Abstract of Report by "Vernon" on "A" and "B" Tunes, dated 13th December 1903.

"A" tune has not been much used owing to the fact that land offers such a great impediment to it.

"B" tune is in continual use between "Hector," lying in dockyard, and Portland.

Correspondence was maintained between "Niger" and "Hector" up to 25 miles on "A" and 60 miles on "B."

"Culver" signalling on "A" tune with maximum power (14-m.m. spark) cannot interrupt correspondence between "Hector" and Portland on "B," but can if we use "Plain" or "A."

"Hector" signalling on "Plain" or "B" to Portland does not interfere with "Culver" signalling with "A."

When signalling to Portland from "Hector" it is found to be immaterial whether "B" is sent and received on "Plain" jigger or "Plain" sent and received on "B" jigger, only when the limits of distance are nearly reached does it become of importance to use the proper receiver for the sender in actual use, hence until this point is reached "B" can be interrupted by "Plain," *i.e.*, any ordinary untuned system.

"B" tune sent on 20 volts and hammer make-and-break does not appear to signal further than "Plain" under the same circumstances.

"B" tune is, however, capable of taking up more energy than the above arrangement will give it, whereas "Plain" is not so capable, therefore when using an Isenthal interruptor (which increases the available power), "B" tune can signal further than "Plain" in about the ratio of $\frac{7}{5}$, and the same result can be obtained by using two coils, alternators, &c.

Comparing "A" and "B" (in fact, any tuned systems) with "Plain," it is found that with the former—

(*a.*) It is much easier to use Isenthals, &c. This materially increases the accuracy and rapidity of signalling, a point of great importance for war or peace purposes.

(*b.*) There is much less strain on the insulation of the system.

It seems probable that when more experience has been gained, the use of gaffs, insulated wire, charging appliances, hammer makes-and-breaks, cowtails, oil insulators, &c. may be abolished, so that the use of the tuned system will lower the cost of the installation.

(*c.*) It is easier to block out a tuned system than an untuned one.

For example.—If one ship and her friend are corresponding with a tuned system, it will cause *less* disturbance to an enemy than if "Plain" were used.

(*d.*) It is easier to introduce devices permitting greater selection in a tuned system, *i.e.*, by introducing devices into the aerial you can increase your chances of getting signals through, in spite of anything the enemy may do.

If an enemy chose to signal on either "A" or "B" tune, we could use the other tune; but if he does not choose to use either, or, in fact, tries to interfere, it is considered that our present "A" and "B" tunes will not always prevent him doing so.

In other words, "A" and "B" tunes, as at present fitted, do not fulfil war requirements of wireless telegraphy. They do, however, increase the output, each is superior to "Plain," and they do not interfere with each other, and that means that more practice can be carried out. The question whether a signal can or cannot be passed through will often be settled merely by the speed and experience of the operators.

General Remarks.

It must be mentioned that our "A" and "B" tunes are by no means confined to our Service alone. It is more than probable that Italy has both these tunes, France is known to have something very like "A," as well as the liners, therefore there is nothing secret about that, and, as already stated, "B" can be upset by all existing installations.

Abstract of Reports on "A" and "B" Tunes in the Cruiser Squadron. Extracted from the Half-yearly Reports of Torpedo Exercise of "Good Hope" and "Drake," 30th June 1904.

Aerials Used:—

120-feet single.
180-feet single
180-feet double.

The results with the 120-feet aerial were far inferior to those obtained with 180-feet, and the double 180-feet gave longer distances than the 180-feet single.

Distances Obtained:—

Maximum with "A" jigger	72 miles.
Maximum with "B" jigger	81 „
Maximum with "Vernon's" jigger for "B" tune	105 „

The "Vernon's" jigger for "B" tune always took in clear signals before such signals were obtained on the "B" jigger.

Interference and Screening:—

"A" clear of "Plain" at 9 miles.

"A" clear of "B" at 15 miles.

"Plain" clear of "A" at 14 miles.

"B" waves appear to be less affected by screening of funnels, masts, &c. than are "Plain" waves when signalling to ships ahead.

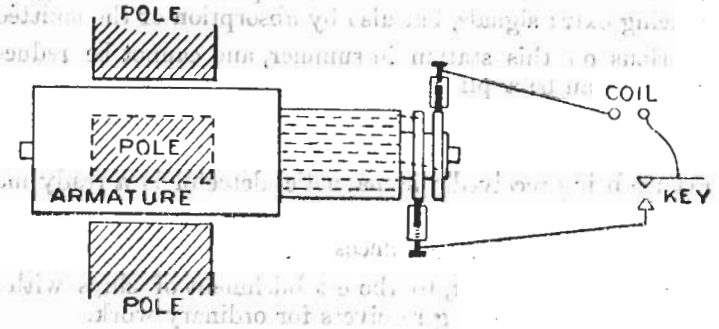
The "B" jigger appeared to be superior to the "Plain" Service jigger for receiving "Plain" waves, and "B" tune is now almost exclusively used for communicating with ships fitted with "Plain" only.

Alternator :—

A fan motor was fitted with slip rings in the "Good Hope," with the following results :—

Lawrence Scott Fan Motor, fitted with Slip Rings to Supply Alternating Current to W.T. Coil for "B" Tune.

FIG. 8.



The motor is 4-pole, and runs at 1,350 revolutions per minute. The slip rings are fitted on the commutator end of the shaft, and connected to strips 90 degrees apart, as shown.

The brushes are carbon, made out of the positive element of Obach Q Cell, and are mounted in adjustable spring holders.

The brush holders are mounted on the bolts securing the main brush holders.

Sparkless running is obtained.

The frequency would be about 45.

So far the motor has only been tried up to 30 miles, at which good signals have been transmitted.

With a small spark, sending may be quick, but with a big spark, sending must be slow, as the motor loses speed at every make of the key.

A steadying resistance across the brushes was tried, but was not satisfactory.

The liability of the motor to alter speed when sending could be got over either by fitting a heavy fly wheel or by using a shunt motor, if available.

Remarkably thick and brilliant oscillatory sparks up to 10 m.m. can be obtained on "B."

The device is no use for "A" or "Plain."

Abstract of Captain Jackson's Report on the Wireless Telegraphy Tunes and Magnetic Detectors in use on the Mediterranean Station, dated 13th August 1904.

A Tune :—

Distances obtained in the open sea vary greatly, 40 to 50 miles being about the average maximum, though distances up to 130 miles have been obtained.

As now fitted, "A" tune should be capable of signalling 50 miles in the open, failure to do so must be attributed to (*a*) faulty tuning, (*b*) want of practice at long distances, (*c*) instruments joined up for double reception.

"A" tune is almost free from atmospheric disturbances, and from interference by other tunes. Ships of the United States Navy, however, near Tangiers, interfered with "A" tune at Gibraltar, showing that the wave length they were using affects the "A" receiver.

"A" tune is a satisfactory fitting for moderate distances, when no land intervenes, and its adoption in the Service, now authorised, will be found beneficial.

"B" Tune :—

Distances, as a rule, have been over 50 miles, and 60 miles (or 80 with an Isenthal interrupter) should always be obtainable when atmospheric disturbances are not present. For failure to do so the causes given for "A" equally apply to "B." "B" tune,

compared with "Plain," has all the advantages of a tuned over an untuned system, does not interfere with "A" except at very short distances, and in the "Duncan" has been found more reliable than "Plain" at long distances. It has, however, a disadvantage on this station in that it is used by the Italians.

Loss of Signalling Distance :—

(1.) Instruments joined up for double reception, which will be a necessity for scouting, cause a loss of distance of probably 30 per cent. to 40 per cent.

Experiments are being conducted in "Duncan," with a view to reducing this loss.

(2.) A disturbed electrical state of the atmosphere decreases signalling distances, not only by producing extra signals, but also by absorption of the emitted waves.

This loss is serious on this station in summer, and cannot be reduced unless more power for transmission can be applied.

Magnetic Detector :—

When extras are being received the magnetic detector is a ready means of getting clearer signals.

For very long-distance work it is a necessity.

It can be added, with its tuner, to the establishment of ships with advantage, but cannot at present replace the existing receivers for ordinary work.

Recommendations for further Improvement—General :—

(*a.*) That "A" tune be adopted and supplied to all ships in H.M. Service fitted with Wireless Telegraphy.

(*b.*) That endeavours be made to bring "B" up to standard of "A," as regards non-interference.

(*c.*) That steps should be taken to obtain a tune of greater power, which could eventually replace "B," which would be reliable at distances over 100 miles, and could be supplied to shore stations and special ships, such as flagships and 1st-class cruisers.

Meantime, more transmitting power is required in our shore stations.

(*d.*) That, as standardisation as regards tuning throughout the "Service" is very important, ships should be carefully tuned to a standard tune or tunes on fitting out in England before leaving for their stations.

(*e.*) That the introduction into the "Service" of telegraphists is necessary for successful Wireless Telegraphy. Failing this, a much longer course of instruction in electricity and telegraphy, and the permanent adoption of this work by signal ratings, is necessary.

Local :—

(*a.*) To eliminate the loss of distance when all ships are joined up for double reception. When two or more ships are in company, one should look out on "A" and the other on "B," answering all signals made in the tune on which they are watching, when any other ships present are called up by distant vessels. Till all ships are tuned a third ship should look out on "Plain."

(*b.*) Part of the daily exercise should occasionally include use of magnetic detector.

(*c.*) That whenever possible the daily exercise be arranged so as to take place during separation or approach of ships, and that double reception be then practised.

(*d.*) That it should be made generally known in the Squadron that phenomenal distances must not be expected, but that, when using single reception, if 40 miles on "A" and 50 on "B" are not obtainable in the open sea, when no atmospheric disturbances are present or approaching, the instruments cannot be in adjustment or the operators are not up to the standard.

(*e.*) Also that it should be made known that with "A" tune a spark longer than half an inch is detrimental for long distance signalling. With "B" the maximum steady spark is best for long distances. Broken sparks are never good with any system.

Abstract of Reports on "A" and "B" Tunes in the Channel Fleet, dated 26th October 1904.

"A" Tune :—

Distances greater than 30 miles were not tried on "A," but up to this distance good communication was established during very bad atmospheric disturbances.

When hills intervened between the communicating ships "A" tune was useless "A" tune signals were weakened by connecting up the "B" receiver in parallel to the same aerial, even when a small inductance was used in the aerial immediately outside the "B" box.

"B" Tune :—

Distances up to 90 miles were obtained except during atmospheric disturbances; and on one occasion up to 115 miles, 3½-mm. spark on "B" did not appear to transmit signals as far as best spark on "Plain," but on these occasions, as the coil was not good, it was easier to obtain the 1-inch "Plain" than the 3½-mm. "B."

The spark on "B" was increased 50 per cent. by using two coils with primaries in series, secondaries in seres, condensers in parallel, and 40 volts pressure.

When receiving signals on "B" tune at distances over two miles, no records were received from the "A" box when joined in parallel to the same aerial, nor did the fact of having the "A" receiver joined weaken the "B" signals.

Considerable trouble was experienced from dampness of coils when sending, and from unreliable Marconi coherers when receiving.

JOHNSON'S SECRET WIRELESS INVENTION, REPORTED ON 25TH NOVEMBER 1904.

This consists in using a tuned reed with the hammer make-and-break of the spark coil, thereby emitting a definite number of sparks per second; and by employing a similarly tuned reed in place of the diaphragm of the receiving telephone; which latter was joined direct to aerial and earth without any coherers, &c.

Results :—

On an *ordinary* telephone signals could be received at one-quarter of a mile; but when the tuned reed was substituted, no signals were obtained at 60 yards.

The idea of mechanical tuning is, we feel sure, a sound one; but Mr. Johnson's application of it is very crude and imperfect, and it has not been thought desirable to recommend any further trials.

WIRELESS CONTROL SYNDICATE.

This was an invention of a Mr. Gardner for automatically controlling torpedoes.

The small measure of success attained in November 1903 was not considered sufficient to warrant any further trials; particularly as it was hard to see the Naval application if the interference of an enemy had been able to be overcome; which was not the case in the present instance.

ABSTRACTS OF REPORTS.

Abstract of Report (dated 23.12.03) by Lieutenant and Commander Percy C. Ryan, on Experiments in Wireless Telegraphy carried out in H.M.S. "Bat."

Results :—

Using single aeriel wire from masthead to port quarter, length 160 feet, perfect signals were maintained with Malta up to 30 miles on plain aeriel. When a kite was flown carrying 100 fathoms of sounding machine wire, clear signals were maintained up to 80 miles.

On other occasions using the kite, signals were received from H.M.S. "Duncan" at 120 miles, and from Malta up to 96 miles.

With masthead aeriel only, after raising it 12 feet by means of a boat-hook stave, signals were exchanged with Malta up to 46 miles.

Remarks :—

Service instruments were found too big and too delicate for a destroyer, the relay recording false signals owing to vibration.

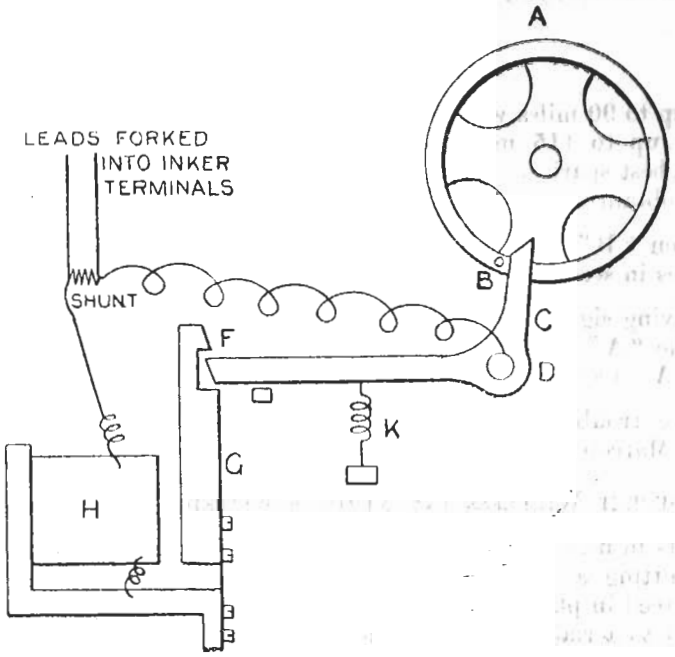
A smaller set received all signals in every kind of weather, and at any speed. I consider this to be due to a double relay, which retards the action, and which appears to be necessary for destroyers.

I consider that on all occasions of speed and weather, destroyers will be able to communicate with battleships and cruisers up to 40 miles, with an ordinary aeriel wire from masthead to propeller guard.

When a kite can be used, up to 86 miles.

Lieutenant Ryan's Apparatus for automatically starting and stopping the Inker.

FIG. 9.



In attached sketch "A" represents the second wheel of the train of clockwork working the paper tape.

"B" is a stud fitted on rim of wheel "A," which is engaged by toe of lever "C."

"F" is a platinum contact between lever "C" and armature "G" of electro-magnet "H."

Magnet "H" is forked in with inker, and shunted with 1,000 W. non-inductive shunt.

The current energises the magnet "H," causes it to attract the armature "G" and release the catch at "F." The pressure of wheel "A" trying to revolve, tilts up the lever "C," until the stud "B" has revolved clear of the toe, when "C" will be pulled back to its place by spring "K." The clockwork is now released and continues to revolve till stud "B" again encounters the toe of lever "C."

While the clockwork is actually revolving, the contact at "F" is always broken, so that the magnet "H" does not waste any current. When the stud comes round again, if signals have ceased it engages toe of "C," tilts lever "C" into contact with inker magnets at "F," and stops clockwork.

If, however, a signal is not finished the instant contact is made at "F," it releases the wheel so quickly that no difference in speed of clockwork is perceptible.

When atmospheric disturbance causes the tape to run away, I used a moveable condenser in the aeriel wire. By opening the plates, which are 8-inch diameter, cut to ¼ inch apart, any ordinary atmospheric is cut out without a great loss of sensitiveness.

NOTE.—For auto-inker attachment being introduced, *see* page 4.

Abstract of "Vernon's" Report (July 1904) on Experiments with "Roof" Aerials.

(*a*) "Roof" aerials give much stronger signals than ordinary aerials. We can get good communication with Dover, 100 miles overland, probably equal to 200 miles by sea.

(*b*) "Roof" aerials permit of much longer wave lengths being employed with them than with ordinary aerials. As the wave length increases, so does the efficiency fall off with all aerials, but not so fast with "Roof" aerials as with other forms.

We have been able to use 5,000-foot wave length (equal to Poldhu) from "Minotaur" and yet receive signals. Under such conditions the tuning is very critical, and the extent to which "Plain," "A," and "B," can be cut out is very great.

Receiving a wave length of about 3,000 feet from Portland, it has been found that "Culver" can cause no interference when using "A," "B," or "Plain" (*i.e.*, anything she has), whilst under the same conditions the "Caesar" at Spithead (and therefore probably about 2 miles away) causes no inconvenience on "A" or "B," but does considerably interfere on "Plain" when a spark length of $\frac{1}{2}$ inch has been exceeded.

"Plain" is, therefore, the most difficult tune to block, and how much it can be blocked depends on how long a wave length is used, whilst the distance the signals are required to travel governs the length of wave it is permissible to employ.

We know that a 15,000-foot wave can be blocked from "Plain" at half-a-mile, but a 15,000-foot wave could not be received here from Portland with the present amount of power, but could be received from Culver Cliff.

Summarising results, using a "Roof" aerial and the present power available in ordinary installations:—

(1) Using the fundamental wave length of the "Roof" aerial, good signals are obtained to Dover, and it is considered probable signals will travel a good deal further than on any present Service arrangement.

(2) Artificially increasing the wave length (which can be very simply done) it is found that Portland can signal to us easily whatever is done on "A" and "B" tune at 2 miles, and it is considered that "Plain" can probably be blocked at three or four miles.

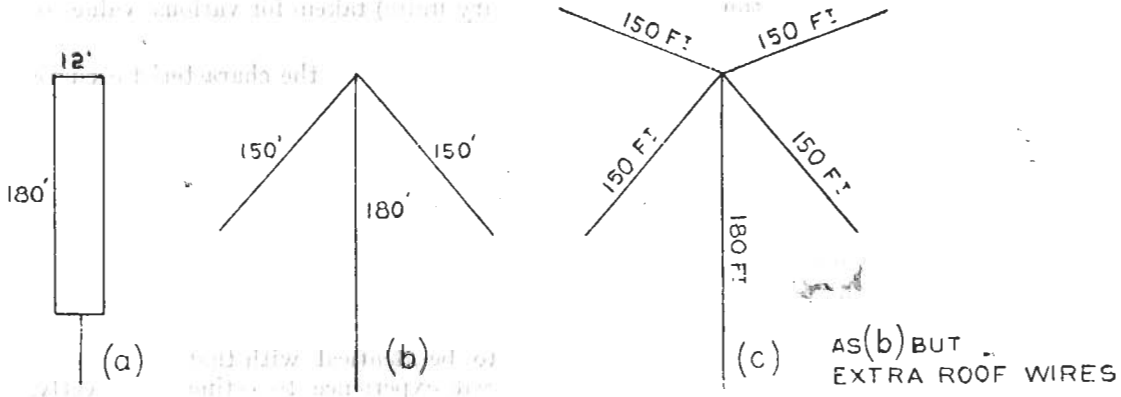
(3) By further increasing the wave lengths it is considered certain that Culver could signal to us easily whatever was done on "A" or "B," or "Plain," at a distance of half a mile or less.

Abstract of a Report by "Vernon" on "Roof" Aerials, dated May 1904.

Opportunity for undermentioned experiments:—

Poldhu was using a special long wave which tunes to 2 m.f. in the primary of Poldhu oscillator for signalling to the "Campania," going across the Atlantic with Mr. Marconi, who was finding out what increase of day distance he could obtain with this special wave.

FIG. 10.



Three forms of aerial were tried in "Hector" (*see* Fig. 10).

(*b*) and (*c*) were, perhaps, respectively twice and three times as good as (*a*).

(*b*) would be a convenient aerial on board ship.

The principal wave length from Poldhu was found to be 1·98 statute miles (subject to an error of perhaps 25 per cent. due to lack of standard condensers).

Poldhu was too distant for the measurement of other wave lengths in system.

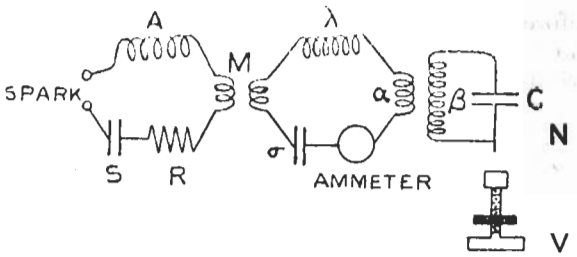
The strongest possible signals were obtained by first getting simple resonance and then connecting a capacity of ·05 m.f. across primary of M.D. This capacity at least doubled strength of signals.

"Devastation," one mile from "Hector," could just interfere with the 1-inch "Plain" when "Hector" adjusted to Poldhu with single resonance, but the capacity across the M.D. blocked "Devastation" out altogether, at the same time doubling strength of the signals from Poldhu. This shows the great importance of long waves for war purposes.

NOTE.—The wave length Poldhu was using in above experiments was much longer than the one they now (October, 1904) use.

Method of Tuning Receiving Jiggers adopted by "Vernon."—Abstract of Report dated May 1904.

Fig. 11.



The sender consists of an adjustable self-induction A, a capacity S, a resistance R, and a spark gap, fed from an induction coil, giving off waves whose frequency depends on the values given to A and S.

The receiving circuit consists of an artificial aerial, $\lambda\sigma$, joined up as shown to the jigger $\alpha\beta$ under test, whose secondary B is short-circuited by a capacity C equal to the capacity of the coherer (*see* p. 52).

The receiver is influenced by the sender by a few turns of mutual induction M. The potential across the coherer C is measured by the length of spark which can be drawn off a needle point N into an adjustable insulated screw thread V. The current in the primary α of jigger is measured by a hot wire ammeter.

To use the Apparatus:—

Suppose we wish to make a jigger to receive tune "B" on a 180-feet aerial. The wave length given off by tune "B" must be first measured, *see* p. 49.

Calculate the λ and σ of the 180-feet aerial as described in A.R. for 1903. Knowing these values another calculation gives how many turns of wire and what area of tinfoil, &c. to use for making them up.

Lastly any jigger, $\alpha\beta$, is joined up as shown.

The sender is then started in operation, and the values of the potential across the coherer and the current in the primary (in arbitrary units) taken for various values of wave lengths given off by sender.

A curve is plotted from these values, which may be called the characteristic curve of the jigger under test, as it shows what are the particular wave lengths for which the jigger is suitable.

Being guided by previous results, a jigger is finally reached which has some one or more peaks on the wave lengths it is desired to receive.

This jigger so designed will be a good jigger for receiving the given wave, and of the various jiggers which can be made with the required peaks, the best for distance will be that with the highest peak, the best for non-interference that with the sharpest peak, *i.e.*, least flat-topped.

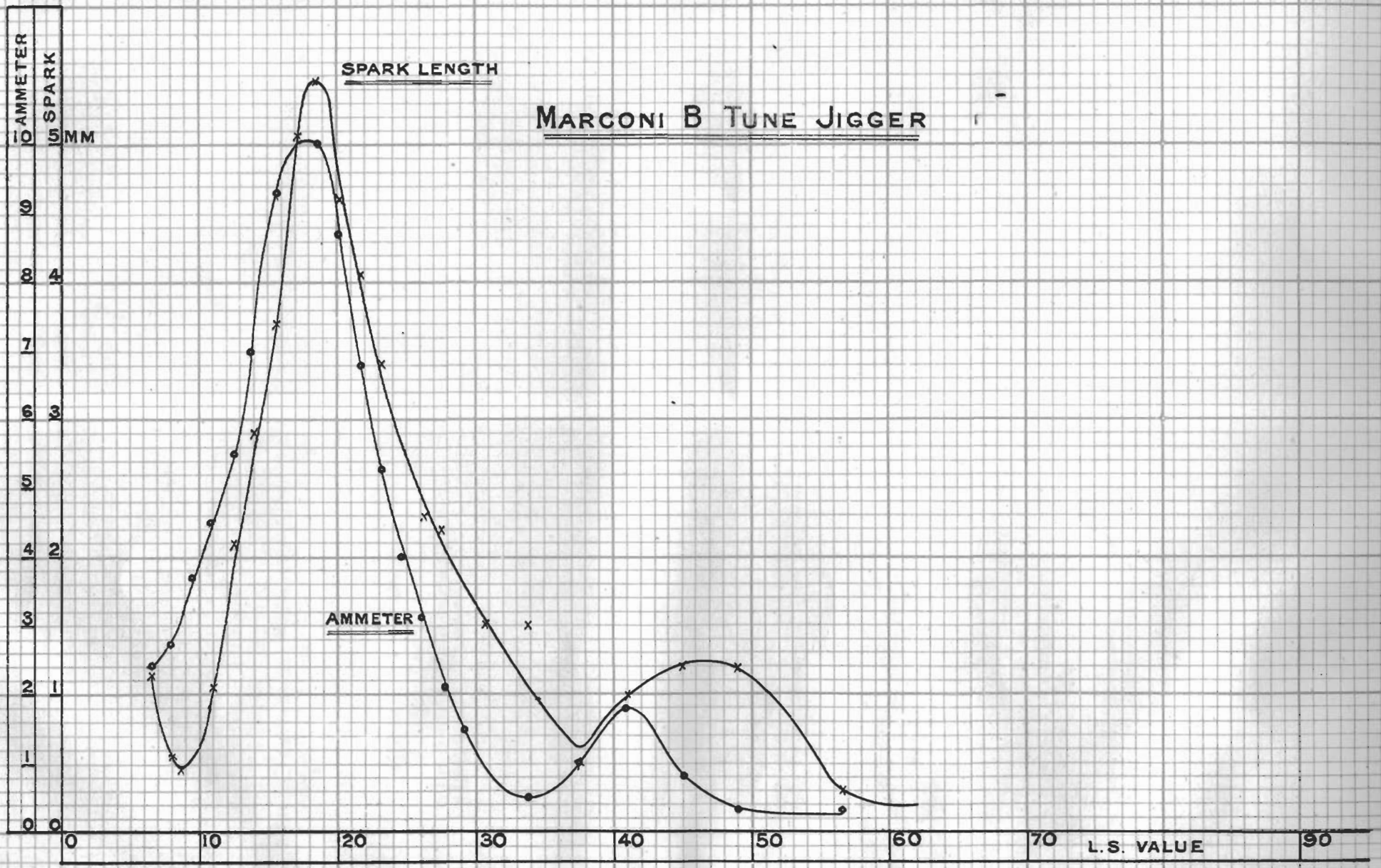
This latter assumes, however, the damping to be identical with that of the wave length intended to be used on, which requires great experience to estimate correctly, so that though it is easy to make up good jiggers by getting peaks to a given wave length, it is much more difficult to decide between several patterns of good jiggers, made by above process, by means of the actual heights of the peaks. The curves in the plates are those of the Marconi B jigger and the Vernon No. 1 jigger.

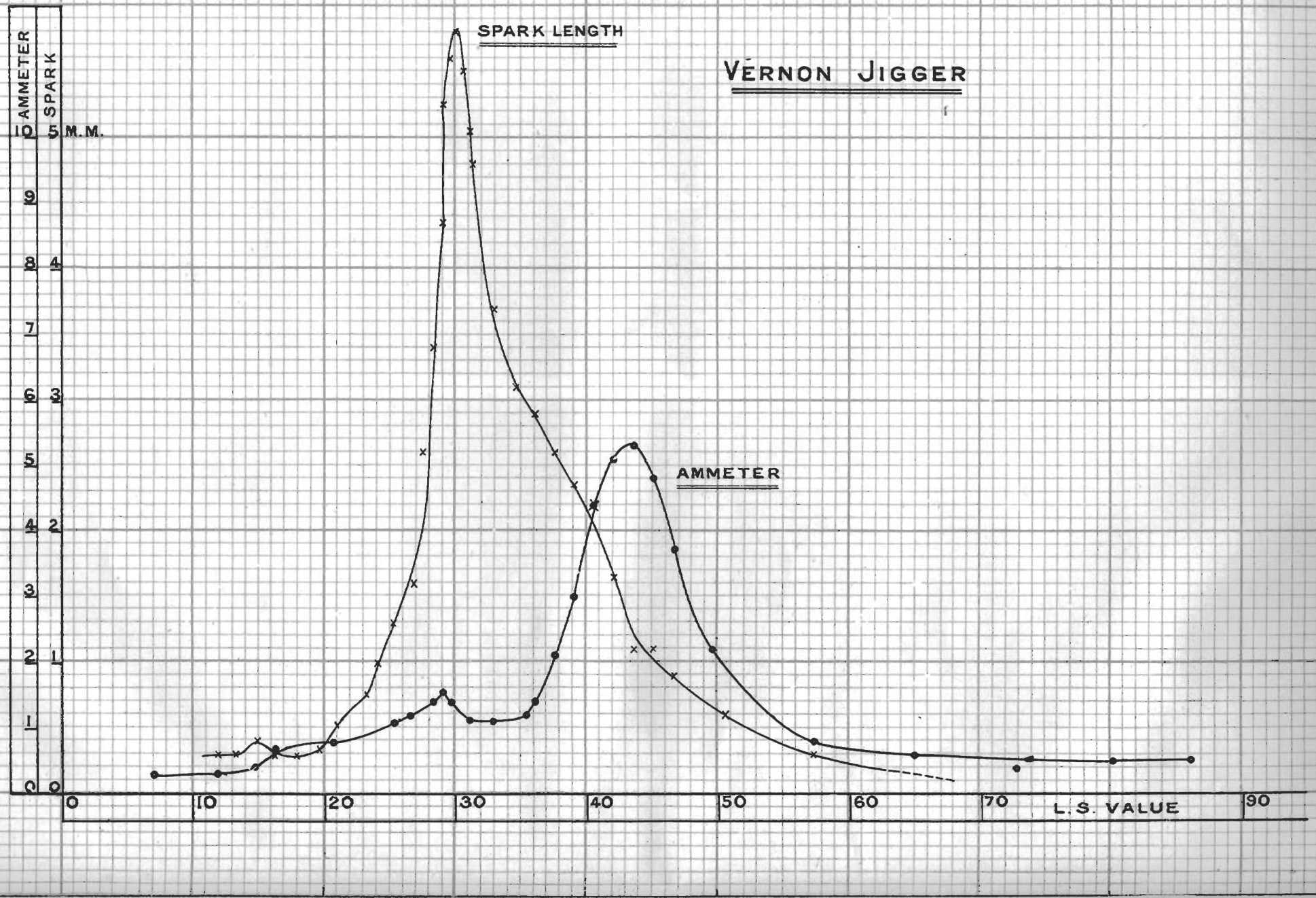
It will be noticed that ours has a large sharp peak on the shorter wave given off by "B" tune, whilst the B jigger has no peak there and only a small flat-topped mound on the long wave given off by "B" tune. Also, the B jigger obtains its large spark peak with a large current peak, whereas Vernon No. 1 jigger gets the large spark peak on a small current.

We have a theory that the ratio *spark peak* to ammeter peak should always be made as large as possible; which seems to be borne out in practice.

Results of Experiments on "Vernon" Jigger for "B" Tune.

H.M.S. "Drake" and "Good Hope" were supplied with "Vernon" jiggers in addition to their Marconi "B" tune jiggers, and tested the jiggers against each other whilst they were going to Gibraltar from Portsmouth. The "Hector" at Portsmouth was similarly fitted.


MARCONI B TUNE JIGGER
SPARK LENGTH
AMMETER
AMMETER
SPARK
MM
0
1
2
3
4
5
6
7
8
9
10
0
10
20
30
40
50
60
70
90
L.S. VALUE


VERNON JIGGER
SPARK LENGTH
AMMETER
AMMETER
SPARK
M.M.
10
9
8
7
6
5
4
3
2
1
0
5
4
3
2
1
0
0
10
20
30
40
50
60
70
90
L.S. VALUE

The results in "Hector" were :—

Marconi jigger failed to record good signals at 76 miles.

"Vernon" jigger gave good signals up to 107 miles. This result is not good as far as distance is concerned, but not only were the conditions unfavourable to long distances (land, position of "Hector" in dockyard, lightning conductors in ships, &c.), but also great care was taken not to push the sending spark to its limits in order to ensure that the conditions of test should remain the same for both jiggers.

The results appear to show that "Vernon" jigger on that occasion was about 40 per cent. more efficient for distance than the Marconi one.

In similar experiments from Portland to "Hector," the "Vernon" jigger always proved itself to be very superior in sensitiveness to the Marconi one.

Freedom from "A" Tune.

Culver Cliff W.T. Station sending with 8 mm. "A" tune affected signals being received on Marconi "B" jigger in "Hector," but the "Vernon" jigger was unaffected by any spark on "A" tune from Culver Cliff.

Freedom from Plain.

No difference between the two jiggers could be detected, as both received "Plain" nearly as well as "B" tune. But by inserting a capacity and inductance in parallel with the jigger, it was found that the Marconi "B" jigger gave better signals with 1 mm spark on "Plain" from Culver than "Vernon" jigger with 10 mm., thus showing that "Vernon" jigger could easily be made ten times better than is the Marconi "B" jigger for cutting out interferences.

For report of this jigger from "Drake" and "Good Hope," *see* page 14.