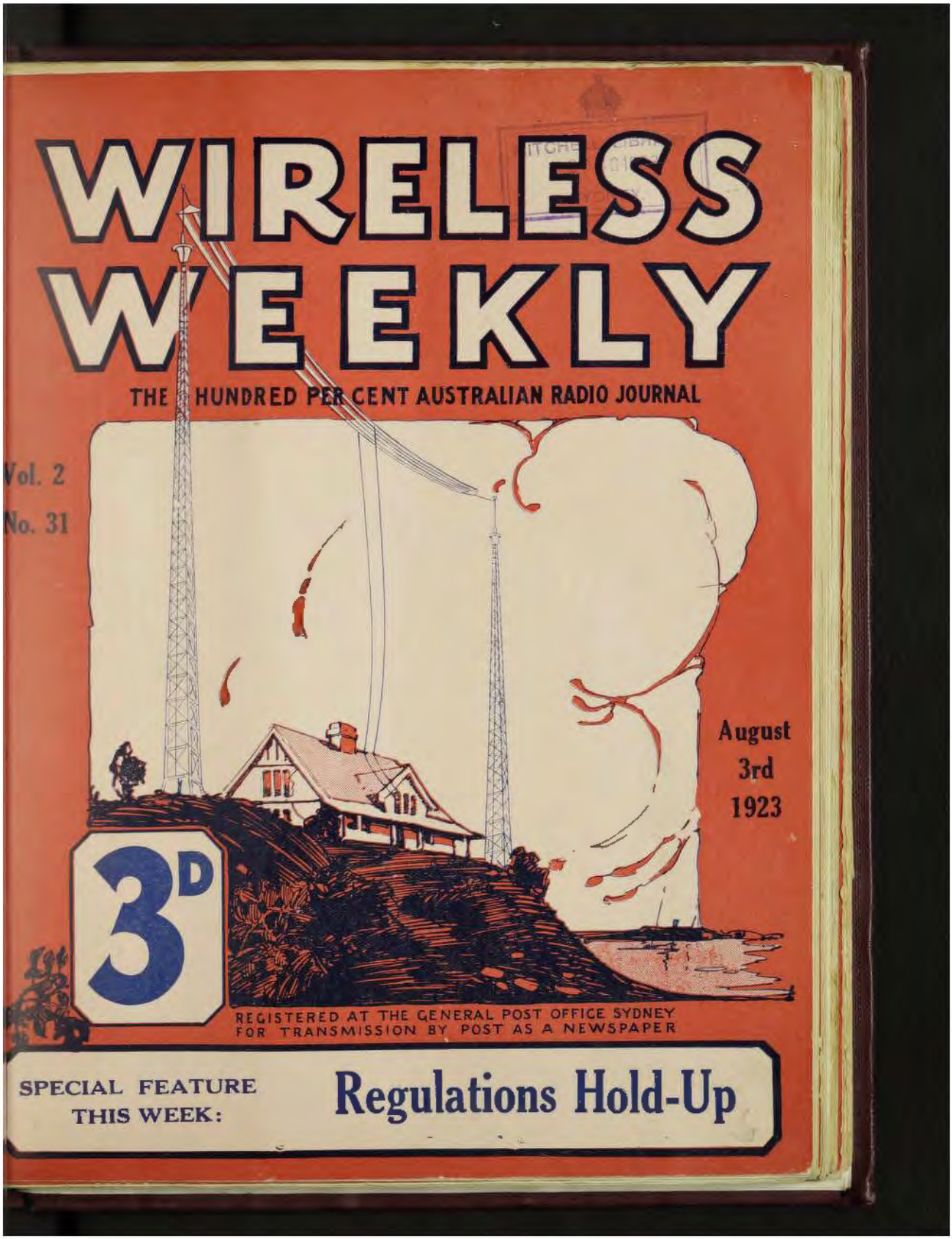


THE WIRELESS WEEKLY
A Journal Devoted to the Interests of Wireless Enthusiasts both Amateur and Professional

Vol. 2. August 3, 1923. No. 31

REGULATIONS HOLD-UP.

On Tuesday, 24th July, was received authentic information from Melbourne to say that the Regulations had been approved, and would be gazetted on Thursday, 26th July, and come in force on August 1st.

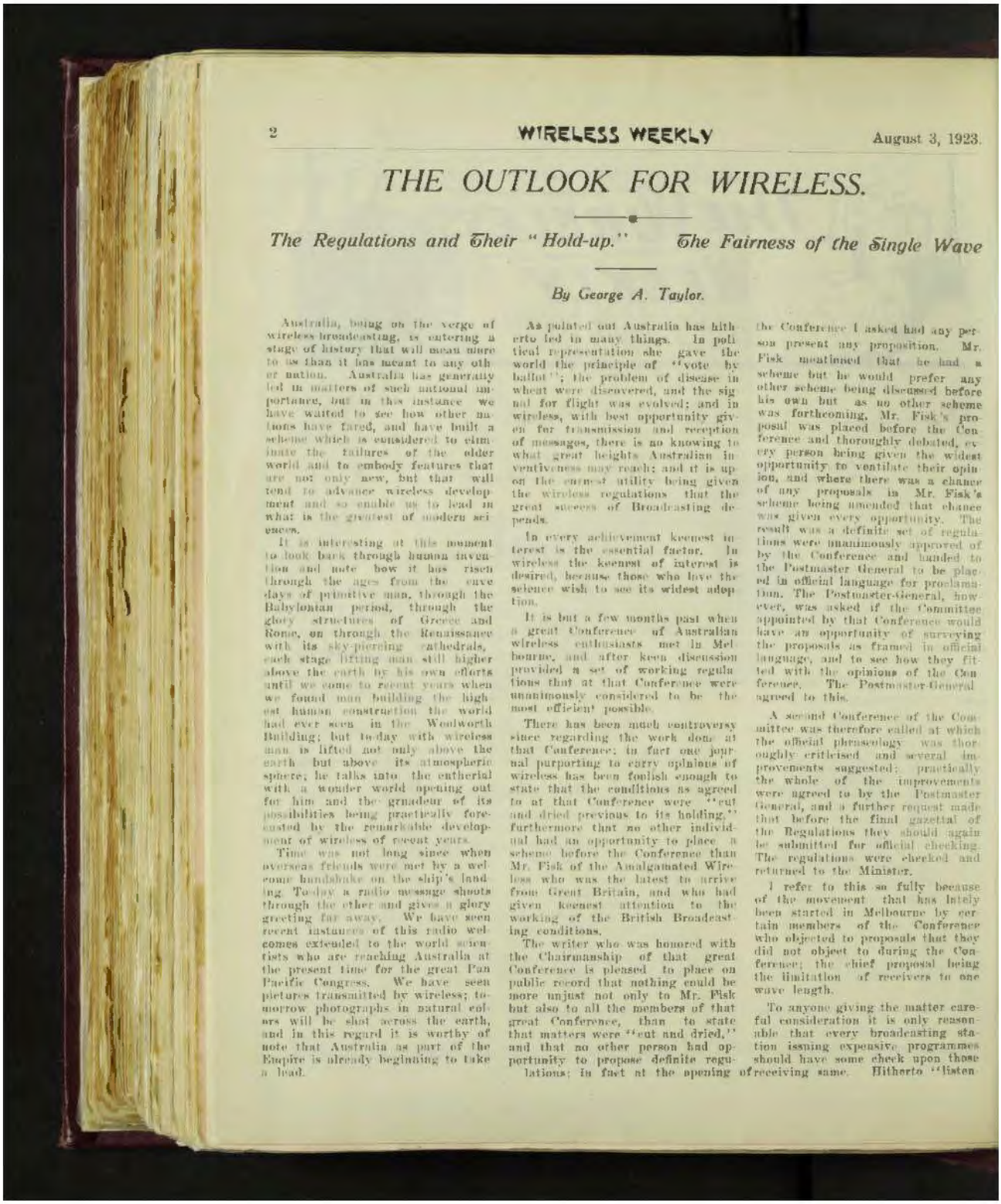
Between the two days apparently, certain influeuces got to work with the result that the Regulations are still held up.

An emphatic protest on behalf of the majority of Radio Retail Traders of New South Wales is here made with a request that the Regulations be put into operation at once, and at a later date amended if they are found not suitable.

Roster for Week ending 8th August, 1923

	7.30 to 8.0	8.0 to 8.30	8.30 to 9.0	9.0 to 9.30	9.30 to 10
Thursday, 2..	2 ER	2 GR	2 ZG		
Friday, 3 ...	2 DS	2 WV		2 BB	
Saturday, 4....	2 JM	2 BB	2 GR	2 ZG	2 ER
Sunday, 5....	7 to 7.45 2 GR		7.45 to 9.15 2 CM		9.15 to 10.0 2 JM
Monday, 6		2 WV	2 GR	2 ZG	2 ER
Tuesday, 7	2 ER	2 JM	2 GR		
Wednesday 8.	2 ZG	2 WV	2 GR		

Vacant times may be booked by Transmitters by ringing Red. 732 between 9 a.m. and 5.30 p.m. daily.



THE OUTLOOK FOR WIRELESS.

The Regulations and Their "Hold-up." The Fairness of the Single Wave

By George A. Taylor.

Australia, being on the verge of wireless broadcasting, is entering a stage of history that will mean more to us than it has meant to any other nation. Australia has generally led in matters of such national importance, but in this instance we have waited to see how other nations have fared, and have built a scheme which is considered to eliminate the failures of the older world and to embody features that are not only new, but that will tend to advance wireless development and so enable us to lead in what is the greatest of modern sciences.

It is interesting at this moment to look back through human invention and note how it has risen through the ages from the cave days of primitive man, through the Babylonian period, through the glory structures of Greece and Rome, on through the Renaissance with its sky-piercing cathedrals, each stage lifting man still higher above the earth by his own efforts until we come to recent years when we found man building the highest human construction the world had ever seen in the Woolworth Building; but to-day with wireless man is lifted not only above the earth but above its atmospheric sphere; he talks into the ontherial with a wonder world opening out for him and the grandeur of its possibilities being practically forecasted by the remarkable development of wireless of recent years.

Time was not long since when overseas friends were met by a welcome handshake on the ship's landing. To-day a radio message shoots through the ether and gives a glory greeting far away. We have seen recent instances of this radio welcomes extended to the world scientists who are reaching Australia at the present time for the great Pan Pacific Congress. We have seen pictures transmitted by wireless; to-morrow photographs in natural colors will be shot across the earth, and in this regard it is worthy of note that Australia as part of the Empire is already beginning to take a lead.

As pointed out Australia has hitherto led in many things. In political representation she gave the world the principle of "vote by ballot"; the problem of disease in wheat were discovered, and the signal for flight was evolved; and in wireless, with best opportunity given for transmission and reception of messages, there is no knowing to what great heights Australian inventiveness may reach; and it is upon the earnest utility being given the wireless regulations that the great success of Broadcasting depends.

In every achievement keenest interest is the essential factor. In wireless the keenest of interest is desired, because those who love the science wish to see its widest adoption.

It is but a few months past when a great Conference of Australian wireless enthusiasts met in Melbourne, and after keen discussion provided a set of working regulations that at that Conference were unanimously considered to be the most efficient possible.

There has been much controversy since regarding the work done at that Conference; in fact one journal purporting to carry opinions of wireless has been foolish enough to state that the conditions as agreed to at that Conference were "cut and dried previous to its holding," furthermore that no other individual had an opportunity to place a scheme before the Conference than Mr. Fisk of the Amalgamated Wireless who was the latest to arrive from Great Britain, and who had given keenest attention to the working of the British Broadcasting conditions.

The writer who was honored with the Chairmanship of that great Conference is pleased to place on public record that nothing could be more unjust not only to Mr. Fisk but also to all the members of that great Conference, than to state that matters were "cut and dried," and that no other person had opportunity to propose definite regulations; in fact at the opening of the Conference I asked had any person present any proposition. Mr. Fisk mentioned that he had a scheme but he would prefer any other scheme being discussed before his own but as no other scheme was forthcoming, Mr. Fisk's proposal was placed before the Conference and thoroughly debated, every person being given the widest opportunity to ventilate their opinion, and where there was a chance of any proposals in Mr. Fisk's scheme being amended that chance was given every opportunity. The result was a definite set of regulations were unanimously approved of by the Conference and handed to the Postmaster General to be placed in official language for proclamation. The Postmaster-General, however, was asked if the Committee appointed by that Conference would have an opportunity of surveying the proposals as framed in official language, and to see how they fitted with the opinions of the Conference. The Postmaster-General agreed to this.

A second Conference of the Committee was therefore called at which the official phraseology was thoroughly criticised and several improvements suggested; practically the whole of the improvements were agreed to by the Postmaster General, and a further request made that before the final gazettal of the Regulations they should again be submitted for official checking. The regulations were checked and returned to the Minister.

I refer to this so fully because of the movement that has lately been started in Melbourne by certain members of the Conference who objected to proposals that they did not object to during the Conference; the chief proposal being the limitation of receivers to one wave length.

To anyone giving the matter careful consideration it is only reasonable that every broadcasting station issuing expensive programmes should have some check upon those receiving same. Hitherto "listen-

Wireless Dance given by South Australian Division of the Wireless Institute of Australia

ers-in'' have had the privilege of altering their receivers to receive any wave length and so pick up any concert items or news matter that was being transmitted generally, and because future ''listeners-in'' are to be limited to one wave length to a particular broadcasting station in order to pay that broadcasting station what was listened to, petitions are now being prepared to hold up the Regulations practically indefinitely. It may be pointed out that it is just as fair to prevent the general ''listener-in'' as it is for a shop-keeper to say to a person ''you must pay so much for the particular goods I am selling instead of being able to take what you like from various shops.'' Furthermore, no sane person would consider it fair for any individual by means of a battery and a few yards of wire to connect up with the telephone wires passing the front of his house and have all the advantages of telephonic communication without paying for the privilege.

One reason for the objection to the limitation of wave length is that the firm that is in charge of that wave length may charge a heavy price for the use of same; a simple reply to that is that no person will be compelled to buy any particular wave length—there will be competition amongst broadcasting stations just as there is competition to-day amongst shops selling goods, and the firm that gives the best programmes at the most reasonable price is going to have the maximum business. Some broadcasting stations may commence by allowing ''listeners-in'' to have the use of their wave length free of charge, provided that the apparatus is bought from shops, licensed by that particular station; in fact, there are so many arguments in favour of the idea of a single wave length that the opposition is unreasonable. Furthermore, an important point to be taken into consideration is that Australia has waited long enough to get an efficient Broadcasting System in operation, and it is unfair to the various dealers in wireless apparatus and electricians generally to be so long delayed from the great business that will inevitably follow the gazettal of the Regulations for Broadcasting; hence there is everything against the attempted hold-up of the proclamation of the Regulations by some dissatisfied individuals.

In justice to them, however, I give them the credit of being in every way sincere in their endeavours to win what they consider would be a wider field for wireless activity; but it would be far more reasonable for them to agree to the proposed Regulations being put into practical operation so that in the event of any amendments being found necessary a united effort of all those interested in wireless development could be made to have such amendments put into effect. The wisest course, therefore, for all interested in the best development of wireless in this wide continent, that is keenly appealing for it, is to unite in an association such as the Association for ''Developing Wireless in Australia, New Zealand and Fiji, to develop this great science through its widest possibilities, and also to be a powerful factor for winning the best conditions for trading, as well as the best conditions for the public generally.

I cannot close this appeal that the fairness of the single wave be agreed to, without giving my best thanks to that fine army of enthusiasts — all the members of the recent Australasian Broadcasting Conference—coupled with every good wish to the Postmaster-General, Mr. W. G. Gibson and his capable Secretary, Mr. J. Oxenham, who I can personally vouch are as keen in giving the widest advantages of wireless to the public as the public is of receiving same.

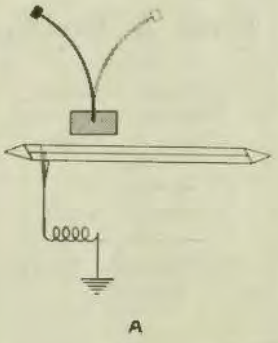
Rev. Hugh Thompson Kerr, of the Shadyside Presbyterian Church, of Pittsburgh, Pa., is minister of one of the largest ''Wireless Flocks'' in the world. He has received letters from hundreds in the United States and Canada, and the choir of his church has been heard many times in the sick wards of some of the best known soldier and sailor hospitals of the United States and Canada.

The Radio in Size between Your Antenna and Your Coil.

THE FOURTH OF A SERIES OF ARTICLES WRITTEN BY SIR OLIVER LODGE, F.R.S., D.Sc., LL.D.

"I propose here to interpolate, among calculated and practical considerations, a little theoretical point of some interest. For radio fans and amateurs, surely like to think occasionally of the ether whose properties they are utilising."—Author.

In electromagnetic waves the electric energy and the magnetic energy are equal. Or in more general terms, in every wave or system of waves, the kinetic and the potential energies are equal. This is obvious, because the energy alternates from one form to the other. At one instant it is static; at the next it is kinetic. Hence the two energies must be equal.



A

IS THIS RATIO BETTER—

Whether to use a small coil connected to a large antenna, in order to obtain a specified rate or vibration (as is shown in the accompanying diagram A), is analogous to the problem of determining whether to use a small weight connected to a large spring in order to obtain a similar result.

So it is also with the discharge of a Leyden jar, or any other capacity area. At one instant it is charged electrically, and at the next (that is, after a quarter swing) it is momentarily discharged, and all the energy is contained in the rushing current. Then once more the energy piles itself up statically in the opposite direction, and then swings back again. So it is, even in a swinging pendulum: the potential energy at the end of the swing is equal to the kinetic energy in the middle. So it is, also, in a vibrating spring.

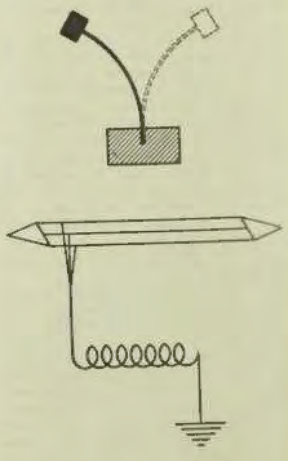
Consider, then, a spring with a load on it, which you can set vibrating. At the extremity of the swing the energy can be called "elastic energy," or the energy of recoil. It is static. It depends on the elasticity of the spring; it does not depend on the inertia of the load. It does not depend on inertia at all; it would be the same if the spring was bent an equal amount and not loaded.

But now let the spring go, and consider what happens as the load is rushing past the middle position. The whole energy is now the energy of movement. It depends wholly on inertia, that is, on the massiveness of the load; it does not depend on the elasticity of the spring at all. It would be just the same for the same moving load if the spring were simultaneously abolished.

This energy may be called "inertia energy," or the energy of current or movement.

The elastic and the inertia energies must be equal. The spring adapts itself to them. Its rate of vibration is thereby determined. If it is a very stiff spring with a small load it will vibrate with extreme rapidity. It must—in order that the motion energy can equal the elastic energy. If, on the other hand, it is a weak spring heavily loaded, it will vibrate very slowly, because, since the energy is small, the motion of a massive body must be slow.

Continued on Page 20



B

—THAN THIS RATIO?

Or should the experimenter use a large coil connected to a small antenna, as shown at B, in order to obtain the same results as in diagram A? The problem is comparable to that of determining whether to use a large weight on a small spring to attain the same rate of vibration as a small weight on a large spring.

MAKE YOUR OWN

Four Ways to Get Good Modulation.

PART II.

The four standard methods may be listed as (1), the use of the microphone in the antenna circuit for low-power transmission; (2), the use of a magnetic transformer; (3), grid modulation and (4) Heising modulation. The latter two of these methods are here described by one of the foremost authorities in this field—

PROF. J. H. MORECROFT.

When a vacuum tube is used to generate the high-frequency power sent off from the antenna by a radio telephone transmitter, the very rigid control which the grid potential exerts over the plate current offers a ready means for modulating the plate current—and the plate current controls the amount of power which the tube supplies to the antenna.

An arrangement suitable for a small transmitter that uses one tube is shown in Figure 1. When proper coupling is used between coils L1, L2, and L3 the tube will oscillate and supply alternating current to the antenna, the frequency of which is approximately that fixed by the inductance and capacity of the antenna circuit.

The amount of plate current which the D.C. generator B, supplies to the tube is determined by the potential of the grid of the tube, and this potential is controlled in turn by the voice currents set up by microphone M, acting on the grid through transformer A. The condenser C1, is advisable as it facilitates the oscillation of the tube; it must not be more than about .001 microfarad, however, otherwise distortion of the speech will result.

In some sets there is also connected across the secondary of transformer A (called the "modulation transformer") a resistance of about one megohm; it is supposed to improve the quality of the speech. The condenser C2, is advisable, not only to facilitate the setting up of oscillations but also to protect the insulation of the armature of machine B, which is subjected to high-frequency dielectric losses if not shunted by this condenser.

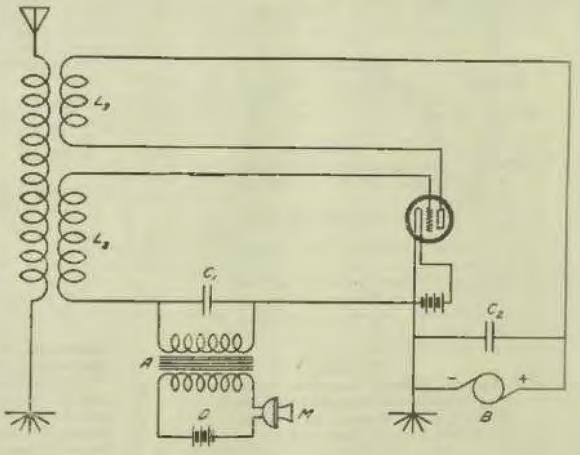


Figure 1

The modulation transformer A, must be especially designed for the microphone and tube with which it is to be used. It generally has a fairly high transformation ratio, sometimes as much as twenty-five to one.

The primary coil, in series with the microphone, must be of low resistance, as low as that of the microphone itself or lower; if not, the variation in microphone resistance, brought about by the voice waves, will not materially affect the current from battery D, and if this current does not fluctuate there will be no voltage induced in the secondary coil, and so the tube output will not be controlled.

It might seem advisable to wind the transformer with an extremely high ratio (say five hundred to one), so that even with but little fluctuation in the primary current sufficient voltage will be induced in

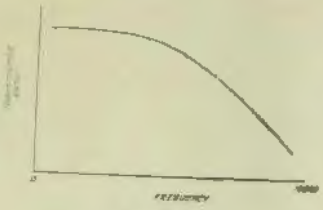


Figure 2.

the secondary to properly modulate the antenna output. Such a high ratio would require a great many turns of fine wire in the secondary, however; this would be sure to bring about speech distortion as the consonants, the high-frequency waves of the voice, would not be repeated through the transformer.

The voltage transformation ratio of a transformer is not the same for all frequencies; if the secondary has a great many turns this ratio decreases very rapidly for the higher voice frequencies.

This effect is suggested in Figure 2, which gives the ratio of transformation for such a transformer: for the high voice frequencies the ratio is much less than for the lower ones, so that the high-frequency consonants would not come through the transformer with their proper relative magnitude and the voltage affecting the grid potential would be deficient in consonant sounds. The power radiated from the antenna would thus be deficient in the high-frequency sounds of the voice and the speech received by the listener would be drummy and indistinct, no matter how good the receiving set might be.

It is to be pointed out, however, that even if the quality of the speech sent out by the broadcast station is excellent, an improper adjustment of a regenerative receiving set will always make it seem poor. A transmitting station is frequently blamed for poor speech quality when actually the quality is spoilt right in the receiving set itself; we shall analyze this point later.

The scheme given in Figure 1, which we have just examined, called grid modulation, is not all that might be desired because even with the best adjustment it is impossible to obtain a high percentage of modulation (which causes wide variations in the antenna current) without getting poor quality.

As long as we are content to change the amplitude of the antenna current by perhaps 25 per cent. (or in other words get 25 per cent. modulation) the quality of received speech is fair, but when it is pointed out that in radio telephone transmission it is the change in amplitude of the antenna current brought about by the voice and not the actual antenna current, which determines how far the signal will carry, it is evident that some scheme that will permit greater modulation is to be desired.

Such a one is indicated in Figure 3; in Europe it is called plate modulation, or choke-coil modulation, but in the United States it is styled the Heising scheme of modulation, because Heising was responsible for its development in this country.

This Heising method of modulating the antenna current is almost universally used in the better class broadcasting stations of to-day; although it is expensive to install and maintain, compared to the other schemes, the quality of speech obtained when it is properly adjusted makes it far superior to any other method so far devised.

Many radio enthusiasts seem to object strenuously to this scheme because they have to "waste" half their tubes; only half of them are oscillating to produce antenna power and their antenna current is much less than when they connect all their tubes in parallel to act as oscillators to supply power to the antenna, and modulate by the grid method.

With all the tubes acting as oscillators the antenna current is about 50 per cent. greater than when connected for the Heising modulation scheme; hence it seems as though the Heising scheme must be inferior to the other. But we have to again emphasise the fact that such a judgment is based on a misconception as to what radio telephony really is; as stated before the reading of the antenna ammeter is no criterion at all regarding the usefulness of a set to transmit telephone signals—it is the variation of antenna current produced by the voice that measures the station's efficiency and not the antenna current itself.

One transmitting station that has two amperes of current in the antenna as read on the hot wire ammeter, using the Heising modulation scheme, should be able to telephone twice as far as is possible for another station that has a much greater antenna current with a less perfect system of modulation.

In some of the large stations used for broadcasting it has sometimes seemed advisable actually to use more tubes for modulators than were used for oscillators.

The set shown in Figure 3 has only two tubes; in the average 500 watt broadcasting station two oscillators operate in parallel and either two or three tubes (of the same size as oscillators) are connected in parallel with each other to act as modulators. The connection scheme shown in Figure 3 was used extensively during the war for Signal Corps sets and for the sets used on naval vessels. The circuit is divided by the dash line to indicate the two parts; all the apparatus to the left is used to make the oscillator function to furnish the high frequency power to the antennas while that to the right is the required addition to the circuit to speech-modulate the antenna power.

The two tubes, oscillator and modulator, both draw their plate current through the iron-core choke coil D; for the ordinary five-watt tubes this coil should have an inductance of about two henries. The grid biasing batteries and filament current of both tubes are so adjusted that the plate current of each is equal and equal to about half the total possible plate current, fixed by the amount of electron emission from the filaments.

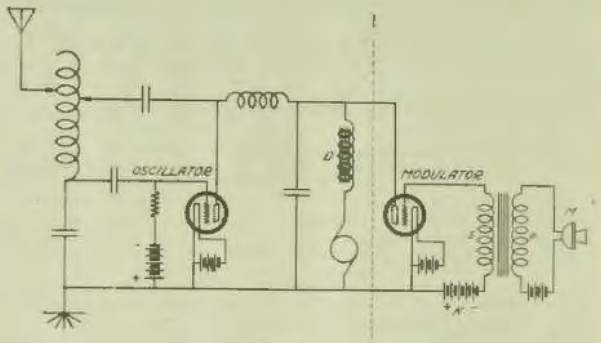


Figure 3.

In Figure 4 is shown the static characteristics of the two tubes (supposedly the same for each); the grid of each tube is so adjusted in potential that the current taken by each is equal in amount to AC of Figure 4, this equality of currents to be obtained when the oscillator tube is oscillating and no speech is acting on the microphone of the modulator. This means that the grid battery K of the modulator must have the voltage OB and that the grid battery voltage of the oscillator, plus whatever resistance drop there is in the grid leak due to the grid current taken by the oscillator, is also equal to OB.

As the amount of grid current flowing in the oscillator tube depends upon the adjustments of inductance, coupling, etc., the proper amount of grid battery for the oscillator cannot be obtained when the oscillator is not operating; no ammeter should be put in the plate circuits after the set starts to oscillate and the amount of grid battery adjusted to give equality of plate currents (the currents in the two plate circuits will not then be equal when the set ceases to oscillate). The amount of plate current in the oscillator, AC, corresponds to a cer

tain definite amount of power in the antenna.

If the grid of the modulator tube is now made to go up and down in potential, about the point B of Figure 4, the plate current of this tube must go correspondingly up and down. As both tubes get their plate currents through coil D, however, and as this has sufficient choking action (the technician says it has sufficient reactance) to maintain the current through itself essentially constant, the plate current of the oscillator must go down and up by the same amount that the modulator current goes up and down. The sum of the two currents must continually be equal to twice the current AC.

This means that if the modulator current decreases to the value AE, (Figure 4) the oscillator plate current must rise to AG so that AE plus AG is equal to twice AC. As stated before, the power in the antenna depends directly upon the amount of plate current supplied to the oscillator tube so that it is evident that the microphone M, controlling, through the modulation transformer S-P, the grid potential of the modulator tube, actually controls the amount of alternating current in the antenna. Moreover, the control exercised by this connection scheme is such that the fluctuation in amplitude of the antenna current represents the voice waves actuating the microphone M, more faithfully than is the case for any other modulation scheme so far tried.

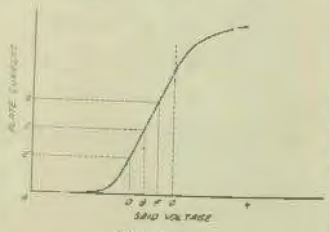


Figure 4.

In the large broadcasting stations the microphone does not directly control the potential of the modulator tube grids, so it is necessary to use some intermediate tubes for amplifying. Thus the microphone into which the broadcaster talks works into an ordinary resistance-coupled, two or three-tube speech-amplifier which controls the grid potential of a five-watt tube; this tube controls the grid potential of a fifty-watt tube, which, in turn, acts directly on the grids of the modulator.

In this manner have the skilled researchers in this branch of radio communication developed that wonderful system of control by which the micro-watts, sent out by the voice, control, accurately and instantaneously, the kilowatts of power necessary for communicating the hundreds and thousands of miles which are now easily covered by all the best radio telephone stations.

Amateur Wireless Licenses.

VICTORIA.

Wireless Licenses for experimental purposes have been issued during the month of May, 1923, to the following:—

RECEIVING ONLY.

Call Sign.	Name.	Address.
3 W D	Anthony, T. C.	82a The Esplanade, Middle Brighton. R.
3 W E	Myer's Pty., Ltd. (G. W. Steane)	Bourke St., Melbourne. R.
3 W F	Wentworth, C. S.	91 The Avenue, Coburg. R.
3 W G	Johnson, C. E.	236 Montague St., South Melbourne. R.
3 W H	Owen, F. P.	40 Rothesay Ave., St. Kilda. R.
3 W I	Rogers, V. E.	5 Stirling St., Kew. R.
3 W J	Richardson, R. G.	228 Montague St., South Melbourne. R.
3 W K	Gates, D. J.	Errol St., Footscray. R.
3 W L	Crook, B. H.	201 Auburn Rd., Auburn. R.
3 W M	Woodbridge, J.	100 Union St., Windsor. R.
3 W N	Parker, A.	35 Hoddle St., Elsternwick. R.
3 W O	Brayton, E.	Benjamin St., Sunshine. R.
3 W P	Davidson, J. H.	35 Albert Rd., South Melbourne. R.
3 W Q	Hart, W. L.	35 Bellairs Ave., Yarraville. R.
3 W R	Riddle, E. D.	19 Hawthorn Rd., Northcote. R.
3 W S	Searle, S.	15 Campbell Grove, Northcote. R.
3 W T	Officer, V. W.	384 Neerim Rd., Murrumbeena. R.
3 W U	Judd, A. J.	28 King St., Prahran. R.
3 W V	Hopkins, W. R.	14 Broadway, Camberwell. R.
3 W W	Bowyer, F.	20 Moonya Rd., Murrumbeena. R.
3 W X	McKendrick, W. T.	19 Munro St., Armadale. R.
3 W Y	Briggs, D. C.	Carrier St., Benalla. R.
3 W Z	Reid, W. M.	178 Lygon St., East Brunswick. R.
3 X A	Cross, C.	99 Ballantyne St., Northcote. R.
3 X B	Osborn, A. G.	35 Ormond Rd., Moonee Ponds. R.
3 X C	Elder, N. G.	17 Adelaide St., Malvern. R.
3 X D	Parsons, G. R.	Edward St., Kew. R.
3 X E	Thorne, S. N.	21 Meek St., Brighton. R.
3 X F	Chaffer, M.	41 Norwood Crescent, Moonee Ponds. R.
3 X G	Morris, H. W.	8 Johnston St., Glenferrie. R.
3 X H	McLeod, H. A.	28 Wandra Rd., Malvern. R.
3 X I	Damyon, F. G.	165 Glen Eira Road, Ripponlea. R.
3 X J	Purbrick, J. M. deV	Wangaratta. R.
3 X K	Paynter, J. E.	Mitchell St., Euchuca. R.
3 X L	Snell, A. H.	21 Grant St., Brunswick. R.
3 X M	McCulloch, G. R.	511 Havelock St., Ballarat. R.
3 X N	Leaney, W. G.	12 Henry St., Northcote. R.
3 X O	Adams, F. J.	43 Bay St., Brighton. R.
3 X P	New Systems Telephones (R. Allsop)	54 Market St., Melbourne. R.
3 X Q	Twiss, N. A.	14 McMillan St., Elsternwick. R.
3 X R	Shapcott, L. C.	63 Rowena Parade, Richmond. R.
3 X S	Rains, A. L.	236 Glenhuntly Rd., South St. Kilda. R.

The Flame Microphone.

SOUND WAVES IN AIR ARE TRANSLATED DIRECTLY INTO ELECTRICAL ENERGY THROUGH A FLAME, WITHOUT VIBRATING DIAPHRAGM. IT IS THE RESULT OF PHONOFILM DEVELOPMENT.

By Dr. LEE DE FOREST.

Following the cordial public reception given to the invention of the de Forest Phonofilm or talking motion picture which was formally given a demonstration before the members of the New York Electrical Society in the Auditorium of the Engineering Societies Building, Dr. Lee de Forest announces that he has realised the dream long held by telephone engineers, namely, the translating of sound waves in the air directly into electrical currents, thereby eliminating the vibrating diaphragm.

An entirely new form of microphone device has been evolved by the inventor, in part as a result of his development of the Phonofilm, a speaking flame, if you please, which gives promise of revolutionising the present methods of transmitting voice sound waves into electrical waves and without the distortion associated with the older methods of voice transmission. The field of immediate application of the talking flame device is not only in the province of the talking motion picture film, but in the world of radio as well, and especially in those stations used for broadcasting the human voice to the millions of radio listeners throughout the country.

DIRECT TRANSFORMATION OF SOUND INTO ELECTRICAL ENERGY.

"In response to the numberless inquiries of scientists, educators, engineers and others directly interested in the development of the talking motion picture art," says Dr. de Forest in a statement issued by the de Forest Laboratories, "I should like to take this occasion to announce that as a result of my development of the new Phonofilm my investigations and experiments have resulted in revealing what I consider will be another revolutionary step forward in the transmission of the human voice or sound through space. The advance itself may be regarded as a technical one from the engineering point of view, and yet from the benefits to be derived from the world at large the improvement is somewhat marvellous in that by means of it hereafter we shall be enabled to change voice or sound waves directly into electrical energy.

NO DIAPHRAGM USED.

"It has for a long time been realised by telephone and acoustic engineers that the necessity for a diaphragm at the transmitter introduces at the very outset of the sound translation problem a source of distortion and imperfection. It is the diaphragm more than any one element which introduces the deformation in recording and in reproducing voice and music on the phonograph as well as in telephone transmission. Therefore for many years efforts of telephone and phonograph engineers have been devoted to reducing as far as possible distortions thus introduced by the natural period of vibration of the diaphragm, or membrane, against which the sound waves impinge. But these engineers have not looked elsewhere in the realm of physics with sufficient scrutiny. Otherwise we should long ago have been free of the necessity for using any diaphragm whatsoever at the transmitter element of apparatus, the object of which is to translate sound into electric currents with the minimum possible distortion, regardless of the expense of the elaborateness of the apparatus thereby involved. I do not here refer to the ordinary microphone transmitter, millions of which are in use throughout the world, and which must necessarily be as simple and cheap as possible. For such telephone apparatus the carbon microphone with diaphragm may possibly always be used.

PROVIDE ACCURATE TRANSLATION.

"But where exact and accurate translation of sound waves into electric currents is desired it is quite unnecessary to use a vibrating diaphragm. There are, I have found, a variety of ways of doing this. The discovery of the Audion first came to me as a result of observation of a sensitive gas flame. From this rudimentary idea, which originated in 1900, was developed, during the ensuing five years, the three-electrode vacuum tube which was destined to become the telephone repeater or amplifier for which telephone engineers had been vainly searching for 20 years. For these were working, always along the well beaten path of a telephone receiver clamoured by some more or less ingenious method to a carbon microphone controlling a local source of electric energy.

"And now, in exactly the same way, starting from exactly the same point of investigation, the sensitive gas flame, has been evolved a new form of microphonic device, which does directly what the telephone engineers have so long vainly dreamed of accomplishing, that is, turning sound waves in the air directly into electric currents. Take the ordinary bat-wing gas burner or a certain form of Welsbach mental gas light, or special forms of oxy-acetylene gas flames, insert two heat resisting electrodes therein, in proper relation to the flame and to each other, connect these electrodes

to an appropriate electro-motive force. You will then have an extremely sensitive sound converter which gives an electric reproduction of the sound waves in the air enveloping the flame which is of an entirely different order of fidelity from that ever obtained from any form of microphonic device, using a diaphragm whether this be of the carbon, electro-magnetic, or electro-static variety.

"Here again history repeats itself. After I had first used the gas flame as a detector of wireless signals I next tried the intensely heated gas in an electric arc and found the same phenomena, although very imperfect on account of the overwhelming loud disturbances due to the arc itself. So again it has been found that a long electric arc in the air possesses the property of modulating to some extent the electric current passing between the electrodes in response to the changes of air pressure produced by the impinging sound waves.

"In Germany, an investigator by the name of Vogt, has found a similar action in the ionic currents passing through the air between a Nernst glower and cold anode placed nearby. All of these electric reproductions of sound waves are naturally extremely weak, and must be amplified, by means of a series of Audion amplifiers, several thousand times before they can be applied to any useful purpose.

"More recently Dr. Phillip Thomas, of Pittsburgh, has demonstrated that a high-potential low-current discharge between two electrodes in air may be 'modulated' by sound waves. This is a return to the method which I showed in a patent taken out in 1906 for controlling very simply by the voice the high-frequency, high-potential currents in a radio telephone transmitter.

THE THERMO MICROPHONE.

"But I have found still another method of translating sound waves direct into electric currents without the imposition of any diaphragm. This arrangement, independently suggested to me by Mr. Theodore W. Case, is the reversal of the well-known 'Thermophone,' a device wherein an extremly fine platinum wire, through which is passed telephonic currents, reproduces these in the form of sound waves due to the alternate heating and cooling of the air immediately surrounding the extremely fine wire.

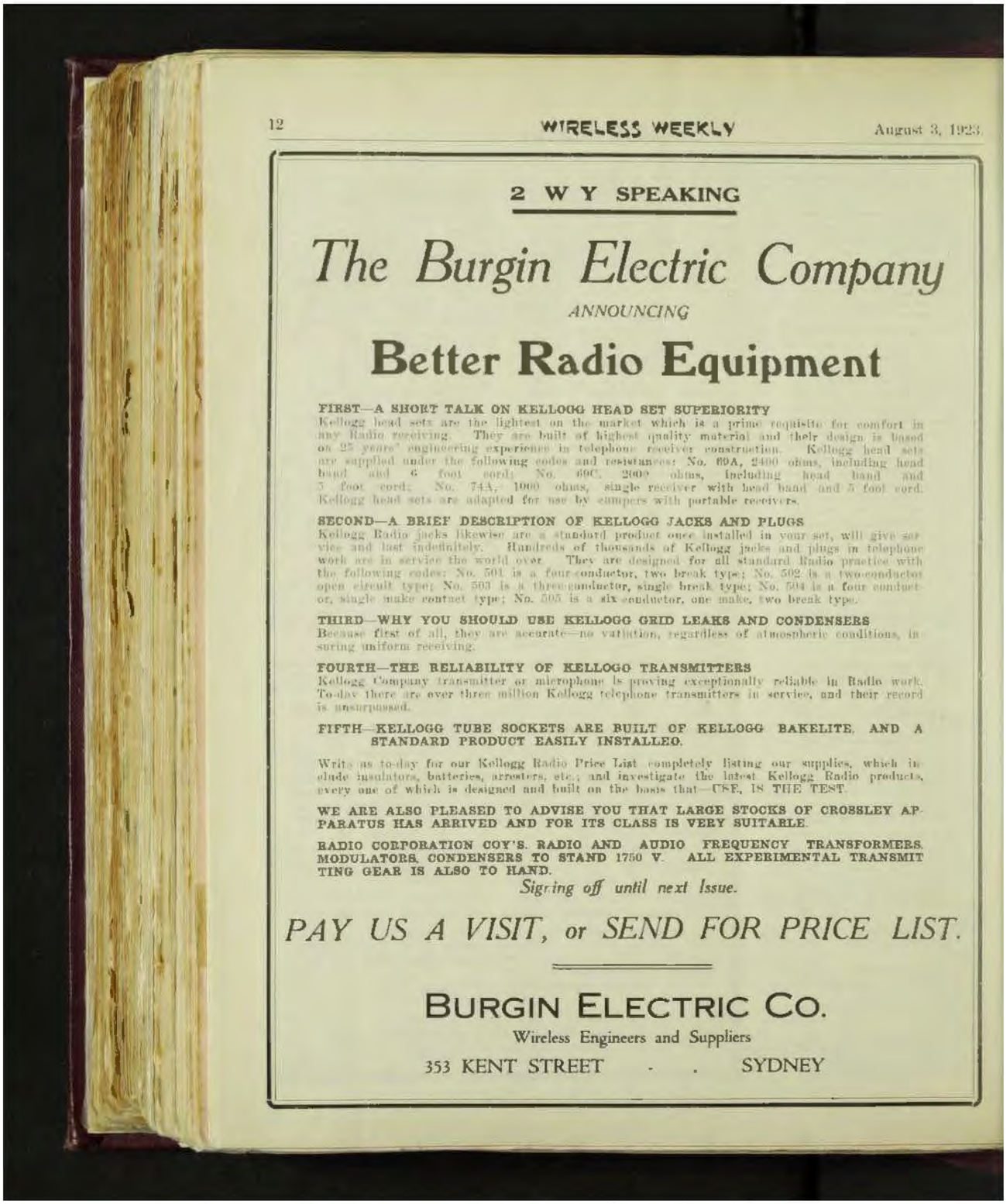
"In my phonofilm work we have found in the same way that when a series of very fine and very short platinum wires are heated to a dull red from a local source of current the resistance of these wires changes, alternately increasing and decreasing in conformity with the sound waves impinging thereon; so that from a telephone transformer connected in series with the battery and this thermo-microphone, a remarkable faithful representation of the sound wave is obtained, even though the frequency of these be as high as 3000 per second. The sensitiveness of this device is greatly enhanced through a gentle stream of air, by fluid evaporation in the neighbourhood, and by other auxiliary means. In a word, therefore, there now exist several ways of obtaining extraordinarily faithful reproductions of sound waves in the form of electric currents, entirely unlike the diaphragm methods on which telephone engineers have been working from the beginning of their art.

"Part of the sound records used in the Phonofilm have been made by utilising one or the other of the new converters which I have just been describing. Of all the diaphragm types of transmitters unquestionably the electro-static type as perfected by engineers of the Western Electric Company comes nearest to approximating perfection. While this is extremely insensitive compared with the best carbon microphonic type, there is no comparison between the fidelity of reproduction by the two means. But one listening in a telephone to the reproduction by means of the flame microphone, and then by means of the electro-static microphone, will at once exclaim that the fidelity of reproduction in the first case is of quite a different order from that obtained even from the highly perfected diaphragm of the best electro-static microphone."

With a new type of wireless receiving set, music and speech may be received over long distances without the troublesome and complicated storage battery.

Cadmium, one of the metals with which the public has little in common, is used in a new type of storage battery tester to accurately determine the conditions of the battery plates.

Conversation, speeches, and music from "WJZ," the Newark broadcasting station of the Westinghouse Co., have been heard and reported in England.

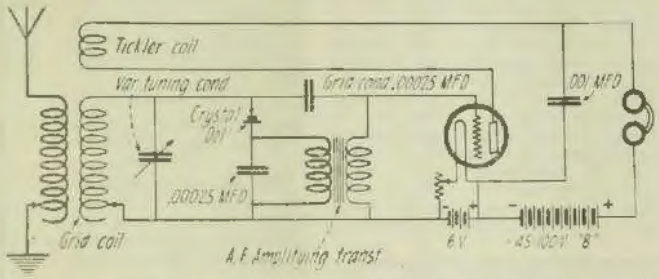


Simple Reflex Circuit.

By CLYDE J. FITCH.

A very simple reflex circuit that is especially adapted for broadcast reception is shown in the illustration. This circuit is much simpler than the regular reflex circuit in that it uses less equipment to attain practically the same amplification and in addition is easier to tune. The results obtained from this circuit were made possible by simply combining the regenerative property of a vacuum tube with the detecting property of a sensitive crystal, and then using the same vacuum tube for a one-step audio-frequency amplifier. This circuit has been thoroughly tested and has given excellent results.

Almost any simple one-tube radio receiving set can easily be converted into this simple reflex set by merely adding an audio-frequency amplifying transformer and a crystal detector and making a few minor changes. Much louder signals will be the result, and the additional expense is well worth while.



(Continued on Page 16)

CROYDON RADIO CLUB.

The last meeting of the Croydon Radio Club was held at the club rooms, "Rockleigh," Lang Street, Croydon, on Saturday, July 21st.

The need for members of the club to become proficient in Morse code was stressed, and such practice will be given at every meeting. The club is fortunate in having some first-class operators among its members, who are willing to instruct members.

Mr. McIntosh (2ZG) was present, and gave a very interesting lecture upon the development of the science of radio telegraphy and telephony, as well as some useful hints on experimenting.

Mr. McIntosh is known as a very keen experimenter, who is always ready to give the experimenter valuable and interesting information which he has acquired by experimenting.

The members were very grateful for the lecture, and a hearty vote of thanks was passed to the lecturer.

An invitation was received from the North Sydney Radio Club to visit them on one of their club nights.

Meetings are held every Saturday evening, at 7.30. Intending members should communicate with the Hon. Secretary, G. Maxwell Cutts, "Carwell," Highbury Street, Croydon.

CORRECTION.

We wish to correct a statement in our Victorian Notes on July 10, Vol. 29, that Amalgamated Wireless broadcasted on their De Forest Radio Phone. The machine that was actually used was a Marconi Standard ½ K.W. Set.

AMATEUR RADIO TESTS WITH NEW ZEALAND.

4th AUGUST TO 18th, 1923.

The tests will commence nightly the above dates. One N.S.W. transmitter and one N.Z. transmitter will work each night.

The tests will commence nilghtly at 9.30 p.m. and continue until 10.10 p.m. A N.S.W. transmitter

will start the test each night. Each transmitter will be allowed twenty minutes during which time he may send C.W. alone or ten minutes C.W. and ten minutes 'phone.

Each transmitter will be given two secret call signs, one to be used for C.W. and the other for 'phone. During transmission each station must send his call signal and secret call at least 8 (eight) times at a speed of eight words per minute. Complete short messages may also be sent, and if 'phone is used one loud gramaphone record should be played.

Between 3 a.m. and 7 p.m. on both Sundays during the tests, will be a "free for all" period, but before starting to transmit make sure that you are not going to interfere with another transmitter.

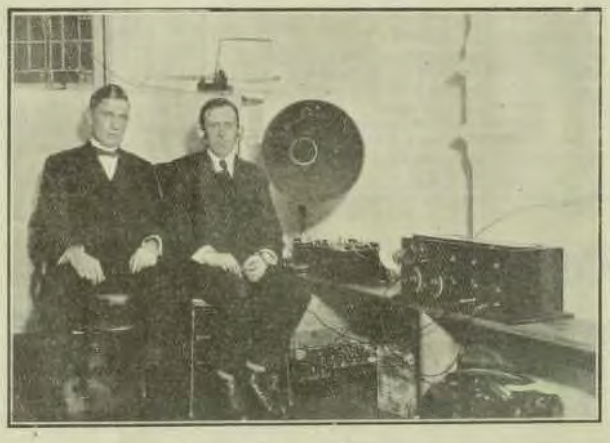
After the New Zealand transmitter has finished each night, the successful log using the least number of valves.

Logs should be forwarded to the Organising Secretary, immediately the tests finish. Any arriving after August 25th cannot be recognised.

Results will be announced at a special meeting to be held on Monday, 10th September.

CAMPSIE AND DISTRICT RADIO CLUB.

The 26th general and business meeting of the Campsie and District Radio Club was held in the club room, Graveur's Hall, Beamish St., Campsie, on Wednesday, July 18th, at which was a very good attendance. Mr. Mawson delivered a lecture on valves, also the discovery of the Flemming valve, which proved very interesting and instructive. After his address Mr. Mawson was accorded a vote of thanks,



Mr. L. C. Jones Giving a Wireless Demonstration.

New South Wales transmitter should, if he has been reported Q.S.A. by the New Zealand transmitter, call him up and carry out definite two-way communication.

This test will commence on August 4th and continue to 18th August. Mr. B. McIntyre informs us that he has now made arrangements that will allow for late entries until the 1st of August, but it will be necessary to apply directly to Mr. McIntyre at Livingstone Avenue, Pymble.

Prizes will be awarded to the transmitting station who is received strongest in New Zealand using the minimum of power, and to the receiving station with the most successful log using the least number of valves.

which was carried by acclamation.

Questions asked by various members were next dealt with.

Mr. Mawson (2DH) proposed to transmit from his station buzzer messages to the club for our next meeting. Members who have head 'phones are requested to bring them along, and so make the evening interesting.

All inquiries as to membership should be addressed to the Hon. Secretary, W. Hughes, "Lock Venachar," Evaline Street, Campsie.

The first half-yearly meeting of the Campsie and District Radio Club was held in the club room, Graveur's Hall, Beamish Street, Campsie, on Wednesday, July 11th.

After the minutes had been read and received, the election of officers for the ensuing half-year took place, which resulted in the following: President, R. Shelton; Vice-Presidents (2), R. Hobbs and A. Keep; Secretary, W. Hughes; Assistant Secretary, E. R. Mawson; Treasurer, W. Hughes; Technical Committee, E. R. Mawson, A. Keep, R. Hobbs, R. Shelton, W. Hughes; Club Council, A. Keep, O. E. Henry, E. R. Mawson, R. Hobbs, R. Shelton, C. Weinert, W. Hughes; Auditors, E. R. Mawson and R. Hampton.

NORTHBRIDGE AND DISTRICT WIRELESS EXPERIMENTAL SOCIETY.

The general monthly meeting of the Society was held on July 25th, in the Society's club rooms.

Previous to the meeting starting the members present were listening in on the club's set.

The President during the meeting, stated that the electric light power having been completed, the society was now in a position to charge accumulators, etc., of their own.

The society has extended an invitation to the members of the local sub-branch of the R.S. & S.I.L.A. to a wireless concert, at the society's room, on July 26th. The Hon. Secretary, A. H. Vincent, "Abbeyville," Sailors' Bay Road, Northcliffe, would be pleased to answer any communications.

KILLARA RADIO CLUB.

The sixth general meeting of the Killara Radio Club was held on July 20th.

After half an hour's buzzer practice, Mr. Greenwell took the chair, and called the meeting to order.

Lectures were then delivered by Messrs. Hurll and Gray, the former on inductance and capacity, which was explained by an analogy, and the latter on the principles of the valve.

At the next meeting a demonstration of long wave reception will be given by some of the members, also a lecture on the construction of valve sets.

Please address all communications to the Secretary, "Moylough," Florence Street, Killara.

COASTAL RADIO SERVICE.

Mr. C. M. Urquhart, radio telegraphist, Broome Radio Station, transferred to Wyndham Radio Station as radio telegraphist in charge.

Mr. R. C. Anderson, radio tele-

graphist, Wyndham, transferred to Perth Radio.

Mr. E. J. Roberts, radio mechanic, Wyndham Radio, transferred to Perth Radio, on completion of tropical service.

Mr. D. Bowles, radio mechanic, Brisbane radio, transferred to Sydney Radio.

Mr. A. P. Hosking, radio telegraphist, Melbourne Radio, transferred to Broadcasting Department at Melbourne.

Mr. J. M. Johnson, radio telegraphist, Adelaide Radio to Engineering Department at Sydney.

Mr. J. G. Cookson, radio mechanic, Sydney Radio, to Broadcasting Department at Sydney.

MARRICKVILLE AND DISTRICT RADIO CLUB.

A business meeting of this club was held in the club rooms, Perry Street, Marrickville, on Monday, 23rd instant.

In view of the fact that the club was moving to new premises at the School of Arts, Illawarra Road, Marrickville, the main part of the evening was taken up on matters concerning reorganisation. A motion is at present before the chair that the club restricts its membership to fifty.

LEICHHARDT AND DISTRICT RADIO SOCIETY.

On Tuesday, July 24th, members of the Leichhardt and District Radio Society held their 40th general meeting, in the club room, 176 Johnston Street, Annandale, when a very interesting and instructive lecture in the nature of a travelogue was delivered by Mr. William J. Zech. It was illustrated by a number of very fine lantern slides, the lantern being kindly loaned and operated for the occasion by Mr. Geo. Collett. The lecturer dealt with a great variety of subjects and places from all over the world, and the night's entertainment was greatly appreciated by all present, who accorded the lecturer a very hearty vote of thanks by acclamation at the conclusion of his discourse.

The next meeting is a business one, to be held on Tuesday next, August 7th, and a good roll up of members is anticipated on that occasion.

Inquiries from those interested in the activities of the society are welcomed, and should be addressed to the Honorary Secretary, Mr. W. J. Zech, 145 Booth Street, Annandale.

WYONG RADIO CLUB.

Last week end the members and officials of the newly formed Wyong Radio Club entertained Messrs. Renshaw and Mingay, Hon. Secretary and Hon. Treasurer respectively of the Wireless Institute, in a manner which left nothing to be desired.

Wyong, situated beyond Gosford, and near Tuggerah Lakes, extended the invitation unofficially as the Club has only just come into being and it was desired that members and officers should receive some illumination from their visitors regarding the task they have undertaken, viz., that of making their club as near the best as possible in the State. The visitors left Sydney on the mid-day train on Saturday, arriving at Wyong about 4 p.m., and were welcomed on arrival by Mr. Percy Macdermott, President, and Mr. Albert H. Warner, Patron. A fine demonstration set was taken along by Messrs. Renshaw and Mingay, and they were at once driven to the residence of the Hon. Secretary, Mr. S. Adams, where the set was installed on Mr. Adams' aerial. A preliminary test was conducted before tea and using

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(Continued from page 13.)

To convert the simple one tube receiving set into the standard reflex set, a radio-frequency amplifying transformer and a potentiometer will be required, in addition to the above equipment; therefore, this simple reflex set is less expensive and easier to construct, and consequently represents a gain in efficiency.

The diagram gives practically all of the information required to connect the apparatus. It may be well to mention here that better results are obtained with a double circuit tuner as shown than with a single circuit tuner, due to the fact that the addition of a crystal detector introduces resistance into the circuit, and this resistance tends to decrease the selectivity and thereby makes it difficult or practically impossible to tune out the unwanted stations and still retain the wanted station. As the crystal detector circuit absorbs much of the radio-frequency energy, it is necessary to use a tickler coil that is capable of very close coupling to the grid coil, for which honeycomb or spider web coils may be used.

Various types of audio-frequency transformers were tried in this circuit, and all types gave excellent results, although the high ratio transformers, some as high as 10 to 1, seemed to give the best results. Different types of crystal detectors were used, and all proved successful; also different values of fixed condensers were tried, but the values indicated in the diagram gave the best results.

Tuning is accomplished by first tuning in the station with the crystal detector disconnected, thus putting the audio-frequency transformer out of use, except for the fact that the secondary of the transformer is used for a grid leak resistance. Many crystal detectors may be disconnected by simply removing the cat whisker from the crystal. Now the station may be tuned in the circuit being the same as a single tube regenerative circuit. After tuning in the station to its maximum intensity with the tickler coil placed as close as possible to the grid coil without generating oscillations in the circuit, the crystal detector may be connected, and if adjusted on a sensitive spot, the station will be nearly as loud as before. As the crystal detector circuit absorbs some of the radio-frequency energy from the grid circuit, it will be necessary to move the tickler coil up closer to the grid coil before the tube starts to generate oscillations again. A slight read-

justment of the tuning condenser will be necessary after moving the tickler coil. Obviously, more energy is fed back from the plate circuit of the tube to the grid circuit with the closer coupling, and more energy is absorbed in the crystal detector circuit where it is rectified and passed on through the amplifying transformer and impressed on the grid and filament of the tube in the form of audio-frequency energy, where it is amplified by the vacuum tube and made audible in the phones or loud-speaker. The stations will then be received.

To the Editor

AUSTRALIAN AMATEUR TRANSMITTERS.

Cremorne.

Dear Sir,

May I, through the medium of this widely read paper, take the liberty of asking you a favour? It seems a wonder to me that it has not before been asked—and granted—being practically a necessity to experimenters. It is simply, will the transmitters of this and other States please send their call signs in C/W before each record.

We are all aware of the fact that C/W carries much further than speech, and to the experimenter who cannot always hear the speech of a distant station loudly enough to "log" the call it would be a great boon. There are, of course, many stations who do this, but then again there are some who do not like the Morse part as much as the speech. Frequently I have heard carriers of distant stations, presumably in other States, but even though I have waited for ten minutes or so in the hope of "logging" the call, no Morse was forthcoming.

Recently I saw a letter in this paper stating that the N.S. Welshmen do not seem as enthusiastic about testing with other States as those of other States, but if this request is granted it will be no longer necessary to arrange tests, as every station will give distant fellow experimenters a fair chance of doing their best.

If the lucky owners of transmitters will grant this favour, they will, I am sure, have the hearty thanks of all real experimenters as well as those of

C. P. SMITH.

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a detector and two stages of audio, Mr. Marsden was brought in strongly. Arrangements had been made for Mr. Marsden to transmit a special message to Wyong Club during his transmission period on the Saturday night.

A full meeting of members took place at 7.30 p.m., and was addressed by the visitors at length, as all present were quite new to radio. After the address everybody listen-

ed in and Messrs. Marsden, Best, McIntosh, Marks and Colville were all heard in the order of roster time mentioned.

Strength in all cases showed little variation, though Messrs. Marsden and Marks were the strongest. The meeting adjourned at 11 p.m., and the members again met on Sunday morning when Mr. Renshaw and Mr. Mingay in turn lead their listeners through elementary principles and set operation.

On Sunday afternoon the visitors were taken in charge by Mr. L. Warner, and a visit of inspection was made of the new club-rooms near the railway station which were considered excellent. A motor run through the district as far as Gosford was then indulged in and proved very refreshing. A stop for tea was made at Mr. Warner's home on Wyong River after which the train was taken for home.

Messrs. Renshaw and Mingay speak in very glowing terms of the hospitality extended to them and the great enthusiasm of the members of the new club.

Two big generators of 28,000 Kv-a each, which have been under test in the Westinghouse shops, will soon be shipped to Southern California within a few miles of the Mexican border. They are for the new hydro-electric development of the Southern California Edison Company.

"The Wireless Dispatcher" has arrived. Boss John Frazier, of the telephone department of the Westinghouse Electric Company at East Pittsburgh, "dispatches" prize fights, conventions, banquet speeches, and music from places in and near the city of Pittsburgh, Pa., to all of the KDKA wireless listeners.

The Australasian Radio Relay League

By J. W. Robinson, Publicity Officer, Australasian Radio Relay League

Wireless Weekly has been appointed the official organ of the Australasian Radio Relay League. This decision was arrived at at a meeting of the committee which was held on Thursday July 19, when the matter of publicity was fully discussed.

In the absence of the President (Mr. Charles Maclurcan) and the Vice-Presidents, Mr. W. J. Macardy, Treasurer, occupied the chair.

The publicity officer of the League (Mr. J. W. Robinsan) furnished a report urging the members of the committee to take immediate steps towards appointing an official organ for the purpose of being able to make authoritative statements on behalf of the body. In this report he pointed out that the American Radio Relay League which is a well and successfully conducted movement conducts its own official magazine named "Q.S.T." This book, which is issued monthly does much towards keeping members of the League together and is in a large way successful for the healthy position in which the American League finds itself to-day. It is read by all the American League members and thus keeps them well posted with current happenings among amateurs who are members of the League. The Australasian League the report stated was not in a position to warrant it attempting to conduct an official publication of its own, but it was desirable that one of the Radio Journals should be asked if it would act as the official organ of the League. There were several radio papers published, but the publicity officer recommended Wireless Weekly on the ground that it was printed weekly and would constantly keep members in touch with the doings of the committee and League members.

Mr. Maclardy, Editor of Wireless Weekly, informed the meeting that he would be pleased to allow the paper to act as the League's official organ and added that if the meeting decided to appoint it as such, he would see that the League was catered for in its columns. He would reserve a certain amount of space in each issue, and no doubt the publicity officer would avail himself of the opportunity to fill it.

On the motion of Mr. Charlesworth, seconded by Mr. Marsden, it was unanimously decided to appoint Wireless Weekly as the official organ of the League.

Each issue of Wireless Weekly will, therefore, contain details of the doings of League members. At the present time when the efforts of the League officials are fully concentrated on the organising of the movement, there may be but little to chronicle, but when operations are in full swing, both active and associate members will doubtless find in the columns of Wireless Weekly much that will interest them.

WORK OF THE COMMITTEE

The members of the committee have been hard at work during the past week and have now almost completed the arrangements for actual working. After much discussion the State has been divided into districts and a special plan has been prepared showing these divisions. It is hoped to publish this diagram in the near future.

Within a few days steps will be taken to circularise amateurs, and to point out to many, who up to the present have not displayed any great amount of interest in the League, the benefit which they may secure by becoming members.

Applications continue to reach the Honorary Treasurer and the Organising Secretary in increasing numbers, and there is, it seems very little doubt that within a very short time the Australasian Radio Relay League will become a body of such standing that it will be able to speak on behalf of practically the whole of the amateur movement.

Sydney, 21st July, 1923.
(To the Editor.)

Dear Sir,

Some few weeks ago you printed "A Few Suggestions" of the lines along which experimenters could work, "real worth while experiments" for "real worth while experimenters." One of the suggestions was that of investigating short wave working, and I am pleased to see "Q.S.Y." refers to the subject.

Are we to conclude that we have no "real worth while" experimenters on this side of the Pacific? It would appear so, for yet another reason. "The howling valve nuisance" was dealt with in a recent article, yet, according to "2X" "the interference from this cause is terrific." It would appear therefore that the offenders have taken and are taking no steps to eliminate this defect in their receivers. This may be due to either both or two reasons. First, they do not care, in which case I would remind them of the awful end of "Don't Care" (in my childhood days I was often told "Don't care was made to care; don't care was hung"); second, they do not know how to eliminate it. In which case the attached diagram of connections suitable for a two (or more) valve set may be of assistance

The aerial may be either directly connected or "loose coupled" to the grid of No. 1 valve, an inter-valve transformer is inserted between Nos. 1 and 2 valves, and the reaction coil is coupled to this transformer instead of directly to the aerial.

Subsequent valves are audio frequency amplifiers, which may be either "impedance" or transformer coupled.

E. JOSEPH.

Continued from page 4.

All this is elementary and simple mechanics. But now apply it to the electrical analogue. Are we to regard a Hertz vibrator, or a radio transmitting station, as represented by a stiff spring and a light load, or a feeble spring and a heavy load?

Or again, should we not rather try to arrange it so that the spring is moderately stiff and the load moderately massive, the one being adapted to the requirements of the other, and neither being over-balanced by the other?

Now, in the electrical case, the oscillating thing is a group of electrons. They are very highly charged, but they are certainly not massive. They possess a kind of inertia due to the magnetic field which surrounds them when they are in motion. But the magnetic field due to a moving charge is but feeble, unless the charge is great and the motion exceedingly fast.

Now the electrons, though not massive, are highly charged, and they are presumably moving very quickly. Hence their current or magnetic energy is by no means negligible. But to bring it up to the required amount we must magnify it by coiling up the path of the electrons into a close spiral, so that all the magnetic fields reinforce each other, and give a large combined result. In that way, by the use of a sufficient coil, we may make the inertia what we please, and obtain the required amount of kinetic energy.

Now what about the static energy?

Here we must regard the ether as strained. And the ether's rigidity is excessively high. We know that; because of the rate at which light travels. Its elasticity compared with its density is accurately determined as equal to the square of the velocity of light; that is to say the ratio of the two is excessively great. A very small amount of distortion will account for a great amount of energy. But, to make room for all the electrons which are to take part in the discharge, an extensive area is required. If we use only a small area, we can hardly get any charge in it. It is like trying to bend a very stiff spring.

A tuning fork, for instance, can be excited by a blow, or by a succession of timed impulses in synchronism with its natural period—which is practically what a violin bow does. Such a bow grips and releases a string or a spring in a synchronous and therefore effective manner. But a tuning fork hardly yields to a steady pull. The amount a small force can thus bend the prong of a stiff fork is insignificant. To be able to bend it sufficiently the spring must be long. And the greater the rigidity of the material the longer it must be. That means that in order to get an effective capacity area, it must be of large extent. It must be the most visible and conspicuous item in a radio station. On the other hand, the coil responsible for the magnetic energy may be quite small—we might even say the smaller the better, within certain limits. The capacity area should be quite big—we might almost say the bigger the better, again within certain limits.

There is no doubt a best relation between the size of the capacity area and the size of the inductance coil, and this relation is determined by the fact that the electric and magnetic energies must be equal. A great margin of variation is permissible; just as is the case in musical instruments, which may vary from the stiffness of a tuning fork to the laxness of the column of air in a flute, with all manner of strings and reeds as intermediaries.

So it is with a radio station. One may be working with a small capacity and a large inductance, while another one may be working with a great capacity and a small inductance; and yet both may have the same period of vibration; and will have, if the product of capacity and inductance is the same for both.

But there is sure to be a best relation between the two things; which, however, overridden in practice, it may be instructive to consider.

And it is specially instructive to realise that the great size of the antenna, as compared with the small size of the coil which is in circuit with it, is an immediate consequence of the relation which exists between the two properties of the ether—its elasticity and its density. One is incomparably bigger than the other. The ratio, in e.g.s. measure, is 10.21. Hence, we may say that the ratio between the size of an antenna—which depends on the ether's elasticity—and the size of the little coil—which depends on the ether's density—should also be of something like the order 10.21.

No, it can hardly be as big as that, even with the best possible arrangement. But it is legitimate to regard that as a sort of ideal, and to emphasise the importance of a big, as well as of a high, antenna, and of a small compact coil.

The size of the antenna has to be fixed by practical and often financial considerations. The size of the coil is at our disposal, and must be determined by the rapidity of vibration—that is, the wavelength that we want. And it must be adjusted so as to give this wavelength when worked in combination with the given antenna.

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