Connections likely to give trouble.

First make sure that all the connections are good, those most likely to give trouble being between the springs carrying the thermo-junction and the terminals for the flexible leads, and between the ends of the inductances and the tongue pieces.

Transporting.

Before transporting a wavemeter it is a good thing to ease back the screws which regulate the tension of the springs, so as to take all strain off the thermo-junction.

Mutual.

When tuning, so arrange the mutual that the primary wave, the aerial wave, and the resultants can all be measured without changing the mutual, and if possible without moving it.

Difficult cases.

In cases of difficulty, it is sometimes necessary to measure the two resultants with the mutual in different places. The deflections of the galvanometer are entirely due to the position of the mutual, and have nothing to do with the relative strength of the waves transmitted.

Convenient positions for mutual.

In Service Mark I. the most convenient position for the mutual is immediately under the B tuner.

For the Service Mark II. and C tune sets the most convenient form of mutual is a ring of Pattern 733 wire of about 1 foot in diameter, with its ends connected to a length of flexible cabin wire led through the screen to the wavemeter, which may be anywhere outside the screen. The inductance of such a mutual will be between 2 and 3 mics. It is advisable to make the connection between one end of the ring and the cabin wire temporary, so that it can be opened if desired.

Having found a suitable place for the ring, regulate the deflection of the galvanometer by making the ring larger or smaller by crushing it up or opening it out.

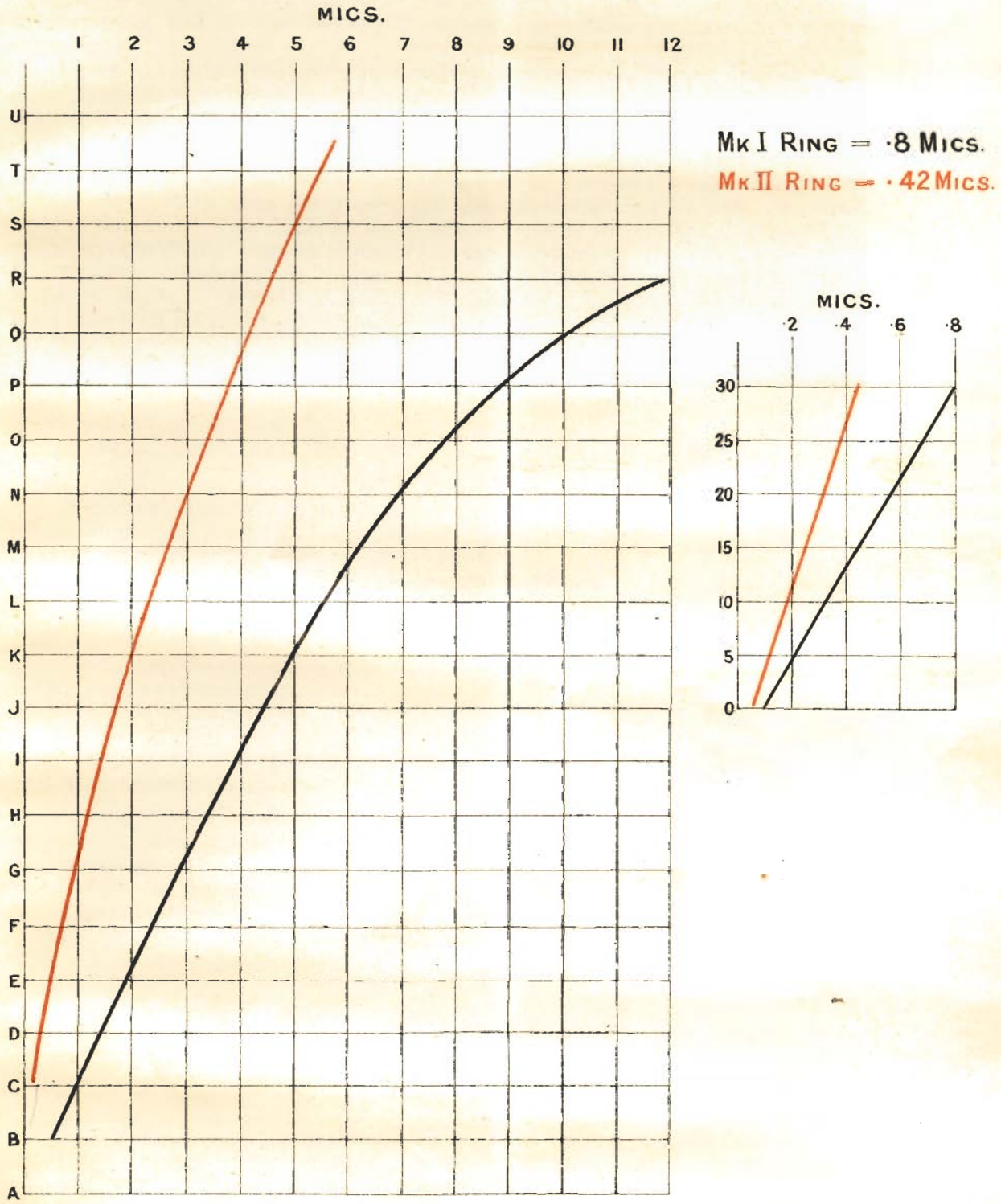
Small errors likely to arise.

Small errors are likely to creep in when measuring the L.S. of an aerial by plain spark, but if the two outgoing waves have their L.S. values equally on each side of the primary L.S., the transmitting circuit is in tune, and there is no room for error if the outgoing waves and the primary are all measured with the same mutual.

For accurate work the pointer of the vane condenser should be set to one position, the person's hands removed from it, and the key pressed and a reading obtained.

Two or three such series will fix the position of resonance with accuracy.

Curves of Rejector Inductance.



THE VALUES OF THE CAPACITIES (IN JARS) MARKED ON THE REJECTOR CONDENSER ARE VERY NEARLY ACCURATE.

Should the spark be irregular, a very rapid series of shorts will sometimes give steadier readings than a long. Unsteady spark.

With the Service Mark II. sets, there is great difficulty in tuning, due to the tendency to arc when the spark is reduced; this is most easily got over by making a succession of shorts rapidly, as mentioned above.

Always remember that possibly a third wave will appear on the wavemeter. Probable third wave.

This is not a true wave, and should be disregarded; it usually appears near the primary wave, and is rather misleading, unless observations are taken over a good wide range.

Unless the circuits are nearly in tune it is difficult to find the two true waves.

Always start tuning with a fairly tight coupling, as the waves are more sharply defined and more widely separated.

If it is necessary to measure waves over 2,000 L.S., it will be found easiest to make a small additional plug condenser, so as to be able to increase the capacity by steps of half a jar. With extra inductance, and the wavemeter capacity only, the movement of the needle is too slight to be of any use even if the mutual is increased up the point of sparking, between plates of the vane condenser. Tuning long waves.

The two mutuals supplied in the box are hardly ever required; a loop of wire which can easily be twisted to any size or shape is much more convenient, and is the form of mutual referred to in the above notes.

WAVEMETERS.

It has been observed that if a pair of ordinary Service telephones be shunted across the thermal junction of a wavemeter, a very good tuning effect can generally be obtained. When the condenser is adjusted to within 2 or 3 degrees of the point of resonance, the sound in the telephones increases to a very marked extent. Tuning by sound.

It has been found by trial that the degree of accuracy is about the same as a Paul's galvanometer, but much time is saved when using the telephones, as it is possible to keep the eyes fixed upon the pointer of the condenser, instead of having to look at the galvanometer. Degree of accuracy.

The telephones and the galvanometer can be used in parallel, as there is no loss in either deflection or sound when both together are used. For the present it is advisable to do so, as the telephone method has not been sufficiently long under trial to be regarded as reliable.

During the calibration of wavemeters it has been observed that inductance coils of the same value vary in efficiency, even when both insulation between turns and connections are good. Upon investigation this was found to be due to dirt and moisture having collected upon the inside surface of the ebonite formers. Wavemeter inductances.

Should any inductance coil not give a good deflection of the galvanometer, the wooden end pieces should be removed and the inside thoroughly cleaned and dried. This will not alter the inductance value.

NOTES ON RECEIVING CIRCUITS.

Too much importance cannot be attached to the fact that for the proper use of tuned shunts all three circuits, the aerial, acceptor, and rejector must each separately be in tune with the incoming wave. Notes on receiving circuits.

All rejectors are very similar, and a set of curves of the rejector adjustments for the various Service waves, together with instructions for their use, are given in this report.

It should be noted that up to the H stop in the Mark II. the ring more than overlaps the stops on the box, and that for very low inductances it overlaps several stops. Thus A30 overlaps the D stop.

The inductance of the M.D. primary is about 75 mics. The acceptor values given are based on 75 mics for the M.D., but as the values of the acceptor condenser are allowed to vary 10 per cent. from the engraved figures it is impossible to state the acceptor values accurately.

The greatest importance must be attached to the insulation of the aerial at the base, both inside and outside the office, and the face of the tuner must be kept Insulation of aerial important for receiving.

perfectly clean and dry, and this is especially noticeable with long waves. This is made very plain by the consideration of the following well-known formulæ :—

Theoretical investigation.

The back E.M.F. of the inductance of the tuner is given by the equation $E = pLC$, where p is 2π times the frequency of the incoming wave, L is the inductance in henries, and C is the maximum current in amps. Suppose the insulation to be so bad that half the aerial current runs to earth, the resistance being non-inductive, then the back E.M.F. of this resistance equals c R, and as the waste is half the total both these currents are equal, and both the back E.M.Fs. are equal. That is to say—

$$pLC = CR$$

or—

$$pL = R$$

Now the frequency varies inversely as the wave-length, therefore $p = 2\pi f$ varies inversely as the wave-length, but L varies as the square of the wave-length, because the wave-length = $206\sqrt{L.S.}$, and the capacity of the aerial remains unchanged. Therefore the factor pL varies directly as the wave-length. That is to say, to receive a wave double the length the insulation must be twice as good, or, with a given state of affairs the loss will be double if the wave-length is doubled. This becomes very apparent, especially with small aerials, when smoke blowing on the feeders will entirely stop signals on long waves, though they may still be quite strong on short waves.

Insulation and continuity resistance of rejector.

The insulation of the stops and ring of the rejector is also very important, but a low continuity resistance is still more so.

The stops and ring must be perfectly clean, and due to its low resistance, signals on the Mark II. rejector will be found better when the ring only is used than when part of the ring is used in conjunction with some of the box inductance.

Tuning the acceptor for very long waves.

The very long wave used by Clifden (L.S. 4,500) needs an acceptor of about 70 jars. To get this, put in the 50 jars of the telephone condenser in parallel with the No. 1 acceptor.

Amount of capacity used in rejector important.

It has been found that, provided the aerial, acceptor, and rejector are all three properly in tune when the capacity used in the rejector bears a certain proportion to the inductance, that signals are noticeably strengthened, this effect being most marked when the inductance is between 1 and 2 mics.

On the other hand, the larger capacity used, the more effectually does the rejector stop signals on wave-lengths other than the one desired.

In the attached table the rejector values given in the left-hand column are those suitable for strengthening signals, whilst the values in the right-hand column will be found better for cutting out interference when the desired signal is strong :—

Tune.	Wave-length.	L.S.	Acceptor.	Rejector.	Rejector.
R - - -	2,500	146	1·9	100 H 12	300 D 10
S - - -	3,300	256	3·5	200 H 0	400 E 9
T - - -	4,200	415	5·6	300 H 7	600 E 13
U - - -	5,000	589	8·1	300 J 8	600 F 18
Destroyer - -	700	11·5	0·15	25 D 8	—

No. 5 condenser.

It was found during the trials of the destroyer's installation between H.M.S. "Usk" and H.M.S. "Vernon" that when receiving a 700-foot wave on "Vernon's" big aerial, a 25-jar rejector value seriously weakened signals.

Experiment showed that a much smaller rejector value, while still very effective, did not weaken signals.

For this purpose a No. 5 condenser, arranged so as to be attached below the No. 2 condenser, will be supplied to battleships and cruisers for use when receiving from destroyers.

The No. 5 condenser will have two plugs, value 6 and 12 jars.

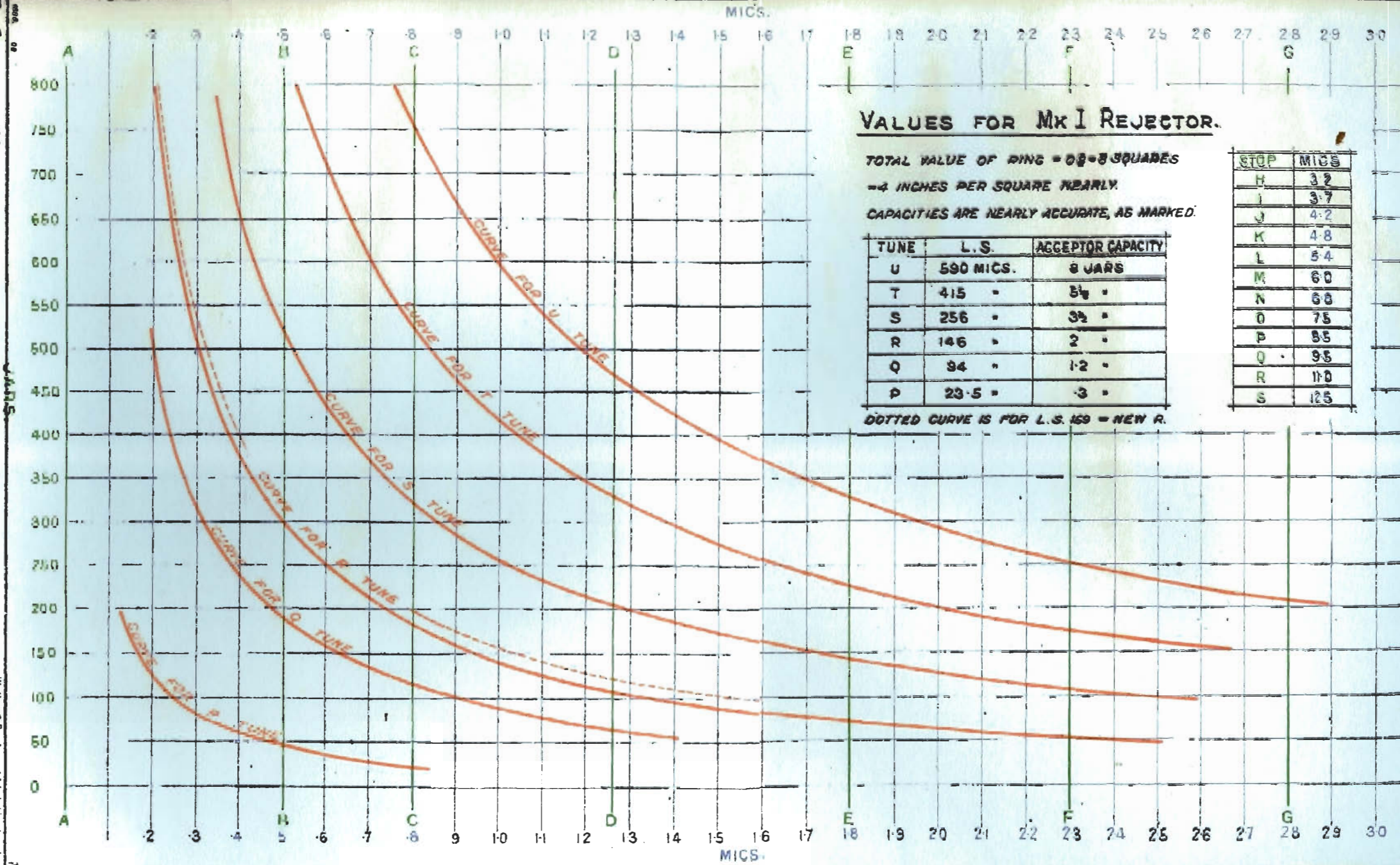
INSTRUCTIONS FOR THE USE OF CURVES OF REJECTOR VALUES.

To obtain an appropriate rejector setting for any Service tune—

(1) Select any rejector capacity, and look it out in the column on the left marked JARS.

(2) Follow along the line abreast this capacity to the point where it cuts the curve of the tune required.

To face page 44.



VALUES FOR MK I REJECTOR.

TOTAL VALUE OF RING = 0.8 = 8 SQUARES
= 4 INCHES PER SQUARE NEARLY.
CAPACITIES ARE NEARLY ACCURATE, AS MARKED.

TUNE	L.S.	ACCEPTOR CAPACITY
U	590 MICS.	8 JARS
T	415 "	5¼ "
S	256 "	3½ "
R	146 "	2 "
Q	94 "	1·2 "
P	23·5 "	·3 "

DOTTED CURVE IS FOR L.S. 169 = NEW R.

STOP	MICS
H	3·2
J	3·7
J	4·2
K	4·8
L	5·4
M	6·0
N	6·8
O	7·5
P	8·5
Q	9·5
R	11·0
S	12·5

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(3) Follow the heavy vertical line nearest to the left of this point up or down, and read off the stop on the box of the rejector at the top or bottom from the capital letters in the lines marked STOP.

(4) Adjust the position of the arm till signals are loudest.

The note on the curve shows how the approximate position of the arm can be read off.

Example.—To set a rejector for S tune, using 350 jars :— Example.

For Mark I. rejector— Mark I. rejector.

Follow along the line abreast 350 jars in the jars column till it cuts the S tune curve ; nearest heavy vertical line is marked B.

Set rejector to 350 B.

To get approximate position of arm :—

Note says that value of ring is 4 inches per square.

The 350 jars line cuts the S tune curve $2\frac{1}{4}$ squares to the right of the B stop line, and $2\frac{1}{4}$ by 4 = 9 inches.

Approximate rejector setting will be 350 B 9.

For Mark II. rejector— Mark II. rejector.

Follow along the line abreast 350 in the jars column till it cuts the S tune curve ; nearest heavy vertical line is marked E.

Set the rejector to 350 E.

To get the approximate position of the arm :—

Note says that total value of ring is ·42 mics = 4 squares = ·1 mic per square.

350 jars line cuts the S tune curve 2 squares to the right of E line.

Therefore ·2 mics are required = half the ring = 15 inches.

Therefore set the rejector to 350 E 15.

NOTES.—The value in mics of the various stops is marked along the top and bottom, the values of the remaining stops being given in the right-hand top corner.

The L.S. values of the tunes, and their approximate acceptors readings are given in the right-hand bottom corner.

In the Mark II. rejector the value of the ring overlaps the D stop, that is to say, A 30 = B 25 = C 17 = D 3.

It will be found that signals are best on the A stop (the chopper switch down) so the A stop should be used with the ring instead of the B or C stops with less ring. A stop best with Mark II. rejector.

That is to say, for R tune with 600 jars, use 600 A 18 in preference to 600 B 7 or 600 C 2.

Never use the B or C stops.

The values of the stops of Mark II. rejectors numbered above 576 are slightly higher than those given above.

HORSEA EXPERIMENTS.

During the time the "Furious" was cruising in the North Sea for trials with the Service installation, Mark II., in "Vernon," the opportunity was taken to carry out some experiments with long waves from Horsea. A temporary installation has been erected there which is capable of sending 5 waves, of about 7,000, 8,000, 9,000, 10,000, and 12,000 feet. Experiments with long waves.

Resonance is obtained at 30 cycles, and a total of 8 K.W. is developed whilst actually sparking.

Experiments were started, using several different forms of spark gap with air or steam jets, available for playing on the spark, with the object of giving signals a musical sound. Air and steam jet.

The steam jet gave promising results, but as it did not seem to matter how wet the steam was, superheated steam being apparently useless, a drip of water on the balls was tried. This also seemed promising for obtaining a note, and further experiments in this direction will be carried out.* Water drip on balls.

When receiving from H.M.S. "Furious," signals were always stronger than in "Vernon," but in the North Sea atmospherics were also more pronounced. It was found possible to considerably reduce the atmospherics without weakening signals in the following way :— Receiving at Horsea.

A long thin inductance of about 450 mics (360 turns on a long insulator) was joined up to a wavemeter condenser as an acceptor between the E terminal of the M.D. and the E bar of the rejector. The inductance must be long Arrangement to reduce atmospherics.

* NOTE.—Alcohol vapours are also under trial, the alcohol being dripped in, the difficulty being to prevent slight explosions.

and thin, and it must be mounted vertically over the condenser, the object to be obtained being to keep down capacity between one turn of the inductance and others, and also between the inductance and earth.

It must be borne in mind that the waves received (T and S tunes) were considerably below the normal of the Horsea aerial.

Experiments are still in progress to find out to what extent it is useful when receiving waves longer than the normal of the aerial.

Receiving a wave shorter than the natural wave-length of the aerial.

An aerial condenser similar to those supplied to ships was used for reducing the L.S. of the aerial below its normal value when receiving from "Furious." Up to 1 jar the condenser was found very efficient, but above this value the strength of signals falls off.