An aerial wire has distributed along its length both capacity and self-inductance, and for mathematical purposes it is of great importance to replace these constants by a single inductance λ, and a single capacity σ. The method of calculating this was explained in A.R./03, pages 111 and 112, and this year we have thoroughly examined these formulæ, and find they are valid for all frequencies below the fundamental of the aerial wire.

That is, the "L S value" of the aerial shown in Fig. 38 is—

$$(\lambda + l)\frac{S\sigma}{S + \sigma} \qquad (1)$$

which reduces to—

$$(\lambda + l)\,\sigma \text{ when } S = \infty$$

for all kinds of aerials, inductances, &c., *provided* the resulting wave given by (1) is not smaller than the fundamental value $\lambda\,\sigma$.

That is, provided—

$$(\lambda + l)\frac{S\sigma}{S + \sigma} \text{ is greater than } \lambda\,\sigma$$

the formula is correct. For tune "A" therefore, this method is no use; and in this case it can be shown that the aerial can be replaced by the circuit in Fig. 39.

FIG. 38.

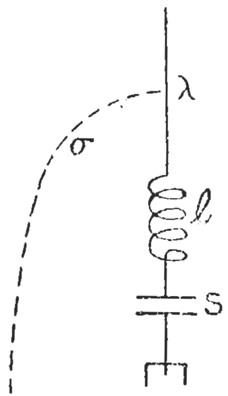
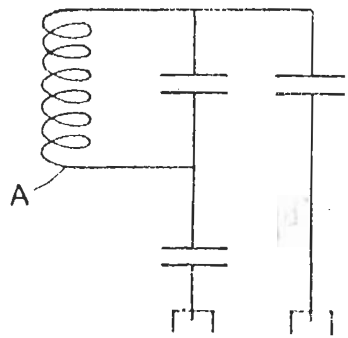


FIG. 39.

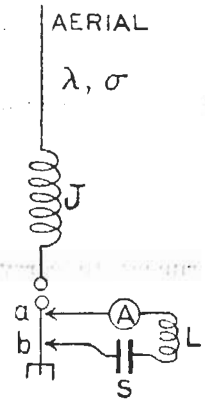


A being the foot of the aerial wire to which sending or receiving gear is attached. This circuit, however, is rather too complicated to be of much practical use.

Measurement of the Capacity and Induction of an Aerial.

The capacity and induction of an aerial are altered by the proximity of steel stays, iron masts, &c., and it is a good thing to measure them directly. This can be done by using a tuned circuit on the earth wire. (*See* Fig. 40.)

FIG. 40.



The L S value is measured on the tuned circuit L, S, A, as above, first for the simple aerial without J, and then with the induction J in series, as in Fig. 36.

The measured L S value is $\lambda\,\sigma$, without J; $(\lambda + J)\,\sigma$, after J has been introduced.

When these L S have been measured, and J is known, λ and σ can be found. A good value to take for J would be about two or three hundred micro-henries when examining a roof aerial, and about one hundred mic. for a vertical aerial; J must be taken larger than λ.

It is well to use a second or third value of J, giving other values of λ and σ to act as a check on the first results.

It will be found easier to carry out this measurement if a small coil of wire is introduced between *a* and *b*, as described above on page 50, and its induction considered as part of the added induction J. In the example of this method given below, such a coil was introduced. It consisted of two and a half turns of Pattern 611, about 3 inches diameter, and had an induction of 1·5 micro-henries.

The λ and σ of various aerials obtained by this method, will be found on page 55, under roof aerials.

The following is an example of measuring the λ and σ of an aerial, which was T-shaped, with arms 75 feet long:—

—	J.	L S.	J + λ (λ = 62·5).	σ
I.	1·5	34·	64·	·531
II.	35·9	53·1	98·4	·540
III.	64·1	66·6	126·6	·526
IV.	115·0	94·6	177·5	·535
V.	235·0	158·	297·5	·531

J in the first column is the induction that was added, as in Fig. 40.

The second column is the measured L S value given by the tuned circuit.

To calculate λ and σ, first take I. and V. together.

From I. $(\lambda + 1{\cdot}5)\,\sigma = (\lambda + J)\,\sigma = 34$ the L S value.

From V. $(\lambda + 235)\,\sigma = (\lambda + J)\,\sigma = 158$ the L S value.

Subtract $233 \cdot 5\,\sigma = 124.$

$$\sigma = \frac{124}{233 \cdot 5} = 0 \cdot 531.$$

Putting this value of σ in the first of the above expressions—

$$(\lambda \times 1 \cdot 5) \times \cdot 531 = 34$$

$$\text{Therefore } \lambda = 62 \cdot 5.$$

To check this result by the other readings, take $\lambda = 62 \cdot 5$ and tabulate $(\lambda + J)$ as in the third column, then divide the second column, which is the LS value and equal $(\lambda + J) \times \sigma$, by this, thus obtaining the value for σ, tabulated in the last column.

In this experiment the values of σ agree fairly well, so that the experiment is reliable. Take a mean of the different results and σ becomes $0 \cdot 533$.

Then with value of σ obtain the final value of λ as above from the first readings—

$$(\lambda + 1 \cdot 5) \times \cdot 533 = 34 \therefore \lambda = 62 \cdot 3.$$

So that $\lambda = 62 \cdot 3$, $\sigma = 0 \cdot 533$ and $\lambda\,\sigma = 33 \cdot 2$.

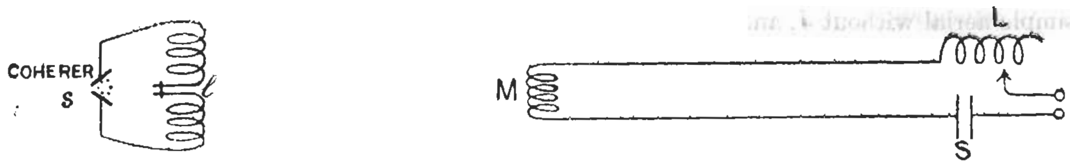
Measuring the Capacity of a Coherer.

This was a very difficult experiment to carry out, but was rendered necessary before being able to adopt the method of designing jiggers described on page 20.

The following method was used—

A coil of fine wire l, consisting of a jigger secondary, was used as an induction; the coherer was connected up to its ends and acted as a capacity, thus forming a tuned circuit. The coherer was arranged to work an inker through a relay in the ordinary way.

Fig. 41.



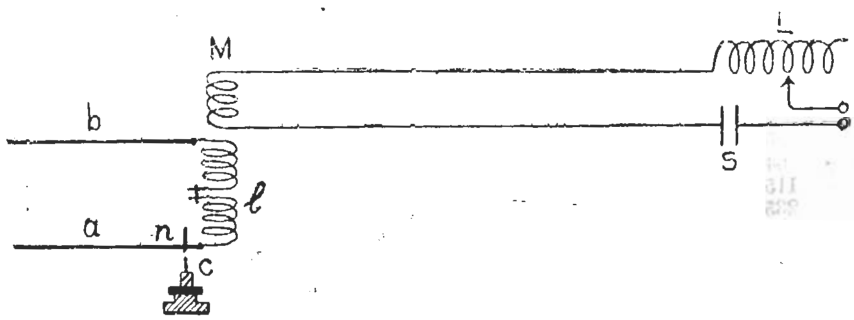
This tuned circuit, $l\ s$, was influenced by a resonating circuit L, M, S.

S being a capacity, L an adjustable induction, and M a few turns of wire several feet away from L and S, arranged so that although M was near enough to influence l, L was some way off and would have very little effect.

The distance between l and M was increased until M would only just influence l sufficiently to work the coherer when L was adjusted carefully, showing that the two tuned circuits must be in resonance for this value of L.

The coherer was now disconnected and replaced by two metal rods, a and b; l was then taken close up to M; a needle point, n, was attached to the bar a, and sparks were taken between this point and a small insulated rod, c.

Fig. 42.



The length of the bars a and b, which act as the two plates of a condenser, was then varied until the sparking length between n and c was a maximum, L not being altered.

The circuit $l\ a\ b$ was thus got into resonance with S L and M, which was previously in resonance with l and the coherer s attached. Therefore $l \times s$, the capacity of the coherer $= l \times$ the capacity between a and b, so that the capacity between a and $b =$ that of the coherer.

Several coherers were examined, and were found to give very nearly the same results.

The arrangement of the flexible leads going to the coherer influenced the capacity slightly. The capacity decreases if these wires are bunched together. Tuning the coherer up or down made no difference.

The resulting capacity was that between two straight pieces of No. 19 gauge wire **17·5 inches** long and $4\frac{1}{2}$ inches apart, that is, about 1·8 cm. capacity.

Condensers were made up to this capacity, and have been of great use in experimenting with jiggers.

Are Acceptors and Rejectors independent of their Outside Circuits.

The solution of the equations to an alternating current problem always consists of two parts:—

(1.) The "forced current" part. This gives what *eventually* happens after the steady state has been reached, and is the only part which the electrical engineer has usually any necessity to consider.

(2.) The "evanescent" terms. This gives what *first* happens, before the steady state is reached; and is the more important in Wireless as the sending wave is less persistent or well tuned.

Now theory shows that acceptors and rejectors are only independent of their outside circuits with reference to the forced currents, consequently experiments were undertaken to ascertain the importance of the "evanescent" terms in practical Wireless.

Fig. 43.

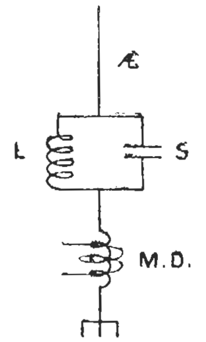
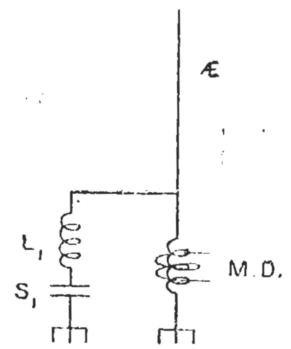


Fig. 44.



In Fig. 43 L S was adjusted so that the telephone gave a *minimum* sound, that is, that L S was a rejector. The aerial was then changed for a different one; and it was found that a *new* rejector value was required for the minimum sound.

In Fig. 44 L_1 S_1 was similarly adjusted, with a similar result; that is, the acceptors and rejectors are *not* independent of the outside circuits.

We next tried the standard tuned shunts arrangements (page 42), and again found this to be the case. Taking this latter case, it is evident therefore that a wave length cannot be measured by adjustments to *one* part of the circuit alone. It is not enough to say, "Because my rejector (acceptor or aerial) tunes at x, therefore my wave length is x," because it is found not to be true. It is less and less true as the "evanescent" terms get more and more important, which occurs when the sending wave is least well tuned; and as the sending wave becomes more persistent so does it get more nearly true that any one part of the circuits can be used as a "wave meter."

When, however, *all* parts of the circuits have been arranged so as to give maximum sounds, then the actual results given on page 44 show that with a fairly well tuned and pure wave all the different parts indicate the same wave length.

A few experiments recently made on B tune appear to indicate that with it the acceptor and rejector should be adjusted to the same wave as the aerial has been tuned to.

Varying Strength of the two Waves given off by an Oscillator.

"B" tune was used for this experiment, and the wave lengths were measured by simple resonance on a receiving aerial wire, using a H.W. ammeter for distances between the aerials of less than 150 feet; and an M.D. for greater distances.

It was found that close up to the sending aerial, the ammeter indicated that the long wave of "B" tune was (say) four times as strong as the short wave.

As the distance increased the shorter wave became more nearly equal; until at about 100 feet distance the strengths were equal; whilst at 150 feet the short wave was 50 per cent. the more powerful.

It is probable that this indicates that the short wave is the more rapidly radiated; so that at short distance the long wave only *appears* strongest by electro-magnetic induction.

At about 2 miles distant, as at 14 miles, the short wave is estimated at twice the strength of the longer wave.

At 56 miles the short wave alone was distinguishable for a long time; on a roof aerial, however, it was found that the *long* wave alone was distinguishable, and lately we have succeeded in getting both waves on a short aerial, and it would now appear that at this distance the long wave is the more powerful when using "tuned shunts" and the less powerful when using "simple resonance."

Mr. Marconi has observed that in Mid-Atlantic his tune from Poldhu appears to become somewhat longer than it is close to Poldhu, and we believe this may be due to the smaller dissipation of the longer wave making the resultant of the two appear longer.

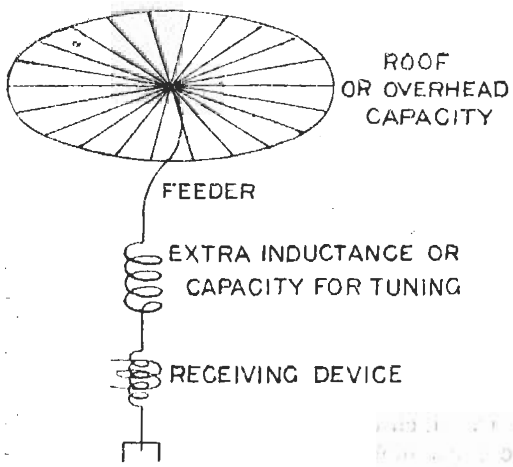
The two waves given off by an oscillator probably greatly increase the difficulties of tuning out the undesired waves at short distances. A shunt which is very suitable for one of the waves will not be so good for the other one. If this is correct, it is another point in favour of tuning out interference by adjustments of tuning to one's own wave or waves, in preference to adjustments to the interfering ones.

Roof Aerials.

Abstracts of two reports on these new aerials are given on pages 18, 19.

It will be seen that they are well suited for long waves, and for a *given* height the ideal form of Æ would appear to be of the following shape:—

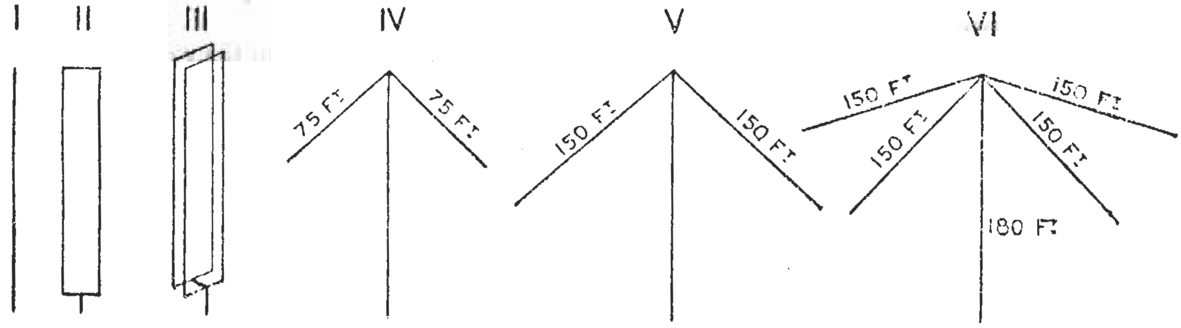
Fig. 45.



where the overhead capacity can always be increased with advantage of distance until no extra inductance is required in the receiver to bring it into tune; and it may be possible that it is of advantage to increase the capacity beyond this point, and then to bring into tune by the introduction of a series condenser.

The capacity of the roof does not vary proportionally with the number of wires; a few wires catch the electrostatic lines of force almost as well as a larger number—as the following measurements show:—

FIG. 46.



—	I.	II.	III.	IV.	V.	VI.
λ	42	24	20·6	63	75·5	85
σ	·29	·56	·82	·53	·72	1·18
	72·6	75	77	109	130	147
λσ	12·2	13·5	16·8	33·4	54·4	100
Wave in feet	**720**	**756**	**844**	**1,190**	1,520	**2,060**

In this table λ and σ are the **virtual inductance and capacities of the aerials,** which **are each 180 feet high, obtained by actual measurements (page 51, also A.R./03, page 111), and λ σ is the L S value of the fundamental of the aerial.** The column "*h*" is calculated, and gives the height (in feet) of the "centre of effort" (or point where the resultant capacity may be assumed to be concentrated) above the instruments.

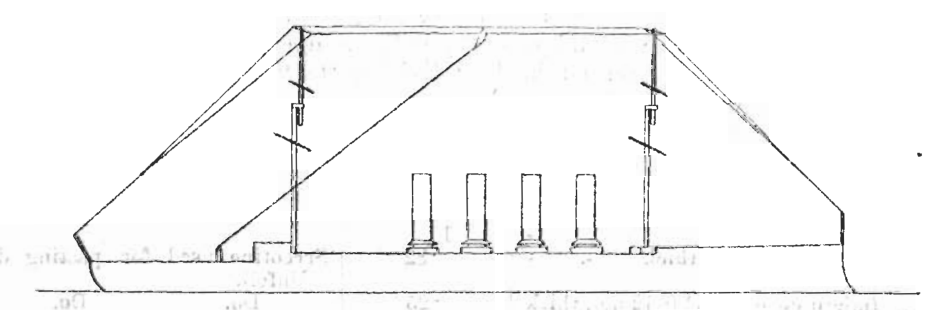
As the last three aerials are better than the first three when receiving a long wave, it is probable that the extra efficiency is produced, more by the increase in "*h*" than by the increase in capacity.

III. and IV. are good examples—IV. is found better **than III. and it has** more "*h*" but less "σ."

Methods of calculating aerials are given on page 33.

In a sea-going ship it is expected the following aerial should get signals 2,000 miles from Poldhu at night—

FIG. 47.



and experiments are much wanted in seagoing ships as to the best form to adopt.

The following points should be borne in mind:—

(1) Two parts overhead increase the capacity largely, and the larger the overhead capacity the greater the distance.

(2) The capacity is roughly proportional to the length of the wires; but the prolongers to bow and stern may also tend to lower the resultant height. Hence best Æ for battleships (with short distances between masts) may not be the same as for cruisers with longer distances.

(3) The atmospherics increase with capacity.

(4) The feeder should go to the centre of the roof, and come down on deck, with as *short* a lead (not necessarily vertical) as possible. (Any increase of capacity of the feeder lowers the height of the resultant.)

(5) It is expected that triatic stays will largely reduce the distances obtainable; probably by 500 miles from Poldhu.

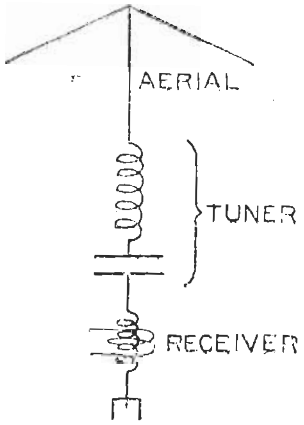
(6) It is proposed to insulate the triatic stays, by means of strain insulators, and use them as the overhead part of the aerial for both transmitting and receiving signals.

(7) With this aerial a longer wave can be obtained, which it is intended shall replace B tune for Naval purposes, and it will be designated C tune.

Further experiments.

It is found that all tunes, short or long, can be well received on the roof by—

FIG. 48.



inserting a tuner in aerial to get into tune; using a capacity for shorter waves than the natural wave of aerial plus receiver; and an inductance for a longer wave. (*See* page 50.)

It is not yet known whether *short* tunes can be *sent* on this aerial. Long tunes are certainly sent with much greater strength by this form of aerial; the tune being lengthened by suitable oscillator or by employing "Plain" with inductance at foot of aerial to bring tune to desired wave length.

It is interesting to note that the best tuned waves we have yet used are "plain" with large inductance at the foot, and Messrs. Muirhead always use this form of Æ (*see* page 25), and must be considered the inventors of this type of aerial.

It is considered probable that this form of Æ will improve "B" tune both for sending and receiving. As to "A" tune, it is reported that these aerials *receive* good signals; but no experiments with sending "A" tune have yet been tried.

HYSTERESIS OF CONDENSERS.

Whether interferences of an enemy can or cannot be cut out will often depend on the amount of "tuning" (*see* page 40) which can be put into the circuit, and this again depends on the waste of energy (or "hysteresis") which occurs in the condensers used. Many condenser materials have therefore been examined for this waste. The method of measurement adopted consists in observing the ammeter reading at resonance, first with the sample under test, and secondly with an *air* condenser adjusted to have the same capacity. The fraction obtained by dividing the first reading by the second we call the "efficiency" of the condenser under test.

Material.	Efficiency.	Remarks.
(1.) Air - - - -	1·	
(2.) Glass (window) 4 mm. thick - -	·82	Seccotine used for pasting down tinfoil.
(3.) ,, (microscope cover) 0·12mm. thick	·25	Do. Do.
(4.) ,, ,, ,, ,, -	·46	Seccotine used at edges only.
(5.) Leyden jar - - -	·91	Do. Do.
(6.) Ebonite 0·65 mm. thick - - -	·70	Seccotine used.
(7.) Mica 0·15 mm. - - -	·31	Do. Do.
(8.) Celluloid 0·06 mm. - - -	·13	Do. Do.
(9.) Paper, paraffined (out of new Newton coil) - - - -	·16	No seccotine.
(10.) Paper, varnished (out of old Newton coil) - - - -	·70	Do. Do.
(11.) Paper, varnished, (out of old Nowton coil) - - - -	·10	Seccotine used
(12.) Thin mica - - - -	97	Foil pushed down with wax.
(13.) ,, ,, - - - -	95	No wax
(14.) ,, ,, (3 layers) - -	99	Wax.
(15.) ,, ,, - - - -	99	No wax.

Notes.—It is interesting to observe the enormous losses caused by the seccotine—No. 2 is probably superior to No. 3 only in the fact that the relative thickness of glass to seccotine is much greater.

Nos. 12 to 15 are samples submitted by Messrs. Muirhead. They are all very good for efficiency, and as No. 12 is the cheapest to manufacture this type is being used in some "tuned shunt" condensers now being manufactured for trial.

Lieut. Nichol's Spark Gap.

In order to overcome the injurious effects of a long stretch of shielded wire in the cowtail, &c. Lieut. Nichol proposed to place an auxiliarly spark gap on deck, joined between the aerial where it connects to the cowtail and an earth made on deck; and to open the ordinary spark gap at the coil so that the spark should take place on deck, and thereby overcome the screening effects.

Some experiments were made with this, and it was found to improve "plain aerial" signals; but in view of the impossibility of adapting it to the tuned systems we now use, it has not been introduced.

Lieut. Groves' Magnifying Telephone.

This was an attempt to increase the sound in the telephone of a magnetic detector by making the telephone work a microphone, which in turn worked a new telephone to which the ear was applied. Many forms of microphones were tried, and Lieut. Groves succeeded in getting magnification of *loud* sounds, but only diminution of weak ones, consequently the system has not been found useful.

Lieut. De Kantzow's Revolving Disc.

This is a disc of paper secured to a motor and placed in the spark gap, which punctures the paper, and therefore enables the number of sparks made per second to be calculated from the diameter of disc and speed of revolution. It has been found serviceable for this purpose, but we were not able to get a high enough speed of revolution to measure the number of oscillations of each individual spark.

Lieut. Yeats-Brown's Opposition Telephones.

Two magnetic detectors are used: The aerial windings are in parallel, and joined to aerial and earth through tuning devices so as to make most of the friendly wave being received on one winding and most of the enemy wave on the other.

The telephone bobbins are in opposition, and their efficiency is altered by shunting one of them with a Wheatstone bridge so that the strong enemy wave on one M.D., affecting an inefficient telephone bobbin, shall exactly neutralise the weak enemy wave affecting the other M.D. with the more efficient telephone bobbin.

It was found that signals from an aerial about 20 feet away gave loud sounds without any aerial or earth on; but on putting the aerial and earth on, very little increase in the sound could be heard after the opposition telephones had been adjusted as well as possible.

It can be shown that exact neutralisation is impossible unless the time-constants of the telephone and shunt circuits are equal. This means self-inductance in the Wheatstone bridge branch, and time could not be spared to continue this experiment.

A similar idea might perhaps be applied to the aerial windings or to jiggers, but in these cases the difficulty would be the phase difference of the incoming currents.

Instructions for use of Resistance in W.T. Coil Circuit.

Insert one of the resistances in series with the primary of coil (which may be a 20 or 80-volt coil) and the dynamo mains.

Adjust the sliding contact so that the full resistance (about 5·7 ohms) is in circuit.

Starting with no tension on regulating screw, gradually increase the tension, until the signalling spark is satisfactory and the minimum amount of sparking is visible at the coil contacts.

If the signalling required cannot be obtained, reduce resistance cautiously. With great care in adjusting tension of regulating screw, the coil can be worked with about 2 ohms resistance, getting as long sparks as can be obtained on an Isenthal (7 mm. on B tune). In this case, however, a small amount too much tension on regulating screw will cause an arc to form at key contacts.

This arc will do no harm, however, if the coil circuit is at once broken (raise side lever of key).

With about 4 ohms in coil circuit the arc does not form, and no harm can be done.

The Officer in charge of the W.T. should settle on the safe minimum resistance allowable for ordinary work, and only use lower values in special cases.

It is to be particularly noted as quite essential that the coils must first be altered as given in the "Instructions for altering W.T. coils." Unless this is done, too great a tension will always establish an arc (even with 10-ohm resistance).

H.M.S. "Vernon,"
29.9.1904.

Supplement to Instructions for fitting Safety Levers, &c.

1. To make the gear work smoothly :—

(*a*) Saw off the knob at the end of the A. and B. switch.

(*b*) File down and gently ease the spring contacts at the casings K. and M., until the lever N. goes comfortably home when its end is allowed a 3-inch drop. The string should then be secured to the lever N. by boring a hole through lever half way along it, reeving string through and knotting.

The lever should have a 4 to 5 inch drop when in use.

2. The casing M. will probably require a strengthening band fitted to it; as it has not been made solid drawn as was originally intended.

3. Instead of the flexible wires going from the A. and B. switch off to the receivers, stretch a piece of bare aerial out horizontally from the switch, and tap off it as required to the receivers.

4. A very convenient sending arrangement using one coil alone is to fit spark gaps to each set of jars and join the inner ends of oscillators together and to one end of coil secondary. The other end of coil secondary is then joined to whichever tune it is desired to use.

"Vernon," May 1904.

REPORT OF WIRELESS TELEGRAPHY PROGRESS IN H.M.S. "DEFIANCE."

Apparatus in "Dreadnought."—The Wireless Telegraphy apparatus which was removed from H.M.S. "Dreadnought" previous to the Peace Manœuvres for 1904 has since been replaced, and consists of "A" and "B" tunes and also a set for "Plain" aerial working. Instruction is being carried out on board that ship as well as in "Defiance."

Tuning Apparatus.

"A" Tune.—The apparatus for "A" tune has been used only between the "Defiance" and "Dreadnought," and no long-distance signalling has been carried out with it. It has been found impossible to even reach Rame Head on "A" tune on account of the surrounding land. The transmitting circuits have been tuned up with a testing spark gap manufactured in "Defiance."

"B" Tune.—Constant communication has been maintained on "B" tune between Rame Head and "Defiance" and "Dreadnought," but no opportunity has been found as yet of increasing the range of signalling. The transmitting circuits have been tuned up with the hot wire voltmeter supplied. Also a thermal junction has been manufactured on board for this purpose.

Tomahawk Switches.—The receiving boxes for "A" and "B" tunes have all been fitted with the tomahawk switches supplied, and two transmitting keys have been altered with the supplementary gear.

"A" and "B" Switches.—The copper springs, forming the transmitting contact on the "A" and "B" switch, appear to require strengthening, as after a time they get bent too far down and do not make good contact. This has been done by fastening a small strip of brass up under the hooks of the springs, which prevents the copper plate forming them, from coming away from the woodwork of the switch.

Plugs in Top of Secondary Cells.—It is suggested that the plugs in the top of the secondary cells be made large enough to admit of the hydrometer supplied being placed through, or that a suitable receptacle be supplied for taking the density and for mixing the acid in.

Resistance for 20-Volt Coils.—The resistance supplied for the 20-volt coils, when used with 80 volts, has been connected up and used.

Heightening "Defiance's" Mast.—The existing mast of "Defiance" is now being heightened, so as to give a total height from the cowtail of 145 feet instead of 98 feet as formerly. This is being done with a longer topmast and gaff, the former having been obtained from the "Cleopatra."

Practical Instructions carried Out.—Practical instruction in tuning-up "A" and "B".—Tunes, winding jiggers, making condensers, &c., is being carried out.

Daily Communication with Rame Head.—Communication is being held daily with Rame Head, so as to ensure all the apparatus being in working order.

ALTERNATORS.

It has been found these can be very satisfactorily used for charging the Wireless circuit, and are in particular suitable for developing the full energy of the B tune jars, and for larger powers.

The chief difficulties met with are the tendency of the alternator to "race" when the key is pressed; and the tendency to cause an arc at the spark gap when the spark passes, thereby practically short-circuiting the alternator.

The racing tendencies are due to the lag and lead of the alternating current on the impressed pressure (according as the speed is too fast or too slow); which lag or lead re-acts on the field magnetism, and causes the variations of speed.

Hence at one particular speed, when there is neither lag nor lead, the motor will maintain its speed constant. (This refers to single field rotary converters such as an ordinary motor fitted with slip rings; if there is a *double* field these difficulties do not occur.)

But when the lag and lead are zero, the system is in "resonance"; that is, the longest sparks can be drawn at the spark gap; hence in practise the method of finding the best speed consists in slowly opening the spark gap and varying the speed until the longest sparks are obtainable. This speed should then be noted.

The tendency to arc is overcome by adding inductance either to the primary or secondary of the transformer (or spark coil). This has the effect of allowing far greater "resonance rises" of voltage to occur; that is, when the key is pressed, the voltage on the spark gap continually builds itself up; requiring perhaps several alternations to occur before the spark gap voltage rises sufficiently to break it down; then, when the spark *does* pass, the capacity which is charged is thereby short-circuited, hence the *resonance is destroyed*, and the voltage falls so much that an arc cannot be maintained.

Space does not permit going into this subject fully this year, but the above short resumé may perhaps enable the raison d'être of the following two circuits (Figs. 49 and 50) to be understood; which are the ones now employed when using ordinary induction coils as transformers and a 4-pole motor fitted with slip rings as an alternator. Fig. 49 is suitable for a capacity of 15 jars (*i.e.*, "B" tune), and Fig. 50 for a capacity, of 60 jars; which latter are made up of the Poldhu condensers described in AR/03 page 124, and are being used for experiments for a long-distance installation.

FIG. 49.

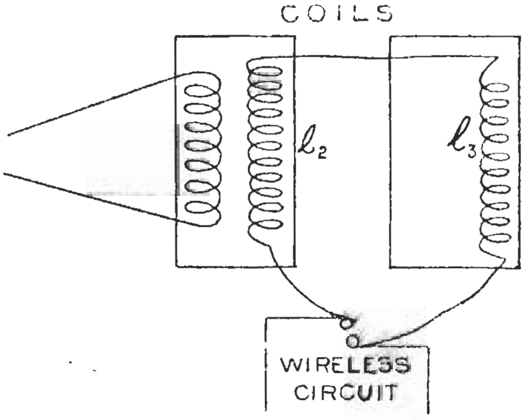


FIG. 50.

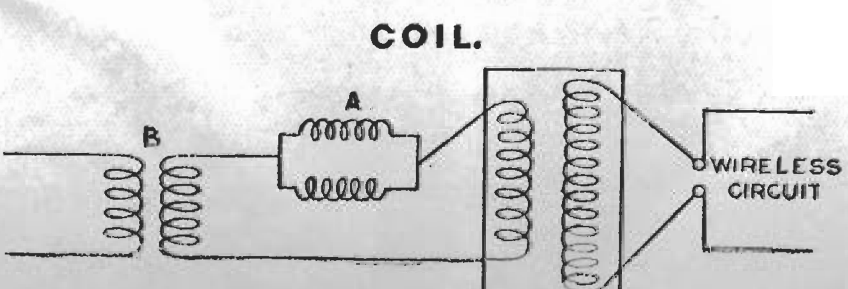
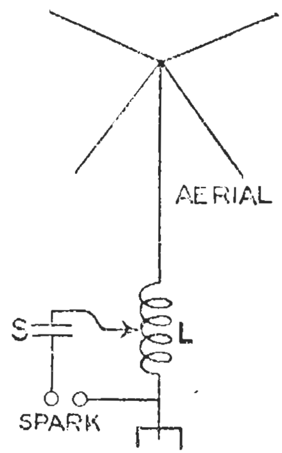


Fig. 49 will give more energy to the "B" tune jars than they can take (12-mm. spark), whilst Fig. 50 gives 8·5 mm.; the jars will stand 12 mm.; recourse will have to be had to special transformers which have been designed. It is interesting to observe that Fig. 49 is identical with the Poldhu circuit described in A.R./03; whilst Fig. 50 is identical with the De Forest circuit given on page 21, and both circuits are really identical in principle, *i.e.*, they utilise outside inductance in order to develop resonance. In "Vernon" design of transformers for a long-distance station it is proposed to put the extra inductance in secondary circuit (*i.e.*, the Poldhu method), as this is less dangerous, and from calculations also appears to be slightly more compact, and not so heavy.

Long-Distance Experiments.

Fig. 51.



These have been made as in Fig. 51, using Slaby-D'Arco connections for the oscillator, and charging the 60 jars as in Fig. 50.

Signals have been received at Felixstowe with 6-mm. spark. **This is 130 miles** over land, and is the only test so far made, as we have no ship or station to test with.

It is expected that about 200 to 300 miles over sea will be attained.